Marine Benthos of the Continental Shelf of Southwest and Southeast Coast of India

Thesis submitted to

Cochin University of Science and Technology

in partial fulfillment of the requirements

for the award of the degree of

Doctor of Philosophy

SMITHA C K

Department of Marine Biology Microbiology and Biochemistry
Cochin University of Science and Technology
Kochi- 682 016, Kerala, India

April 2011

Marine Benthos of the Continental Shelf of Southwest and Southeast Coast of India

Ph. D Thesis in Marine Biology

Author

Smitha C K
Department of Marine Biology Microbiology and Biochemistry
Cochin University of Science and Technology
Kochi- 682 016, Kerala, India
Email: smithack07@gmail.com

Supervising Guide

Dr. R. Damodaran
Professor (Retd.)
Department of Marine Biology Microbiology and Biochemistry
Cochin University of Science and Technology
Kochi- 682 016, Kerala, India
Email: rdcusat@yahoo.com

April 2011

Cover page illustration
Front page: A portrait of Sea
Back page: *Heterospionid* polychaete

Department of Marine Biology Microbiology and Biochemistry
Cochin University of Science and Technology
Kochi- 682 016, Kerala, India
Email: rdcusat@yahoo.com

Dr. R. Damodaran
Professor (Retd.)

Date:…………………

Certificate

This is to certify that the thesis entitled "***Marine Benthos of the Continental Shelf of Southwest and Southeast Coast of India***" is an authentic record of the research work carried out by ***Ms. Smitha C K***, under my supervision and guidance in the Department of Marine Biology, Microbiology and Biochemistry, Cochin University of Science and Technology, in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Marine Biology of Cochin University of Science and Technology, and no part thereof has been presented for the award of any other degree, diploma or associateship in any University.

Prof. Dr. R. Damodaran
Supervising guide

Declaration

I hereby declare that the thesis entitled "***Marine Benthos of the Continental Shelf of Southwest and Southeast Coast of India***" is an authentic work carried out by me under the supervision and guidance of Dr. R. Damodaran (Retd.) Professor, School of Marine Sciences, Cochin University of Science and Technology, for the Ph.D degree in Marine Biology of the Cochin University of Science and Technology and no part thereof has been presented for the award of any other degree, diploma or associateship in any University.

Smitha C K

Cochin-16
Date:

.... to my beloved

Mummy

Acknowledgement

I wish to express my profound sense of gratitude and indebtedness to my Supervising Guide Dr.R. Damodaran, Professor (Retd.), Department of Marine Biology, Microbiology and Biochemistry for his constant encouragement, invaluable advices and critical assessment throughout the tenure of my research work. His support during the preparation of the manuscript is highly commendable.

I am thankful to Dr. H.S.Ram Mohan, Dean and Director of School f Marine Sciences, CUSAT, for their wholehearted support during the tenure of my research.

I am greatly indebted to Dr. Chandramohanakumar, Registrar, CUSAT and Head, Department of Marine Biology, Microbiology and Biochemistry, for the encouragement and support I received throughout the tenure of my doctoral programme and for providing necessary facilities.

I gratefully acknowledge Dr. Sanjeevan, Director, CMLRE for lending me the samples for my research work. I am grateful to Dr. Rosamma Philip for the help to decide my topic of research and the valuable suggestions that given throughout my research work.

I am grateful to U.G.C for given me the financial assistance to complete my research work.

I sincerely thank Dr. Babu Philip, Dr. A.V.Saramma, Dr. Aneykutty Joseph, Dr.S.Bijoy Nandan, Dr. A.A.Mohammed Hatha of the Department of Marine Biology, Microbiology and Biochemistry for their support and cooperation. Sincere thanks also extended to retired professors, Dr. C.K.Radhakrishnan, Dr. N.R.Menon, V.J.Kuttiyamma and Dr. Mohammed Salih.

I wish to keep on record my wholehearted and sincere gratitude to Dr.A.V.Raman, Andhra University, Dr.Ajmal Khan and Dr.Antony Fernando, Annamalai University, Dr. D.B.James, Scientist (Retd), CMFRI, Dr. Vasily Radhashevsky, Russia and Dr. Minoru Imajima, Japan.

I am happy to record my sincere thanks to the members of the administrative and supportive staff, Department of Marine Biology, Microbiology and Biochemistry for their help and cooperation throughout the course of my research work.

I thank Mr. P.J. Manuel, librarian, and other staff, School of Marine Sciences Library for their commendable cooperation.

I am very much grateful to my seniors and friends, Dr.Joydas T.V, Dr. Sajan Sebastian, Dr. Feebarani John, Dr. Arun A.U, Dr.Selvan.S, Dr. Nandini Menon, Dr. Soja Luis, Dr.Prabhakaran. P, Dr. Gisha Sivan, Dr.Anupama Nair P R, Dr.Bindia Bhargavan and Dr.Priyalakshmi G.

The acknowledgement will not be complete without expressing my sincere thanks to my colleagues, Mr. Nousher Khan K, Abdul Jaleel K.U, Anil Kumar, P.R, Jini Jacob, Dr. Sreedevi N. Kutty and Neil Scholastin Correya.

I am grateful to Abhilash K.R, Iqbal K.P, Anish V Pachu, Dr. T. Ganesh, Ravikumar, Eldose P Mani, Kashi, Smitha B.R, Dr. Limnamol V.P, and Abhilash K.S.

Special thanks to Nisha.R and Anu Philip, Dept. of Instrumentation, Pramitha. V, IIT, Chennai and Shyamkumar, STIC,for the invaluable help and support from time to time.

I am thankful to Suja, Animol, Roja Sebastian, Chitra Som R.S, Remya Varadarajan, Jisha Jose, Dr. Simi Joseph P, Padmakumar K.B, Bhuvaneshwari, *Chippi, Iswarya, Dr. Sanil Kumar M.G, Dr. Smitha V Bhanau, Kesavan Namboothiri, Anit M Thomas, Jisha V.K, Naveen Sathyan, Chaithanya E.R, Swapana P. Antony, Manjusha, Sudha, Smitha S.L, Sreedevi O.K, Sumi Liz Jose, Anu Pavithran, Jimly C Jacob, Remya K.D, Jayanthi T.T, Sreejamol K.L, Shameeda, Preethi, Rani, Geetha, Vineetha, Deborah, Harishankar, Asha, Cilla Abraham, Sini P.J, Beena S John, Sisodia and all other friends.*

Sincere thanks to Pradeep, Vinod A.P, George Jolly and Binoop for their kind cooperation.

My heartful gratitude to my family members for their support during the tenure. Above all, I thank God Almighty for the blessing showered upon me during my research work.

Smitha C.K

CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter 1

INTRODUCTION

Marine benthos are organisms which make use of sea bottom either for feeding, breeding or resting. The term 'benthos' is derived from the Greek word 'βένθος' meaning, 'depths of the sea' and first used by Haeckel in 1890. Approximately 98% of all marine species are supposed to belong to the benthos (Peres, 1982). They include a wide variety of flora, fauna and micro organisms. The term "phytobenthos" used to denote plant community whereas "zoobenthos" for animal community. They are also ubiquitously distributed and highly diverse in marine sediments.

Benthos are classified into three functional groups and they are infauna, epifauna and hyper-fauna, i.e, those organisms living within the substratum, on the surface of the substratum and just above it respectively. Based on the habitat, benthos are classified into soft -bottom and hard-bottom benthos. Benthic communities comprise of species differing in terms of their ecology, life strategies and body size. Thus another arbitrary classification based on the size of the benthos is macrofauna, meiofauna and microfauna, having a size range more than 0.5 mm, between 0.5mm and 0.063mm and less than 0.063mm respectively. This division reflects differences in sampling techniques for the three groups. Macrofauna are organisms larger than 500μm, which are visible by naked eye, mainly invertebrate animals such as polychaetes, crustaceans, molluscs, echinoderms etc. Meiofauna consists of nematodes, harpacticoid copepods, foraminiferans, polychaetes, kinorhynchs, tardigrades, and some of the invertebrate species living within the sediment grains temporarily as a part of their life cycles. The micro fauna are unicellular organisms that include bacteria, fungi, protozoans and blue-green algae and occur in every square millimeter of the sediment and water environment.

Benthos are important in the energy cycle of the sea by making use of the organic matter draining down from the surface waters. They are important in the recycling of nutrients and oxygenation of sediment substratum. The benthic organisms are depending upon the nature of the substratum and hydrographic conditions overlying it. They sustain the demersal fishery resources of the region by offering trophic support. They inevitably enrich the planktonic community by the supply of meroplankton. Benthic organisms link the primary producers, with higher trophic levels, such as fishes, by consuming phytoplankton and then being consumed by larger organisms. Thus, they provide the key linkage between primary producers and higher trophic level animals, in the marine food web. So, benthic productivity of the adjacent seas of any maritime country is of fundamental interest to access the total fishery potential pertaining to that area.

The continental shelves of the world's oceans represent about 10% of the oceanic area, but it comprises 99% of the total fish harvest from the marine environment. The continental shelf is the shallow underwater extension of a continent up to 200m depth. The substratum of this zone is generally of a soft consistency and is largely composed of sand, mud and clay. The ample supply of food and oxygen and the optimum conditions of temperature, light intensity and salinity are responsible for the richness of the fauna in this zone. The areas promote nutrient recycling and provide feeding opportunities for fish and shell fish populations. The bottom deposits which are of great importance to benthic animals in general are mostly terrestrial in origin.

Benthic organisms inhabit an area of sea bottom which extends from the splash zone high above the high tide level to the bottom of the deepest trench. The most important feature of benthic environment is its heterogeneity. The purpose of quantifying benthos of the sea includes their quantitative and qualitative aspects and their importance in nourishing demersal fishery resources. Generally benthic communities are much more diverse in nature in terms of species richness than those of the surface and mid water layers or pelagic realm. Benthic algae and submerged aquatic vegetation provide ideal habitat for juvenile fish. Benthic invertebrates are among the most important components of estuarine and coastal ecosystems. The study of benthos in more recent years proved useful to follow changes in biological diversity, evaluating marine pollution effects especially assessing long term changes and detecting input from diffuse sources (Gray *et al*., 1992). It is generally recognized that the detailed understanding of the bottom fauna is necessary to obtain the comprehensive picture of the fishery potential of an area (Damodaran, 1973).

Benthic substratum contains a heterogeneous assemblage of animals and forms a major centre of secondary productivity. The members of the fauna are chiefly composed of polychaetes, crustaceans, molluscs and they feed on organic matter and in turn form food of demersal fishes. Macro and meiobenthos are primary consumers and found to feed on organic matter. Thus the interaction between meio and macrobenthos species allows an efficient utilization of detritus. Such processes are possibly to affect the magnitude of the secondary production available to higher trophic levels. Benthic infauna introduces temporal and spatial heterogeneity to the aquatic sediments through processes such as burrow irrigation and sediment ingestion and ejection. Meiobenthos are actively participating in the biogeochemical cycles by their metabolic consumption and they affect the microbial regime spatially and temporally by affecting redox boundaries and chemical fluxes in sediments (Aller and Aller, 1992).

India, a vast maritime nation is empowered with a coastline of 8129 Km. Scattered attempts have been made to understand the quantitative nature and community structure of benthos from different from different regions of the country. Attempts have been made to study the benthos of the entire shelf region of west coast, so far by Neyman (1969); Harkantra *et al* ,(1980), Parulekar *et al.*,(1982), Jayaraj *et al.*,(2007), Joydas and Damodaran (2009). Sajan and Damodaran (2007) and Sajan *et al*.,(2010) were studied on meiobenthos from the shelf regions of the west coast of India. Since these studies were carried out with different methodologies and objectives, their utility under is limited in understanding the benthic community. Ganapati and Rao (1959) made a preliminary work on benthos in the continental shelf of north-east coast of India which was based on some grab and dredge hauls made at widely separated stations. The aspects of quantitative distribution, standing crop and annual production of benthos of Indian seas and the effectiveness of the data for assessing the potential demersal resources were also studied by Parulekar *et al.,* (1982). Bouillon *et al*., (2002) studied the relative importance of different primary carbon sources to invertebrates in the intertidal mangrove forest located along southeast coast of India. Ganesh & Raman (2007) studied the macrobenthic community structure of the northeast Indian shelf.

On 26th December 2004, the Indian coastline experienced the most devastating tsunami in recorded history. The tsunami was triggered by an earthquake of magnitude Mw 9.3 at 3.316°N, 95.854°E off the coast of Sumatra in the Indonesian Archipelago at 06:29 hrs making it the most powerful in the world in the last 40 years. The earthquake of 26th December 2004 occurred off northwest of Sumatra is not an unusual earthquake from the Plate Tectonics point of view. It has occurred in the vicinity of seismically active zone, close to Sunda Trench in the water depths of about 1300 m. The earthquake hypocenter is located relatively at shallow depth. The high magnitude, Mw 9.3 of the earthquake and its shallow epicenter has triggered tsunami in the northeast Indian Ocean (DOD Report, 2005-06). The waves propagated through the Bay of Bengal and the Arabian Sea, Indian Ocean. Subsequently these waves have been transformed into a chain of catastrophic oscillations. These huge oscillatory waves struck the east and west coast of Peninsular India and the coast of Tamil Nadu, Nagapattinam was the worst-affected area with large loss of property and life. The tsunami event has left significant geological signatures with changes in coastal geomorphology and deposition of sediments along the coast, derived from the waves (Nagendra *et al.*, 2005). The increase in suspended sediment concentration along the South, West and East coast is shown by remote sensing data by Ramakrishnan *et al.,* (2005). They report that tsunami churns the shallow water sediments and increases the sediment load in coastal waters suggesting strong turbulence and mixing in near shore waters. Altaff *et al,* (2005) studied the impact of tsunami on meiofauna of Marina beach, Chennai, east coast of India.

It is noteworthy that physical disturbance can affect infaunal community structure not only directly by changing survivorship of each component species, but also indirectly by altering the abundance and performance of dominant and/or keystone species (Kneib, 1988 and Hamilton, 2000). Tsunamis are responsive to changes in water and sediment quality, they are ubiquitous, and are not typically seen as an economic or recreational resource themselves (Mackie, 2001). Extreme physical disturbances such as tsunamis are expected to affect the abundance and diversity of the infaunal community (Whanpetch *et al.*, 2006). A tsunami moves silently, but rapidly across the ocean and raises unexpectedly as destructive high waves along shallow coastal water, causing widespread devastation overland along the coast (Vasudevan *et al.*, 2007).

Given the rarity of the phenomenon and the uniqueness of the impacts caused by tsunamis, such as the massive scale of disruption and inundation by sea water, studying how a natural system responds to such an event is of great scientific interest. Tsunamis are one of the most catastrophic wave motions, which cover a large parts of the sea and behave intricately especially in coastal areas. The cost effective method to monitor changes in environment and to assess the impact on biota by natural hazards can be provided benthic faunal studies. Though this is a temporary phenomenon as most of the sediment particles tend to be either dissipated towards offshore or settled to bottom, this might be having significant effect on the marine biota.

Tsunami is a serious form of natural disasters that affects the coastal ecosystem. These are large waves that are generated when the sea floor is deformed by seismic activity. Besides the loss of lives, the tsunami must have severe impacts on the infrastructure, the fisheries and the coastal ecosystem. The littoral, neritic and benthic zones of Andaman Nicobar island as well as the littoral and neritic zones of Bay of Bengal are likely to have been disturbed intensively (Krishnankutty, 2006).

Benthos of the continental shelf waters of India have been studied by Center for Marine Living Resources and Ecology in 2001. Therefore it was decided to revisit the same region, southwest and southeast continental shelf of India on 5th -19th 2005. The present study was focused on the biodiversity and ecology of benthos of southwest and southeast coast continental shelf of India. The data collected were compared with the previously available data in order to understand whether the tsunami has affected the continental shelf benthos.

The main targets of the present study as follows:

- To analyse and compare the standing crop of macrobenthos and meiobenthos and its variation in relation to depth and latitudes before and after the 26th December 2004 tsunami.
- To understand the numerical abundance of macrobenthos and meiobenthos and its spatial variation before and after the 26th December 2004 tsunami.
- To study the qualitative composition of all the groups of macrobenthos and to have a detailed analysis of major groups before and after the 26th December 2004 tsunami.
- To know the community structure of benthos before and after the 26th December 2004 tsunami.
- To understand the hydrography of the southwestern and southeastern continental shelf.
- To compare the sediment characteristics before and after the 26th December 2004 tsunami.
- To obtain the correlation of macrobenthos and meiobenthos with hydrographical and sediment parameters.

- To find out the trophic relationships of macrobenthos and meiobenthos of the southwestern and southeastern continental shelf of India before and after the 26th December 2004 tsunami.

To track the above challenges, a dedicated cruise (cruise no. 230) was organized by Marine Living Resources and Ecology, Department of Earth Science, Government of India to study the impact of tsunami along the continental shelf waters of the southwest and southeast coast of India as a part of benthic productivity studies. In this cruise, 39 stations were covered, falling under 10 transects, extending from off Kozhikode to Cape Comorin in the southwest coast and off Nagapatnam to off Krishnapatnam in the southeast coast, with a view that distance between two transects and two stations are not exceeding 30 nautical miles, thereby covering all degree square of the shelf areas in the sampling. Kannur transect was covered by cruise number 233. In each transects, sediment samples were collected from 30m, 50m, 100m and 200m depth ranges in order to study the depth wise variation of fauna. An additional sampling was made from 75m depth off Kollam transect. In the Kannur transect, samples were collected from 50m and 100m depth range only. Sampling was not possible beyond 50m off Trivandrum due to technical reasons. Altogether 41 stations were covered for the present study.

…..൩൪…..

Chapter 2

REVIEW OF LITERATURE

Contents

2.1 Macrobenthos

The studies on benthos long back to the middle of 18th century. The benthic study started by two Italians, Marsigli and Donati around the year 1750, by collecting the benthic samples from shallow water using a dredge (Murray & Hjort, 1965). The Challenger Expedition (December 1872 to May 1876) carried out special investigations on many aspects including benthic studies of the oceans of the world. Marion (1883 a, b) described the nature of different bottom areas and the species composition of flora and fauna on the entire shelf of the gulf of Marielles (France) and extended his comparative analysis to include both the nature of the bottom and the faunal composition down to a water depth of 2000m. These studies were concentrated only on qualitative aspects.

It was John Peterson (Peterson, 1911, 1913) who, first of all made a quantitative approach to the benthic studies; the number of individuals and weight of organic matter was expressed per unit of bottom area in this study. Placing supreme importance on those species, which predominate in weight, Peterson developed his community concept (Peterson, 1914, 1915 and 1918). Brotskaja and Zenkevich (1939) substituted Peterson's community by new unit which they called complexes. Thorson (1957) proposed additions to the community concept of Peterson and developed the isocommunity concept, which was the seed of vertical zonation.

Sanders (1968, 1969) carried out epibenthic sled sampling in different coastal areas and compared population size as well as diversity in deep sea and shallow water soft substrata. He noticed sharp decrease in biomass near the shelf edge and it was attributed to the fact that in deep sea, the percentage of small sized species in the whole fauna is higher in comparison to that on the shelf. He found that increasing depth would affect abundance slightly and biomass considerably. Buchanan *et al.,* (1978) made a seasonal study on the shelf bottom macrofauna from 20m down to 80m off the coast of Nortumberland and observed that the seasonal changes in abundance and biomass appeared to be independent of the composition of the assemblage.

Bogdanos and Satsmadjis (1985) analysed the macrobenthos of the Greek Gulf of Pagassitikos with a view to depict accurately the biocoenosis of the entire range of soft substrata. Gaston (1987) studied the feeding and distribution of polychaetes of the Middle Atlantic Bight and found that the proportion of carnivorous polychaetes were greatest in coarse sands and decreased significantly with water depth across the continental shelf. Franz and Harris (1988) studied the seasonal and spatial variability in macrobenthic communities in Jamaica Bay, New York. Macrobenthic community structure along a putative pollution gradient in Southern Portugal were analysed by Austen *et al.,* (1989).

Service and Feller (1992) made an analysis of seasonal and yearly trends in subtidal macrobenthic samples from sandy and muddy sites in North Inlet and showed large fluctuations in faunal abundance and high variability between replicate samples. Graf (1992) studied the benthic–pelagic coupling and developed an energy flow equation for marine sediments. Pancucci-Papadopoulou *et al.,* (1999) studied the benthic invertebrate communities of NW Rhodes Island, in relation to hydrographical regime and geographical location.

Ecologists have recognized topographical heterogeneity as a major factor regulating species distribution and abundance within a community (Emson & Faller-Fritsch,1976, Raffaelli & Hughes, 1978, Genin *et al..*, 1986, Bourget *et al..*,1994). Community characteristics such as diversity and richness are also modified by topographical heterogeneity (MacArthur and MacArthur, 1961; Simpson, 1964; Menge *et al.*, 1983; Menge *et al.*, 1985). The role of topographical heterogeneity may change with scale. It is known to alter predator-prey relationships at small scale (Gosselin & Bourget, 1989, Hixon & Beets, 1993) while at larger scales; topographical heterogeneity probably does not modify this interaction.

Basford *et al.,* (1990) studied the infauna and epifauna of the northern North Sea and reported that the major determinant of infaunal community composition was sediment granulometry, with depth being of secondary importance. For the epibenthos, depth was the major factor and the sediment composition seemed less significant. Archambault & Bourget (1996) studied the scales of coastal heterogeneity and benthic intertidal species richness, diversity and abundance. Albani *et al.,* (1998) studied about the distribution of sediment and benthic Foraminifera in the Gulf of Venice, Italy. Alongi & Christofferson (1992) investigated benthic infauna and organism-sediment relations in a shallow, tropical coastal area: influence of outwelled mangrove detritus and physical disturbance. In the framework of a benthic flows study in sub-oxic environments, the relationships between macro and meiobenthic community structure were investigated by Albertelli *et al.,* (1998). Banta *et al.,* (1999) analysed the effects of two polychaete worms, Nereis diversicolor and Arenicola marina, on aerobic and anaerobic decomposition in sandy marine sediment.

In the present era there is a voluminous amount of literature concentrating on benthos were available. Aller *et al.,* (2002) studied benthic faunal assemblages and carbon supply along the continental shelf break-slope off Cape Hatteras, North Carolina. Aguado and Lopez (2003) studied on taxonomy of family Paraonidae from Coiba National Park (Pacific Ocean, Panama). Aguado and Martin (2004) studied on Pisionidae (Polychaeta) from Coiba National Park with the description of a new species and two new reports of Pisione. Ajmal Khan *et al.,* (2004) studied about a new indicator macro invertebrate of pollution and utility of graphical tools and diversity indices in pollution monitoring studies. Al-Hakim & Glasby (2004) studied about polychaeta (annelida) of the Natuna islands, South China Sea. Boyle *et al.,* (2004) studied the strategies for molecular genetic studies of preserved deep-sea macrofauna.

Alcantara and Weiss (2005) studied about the seasonal variations of the Spionida (Palpata: Canalipalpata) in the sublittoral zone of the Gulf of California. Aguirrezabalaga & Ceberio (2005) studied on Spionidae (Annelida: Polychaeta) from the Capbreton Canyon (Bay of Biscay, NE Atlantic) with descriptions of a new genus and three new species. Aguado *et al.* (2006) studied about two new species of Syllidae (Polychaeta) from Japan. Brandt *et al.* (2007) studied about the biodiversity of the deep Southern Ocean benthos. Barnes & Conlan (2009) studied about the disturbance, colonization and development of Antarctic benthic communities.

Evolution of the deep-sea macrofauna is poorly understood, in large part, because little is known about genetic variation on sufficiently large geographic and bathymetric scales to reveal patterns of population structure and differentiation. The main impediment to obtaining genetic data from the deep-sea macrofauna is that most collections have been fixed in formalin, which degrades DNA. Over the past decade, developed techniques to acquire DNA from formalin fixed molluscs and have begun to explore how evolutional folds in this enormous and remote ecosystem (Chase *et al*., 1998b; Etter *et al*., 1999; Quattro *et al*., 2001).

2.1.1 In Indian Scenario

East Coast of India: It was the studies of Annandale (1907) and Annandale & Kemp (1915) on the ecology of Gangetic delta and the fauna of Chilka Lake which pioneered the work on benthos in India. Panikkar and Aiyar (1937) studied the bottom fauna of the brackish water areas of the Madras city. Samuel (1944) described the animal communities of the sea bottom of Madras coast. Ganapati and Rao (1959) made a preliminary work on benthos in the continental shelf of north-east coast of India which was based on some grab and dredge hauls made at widely separated stations. The aspects of quantitative distribution, standing crop and annual production of benthos of Indian seas and the effectiveness of the data for assessing the potential demersal resources were also studied by Parulekar *et al.,* (1982). Bouillon *et al*., (2002) studied the relative importance of different primary carbon sources to invertebrates in the intertidal mangrove forest located along southeast coast of India.

Raman and Adiseshasai (1989) made studies on macro benthos of the littoral areas off Visakhapatnam. Mohana Rao *et al.,* (2001) studied submerged beach ridge lineation and associated sedentary fauna in the inner shelf of Gopalpur coast, Orissa, Bay of Bengal. Taxonomy and distribution of benthic foraminifera from the sediments off Palk Strait, Tamil Nadu, East coast of India was studied by Gandhi *et al.,* (2002). Mohan *et al.,* (2002) studied distribution of recent Ostracoda off Karikkattukuppam, near Chennai in the southeast coast of India. Foraminiferal fauna from the surface sediments of the Chilka Lake along the east coast of India has been studied as regards distribution of its assemblages by Jayalakshmy and Rao (2003). Raut *et al.,* (2005) studied macrobenthos in the Kakinada Bay and adjacent mangrove channels in the Godavari delta, east coast of India. Ganesh and Raman (2007) studied macro and epifauna in the shelf waters of Bay of Bengal along northeast India. They were reported that depth, sand, sediment organic matter and sediment mean size influenced epifauna distribution, whereas for infauna, salinity, temperature, mean particle diameter, sand and depth proved important. Ingole (2007) studied the biodiversity of benthic polychaetes in the coastal waters of Paradip in the east coast of India.

West Coast of India: Kurien (1953) analyzed the occurrence of bottom fauna in relation to the bottom deposits of the Travancore coast. Seshappa (1953) made quantitative studies using grab samples, in the inshore sea bottom of Malabar Coast. Later, Kurien (1967, 1971) made an extensive survey of bottom fauna along the south west coast of India. Desai and Krishnankutty (1966, 1967) studied the benthic fauna of Cochin estuary. Harkantra (1975) studied the benthos of the Kali estuary, Karwar. Kurien *et al*., (1975) studied the bottom fauna of the Vembanad Lake. Parulekar *et al*., (1976) conducted the quantitative assessment of benthos off Mumbai.

Parulekar *et al*., (1980) assessed the annual cycle of environmental and biotic factors in relation to distribution, production and trophic relations in the Mandovi, Cumbarjua canal and Zuari estuarine system of

Goa. Harkantra and Parulekar (1981) made a study on the ecology, distribution and production of benthic fauna in relation to demersal fishery resources of coastal zone of Goa. Ansari *et al.*, (1986) studied the effect of high organic enrichment of benthic polychaete population in the Mandovi estuary of Goa. Harkantra and Parulekar (1987) were studied macro benthos off Cochin.

Vizakat *et al.,* (1991) studied the community structure of benthos in relation to texture and organic carbon content of sediment and bottom water salinity in the Konkan coast. Saraladevi *et al.,* (1991) studied the communities and co existence of benthos in northern limb of Cochin back waters. Sunil Kumar (1993) conducted a study on the benthic fauna of the mangrove swamps of Cochin area. Ansari and Parulekar (1994) studied the ecological energetics of benthic communities in the Mandovi- Zuari estuarine system. Macro benthos in the near shore coastal system was studied by Mathew and Govindan (1995). Benthic fauna of the Kayamkulam backwaters and Arattupuzha coast along southwest coast of India analysed by Prabha Devi *et al.,* (1996). Macrobenthos of the Vashishti estuary, Maharashtra, west coast of India was studied by Nair *et al.,* (1998). Sheeba (2000) studied the distribution of benthic infauna in the Cochin back waters in relation to environmental parameters. Levin *et al.,* (2000) studied the macrobenthic community structure within and beneath the oxygen minimum zone, NW Arabian Sea.

Damodaran (1973) studied the benthos of the mud banks of Kerala coast and worked out the seasonal variation of macro fauna and also correlation between benthos and fishery. Pillai (1977) studied the distribution and seasonal abundance of macro benthos of Cochin backwaters. Anzari *et al.,* (1977) undertook an investigation of shallow water macro benthos in five Bays along the Central West Coast of India. Ansari *et al*., (1994) studied the macro benthic assemblage in the soft sediments of Marmagoa harbour, Goa. Harkantra and Parulekar (1994) studied the population dynamic, biomass production and analysis of community structure of soft sediment dwelling macro invertebrates of the shallow waters of Rajpur Bay in relation to certain environmental parameters.

Gopalakrishanan and Nair (1998) studied the macro benthic fauna of Mangalore coast, where effluents from a fertilizer factory and iron ore exporting company were discharged. Macro benthic communities of the coastal waters of Dhabol, west coast of India studied by Ingole *et al*., (2002). Ingole *et al.,* (2002) investigated macrobenthic community of shallow subtidal muddy deposit off Dhabol, west coast of India. Kumar *et al.,* (2004) observed that changes in the textural characteristics of the sediment and the higher level of organic carbon were found to be associated with the reduced frequency of occurrence of macrobenthos at the stations located near the effluent outfall along the coastal waters of Chitrapur, west coast of India.

Harkantra and Rodrigues (2003) studied the pattern of species succession of soft-bottom macro fauna in the estuaries off Goa, west coast of India. Raghunathan *et al*., (2003) studied the effect of highly turbid seawater on the distribution, biomass and species diversity of intertidal macrofauna of Gopnath, Mahuva and Veraval coasts. Ingole (2007) studied the biodiversity of benthic polychaetes from the coastal waters of Paradip, Bay of Bengal. Jayaraj *et al*., (2007) studied the influence of environmental properties on macro benthos in the northwest Indian shelf and reported that the benthos were controlled by a combination of factors such as temperature, salinity, dissolved oxygen, sand and organic matter and no single factor could be considered as an ecological master factor. Combination of different factors such as sediment texture sediment sorting and depth were found to influence the distribution of macrobenthos. Spatial variations observed in the benthic community were presumably linked to the variations in sediment granulometry and the energy level conditions prevailing in the area (Jayaraj *et al*., 2008a). The infaunal benthic community of soft bottom sediment of the tropical eastern Arabian Sea shelf was analysed by Jayaraj *et al*., (2008b). They reported that the variations in the macrobenthic community were mainly controlled by sediment texture, depth, and dissolved oxygen. Joydas and Damodaran (2009) studied the diversity and abundance of macrobenthos along the shelf waters of west coast of India.

Some of the workers covered both the coasts of India. Sanders (1968) studied the bottom fauna of samples along the east and west coast of India and studied their species diversity. Neyman (1969) made a detailed study on the bottom fauna of the shells in the northern part of Indian Ocean from the dredge collections. This was the first study which covered the entire length of Indian coast. Parulekar *et al*., (1982) studied the benthic production and assessment of demersal fishery resources of the Indian seas. Ansari *et al*., (1996) studied macro benthos of the EEZ of India. Saraladevi *et al*., (1996) studied the bottom fauna and sediment characteristics of the coastal regions of South west and South east coast of India.

As far as benthos is concerned sampling is an inefficient process and because of this, our knowledge of species diversity of this group of organisms is very poor. The degree of difficulty in sampling benthos increases with depth. Thus, the intertidal area, which is directly accessible at low tide, is relatively well studied than any other benthic region. The immediate sub tidal, down to about 30m can be sampled and o bserved by SCUBA equipped biologist, but sampling efficiency declined rapidly with depth as the working time, manual dexterity and visibility decrease (Phole and Thomas, 2001) from 30 to about 100m, the bottom can be observed using video cameras on Remotely Operated Vehicles (ROV), tethered under water vehicles controlled from a ship etc., however, most ROV`s are incapable of effective sampling. Recent technological advances provide the diver with new equipments, like, underwater telephone, under water tape recorder, portable suction sampler, photographic equipment, dry suits, drilling equipment etc. that have considerably enlarged the range of observation and improved underwater experimentation at least in some regions. Satellite imaginary techniques are also being used in benthic studies (Rumohr, 1995).

Cheriyan (1967) studied the hydrography of the Cochin harbour area. The distribution of macro benthos is closely related to water temperature salinity and dissolved oxygen (Haiming *et al*., 1996). Benthos varies greatly in there responses in variation in water quality. In the estuarine and back water regions it appeared that the most important factor governing quantitative distribution of benthos in the salinity (Desai and Krishnankutty, 1966). They found that areas of high salinity in the back waters, which are rich in nutrients and chlorophyll, support a denser benthic population. Harkantra (1975) noticed that poor biomass during the monsoon coincided with the low salinity. Damodaran (1973) while working in Narakkal mud bank region noticed a decrease in bottom fauna after July to August due to poorly oxygenated conditions of bottom water.

Sanders (1958) hypothesized that deposit feeders were more abundant in muddy environments because fine sediments tend to be organic rich. The grain-size characteristics of sediments from the Narakal mud bank, north Cochin, were analysed by Dora *et al.,* (1968). Josanto (1971) studied the grain size distribution of the Cochin backwater sediments. Nair *et al*., (1982) studied the distribution and dispersal of clay minerals on the western continental shelf of India. The continental shelf produces maximum biomass and the production decreases with the increasing depth. Richness of benthos in the Arabian Sea is related to the upwelling phenomenon while the high biomass values in the northern Bay of Bengal are due to the riverine enrichment (Parulekar *et al*., 1982). Rao and Sarma (1982) studied the sediment- polychaete relationship in the Vasishta Godavary estuary and reported that carnivores restricted to sandy substrata and for detritus feeders, the influencing factor appears to be the organic matter content of the sediment than the substrata. Generally benthos preferred medium grain sized texture with low organic matter and high organic matter had an adverse effect especially on filter feeders.

Community structure of sand-dwelling macrofauna of Siridao beach, Goa, west coast of India was studied by Harkantra and Parulekar (1985). While studying benthos of the backwaters in and around the industrial belt at Eloor, Sarala Devi and Venugopal (1989) observed the polychaetes species *Capitella capitata* more abundant in the area near the discharge of industrial effluents. Raman *et al*., (1995) studied the clay mineral distributions in the continental shelf sediments between the Ganges mouths and Madras, east coast of India. Levin *et al*., (2000) studied macro benthic community structure within and beneath the oxygen minimum zone, NW Arabian Sea. Cook *et al*., (2000) studied nematode abundance at the oxygen minimum zone in the Arabian Sea. Sediment distribution and placer mineral enrichment in the inner shelf of Quilon was studied by Prakash (2000).

Macro benthic abundance in the vicinity of spreading ridge environment in the central Indian Ocean was studied by Ingole (2003). Kumar *et al*., (2004) investigated spatial and temporal variations of macro benthos in relation to sediment characteristics in the coastal waters of Chitrapur, west coast of India. Sheeba *et al*., (2004) studied the bottom fauna of the dredging and dredge spoil disposing sites of Cochin harbor. Harkantra and Rodrigues (2003) studied environmental influence on the species diversity biomass and population density of soft bottom macro fauna in the estuarine system of Goa, west coast of India. Macrofauna are a highly sensitive group of metazoans and a slight change in their natural environment could induce a high stress on the organisms already adapted to the stable conditions. The physical disturbance to the benthic sediment may have long-term effects on the benthic biota and restoration of the disturbed benthic habitat may take a few decades to achieve the initial baseline levels. The physically disturbed benthic habitat may require a longer period for restoration than commonly believed (Ingole *et al*., 2005). Khan and Murugesan (2005) studied the polychaetes diversity in Indian estuaries and the information on polychaetes is available only from 8 estuaries out of 33 on the east coast and only 4 out of 34 on the west coast. Ingole and Koslow (2005) observed that the macrofaunal biomass of the Central Indian Ocean Basin decreased away from the shore. They were also reported that the megafaunal assemblage has high biomass and low diversity. Pavithran and Ingole (2005) studied macrobenthic standing stock in the nodule areas of central Indian Ocean basin.

Bottom trawling causes abrupt variations in the abundance, biomass and diversity of infaunal communities immediately after trawling (Joice and Kurup, 2006). Queiros *et al.*, (2006) argued that the impact of chronic bottom trawling on benthic infauna depends on the natural disturbance levels to which benthic communities are adapted. Verlecar *et al.*, (2006) studied biological indicators in relation to coastal pollution along Karnataka coast, west coast of India. The composition and feeding patterns of the macrofauna in the Central Indian Ocean Basin studied by Pavithran *et al.,* (2007). Biogeochemistry of the surficial sediments of the western and eastern continental shelves of India was studied by Jacob *et al.,* (2008). They observed that the surface sediments of the west coast contained a greater quantity of total organic matter when compared to the east coast. The differences in the productivity patterns and the hydrographical conditions were found to exert a major influence on the quantity and composition of organic matter in the surface sediments of the western and eastern continental shelves of India. Alagarsamy (2009) studied the environmental magnetism and application in the continental shelf sediments of India.

2.2 Meiobenthos

A few of the meiofaunal organisms have been known and studied since 1700`s, long before the name "Meiofauna" was established for them. One of the first of this was the discovery of the Kinorhyncha by Dujardin in 1851. In 1901, Kovalevsky studied Microhedylidae (Gastropod) from the eastern Mediterranean, and in 1904, Giard described the first Archiannelid, *Protodrilus*, from the coast of Normandy. These pioneers of meiofauna studies concentrated only on isolated taxa, often the exceptional species of known invertebrate groups, not the ecological relations and community aspect. Nicholls (1935) introduced the term "interstitial fauna" to denote the meiofaunal organisms. Delamare Deboulteville (1960) was the first to conduct meiofauna research along the African shores. The intertidal zone of the French Atlantic coast was the investigative area of Renaud Debyser and Salvat, who during the beginning of early 1960`s compiled comprehensive accounts of the interstitial fauna and their abiotic ecological factors.

Wieser (1953b, 1960) studied the nutritional quality of nematodes with the help of pharynx organization. Wieser (1959) made the first general account of relationships between meiofaunal composition and granulometric characteristics of the sediment. In the 1969, McIntyre compiled the first review of the ecology of marine meiobenthos. Studying the fauna of the Normandy coast of the channel, the Swedish researcher Swedmark (1964) focused attention on the rich interstitial fauna, and described many previously unknown species. It is considered a classic work among the meiofaunal literature.

Meiofauna were useful in determining the effects of anthropogenic perturbation in aquatic ecosystems (Coull and Chandler, 1992), especially in the study of the effects of pollution and physical disturbances (e.g., Boyd *et al.*, 2000; Schratzberger *et al.*, 2000, 2002a; Gheskiere *et al.*, 2005). These ubiquitous organisms occur in most aquatic habitats, typically in high population densities, in shallow waters (Platt and Warwick, 1980). Considering their roles, such as enhancing nutrients cycles and offer as food for higher trophic groups in marine ecosystems (Coull, 1999), and their use as biological indicators (Kennedy and Jacoby, 1999), it is important to study the response of meiofauna.

The term 'meiofauna' was first used by Mare (1942), and is derived from the Greek '*meio*' meaning smaller, to define an assemblage of mobile or hapto-sessile (animals attached to a substratum, but capable of detachment and slowly changing their position) benthic invertebrates between macrofauna (>500 μm) and microfauna (<31-63 μm) in size. It is often used as a synonym with 'meiobenthos,' since most meiobenthos are animals (McIntyre, 1969). Meiofauna can be further classified into permanent and temporary groups. The term 'permanent meiofauna' refers to those groups showing meiofaunal size throughout their life, and 'temporary meiofauna' refers to those species with immature stages of meiofaunal size, where mature stages are of macrofaunal dimensions (McIntyre, 1969). Meiofauna mainly encompass benthic multi-cellular metazoans, but also include some protists, such as foraminifers and ciliates (Higgins and Thiel, 1988; Giere, 1993).

Meiofauna are high quality food sources for fish, shrimp and mollusc larvae and important components in benthic food chains (Bell and Coull, 1978; Ellis and Coull, 1989; Gee, 1989; Coull, 1990). Hence, they play an important role in trophic transfer in the marine ecosystem (Warwick, 1989). They also make use of organic detritus in sediments and are grazers of benthic bacteria and microalgae. Their grazing rate on bacteria is almost similar to the production of bacteria, so they can regulate the productivity of bacteria (Montagna *et al.*, 1995). As meiofauna are the food sources of higher trophic organisms, their community structure, diversity pattern and biomass changes can influence the recruitment of juveniles of macrofauna. The biomass of meiofauna is usually less than 20% of that of the macrofauna (Coull, 1988). However, their production is similar to or even higher than that of macrofauna (Coull, 1988). Hence, they are important to the process of global biological, geochemistry recycling. Compared with macrofauna, the easier field sampling, higher species richness, shorter life cycles (3-5 generations per year) and lack of larval stages, make meiofauna important in environmental assessment and ecosystem health monitoring (Coull and Chandler, 1992; Bongers and Ferris, 1999; Kennedy and Jacoby, 1999).

Moore (1931) and Rees (1940) in Great Britain, as well as Krogh and Spärck (1936) in Denmark, quantitatively investigated meiobenthos and enumerated all taxa. It was Remane, the 'father of meiofaunal research' (Coull and Giere, 1988), who first recognized the definable ecological assemblages of meiofauna in sandy, muddy and phytal (plant-based) habitats. Remane was the first worker to recognize that 'these biocoenoses differ not only by species abundance and composition, but also in morphological and functional features' (Remane, 1932). While working on the meiofauna of Massachusetts's sandy beaches, Pennak and Zinn (1943) discovered and described a unique subclass of Crustacea, the Mystacocarida. During the 1930s-1950s the Swedish marine biologist Swedmark originated studies on the systematics and ecology of the marine interstitial fauna, particularly the Gastrotricha. He summarized much of his and others' observations in his classic paper "The Interstitial Fauna of Marine Sand" (Swedmark, 1964), which, even today, is still a standard textbook for all students of meiobenthology.

During the mid 1960s, most of the works were on systematics and descriptive ecology of meiofauna. In this period, meiofaunal studies were entered in a rapid growth stage due to a variety of factors like, more scientists were working on meiofauna, there was a renewed interest in the ecology of these organisms, better sampling and extracting techniques were discovered, new equipment was readily available and better communication amongst meiobenthologists was established (Hulings and Gray, 1971). Remarkable achievements during this period included that (1) certain taxa were found to be restricted to certain sediment types, as was their vertical position in the sediment, (2) the anoxic layers of certain sediments were demonstrated to harbour few meiofauna, (3) in most shallow areas of the world (<100 m) there were about 10^6 meiofaunal organisms per square metre of sea bottom, while the meiofaunal biomass in estuaries and the deep-sea tended to equal that of the macrofauna and (4) changes in tidal exposure were observed to be often the primary factors restricting the interstitial fauna of sandy beaches (Coull and Giere, 1988).

During 1960s to the 1970s, occurred a surge of ecological interest in meiofauna, and in 1969 McIntyre (1969) published the first overall review of meiofaunal ecology. A primary emphasis was in the ecophysiology and behaviour of meiofauna: studies measuring respiration rates, preferences and tolerances to various natural environmental parameters (e.g., temperature, salinity, anoxia), and attempts to ascertain the functional and life history parameters of meiofauna were conducted primarily in the laboratory (Coull and Giere, 1988). It was speculated that some anaerobic meiofaunal organisms may have been the primitive metazoan, since the early Precambrian atmosphere lacked oxygen (Coull and Giere, 1988). The analysis of community structure by measuring species diversity was a popular ecological technique during this era and widely employed by meiobenthologists. Meiofauna were considered as a suitable bioassay of community health and rather sensitive indicators of environmental change. Considerable research is still in progress regarding these topics (e.g., Moens and Vincx, 2000; Kim and Shirayama, 2001 for physiology; Austen and Somerfield, 1997; Suderman and Thistle, 2003; Sutherland *et al*., 2007 for bioassays).

During 1970s to 1980s, major works were on experimental ecology and phylogenetic considerations. A number of investigations were dedicated to the study of macrofaunal-meiofaunal interactions, including predator and prey interactions (with or without exclusion cages), the role of meiofauna as food for higher trophic levels, the effects of macrofaunal community on meiofaunal distribution and the re-colonization of meiofauna into disturbed areas (Coull and Giere, 1988). Pollution effects on meiofauna were studied in the laboratory and in the field. In most cases these experiments comprised hypothesis testing. Such experimental treatments have caused a significant input of statistical rigor to meiofaunal ecology. Much of the present day ecological research is at a stage where hypotheses are proposed, experimentally tested via some manipulations (e.g., addition of predators, addition of a pollutant, change of habitat) and the response quantitatively noted (Coull and Chandler, 1992).

The first attempts to place meiofauna into a phylogenetic perspective began in the 1960s. From the 1980s this type of meiofaunal, systematic research experienced a broader emphasis, i.e., where to place taxa and how, phylogenetical1y, to relate one taxon to another. With the popularization and relative accessibility of electron microscopes, many new and unique characters have been discerned and new ideas related to animal phylogeny proposed. This phylogenetic approach to metazoan systematics has been the forte of meiobenthologists and it is becoming rather obvious that understanding meiofaunal evolution is a key for the understanding of invertebrate evolution.

In recent meiofaunal research, many more scientists devoted themselves to the research of meiofauna, with topics ranging from studies using meiofauna as biological indicators, macrofauna-meiofauna-bacteria relationships, meiofaunal biology and physiology, to community ecology and systematic taxonomy. Austen and Schratzberger in Great Britain have published a series of papers dealing with meiofauna and pollution and physical disturbance, such as responses of meiofauna (especially nematodes) to heavy metals, tributyltin (TBT), organic enrichment, biological (such as macrofauna) and physical disturbances (including trawling) using both field investigations and microcosm experiments (e.g., Austen and Somerfield, 1997; Austen and McEvoy, 1997a, b; Widdicombe and Austen, 2001; Austen and Widdicombe, 1998; Austen *et al*., 1998; Schratzberger and Warwick, 1998a, b, Schratzberger and Warwick, 1999a, b; Schratzberger, *et al*., 2002a, b; Schratzberger and Jennings, 2002). Studies using meiofauna and nematodes in pollution monitoring are still of importance and some new methods have been proposed, such as the use of a maturity index to reflect the state of the sediment environment (Bongers, 1990; Bongers *et al*., 1991). Synchronous sampling for macrofauna, meiofauna and bacteria shows that meiofaunal patterns are more often correlated with bacteria and the protein concentration than with macrofaunal patterns, indicating a potential utilization of bacteria as a major food source by meiofaunal organisms (Papageorgiou *et al*., 2007). Laboratory studies for meiofaunal culture, feeding ecology, life history and embryo development also received considerable interest (Wang and Zhang, 1994; Moens and Vincx, 1997, 1998, 2000; Houthoofd *et al*., 2003; Vangestel *et al*., 2008; Pascal *et al*., 2008). Nematode sperm and buccal cavity morphology were studied using scanning and transmission electron microscopy (e.g., Zograf *et al*., 2004; Yushin, 2007, 2008). Although many new meiofaunal species have been described in the last century, many new species are still being discovered and publications are still forthcoming (e.g., Huang and Zhang, 2004; Zhang, 2005; Huys and Mu, 2008).

The most important progress for meiofaunal research is the introduction of molecular techniques, fatty acid profiles and stable isotope analyses into the studies of phylogenetic taxonomy and functional ecology of these animals. Since Blaxter *et al.,* (1998) produced a molecular evolutionary framework for the phylum Nematoda, many articles have been published on the molecular, phylogenetic systematics of nematodes (Derycke *et al.*, 2005; Bhadury *et al.*, 2005, 2006, 2007, 2008; Shen *et al.*, 2007). In addition, DNA barcoding techniques have the potential for straightforward identification of meiofauna, which will enable their use in environmental monitoring (Bhadury *et al.*, 2006). Moens *et al.*, (2002, 2005) also found that nematodes had different food sources in different habitats and there were species-specific differences identified from the use of stable isotope analysis. More recently, Rzeznik-Orignac *et al.*, (2008) analyzed the stable isotopes of four dominant nematodes and pooled copepod samples, the results of which indicated that it was necessary to analyze meiofaunal feeding habits at the species or genus level.

2.2.1 In Indian Scenario

East Coast of India: - The major efforts in studying the benthos of the Indian subcontinent began with the work of Annandale (1907), which paved way to the beginners in benthic studies later on. Panikkar and Aiyar (1937) studied the brackish water fauna of the Madras coast. Ganapthi and Rao (1962) studied the interstitial fauna of Andhra coast, south east coast of India. The meiofauna and macrofauna of Porto Novo, southeast India was analyzed by McIntyre (1968). Numerous studies were reported on meiofauna of different coastal areas and backwaters of east coast of India and was by Ganapthi and Sarma (1973), Sarma and Ganapathi (1975), Ansari and Parulekar (1981) Ansari *et al.* (1982) Rao (1986), Rao and

Murthi (1988), Vijayakumar *et al.,(*1991 and 1997), Chatterji *et al.,*(1995). Meiofauna of Pichavaram mangroves along south east coast of India were studied by Chinnadurai and Fernando (2003). Impact of Tsunami on meiofauna of Marina beach, Chennai, south east coast of India were studied by Altaff *et al.*, (2005).

West Coast of India: - Studies on interstitial fauna of the south west coast of India were attempted by GovindanKutty and Nair (1966) Govindan Kutty , 1967), Desai and Kutty (1967a,1967b and 1969) and Rajan (1972). Kurein (1972) in his study on the ecology of benthos of the Cochin back waters showed that meiofauna are more numerous in the finer sediments and their abundance is not affected by tidal changes. Damodaran (1973) studied meiobenthos of the mud banks of Kerala coast. Mallik (1976) studied the grain- size variation in the Kavaratti lagoon area.

Numerous workers studied meiofauna of different coastal areas and backwaters of west coast of India. The major works were by Ansari *et al.* (1977b), Ansari *et al.,* (1980), Abdual Aziz and Nair (1983) Reddy and Hariharan (1985, and 1986), Ingole *et al.,* (1992), Ansari and Parulekar (1993) respectively. Ansari *et al.,* (2001) studied about the population fluctuation and vertical distribution of meiofauna in a tropical mudflat at Mandovi estuary, west coast of India. They were observed that the meiofauna in the mudflats serve as food for the higher trophic levels. Sajan and Damodaran (2005) studied the community structure and vertical distribution of marine free-living nematodes in the shelf sediments of the west coast of India. Faunal composition of meiobenthos of the shelf regions of the west coast of India was analysed by Sajan and Damodaran (2007) and Sajan *et al.,* (2010).

Many workers attempted to study the ecology of meiofauna from different estuaries and back waters. The major workers in this direction include Murthy and Rao (1987); Rao (1987b); Harkantra and Parulakar (1989); Bhat and Neelakandan (1991); Ansari and Ganus (1996); Ansari and Parulekar (1998); Ingole and Parulekar (1998); Rao and Sarma (1999). Pollution and its impact with meiofauna were recognized by many workers (Varshney., 1985; Rao., 1987a,b., Ingole *et al.,* 2000). Quantitative studies have been made on meiofauna from west and east coast of India (McIntyre,1968; Thiel, 1966; Sanders, 1968); and Central Indian Ocean (Sommer and Pfannkuche, 2000; Ingole *et al*., 2000). Ingole and Koslow (2005) observed that the meiofaunal biomass increased with distance from the shore of the Central Indian Ocean Basin.

Sediment characters such as grain size, grain shape, sorting and pore space and organic matter are known to directly or individually affect the numbers and type of species found in soft bottom environments (e.g. Gray, 1974). Grain size is a key factor, which directly determines spatial and structural conditions of meiofauna habitats (Sanders, 1958). Physicochemical characteristics such as temperature, salinity and dissolved oxygen have always been a subject of interest in meiobenthic research. Meiofauna is present in polar ice and tropical shores around hot hydrothermal vents and under the extremes of temperature fluctuations of supra littoral fringes. It seems that in most of environments, temperature does not prevent meiofaunal colonization. However temperature can have a structural impact on meiofauna. In the sub littoral bottom, the influence of temperature on meiofauna distribution is negligible. As in the case of temperature, meiofaunal organisms exist under all salinity regimes from fresh water to brackish water shores, from oceanic to brine seep areas.

Decrease in oxygen levels in the overlying water column and also in the interstitial space ultimately result in the sparse distribution of meiofauna (McIntyre, 1969).

The earlier works on nematode systematics were done by Timm (1961, 1967a, b) from the seas around the Indian subcontinent and Gerlach (1962) from the Maldives islands. These workers described around 120 species of nematodes from Indian waters. From Indian waters, some preliminary knowledge of free-living nematodes is recorded previously from prominent estuaries and back waters. Meiofaunal organisms play and important role in the cycling of nutrients in the world`s oceans. The majority of benthic invertebrates has no direct commercial or recreational values, but provides much of the food for the bottom feeding species that are themselves important in the regions of commercial fisheries.

The nematode community can be effectively used as a sensitive indicator of benthic environment and can be used as a monitoring tool for impact assessment studies (Nanajkar and Ingole, 2007). Variables such as depth, latitude, organic matter (OM) and amount of clay were the most relevant parameters influencing the biomass and density of meiofauna, while depth and temperature were the important parameters explaining the distribution of the nematode communities along the western Indian shelf (Sajan *et al*., 2010).

Most tsunami originates from seismic displacement of the sea floor. In general, earthquakes of surface wave magnitude (Ms) exceeding 7 can be potentially tsunamigenic (De Lange and Healy, 2001) and have the ability to cause significant damage to the coastal system, to property or lives (Bryant, 2001). The maximum tsunami run-up was obtained along the coast of Nagapattinam district in the east coast of India during the tsunami occurred on 26th December 2004 (Narayan *et al*., 2005). Due to the impact of the tsunami, oligochaetes, nematodes and harpacticoids showed reduced populations along the Marine beach, east coast of India (Altaff *et al*., 2005).

Although a number of investigations on benthos from Indian subcontinent, no other efforts have been made till date on the macro and meiobenthos from the shelves of the east and west coast of India after the Indian Ocean tsunami event on December 26th 2004.

…..ᗣᗢ…..

MATERIALS AND METHODS

Contents

3.1 Study Area

The area selected for the present study was the continental shelf of southwest and southeast coast of India. The Arabian Sea in the northwestern and the Bay of Bengal in the northeastern Indian Ocean forms the western and eastern boundary of India. Arabian Sea extending from latitudes 0° and 25 ° N to 50 ° and 80 ° E and its total area is about 6.225 x 10^6 Km^2. The Gulf of Aden extended by the Red sea and the Gulf of Oman extended by the Persian Gulf, are its principal arms. The Arabian Sea on its northern, eastern and western sides is bordered by the landmass of Asia and Africa (Qasim, 1998) and in the south by Central Indian Ocean Ridge, the Carlsberg ridge, and the Chagos-Laccadive (Maldives) ridge (Demopoulos *et al*., 2003).

The Bay of Bengal is characteristically different from the other tropical basins of the world. It extending from latitudes 0° and 23 ° N and longitude 80 ° and 100° E and its total area is approximately 4.087 x 10^6 km^2 (Qasim, 1998). It is bounded by India (to the west), Bangladesh (to the north) and Myanmar, and the Andaman Sea (in the east). The Bay of Bengal is bordered to the north by a wide continental shelf that narrows to the south. The deep floor of the bay is occupied by a vast abyssal plain that slopes to the south. The main submarine features include the beginning of the long, seismically active Java Trench near the Nicobar-Sumatra mainland and of the aseismic Ninety East Ridge. The bay itself was formed as the Indian subcontinent collided with Asia within roughly the past 50 million years.

In the SW coast of India, the study area extends from the latitude 11° 59"N to 07° 10"N and longitude 75° 05"E to 77° 19"E (Off Kannur to Off Cape Comorin, 7 transects) and in the SE coast from latitude 10° 59"N to 14° N and longitude 79° 58"E to 80° 24"E (Off Nagapatnam to Off Krishnapatnam, 4 transects). The transects are Kannur, Kozhikode, Vadanappilly, Kochi, Kollam, Trivandrum and Cape Comorin along the SW coast where as Nagapatnam, Cuddallore, Chennai and Krishnapatnam in the SE coast.

In each transects, sediment samples were collected from 30, 50, 100 and 200m depth ranges in order to study the depth wise variation of fauna. An additional sampling was made from 75m depth Off Kollam transect where the shelf was wider. In the Kannur transect, samples were collected from 50m and 100m depth only. Sampling was not possible beyond 50m off Trivandrum due to technical reasons. Station details of the study area are presented in the Table 3.1and Fig.3.1.

3.2 Methodology

Samples for the present study was collected onboard Fishery and Oceanographic Research Vessel (FORV) Sagar Sampada (Fig.3.2), owned by Department of Earth Science, Government of India, during cruise number 230, in the Southwest and Southeast coast of India between 5th and 19th January 2005. Kannur transect was covered during the cruise number 233.

Samples for hydrographical parameters like, temperature, salinity and dissolved oxygen were collected from each station. Sediment samples were collected for estimation of organic matter and texture analysis and for macrobenthos and meiobenthos from each station. In order to ensure precision, duplicate sampling was made for benthic faunal analysis. Samples for epifauna were collected from certain stations.

Samples for hydrographical parameters were collected by using Sea-Bird CTD from all the stations. It consists of SBE 11 deck unit (for real-time readout using conductive wire) and the SBE 9 Underwater unit. Surface hardware consists of the SBE 11 Deck unit attached with a computer (Fig.3.3). The underwater hardware consists of a main pressure housing comprising power supplies, acquisition electronics, telemetry circuitry, and a suite of modular sensors all mounted within a stainless steel guard cage (SBE 9CTD underwater unit, Fig.3.4). The surface and underwater hardware are connected with conductive wire and a slip ring equipped winch.

Sediment samples were collected by using a Smith Mc-Intyre grab of $0.2m^2$ in area (Fig.3.5 and 3.6). It traps a substantial volume, even of dense sediment, as its open mouth covers a surface area of $0.2m^2$. The grab is mounted on a sturdy, weighted, steel frame, suspended from the lowering wire, with springs to force the two-jaw bucket into the ocean bottom when released, achieving deeper penetration. Two tripping pads, positioned below the square-phased frame, on which the bucket is suspended, make contact with the bottom first and are pushed upward to release two latches holding the spring-loaded bucket jaws. A free-fall from about 10meters (33ft) above the ocean floor is generally sufficient to allow sampling of even compacted bottoms. After the bucket has been driven into sediment, rising of the wire exerts tension on cables connected to the end of each bucket-jaw arm. Increasing pull on wire causes the jaws to tightly shut. When released, the springs exert a force to ensure good penetration of the open-mouthed bucket into compact sediments. Safety pull-pins are provided to prevent any premature or accidental release of the cocked assembly.

During sampling the vessel was maintained stationary and the wire was kept as vertical as possible to ensure vertical set down and lift-up of the grab at right angles to the bottom. It is recommended that the final 5m of descent be at the rate less than 0.5m/s to minimize shock bow wave disturbance (ICES, 1994). The sample showed a distinguishable undisturbed surface layer often including loose flocculent deposits and no sign of sediment leakage, such as from incompletely closed buckets.

Sub samples for meiobenthos were collected by using a cylindrical glass corer of 2.5cm inner diameter and 30 cm long, from the undisturbed grab samples (Fig.3.7 and 3.8). Duplicate sampling was made from each station to understand the sampling variation. When there was only a single grab haul, two corers were collected from the single grab. Core samples were sliced into pieces of 4cm length (i.e., 0-4cm, 4-8cm, 8-12cm etc.), to study the vertical distribution. Then the samples were transferred to properly labeled plastic bottles with 4% neutral formalin.

Sub sampling was made for the study of sediment characteristics. Approximately 150 grams of wet sediment from each station were taken for the studies of sediment characteristics like, estimation of organic matter and sediment texture analysis. The samples were dried onboard at 60^{o} C in a hot air oven. The dried samples were taken to the laboratory for further analysis.

After taking the subsamples for meiobenthos and sediment characteristics, the entire grab content was unloaded to a plastic container and mixed with sea water. Then the samples were processed over sieves of appropriate mesh sizes (0.5mm) on board in order to reduce the bulk of the material transported to the laboratory (Fig.3.9, 3.10). The sieving was accomplished onboard soon after sample collection in order to avoid sample degradation or fixing before further processing. Since immediate processing was not possible, sieved sediment with specimens were transferred into plastic bottles and were fixed with 5-8 % neutral formaldehyde. Samples were properly labeled with details like cruise number, station, grab, depth and date.

In the shore laboratory, prior to the extraction of meiofauna and macrofauna, selective staining of the samples for recognition and discriminations between dead shells and freshly dead animals were carried out. For this the sediment samples were bulk stained with Rose Bengal. Fixed sediment samples contain a mixture of formalin, Rose Bengal and sediment components such as sand, silt, clay and organic detritus in addition to the fauna. Sieved tap water was used to extract various meiofauna from the sediment. Meiobenthos were separated by sieving through two sieves 0.5mm & 63µm sieves. Meiofauna were separated from sediment by decantation. Washing was carried out till the clear sediment with meiofaunal organisms remain on the 63 µm sieve. The meiofaunal samples were, transferred to small Petri dish with minimum amount of water and the sorting carried out, in water under the binocular stereomicroscope of higher magnification. Count was taken of all individuals of all groups represented. Organisms were identified to major taxa, like, nematoda, polychaeta, foraminifera, harpacticoidea. All the other taxa appearing in small numbers (eg, turbellarians, halacarida, kinorhyncha etc.) were pooled in one category, as `others`. Wet weight of nematodes, polychaetes, foraminiferans (with shell), harpacticoid copepods and others were determined by direct weighing of larger number of individuals by using a high precision electric balance as followed (Holme and McIntyre, 1971).

Macrobenthos were separated by sieving through 0.5mm sieve. The organisms retained in the sieve are considered as macrobenthos. All the macrobenthic specimens were picked out from the sediment and sorted out. Before sieving, samples were treated with rose Bengal in order to enhance the colour contrast of the organisms. Identification was carried out up to species level for major group's polychaetes and molluscs. Whereas up to family, order, genus or species for crustaceans and other groups of organisms. In some specimens could not be identified due to damage or unresolved taxonomic problems. In case of doubtful identification, the lowest reliable taxonomic level was given.

Identification was followed by a count of individuals per species for polychaetes and molluscs and groups for the rest of organisms. Group wise biomass was estimated for polychaetes, crustaceans, molluscs (without shell) and others on a fresh/wet weight basis by using a high precision electronic balance. Biomass provides information on energetics of a community. Benthos is fundamental part of the food chain. Biomass measurement can indicate how important the community as food for other organisms. Wet weight was converted into dry weight with the conversion factors developed by Parulekar *et al* (1980). The conversion factors were 0.119 for polychaetes, 0.141 for crustaceans, 0.062 for molluscs and 0.09 for other groups. Individual organisms having wet weight more than 0.5g were not included in extrapolating to 1m^2, instead, taken as such in order to avoid a biased picture.

Epifauna were collected by using Naturalist's dredge (Fig.3.11) as the hauling time and the hauling speed depends upon the conditions of the sea, and nature of the substratum depth. The dredge was made up of a metal frame fitted with a nylon mesh and appropriately weighted. The heavy metal frame of the dredge is designed for breaking off pieces of rocks, scraping organisms off hard substratum and for limited penetration and collection of sediments and fauna. The dredge has two hinged towing arms which come together at the towing point. One arm is shackled to the tow-rope, the other being joined by a weak link consisting of several turns of twine. If the dredge comes fast on the sea bed the weak link is intended to break, allowing the arms to open out and free the dredge. Hauling time was 10-15 minutes and the length of the wire rope released was three times more the depth at which the dredge was operated. During the hauling time the research vessel speed was maintained at 2 knots/hr. All the fauna thus obtained were washed with seawater and transferred to plastic trays. The organisms were picked out from the substratum immediately after the collection. Then the samples were transferred to labeled plastic bottles with 5% neutral formalin. In the laboratory, the epifaunal samples were sorted out, enumerated and identified up to family, order, genus or species level.

Particle size is one of the principle controlling factors of benthic community structure. Visual observations were made on the nature of sediments. Sediment texture was also analyzed by using particle size analyzer. Organic carbon in the sediment was estimated by wet oxidation method (El-Wakeel & Riley, 1957). For this, salt was removed prior to the estimation. The organic carbon was then converted into organic matter (Wiseman & Bennete, 1960).

The data obtained during the present study, 2005 were compared with the previously available, 2001 data.

3.3 Statistical Analysis

A set of statistical approaches was carried out for the simplification and explanation of the massive biological data. For convenience, statistical techniques like Univariate and Multivariate analysis that is included in the PRIMER version 5.2.8 (Plymouth Routines In Multivariate Ecological Research) software package developed at the Plymouth Marine Laboratory (Clarke and Warwick, 1994; Clarke and Gorley, 2001) was followed.

3.3.1 Univariate Methods

The univariate methods include a set of species diversity indices. The following diversity indices were carried out for the estimation of community structure of macro and meiofauna along the continental shelf of southwest and southeast coast of India.

Species richness (Margalef's index, d):- The species richness is often given simply as the total number of species. Margalef's index (Margalef, 1958) is the measure of total number of species present for a given number of individuals. Species richness $d = (S-1)/\text{Log}(N)$ where N= total number of individuals; S= total number of species.

Evenness index (Pielou's index, J'):- Evenness was measured by Pielou's evenness index (Pielou, 1975) expressed as $J'=H'/\text{Log}(S)$ where H' is the Shannon diversity; Log S= maximum possible value of Shannon index.

Species diversity (Shannon index, H′ (log2):- Species diversity was measured by Shannon-Wiener index (Shannon, 1949) expressed as species diversity H′= -SUM (Pi^x Log (Pi)) where Pi is the proportion of the total count arising from the i^{th} species.

Species dominance (Simpson's dominance index, Lambda'):- Species dominance was measured by Simpson's index (Simpson, 1949) expressed as species dominance λ′= {SUM i Ni (N-1)}/ {N (N-1)} where Ni is the number of individuals of species i.

3.3.2 Multivariate Methods

Multivariate analysis was conducted to determine whether biological assemblages respond to different types of disturbances by small, but consistent changes in the relative abundance of species. These are characterized by comparisons of two or more samples on the extent to which these samples share particular species, at comparable levels of abundance. Similarity index, Cluster analysis, MDS, Dominance plot and BIO-ENV were attempted. All these techniques are thus found on similarity coefficients so as to facilitate clustering and ordination. Clustering analysis used to find species to groups, whereas ordination attempt to place them spatially so that similar species are close and dissimilar ones are far.

Cluster analysis: - Cluster analysis was done to find out the similarities between groups. The most commonly used clustering technique is the higherarchial agglomerative clustering method. The results of these are represented by a tree diagram or dendrogram with the X-axis representing the full set of samples and the Y-axis defining the similarity level at which the samples or groups are fused. Bray-Curtis coefficient (Bray and Curtis, 1957) with square root transformation was used to produce dendrogram.

K–dominance: - Multiple k-dominance plots facilitated discrimination of polychaetes according to species relative contribution to abundance.

Bioenv analysis:- Bioenv was attempted to measure the rank correlations of fauna with environmental variable such as depth, temperature, salinity, dissolved oxygen, percentage of organic matter, sand, silt and clay.

…..ഇൽ…..

Chapter 4

HYDROGRAPHY

Contents

4.1 Introduction

Among the various biotic and abiotic factors which influence the physico-chemical properties of the environment and in turn the life of marine organisms, temperature, salinity and dissolved oxygen are vital. Either individually or together they are taken to be very important in influencing the biology of the organisms (Kinne, 1963). The hydrographical features play an important role in sedimentation and the distribution of fauna.

Temperature affects most of the biochemical and physiological processes of organisms. Water temperature is one of the most critically important regulators of the distribution, abundance and activity of marine biota. Kinne (1963) conducted a comprehensive review of the effects of water temperature on marine and brackish water animals. The results of this review indicated that biological processes may be greatly affected by water temperature fluctuations, gradients, ranges, and averages, as well as by the frequency and intensity of changes, duration of patterns, and accumulated heat units. Most marine and estuarine species or populations within species, have characteristic tolerable temperature ranges that include specific high and low lethal temperatures. Gradual water temperature changes are usually better tolerated by all species than sudden changes (Kinne 1963).

There is an obvious increase in temperature in the Arabian Sea from north to south in shallow waters but in deep waters, there is a decrease in temperature observed from north to south (Qasim, 1982). Temperature is an important factor which influencing the density of polychaetes (Jayaraj *et al.*, 2007). Temperature is an important factor which influencing the distribution pattern of infauna (Ganesh and Raman, 2007). Joydas and Damodaran (2009) reported that a progressive decrease of temperature with increase in depth and it was found to be analogous to the decrease in the abundance and biomass of macrofauna. The bottom temperature and depth were the most important parameters explaining the distribution of nematode communities along the western Indian shelf (Sajan *et al.*, 2010).

The salinity of the ocean has great importance and it is the most widely recognized property of sea water. Distribution of organisms is determined in part by their salinity tolerances. Marine biota shows a wide range of ability to withstand salinity changes also. Salinity in the surface layers of Arabian Sea decreases from north to south (Babu *et al.*, 1980; Qasim, 1982, Joydas and Damodaran, 2009; Sajan *et al.*, 2010). Low surface salinity in the south is due to intrusion of the Bay of Bengal waters (Darbyshire, 1967). Babu *et al* ,(1980) and Shetye *et al*,(1991) reported a layer of maximum salinity in the 50m and 100m depth range. The most important factors affecting benthos were temperature, salinity, dissolved oxygen, sand and depth, and no single factor could be considered as an ecological master factor (Harkantra and Parulekar, 1991, Jayaraj *et al.*, 2007). Ganesh and Raman (2007) reported that infauna was strikingly influenced by the salinity variations. Salinity was found to negatively correlate with copepods, biomass of total meiofauna and diversity (Sajan *et al*, 2010).

Dissolved oxygen play a significant role in the distribution and diversity of benthic fauna. Shallow-water infaunal species typically exhibit responses at changes in oxygen concentrations. Distribution of organisms showed direct relationships to the oxygen profiles, but the biological responses to the oxygen concentrations varied with respect to the type of organisms. Meiofauna appear to be more broadly tolerant of oxygen depletion than the macrofauna (Giere, 1993). Generally, crustaceans and echinoderms are the next most sensitive, followed by annelids, selected molluscs, although there are exceptions (Diaz and Rosenberg 1995, Gray *et al*., 2002, Karlson *et al*., 2002). The decrease of benthos in deeper waters may be due to the low value of dissolved oxygen (Jayaraj *et al*., 2007). Joydas and Damodaran (2009) reported that a progressive decrease of dissolved oxygen with increase in depth in western continental shelf of India and it was corresponding to the decrease of numerical abundance and biomass of macrofauna. Among the hydrographical parameters, dissolved oxygen showed a positive correlation with biomass and density for all the meiofaunal groups and diversity of nematodes (Sajan *et al*., 2010).

4.2 Results

In the late post monsoon period, the data of hydrographical parameters were analyzed and the results were as follows:

4.2.1 Temperature

Depth-wise variation in each transects:-Depth-wise variation of bottom temperature in each transect is presented in Table 4.1. It showed great variation in each transects along the two coasts. The range of bottom temperature was from a minimum of 13.06°C (off Kochi, 229m) and a maximum of 29.29°C (off Kannur, 50m) in the southwest coast and a minimum of 13.45°C (off Chennai, 200m) and a maximum of 27.37°C (off Krishnapatnam, 31.7m) along the southeast coast.

Along southwest coast, transects, off Kannur, off Kozhikode, off Vadanapilly and off Trivandrum showed a decrease in bottom temperature with increase in depth. Off Kollam transect, bottom temperature showed an increase from 30m to 75m depth range and then decreased. Along southeast coast, off Nagapatnam transects showed a decrease of bottom water temperature from 30m to 200m depth ranges. Off Cuddallore and off Chennai transects, temperature increased from 30m to 50m and then decreased to 200m depth ranges. Off Krishnapatnam showed a decrease in temperature from 30m to 50m and increased to 100m and sharply decreased to 200m depth ranges.

When both the coasts were taken into consideration, the maximum difference of bottom temperature observed off Kochi transect and it was 15.43 °C along the southwest coast whereas off Cuddallore and the value was 13.81 °C along southeast coast. The minimum difference was noticed off Vadanapilly and it was 13.86 °C in the southwest coast and off Krishnapatnam and the value was 12.7 °C along the southeast coast. The mean temperature along southwest coast decreased from off Kannur to off Vadanapilly and increased to off Trivandrum and again decreased to off Cape Comorin. Whereas along southeast coast, bottom temperature decreased from off Krishnapatnam to off Cuddallore and increased to off Nagapatnam.

Latitudinal variation in different depth ranges: The latitudinal variations in temperature in different depth ranges along the southwest and southeast coast were presented in the Table nos. 4.2, 4.3 and Fig. no 4.1, 4.2.

Along southwest coast at 30m depth range, the bottom temperature showed a decrease from off Kozhikode to off Vadanapilly and then increased to off Kochi and then the values were homogenous upto off Cape Comorin. In the 50m depth range, bottom temperature showed an increase from off Kannur to off Kozhikode then decreased to off Vadanapilly and again increased upto off Trivandrum and decreased at off Cape Comorin. At 100m and 200m depth ranges, the bottom temperature showed an irregular variation along transects.

Along southeast coast at 30m depth range, showed a decrease from off Krishnapatnam to off Chennai and then increased to off Nagapatnam. At 50m depth range, bottom temperature increased from off Krisnapatnam to off Cuddallore and decreased off Nagapatnam. Off Chennai and off Cuddallore showed similar temperature. In the 100m depth range, bottom temperature showed a decrease from off Krishnapatnam to off Cuddallore and then sharply increased to off Nagapatnam. In the 200m depth range, bottom temperature decreased from off Krishnapatnam to off Cuddallore and then increased to off Nagapatnam.

4.2.2 Salinity

Depth-wise variation in each transects: - Depth-wise variation of bottom salinity in each transect is presented in Table 4.1. Salinity varied from a minimum of 33.72‰ (off Cape Comorin, 50m) to a maximum of 35.92‰ (off Kozhikode, 110m) along the southwest coast and a minimum of 32.09‰

(off Chennai, 33.4m) to a maximum of 36.42‰ (off Cuddallore, 169m) along the Southeast coast. Salinity showed slight variation with depth.

Along southwest coast, transects, off Kannur and off Trivandrum showed a decrease in bottom salinity with increase in depth. Off Kozhikode showed an increase in salinity from 30m to 100m and decreased to 200m depth ranges. Off Vadanapilly and off Cape Comorin, salinity decreased from 30m to 50m then increased to 100m and again decreased to 200m depth ranges. Whereas in the off Kochi and off Kollam, an increase in salinity from 30m to 100m and a decrease to 200m depth ranges were observed. Along southeast coast, off Nagapatnam, off Cuddallore and off Chennai transects showed an increase of bottom water salinity from 30m to 200m depth ranges. Whereas Off Krishnapatnam showed a decrease in salinity from 30m to 50m and increased to 200m depth ranges.

When both the coasts were taken into account maximum difference in salinity within a transect was noticed 1.79‰ off Kollam in the southwest coast, whereas 2.78‰ off Cuddallore in the southeast coast. Minimum difference in salinity within a single transect was noticed 1.38‰ off Cape Comorin in the southwest coast, whereas 1.5‰ off Krishnapatnam in the southeast coast. The mean salinity showed an irregular variation along southwest and southeast coasts.

Latitudinal variation in different depth ranges: - The bottom salinity during the sampling time at different depth ranges was presented in Table 4.2& 4.3, Fig.4.3 & 4.4.

Along southwest coast at 30m depth range, the bottom salinity showed an increase from off Kozhikode to off Kollam then decreased to off

Trivandrum and increased to off Cape Comorin. In the 50m depth range, bottom salinity showed a decrease from off Kannur to off Kochi then increased to off Cape Comorin. At 100mdepth range, salinity showed an irregular variation along transects. In the 200m depth range, the bottom salinity showed a decrease from off Kozhikode to off Vadanapilly then increased to off Kochi and again decreased to off Cape Comorin.

Along southeast coast at 30m depth range, salinity showed an irregular variation along transects. At 50m and 100m depth ranges, bottom salinity increased from off Krisnapatnam to off Cuddallore and decreased off Nagapatnam. In the 200m depth range, salinity showed an irregular variation along transects.

4.2.3 Dissolved Oxygen

Depth-wise variation in each transects: - Depth-wise variation of dissolved oxygen in each transect is presented in Table 4.1. Generally there was a sharp decrease in dissolved oxygen with increase in depth. Along the southwest coast it ranged from 1.12 ml/l (off Kollam, 186m) to 4.53 ml/l (off Kochi, 29.60m and off Kollam, 33.80m) and 1.13 ml/l (off Krishnapatnam, 203m) to 4.41 ml/l (off Nagapatnam, 30m).

Along southwest coast, transects, off Kannur, off Kochi, off Kollam off Trivandrum and off Cape Comorin showed a decrease in bottom dissolved oxygen with increase in depth. Off Kozhikode and off Vadanapilly showed an increase in dissolved oxygen content from 30m to 50m and then decreased to 200m depth ranges. Along southeast coast, off Nagapatnam and off Chennai transects showed a decrease of bottom water dissolved oxygen from 30m to 200m depth ranges. Whereas off Cuddallore and off Krishnapatnam showed an increase of dissolved oxygen from 30m to 50m and then decreased to 200m depth ranges.

When both the coasts were compared, maximum difference in dissolved oxygen within a transect was noticed 3.41 ml/l off Kollam in the southwest coast, whereas 3.37 ml/l off Krishnapatnam in the southeast coast. Minimum difference in dissolved oxygen within a single transect was noticed 3.16 ml/l off Cape Comorin in the southwest coast, whereas 2.61 ml/l off Nagapatnam in the southeast coast. The mean dissolved oxygen along southwest coast showed an irregular variation along transects. Whereas along southeast coast, dissolved oxygen decreased from off Krishnapatnam to off Chennai or off Cuddallore (both transects showed same value) and then increased.

Latitudinal variation in different depth ranges: - The dissolved oxygen level in the sea bottom during the cruise number 230 & 233 along the Southwest and Southeast coast was presented in Table 4.2, 4.3 and Fig.4.5, 4.6.

Along southwest coast at 30m depth range, the bottom dissolved oxygen showed an increase from off Kozhikode to off Kollam then decreased to off Cape Comorin. In the 50m depth range, bottom dissolved oxygen showed an increase from off Kannur to off Vadanapilly then decreased to off Kochi and increased to off Kollam and again decreased to off Cape Comorin. At 100mdepth range, dissolved oxygen showed an increase from off Kannur to off Kozhikode then sharply decreased to off Vadanapilly then increased to off Kochi and again decreased to off Cape Comorin. In the 200m depth range, the bottom dissolved oxygen showed an increase from off Kozhikode to off Kochi and decreased to off Kollam and again increased to off Cape Comorin.

Along southeast coast at 30m depth range, dissolved oxygen showed a decrease from off Krishnapatnam to off Cuddallore then increased to off Nagapatnam. At 50m and 100m depth ranges, dissolved oxygen showed an irregular variation along transects. In the 200m depth range, bottom dissolved oxygen showed an increase from off Krishnapatnam to off Nagapatnam.

4.3 Discussion

Hydrographical parameters like temperature, salinity and dissolved oxygen shows variation with different depths and latitudes. Among them, temperature showed highest variations along both the coasts. While, comparing both the coasts, Arabian Sea was warmer than the Bay of Bengal. Temperature shows the highest variation and salinity the least. The general trend of bottom temperature and dissolved oxygen was a decrease with increase in depth and salinity increased with increase in depth along the southwest and southeast coasts.

Along southwest coast, variation of bottom temperature at different depth ranges shows an increase from 30m to 100m depth range and then decreased to 200m. In the 30m depth range, the bottom temperature along the southwest coast transects shows minimum variations. In the 30m and 100m depth range, temperature was high off Kozhikode. In the 50m depth range, comparatively higher temperature was observed off Kannur transect. The central part of the Arabian Sea is warmer than the southern part because of the influence of Persian Gulf waters (Wyrtki, 1971). This may be the reason of the higher values of temperature towards north. In the 200m depth range temperature was high off Kollam. So, higher temperature observed along northern transects compared to south from

30m to 50m depth ranges. Joydas and Damodaran (2009) also reported same trend along southwest continental shelf of India.

Along southeast coast, bottom temperature variations were irregular along transects and at different depth ranges. In the 30m and 200m depth ranges, temperature was high off Krishnapatnam compared to other transects. In the 50m depth range, temperature was higher off Cuddallore and off Chennai. In the 100m depth range, comparatively higher temperature was observed off Nagapatnam transect. The temperature values of the bottom waters along the outer shelf of the east coast were low compared to the inner shelf (Jacob *et al*., 2008).

Salinity shows least variation along transects as well as in different depth ranges. Though the variation was small, a general trend shows an increase in salinity from near shore waters to the shelf edge along both the coasts. In the southwest coast at 30m depth range, bottom salinity shows high values recorded at northern region and was highest off Vadanapilly. In the 50m depth range, salinity was high at off Kannur transect. Off Kozhikode recorded high salinity in the 100m and 200m depth ranges. Generally higher salinity observed to northern transects. Similar trend was observed in the west coast shelf waters by Joydas & Damodaran, (2009). During the northeast monsoon season, low saline water from the Bay of Bengal joins the northward flowing equatorial Indian Ocean water and flows as a northward surface current along the west coast of India (Pankajakshan & Ramaraju, 1987). The lower salinity of southern region can be due to this incursion of low saline waters from the Bay of Bengal to the west coast (Darbyshire, 1967; Wyrtki, 1971).

In the southeast coast, highest salinity at 30m, 50m, 100m and 200m depth ranges was observed at off Cuddallore compared to other transects.

Comparing both the coasts, southwest coast was more saline than the southeast coast. But the highest salinity was recorded at Cuddallore, 200m depth, in southeast coast. In the southeast coast the salinity in the near shore waters is less compared to Arabian Sea may be because of the large amount of river water input to the Bay of Bengal.

Dissolved oxygen content of the bottom waters shows a decrease with increase in depth, like bottom temperature variation along both the coasts. The dissolved oxygen concentrations of the bottom waters along the outer shelf of the east coast were low compared to the inner shelf (Jacob *et al.*, 2008).

In the southwest coast, at 30m depth range, bottom dissolved oxygen shows high values along southern region and was highest at off Kochi and off Kollam. In the 50m depth range, high DO was observed off Vadanapilly compared to other transects. In the 100m depth range, DO was highest off Kozhikode and in the 200m depth range, it was at off Kochi.

Along southeast coast bottom dissolved oxygen was varied irregularly at different depth ranges and along transects. In the 30m and 100m depth ranges dissolved oxygen level was high at off Nagapatnam. In the 50m depth range, high DO value observed off Krishnapatnam. In the 200m depth range off Nagapatnam and off Cuddallore was recorded high dissolved oxygen.

Chapter 5

SEDIMENT CHARACTERISTICS

Contents

5.1 Introduction

Sediment characters play a very important role in deciding the nature of the marine benthic environment. The variation in grain size and the distribution of organic matter of the substrate determines the composition and distribution of the benthic community. The organic fraction of the particle input to the sediment is a potential source of energy for benthic organisms.

Vital importance of sediment composition in deciding the nature and composition of benthos had already been emphasized (Sanders, 1958). Substratum provides the anchor to live and food in the form of organic matter to the bottom fauna. The distribution of macrobenthos is highly correlated with the substratum type, which in turn related to the environmental conditions such as current speed and organic matter availability (Buchanan, 1984). Among the physical parameters temperature, salinity, food availability and nature of the substratum are considered to be the most significant in regulating the distribution, abundance and reproductive cycle of benthic organisms (Ingole and Parulekar, 1998).

The Arabian Sea and Bay of Bengal are seas bordering the Indian subcontinent and they represent two hydrologically and biogeochemically contrasting areas (Dileep Kumar *et al*., 1998).

The continental shelf of the west coast of India comprises a complex heterogeneity of sedimentary environments. The geomorphology of this area up to 60m depth from the coast is even with gentle inclinations while outer shelf in the depth range of 90-120m has uneven local undulations of more or less 5m (Nair and Hashimi, 1986). The shelf is composed of three different sediment types (Hashimi, 1981) of different in origin. A near shore sand zone, extending from the shore to a water depth of 5-10m, is succeeded by the mud zone (silt and clay), which extends to a depth of 50-60m (inner shelf). Beyond 50-60m (outer shelf) is covered by coarse calcareous sand. The referred coastal sediment zones are originated as a result of geological processes of weathering and erosion of the coastal rocks. The age of calcareous sands of the outer shelf is of late Pleistocene origin, when the sea level was 60m to 90m below the present sea level. The radio carbon age of the calcareous sediments are 9000 and 11000 years before the present, and is termed as relict (Nair, 1974; Nair *et al*., 1979).

Several studies have been conducted to analyze the substrata of the western continental shelf of India. Most of the works were before the Indian Ocean tsunami on 26th December 2004 and only few studies were attempted in the continental shelf area after the devastating tsunami. The shelf widths range as much as over 100 miles off Bombay tapering to as little as 30 miles off Cochin (Nair and Pylee, 1968). Parulekar *et al* (1976) found, the substrata off Mumbai up to 60 km to of a uniformly muddy nature.

Harkantra *et al.,* (1980) studied the entire west coast upto 75m and noticed 7 major types of substrata. Hashimi and Nair (1981) observed clayey silt in the inner shelf and sand in the outer shelf of Karnataka. Hashimi (1981) made a comparative study of the western and eastern continental shelves around Cape Comorin up to a depth of 50m and found a higher proportion of sand from Kollam to south.

Nair *et al*., (1982) studied the distribution and dispersal of clay minerals on the western continental shelf of India. Harkantra and Parulekar (1987) studied the texture off Cochin and reported that the substrate was mainly sandy with varied proportion of silt and clay. Sriram *et al*, (1998) analysed the inner shelf sediments of Mangalore and observed the silty nature of sediment upto 30m and beyond that the fine sand was observed. Study of bottom sediments of Cochin estuary and the adjoining nearshore continental shelf was carried out by Paul (2001) and reported that the estuarine sediments are sandy silt to clay and inner shelf sediments are mud.

Harkantra and Nagvenkar (2006) studied the texture and organic matter along the shelf region of Goa and noticed silty clay in seep and sand silt clay in non-seep area. They also observed that the organic carbon was high at seep sites. Spatially, sand dominating sediment was noticed in the southern transects of the west coast of India whereas fine sediment dominated in the northern transects (Jayaraj *et al*., 2007). Along the southwest coast of India, the shelf sediment was dominated by sand (Jacob *et al*., 2008).

There was an appreciable variation in sediment substrata along the continental shelf of west coast of India. Seven different types of substrata were noticed and majority was sandy (Joydas and Damodaran, 2009, Sajan *et al*, 2010 a). Jacob *et al*., (2009) studied the texture of sediment of west coast of India during late summer monsoon and pre-monsoon. A dominance of sand and silt were observed during pre monsoon whereas in late summer monsoon the texture mainly sand followed by silt and clay.

The characteristics of the sediment substrata along the continental shelf of west coast of India were studied by many workers (Nair, 1975; Hashimi *et al*., 1978; Paropkari *et al*., 1987; Narayana & Prabhu, 1993; Jayaraj *et al.*, 2008 b). They were reported that the sediment substrata of the shelf area were dominated by sand components.

The topography of the eastern continental shelf is monotonous except for some canyons cutting deeply into the shelf. The eastern shelf is narrower than the western shelf. The 100 fathom isobath is considered the outer limit of the shelf (Siddique, 1967). The outer limit of the eastern continental shelf of India lies at about 200 m and the inner shelf and the continental slope are covered by clastic sediments (Rao, 1985). The outer shelf is covered by calcareous relict sediments and off the river mouths the shelf is covered by fine-grained terrigenous sediments. The shelf at the mouths of the rivers receives a large part of its sediment from the rivers Ganges, Brahmaputra and Mahanadi in the north, Godavari and Krishna in the central region, all forming fertile, heavily populated deltas. Sediment from the rivers has made the bay a shallow sea, and the waters have reduced the salinity of surface waters along the shore.

The east coast is considered to be less productive than the west coast (Madhupratap *et al.,* 2003). Although the riverine flux may bring in nutrients, these are thought to be lost to the deep because of its narrow shelf (Qasim, 1977; Radhakrishna *et al.,* 1978; Sen Guptha, De Souza and Joseph, 1977).

Murty and Rao (1989) studied the caly mineralology of Visakhapatnam shelf sediments, east coast of India. Vijayakumar *et al* (1991) studied the sediment characteristics of Kakinada bay and backwaters, east coast of India and observed that the bottom deposits were predominantly muddy in the backwaters and sandy silt in the bay. Raman *et al*., (1995) studied the clay mineral distributions in the continental shelf sediments between the Ganges mouths and Madras, east coast of India.

The maximum tsunami run-up (10 to 12 m) was obtained along the coast of Nagapattinum district. It seems that lesser width of the continental shelf near the coast of Nagapattinam district and the interference of the direct wave and the reflected wave from Sri Lanka developed largest tsunami run-up in Nagapattinam district (Narayan *et al*., 2005). Thangadurai *et al*.,(2005) studied the sediment characteristics of inner continental shelf of Ennore, Chennai, southeast coast of India and it was mostly sandy silt and silty sand. Altaff *et al*., (2005) studied the variation of sand grains along intertidal area of Marina beach after 26th 2004 tsunami.

Sediment characteristics of the m-9 tsunami event between Rameswaram and Thoothukudi, Gulf of Mannar, southeast coast of India was analysed by Singarasubramanian *et al* (2006) and observed that the sediments were fresh, grey to dark grey in color. The granulometric analysis of sediments indicates a moderately well sorted nature of the sediments. Along the southeast coast of India, the shelf sediment was dominated by silt (Jacob *et al*., 2008).

Impact of tsunami on texture and mineralogy of a major placer deposit in southwest coast of India while the mineral grains collected during pre-tsunami period show well-sorted nature, the post-tsunami samples represent moderately to poorly sorted nature (Babu *et al.*, 2007). Srinivasalu *et al.*, (2008) studied the sediments along the southeast coast of India and it indicates that the sediments are mainly of fine to medium-grained sand. Sundararajan & Natesan (2010) studied the environmental significance in recent sediments along Bay of Bengal and Palk Strait, East Coast of India. The surface sediments in the study area during pre monsoon are generally clayey silt in nature.

Particle size of sediments has also been shown by many workers to have a profound effect on the meiofauna (Wieser, 1959b; Boaden, 1962; Gray, 1966, 1967; Jansson, 1967). Wieser (1959c) stated that 200micrometer (mean grain size) is the critical grade for the meiobenthos whereas sediment characteristic has been regarded as cardinal factor in the distribution and abundance of the meiobenthos (McIntyre, 1969; Peres, 1982). Meiofauna facilitates biomineralization of organic matter (OM) and enhances nutrient regeneration (McIntyre, 1969; Feller and Warwick, 1988; Montagna *et al.*, 1995). The interstitial space and porosity of the sediment are considered to be important factors (Crisp and William, 1971), which facilitates the meiofauna to modify their shape and movement, in the sediment (Swedmark, 1971). Detritus is of vital importance for the nutrition of meiofauna organisms in sediments (Giere, 1975; Tenore, 1977; Gerlach, 1978; Briggs *et al.*, 1979). Shirayama (1984) reported a close correlation between meiofaunal abundance and the organic carbon content of the sediment. In Indian waters, Ansari and Parulekar (1998) studied in relation between sediment grain size and meiofauna off Goa and noticed a significant relation between meiofaunal abundance, distribution and sediment size.

Distribution and abundance of meiofauna are mainly controlled by sediment characteristics and food availability (Vincx *et al.*, 1990; Coull, 1999; Liu *et al.,* 2005). They serve as food for a variety of higher trophic levels and exhibit high sensitivity to anthropogenic inputs making them excellent environmental indicators (Boyd *et al*., 2000; Gheskiere *et al.,* 2004; Schratzberger *et al*., 2006). Numerically, nematodes are the dominant taxa among meiofauna. Sajan *et al* .,(2010) reported that organic matter (OM) and amount of clay were the most relevant parameters which influencing the biomass and density of meiofauna, along the western Indian shelf.

Sediment grain size is an important factor which influencing the macrofauna. Sediment composition is of vital importance to the biota of the marine environment (Sanders, 1958). It provides both the substratum to live and food in the form of organic matter to the bottom-dwelling fauna. Although benthic assemblages are associated with depth and sediment grain size, Snelgrove and Butman (1994) suggested that, the amount of hydrodynamic energy and available organic material are more likely to be the primary driving forces. Varshney and Govindan (1995) reported that foraminiferans were abundant at sandy bottom while polychaetes preferred clayey silt bottom.

Habitat, such as grain size of sediments plays a role in determining the species distribution of macrofauna (Zimmermann, 2006). Low values of population density and biomass of macrofauna were found comparatively in fine-grained silty clay sediments (Chakraborty *et al.,* 2007). Ganesh and Raman (2007) were reported sediment grain size and organic matter influenced the distribution of macrofauna. Generally benthos preferred medium grain sized texture with low organic matter and high organic matter had an adverse effect especially on filter feeders (Jayaraj *et al.*, 2007). Variations in the macrobenthic community were mainly controlled by sediment texture (Jayaraj *et al.*, 2008). Spatial variations observed in benthic community were presumably linked to the variations in sediment granulometry (Jayaraj *et al.*, 2008). The nature of the substrate can influence on the diversity of benthic organisms.

It is well known that benthic-living organisms receive a major part of their food resources from pelagic production. Both naturally occurring and anthropogenic activities may cause variations in the organic sedimentation to the seafloor, which subsequently influence the composition of the benthic assemblages. Thus, an excess of organic material often results in an elevated biomass and number of individuals (Holte *et al.*, 2004).

Organic carbon content is a very important component in marine sediments. It is derived either from terrestrial, as organic detritus or productivity from the surface layers of water. The concentration of organic matter in the sediments depends on the quantity of supply of organic matter and the condition of deposition. The organic content of sediments is of primary importance in studies of benthic ecosystems. Murty *et al* (1968) studied the distribution of organic matter in the west coast of India and revealed that the sediments in the inner shelf and the continental slope are characterized by a higher content of organic matter while the sediments in the region in between were relatively poor in their organic matter content. Positive relationship between the abundance of benthic fauna and concentration of organic carbon in sediments had been documented by many workers (Damodaran, 1973; Parulekar *et al.*, 1975, and Anbuchezhian *et al.*, 2009). Organic matter in surface sediments is an important source of food for benthic fauna (Gray, 1974; Pearson and Rosenberg, 1978; Lopez and Levinton, 1987; Lopez *et al.*, 1989; Cocito *et al.*, 1990; Snelgrove and Butman, 1994). Distribution of organic matter was found to be related with substrata. Generally clay and silt substrata can retain more organic matter than sand.

In addition to texture, the chemical composition i.e. organic content of bottom sediments may be a causative factor than the sediment grain size in determining infaunal distribution since it is a dominant source of food directly for deposit feeders and indirectly for suspension feeders. Organic matter may influence benthos through the availability of food supply and the consumption of organic matter bound sediment and subsequent generation faecal pellets will alter the mechanical composition of sediments. Several works have been carried out to estimate the organic content of bottom deposits of marine as well as backwaters of west coast of India.

Parulekar *et al.,* (1976) studied the organic matter off Mumbai, where the sediment was rich in clay and silt and had higher organic matter content than that of the sand. Harkantra *et al.,* (1980) studied the percentage of organic carbon along the shelf of west coast of India upto a depth of 75m. They also observed high values for organic carbon in the fine sediments, whereas coarse substrata had low organic carbon content.

Mathew and Govindan (1995) studied the sediment organic matter in the nearshore coastal system off Bombay and reported an inverse relationship between organic matter and sediment texture. Productivity is the main controlling factor for the organic carbon enrichment. Texture and reworking also influence the organic carbon variations (Thamban *et al.*, 1997). Tatavarti *et al.,* (1999) studied mudbank regime off the Kerala coast during monsoon and non-monsoon seasons and observed that the high organic matter content was present in fine sediments. The thick tropical vegetation in the catchment areas of rivers and estuaries, presence of some mangrove patches on estuarine banks, high rate of primary production in tropical estuaries and shelfs, prevailing anoxic condition and fine particle size of sediments are important factors responsible for the higher concentration of organic matter in the estuary and shelf (Paul, 2001).

Ingole *et al.,* (2002) studied the sediment characteristics of coastal waters of Dabhol and reported that the high organic matter present in the study area reflected on the high biological productivity of the area, particularly of benthic production. Harkantra and Rodrigues (2004a) studied the sediment characteristics off Mangalore and reported that the percentage of organic carbon in the sediment showed close agreement with the site position of sub-tidal region.

For the Indian northeast shelf, organic matter correlated significantly with silt. Silt increased with depth, as did sediment organic matter. Off Kakinada, where the River Godavari opens into the sea, sediment organic matter was highest (Ganesh and Raman, 2007). Organic matter was higher in shallow depths than in deeper areas during pre-monsoon and post-monsoon seasons, respectively along the northwestern Indian shelf (Jayaraj *et al.*, 2008a). The sediment granulometry in a tropical continental margin of southwest coast of India was studied by Jayaraj *et al.,* (2008, b) and reported that the organic matter concentration of the sediment was high in the mid shelf. There was a tendency of higher organic matter content in fine-grained sediments of northern region compared to the southern region (Jayaraj *et al.*, 2008, b).

The surface sediments of the west coast contained a greater quantity of total organic matter when compared to the east coast, but the percentages of labile constituents of total organic matter in the sediments were found to be higher in the east coast compared to the west coast (Jacob *et al.*, 2008). The differences in the productivity patterns and the hydrographical conditions were found to exert a major influence on the quantity and composition of organic matter in the surface sediments of the western and eastern continental shelves of India (Jacob *et al.*, 2008). In general the percentage of organic matter showed an increase with increase in depth along the shelf area of west coast of India (Joydas & Damodaran, 2009). They also reported that the finer sediments retained more organic matter than coarser ones. One of the parameters influencing the density and biomass of meiofauna along the western Indian shelf was found to be organic matter (Sajan *et al.,* 2010a).

The present chapter deals with the sediment conditions after the impact of tsunami along the southwest and southeast continental shelf region of India were analyzed. The data were compared with the previously available data.

5.2 Results

Sediment conditions after the impact of tsunami along the southwest and southeast continental shelf region of India were analyzed.

5.2.1 Texture

The grain size is the most fundamental property of the sediment. Studies of grain size are being used as the primary factor in understanding the nature of sediments. Direct or visual observation of the sediment nature was made on collection. The colour of the substratum was also checked. It was greenish, greenish gray or grayish in colour. When both the coasts were taken into account four types of substrata were observed i.e. sand, sandy silt, clayey silt and sand-silt-clay.

Depth-wise variation in each transects: - The depth-wise variation of sediment texture in each transect in the current study is presented in Table 5.2, 5.3 and Fig. 5.1, 5.2.

Southwest coast

Off Kannur, samples available from 50 and 100m depth only in the present study. Sediment was grayish in colour and texture was sandy in 50m and sandy silt in 100m depth. The sand percentage varied from 32.29 (100m) to 79 (50m), silt content varied from 13.29(50m) to 52.75 (100m) and clay status was ranged from 7.71(50m) to 14.96 (100m).

Off Kozhikode transect, sediment color was greenish gray and texture was clayey silt in 32m and sandy in nature, in the remaining depths. The sand varied from 0.9 (32m) to 84.73 (208m), silt ranged from 2.46 (208m) to 72.84 (32m) and clay ranged from 9.97 (110m) to 26.26 (32m). Towards deeper stations there was a progressive increase in the percentage of sand.

Off Vadanapilly, color of the sediment was greenish gray and texture was sandy. The sand varied from 72.78(54m) to 96.55(190m), silt ranged from 1.00(30m) to 14.22(54m), and clay status was ranged from 2.31(190m) to 13(54m).

Off Kochi, sediment color was greenish gray and texture was sandy in nature. The sand percentage shows a decrease with increase in depth. Silt shows an increase in percentage to the deeper waters and clay also shows same trend up to 101m depth. The sand varied from 74.56 (229m) to 95.09 (29.60m) silt ranged from 0.32(29.6m) to 17.58(229m), and clay range was from 4.59(29.6m) to 8.51(101m).

Off Kollam, sediment was slightly greenish in colour and texture was sandy in nature except 33.8m depth and there was sandy silt. The sand percentage varied from 28.88 (33.8m) to 94.75 (186m), silt content varied from 2.06 (186m) to 54.90 (33.8m) and clay ranged from 3.19 (186m) to 16.21 (33.8m).

Off Thiruvananthapuram, samples available from 37.6m and 58.3m depth only. Sediment was greenish gray in colour and texture was sandy in nature. The sand percentage varied from 93.31 (58.3m) to 97.79 (37.6m), silt content varied from 0.00 (37.6m) to 2.92 (58.3m) and clay ranged from 2.21 (37.6m) to 3.77 (58.3m).

Off Cape Comorin, sediment was greenish gray in colour and texture was sandy in nature. Coarse sand with rock pieces and pebbles observed at 32.1m and 50.11m depth. Coarseness of the sediment decreased with increase in depth. The sand percentage varied from 86.55 (50.11m), silt content varied from 0.06 (32.1m) to 7.72 (50.11m) and clay ranged from 4.51 (122.8m) to 6.46 (32.1m).

Southeast coast

Off Nagapatnam, sediment was greenish gray in colour and the texture was sandy in nature. The sand percentage varied from 89.83 (30m) to 96.69 (102m), silt content varied from 0.05 (43.1m) to1.69 (30m) and clay range was from 2.75 (102m) to 8.47 (30m).

Off Cuddallore, sediment was greenish gray in nature and texture was sandy in nature except 169m depth. Here the texture was sand-silt-clay in nature. The sand percentage varied from 50.12 (169m) to 95.32 (110m), silt content varied from 0.3 (52.3m) to 28.10 (169m) and clay range was from 2.16 (30.9m) to 21.79 (169m).

Off Chennai, sediment was greenish gray in nature and texture was clayey silt in 33.4 and 57.5m and sandy in 99.5 and 200m depth. In 99.5m depth hard rock particles also were observed. The sand percentage varied from 15.30(33.4m) to 82.51 (99.5m), silt content varied from 4.17 (99.5m) to 52.82 (33.4m) and for the clay range was from 10.78 (200m) to 35.44 (57.5m).

Off Krishnapatnam, sediment was greenish gray in colour and texture was sandy in nature in 31.7m and 98.6m. In 55 and 203m depth sediment texture was clayey silt. The sand percentage varied from 0.73 (203m) to 90.61 (98.6m), silt content varied from 1.81 (98.6m) to 60.21 (55m) and clay ranged from 7.58 (98.6m) to 45.75 (203m).

Latitudinal variation in different depth ranges: - The latitudinal variation of sediment texture in different depth ranges is presented in Table 5.2, 5.3 and Fig.5.1, 5.2.

Southwest coast

30m depth range: - Generally sediment was sandy in nature except Kollam & Kozhikode transects. In Kollam transect the sediment was clayey silt in nature and the percentage of sand is very low. In Kozhikode transect texture was sandy silt and the percentage of silt is high (Table 5.2a, Fig.5.1a).The average value of all transects were taken into account indicate a silty sand nature for this depth range.

50m depth range: - Sediment texture of all transects was sandy in nature. Higher sand percentage was observed at Kollam transect and minimum at Vadanapilly. Sand percentage in the sediment increased as moved towards south. (Table 5.2b, Fig.5.1b). The average value of all transects were taken into account indicate a sand nature for this depth range.

75m depth range: - Sample taken from Kollam transect only. Sediment texture was sandy in nature (Table 5.2c).

100m depth range: - Generally sediment was sandy in nature except at Kannur, here the sediment was sandy silt in nature. Sand percentage is higher towards lower latitudes (Table 5.2d, Fig.5.1c). The average value of all transects were taken into account indicate a sand nature for this depth range.

200m depth range: - Sediment texture in all transects was sandy in nature. But in off Kochi there was a considerable percentage of silt and clay present along with sand (Table 5.2e, Fig.5.1d). The average value of all transects were taken into account indicate a sand nature for this depth range.

The average values of sediment texture along the southwest coast of India indicate that the major content of the substratum was sand followed by silt and clay (Table 5.4a, Fig.5.3a).

Southeast coast

30m depth range: - Texture of sediment is sandy in all transects except off Chennai, here it is clayey silt in nature (Table 5.3a, Fig.5.2a). The average value of all transects were taken into account indicate a sand nature for this depth range.

50m depth range: - In this depth range off Nagapatnam and off Cuddallore transects shows sandy texture and off Chennai and off Krishnapatnam shows clayey silt substrata. Sand percentage decreased and silt percentage increased towards lower latitudes (Table 5.3b, Fig.5.2b). In broad sense this depth range can be considered as sand-silt-clay in nature.

100m depth range: - Texture of sediment was sandy in nature along all transects (Table 5.3c, Fig.5.2c). The average value of all transects were taken into account indicate a sand nature for this depth range.

200m depth range: - In this depth range off Nagapatnam and off Chennai transects shows sandy texture, off Cuddallore shows sand-silt-clay and off Krishnapatnam shows clayey silt substrata (Table 5.3d, Fig.5.2d). The mean value indicate a sand-silt-clay nature for this depth range.

In the present study the mean values of sediment texture along the southwest and southeast coast of India shows the major content of the substratum was sand followed by silt and clay (Table 5.4b, Fig.5.3b).

5.2.2 Organic Matter

Depth wise variation in each transect: - Depth-wise variation in percentage of organic matter in each transect in the post tsunami study is presented in Table 5.1.

Southwest coast

Off Kannur, samples from 50 and 100m depth range only and organic matter ranged between 1.36 (50m) and 4.87 (100m). Average value of organic matter in this transect was 3.12%. In 50m depth organic matter percentage was lower because the substrata was sandy in nature and in 100m depth it is higher due to the higher amount of silt-clay admixture.

Off Kozhikode, percentage organic matter content in the substrata ranged from of 2.14 (46.27m) to 9.78 (32m). OM decreased from 30m to 50m and then increased to 200m depth ranges. Average organic matter for this depth range was 4.31% mainly due to the high value recorded at 30m depth.

Off Vadanapilly, organic matter content of sediment was varied between 0.34 % (30m) to 2.20 % (190m). OM irregularly varied at different depth ranges. Average value of organic matter of this transect was 1.35 %.

Off Kochi, percentage organic matter was ranged between 0.31 (29.6m) to 2.79 (101m). OM increased from 30m to 100m and then decreased to 200m depth ranges. Average organic matter in this transect was 1.42%.

Off Kollam, percentage organic matter was ranged between 0.77(52 &75m) to 3.59 (33.8m). OM irregularly varied at different depth ranges. Average organic matter along this transect was 1.80%.

Off Thiruvananthapuram, samples were available only from 37.6m and 58.3m depth. Percentage organic matter in this transect was 0.6 (37.6m) to 0.65 (58.3m). Average organic matter was 0.63%.

Off Cape Comorin, percentage organic matter distribution ranged between 0.31 (122.8m) to 5.76 (216m). OM irregularly varied at different depth ranges. Average organic matter distribution in this transect was 2.75.

Southeast coast

Off Nagapatnam, percentage organic matter distribution was ranged between 0.33 (102m) to 2.73 (188.7m). OM irregularly varied at different depth ranges. Average organic matter distribution in this transect was 1.06%.

Off Cuddallore, percentage organic matter distribution was ranged between 0.31 (30.9m) to 3.32 (169m). OM irregularly varied at different depth ranges. Average organic matter distribution in this transect was 1.83%.

Off Chennai, percentage organic matter distribution was ranged between 2.71 (33.4) to 3.86 (99.5m). OM increased from 30m to 100m and then decreased to 200m depth ranges. Average organic matter distribution in this transect was 3.36%.

Off Krishnapatnam, distribution of organic matter was ranged between 0.43 (98.6m) to 3.32 (55 & 203m). OM irregularly varied at different depth ranges. Average organic matter along this transect was 2.13%.

Latitudinal variation in different depth ranges:- The latitudinal variation of sediment organic matter in different depth ranges is presented in Table 5.2, Fig.5.1.

Southwest coast

30m depth range: - The lower value of percentage organic matter in this depth range observed off Kochi and higher value was off Kozhikode and the values were 0.31% and 9.78%. OM decreased from off Kozhikode to off Kochi and then increased to off Kollam and again decreased to off Cape Comorin. The average organic matter in this depth range was 2.52% (Table 5.2a, Fig.5.4a).

50m depth range: - The percentage organic matter shows a minimum along off Thiruvananthapuram and maximum off Cape Comorin and the values were 0.65 and 4.45%. OM increased from off Kannur to off Kozhikode and then decreased to off Trivandrum and again increased to off Cape Comorin. The average organic matter in this depth range was 1.76% (Table 5.2b, Fig.5.4b).

75m depth range: - Sample taken from Kollam transect only. The value of organic matter was 0.77% in this depth ((Table 5.2c).

100m depth range: - The percentage organic matter shows a minimum along off Cape Comorin and maximum off Kannur and the values were 0.31

and 4.87%. OM decreased from off Kannur to off Vadanapilly and increased to off Kochi and again decreased to off Cape Comorin. The average organic matter in this depth range was 2.39% (Table 5.2d, Fig.5.4c).

200m depth range: - The percentage organic matter shows a minimum along off Kochi and maximum off Cape Comorin and the values were 1.25 and 5.76%. OM decreased from off Kozhikode to off Kochi and then increased to off Cape Comorin. The average organic matter in this depth range was 2.64% (Table 5.2e, Fig.5.4d).

The average values of organic matter along the southwest coast of India shows a minimum value in the 50m and maximum in 200m depth ranges (Table 5.4a, Fig.5.6a). OM decreased from 30m to 50m and then increased to 200m depth ranges.

Southeast coast

30m depth range: - The percentage organic matter shows a minimum along off Cuddallore and maximum off Chennai and the values were 0.31 and 2.71%. OM irregularly varied along transects at this depth range. The average organic matter in this depth range was 1.2% (Table 5.3a, Fig.5.5a).

50m depth range: - The percentage organic matter shows a minimum along off Nagapatnam and maximum off Chennai and the values were 0.83 and 3.56%. OM increased fro off Krishnapatnam to off Chennai then decreased to off Nagapatnam. The average organic matter in this depth range was 2.49% (Table 5.3b, Fig.5.5b).

100m depth range: - The percentage organic matter shows a minimum along off Nagapatnam and maximum off Chennai and the values were 0.33 and 3.86%. OM irregularly varied along transects at this depth range. The average organic matter in this depth range was 1.51% (Table 5.3c, Fig.5.5c).

200m depth range: - The percentage organic matter shows minimum along off Nagapatnam and maximum and similar values observed along off Cuddallore, off Chennai and off Krishnapatnam and the values were 2.73 and 3.32%. The average organic matter in this depth range was 3.17% (Table 5.3d, Fig.5.5d).

The average values of organic matter along the southeast coast of India shows a minimum value in the 30m and maximum in 200m depth ranges (Table 5.5b, Fig.5.6b).

5.3 Discussion

The sediment texture in the present study (2005 data) showed considerable variations along the continental shelf region of the southwest and southeast coast of India. When both the coasts were taken into account four types of substrata were observed i.e., sand, sandy silt, clayey silt and sand-silt-clay. Among this, sand was predominant substrata along both the coasts. During the 2001 data the sediment texture along the southwest coast was sandy whereas along southeast coast, siltysand.

Along the southwest coast, in the 2005 data, the substrata were composed of sand, sandy silt and clayey silt particles. The sediment was mainly composed of sand. Along the southwest coast transects, Vadanappilly, Kochi, Thiruvananthapuram and Cape Comorin shows sandy substratum in all the depth ranges (30m, 50m, 100m & 200m).

The reason for the fine sediments in the nearshore area is due to the trapping of coarse sediment in the estuaries and subsequent deposition of sediments in the inner shelf (Veerayya & Murty, 1974; Hashimi & Nair, 1981; Hashimi *et al*., 1981; Narayana & Suresh Kumar, 1994). During the present study, in the 30m depth range shows a wide variation in the sediment texture along different transects. In the Kozhikode and Kollam transects silt content was very high in the substratum. Joydas,(2002) was reported similar results in silt variation. In other transects sand was dominating. The elevated percentage of fine sediments in the nearshore region of Kollam is due to the trapping of sediments by the Ashtamudi backwaters (Hashimi *et al*., 1981). The continental shelf of southwest of India reveals the influence of estuaries on sediment texture of shelf areas (Nair & Hashimi, 1986). In general the outer shelf was sandy in nature. This sandy nature of the sediment may be due to the relict nature of the sediments and the absence of conditions favorable for deposition (Hashimi & Nair, 1981).

Sediment OM showed considerable variation with respect to depth as well as latitude. In general, more organic matter is retained in the fine sediments i.e., silt or clay than the coarser one. Along southwest coast, the present study has recorded lowest mean value of organic matter in the 50m and highest in the 200m depth ranges. Relatively high organic matter was observed in 30m depth range, where the silt is present in considerable amount in sediment substrata. This indicates that terrestrial derivation is the main source for accumulation of organic matter in the shelf area (Reddy, 1995; Seetharamaiah & Swami, 1997). The low organic matter content in certain stations found to be due to the sandy nature of substrata. Organic matter showed a decrease from 30m to 50m depth range and then it showed an increase with increase in depth.

In the southeast coast of India during the present study, the substrata were composed of sand, sand-silt-clay and clayey silt particles. The dominant component of the sediment was sand followed by silt and clay. Along the Nagapatnam transect the sand particles were dominating in all the depth ranges. Cuddallore transect, in the 30m, 50m, 100m depth ranges the sand was dominating and at the 200m depth range the sediment nature was sand-silt-clay. Chennai transect shows clayey silt nature in 30m and 50m depth ranges, whereas in the 100m and 200m depth ranges it was sandy in nature. In the Krishnapatnam transect, the sediment nature was sandy in 30m and 100m whereas clayey silt in 50m and 200m depth ranges.

In the southeast coast of India, the organic matter recorded lowest mean value in the 30m and highest in the 200m depth range. The reason for the low content of organic matter in 30m depth range is attributed to the relict nature of sediment and low biological productivity (Venkatesh Prabhu, 1992) or due to the greater turbulence and hence the greater aeration (Seetharamaiah & Swami, 1997). The higher organic matter in the deeper area, as noticed in the present study could be due to the favorable physico-chemical, sedimentological and hydrographic conditions (Seetharamaiah & Swami 1997).In the 200m depth range the Krishnapatnam station was clayey silt and the Cuddallore was sand-silt-clay in nature. This could be the reason for higher organic matter content in 200m depth range in the present study. Higher values were recorded in fine substrata of clay and silt, whereas sandy substrata exhibited low organic carbon (Harkantra *et al.*, 1980; Prabhu and Reddy, 1987). Hobbs (1982) has reported that association between clay content and the organic carbon is probably the result of great surface area presented by a large volume of clay particles and of the chemically active nature of clays. Kolla *et al.*. (1981) have stated that the high organic matter content in the sediments of the Indian continental margin is primarily due to its preservation, which result from the impingement of low oxygenated water on the sea floor and from the high sedimentation rates.

For the convenience of comparison, present data was processed as the pattern of 2001 data like, 30-50m, 50-75m, 100-150m and beyond 150m depth ranges. Along southwest coast, percentage distribution of sand, silt and clay did not show any significant variations in all the depth ranges. Even though there were no significant variations observed at different depth ranges, the sediment texture showed some noticeable variations in certain stations.

When comparing the sediment texture along the southwest coast during 2001 and 2005, certain changes were noticed. In the 30-50m depth range, off Kollam shows an increase of sand percentage from 8.89% to 28.88% during 2001 and 2005 respectively. Percentage of silt was decreased from 72.56% to 54.90% during 2005. No other transects showed considerable changes in this depth range during post tsunami period (2005) compared to 2001.

In the 50-75m depth range, off Kannur showed an increase in sand percentage from 50.13% (2001) to 79.00% (2005). Silt percentage shows a decrease from 36.47% to 13.29%. It means a considerable amount of silt was replaced by sand particles during 2005. No other transects showed considerable variations in this depth range during post tsunami period (2005) compared to 2001.

In the 100-150m depth range, off Kannur showed a decrease in percentage of sand from 53.92% to 32.29%. Silt percentage showed an increase from 38.76% to 52.75%. In this station, sand was replaced by silt particles. Off Vadanapilly showed an increase of sand percentage from 71.71% to 91.38%. Silt showed a decrease from 20.47% to 5.90%. Here silt was replaced by sand particles. Off Kochi showed an increase in sand percentage from 68.69% to 85.00%. Silt percentage showed a decrease from 25.34% to 6.49%. Here also, silt was replaced by sand particles. No other transects showed considerable alterations in this depth range during post tsunami period (2005) compared to 2001.

Beyond 150m depth range, off Vadanapilly showed an increase of sand percentage from 71.99% to 96.55%. Silt showed a decrease from 21.20% to 1.14%. Silt was replaced by sand particles. Percentage of clay did not show much variation along transects. No other transects showed considerable changes in this depth range during post tsunami period (2005) compared to 2001.

Along southwest coast, percentage distribution of organic matter did not show any significant variations in all the depth ranges during 2005 compared to 2001. But the direct observation indicates some changes as follows. In the 30m depth range, OM increased during 2005 except off Vadanapilly and off Kochi. In the 50m depth range, OM decreased during 2005 except off Cape Comorin. In the 100m depth range, OM decreased during 2005 except off Kannur. In the 200m depth range, OM decreased except off Vadanapilly and off Cape Comorin.

Along southeast coast, percentage distribution of sand and clay did not show any significant variations in all the depth ranges. Percentage of silt did not show any significant variations in 30-50m, 50-75m and 100-150m. But beyond 150m depth range, silt showed a significant reduction (p-value < 0.02) during 2005 compared to 2001. Even though there were no other significant variations observed the sediment texture showed some obvious variations in certain stations.

While comparing the 2001and 2005 data along southeast coast, in the 30-50m depth range off Chennai, percentage of sand decreased from 88.58% to 15.3%. Silt showed an increase from 6.17% to 52.82%. Clay also showed an increase from 5.25% to 31.89%. In this station, sand was replaced by silt and clay particles during 2005. No other transects showed considerable changes in this depth range during post tsunami period (2005) compared to 2001.

In the 50-75m depth range, off Cuddallore showed an increase in sand percentage from 66.99% to 89.59%. Clay content decreased from 23.5% to 10.12%. Clay was replaced by sand particles during post-tsunami period. Off Chennai showed a decrease in silt percentage from 88.66% to 46.67%. Percentage of clay showed an increase from 4.00% to 35.44%. Off Krishnapatnam also showed a decrease in percentage of silt from 91.22% to 60.21%. Percentage of clay increased from 5.25% to 30.84%. Off Chennai and off Krishnapatnam showed a trend was that a considerable amount of silt was replaced by clay particles during post tsunami period. No other transects showed considerable changes in this depth range during post tsunami period (2005) compared to 2001.

In the 100-150m depth range, off Nagapatnam showed an increase in percentage of sand from 38.00% to 96.69%. Silt showed a decrease from 53.00% to 0.56%. Here silt was replaced by sand particles. Off Chennai showed an increase in percentage of sand from 72.00% to 82.51%. Silt showed a decrease from 24.00% to 4.17%. Off Krishnapatnam showed an increase in percentage of sand from 75.97% to 90.61%. Percentage of clay decreased from 21.75% to 7.58%. No other transects showed considerable changes in this depth range during post tsunami period (2005) compared to 2001.

Beyond 150m depth range, off Nagapatnam showed an increase in percentage of sand from 12.00% to 93.04%. Silt was decreased from 68.00% to 1.52%. Percentage of clay decreased from 20.00% to 5.44%. Here silt and clay were replaced by sand particles. Off Cuddallore showed an increase in sand percentage from 42.88% to 50.12%. Silt percentage decreased from 52.37% to 28.12%. Percentage of clay increased from 4.75% to 21.79%. Off Chennai showed an increase in percentage of sand from 17.75% to 76.44%. Silt was decreased from 78.75% to 12.78%. Here, silt was replaced by sand particles. Off Krishnapatnam showed a decrease in percentage of silt from 88.75% to 53.52%. Percentage of clay increased from 10.50% to 45.75%. Here a considerable amount of silt was replaced by clay particles. No other transects showed considerable changes in this depth range during post tsunami period (2005) compared to 2001.

Along southeast coast, percentage distribution of organic matter did not show any significant variations in all the depth ranges. But the direct observation indicates some changes as follows. In the 30-50m depth range, OM decreased except off Krishnapatnam. In the 50-75m depth range, OM decreased off Nagapatnam and Cuddallore and increased off Chennai and off Krishnapatnam. In the 100-150m depth range, OM decreased during 2005 off Nagapatnam and increased off Chennai and off Krishnapatnam. Data during 2001 was not available from off Cuddallore. Beyond 150m depth range, OM increased except off Cuddallore.

These changes during 2005 compared to 2001 along southwest and southeast coast can be due to the impact of 26th December 2004 tsunami. The December 2004 tsunami generated by the M 9.0 Sumatra-Andaman earthquake devastated many parts of the Kerala coast too (Kurian *et al*., 2005; Narayana *et al.,* 2005; Kurian and Praveen, 2010). Narayana *et al.* (2005) studied the nature of the sedimentation induced by this tsunami along the Kerala Coast of India and reported that the tsunami surge had affected along the continental shelf to the southwest coast. Kurian *et al.,* (2006) reported that, analysis of offshore bathymetric data indicates the shifting of depth contours towards shore, indicating erosion of sediments and deepening of inner shelf of southwest coast of India due to the tsunami.

Narayana *et al..* (2007) demonstrated that the December 26, 2004 tsunami transported landwards significant volumes of sediment from the mid- and inner-shelf regions of the southwest coast of India. Tsunami creates a significant exchange of materials from the shelf and near shore zones to beach and estuarine environments. The tsunami eroded and transported landwards significant volumes of distinct black sands, rich in heavy minerals, from the shelf onto the beaches of the Kerala region, and up to 500 m inland of the southwest coast (Narayana *et al..* (2007).

Babu *et al.*,(2007) reported that the recent high intensity tsunami waves have also brought considerable quantities of shelf sediments towards the coast. The sediment grains are apparently more altered in the post-tsunami samples which could be due to the mixing of shelf sediments with the onshore sands. The shelf of the Kerala coast may host older sediments and possibly more altered or the shelf sediments could have been subjected to intense weathering due to sub aqueous conditions. The post-tsunami sediments might have been transported from the Shelf region of Kerala Coast or partly formed due to the reworking of deeper onshore sediments that were lying below the water table (Babu *et al*., 2007).

Srinivasalu *et al.,* (2009) reported that the sediments from the near shore continental shelf and beaches are deposited in mudflats, agricultural fields, backwaters and river mouths. The foraminiferal assemblages recorded in the tsunami sediments from north of Chennai and north of Pondicherry indicate an entrainment of sediment by the tsunami from the inner shelf region with a water depth of less than 30m (Rajeshwara Rao and Charles, 2005; Bahlburg and Weiss, 2007).

Hussain *et al,.* (2006) reported that the tsunami sediments deposited on the beaches, creeks/estuaries and mangrove swamps in the Andaman Islands have been mainly derived from the shallow littoral to neritic bathymetry and not from deeper bathyal territories. Murthy *et al* (2006) reported that, the Tamil Nadu severely affected by the tsunami surge and inundation caused by the great Sumatra earthquake of 26 December 2004 (*M*w 9.3).

The changes occurred in the post-tsunami period (2005) compared to 2001 data indicate that the 26th December 2004 tsunami had an impact on the sediment substrata along southwest and southeast continental shelf of India.

…..ജൽ…..

Chapter 6

MACROBENTHOS

Contents

6.1 Introduction

Ocean bottoms are the most widespread habitat on Earth and support high biodiversity and key ecosystem services. Because of the inaccessibility and vastness of the world's oceans, our knowledge of marine biodiversity was limited than of terrestrial diversity. The analysis of benthic communities has been considered as a tool for describing the functioning of the ecosystems (Gray, 1981). Nearly 40% of the total open ocean area and 30% of the total area of the world's continental shelves lie within the tropics (Alongi, 1990). Diversity of benthic habitat peaks in tropics.

Macrobenthos in marine sediments play important roles in ecosystem processes such as nutrient cycling, pollutant metabolism, dispersion and burial, and in secondary production (Snelgrove, 1998). It is therefore important to improve our understanding of biodiversity in marine sediment. Marine systems differ from terrestrial systems in a number of ways, and paradigms concerning terrestrial patterns of biodiversity may not be applicable to marine situations (May, 1994; Gray, 1997; Heip *et al.*, 1998). Many benthic species have pelagic larvae that remain floating in the water for days or months, and since unlike most terrestrial systems, barriers to dispersal are relatively weak, many species may disperse over much broader ranges than on land.

The number of species has been the traditional measure of biodiversity in ecology and conservation, but the abstract concept of biodiversity as the 'variety of life' (Gaston 1996) cannot be encompassed by a single measure (Harper & Hawksworth ,1994, Heywood &Watson 1995, Warwick & Clarke ,1995). Local richness and biotic differences are positive components of biodiversity, whereas biotic similarity is negatively related to overall biodiversity (Colwell & Coddington, 1994). Ellingsen (2001) evaluated different measures of marine biodiversity, and suggested that, in addition to species diversity, distributions of species and community differences should be taken into account when measuring marine biodiversity. Many studies on the link between species richness and habitat diversity (Izsak and Price, 2001; Hewitt *et al*., 2005; Thrush *et al*., 2006) emphasize the importance of understanding habitat-species richness relationships for coastal management and biodiversity conservation. The available evidence suggests that environmental factors such as productivity, temperature, and sediment grain-size diversity play dominant roles in determining patterns of regional-scale species richness and patterns in species turnover, and it is probably the regional scale that primarily determines local species richness (Gray, 2002).

In the case of Indian waters, most of the qualitative studies on benthos were localised in and around various estuaries (Damodaran,1973; Parulekar *et al*., 1980; Harkantra and Parulekar,1981; Vizakat *et al*,1991; Venkatesh Prabhu *et al*.,1993; Ansari *et al*.,1994; Harkantra and Parulekar, 1994; Sarala Devi *et al.* ,1996; Gopalakrishnan and Nair,1998; Sunil kumar, 1999; Sheeba, 2000). In general, most of the studies showed that polychaetes were the most abundant fauna followed by crustaceans or molluscs. Some authors have indicated the abundance of echiuroids (Venkatesh Prabhu *et al.*, 1993; Harkantra and Parulekar, 1994), echinoderms (Harkantra *et al.*, 1980; Venkatesh Prabhu *et al.*, 1993) and Sipunculids (Harkantra and Parulekar, 1994) in certain regions. Sheeba (2000) reported that the diversity of mangrove region has recorded an abundance of tanaids and amphipods, which outnumbered all other groups in certain stations.

Harkantra *et al.* (1980) recorded the major fauna of the shelf region of west coast up to a depth of 75m. Ganesh and Raman (2007) studied on macrobenthic community structure along north-eastern continental shelf of India. Jayaraj *et al.*,(2007 and 2008a) investigated on the macrobenthos along the north-western Indian shelf. Jayaraj *et al.,* (2008b) studied on macrobenthos along southwest coast of India from 20m to 200m depth ranges. Joydas and Damodaran (2009) studied macrobenthos along the western continental shelf of India.

This chapter deals with the numerical abundance, biomass and faunal composition of macrobenthos along the southwest and southeast continental shelf of India. Being the dominant group, special attention is given for polychaetes. Diversity indices were calculated for the polychaetes and groups separately. Similarity index were calculated. Clustering of stations and MDS plots were analysed to support the similarity between stations. Dominance plots were worked out for polychaetes species. All the analysis was carried out separately for both the coasts. The data of present study, during 2005 was compared with the previously (2001) available data from Centre for Marine Living Resources and Ecology, Ministry of Earth Sciences. 'Anova – Two factor without replication' was used to compare the data. The species abundance along southeast coast was not compared as previous data was not available.

For different terms of diversity indices with different ecological importance were used. They were species richness, species evenness, species diversity and species dominance. The species richness (Margalef's index) is used to estimate the total number of species in a given area. Species richness is a straight forward count of the number of species. More the number of species in a sample or more the species present in a species list of a given environment, the greater will be the species richness. The term evenness is used for the numerical percentage of composition. High evenness occurs, when the species present are virtually in equal abundance, which is conventionally equated with high diversity. The less numerically equal the species are, the less diverse the sample is or, conversely, the greater dominance in the fauna (Sanders, 1968). Species dominance is the relatively occurrence of species with other species. The dominant species will have high relative occurrence. The term species diversity is used for the number of species per number of individuals. The highest species diversity possible is when only one individual represents every species and the lowest diversity possible is when community consists of only one species (Soetaerp and Heip, 1990). Species diversity measurements are often more informative than species counts alone because they take into account two factors, species richness and evenness (Magurran, 1988).

6.2 Results

6.2.1 Biomass and Numerical Abundance

Depth-wise variation in each transect: - Depth wise variation of biomass (wet weight, g/sq.m) and numerical abundance (No/sq.m) of group wise macrofauna in each transect was presented in the Table 6.1 and 6.5.

Southwest coast

Off Kannur transect, the samples were taken from 50m and 100m depth ranges only. The biomass of macrofauna shows a minimum of 2.005 g/sq.m at 100m to a maximum of 3.100 g/sq.m at 50m depth range. Mean value of biomass along this transect was 2.553 g/sq.m. The higher biomass in the 50m depth range was due to the larger size of polychaetes individuals. For biomass polychaetes contributed 48.87% in 50m depth range. Whereas in the 100m depth range crustaceans were the major group and contributed by 53.12% and it was due to the larger size of crustacean individuals.

Numerical abundance of macrobenthos ranged from a minimum of 1638 No/sq.m at 50m and a maximum of 2060 No/sq.m at 100m depth ranges with a mean density of 1849 No/sq.m. Polychaetes were dominated in 50m and 100m depth ranges with 56.79% and 71.24% respectively. Numerical abundance along this transect showed an increase from 50m to 100m depth range.

Off Kozhikode transect, biomass ranged from a minimum of 6.397g/sq.m (100m) to a maximum of 30.200 g/sq.m (50m) with a mean value of 16.914 g/sq.m. Polychaetes were the major groups in 50m (74.83%), 100m (78.32%) and 200m (94.62%) depth ranges. In the 30m depth range, molluscs dominated with 52.18% and were due to the larger size of molluscs. High biomass of macroinfauna was observed in shallow waters along this transect.

Numerical abundance of macrobenthos ranged from a minimum of 160 No/sq.m at 30m and a maximum of 4460 No/sq.m at 50m depth ranges with a mean density of 1976 No/sq.m. Polychaetes were dominated in abundance in all the depth ranges and contributed with 43.27% (30m), 78.81% (50m), 86.75% (100m) and 91.28% (200m). Abundance of macroinfauna was low in 30m depth range than the other depth ranges along this transect.

Off Vadanapilly transect, biomass ranged from a minimum of 2.935 g/sq.m (100m) to a maximum of 20.750 g/sq.m (50m) with a mean value of 9.705 g/sq.m. In this transect, polychaetes were dominated in 30m, 50m and 200m with 55.69%, 52.05% and 81.13%. Crustaceans were dominated in the 100m depth range with 62.69%. High biomass of was observed in shallow waters along this transect.

Numerical abundance of macrobenthos ranged from a minimum of 705 No/sq.m at 100m and a maximum of 7335 No/sq.m at 50m depth ranges with a mean density of 2656 No/sq.m. Polychaetes dominated in 30m, 100m and 200m depth ranges with 87.40%, 59.93% and 57.37% respectively. In the 50m depth range foraminifera were dominant with 48.12% contribution. High abundance of macrobentic infauna was observed in shallow waters along this transect.

Off Kochi transect, biomass ranged from a minimum of 3.260 g/sq.m (100m) to a maximum of 17.325 g/sq.m (50m) with a mean value of 7.441g/sq.m. In this transect, polychaetes were dominated in all the depth ranges. They contributed by 69.79%, 48.77%, 58.13% and 59.81% in the 30m, 50m, 100m and 200m depth ranges respectively. High biomass of macroinfauna was observed in shallow waters along this transect.

Numerical abundance of macrobenthos ranged from a minimum of 610 No/sq.m at 200m and a maximum of 4038 No/sq.m at 50m depth ranges with a mean density of 1668 No/sq.m. In the, 50m, 100m and 200m depth ranges, polychaetes were dominated with 38.02%, 61.77% and 86.89%. But in 30m depth range, foraminifera were dominated with 50.46%. High abundance of macroinfauna was observed in shallow waters along this transect.

Off Kollam transect, biomass ranged from a minimum of 4.375 g/sq.m (100m) to a maximum of 17.275 g/sq.m (50m) with a mean value of 9.915 g/sq.m. In this transect, polychaetes were dominated in all the depth ranges. They contributed by 72.67%, 36.76%, 32.57%, 79.16% and 52.27% in the 30m, 50m, 75m, 100m and 200m depth ranges respectively. High biomass of macroinfauna was observed in shallow waters along this transect.

Numerical abundance of macrobenthos ranged from a minimum of 723 No/sq.m at 75m and a maximum of 4795 No/sq.m at 200m depth ranges with a mean density of 2423 No/sq.m. Polychaetes were dominated in 30m, 50m and 100m depth ranges with 69.75%, 66.53% and 92.97% respectively. In the 75m depth range, foraminiferans dominated with 49.52%. In the 200m depth range, crustaceans dominated in the 200m depth range 74%. In the 200m depth range, a hike in abundance observed due to the higher number of crustaceans.

Off Trivandrum transect, samples taken from 30m and 50m depth ranges only. The biomass ranged from a minimum of 12.925g/sq.m (50m) to a maximum of 18.125 g/sq.m (30m) with a mean value of 15.525 g/sq.m. In this transect, polychaetes were dominated in the 30m and 50m depth ranges with 63.61% and 33.08% respectively.

Numerical abundance of macrobenthos ranged from a minimum of 1993 No/sq.m at 30m and a maximum of 3225 No/sq.m at 50m depth ranges with a mean density of 2609 No/sq.m. Polychaetes dominated in 30m and 50m depth ranges and the contribution was 79.30% and 61.24%.

Off Cape Comorin transect, biomass ranged from a minimum of 3.767g/sq.m (100m) to a maximum of 11.400 g/sq.m (50m) with a mean value of 6.813 g/sq.m. In this transect, polychaetes dominated in 100m depth range only with 47.12%. In the 30m and 50m depth range crustaceans dominated with 40.51% and 39.04% respectively. In the 200m depth range molluscs dominated with 69.28%. High biomass of macroinfauna was observed in shallow waters along this transect.

Numerical abundance of macrobenthos ranged from a minimum of 678 No/sq.m at 30m and a maximum of 2370 No/sq.m at 50m depth ranges with a mean density of 1380 No/sq.m. Crustaceans were dominated in the 30m (64.58%) and 50m (42.195) depth ranges. Whereas polychaetes in 100m (61.75%) and 200m (90.44%) whereas depth ranges.

Southeast coast

Off Nagapatnam transect, biomass ranged from a minimum of 4.200g/sq.m (100m) to a maximum of 17.000 g/sq.m (200m) with a mean value of 10.893 g/sq.m. Polychaetes dominated in the 30m and 200m depth ranges with 57.51% and 76.03% respectively. In the 50m and 100m depth ranges crustaceans were dominated with 35.03% and 25.24% respectively.

Numerical abundance of macrobenthos ranged from a minimum of 416 No/sq.m at 100m and a maximum of 2573 No/sq.m at 200m depth ranges with a mean density of 1413 No/sq.m. Polychaetes dominated in 50m, 100m and 200m depth ranges with 41.37%, 77.76% and 84.16% respectively. Crustaceans dominated in 30m depth range with 54.65%.

High abundance of macroinfauna was observed in 200m depth along in this transect.

Off Cuddallore transect, biomass ranged from a minimum of 3.870g/sq.m (100m) to a maximum of 22.807 g/sq.m (30m) with a mean value of 11.257 g/sq.m. Polychaetes were dominated in all the depth ranges with 22.30%, 54.60%, 74.55% and 31.87% respectively. In the 30m depth range, crustaceans contributed 22.12%. High biomass of macroinfauna was observed in shallow waters along this transect.

Numerical abundance of macrobenthos ranged from a minimum of 1123 No/sq.m at 200m and a maximum of 2524 No/sq.m at 30m depth ranges with a mean density of 1770 No/sq.m. Polychaetes dominated in 50m, 100m and 200m depth ranges with 46.83%, 75.28% and 71.27% respectively. Crustaceans were dominated in 30m depth range with 65.30%. High abundance of macroinfauna was observed in shallow waters along this transect.

Off Chennai transect, biomass ranged from a minimum of 2.919g/sq.m (30m) to a maximum of 9.175 g/sq.m (50m) with a mean value of 6.307 g/sq.m. Polychaetes dominated in 50m, 100m and 200m depth ranges with 27.25%, 23.26%, 40.56%. Crustaceans dominated in the 30m depth range with 44.54%. In the 30m depth range, biomass was comparatively lesser than the other depth ranges.

Numerical abundance of macrobenthos ranged from a minimum of 303 No/sq.m at 30m and a maximum of 2768 No/sq.m at 200m depth ranges with a mean density of 978 No/sq.m. Polychaetes were dominated in 50m, 100m and 200m depth ranges with 40.44%, 56.00% and 85.91% respectively. Crustaceans were dominated in 30m depth range with

56.20%. In Chennai, high abundance observed in deeper waters than the shallow area.

Off Krishnapatnam transect, biomass ranged from a minimum of 9.962g/sq.m (100m) to a maximum of 31.170 g/sq.m (30m) with a mean value of 18.814 g/sq.m. Polychaetes dominated in the 30m, 50m and 100m depth range with 18.61%, 28.08% and 61.63%. Molluscs dominated in the 200m depth range with 79.56%. High biomass of macroinfauna was observed in shallow waters along this transect.

Numerical abundance of macrobenthos ranged from a minimum of 350 No/sq.m at 50m and a maximum of 2995 No/sq.m at 100m depth ranges with a mean density of 1311 No/sq.m. Polychaetes dominated in all the depth ranges with 43.24%, 27.14%, 57.85% and 77.02% respectively. Krishnapatnam transect also showed high abundance of macrofauna in deeper water than the shallow area.

Latitudinal variation in different depth ranges:-

Latitudinal variation of biomass (wet weight in g/sq.m) and numerical abundance (No/sq.m) of macrobenthos along the southwest and southeast coast of India at different depth ranges were presented in the Table 6.2 to 6.4 and 6.6 to 6.9; Fig.6.1 to 6.6.

Southwest coast

30m depth range: - The biomass of macrofauna varied from a minimum value of 3.955g/sq.m off Kochi and to a maximum of 18.125 g/sq.m off Trivandrum transect. The high value at the Trivandrum transect was due to the abundance and biomass of polychaetes and crustaceans. The average biomass of this depth range was 10.268 g/sq.m. The numerical abundance was ranged from a minimum of 208 No/sq.m off Kozhikode to a maximum of 1993 No/sq.m off Kollam transects. The average numerical abundance in this depth range was 1220 No/sq.m. There was no noticeable trend in biomass and abundance along this depth.

50m depth range: - The biomass of macrofauna was varied from a minimum value of 3.100g/sq.m off Kannur and to a maximum of 30.200 g/sq.m off Kozhikode transects. The average biomass of this depth range was 18.313 g/sq.m. The numerical abundance ranged from a minimum of 1638 No/sq.m off Kannur to a maximum of 7335 No/sq.m off Vadanapilly transects. The average abundance of this depth range was 3835 No/sq.m. The general trend in biomass and abundance that showed a decrease towards southern transects.

100m depth range: - The biomass of macrofauna varied from a minimum value of 2.005 g/sq.m off Kannur and to a maximum of 6.397 g/sq.m off Kozhikode transects. The average biomass of this depth range was 3.957 g/sq.m. The numerical abundance ranged from a minimum of 705 No/sq.m off Vadanapilly to a maximum of 2060 No/sq.m off Kannur transects. The average abundance of this depth range was 1243 No/sq.m. There was no noticeable trend in variation of biomass along transects whereas abundance showed a decrease from off Kannur to off Vadanapilly and then increased towards south.

200m depth range: - The biomass of macrofauna varied from a minimum value of 3.975g/sq.m off Vadanapilly and to a maximum of 22.750 g/sq.m off Kozhikode transects. The average biomass of this depth range was 9.305 g/sq.m. The numerical abundance was ranged from a minimum of 610 No/sq.m off Kochi to a maximum of 4795 No/sq.m off Kollam transects. The average abundance of this depth range was 1882

No/sq.m. Biomass showed an increase from off Vadanapilly to southern transects. Numerical abundance decreased from off Kozhikode to off Kochi and a comparatively higher abundance of crustaceans observed in off Kollam transect.

Southeast coast

30m depth range: - The biomass of macrofauna was varied from a minimum value of 2.919g/sq.m off Chennai and to a maximum of 31.170 g/sq.m off Krishnapatnam transects. The average biomass of this depth range was 17.604 g/sq.m. The numerical abundance ranged from a minimum of 303 No/sq.m off Chennai to a maximum of 2524 No/sq.m off Cuddallore transects. The average abundance of this depth range was 1418 No/sq.m. Biomass showed a decrease in southern transects whereas no noticeable trend in variation of abundance along transects.

50m depth range: - The biomass of macrofauna varied from a minimum value of 3.950g/sq.m off Cuddallore and to a maximum of 16.025 g/sq.m off Krishnapatnam transects. The average biomass of this depth range was 10.688 g/sq.m. The numerical abundance ranged from a minimum of 340 No/sq.m off Chennai to a maximum of 1655 No/sq.m off Cuddallore transects. The average abundance of this depth range was 869 No/sq.m. Biomass showed a decrease in southern transects whereas abundance was high at southern transects.

100m depth range: - The biomass of macrofauna was varied from a minimum value of 3.870 g/sq.m off Cuddallore and to a maximum of 9.962 g/sq.m off Krishnapatnam transects. The average biomass of this depth range was 6.004 g/sq.m. The numerical abundance ranged from a minimum of 416 No/sq.m off Nagapatnam to a maximum of 2995

No/sq.m off Krishnapatnam transects. The average abundance of this depth range was 1423 No/sq.m. Biomass and abundance generally showed a decrease in southern transects.

200m depth range: - The biomass of macrofauna was varied from a minimum value of 9.650g/sq.m off Cuddallore and to a maximum of 18.100 g/sq.m off Krishnapatnam transects. The average biomass of this depth range was 12.975 g/sq.m. The numerical abundance was ranged from a minimum of 588 No/sq.m off Krishnapatnam to a maximum of 2768 No/sq.m off Chennai transects. The average abundance of this depth range was 1763 No/sq.m. Biomass showed an increase from off Chennai to off Nagapatnam and abundance also high at southern transects.

Along the southwest continental shelf of India, the biomass of macrofauna varied from a minimum of 2.005 g/sq.m (Kannur, 100m) to a maximum of 30.200 g/sq.m (Kozhikode, 46.27m). The major groups contributing biomass were polychaetes and crustaceans. The biomass was minimum in the 100m and maximum in the 50m depth range. The average biomass along the entire southwest coast was 10.461 g/sq.m.

The numerical abundance of macrofauna along the southwest continental shelf of India varied from a minimum of 208 No/m^2 (Kozhikode, 32m) to a maximum of 7335No/m^2 (Vadanapilly, 54m). Numerically, polychaetes and crustaceans were the major groups. The abundance was minimum in the 30m and maximum in the 50m depth range. The average numerical abundance along the entire southwest coast was 2045 No/m^2.

Biomass of macrofauna along the southeast continental shelf of India varied from a minimum of 2.919 g/sq.m (Chennai, 33.4m) to a maximum of 31.170 g/sq.m (Krishnapatnam, 31.7m). The major groups contributing biomass were polychaetes and molluscs. The biomass was minimum in the 100m and maximum in the 30m depth range. The biomass shows a decrease from 30m to 100m, and then it increased to 200m depth range. The average biomass along the entire southeast coast was 11.08 g/sq.m.

Along the southeast continental shelf of India, numerical abundance of macrofauna was varied from a minimum of 303 No/m^2 (Chennai, 33.4m) to a maximum of 2995 No/m^2 (Krishnapatnam, 98.6m). Numerically polychaetes and crustaceans were the dominant groups. The abundance shows a decrease from 30m to 50m, and then it increased with increasing depth. The average numerical abundance along the entire southeast coast was 1368 No/m^2.

6.2.2 Faunal Composition

Polychaetes were the major group followed by crustaceans. Molluscs were comparatively less than the former two groups. Other than these three groups, some other groups contributed to the biomass and numerical abundance in certain stations and they are termed as 'others'. The major group, polychaetes were identified upto species level. The rest of the fauna were identified upto lowest possible taxonomic level.

A total of 298 species of polychaetes were identified from the southwest and southeast continental shelf of India. Among this, group Errantia was represented by 139 species, group Sedentaria by 152 species and 7 remain unidentified. These species are from 15 families of Errantia and 21 families of Sedentaria (Table 6.10a, and b).

Based on abundance, polychaetes were differentiated into three groups as "abundant", "moderately present" and "rare". The "abundant" ones were those were observed at least 50% of stations along the southwest or southeast coast. The "rare" corresponds to those which were represented by 1-3 individuals in one station (in 1sq.m) only. The "moderately present" were those, which occupy an intermediate position between the above two. This differentiation was separately performed for both southwest and southeast coast (Table 6.12a and b).

Southwest coast

Polychaetes: - Along the southwest coast, 253 polychaete species were identified from the different depth ranges. These species are from 14 families of errantia and 19 families of Sedentaria. Among these polychaetes species, 22 were abundant, 184 moderately present and 47 were rare. Of the total individuals, 23.77% were from group errantia and 76.23% from group sedentaria. *Prionospio (M) andamanensis* was the most dominating species along the southwest coast followed by *Prionospio pinnata*.

In the 30m depth range, a total of 118 polychaete species were identified. In this 53 species were from Errantia and 65 were from Sedentaria. Among these, 21 were abundant, 90 moderately present and 7 rare. Of the total individuals, 27.61% were from group errantia and 72.39% from group sedentaria. Very high occurrence of *Magelona cincta* observed in off Vadanapilly and off Kollam transects whereas the species was absent in all other transects in this depth range. *Prionospio (M) andamanensis* was highly abundant in Trivandrum transect and absent in off Kochi, off Kollam and moderately present in the remaining transects. *Eurythoe parvecarunculata* was highly abundant in off Vadanapilly and rarely present in off Kochi and absent in all other transects. *Scolelepis branchia* was abundant in off Kochi and moderately present in off Trivandrum and absent in other transects. *Ancistrosyllis parva* was abundant in off

Vadanapilly and absent in off Cape Comorin and moderately present in remaining transects. Most abundant species in this depth range was *Magelona cincta, Prionospio (M) andamanensis, Eurythoe parvecarunculata, Scolelepis branchia and Ancistrosyllis parva.*

In the 50m depth range, a total of 204 polychaete species were recorded. In this 88 species were from Errantia and 116 were from Sedentaria. Among these, 22 were abundant, 157 moderately present and 25 rare. Of the total individuals, 33.11% were from group errantia and 66.89% from group sedentaria. *Prionospio pinnata* was highly abundant at off Kozhikode and absent in off Trivandrum and Cape Comorin and moderately present in other transects. *Eurythoe* sp1 was highly abundant in off Kollam and moderately present in off Kozhikode and off Kochi, and absent in other transects. *Notomastus fauveli* was abundant in off Kochi, off Kollam, off Vadanapilly and absent in off Kannur and moderately present in other transects. *Prionospio (M) andamanensis* was abundant in off Trivandrum, off Kozhikode and moderately present in off Vadanapilly and off Kochi and absent in remaining transects. *Tharyx dorsobranchialis* was abundant in off Vadanapilly, off Kollam and off Kozhikode and absent in off Cape Comorin and moderately present in remaining transects. *Cossura coasta* was abundant in off Kozhikode and absent in off Trivandrum and off Cape Comorin and moderately present in other transects. Most abundant species were *Prionospio pinnata, Eurythoe sp1, Notomastus fauveli, Prionospio (M) andamanensis, Tharyx dorsobranchialis and Cossura coasta.*

In the 100m depth range, a total of 131 polychaete species were observed. In this 60 species were from Errantia and 71 were from Sedentaria. Among these, 22 were abundant, 96 moderately present and 13 rare. Of the total individuals, 18.50% were from group errantia and

81.50% from group sedentaria. *Prionospio (M) andamanensis* was abundant in Kozhikode and Kollam transects and absent in off Kannur and moderately present in other transects. *Prionospio cirrifera* was highly abundant in off Kannur moderately present in off Vadanapilly and absent in other transects. *Tharyx dorsobranchialis* was abundant in off Kannur and moderately present in other transects. *Magelona cincta* was abundant in off Kannur and absent in off Vadanapilly and moderately present in remaining transects. Most abundant species were *Prionospio (M) andamanensis, Prionospio cirrifera, Tharyx dorsobranchialis* and *Magelona cincta.*

In the 200m depth range, a total of 73 polychaete species were recorded. In this 26 species were from Errantia and 47 were from Sedentaria. Among these, 21 were abundant, 51 moderately present and 1 rare. Of the total individuals, 2.71% were from group errantia and 97.29% from group sedentaria. *Prionospio pinnata* was highly abundant at off Kozhikode and absent in off Kollam and off Cape Comorin and moderately present in remaining transects. A very high occurrence of *Prionospio (M) andamanensis* was observed at off Kollam followed by off Vadanapilly and absent in all other transects. *Paraonis gracilis gracilis* was abundant in off Cape Comorin, off Kozhikode, off Kochi and moderately present in off Vadanapilly and absent in off Kollam transects. *Tharyx dorsobranchialis* was abundant in off Kollam and off Cape Comorin absent in off Vadanapilly and moderately present in remaining transects. Most abundant species were *Prionospio pinnata, Prionospio (M) andamanensis, Paraonis gracilis gracilis* and *Tharyx dorsobranchialis.*

Crustaceans

Crustacea was the second dominant group among the benthic infauna of the present study. Ostracods, amphipods, copepods, isopods, decapods and cumaceans were the major groups among crustaceans. This was followed by pycnogonids, sand lobsters, stomatopods, tanaids, caprellids, mysids and barnacles.

In the 30m depth range, amphipods were dominating followed by benthic copepods and isopods. Comparatively high abundance of copepods was recorded off Cape Comorin. In the 50m depth range, ostracods were dominating followed by amphipods, copepods, isopods, decapods and cumaceans. Amphipods, isopods, copepods and cumaceans were dominated in the 100m depth range. In the 200m depth range, ostracods were the most dominating followed by amphipods and cumaceans. Cumaceans were identified upto species level and *Campylaspis* sp. was very common in all the depth ranges.

Molluscs

Among molluscs, bivalves and gastropods were the major groups. *Aloides bifrons*, *Cardium* sp. and *Donax* sp. were the dominant species. In the 30m depth ranges bivalves and gastropods were dominating. In the 50m depth range, bivalves dominated. Among this *Aloides bifrons*, *Donax* sp. and *Pecton* sp. were common. In the 100m depth range also bivalves were dominating. Among this *Potlandia* sp. was dominating. In the 200m depth range, scaphopod *Dentalium* sp. was dominating followed by bivalve *Chione* sp.

Others

Foraminiferans, nemerteans, nematodes, oligochaetes, echiuroids, sipunculids, lampshells, bryozoans, echinoderms, balanoglossus, cephalochordates, and fishes were constituted the other groups. Among this, foraminiferans, nemerteans, oligochaetes and echinoderms were the dominant groups.

In the 30m depth range, high abundance of foraminifera were observed off Kochi transect. Echiuroids were reported from off Kozhikode. Nemerteans and brittle stars were common in this depth range. In the 50m depth range, foraminiferans, nemerteans, brittle stars and nematodes were dominating. In the 100m depth range, oligochaetes followed by nemerteans and cephalochordates were dominating. In the 200m depth range, oligochaetes were dominating followed by nematodes and nemerteans.

Southeast coast

Polychaetes: - Along the southeast coast 185 polychaete species were identified from the different depth ranges. These species are from 14 families of errantia and 20 families of Sedentaria. Among these, 30 were abundant, 102 moderately present and 53 rare. Of the total individuals, 19.88% were from group errantia and 80.12% from group sedentaria. The most dominating polychaete species along the southeast coast was *Tharyx dorsobranchialis* followed by *Paraonis gracilis gracilis, Prionospio (M) andamanensis* and *Amphicteis gunneri.*

In 30m depth range, a total of 117 polychaete species were identified and 1 remains as unidentified. Among this 57 were from Errantia and 60 were from Sedentaria. Among these polychaetes species, 30 were abundant, 69 moderately present and 19 were rare. Of the total individuals, 48.14% were from group errantia and 51.86% from group sedentaria. *Nephtys dibranchis* was present in all transects abundant off Nagapatnam followed by off Cuddallore.

Prionospio sp1 was abundant in off Nagapatnam and moderately present in other transects. *Paraonis gracilis gracilis* was abundant in off

Nagapatnam and absent in off Chennai and moderately present in remaining transects. Most abundant species were *Nephtys dibranchis, Prionospio* sp1 and *Paraonis gracilis gracilis.*

In 50m depth range, a total of 110 polychaetes were identified. Among this 46 were from Errantia and 64 were from Sedentaria. Among these polychaetes species, 29 were abundant, 63 moderately present and 18 were rare. Of the total individuals, 46.32% were from group errantia and 53.68% from group sedentaria. *Ancistrosyllis parva* were abundant in off Cuddallore and rarely present in off Nagapatnam and absent in other transects. *Nephtys dibranchis* was present in all transects and abundant in off Cuddallore followed by off Nagapatnam. Most dominant species were *Ancistrosyllis parva, Prionospio* sp.1 and *Nephtys dibranchis*.

In 100m depth range, a total of 93 polychaetes were identified. Among this 32 were from Errantia and 61 were from Sedentaria. Among these polychaetes species, 30 were abundant, 52 moderately present and 11 were rare. Of the total individuals, 14.42% were from group errantia and 85.58% from group sedentaria. *Prionospio (M) andamanensis* was highly dominant in off Cuddallore and off Krishnapatnam and it was absent in the remaining two transects. *Amphicteis gunneri* was abundant in off Cuddallore and off Nagapatnam and absent in other transects. *Tharyx dorsobranchialis* was present in all transects and abundant in off Krishnapatnam followed by off Cuddallore. *Ancistrosyllis parva* was abundant in off Krishnapatnam and absent in off Nagapatnam and moderately present in remaining transects. *Malacoceros indicus* was abundant in off Krishnapatnam and absent in other transects. Most dominating species were *Prionospio (M) andamanensis, Amphicteis gunneri, Tharyx dorsobranchialis, Ancistrosyllis parva* and *Malacoceros indicus.*

In 200m depth range, a total of 71 polychaetes were identified. Among this 21 were from Errantia and 50 were from Sedentaria. Among these polychaetes species, 25 were abundant, 40 moderately present and 6 were rare. Of the total individuals, 5.57% were from group errantia and 94.43% from group sedentaria. *Tharyx dorsobranchialis* was highly abundant in off Nagapatnam and off Chennai and absent in off Krishnapatnam and rarely present in off Cuddallore. *Paraonis gracilis gracilis* was highly abundant in all transects except off Krishnapatnam where it was absent. *Amphicteis gunneri* was highly abundant at off Nagapatnam and was absent at off Chennai and off Krishnapatnam and rarely present in off Cuddallore. *Cossura coasta* was highly abundant at off Chennai and moderately present in all other transects. Most dominant species were *Tharyx dorsobranchialis, Paraonis gracilis gracilis, Amphicteis gunneri* and *Cossura coasta*.

Crustaceans

Amphipods, cumaceans, copepods were the major groups of crustaceans. In the 30m depth range, amphipods followed by copepods, cumaceans, decapods were common. Amphipods were highly abundant at off Cuddallore transect. In the 50m depth range, amphipods, copepods and cumaceans were dominating. In the 100m depth range, Amphipods and cumaceans were the main groups. In the 200m depth range, the samples were rich in amphipods, copepods and cumaceans. Cumaceans were identified upto species level and *Campylaspis* sp. was very common in all the depth ranges.

Molluscs

Portlandia sp. and *Dosinia rustica* were the dominant species along southeast coast. In the 30m depth range, *Corculam monstrosum* and *Telinna* sp. were dominated. In the 50m depth range, bivalves were the major groups and Dosinia rustica was the dominant species. In the 100m depth range, bivalves were the dominating groups. *Portlandia* sp. and *Dosinia rustica* were the dominant species. In the 200m depth range, bivalves were the dominating groups. *Telinna perrieri* was the dominating species.

Others

Foraminiferans, nemerteans and echinoderms were the major groups. In the 30m depth range, *Branchiostoma lanceolatum*, brittle stars, *Holothuria* sp. and nemerteans were common. In the 50m depth range, foraminiferans, brittle stars and fishes were the dominating groups. Among fishes, *Trichonotus setiger* was dominating. In the 100m depth range, brittle stars and oligochaetes were the dominating groups. Foraminiferans and oligochaetes were common in the 200m depth range.

Polychate species occurrence during 2001 and 2005 along southwest coast was listed in Table 6.11. *Prionospio (M) andamanensis* was the most dominating species along the southwest coast followed by *Prionospio pinnata* during 2005. During 2001 data along southwest coast the dominant species was *Magelona cincta* followed by *Prionospio pinnata*.

6.2.3 Cluster analysis (Bray-Curtis similarity)

Similarities between stations in each depth range with respect to polychaete species as well as with respect to groups together were calculated by using PRIMER 5v for windows. The cluster analysis and MDS also was done along both the coasts separately to support the similarity index (Fig.6.7 to 6.14).

Similarity index with respect to polychaetes

Similarity between stations with respect to polychaete species is presented in Table no 6.13a and b.

Along southwest coast at 30m depth range, off Vadanapilly and off Kollam transects showed highest similarity and are clustered at 31.63% similarity level. In the 50m depth range, the highest linkage was between off Vadanapilly and off Kochi at 56.10%. In the 100m depth range, maximum similarity observed between off Kozhikode and off Kollam and is clustered at 46.71% similarity level. In the 200m depth range, greatest similarity was recorded between off Kochi and off Kozhikode at 41.83%.

Along southeast coast at 30m depth range, similarities were high between off Cuddallore and off Nagapatnam and are clustered at 48.03%. In 50m depth range, similarity was higher between off Cuddallore and off Nagapatnam and was linked at 43.03% similarity level. In 100m depth range, greatest similarity was observed between off Krishnapatnam and off Cuddallore at 46.33% similarity level. In 200m depth range, most similarity was between off Chennai and off Cuddallore and are clustered at 37.76% level.

Similarity index with respect to groups

Similarity between stations with respect to groups is presented in Table no 6.14a and b.

Along southwest coast at 30m depth range, highest similarity (57.78%) was noticed between off Cape Comorin and off Trivandrum. In 50m depth range, highest linkage observed at 59.45% similarity level and was between off Cape Comorin and off Trivandrum. In 100m depth range, greatest similarity was observed between off Kochi and off Kozhikode and is clustered at 46.32% similarity level. In 200m depth range, similarity was highest between off Kochi and off Kozhikode and was 46.94%.

Along southeast coast at 30m depth range, maximum similarity was observed between off Cuddallore and off Nagapatnam and was 56.80%. In 50m depth range, highest linkage was between off Krishnapatnam and off Chennai and are clustered at 57.80% similarity level. In 100m depth range, greatest similarity (54.88%) found between off Chennai and off Cuddallore. In 200m depth range, high similarity percentage formed between Chennai and off Nagapatnam and is clustered at 57.35% similarity level.

6.2.4 Community Structure

Community structure based on polychaetes

Community structure based on polychaetes is presented in Table no 6.15; Fig.6.15.

Species richness index (Margalef's index, d):- Along southwest coast, in the 30m depth range, species richness increased from off Kozhikode to off Vadanapilly then decreased to off Kollam and again increased to off Cape Comorin. In the 50m, 100m and 200m depth ranges, species richness were irregularly varied along different transects.

Along southeast coast, in the 30m depth range, species richness was irregularly varied along transects. In the 50m depth range, it increased from off Krishnapatnam to off Cuddallore and then decreased to off Nagapatnam. In the 100m depth range, species richness increased from off Chennai to off Nagapatnam. It showed an increase from off Krishnapatnam to off Nagapatnam in the 200m depth range.

Evenness index (Pielou's index, J'):- Along southwest coast in the 30m depth range, evenness of polychaete species decreased from off Kozhikode to off Vadanapilly then increased to off Kochi and decreased to off Trivandrum and again increased to off Cape Comorin. In the 50m depth range, it decreased from off Kannur to off Kozhikode and increased to off Vadanapilly then decreased to off Kollam and again increased to off Cape Comorin. In the 100m depth range, it decreased from off Kannur to off Kozhikode and increased to off Vadanapilly and then decreased to off Kollam and again increased to off Cape Comorin. In the 200m depth range, evenness of polychaete species showed an increase from off Kozhikode to off Kochi then decreased to off Kollam and again increased to off Cape Comorin.

Along southeast coast, evenness of polychaete species do not show much variation at 30m, 50m, 100m and 200m depth ranges and the minute variations along the transects were irregular.

Species diversity index (Shannon index, H′ log2):- Along southwest coast in the 30m depth range, species diversity varied irregularly along different transects. Higher diversity observed off Cape Comorin. In the 50m and 100m depth range species diversity of polychaetes showed similar trend along transects. It decreased from off Kannur to off Kozhikode then increased to off Vadanapilly and decreased to off Kollam and again increased to off Cape Comorin. In the 200m depth range, it increased from off Kozhikode to off Kochi and decreased to off Kollam and again increased to off Cape Comorin.

Along southeast coast, in the 30m depth range, it decreased from off Krishnapatnam to off Chennai then increased to off Cuddallore then again decreased to off Nagapatnam. In the 50m depth range, it increased from off Krishnapatnam to off Cuddallore and decreased to off Nagapatnam. In the 100m depth range, it decreased from off Krishnapatnam to off Chennai then increased to off Nagapatnam. In the 200m depth range, species diversity of polychaetes showed an increasing trend from off Krishnapatnam to off Nagapatnam.

Species dominance index (Simpson's index, Lambda'):- Along southwest coast in the 30m depth range, species dominance increased from off Kozhikode to off Vadanapilly and decreased to off Kochi then increased to off Trivandrum and again decreased to off Cape Comorin. In the 50m depth range, Simpson's index increased from off Kannur to off Kozhikode then decreased to off Vadanapilly then increased to off Kollam and again decreased to off Cape Comorin. In the 100m depth range, species dominance showed considerable variations along transects and it increased from off Kannur to off Kozhikode the sharply decreased to off Vadanapilly then increased upto off Kollam and then decreased to off Cape Comorin. In the 200m depth range, it showed a decreasing trend from off Kozhikode to off Kochi then increased to off Kollam and again decreased to off Cape Comorin.

Along southeast coast, in the 30m depth range, species dominance showed an irregular variation along transects. In the 50m depth range, it showed a decreasing trend from off Krishnapatnam to off Nagapatnam. In the 100m depth range, Simpson's index decreased form off Krishnapatnam to off Chennai then decreased to off Nagapatnam. In the 200m depth range, it showed an irregular variation along transects.

The average species diversity indices along the southwest coast of India at different depth ranges, species richness (d), evenness (J') and Shannon diversity (H'log2) were revealed a trend that they increased from 30m to 50m and then decreased with increase in depth. But species dominance (Lambda') shows an opposite trend which decreased from 30m to 50m and then increased with increase in depth.

The mean species diversity indices along the southeast coast of India at different depth ranges, Species richness (d) and Shannon diversity (H′log2) were decreased with increase in depth. Evenness (J′) increased from 30m to 50m then decreased to 100m and again increased to 200m depth ranges. Simpson's index, (Lambda′) showed similar values in 30m and 50m depth range it increased with increase in depth.

Community structure based on groups

Community structure based on groups are presented in Table no 6.16; Fig.6.16.

Species richness index (Margalef's index, d):- Along southwest coast in the 30m depth range, species richness decreased from off Kozhikode to off Vadanapilly and increased to off Kollam then decreased to off Trivandrum and again increased to off Cape Comorin. In the 50m depth range, it decreased from off Kannur to off Kochi then increased to off Trivandrum and decreased to off Cape Comorin. In the 100m depth range, it decreased from off Kannur to off Kozhikode and increased to off Kollam and again decreased to off Cape Comorin. In the 200m depth range, it increased from off Kozhikode to off Vadanapilly and decreased to off Kollam and again increased to off Cape Comorin.

Along southeast coast, in the 30m depth range, species richness irregularly varied along transects. In the 50m depth range, it increased from off Krishnapatnam to off Cuddallore and decreased to off Nagapatnam. In the 100m depth range, species richness showed an increasing trend from off Krishnapatnam to Nagapatnam. In the 200m depth range, species richness irregularly varied along transects.

Evenness index (Pielou's index, J′):- Along southwest coast in the 30m depth range, evenness increased from off Kozhikode to off

Vadanapilly and decreased to off Kochi and then increased to off Kollam and then decreased to Cape Comorin. In the 50m depth range, it decreased from off Kannur to off Vadanapilly and increased upto off Trivandrum and again decreased to off Cape Comorin. In the 100m depth range, it showed an irregular variation along transects. In the 200m depth range, it increased from off Kozhikode to off Vadanapilly and decreased to off Kollam and again increased to off Cape Comorin.

Along southeast coast, in the 30m depth range, it showed a decreasing trend from off Krishnapatnam to off Nagapatnam. In the 50m depth range, it varied irregularly along transects. In the 100m depth range, it showed an increasing trend from off Krishnapatnam to off Nagapatnam. In the 200m depth range, it increased from off Krishnapatnam to off Chennai and then decreased to off Nagapatnam.

Species diversity index (Shannon index, H′ log2):- Along southwest coast in the 30m depth range, it decreased from off Kozhikode to off Kochi and increased to off Kollam and again decreased to off Cape Comorin. In the 50m depth range, similar species diversity observed off Kannur and off Kozhikode and then it decreased to off Vadanapilly and increased to off Trivandrum and again decreased to off Cape Comorin. In the 100m depth range, it decreased from off Kannur to off Kozhikode and increased upto off Kollam and again decreased to off Cape Comorin. In the 200m depth range, it increased from off Kozhikode to off Vadanapilly and decreased to off Kollam and again increased to off Cape Comorin.

Along southeast coast, in the 30m depth range, it showed a decreasing trend from off Krishnapatnam to off Nagapatnam. In the 50m depth range, it varied irregularly along transects. In the 100m depth range, it showed an increasing trend from off Krishnapatnam to off Nagapatnam. In the 200m depth range, it showed an irregular variation along transects.

Species dominance index (Simpson's index, Lambda'):- Along southwest coast in the 30m depth range, it increased from off Kozhikode to off Kochi and decreased to off Kollam and again increased to off Cape Comorin. In the 50m depth range, it increased from off Kannur to off Vadanapilly and then decreased to off Trivandrum and again increased to off Cape Comorin. In the 100m depth range, it increased from off Kannur to off Kozhikode and decreased to off Kollam and again increased to off Cape Comorin. In the 200m depth range, it decreased from off Kozhikode to off Vadanapilly and increased to off Kollam and again decreased to off Cape Comorin.

Along southeast coast, in the 30m depth range, it showed an increasing trend from off Krishnapatnam to off Nagapatnam. In the 50m depth range, it increased from off Krishnapatnam to off Cuddallore and then decreased to off Nagapatnam. In the 100m depth range, it showed a decreasing trend from off Krishnapatnam to off Nagapatnam. In the 200m depth range, it varied irregularly along transects.

The average species diversity indices along the southwest coast of India at different depth ranges, species richness (d) and species diversity (H'log2) were revealed a trend that they increased from 30m to 50m and then decreased with increase in depth. Evenness (J') was increased with increase in depth upto 100m and the decreased towards 200m. Simpson's dominance decreased with increase in depth from 30m to 50m and then increased towards 200m depth ranges.

The average species diversity indices along the southeast coast of India at different depth ranges, species richness (d), Evenness (J′) and species diversity, (H′log2) increased with increase in depth upto 100m and then decreased towards 200m depth range. Simpson's index, (Lambda′) showed an opposite trend which decreased with increase in depth from 30m to 100m and then decreased towards 200m depth ranges.

6.2.5 K- Dominance of Polychaetes

Multiple k-dominance plots facilitated discrimination of polychaetes according to species relative contribution to abundance. Along southwest coast upto 24 species contributed 70% of the total polychaetes at 50m, while it required 10 species for 100m, 9 species for 75m, 6 species for 30m and 4 species for 200m depth ranges. Along southeast coast, upto 29 species constituted 70% of the total polychaetes at 30m, while it required 27 species for 50m, 7 species for 100m and 6 species for 200m depth ranges (Fig.6.17).

Along southwest coast at 30m depth range 70% of the total polychaetes were contributed by 6 species. *Magelona cincta, Prionospio (M) andamanensis, Eurythoe parvecarunculata, Scolelepis branchia, Ancistrosyllis parva* and *Onuphis* sp. etc. were the dominant species at this depth range. In the 50m depth range 24 polychaete species contributed 70% of the total polychaetes. *Prionospio pinnata, Eurythoe* sp.1, *Notomastus fauveli, Prionospio (M) andamanensis, Tharyx dorsobranchialis, Cossura coasta, Ancistrosyllis parva* etc. were the dominating species in the 50m depth range. In the 75 m depth range, 9 polychaete species contributed 70% of the total polychaetes. *Eurythoe* sp.1, *Prionospio* sp.1, *Aricidea* sp.1, *Malacoceros indicus, Armandia longicaudata*, etc. were the dominating species in the 50m depth range. In the 100m depth range, 10 species were contributed 70% of total polychaetes. *Prionospio (M) andamanensis*, *Prionospio cirrifera*, *Tharyx dorsobranchialis, Magelona cincta, Eurythoe* sp.1 etc. were the dominating species in the 100m depth range. In the 200m depth range, 4 polychaete species contributed 70% of the total polychaetes. *Prionospio pinnata, Prionospio (M) andamanensis, Paraonis gracilis gracilis, Tharyx dorsobranchialis, Aricidea capensis* etc. were the dominating species in the 200m depth range.

Along southeast coast, at 30m depth range 70% of the total polychaetes were contributed by 29 species. *Nephtys dibranchis, Prionospio sp1., Prionospio gracilis gracilis, Onuphis sp.,* etc. were the dominant species at this depth range. In the 50m depth range 27 polychaete species contributed 70% of the total polychaetes. *Ancistrosyllis parva*, *Prionospio sp.1, Nephtys dibranchis, Lumbrineris sp.1, Prionospio gracilis gracilis* etc. were the dominating species in the 50m depth range. In the 100m depth range, 7 species were contributed 70% of total polychaetes. *Prionospio (M) andamanensis, Amphicteis gunneri, Tharyx dorsobranchialis, Ancistrosyllis parva*, *Malacoceros indicus* etc. were the dominating species in the 100m depth range. In the 200m depth range, 6 species were contributed 70% of total polychaetes. *Tharyx dorsobranchialis, Prionospio gracilis gracilis, Amphicteis gunneri, Cossura coasta,* etc. were the dominating species in the 200m depth range.

6.3 Discussion

In the present study, along the southwest coast, polychaetes were the abundant group followed by crustaceans and molluscs they contributed by 56%, 25% and 3% respectively to the total abundance of macrofauna. The mean abundance was minimum at 30m and maximum at 50m depth range along the southwest coast. In the corresponding value during 2001data, along southwest coast, polychaetes (60%) were the abundant group followed by crustaceans (28%) and molluscs (5%). There was a trend observed in numerical abundance and it decreased with increase in depth.

In the present study along the southeast coast, polychaetes (59%) were the abundant group followed by crustaceans (29%) and molluscs (7%). Here the abundance decreased from 30m to 50m and then increased towards deeper waters. The same trend was not reported so far for the distribution of macrofauna along the continental shelf of India. So, it is possible due to the impact of 26th December 2004 tsunami. In the 2001data, along the southeast coast, major group polychaetes contributed by 81% were the abundant group followed by crustaceans, 17% and molluscs (2%). Generally the numerical abundance decreased with increase in depth.

In the present study, at 30m depth range numerical abundance of macrofauna along southwest coast was 1228 No/m^2 along southeast coast 1418 No/m^2. In the 50m depth range it was 3829 No/m^2 and 869 No/m^2 along southwest and southeast coasts respectively. In the 100m depth range, 1243 No/m^2 of abundance recorded along Arabian Sea and 1423 No/m^2 in Bay of Bengal. In the 200m depth range it was 1882 No/m^2 and 1763 No/m^2 respectively.

In the present study the average numerical abundance was higher along the Arabian Sea (2045/m^2) compared to the Bay of Bengal continental shelf (1368/m^2). Saraladevi *et. al.,* (1996) reported similar results from 5m to 15m depth ranges along the southwest and southeast coast of India. Arabian Sea shows higher numerical abundance than along the Bay of Bengal during the 2001study also.

Along the southwest coast, in the present study (2005), polychaetes were dominated in biomass contribution with 58% followed by crustaceans with 18%. The mean biomass was minimum at 100m and maximum at 50m depth ranges. In the 2001 data, polychaetes were dominated with 38% followed by crustaceans with 20%.

Along the southeast coast, in the present study, polychaetes dominated with 35% followed by molluscs with 20% and crustaceans with 17%. Here the mean biomass showed a decreasing trend from 30m to 100m and then increased to 200m depth range. The same trend was not reported so far for the distribution of macrofauna along the continental shelf of India. So, it is possible due to the impact of 26^{th} December 2004 tsunami. In the 2001 data polychaetes dominated with 81% followed by crustaceans with 19%.

In the present study, at 30m depth range biomass of macrofauna along southwest coast was 10.27 and along southeast coast 17.60g/m^2. In the 50m depth range it was 18.31 g/m^2 and 10.69 g/m^2 along southwest and southeast coasts respectively. In the 100m depth range 3.96 g/m^2 of biomass recorded along Arabian Sea and 6.004 g/m^2 in Bay of Bengal. In the 200m depth range it was 9.31 g/m^2 and 12.98 g/m^2 respectively.

In the present study, the average biomass was equal or marginally higher in Bay of Bengal (11.82g/m^2) than Arabian Sea (10.46g /m2). The higher biomass value in the Bay of Bengal was due to the large size of organisms recorded in the study area. In the corresponding 2001data, there was a reversal observed that Arabian Sea (8.85g/m^2) recorded higher biomass than the Bay of Bengal (0.72g/m^2). Along the southwest coast, there was a slight increase in biomass after tsunami was recorded. But it was not statistically significant. But along the southeast coast, there was a marked increase in average total biomass observed after the 26^{th} December 2004 tsunami ($p<0.01$). The biomass before tsunami was 0.72g/m^2 and after was 11.82g/m^2. It may be due to the low value recorded in the previous study.

For the convenience of comparison the 2005 data was processed as the format of 2001 data as 30-50m, 50-75m, 100-150m and beyond 150m depth ranges. Along southwest coast, in the 30-50m depth range, total abundance of macroauna (p-value < 0.04) showed a significant decrease during 2005 than the 2001 data. It indicates that the 26th December 2004 affected in this depth range. In the 50-75m, 100-150m and beyond 150m depth ranges, macrobenthic abundance did not show any significant change during 2005 and 2001.

For biomass, along southwest coast in the 30-50m, 50-75m and beyond 150m depth ranges, macrobenthic infauna did not show any significant change during 2001 and 2005 data along southwest coast. In the 100-150m depth range crustaceans showed a significant decrease in biomass (p-value < 0.005) during 2005 compared to 2001 data. No other changes observed in 100-150m depth range.

Along southwest coast, mean total abundance and biomass of macrobenthic infauna did not show any significant changes during 2005 compared to 2001. Along the Southwest continental shelf of India, the biomass and abundance of macrofauna was high in the 50-75m depth ranges. Jayaraj *et al.,* (2007, 2008a and 2008b) also reported similar results from the northwest continental shelf of India.

Along southeast coast, in the 30-50m depth range, abundance of polychaetes (p-value < 0.05) showed a significant increase during 2005 than 2001. In the 50-75m depth range abundance of molluscs (p-value < 0.0003) and other groups (p-value < 0.03) showed a significant increase during

2005 than 2001. In the 100-150m depth range, abundance of other groups (p-value < 0.04) showed a significant increase during 2005 than 2001. Beyond 150m depth range, abundance of crustaceans (p-value < 0.01) showed a significant increase during 2005 than 2001.

For biomass along southeast coast, in the 30-50m depth range, crustaceans showed a significant increase in biomass (p-value < 0.02) during 2005 than 2001 data. No other variations noticed in this depth range. In the 50-75m depth range total biomass showed a significant increase (p-value < 0.04) during 2005 than 2001 data. In the 100-150m depth no significant variations were recorded for macrofauna biomass. Beyond 150m depth range, crustaceans (p-value < 0.008) and total biomass (p-value < 0.02) showed a significant increase during 2005 than 2001 data.

Along southeast coast, mean total abundance of macrobenthic infauna showed a significant (p-value < 0.008) increase during 2005 compared to 2001. The mean biomass of polychaetes (p-value < 0.007) and mean total of macrobenthic biomass (p-value < 0.01) showed a significant increase along southeast coast during 2005 than 2001.

Along the Southeast continental shelf of India, the biomass was higher in the 30-50m depth range and it shows a decrease from 30-50m to 100-150m depth range and from 100-150m to beyond 150m it was increased. In the case of abundance, it was higher beyond 150m and lower in 50-75m depth ranges.

During the 2005 data along southwest coast a total of 366 infaunal macrobenthic species were identified from the different depth ranges. Polychaetes were the major groups followed by crustaceans and molluscs.

During the 2001 data, along southwest coast, only 173 species of macrobenthic infauna were identified.

Along southwest coast, during 2001, in the 30-50m depth range *Magelona cincta, Prionospio pinnata, Ancistrosyllis parva,* and *Aonides oxycephala* were the dominant species. During 2005, the most dominant species was *Magelona cincta,* as in the previous study. But the other dominating species were changed and are *Prionospio (M) andamanensis, Eurythoe parvecarunculata* and *Scolelepis branchia.*

In the 50-75m depth range, during 2001, *Prionospio pinnata, Magelona cincta,* and *Lumbrineris laterelli* were the dominating species. During 2005, the most dominant species was *Prionospio pinnata,* as in the previous study. But the other dominant polychaetes were altered and are *Eurythoe sp1* and *Notomastus fauveli.*

In the 100-150m depth range, during 2001, *Prionospio pinnata, Prionospio spp.* and *Magelona cincta* were the dominating species. But during 2005 the dominant species were changed and they are *Prionospio (M) andamanensis, Prionospio cirrifera* and *Tharyx dorsobranchialis.*

Beyond 150m depth range, during 2001, *Prionospio pinnata, Paraonis gracilis gracilis, Aricidea fauveli, Cirriformia* sp1 and *Magelona cincta* were the dominating species. But during 2005, the most abundant species during 2005 were *Prionospio pinnata, Prionospio (M) andamanensis, Paraonis gracilis gracilis* and *Tharyx dorsobranchialis.*

During 2001 data along southwest coast the dominant species was *Magelona cincta* followed by *Prionospio pinnata*. But during 2005, *Prionospio (M) andamanensis* was the most dominating species along the southwest coast followed by *Prionospio pinnata* during 2005.

In the present study, with increase in depth there was a decrease in representation of polychaetes. Along southwest coast, of the total 33 families, only 21 families were present in all the depth ranges. Family Arenicolidae was reported from 30-50m depth range only. Sternaspidae was not recorded from 30-50m and was present in deeper waters. Damodaran (1973) reported Sternaspidae from shallow waters. Heterospionidae and Ophelidae were not recorded after 50-75m depth range. Arenicolidae was reported from 30-50m depth range only. Typhloscolecidae were reported from 50-75m depth range only. Family Lacydonidae and Poecilochaetidae were not recorded beyond 100-150m depth range. A total of 6 polychaete families were not reported from the samples collected beyond 100-150m depth range. Of the total individuals, 23.77% were from group errantia and 76.23% from group sedentaria. *Prionospio (M) andamanensis* was the most dominating species along the southwest coast followed by *Prionospio pinnata*. During 2001 data along southwest coast the dominant species was *Magelona cincta* followed by *Prionospio pinnata*.

In the 2005 data, along southwest coast among the non-polychaete taxa, crustaceans and molluscs also showed a decrease with increase in depth. Echiuroids were reported only from 30-50m depth range. Foraminiferans and Echinoderms were totally absent in the samples collected from beyond 150m depth range.

During 2005, community structure for macrofauna along southwest coast indicating that, Margalef's index(d), Pielou's index, (J') and Shannon index, (H'log2) were revealed a trend that they increased from shallow water to deeper waters. But Simpson's index shows an opposite trend. Similar results obtained in the 2001 data also.

During 2005 along southwest coast highest similarity of macrofauna was observed between 30-50m and 100-150m depth ranges. During 2001 data along southwest coast similarity was highest between 50-75m and 100-150m depth ranges.

In the case of K-dominance, during 2005, along southwest coast upto 24 species constituted 70% of the total polychaetes at 50-75m, while it required 10 species for 100-150m, 9 species for 75m, 6 species for 30-50m and 4 species for beyond 150m depth ranges. During 2001 data, upto 26 species constituted 70% of the total polychaetes at 50-75m, while it required 13 species each for 75m and 100-150m, 3 species for 30-50m and beyond 150m depth ranges (Fig.6.17a, b).

Along southeast coast of India, a total of 279 species of macrofauna were identified. Polychaetes were the major groups followed by crustaceans and molluscs. Species abundance along this coast was not compared as previous study was not available. In the present study, at 30-50m depth range, most abundant species during 2005 were *Nephtys dibranchis, Prionospio* sp1 and *Paraonis gracilis gracilis.* In the 50-75m depth range, most dominant species during 2005 were *Ancistrosyllis parva, Prionospio* sp.1 and *Nephtys dibranchis*. In the100-150m depth range, most dominating species during 2005 were *Prionospio (M) andamanensis, Amphicteis gunneri, Tharyx dorsobranchialis, Ancistrosyllis parva* and *Malacoceros indicus.* Beyond 150m depth range, most dominant species during 2005 were *Tharyx dorsobranchialis, Paraonis gracilis gracilis, Amphicteis gunneri* and *Cossura coasta.*

During 2005, the most dominating polychaete species along the southeast coast was *Tharyx dorsobranchialis* followed by *Paraonis gracilis gracilis, Prionospio (M) andamanensis* and *Amphicteis gunneri.*

Along southeast coast, of the total 34 families, only 21 familes were present in all the depth ranges. Heterospionidae not reported beyond 30-50m depth range.Lacydonidae and Ophelidae were not reported beyond 50-75m depth range. Pontodoridae, Oweniidae and Sabellariidae were reported from southeast coast only and from 50-75m depth range. Hesionidae and Flabelligeridae were not reported beyond 100-150m depth range. A total of 5 polychaete families were not reported beyond 100-150m depth range. Of the total individuals, 19.88% were from group errantia and 80.12% from group sedentaria.

Among the non-polychaete taxa, crustaceans and molluscs also showed a decrease with increase in depth along southeast coast. Sipunculids were reported only from 30-50m depth range. Nemerteans were not reported from the samples collected from beyond 150m depth range.

During 2005, community structure for macrofauna along southeast coast indicating that, Margalef's index(d), Pielou's index, (J') and Shannon index, (H'log2) were revealed a trend that they increased from shallow water to deeper waters. But Simpson's index shows an opposite trend. Similar results obtained in the 2001 data also. During 2005 along southeast coast the highest similarity was recorded between 30-50m and 50-75m depth ranges.

In the case of K-dominance, during 2005, along southeast coast, during 2005, upto 29 species constituted 70% of the total polychaetes at 30-50m, while it required 27 species for 50-75m, 7 species for 100-150m and 6 species for beyond 150m depth ranges (Fig.6.17c). Along the southeast coast the species list of macrofauna were not compared as previous study was not available.

From the analysis of data during 2005 and 2001 following aspects are noticed along southwest continental shelf of India (Fig 6.18a).

a) During 2005, in the 30-50m depth range shows a reduction in abundance of macrobenthic infauna than 2001 data.

b) In the 100-150m depth range crustaceans showed a reduction in biomass during 2005 compared to 2001 data along southwest coast.

c) No other significant changes were observed along southwest coast.

It is possible that when the tsunami hit the coastal area, the sediment substrata in the shallow waters get disturbed and churned-up. So it should affect the density and biomass of benthic fauna inhabiting in that area. The 26th December 2004 tsunami generated by the M 9.0 Sumatra-Andaman earthquake devastated many parts of the Kerala coast (Kurian *et al*., 2005; Narayana *et al*., 2005). Kurian *et al*.,(2006) reported that, the analysis of offshore bathymetric data along Kerala coast indicates the shifting of depth contours towards shore, indicating erosion of sediments and deepening of inner shelf due to the tsunami. So, in the present study (2005) indicates that the 26th December 2004 Indian Ocean tsunami gets affected macrofauna along the shallow waters of southwest coast of India.

From the analysis of data during 2005 and 2001 following aspects are noticed along southeast continental shelf of India.

a) In the 30-50m depth range, abundance of polychaetes showed a significant increase during 2005 than 2001. Crustaceans showed a significant increase in biomass during 2005.

b) In the 50-75m depth range abundance of molluscs and other groups showed a significant increase during 2005 than 2001. Total biomass showed a significant increase during post-tsunami period (2005).

c) In the 100-150m depth range, abundance of other groups showed a significant increase during 2005 than 2001.

d) Beyond 150m depth range, abundance of crustaceans showed a significant increase during 2005 than 2001. Crustaceans and total biomass showed a significant increase during 2005.

e) Mean total abundance of macrobenthic infauna showed a significant increase during 2005 compared to 2001.

f) The mean biomass of polychaetes and mean total of macrobenthic biomass showed a significant increase along southeast coast during 2005 than 2001.

If there is an impact of tsunami, the values of abundance and biomass in the present study (2005) should be less than the 2001 data. But along southeast coast, the data is not comparable due to the low values recorded during 2001 (Fig.6.18b). Along southeast coast, the difference is substantial even considering the difference in sampling gear and the differences expressed in the southeast coast during two surveys. So it is possible 2001value obtained for macro and meiofauna along southeast coast could be an underestimate.

Along the southeast coast macrobenthic infaunal abundance showed a decrease from 30m to 50m and beyond it increased to 200m depth range. Biomass of macrofauna along the southeast coast showed a decreasing trend with increase in depth up to 100m and then it showed an increase towards 200m depth range. The same trend was not reported so far for the distribution of macrofauna along the continental shelf of India. So, it is possible due to the impact of 26th December 2004 tsunami.

…..ഇരു…..

Chapter 7

MEIOBENTHOS

Contents

7.1 Introduction

Meiofauna, the term is derived from the Greek word "*meio*" means "smaller". The size of the meiofauna ranges in between 63µm and 500µm. The size range is arbitrary, smaller mesh size sieves are used in fine sediment. Meiofauna, a homogeneous ecological group, live in a wide variety of habitats like freshwater, estuarine and marine ecosystems. They were present in all the sediment types, softest of muds to the coarsest gravels. Meiofauna also occupy several "above sediment" habitats including rooted vegetation, moss, macroalgae fronds, sea ice and various animal structures like coral crevices, worm tubes, echinoderm spines etc. (Higgins & Thiel, 1988). Meiofauna are more phyletically diverse than any other component of the marine biota.

Meiofauna can be classified into permanent and temporary groups. The term 'permanent meiofauna' refers to those groups having meiofaunal size throughout their life, and 'temporary meiofauna' refers to those species with immature stages of larger organisms in meiofaunal size, where mature stages are of macrofaunal dimensions (McIntyre, 1969). Permanent meiobenthos includes the Mystacocarida and many representatives of Rotifera, Nematoda, Polychaeta, Copepoda, Ostracoda and Turbellaria.

Temporary meiofauna includes Gastropoda, Polychaeta, Holothuroidea, Nemertina, Sipunculida etc.

Meiofauna offer high quality food sources for fish, shrimp and mollusc larvae and important components in benthic food chains (Bell and Coull, 1978; Ellis and Coull, 1989; Gee, 1989; Coull, 1990). Hence, they play an important role in trophic transfer in the marine ecosystem (Warwick, 1989). They also make use of organic detritus in sediments and are grazers of benthic bacteria and microalgae. As meiofauna are the food sources of higher trophic organisms, their community structure, diversity pattern and biomass changes can influence the recruitment of juveniles of macrofauna.

Early works on meiofauna were done by Kowalewsky (1901) on the interstitial Opisthobranchs (Microhedylidae) in the Eastern Mediterranean and Cobb (1914, 1920) studied on the nematode populations of North American shores. Giard (1904) recognized significance of meiofauna on the sandy bottoms of coastal Northern France. Quantitative investigations on meiobenthos were done by Moore (1931) and Rees (1940) in Great Britain, as well as Krogh and Sparck (1936) in Denmark. After that, Mare's (1942); Sanders (1958), Wieser (1960) and Mc- Intyre (1961, 1969) contributed significant information on meiofauna.

In Indian scenario, the history of the study of meiofauna is rather recent. Preliminary investigations on meiofaunal nematodes were carried out by Timm (1961, 1967a, b) from the Bay of Bengal region and Gerlach (1962) studied on meiofauna from the Maldives Islands. Ganapati and Chandrasekhara Rao (1962) analyzed meiofauna off Waltair. McIntyre (1968) evaluated meiofauna along off Portonovo, east coast of India. Rao and Ganapati (1968) studied the interstitial fauna of the beach sands of the east coast of India.

Major works on meiofauna of different coastal areas and backwaters of east coast of India were done by Ganapthi and Sarma (1973), Sarma and Ganapathi (1975), Ansari and Parulekar (1981), Ansari *et al* (1982), Rao (1986) Rao and Murthi (1988), Vijayakumar *et al* (1991 and 1997), Chatterji *et al* (1995). Meiofauna of Pichavaram mangroves along south east coast of India were studied by Chinnadurai and Fernando (2003).

Early meiofaunal studies reported from the west coast of India were by Govindan Kutty and Nair (1966) from off Kerala coast, from the Cochin estuary by Kurien (1972) and the mud bank region of Kerala by Damodaran (1973). After that Ansari *et al* (1980) and Parulekar *et al* (1982) were worked on meiofauna along the west coast of India. Sajan and Damodaran (2005) studied the community structure and vertical distribution of marine free-living nematodes in the shelf sediments of the west coast of India. Faunal composition of meiobenthos of the shelf regions of the west coast of India was analysed by Sajan and Damodaran (2007). Feebarani (2009) studied the meiofauna of Cochin backwaters, west coast of India, in relation to macrobenthos and environmental parameters. Sajan *et al*., (2010a, 2010b) studied the meiofauna of the entire continental shelf of west coast of India. These were the major works on meiofauna along the west coast of India.

The studies mentioned above are before the impact of the 26th December 2004 tsunami along southwest and southeast coast of India. Only study after the impact of tsunami was made by Altaff *et al*., (2005) on the impact of tsunami on meiofauna along Marina beach, east coast of India. Hence, the relevance of the study leads to the present work.

The chapter provides the details of the group composition and community structure of meiofauna and similarity index between stations along the continental shelf of southwest and southeast coast of India after the 26th December 2004 tsunami. The data were compared with the previously (2001) available data from Centre for Marine Living Resources and Ecology, Ministry of Earth Sciences. 'Anova – Two factor without replication' was used to compare the data.

7.2 Results

7.2.1 Biomass and Numerical Abundance

Biomass and numerical abundance of meiofauna of the continental shelf of southwest and southeast coast of India were analyzed. Along southwest coast, nematodes dominated followed by foraminiferans for biomass and numerical abundance. In the southeast coast, nematodes and polychaetes were the major contributors for biomass whereas nematodes and foraminiferans for numerical abundance.

Depth-wise variation in each transect:-

Depth-wise variation of biomass (wet weight in mg/10sq.cm) and numerical abundance (No/10sq.cm) of meiobenthos along the southwest and southeast coast of India were presented in the Table 7.1 and 7.5. Nematodes were the major group in abundance in all the depth ranges except at 30m depth (off Kochi and Cuddallore). Foraminifera were dominant in Kochi (44.88%) and Cuddallore (39.26%).

Southwest coast

Off Kozhikode transect, biomass of meiofauna ranged from 0.099 mg/10sq.cm (200m) to 2.131 mg/10sq.cm (50m). The average biomass along this transect was 0.750 mg/10sq.cm. In this transect numerical abundance of meiofauna was varied from 22 No/10sq.cm (200m) to 591 No/10sq.cm (50m) with a mean value of 210 No/10sq.cm.

Off Vadanapilly transect, biomass of meiofauna ranged from a minimum value of 0.659 mg/10sq.cm (200m) to maximum of 2.398 mg/10sq.cm (30m). The average biomass along this transect was 1.255 mg/10sq.cm. In this transect numerical abundance of meiofauna was ranged from 187 No/10sq.cm (200m) to 579 No/10sq.cm (30m) with a mean value of 318 No/10sq.cm.

Off Kochi transect, biomass of meiofauna ranged from a minimum value of 0.228 mg/10sq.cm (200m) to maximum of 4.280 mg/10sq.cm (30m). The average biomass along this transect was 1.390 mg/10sq.cm. In this transect numerical abundance of meiofauna ranged from 56 No/10sq.cm (200m) to 1201 No/10sq.cm (30m) with a mean value of 380 No/10sq.cm.

Off Kollam transect, biomass of meiofauna ranged from a minimum value of 0.424 mg/10sq.cm (200m) to maximum of 4.517 mg/10sq.cm (30m). The average biomass along this transect was 1.557 mg/10sq.cm. In this transect numerical abundance of meiofauna was ranged from 103 No/10sq.cm (200m) to 1417 No/10sq.cm (30m) with a mean value of 451 No/10sq.cm.

Off Trivandrum transect, samples available from 30m and 50m depth ranges only. Biomass of meiofauna ranged from a minimum value of 0.699 mg/10sq.cm (50m) to maximum of 4.863 mg/10sq.cm (30m). The average biomass along this transect was 2.781 mg/10sq.cm. In this transect numerical abundance of meiofauna ranged from 183 No/10sq.cm (50m) to 1711 No/10sq.cm (30m) with a mean value of 947 No/10sq.cm.

Off Cape Comorin transect, biomass of meiofauna ranged from a minimum value of 0.159 mg/10sq.cm (200m) to maximum of 1.154 mg/10sq.cm (50m). The average biomass along this transect was 0.705 mg/10sq.cm. In this transect numerical abundance of meiofauna was ranged from 44 No/10sq.cm (200m) to 296 No/10sq.cm (50m) with a mean value of 174 No/10sq.cm.

The average numerical abundance and biomass of meiofauna along southwest coast showed an increasing trend from off Kozhikode to off Trivandrum.

Southeast coast

Off Nagapatnam transect, biomass of meiofauna ranged from a minimum value of 0.675 mg/10sq.cm (200m) to maximum of 1.824 mg/10sq.cm (30m). The average biomass along this transect was 1.320 mg/10sq.cm. In this transect numerical abundance of meiofauna was ranged from 140 No/10sq.cm (200m) to 485 No/10sq.cm (30m) with a mean value of 318 No/10sq.cm.

Off Cuddallore transect, biomass of meiofauna ranged from a minimum value of 0.273 mg/10sq.cm (200m) to maximum of 2.624 mg/10sq.cm (30m). The average biomass along this transect was 1.023 mg/10sq.cm. In this transect numerical abundance of meiofauna was ranged from 68 No/10sq.cm (200m) to 782 No/10sq.cm (30m) with a mean value of 281 No/10sq.cm.

Off Chennai transect, biomass of meiofauna ranged from a minimum value of 0.125 mg/10sq.cm (200m) to maximum of 0.778 mg/10sq.cm (30m). The average biomass along this transect was 0.750 mg/10sq.cm. In this transect numerical abundance of meiofauna was ranged from 28

No/10sq.cm (200m) to 251 No/10sq.cm (30m) with a mean value of 131 No/10sq.cm.

Off Krishnapatnam transect, biomass of meiofauna ranged from a minimum value of 0.145mg/10sq.cm (50m) to maximum of 1.299 mg/10sq.cm (30m). The average biomass along this transect was 0.694 mg/10sq.cm. In this transect numerical abundance of meiofauna was ranged from 46 No/10sq.cm (50m) to 373 No/10sq.cm (30m) with a mean value of 181 No/10sq.cm.

The average numerical abundance and biomass of meiofauna along southeast coast showed an increasing trend from off Chennai to off Nagapatnam.

Latitudinal Variation in Different Depth Ranges:-

Latitudinal variation of biomass (wet weight in mg/10sq.cm) and numerical abundance (No/10sq.cm) of meiobenthos along the southwest and southeast coast of India were presented in the Table No. 7.2, 7.3, 7.4, 7.6, 7.7 and 7.8. The general trend of meiofauna for biomass and numerical abundance was decreasing with increase in depth, except off Kozhikode. Along off Kozhikode transect biomass and abundance showed an increase from 30m to 50m and then decreased to deeper waters.

Southwest coast

Latitudinal variation at 30m depth range: - Maximum biomass and abundance of meiofauna was recorded off Trivandrum followed by off Kollam. The standing stock showed an increasing trend from off Kozhikode towards southern transects upto off Trivandrum. Nematodes were dominating all transects in this depth range except off Kochi. The maximum percentage abundance (71.76%) and biomass (72.84%) of nematode was recorded off Vadanapilly and off Kozhikode respectively. Foraminifera were dominating off Kochi transect with 44.88% of abundance and 37.78% of biomass. The average biomass and abundance of meiofauna of this depth range was 3.322 mg/10sq.cm and 1017 No/10sq.cm respectively.

Latitudinal variation at 50m depth range: - Maximum biomass and abundance of meiofauna was recorded off Kozhikode followed by off Kollam. The standing stock showed a decreasing trend from off Kozhikode towards southern transects upto off Kochi and after that was irregularly varied. Nematodes were dominating in all transects in this depth range for abundance. But for biomass, polychaetes were dominated off Cape Comorin (42.45%). Percentage abundance and biomass of nematode was high off Kozhikode followed by off Vadanapilly. Percentage biomass of nematodes showed a decreasing trend from off Kozhikode towards southern transects. Percentage biomass of foraminiferans showed a decreasing trend from off Vadanapilly to off Cape Comorin. Percentage biomass of polychaetes showed an increasing trend from off Kochi to southern transects. The average biomass and abundance of meiofauna of this depth range was 1.164 mg/10sq.cm and 307 No/10sq.cm respectively.

Latitudinal variation at 100m depth range: - Maximum abundance of meiofauna was recorded off Vadanapilly followed by off Cape Comorin. Highest biomass was observed off Cape Comorin followed by off Vadanapilly. The standing stock does not show any noticeable trend along the transects. In percentage abundance and biomass, nematodes was dominating along all the transects in this depth range and showed an increasing trend from off Kozhikode towards southern transects upto off Kochi and then it was irregularly varied. The average biomass and abundance of meiofauna of this depth range was 0.589 mg/10sq.cm and 145 No/10sq.cm respectively.

Latitudinal variation at 200m depth range: - Maximum biomass and abundance of meiofauna was recorded off Vadanapilly followed by off Kollam. The standing stock showed an irregular variation along the coasts. Nematodes were dominating in all the transects in this depth range. Percentage abundance (91.80%) and biomass (85.90%).) of nematode was high off Vadanapilly. The average biomass and abundance of meiofauna of this depth range was 0.314 mg/10sq.cm and 82 No/10sq.cm respectively.

Along the southwest continental shelf of India, the wet weight of meiofauna was varied from a minimum of 0.099 mg/10sq.cm (Kozhikode, 200m) to a maximum of 4.863 mg/10sq.cm (Trivandrum, 30m). Nematodes and foraminiferans were contributing major part of biomass. The biomass was minimum in the 200m and maximum in the 30m depth ranges. It shows a decreasing trend with increasing depth. The average biomass along the entire southwest coast was 1.347 mg/10sq.cm.

The numerical abundance of meiofauna along the southwest continental shelf of India, was varied from a minimum of 22 No/10cm^2 (Kozhikode, 100m) to a maximum of 1417 No/10cm^2 (Kollam 30m). Numerically, nematodes and foraminiferans were the major groups. The abundance was minimum in the 200m and maximum in the 30m depth ranges. It shows a decreasing trend with increasing depth. The average numerical abundance along the entire southwest coast was 388 No/10cm^2.

Southeast coast

Latitudinal variation at 30m depth range: - Maximum biomass and abundance of meiofauna was recorded off Cuddallore followed by off

Nagapatnam, the standing stock was high along southern transects. Nematodes were dominating all transects in this depth range except off Cuddallore where foraminifera were dominating off Cuddallore transect with 39.26% of abundance and 35.10% of biomass. The average biomass and abundance of meiofauna of this depth range was 1.631 mg/10sq.cm and 473 No/10sq.cm respectively.

Latitudinal variation at 50m depth range: - Maximum biomass and abundance of meiofauna was recorded off Nagapatnam followed by off Chennai. The standing stock showed an irregular variation in this depth range along the coasts. Nematodes were dominating in all transects for abundance and biomass except off Chennai, polychaetes were contributed high (48.82%) of biomass in this transect. Percentage abundance (66.67%) and biomass (69.87%) of nematode was high off Krishnapatnam. The average biomass and abundance of meiofauna of this depth range was 0.625 mg/10sq.cm and 141 No/10sq.cm respectively.

Latitudinal variation at 100m depth range: - The samples were taken from Cuddallore and Krishnapatnam transects only. Maximum biomass and abundance of meiofauna was recorded off Cuddallore. Nematodes were dominating in both the transects in this depth range for abundance and biomass. Percentage abundance (78.44%) and biomass (62.76%) of nematode was high off Krishnapatnam. The average biomass and abundance of meiofauna of this depth range was 0.783 mg/10sq.cm and 185 No/10sq.cm respectively.

Latitudinal variation at 200m depth range: - Maximum biomass and abundance of meiofauna was recorded off Nagapatnam followed by off Krishnapatnam. The standing stock showed an increasing trend from off

Chennai to off Nagapatnam. Nematodes were dominated for abundance in all the transects in this depth range. For biomass, nematodes were dominating off Cuddallore and off Krishnapatnam and polychaetes were dominated off Nagapatnam and off Chennai. Percentage abundance (83.58%) and biomass (69.01%) of nematode was high off Cuddallore. The average biomass and abundance of meiofauna of this depth range was 0.426 mg/10sq.cm and 92 No/10sq.cm respectively.

Along the southeast continental shelf of India, the wet weight of meiofauna was varied from a minimum of 0.125 mg/10sq.cm (Chennai, 200m) to a maximum of 2.624mg/10sq.cm (Cuddallore, 30m). Nematodes and polychaetes were contributing major part of biomass. The biomass was minimum in the 200m and maximum in the 30m depth ranges. It shows a decrease from 30m to 50m, and then it increased to 100m and the decreased to 200m depth ranges. The average biomass along the entire southeast coast was 0.866 mg/10sq.cm.

Numerical abundance of meiofauna along the southeast continental shelf of India, was varied from a minimum of 28 No/10cm^2 (Chennai, 200m) to a maximum of 782 No/10cm^2 (Cuddallore, 30m). Numerically nematodes and foraminiferans were the dominant groups. The abundance was minimum in the 200m and maximum in the 30m depth ranges. The abundance shows a decrease from 30m to 50m, and then it increased to 100m and again decreased to 200m depth ranges. The average numerical abundance along the entire southeast coast was 223 No/10cm^2.

7.2.2 Diversity of Meiobenthos

The identification of the meiofauna was carried out only upto the group level. Altogether 12 taxonomic groups were identified from the whole meiofaunal samples from the southwest and southeast continental shelf of India. Among these, Nematoda, Foraminifera, Copepoda and Polychaetea were the most dominant groups and recorded in all depth ranges. Some other groups recorded in lower densities were Kinorhynchs, Gastrotrichs, Ostracods, Turbellarians, Cladocerans, Acari, Nemertins and Tardigrads. Some unidentified organisms were also recorded. Maximum density of fauna was recorded in the 30m depth range and it showed a decreasing trend with increase in depth along the southwest and southeast coast.

7.2.2.1 Southwest coast

A total of 10 meiofaunal groups were identified from the southwest continental shelf of India. Nematoda, Foraminifera, Copepoda and Polychaeta, were the most abundant groups which recorded in all depth ranges. The remaining groups recorded in lower densities are Kinorhynchs, Gastrotrichs, Ostracods, Turbellarians, Cladocerans, Acari and some unidentified organisms.

Foraminifera: - They were the protozoan group, which are abundant in meiofaunal samples. Along the southwest coast, in the 30m depth range, foraminifera were ranged from 19 No/10cm^2 off Kozhikode to 596 No/10cm^2 off Kollam. In the 50m depth range, foraminifera were varied from 2 No/10cm^2 off Kochi to 31 No/10cm^2 off Vadanapilly. In the 75m depth range, sample was taken from off Kollam transect only and 7 No/10cm^2 foraminifera were recorded from this station. In the 100m depth range, they recorded a minimum of 0 No/10cm^2 off Kollam to a maximum of 47 No/10cm^2 off Vadanapilly. In the 200m depth range, the range was from of 0 No/10cm^2 off Kozhikode and off Kochi to 2 No/10cm^2 off Vadanapilly and off Kollam.

Nematoda: - They were the most dominating groups in the marine interstitial fauna. In the present study also the nematodes were the dominant group and present in all the samples from all the depth ranges. In the 30m depth range, nematodes recorded a minimum of 121 No/10cm^2 off Kozhikode and a maximum of 685 No/10cm^2 off Trivandrum. In the 50m depth range, it was a minimum of 66 No/10cm^2 off Kochi and 498 No/10cm^2 off Kozhikode. In the 75m station off Kollam recorded 180 No/10cm^2 nematodes. In the 100m depth range, nematodes recorded a minimum of 22 No/10cm^2 off Kozhikode and a maximum of 141 No/10cm^2 off Kochi. In the 200m depth range, it recorded a minimum of 17 No/10cm^2 off Kozhikode and a maximum of 171 No/10cm^2 off Vadanapilly.

Polychaeta: - Polychaeta generally considered as temporary meiofauna since most of them have a larval life. In the present study they contributed a considerable density along the southwest coast. In the 30m depth range, polychaetes recorded a minimum of 2 No/10cm^2 off Kozhikode and a maximum of 69 No/10cm^2 off Vadanapilly. In the 50m depth range, they recorded a minimum of 6 No/10cm^2 off Kochi and a maximum of 49 No/10cm^2 off Cape Comorin. In the 75m depth range, off Kollam they recorded 19 No/10cm^2. In the 100m depth range, their presence was a minimum of 2 No/10cm^2 off Kozhikode and a maximum of 22 No/10cm^2 off Cape Comorin. In the 200m depth range, they recorded a minimum of 1 No/10cm^2 off Cape Comorin and a maximum of 12 No/10cm^2 off Kollam.

Copepoda: - They were the third dominating group in meiofauna samples. They were present in all the depth ranges along the southwest coast of India. In the 30m depth range, copepods recorded a minimum of

22 No/10cm^2 off Vadanapilly and a maximum of 371 No/10cm^2 off Trivandrum. In the 50m depth range, copepod number was a minimum of 2 No/10cm^2 off Kochi and a maximum of 87 No/10cm^2 off Cape Comorin. In the 75m depth range, sample was taken from off Kollam transect only and 11 No/10cm^2 copepods were recorded from this station. In the 100m depth range, copepods recorded a minimum of 0 No/10cm^2 off Kozhikode and off Kochi and a maximum of 20 No/10cm^2 off Vadanapilly. In the 200m depth range, copepods recorded a minimum of 0 No/10cm^2 off Kozhikode and off Vadanapilly and a maximum of 9 No/10cm^2 off Kollam.

Kinorhynchs: - They usually occur in fine sandy to muddy sediments from the eulittoral zone to deep sea. In the present study, they were recorded from Kollam at 50m depth range only.

Gastrotrichs: - They are comparatively less abundant in benthic meiofaunal samples. In the present study their presence was recorded off Kozhikode and off Kollam, 50m depth range only.

Ostracods: - Ostracods were usually found in shallow water stations. Their density was rather poor in most of the stations particularly in deep waters. In the present study record was from off Vadanapilly 30m depth range only.

Turbellarians: - Turbellarians are found in marine and fresh water ecosystems. In the present study, they were recorded from 30m to100m depth ranges along the southwest coast and was absent in 200m depth range. In 30m depth range, turbellarian presence was only at off Vadanapilly transect and recorded 19 No/10cm^2. In the 50m depth range, total absence of this group was only at Kochi and their presence was recorded from all other transects with a maximum of 5 No/10cm^2 at off Kollam. In 75m depth range samples were taken from Kollam transect only and 5 No/10cm^2 were recorded at this station. In 100m dept range, Turbellarians were recorded only from off Cape Comorin and was 5 No/10cm^2.

Cladocerans: - They also found in marine and fresh water ecosystems. In the present study they were recorded from 50m off Kozhikode and 75m off Kollam transects only.

Acari: - Despite their clear cut diagnostic characters halacarids have been little investigated. In the present study, along the southwest coast, halacarids were present in the 50m depth range off Kozhikode and off Kollam.

Unidentified: - A total of 563 No/10cm^2 unidentified individuals also were recorded from the southwest coast.

7.2.2.2 Southeast coast

A total of 9 meiofaunal groups were identified from the southeast continental shelf of India. Nematoda, Foraminifera, Copepoda and Polychaeta, were the most dominant groups and recorded in all depth ranges. The other groups which were present in lower densities are Ostracods, Turbellarians, Nemertins, Acari, Tardigrads and 232 No/10cm^2 unidentified organisms.

Foraminifera: - Along the southeast coast foraminifera were present in all the depth ranges. In the 30m depth range, foraminifera were recorded a minimum of 2 No/10cm^2 off Krishnapatnam and a maximum of 307 No/10cm^2 off Cuddallore. In the 50m depth range, foraminifera recorded a minimum of 0 No/10cm^2 off Nagapatnam and Chennai and a maximum of 4 No/10cm^2 off Krishnapatnam. In the 100m depth range, the minimum was 1 No/10cm^2 off Krishnapatnam and a maximum of 35

No/10cm^2 off Cuddallore. In the 200m depth range, foraminifera recorded a minimum of 0 No/10cm^2 off Cuddallore and a maximum of 8 No/10cm^2 off Nagapatnam and off Krishnapatnam.

Nematoda: - The nematodes were the dominant group and present in all the depth ranges along the southeast coast. In the 30m depth range, nematodes recorded a minimum of 124 No/10cm^2 off Chennai and a maximum of 278 No/10cm^2 off Krishnapatnam. In the 50m depth range, minimum was 31 No/10cm^2 off Krishnapatnam and 214 No/10cm^2 off Nagapatnam. In the 100m depth range, nematodes recorded a minimum of 91 No/10cm^2 off Cuddallore and a maximum of 134 No/10cm^2 off Krishnapatnam. In the 200m depth range, a minimum was 12 No/10cm^2 off Chennai and a maximum of 72 No/10cm^2 off Krishnapatnam.

Polychaeta: - The group contributed considerable density along the southeast coast of India. In the 30m depth range, polychaetes recorded a minimum of 3 No/10cm^2 off Chennai and a maximum of 33 No/10cm^2 off Cuddallore. In the 50m depth range, they recorded a minimum of 1 No/10cm^2 off Krishnapatnam and a maximum of 60 No/10cm^2 off Nagapatnam. In the 100m depth range, polychaeta showed a minimum of 19 No/10cm^2 off Cuddallore and a maximum of 27 No/10cm^2 off Krishnapatnam. In the 200m depth range, they recorded a minimum of 5 No/10cm^2 off Chennai and off Cuddallore and a maximum of 21 No/10cm^2 off Nagapatnam.

Copepoda: - They were the third dominating group in meiofauna samples and present in all the depth ranges along the southeast coast of India. In the 30m depth range, copepods recorded a minimum of 11 No/10cm^2 off Nagapatnam and a maximum of 106 No/10cm^2 off Cuddallore. In the 50m depth range, copepod presence was a minimum of 7 No/10cm^2 off Cuddallore and off Krishnapatnam and a maximum of 31 No/10cm^2 off Nagapatnam. In the 100m depth range, polychaetes recorded a minimum of 5 No/10cm^2 off Krishnapatnam and a maximum of 14 No/10cm^2 off Cuddallore. In the 200m depth range, copepods showed a minimum of 0 No/10cm^2 off Cuddallore and a maximum of 8 No/10cm^2 off Nagapatnam.

Ostracods: - Ostracod density was rather poor in most of the stations. In the present study, along the southeast coast, they were present in 50m and 200m depth ranges only. In the 50m depth range, they recorded a maximum of 3 No/10cm^2 off Nagapatnam. In the 200m depth range, ostracods present only off Nagapatnam and was 2 No/10cm^2.

Turbellarians: - In the present study, the group was present in 30m and 50m depth ranges along the southeast coast and it was absent in 100 and 200m depth ranges. In the 30m depth range, it was recorded a minimum of 0 No/10cm^2 off Krishnapatnam and a maximum of 37 No/10cm^2 off Cuddallore. In the 50m depth range, it was recorded only at off Nagapatnam and was 5 No/10cm^2.

Acari: - The family Halacaridae represent as a common group among meiofaunal samples. In the present study, along the southeast coast, halacarids were present in the 30m depth range only and recorded a minimum of 0 No/10cm^2 off Cuddallore and off Krishnapatnam and a maximum of 8 No/10cm^2 off Nagapatnam.

Nemertins: - Nemertins are often abundant in meiofaunal samples. In the present study they were recorded from 30m depth range off Cuddallore and off Nagapatnam only along the southeast coast. They represented 52 No/10cm^2 and 74 No/10cm^2 off Nagapatnam.

Tardigrads: - The marine meiobenthic tardigrada were recorded from the littoral to the depth of 5000m. Sandy sediments are their preferred substratum. In the present study they were recorded from 30m depth range only along the Southeast coast of India. It was recorded a minimum if 0No/10cm^2 off Krishnapatnam and a maximum of 11 No/10cm^2 off Nagapatnam. They were present off Cuddallore and off Chennai with 1 No/10cm^2 each.

Unidentified Organisms: - A total of 232 No/10cm^2 unidentified individuals also were recorded along the southeast coast.

7.2.3 Community Structure of Meiofauna Groups

Community structure of meiofauna groups along the continental shelf of southwest and southeast coast of India was analysed (Table No. 7.9 to 7.11 and Fig No.7.7) and as follows:

Species richness (Margalef`s index, d):- Along southwest coast, in the 30m depth range the species richness increased from off Kozhikode to off Vadanapilly and then it was decreased towards south. In the 50m depth range it decreased from off Kozhikode to off Kochi and then increased to off Kollam and again decreased to off Cape Comorin. In the 100m depth range, it decreased from off Kozhikode to off Kochi and then it was increased towards off Cape Comorin. In the 200m depth range the Margalef`s index, showed an increasing trend towards south. Along southeast coast, in all the depth ranges, species richness value does not show any noticeable trend.

Evenness index (Pielou's index, J'):- Along southwest coast, in the 30m and 100m depth ranges, evenness index does not show any significant trend in variation. In the 50m depth range it shows an increasing trend from off Kozhikode to off Cape Comorin. In the 200m depth range, the evenness index value decreased from off Kozhikode to off Vadanapilly and then increased upto off Kollam and then decreased to off Cape Comorin. Along southeast coast, in the 30m depth range the Pielou's index, increased from off Nagapatnam to off Cuddallore and then it decreased to Chennai. Chennai and Krishnapatnam showed similar values. In the 50m depth range it increased from off Nagapatnam to Chennai and then it decreased to off Krishnapatnam. In the 100m depth range, samples were taken from Cuddallore and Krishnapatnam only and it was low off Krishnapatnam and high off Cuddallore. In the 200m depth range, there was no prominent trend.

Species diversity (Shannon index, H' (log2):- Along southwest coast, in the 30m,100m and 200m depth ranges the species diversity does not show any significant trend in variation. In the 50m depth range it showed an increasing trend from off Kozhikode to Cape Comorin. Along southeast coast, in the 30m depth range the Shannon index increased from Nagapatnam to Cuddallore and then it was decreased to off Krishnapatnam. In the 50m depth range it increased from off Nagapatnam to off Chennai and then it was decreased to off Krishnapatnam. In the 100m depth range, samples were taken from Cuddallore and Krishnapatnam only the value was low at off Krishnapatnam and high at off Cuddallore. In the 200m depth range it does not in a noticeable trend.

Species dominance (Simpson's dominance index, Lambda'):- Along southwest coast, in the 30m depth range, there was no notable trend in the species dominance. In the 50m depth range, Simpson's index shows a decreasing trend from off Kozhikode to off Cape Comorin. In the 100m depth range, the Lambda' value was almost similar off

Kozhikode and off Vadanapilly and increased to off Kochi and then decreased to off Kollam and again increased to off Cape Comorin. In the 200m depth range, it increased from off Kozhikode to off Vadanapilly then it was decreased upto Kollam and then it is increased to Cape Comorin. Along southeast coast, in the 30m depth range the Lambda'-value increased from Nagapatnam to north Krishnapatnam. In the 50m depth range it was decreased from off Nagapatnam to Chennai and then increased to off Krishnapatnam. In the 100m depth range, samples were taken from Cuddallore and Krishnapatnam only. It was low at off Cuddallore and high at off Krishnapatnam. In the 200m depth range does not show any significant trend.

The average species richness (Margalef`s index, d) index along the southwest coast at different depth ranges was varied in an irregular manner. It increased from 30m to 50m and then it was decreased to 100m and then increased to 200m depth ranges. But in the southeast coast it decreased from 30m to 100m and then it increased slightly in 200m depth range. The average evenness index (Pielou's index, J`) along the southwest coast at different depth ranges was decreased from 30m to 50m and then increased towards100m and then it decreased to 200m depth ranges. But in the southeast coast it was increased from 30m to 50m and then decreased to 100m and then increased to 200m depth ranges. The average species diversity (Shannon index, H' (log2) index along the southwest coast and southeast coast at different depth ranges was showed almost similar trend. It decreased from 30m to 200m depth ranges along the southwest coast and in the southeast coast it decreased from 30m to 100m depth ranges and then slightly increased in 200m. The average species dominance index (Simpson's index, Lambda') along the southwest coast shows increasing trend from 30m to 200m depth ranges as the depth increases. But in the southeast coast it decreased from 30m to 100m and slightly increased to 200m depth range.

7.2.4 Cluster analysis (Bray-Curtis similarity)

The group distribution of meiofauna along and between stations was compared with using hierarchial cluster analysis based on Bray-Curtis similarity calculated on non-transformed group abundance data. The cluster analysis was carried out separately for southwest and southeast coasts. The clusters formed between stations depict the patterns in the similarity matrix (Table No.7.12, 7.13 and Fig.7.8, 7.9). Simper also carried out to elucidate the dissimilarity along transects.

Along southwest coast, in the 30m depth range, off Trivandrum and off Kollam transects showed the highest similarity and are combined, at similarity level 88.88%. In the 50m depth range, the highest linkage was between off Trivandrum and off Cape Comorin at 86.47%. In the 100m depth range, maximum similarity was observed between off Kochi and off Cape Comorin and is clustered at 84.93% similarity level. In the 200m depth range, greatest similarity observed between 85.24% off Kochi and off Cape Comorin. Along southwest coast as a whole, the most similar transects were off Kollam and off Cape Comorin (85.53%). Along southwest coast the most dissimilar transects were off Kozhikode and off Trivandrum which showed an average dissimilarity of 59.40%.

Along the southeast coast, in the 30m depth range, peak similarity noticed between off Nagapatnam and off Cuddallore (77.33%). In the 50m depth range, the highest linkage between off Cuddallore and off Chennai and was clustered at 82.21% similarity level. In the 100m depth range, samples were taken from off Cuddallore and off Krishnapatnam only and

77.94% similarity were observed between these two stations. In the 200m depth range, similarity level was uppermost between off Nagapatnam and off Krishnapatnam (89.53%). As a whole along southeast coast, off Nagapatnam and off Cuddallore were the most comparable transects and was clustered at 85.65% similarity level. Along southeast coast, highest dissimilarity was observed between off Nagapatnam and off Chennai with an average value of 57.26%.

7.3 Discussion

From the studies conducted for meiofauna groups over southwest coast during 2005, nematodes (52.82%) were dominated in abundance followed by foraminiferans (23.21%) and copepods (10.96%). In the previous studies, 2001 data along the southwest continental shelf nematodes dominated with 77% and copepods (11%) were the second and foraminifera (8%) were the third dominating. For biomass, during 2005, nematodes dominated with 50.19% followed by foraminiferans with 20.05% and polychaetes with 16.14%. During the 2001data, nematodes were dominated with 35% followed by copepods with 10%.

Along southeast coast, in the present study nematodes (52.16%) were dominated in abundance followed by foraminifera (17.55%), polychaetes and copepods with 8.59% and 8.45% respectively. In the 2001data along the southeast continental shelf, nematodes dominated with 59% followed by foraminifera with 29% and copepods with 4%. For biomass, in the present study, nematodes dominated with 44.29% followed by polychaetes and foraminifera with 22.10% and 13.55% respectively. During 2001data the biomass of nematodes were dominated with 34% followed by copepods with 26%.

The meiofauna was higher in density along the southwest coast of India than the southeast coast. The Bay of Bengal is traditionally considered to be a less productive compared to the Arabian Sea (Prasanna Kumar *et al*., 2002). Nematodes were the most abundant group and higher in density along the southwest coast than the southeast coast. Foraminiferans were the second dominating group along southwest coast and southeast coast.

For the convenience of comparison 2005 data processed as in the pattern of 2001 data as 30-50m, 50-75m, 100-150m and beyond 150m depth ranges. Along southwest coast, the major groups of meiofauna did not show any significant variation in abundance. But the other groups showed significant increase during 2005 than 2001 in the 30-50m (p-value < 0.01), 50-75m (p-value < 0.03) and 100-150m (p-value < 0.03) depth ranges. No other significant variations recorded in these depth ranges. Beyond 150m depth range, meiofauna did not show any significant variations between 2005 and 2001 data.

For biomass, along southwest coast, in the 30-50m and 50-75m depth range meiofauna did not show any significant variations during 2005 than 2001. In the 100-150m depth range, biomass of copepods (p-value < 0.01) showed a significant decrease during 2005 compared to 2001. Beyond 150m depth range, other groups (p-value < 0.02) and total biomass of meiofauna (p-value < 0.03) showed a significant decrease during 2005 compared to 2001. These decreases can be attributed to the impact of tsunami.

Along southeast coast, in the 30-50m depth range abundance of nematodes (p-value < 0.02) showed a significant increase during 2005 than 2001. In the 50-75m, 100-150m and beyond 150m depth ranges, abundance of meiofauna did not show any significant variations between 2005 and 2001. The huge tsunami waves struck the east coast of Tamil Nadu on 26th December 2004 (Nagendra *et al*., 2005). If there is an impact the value of 2005 data should be less than the previous data (2001) along the east coast. But the present study revealed that an increase in abundance of nematode in the 30m depth range during 2005. The result indicates that the 2001 data in the 30m depth range along southeast coast is an underestimate.

Along southeast coast at 30-50m depth range, biomass of nematodes (p-value < 0.008) and total meiofauna (p-value < 0.01) showed a significant increase during 2005 compared to 2001. In the 50-75m, 100-150m and beyond 150m depth ranges, biomass of meiofauna showed considerable increase during 2005 but it was not statistically significant.

In the present study, a total of ten meiofaunal groups were identified from the southwest continental shelf of India. Nematoda, Foraminifera, Copepoda and Polychaeta, were the most abundant groups which recorded in all depth ranges. The remaining groups recorded in lower densities are Kinorhynchs, Gastrotrichs, Ostracods, Turbellarians, Cladocerans, Acari and some unidentified organisms. Along southeast coast, a total of nine meiofaunal groups were recorded. Nematoda, Foraminifera, Copepoda and Polychaeta, were the most dominant groups and recorded in all depth ranges. The other groups which present in lower densities are Ostracods, Turbellarians, Nemertins, Acari, Tardigrads and some unidentified organisms.

In the present study the general trend of species richness, evenness and diversity were decreasing with increase in depth along the southwest and southeast coast. Species dominance was increased with increasing depth. Similar results were observed during 2001 also. In the present study, highest similarity of meiofauna groups along the southwest coast of India was at 30-50m and lowest at 100-150m depth ranges. Whereas in the southeast coast highest similarity was beyond 150m and lowest in the 30m depth ranges.

Mean total abundance along southwest coast at different depth ranges did not show any significant variations during 2005 than 2001 data. It does not mean tsunami not get affected along southwest coast because certain changes already discussed along this coast. Whereas along southeast coast mean total abundance of other groups (p-value < 0.04) showed a significant increase during 2005 compare to 2001.

Mean total biomass of meiofauna along southwest coast of India, did not show any significant variations between during 2005 and 2001. Whereas along southeast coast, mean total biomass of other groups (p-value < 0.003) and total meiofauna (p-value < 0.02) showed a significant increase during 2005 than 2001. While studying meiofauna during deep-sea disturbance in the Indian Ocean, Ingole *et al* (1999) reported a decrease in the density of meiofauna resulting from their mortality or migration to undisturbed areas. If there is an impact of tsunami, 2005 value should be less than the previous data along the tsunami affected area, the east coast. But the present study revealed that an increase in biomass of meiofauna after the 26th December 2004 tsunami along this coast. It indicates that, the 2001 data for meiofauna along the southeast coast was an underestimate. So the present data can be accepted as a benchmark data along the southeast continental shelf of India.

…..ഇൽ…..

Chapter 8

ECOLOGICAL RELATIONSHIPS

The continental shelf, apart from being a direct substratum for benthic animals, is also a storehouse for dead and non-living matter which, in turn, influences all production chains starting from breaking down of dead materials and enrichment process through primary and secondary level to the fishery resources (Dwivedi, 1973). Benthic ecosystems play an important role in the economy of many coastal states through the provision of food, non-living resources and through control of climate. The continental shelves of the world occupy 7.5% of the total area of the oceans, and are usually defined as the extending from low-water mark to the shelf break where the slope of the seabed steepens markedly. Hydrographic processes play a key role in determining the structure of continental shelf systems largely through their influence on the distribution of sediments and the supply of organic matter from the water column to the seabed (Hall, 2002).

The Arabian Sea and Bay of Bengal are seas bordering the Indian subcontinent and they represent two hydrologically and biogeochemically contrasting areas (Dileep Kumar *et al*., 1998). Arabian Sea is unique for its seasonally oscillating environmental and biological parameters (Qasim, 1982). Monsoon and its allied phenomena like upwelling and turbidity are the main causative factors for this. But seasonal changes diminish with increase in depth. Changes in hydrography and fauna are evident with respect to changes in depth and latitudes (Qasim, 1982). In the deeper area, the temperature variations are less pronounced. Previous studies conducted in different parts of the world revealed that seasonal variations are rarely observed in benthic community structure (Sanders, 1960; Nakao, 1982).

Joydas and Damodaran (2009) made a concerted effort to delineate the fine relationships between fauna and the environmental conditions, within the benthic ecosystem of the western continental shelf of India. They reported that depth is a key factor and hydrographical parameters temperature and dissolved oxygen also were the most important factors that affect the benthic realm. Ganesh and Raman (2007) studied on macrofauna with environmental variable along northeastern continental shelf of India and revealed that depth, sand, bottom water temperature and salinity were the major influencing factors on macrofauna. While studying on the influence of environmental properties on macrobenthos in the northwest Indian shelf, Jayaraj *et al* (2007) reported that, benthos were controlled by a combination of factors such as temperature, salinity, dissolved oxygen, sand and organic matter and no single factor could be considered as an ecological master factor. Jayaraj *et al* (2008, a) reported that the variations in the macrobenthic community were mainly controlled by sediment texture, depth, and dissolved oxygen. Jayaraj *et al* (2008, b) noticed that combination of different factors such as sediment texture, sediment sorting and depth were the key factors which influence the distribution of macrobenthos.

Many studies have correlated the distribution of infaunal invertebrates with sediment texture, leading to the generalization of distinct association between animals and specific sediment types (Peterson, 1913; Ford, 1923; Davis, 1925; Jones, 1950; Sanders, 1958; Jansson, 1967; Johnson, 1977; Nakao, 1982; Grant and Butman, 1987; Palacin *et al.*, 1991). Neyman (1969) noticed that in the muddy bottom of western Indian continental shelf region, at depths of 20 to 75m predominant fauna were Echiuroidea, Bivalvia (Tellinacea) and polychaetes (Eunicidae, Spionidae, Ampharetidae and Terebellidae). Parulekar and Ansari (1981) noticed richer fauna in clayey deposits and there admixture with sand and silt than in the sandy deposits or the coralline areas of Andaman sea.

Harkantra *et al.,* (1982) while studying the benthos of Bay of Bengal noticed that loose sand sheltered rich fauna were as muddy substrate were relatively impoverished. Presumably fine particles of clay sediment result in clogging of the filtering apparatus of the filter feeders. In such regions deposit feeders abound provided there is an adequate supply of food. Venkatesh Prabhu *et al.,* (1993) observed a direct relation between sediment composition and polycheates and echiuroids in off Gangolli region, with the polychaetes exhibiting greater abundance and diversity in clayey silt sediments. He attributed this to the fact that polychaetes prefer environment with limited water movement and sediment rich in fine particles. Ansari *et al.,* (1994) noticed that the numerically dominant taxa occur over a variety of sediment types, responding to sedimentary gradients with changes in abundance. In general highest average total biomass of macrofauna was in sand followed by silty caly and silty sand (Joydas and Damodaran (2009). They also noticed that high average abundance of total macrobenthos in silty clay substratum followed by sand and silty sand.

Although the number of studies has been made in this respect there is little evidence that sediment grain size along is the primary factor deciding in infaunal species distribution. A predominant generalization proposed by Sanders (1958) was that suspension feeders were more abundant in sandy environments and deposit feeders were more abundant in muddy environments. Critical re-examination of data on animal-sediment relationship suggest that many species are not always associated with a single sediment type and that suspension and deposit feeders often co-occur in large numbers (Snelgrove and Butman,1994). Furthermore a number of species alter their trophic mode in response to flow and food flux conditions (Snelgrove and Butman, 1994).

The organic content of the sediment can be a more important factor than sediment texture in determining infaunal distribution because organic matter in sediments is a dominant source of food for deposit feeders and indirectly for suspension feeders (Snelgrove and Butman, 1994). Indeed, Sanders's (Sanders, 1958) original hypothesis was that deposit feeders are more abundant in muddy environments because fine sediments tend to be organically rich. It is because clays tend to be bind organic matter easily and due to the similarity in settling velocity of organic matter and clays (Kemp, 1971). Sediment characters such as grain size, grain shape, sorting and pore space and organic matter are known to directly or individually affect the numbers and type of species found in soft bottom environments (Gray, 1974).

Many studies have been conducted to establish the relation between organic content of sediment and fauna (Sanders, 1958; Gray, 1968; Longbottom, 1970; Field, 1971; Boesch, 1973; Weston, 1990; Eleftheriou and Basford, 1989; Ishikawa, 1989; Alongi and Christoffersen, 1992). Bader (1954), while studying the abundance of bivalves in relation to percentage of organic carbon has observed a decrease in population with >3% of organic carbon. He pointed out that beyond this concentration products of bacterial decomposition and decline in the available oxygen become limiting factors. Ganapati and Raman (1973) have shown that in the Indian waters, organic carbon more than 6% is anoxic to the marine life. Harkantra *et al,* (1980) noticed a decrease in benthic animals when organic carbon was higher than 4%. Venkatesh Prabhu *et al.,* (1993) observed a direct relation between organic matter and ploychaetes and echiuroids in off Gangolli region. Ansari *et al.,* (1994) did not observe any consistent relationship between organic carbon and benthic biomass. They argued that a moderate enrichment has a bio-stimulating effect on benthic community.

All these studies suggest that there is strong relationship between organic matter and faunal distribution. However it has been realized that bulk organic carbon measurements may not accurately reflect the amount of organic carbon that may actually be utilized by an organism (Tenore *et al.,* 1982; Cammen, 1989; Mayer, 1989; Mayer and Rice, 1992). In the controlled laboratory experiments on larval settlements, it was seen that the difference in organic carbon rather than grain- size resulted in the selective settlement of larvae in organic rich sediments, where they developed into adults (Butman *et al.*, 1988; Butman and Grassle, 1992; Grassle *et al.*, 1992a, b). In field studies several deposit feeding opportunistic species have been shown to re-colonize preferentially organic matter rich sediments over non enriched sediments (Grassle *et al.*, 1985 and Snelgrove *et al.*, 1992).

The way in which organisms are able to utilize different types of organic matter is a complex issue (Lopez and Levinton, 1987) and organic matter may take many different forms (Johnson,1974); Whitlatch and Jonson,1974; Mayer ,1989). These different forms of organic matter may be utilized in different ways (Tenore *et al.,* 1982). Apart from the issue of quality of organic matter, there is some controversy over whether deposit feeders utilize primarily detritus or the microbes attached to it (Levinton, 1979; Cammen, 1989). Some studies have suggested that most detritus is not utilized (Newell, 1965; Fenchel, 1970; Hargrave, 1970; Lopez *et al,* 1977), at the same time others have pointed out that microbial carbon alone may be insufficient to support infaunal communities (Tunnicliffe and Risk, 1977; Cammen *et al.*, 1978).

It is an accepted fact that benthos depend upon overlying column of water for their energy requirements. The supply of food to the sub-tidal benthic communities depends on proximity to shore and water depth (Levinton, 1982). Near shore, shallow water localities are richly supplied with both benthic and planktonic primary production, much of which enters the food web as organic detritus. The pelagic supply of organic matter to the benthos similarly decreases with depth and distance from shore (Levinton, 1982).

8.1 Macrofauna

Macrofauna along southwest and southeast continental shelf of India and its ecological relationships were presented in the Table no.8.1.

BIO-ENV results indicate that depth is a key factor for distribution of macrofauna along southwest and southeast coast of India. Temperature, salinity, sand and silt were the most important environmental factors which influencing on macrofauna along southwest coast. Along southeast coast, temperature, salinity, dissolved oxygen sand and silt were the significant ecological factors.

Hydrographical relationships

BIO-ENV results indicate that, temperature is the most important hydrographical factor which influencing on macrofauna along southwest coast. Harkantra and Parulekar (1991) reported that the most important hydrographical factors which influence on benthos were temperature, salinity and dissolved oxygen. While studying macrobenthic infauna along the northwestern continental shelf of India, Jayaraj *et al* (2007) reported that hydrographical factors like temperature, salinity and DO have great influence on the abundance and distribution of benthic organisms. While studying macrobenthic infauna along the southwestern continental shelf of India, Joydas and Damodaran (2009) reported that temperature and dissolved oxygen were the most important hydrographical factors which influencing on macrofauna.

Total biomass and total density of macrofauna and polychaetes was high at temperature above 25^{o}C along southwest coast. For crustaceans it was above 22 ^{o}C. The total biomass, total density of macrofauna, polychaetes and crustaceans was high at above 33‰ salinity along southwest coast. In the case of DO, the total biomass, total density of macrofauna, polychaetes and crustaceans was high at above 1ml/L along southwest coast. With depth there was no trend was observed in the case of abundance of macrofauna along the southwest coast. Jayaraj *et al* (2007) reported similar results from the northwest continental shelf of India. Biomass was low at 100m and high at 50m depth ranges. But generally shallow water area showed high biomass and abundance (Jayaraj *et al*, 2007 and Joydas and Damodaran, 2009).

Along southeast coast, temperature is the most significant hydrographical factor which have influence on macroinfauna. While studying macrobenthic infauna along the northeastern continental shelf of India, Ganesh and Raman (2007) reported that salinity and temperature were the important hydrographical factors which influencing macrobenthic infauna.

Along southeast coast total biomass, total density of macrofauna, polychaetes and crustaceans was high at above 20 ^{o}C. The total biomass, total density of macrofauna, polychaetes and crustaceans was high at above 33‰ salinity along southeast. In the case of DO, the total biomass, total density of macrofauna, polychaetes and crustaceans was high at above 1ml/L along southeast coast. Along the southeast coast abundance showed a decrease from 30m to 50m and beyond it increased to 200m depth range. Biomass of macrofauna along the southeast coast showed a decreasing trend with increase in depth up to 100m and then it showed an increase towards 200m depth range. The same trend was not reported so far for the distribution of macrofauna along the continental shelf of India. So, it is possible due to the impact of 26th December 2004 tsunami.

Sediment relationships

BIO-ENV results indicate that sand and silt were the main sediment characteristics influencing distribution and abundance of macrofauna along southwest and southeast coast.

Harkantra and Parulekar (1991) reported that the most important sediment character which influence on benthos was sand. While studying macrobenthic infauna along the northwestern continental shelf of India, Jayaraj *et al* (2007) reported that sediment character such as sand have great influence on the abundance and distribution of benthic organisms. While studying macrobenthic infauna along the southwestern continental shelf of India, Joydas and Damodaran (2009) reported that sand was the most important sediment character which has great influence on macrofauna. Ganesh and Raman (2007) reported that sand was the important sediment character which influencing macrobenthic infauna.

Along southwest coast, average total biomass and abundance of macrofauna was high in sandy substrata followed by sandy silt. Harkantra *et al* (1982) also reported high abundance of macrofauna in sandy substrata while studying along the shelf of northeastern Bay of Bengal. As far as polychaetes were concerned biomass and abundance were high in sandy followed by sandy silt substrata. For crustaceans biomass and abundance were high in sandy followed by sandy silt substrata. For molluscs biomass was high in clayey silt followed by sandy substrata whereas abundance was high in sandy followed by in sandy silt substrata.

Along southeast coast, average total biomass of macrofauna was high in sandy followed by clayey silt substrata. The average total numerical abundance was high in sandy followed by silty sand substrata. As far as polychaetes were concerned biomass and abundance were high in sandy followed by silty sand substrata. For crustaceans biomass and abundance were high in sandy followed by silty sand substrata. For molluscs biomass was high in clayey silt followed by silty sand substrata whereas abundance was high in sandy followed by in clayey silt substrata.

In the present study, the BIO-ENV results showed correlations with organic matter and macrofauna along southeast coast only. However, along southwest coast the biomass and abundance of macrofauna, polychaetes and crustaceans were high in a range of 0-3% of organic matter content in the substrata. Along southeast coast, it was in a range of 0-4% organic matter.

Depth is a key factor for the distribution of benthos (Joydas and Damodaran, 2009). In the present study along southwest coast biomass and abundance were high in shallow waters. Biomass of macrofauna along the southeast coast showed a decreasing trend with increase in depth up to 100m and then it showed an increase towards 200m depth range.

With increase in depth there was a decrease in representation of polychaetes in the present study. Along southwest coast, family Arenicolidae was not reported beyond 30m depth range. Arenicolidae and Typhloscolecidae were reported from southwest coast only and from 30m and 50m depth range respectively. Heterospionidae and Ophelidae were not recorded deeper than 50m depth range. Family Lacydonidae and Poecilochaetidae were not recorded beyond 100m depth range. Sternaspidae was not recorded from 30m and was present in deeper waters. Damodaran (1973) reported Sternaspidae from shallow waters. A total of 6 polychaete families were not reported from the samples collected beyond 100m depth range. Among the non-polychaete taxa, crustaceans and molluscs also showed a decrease in diversity with increase in depth. Echiuroids were reported only from 30m depth range. Foraminiferans and Echinoderms were totally absent in samples collected from 200m depth range.

Along southeast coast Heterospionidae not reported beyond 30m depth range. Lacydonidae and Ophelidae was not reported beyond 50m depth range. Pontodoridae, Oweniidae and Sabellariidae were reported from southeast coast only and from 50m depth range. Hesionidae and Flabelligeridae were not reported beyond 100m depth range. A total of 5 polychaete families were not reported beyond 100m depth range. Crustaceans and molluscs showed a decrease in diversity with increase in depth. Sipunculids were reported only from 30m depth range. Nemerteans were not reported beyond 100m depth range.

8.2 Meiofauna

Meiofauna along southwest and southeast continental shelf of India and its ecological relationships were presented in the Table no.8.2.

BIO-ENV results indicate that depth is a key factor for distribution of meiofauna along southwest and southeast coast of India. Temperature, sand and silt were the most important environmental factors which influencing on meiofauna along southwest coast. Along southeast coast, temperature, sand, silt and clay were the significant ecological factors.

Hydrographical relationships

BIO-ENV result indicates that temperature is the main influencing hydrographical factor on meiofauna along southwest coast of India. The decrease in temperature to deeper waters leading to the decline of meiofaunal abundance and biomass from 30m to 200m depth ranges along southwest coast. Abundance and biomass of nematodes decreased from 30m to 200m depth ranges as total meiofauna. Abundance and biomass of foraminifera irregularly varied with depth. Density and biomass of polychaetes and copepods and the other groups together were decreasing with increase in depth.

Along southeast coast, BIO-ENV analysis revealed that temperature is the main hydrographical factor influencing the distribution and abundance of meiofauna. The reduction of meiofaunal standing stock with depth is due to the decrease in temperature along southeast coast. Abundance and biomass of meiofauna decreased from 30m to 50m and then increased to 100m and again decreased to 200m depth ranges. The trend of nematodes and foraminifera as similar as the total meiofauna distribution at different depth ranges. Density and biomass of copepods decreased with increase in depth. Abundance biomass of polychaetes increased from 30m to 50m and then decreased 200m depth ranges.

It is evident that there is a sharp decrease in temperature and dissolved oxygen with increase in depth along southwest and southeast coast. Abundance and biomass of meiofauna showed a decline with increase in depth along southwest and southeast coast. Sajan *et al* (2010) reported that, depth and temperature were the important parameters explaining the distribution of the nematode communities along the western Indian shelf.

For meiofauna, biomass and abundance was high at temperature above 22 ^{o}C, DO above 1ml/L and salinity above 33‰ along southwest and southeast coasts. Major group nematode, biomass and abundance were high above 24 ^{o}C, DO above 1ml/L and salinity above 33‰ along both the coasts.

Sediment relationships

Grain size of substrata is a key factor for meiofauna which directly determines spatial and structural conditions, and indirectly determines the physical and chemical characters of the sediment.

BIO-ENV results were indicating that sand and silt were the main sediment characters influences the distribution and abundance of meiofauna along southwest. Whereas sand, silt and clay along southeast coast of India.

Along southwest coast, average total biomass and abundance of meiofauna were high in sandy silt substrata followed by in sandy substrata. As far as nematodes and polychaetes were concerned biomass and abundance were high in sandy silt substrata followed by sandy. Abundance and biomass of meiofauna decreases with increase in clay content in the substrata and it can be due to the scarcity of interstitial spaces.

BIO-ENV results were indicating that sand, silt and clay were the main sediment characters influences the distribution and abundance of meiofauna along southeast coast of India. Along southeast coast, average biomass and abundance of meiofauna, were high in sandy substrata followed by clayey silt. As far as the nematodes, polychaetes and foraminifera were concerned, they were high in sandy substrata followed by clayey silt.

In the present study, the BIO-ENV results did not show any correlation with organic matter with meiofauna along both the coasts. However, along southwest coast the biomass and abundance of meiofauna and nematodes was high in a range of 0-3% of organic matter content in the substrata. Along southeast coast, it was in a range of 0-4% organic matter.

High biomass and abundance of macro and meiofauna was observed in the nearshore regions. One of the reasons for the high biomass and abundance in the nearshore waters can be due to the labile nature of the organic matter in this region. This study showed high average organic matter content in the sediments of the shelf edge along the southwest and southeast coast of India. The organic matter reaching the seafloor at great depths has previously been attacked by several decomposers and so is probably more refractory than organic detritus reaching the shallow bottoms adjacent to the shoreline (Levinton, 1982). Most of the organisms may not be able to use this type of organic matter.

8.3 Trophic relationships of macro and meiofauna

Benthos are the basis for energy flow in the benthic ecosystem (Parulekar *et al.*, 1980). The available information suggests that macrofauna makes a sizable contribution to the benthic energetics of the certain regions of the continental shelf of India (Damodaran 1973; Parulekar *et al.,* 1980; Harkantra *et al.*, 1980; Parulakar *et al.,* 1982; Ansari *et al.,* 1996, Jayaraj *et al,* 2007, 2008; Ganesh and Raman, 2007). The role of benthos in sustaining the demersal fishery is well understood. So an estimation of the benthic standing crops and production can give an idea about the potential demersal fishery resources of the continental shelf (Parulekar *et al.*, 1982; Longhurst and Pauly, 1987). Among the benthic animals, polychaetes are the principal food items of the demerasl fishes (Longhurst and Pauly, 1987). It has been confirmed that polychaetes dominates the benthos numerically over the continental shelf of west coast of India (Harkantra *et al.*, 1980; Parulekar *et al.*, 1982; Joydas and Damodaran, 2009).

Various studies have pointed out the strong mutual links existing between meio and macrofauna (Tipton & Bell, 1988; Service *et al.,* 1992; Giere, 1993). Meiofauna is intensively devoured by the multiple of macrofauna such as polychaetes, Ophiuroids, juvenile fishes and early ontogenic stages of shrimps and crabs (Giere, 1993). Sikora *et al.,* (1977) emphasized that energetically, it is more economical to ingest one meiofaunal organism than numerous dispersed micro-organisms of the same energetic value.

The efficiency of meiofauna in transferring trophic energy to the higher trophic levels was well documented (Coull *et al.*, 1995) clearing the assumptions that meiofauna was a trophic end (McIntyre and Murison, 1973). The benthic communities of the tropical oceans have much importance in interpreting the ecology of tropical demersal communities (Ansari and Gauns, 1996). The available information suggests that in Arabian Sea and the Andaman Sea the meiofauna contribute significantly to the total benthic production (Rodrigues *et al*., 1982, Sajan *et al*., 2010).

Along the southwest continental shelf of India, the post tsunami study showed the average meiobenthic biomass was 1077 kg.wet.wt./km^2 (without the weight of foraminifera). Assuming that the ratio of dry weight- wet weight as 1:4 (Gerlach, 1971 and Wieser, 1960) the dry weight obtained from the wet weight is 269 kg/km^2. Since 34.5% of the dry weight is made up of carbon, it can also be expressed as 92.805 kg C/km^2. Assuming that the average meiobenthic generation time is 3 months, the meiobenthic production will be about 371.22 kg C/km^2/yr. This will call for a demand of 3712.2 kg C/km^2/yr for the production, assuming an ecological transfer efficiency of 10%.

During the 2001data, average meiobenthic biomass along southwest continental shelf was 1750 kg.wet wt. /km^2. The dry weight obtained from the wet weight is 440 kg/km^2. It can also be expressed as in terms of carbon that 151.8 kg C/km^2. The meiobenthic production will be about 607 kg C/km^2/yr.

The production of meiofauna along southwest coast during 2001was 607 kg C/km^2/yr. During 2005, it was only 371.22 kg C/km^2/yr. The reduction in meiobenthic production during the year 2005 is due to the impact of the 26th December 2004 Indian Ocean tsunami.

According to the post tsunami study, along the southwest coast of India, the average biomass of macrobenthic infauna is 10460 kg wet wt/km^2. Using conversion factors developed by Parulekar *et al.,* (1980), the dry weight obtained is 1177 kg/km2. Since 34.5% of the dry weight is made up of carbon (Parulekar *loc.cit*) the above value can also be expressed as 406.07 kg C/km^2. Most of the species of macrobenthos have got a life span of about one year and if suggestion of Sanders (1956), that there is a production of about twice the standing crop for these animals, is accepted, an annual macrobenthic production of about 812.13 kg C/km^2/yr would be obtained. This will call for a demand of 8121 kg C/km^2/yr for the macrobenthic production.

During the 2001data, average macrobenthic biomass along southwest continental shelf was 8850 kg.wet wt. /km^2. The dry weight obtained from the wet weight is 951kg/km^2. It can also be expressed in terms of carbon that is 328 kg C/km^2. The meiobenthic production will be about 656.19 kg C/km^2/yr.

The production of macrofauna along southwest coast during 2001was 656.19 kg C/km^2/yr. During 2005, it was 812.13 kg C/km^2/yr. There was a slight increase in macrobenthic production were observed during 2005 even if there is a reduction in abundance in the 30-50m depth range. It may due to the patchiness of benthic fauna or due the difference in which the sampling gear was used.

Along southeast continental shelf of India, the post tsunami study showed an average meiobenthic biomass of 749 kg.wet wt. /km^2 along the southeast coast of India. The dry weight obtained from the wet weight is 187 kg/km^2. In terms of carbon, it can also be expressed as 64.515 kg C/km^2. The meiobenthic production will be about 258.06 kg C/km^2/yr. This will call for a demand of 2580.6 kg C/km^2/yr for the production.

During the 2001data, average meiobenthic biomass along southeast coast was 104 kg.wet wt. /km^2. The dry weight obtained from the wet weight is 26 kg/km^2. It can also be expressed as in terms of carbon that 8.97 kg C/km^2. The meiobenthic production will be about 35.88 kg C/km^2/yr.

The production of meiofauna along southeast coast during 2001was only 35.88 kg C/km^2/yr. During 2005, it was 258.06 kg C/km^2/yr. If there is an impact of tsunami the value during 2005 should be less than the 2001. But in the present study, the value was very high compared to the previous data. So, the increase in meiobenthic production during the year 2005 indicates that the value along southeast coast during 2001was an underestimate.

Along the southeast coast of India, the average biomass of macrobenthic infauna is 11820 kg wet wt/km^2 and the dry weight obtained is 1220 kg/km^2. The above value can also be expressed as 420.9 kg C/km^2 and annual macrobenthic production of about 841.8 kg C/km^2/yr would be obtained. This will call for a demand of 8418 kg C/km^2/yr for the macrobenthic production.

During the 2001data, average macrobenthic biomass along southeast continental shelf was 720 kg.wet wt. /km^2. The dry weight obtained from the wet weight is 90 kg/km^2. It can also be expressed as in terms of carbon that 31.05 kg C/km^2. The meiobenthic production will be about 62 kg C/km^2/yr.

The production of macrofauna along southeast coast during 2001was only 62 kg C/km^2/yr. During 2005, it was 841.8 kg C/km^2/yr. If there is an impact of tsunami, the values during the 2005 data should be less than the 2001 data. But in the present study, the value was very high compared to the previous data. The very high macrobenthic productivity during the year 2005 compared to 2001 indicates that the value along southeast coast during 2001 was an underestimate.

The southwestern Indian continental shelf area is 33872.85 km^2. So during the 2005 data the benthic production in terms of wet weight along southwest will be 0.39 million tonne (0.03 million tonnes of meiofaunal production and 0.35 million tonnes of macrofaunal production). In the 2001data the benthic production in terms of wet weight along southwest will be 0.36 million tonne (0.059 million tonnes of meiofaunal production and 0.299 million tonnes of macrofaunal production).

The southeastern continental shelf area is 16943.45 km^2. So the benthic production in terms of wet weight southeast coast will be 0.21 million tonne (0.01 million tonnes of meiofaunal production and 0.20 million tonnes of macrofaunal production). In the 2001 data the benthic production in terms of wet weight along southeast will be 0.01 million tonne (0.002 million tonnes of meiofaunal production and 0.012 million tonnes of macrofaunal production).

Along southwest coast the production per year was more or less same and the marginal increase noticed along southwest coast can be due to sampling using 0.2m^2 grab during 2005 survey. Along southeast coast, the difference is substantial even considering the difference in sampling gear and the differences expressed in the southeast coast during two surveys. So it is possible 2001value obtained for macro and meiofauna along southeast coast could be an underestimate.

…..ഇൽ…..

Chapter 9

SUMMARY AND CONCLUSIONS

The tsunami generated on the 26th December 2004 Sumatra-Andaman earthquake had a devastating effect on the peninsular India, mainly along southern region. The present study is an appraisal of the post-tsunami conditions of benthos along the continental shelf of southwest and southeast coast of India where the impact of tsunami occurred. The data for the present study was collected onboard FORV Sagar Sampada during Cr#230 from 5th to 19th January 2005 and was from the stations established in 2001 along the southwest and southeast continental shelf of India. Kannur transect was covered by Cr#233. Therefore the data collected from the study would be compared with the data already available from the stations.

Chapter 1 gives a brief introduction to the subject emphasizing on the scope, significance and objectives of the study.

Chapter 2 confers a detailed account of the past and present benthic research activity from existing scientific information.

Chapter 3 describes the study area and methodologies employed for measuring hydrographical data, sediment characteristics and analysis for macro and meiobenthos. Along the southwest coast samples were collected from seven transects, Kannur, Kozhikode, Vadanapilly, Kochi, Kollam, Trivandrum and Cape Comorin and along the southeast coast, Nagapatnam, Cuddallore, Chennai and Krishnapatnam. From each transects, duplicate grab samples were collected from 30m, 50m, 100m and 200m depth ranges. Samples were also collected for studying hydrographical parameters and sediment characteristics. For meiobenthos, identification was carried out only up to group level. For macrobenthos, the major group polychaetes were identified up to species level and the remaining groups up to lowest possible taxonomic level. This chapter also explains the statistical tests used in the study.

Chapter 4 deals with the hydrographical parameters of the continental shelf of southwest and southeast coast of India. Variations in temperature, salinity and dissolved oxygen along the study area were discussed in this chapter.

Chapter 5 reveals the sediment characteristics along the study area. Even though there were no significant variations observed along southwest coast at different depth ranges, the sediment texture showed some noticeable variations during 2001 and 2005 in certain stations. The substantial differences of sediment characteristics along southwest coast during 2005 as follows. In the 30-50m depth range, off Kollam a considerable amount of silt was replaced by sand particle. In the 50-75m depth range, off Kannur a considerable amount of silt was replaced by sand particles during 2005. In the 100-150m depth range, off Kannur a considerable amount of sand was replaced by silt particles. Off Vadanapilly and off Kochi showed a trend was that a considerable amount of silt was replaced by sand particles. Beyond 150m depth range, off Vadanapilly showed a considerable amount of silt was replaced by sand particles.

Percentage of clay did not show much variation southwest coast. No other noticeable variations observed in sediment texture along southwest coast during post tsunami period (2005) compared to 2001.

Along southeast coast, percentage distribution of sand and clay did not show any significant variations in all the depth ranges. Percentage of silt did not show any significant variations in 30-50m, 50-75m and 100-150m. But beyond 150m depth range, silt showed a significant reduction during 2005 compared to 2001. Even though there was no other significant variations observed the sediment texture showed some obvious variations in certain stations as follows. In the 30-50m depth range off Chennai, considerable amount sand was replaced by silt and clay particles during 2005. In the 50-75m depth range, off Cuddallore considerable amount clay was replaced by sand particles during post-tsunami period. Off Chennai and off Krishnapatnam showed a trend was that a considerable amount of silt was replaced by clay particles during post tsunami period. In the 100-150m depth range, off Nagapatnam and off Chennai considerable amount silt was replaced by sand particles. Off Krishnapatnam a considerable amount of clay replaced by sand particles. Beyond 150m depth range, off Nagapatnam silt and clay were replaced by sand particles. Off Cuddallore a considerable amount of silt was replaced by clay and sand particles. Off Chennai silt was replaced by sand particles. Off Krishnapatnam a considerable amount of silt was replaced by clay particles. No other substantial variations noticed along southeast coast during post tsunami period (2005) compared to 2001.

Organic matter did not show any significant variation along southwest and southeast coast of India during 2005 and 2001.

Chapter 6 depicts the macrobenthos along southwest and southeast coast of India. The major groups were polychaetes followed by crustaceans and molluscs. In the present study (2005) along southwest coast, in the 30-50m depth range shows a decrease in abundance of macrofauna. Beyond this depth, no significant variations were observed. It indicates that the 26th December 2004 Indian Ocean tsunami affected the bottom of shallow waters of southwest coast of India. Along southeast coast, numerical abundance and biomass of macrofauna was recorded comparatively high during 2005. The general trend of numerical abundance and biomass of macrofauna during 2001was that decreasing with increase in depth along both the coasts. During 2005, biomass and abundance of macrofauna decreased at shallow waters (30m depth range) then decreased from 50m to 100m and then increased to deeper waters. But along southeast coast, biomass of macrofauna showed a decrease in shallow waters and increase to deeper waters. Whereas abundance of macrofauna showed a decrease at shallow waters and increase to deeper waters.

During 2005, community structure for macrofauna along southwest and southeast coast indicating that, Margalef's index(d), Pielou's index, (J') and Shannon index, (H'log2) were revealed a trend that they increased from shallow water to deeper waters. But Simpson's index shows an opposite trend. Similar results obtained in the 2001 data also.

The most dominating species changed during 2005 compared to 2001. Along the southwest coast the most dominating species were *Prionospio (M) andamanensis* followed by *Prionospio pinnata* during 2005. But in the previous study (2001) the dominating species were *Magelona cincta* followed by *Prionospio pinnata* along southwest coast. Along southeast coast, the most dominating polychaete species were *Tharyx dorsobranchialis* followed by *Paraonis gracilis gracilis* during 2005. The species abundance along southeast coast was not compared as previous data was not available.

Chapter 7 illustrates meiobenthos along southwest and southeast coast of India. The major groups were nematodes, foraminiferans, polychaetes, copepods etc. Along the southwest coast no significant variation observed in total numerical abundance as well as biomass during 2005 compared to the previous study. Along southeast coast, in the 30-50m depth range abundance of nematodes showed a significant increase during 2005 than 2001. For the remaining depth ranges the samples were insufficient for comparison. For biomass, mean total biomass of meiofauna shows significant increase during 2005 compared to 2001. The general trend of numerical abundance and biomass of meiofauna was that decreasing with increase in depth during 2001and 2005.

Chapter 8 provides the details of ecological relationships with macro and meiobenthos during 2005 January. The BIO-ENV results indicating that depth, temperature, sand and silt were the main factors influencing the distribution and abundance of macrofauna along the southwest coast. Whereas along southeast coast depth, temperature, organic matter, sand and silt were the main influencing factors. Density and biomass of macrofauna was high in sandy substrata along both the coasts.

For meiofauna, along southwest coast BIO-ENV results were indicating that depth, temperature, sand and silt were the main factors influencing the distribution and abundance of meiofauna. Whereas along southeast coast, depth, temperature, sand, silt and clay were the main influencing factors. Along southwest coast, the biomass and abundance of meiobenthos were high in the sandy silt substrata. Along southeast coast, the biomass and abundance of meiobenthos was high in sandy substrata.

Along southwest coast the production per year was more or less same and the marginal increase noticed along southwest coast during 2005 may be due to sampling using 0.2 m^2 grab during 2005 survey compared 0.1 m^2 grab during 2001. Along southeast coast, production per year showed a substantial increase during 2005 than 2001. It is possible that 2001 value obtained for macro and meiofauna along southeast coast could be an underestimate.

Chapter 9 summary and conclusions, summarizes the whole chapters of the thesis.

The list of the tables, figures and references that are discussed in the study have been presented at the end of the thesis.

…..ꙮ…..

TABLES

Table 3.1. Station details of the study area

Transect	St.No.	Latitude	Longitude	Depth (in m)
Kannur	15b	12. 04. 000 N	74. 54. 000 E	52
	15a	11. 56. 000 N	74. 37. 000 E	100
Kozhikode	1	11.21.000 N	75.34.000 E	32
	2	11.19.500 N	75.20.400 E	46
	3	11.17.400 N	74.55.900 E	110
	4	11.17.000 N	74.52.000 E	208
Vadanapilly	5	10.26.700 N	75.49.600 E	32
	6	10.27.000 N	75.41.000 E	54
	7	10.27.300 N	75.29.600 E	105
	8	10.27.500 N	75.26.000 E	190
Kochi	9	09.57.000 N	75.59.000 E	30
	10	09.52.200 N	75.52.000 E	48
	11	09.45.100 N	75.40.900 E	113
	12	09.41.000 N	75.35.000 E	229
Kollam	13	09.00.000 N	76.23.000 E	34
	14	08.58.300 N	76.16.700 E	52
	15	08.55.100 N	76.05.100 E	75
	16	08.54.6540 N	76.02.358 E	95
	17	08.54.434 N	75.59.098 E	186
Trivandrum	18	08.32.056 N	76.48.458 E	38
	19	08.26.902 N	76.42.400 E	58
Cape Comorin	21	08.03.805 N	77.21.621 E	32
	22	07.55.273 N	77.20.207 E	50
	23	07.22.439 N	77.20.024 E	122
	24	07.08.798 N	77.19.349 E	216
Nagapattanam	25	10.59.000 N	79.58.300 E	30
	26	10.57.536 N	80.01.243 E	43
	27	10.58.000 N	80.10.858 E	102
	28	10.58.902 N	80.13.168 E	189
Cudallore	29	11.59.106 N	80.00.627 E	31
	30	11.59.450 N	80.04.614 E	52
	31	11.59.800 N	80.06.858 E	110
	32	11.59.304 N	80.07.304 E	169

Transect	St.No.	Latitude	Longitude	Depth (in m)
Chennai	33	12.45.734 N	80.19.056 E	33
	34	12.48.372 N	80.23.303 E	58
	35	12.50.128 N	80.34.293 E	108
	36	12.49.994 N	80.40.040 E	200
Krishnapattanam	37	14.00.080 N	80.20.140 E	32
	38	14.00.017 N	80.22.131 E	55
	39	13.59.613 N	80.24.381 E	99
	40	13.59.503 N	80.25.950 E	203

Table 4.1. Depth wise variation of hydrographical parameters in each transect along the southwest and southeast coast of India

Transect	St.No.	Depth(in m)	Temp(in °C)	Salinity (in ppt)	DO (in ml L^{-1})
knr	15b	50	29.29	35.17	3.77
	15a	100	25.01	35.84	2.60
kzh	1	32	28.60	34.29	4.30
	2	46.27	28.52	34.55	4.44
	3	110	28.19	35.92	3.87
	4	208	13.58	35.20	1.15
vad	5	30	28.31	34.61	4.30
	6	54	28.30	34.38	4.51
	7	105	24.96	35.87	2.42
	8	190	14.45	35.13	1.18
kch	9	29.60	28.36	33.95	4.53
	10	48	28.49	34.27	4.39
	11	101	27.65	35.69	3.61
	12	229	13.06	35.16	1.28
klm	13	33.8	28.36	33.95	4.53
	14	52	28.60	34.40	4.50
	15	75	28.78	35.29	4.34
	16	95	25.37	35.74	2.50
	17	186	14.47	35.15	1.12
tvm	18	37.6	28.36	33.73	4.49
	19	58.3	28.61	34.53	4.43

Transect	St.No.	Depth(in m)	Temp(in °C)	Salinity (in ppt)	DO (in ml L^{-1})
cape	21	32.1	28.36	33.80	4.41
	22	50.11	27.26	33.72	4.40
	23	122.8	22.64	35.10	1.77
	24	216	14.22	35.09	1.25
naga	25	30	27.22	33.58	4.41
	26	43.1	27.21	33.79	4.30
	27	102	24.66	34.63	2.11
	28	188.7	13.60	35.00	1.18
cudd	29	30.9	27.20	33.64	3.97
	30	52.3	27.26	33.81	4.49
	31	110	21.61	34.86	1.27
	32	169	13.45	36.42	1.18
chen	33	33.4	27.17	32.09	4.34
	34	57.5	27.26	33.79	4.11
	35	99.5	21.83	34.84	1.31
	36	200	13.45	35.00	1.15
krish	37	31.7	27.37	33.55	4.35
	38	55	27.08	33.47	4.50
	39	98.6	22.09	34.82	1.20
	40	203	14.67	34.97	1.13

Table 4.2. Latitudinal variation of hydrographical parameters in each depth range along the southwest coast of India

Table 4.2a. 30m depth range SW coast

St. No.	Transect	Depth (in m)	Temp (in °C)	Salinity (in ppt)	DO (in ml L^{-1})
1	kzh	32	28.60	34.29	4.30
5	vad	30	28.31	34.61	4.30
9	kch	29.60	28.36	33.95	4.53
13	klm	33.8	28.36	33.95	4.53
18	tvm	37.6	28.36	33.73	4.49
21	cape	32.1	28.36	33.80	4.41

Table 4.2b. 50m depth range SW coast

St.No.	Transect	Depth (in m)	Temp (in °C)	Salinity (in ppt)	DO (in ml L^{-1})
15b	knr	50	29.29	35.17	3.77
2	kzh	46.27	28.52	34.55	4.44
6	vad	54	28.30	34.38	4.51
10	kch	48	28.49	34.27	4.39
14	klm	52	28.60	34.40	4.50
19	tvm	58.3	28.61	34.53	4.43
22	cape	50.11	27.26	33.72	4.40

Table 4.2c: 75m depth range SW coast

St.No.	Transect	Depth (in m)	Temp (in °C)	Salinity (in ppt)	DO (in ml L^{-1})
15	klm	75	28.78	35.29	4.34

Table 4.2d: 100m depth range SW coast

St.No.	Transect	Depth (in m)	Temp (in °C)	Salinity (in ppt)	DO (in ml L^{-1})
15a	knr	100	25.01	35.84	2.60
3	kzh	110	28.19	35.92	3.87
7	vad	105	24.96	35.87	2.42
11	kch	101	27.65	35.69	3.61
16	klm	95	25.37	35.74	2.50
23	cape	122.8	22.64	35.10	1.77

Table 4.2e: 200m depth range sw coast

St.No.	Transect	Depth (in m)	Temp (in °C)	Salinity (in ppt)	DO (in ml L^{-1})
4	kzh	208	13.58	35.20	1.15
8	vad	190	14.45	35.13	1.18
12	kch	229	13.06	35.16	1.28
17	klm	186	14.47	35.15	1.12
24	cape	216	14.22	35.09	1.25

Table 4.3. Latitudinal variation of hydrographical parameters in each depth range along the southeast coast of India

Table 4.3a. 30m depth range SE coast

St.No.	Transect	Depth (in m)	Temp (in °C)	Salinity (in ppt)	DO (in ml L^{-1})
25	naga	30	27.22	33.58	4.41
29	cudd	30.9	27.20	33.64	3.97
33	chen	33.4	27.17	32.09	4.34
37	krish	31.7	27.37	33.55	4.35

Table 4.3b. 50m depth range SE coast

St.No.	Transect	Depth (in m)	Temp (in °C)	Salinity (in ppt)	DO (in ml L^{-1})
26	naga	43.1	27.21	33.79	4.30
30	cudd	52.3	27.26	33.81	4.49
34	chen	57.5	27.26	33.79	4.11
38	krish	55	27.08	33.47	4.50

Table 4.3c.100m depth range SE coast

St.No.	Transect	Depth (in m)	Temp (in °C)	Salinity (in ppt)	DO (in ml L^{-1})
27	naga	102	24.66	34.63	2.11
31	cudd	110	21.61	34.86	1.27
35	chen	99.5	21.83	34.84	1.31
39	krish	98.6	22.09	34.82	1.20

Table 4.3d: 200m depth range SE coast

St.No.	Transect	Depth (in m)	Temp (in °C)	Salinity (in ppt)	DO (in ml L^{-1})
28	naga	188.7	13.60	35.00	1.18
32	cudd	169	13.45	36.42	1.18
36	chen	200	13.45	35.00	1.15
40	krish	203	14.67	34.97	1.13

Table 5.1. Depth-wise variation of sediment characters in each transect of southwest and southeast coast of India

Transect	St.no.	Depth (m)	OM (%)	Sand (%)	Silt (%)	Clay (%)	Nomenclature
knr	15b	50	1.36	79.00	13.29	7.71	sand
	15a	100	4.87	32.29	52.75	14.96	sandy silt
kzh	1	32	9.78	0.90	72.84	26.26	clayey silt
	2	46.27	2.14	73.94	10.53	15.53	sand
	3	110	2.63	78.38	11.65	9.97	sand
	4	208	2.67	84.73	2.46	12.82	sand
vad	5	30	0.34	91.15	1.00	7.85	sand
	6	54	1.66	72.78	14.22	13.00	sand
	7	105	1.19	91.38	5.90	2.72	sand
	8	190	2.20	96.55	1.14	2.31	sand
kch	9	29.60	0.31	95.09	0.32	4.59	sand
	10	48	1.31	89.07	3.46	7.47	sand
	11	101	2.79	85.00	6.49	8.51	sand
	12	229	1.25	74.56	17.58	7.86	sand
klm	13	33.8	3.59	28.88	54.90	16.21	sandy silt
	14	52	0.77	92.48	3.33	4.20	sand
	15	75	0.77	91.11	5.23	3.66	sand
	16	95	2.55	81.98	9.01	9.01	sand
	17	186	1.31	94.75	2.06	3.19	sand
tvm	18	37.6	0.6	97.79	0.00	2.21	sand
	19	58.3	0.65	93.31	2.92	3.77	sand
cape	21	32.1	0.48	93.48	0.06	6.46	sand
	22	50.11	4.45	86.55	7.72	5.73	sand
	23	122.8	0.31	93.53	1.96	4.51	sand
	24	216	5.76	89.50	4.94	5.55	sand
naga	25	30	0.34	89.83	1.69	8.47	sand
	26	43.1	0.83	92.35	0.05	7.60	sand
	27	102	0.33	96.69	0.56	2.75	sand
	28	188.7	2.73	93.04	1.52	5.44	sand
cudd	29	30.9	0.31	94.89	2.95	2.16	sand
	30	52.3	2.25	89.59	0.30	10.12	sand
	31	110	1.42	95.32	1.00	3.68	sand
	32	169	3.32	50.12	28.10	21.79	sand-silt-clay

Transect	St.no.	Depth (m)	OM (%)	Sand (%)	Silt (%)	Clay (%)	Nomenclature
	33	33.4	2.71	15.30	52.82	31.89	clayey silt
	34	57.5	3.56	17.89	46.67	35.44	clayey silt
	35	99.5	3.86	82.51	4.17	13.31	sand
chen	36	200	3.32	76.44	12.78	10.78	sand
	37	31.7	1.44	87.28	1.95	10.77	sand
	38	55	3.32	8.94	60.21	30.84	clayey silt
krish	39	98.6	0.43	90.61	1.81	7.58	sand
	40	203	3.32	0.73	53.52	45.75	clayey silt

Table 5.2. Latitudinal variation of sediment characters in each depth range along the southwest coast of India

Table 5.2a: 30m depth range southwest coast

St.no.	Transect	Depth(m)	OM (%)	Sand %	Silt %	Clay %	Nomenclature
1	kzh	32	9.78	0.90	72.84	26.26	clayey silt
5	vad	30	0.34	91.15	1.00	7.85	sand
9	kch	29.60	0.31	95.09	0.32	4.59	sand
13	klm	33.8	3.59	28.88	54.90	16.21	sandy silt
18	tvm	37.6	0.6	97.79	0.00	2.21	sand
21	cape	32.1	0.48	93.48	0.06	6.46	sand
Mean			2.52	67.88	21.52	10.60	silty sand

Table 5.2b. 50m depth range southwest coast

St.no.	Transect	Depth(m)	OM (%)	Sand %	Silt %	Clay %	Nomenclature
15b	knr	50	1.36	79.00	13.29	7.71	sand
2	kzh	46.27	2.14	73.94	10.53	15.53	sand
6	vad	54	1.66	72.78	14.22	13.00	sand
10	kch	48	1.31	89.07	3.46	7.47	sand
14	klm	52	0.77	92.48	3.33	4.20	sand
19	tvm	58.3	0.65	93.31	2.92	3.77	sand
22	cape	50.11	4.45	86.55	7.72	5.73	sand
Mean			**1.76**	**83.88**	**7.92**	**8.20**	**sand**

Table 5.2c. 75m depth southwest coast

St.no.	Transect	Depth(m)	OM (%)	Sand %	Silt %	Clay %	Nomenclature
15	klm	75	0.77	91.11	5.23	3.66	sand

Table 5.2d. 100m depth range southwest coast

St.no.	Transect	Depth(m)	OM (%)	Sand %	Silt %	Clay %	Nomenclature
15a	knr	100	4.87	32.29	52.75	14.96	sandy silt
3	kzh	110	2.63	78.38	11.65	9.97	sand
7	vad	105	1.19	91.38	5.90	2.72	sand
11	kch	101	2.79	85.00	6.49	8.51	sand
16	klm	95	2.55	81.98	9.01	9.01	sand
23	cape	122.8	0.31	93.53	1.96	4.51	sand
Mean			**2.39**	**77.09**	**14.63**	**8.28**	**sand**

Table 5.2e: 200m depth range southwest coast

St.no.	Transect	Depth(m)	OM (%)	Sand %	Silt %	Clay %	Nomenclature
4	kzh	208	2.67	84.73	2.46	12.82	sand
8	vad	190	2.20	96.55	1.14	2.31	sand
12	kch	229	1.25	74.56	17.58	7.86	sand
17	klm	186	1.31	94.75	2.06	3.19	sand
24	cape	216	5.76	89.50	4.94	5.55	sand
Mean			**2.64**	**88.02**	**5.64**	**6.35**	**sand**

Table 5.3. Latitudinal variation of sediment characters in each depth range along the southeast coast of India

Table 5.3a: 30m depth range southeast coast

St.no.	Transect	Depth(m)	OM (%)	Sand %	Silt %	Clay %	Nomenclature
25	naga	30	0.34	89.83	1.69	8.47	sand
29	cudd	30.9	0.31	94.89	2.95	2.16	sand
33	chen	33.4	2.71	15.30	52.82	31.89	clayey silt
37	krish	31.7	1.44	87.28	1.95	10.77	sand
Mean			**1.2**	**71.83**	**14.85**	**13.32**	**sand**

Table 5.3b. 50m depth range southeast coast

St.no	Transect	Depth(m)	OM (%)	Sand %	Silt %	Clay %	Nomenclature
26	naga	43.1	0.83	92.35	0.05	7.60	sand
30	cudd	52.3	2.25	89.59	0.30	10.12	sand
34	chen	57.5	3.56	17.89	46.67	35.44	clayey silt
38	krish	55	3.32	8.94	60.21	30.84	clayey silt
Mean			**2.49**	**52.19**	**26.81**	**21.00**	**sand silt clay**

Table 5.3c. 100m depth range southeast coast

St.no	Transect	Depth(m)	OM (%)	Sand %	Silt %	Clay %	Nomenclature
27	naga	102	0.33	96.69	0.56	2.75	sand
31	cudd	110	1.42	95.32	1.00	3.68	sand
35	chen	99.5	3.86	82.51	4.17	13.31	sand
39	krish	98.6	0.43	90.61	1.81	7.58	sand
Mean			**1.51**	**91.28**	**1.88**	**6.83**	**sand**

Table 5.3 d. 200m depth range southeast coast

St.no	Transect	Depth(m)	OM (%)	Sand %	Silt %	Clay %	Nomenclature
28	naga	188.7	2.73	93.04	1.52	5.44	sand
32	cudd	169	3.32	50.12	28.10	21.79	sand-silt-clay
36	chen	200	3.32	76.44	12.78	10.78	sand
40	krish	203	3.32	0.73	53.52	45.75	clayey silt
Mean			**3.17**	**55.08**	**23.98**	**20.94**	**sand silt clay**

Table.5.4a. Average sediment characteristics at different depth ranges along the southwest coast of India.

Depth(m)	OM (%)	Sand %	Silt %	Clay %	Nomenclature
30m	2.52	67.88	21.52	10.60	silty sand
50m	1.76	83.88	7.92	8.20	sand
100m	2.39	77.09	14.63	8.28	sand
200m	2.64	88.02	5.64	6.35	sand
Mean	**2.33**	**79.22**	**12.43**	**8.36**	**sand**

Table.5.4b Average sediment characteristics at different depth ranges along the southeast coast of India.

Depth(m)	OM (%)	Sand %	Silt %	Clay %	Nomenclature
30m	1.2	71.83	14.85	13.32	sand
50m	2.49	52.19	26.81	21.00	sand silt clay
100m	1.51	91.28	1.88	6.83	sand
200m	3.17	55.08	23.98	20.94	sand silt clay
Mean	2.09	67.60	16.88	15.52	sand

Table 6.1. Group-wise biomass (wet weight g/sq.m) of macrobenthic fauna along the continental shelf of southwest and southeast coast of India.

Transect	St.No.	Depth (m)	Polychaetes	Crustaceans	Molluscs	Others	Total
knr	15b	50	1.515	0.780	0.600	0.205	3.100
	15a	100	0.755	1.065	0.110	0.075	2.005
	1	32	0.860	1.220	4.335	1.892	8.307
	2	46.27	22.600	1.500	3.850	2.250	30.200
kzh	3	110	5.010	0.955	0.000	0.432	6.397
	4	208	21.525	1.100	0.000	0.125	22.750
	5	31	6.215	4.780	0.000	0.165	11.160
	6	54	10.800	2.750	2.700	4.500	20.750
vad	7	105	0.825	1.840	0.000	0.270	2.935
	8	190	3.225	0.375	0.000	0.375	3.975
	9	29.5	2.760	1.185	0.000	0.010	3.955
	10	48	8.450	2.100	2.400	4.375	17.325
kch	11	115	1.895	0.625	0.500	0.240	3.260
	12	229	3.125	1.850	0.000	0.250	5.225
	13	33	11.592	2.032	1.330	0.997	15.951
	14	52	6.350	1.500	3.800	5.625	17.275
	15	75	1.425	0.375	1.025	1.55	4.375
klm	16	95	4.255	0.365	0.530	0.225	5.375
	17	186	3.450	2.375	0.775	0.000	6.600
tvm	18	37	11.530	6.540	0.000	0.055	18.125
	19	58.3	4.275	3.700	2.775	2.175	12.925

Transect	St.No.	Depth (m)	Polychaetes	Crustaceans	Molluscs	Others	Total
cape	21	32	1.320	1.665	0.215	0.910	4.110
	22	50.11	1.775	4.450	0.400	4.775	11.400
	23	123	1.775	0.857	0.190	0.945	3.767
	24	216	2.100	0.350	5.525	0.000	7.975
naga	25	29	7.775	5.030	0.640	0.075	13.520
	26	43.1	2.000	3.100	2.675	1.075	8.850
	27	102	0.665	1.060	0.660	1.815	4.200
	28	188.7	12.925	1.950	1.025	1.100	17.000
cudd	29	30.8	5.085	5.045	3.792	8.885	22.807
	30	52.3	4.750	1.750	0.300	1.900	3.950
	31	95	2.885	0.335	0.000	0.650	3.870
	32	169	3.075	1.850	2.000	2.725	9.650
chen	33	34	0.855	1.300	0.672	0.092	2.919
	34	57.5	2.500	0.400	2.050	4.225	9.175
	35	99.5	1.392	0.295	0.827	3.470	5.984
	36	200	2.900	2.375	1.650	0.225	7.150
krish	37	31.7	5.800	5.425	3.940	16.005	31.170
	38	55	4.500	0.375	0.925	10.225	16.025
	39	107	6.140	1.120	2.300	0.402	9.962
	40	203	2.550	1.000	14.400	0.150	18.100

Table 6.2 Groupwise biomass (wet weight g/sq.m) of macrobenthic fauna along the continental shelf of southwest at different depth ranges

Table 6.2a: 30m depth range Southwest coast

Transect	St.No.	Depth (m)	Polychaetes	Crustaceans	Molluscs	Others	Total
kzh	1	32	0.860	1.220	4.335	1.892	8.307
vad	5	31	6.215	4.780	0.000	0.165	11.160
kch	9	29.5	2.760	1.185	0.000	0.010	3.955
klm	13	33	11.592	2.032	1.330	0.997	15.951
tvm	18	37	11.530	6.540	0.000	0.055	18.125
cape	21	32	1.320	1.665	0.215	0.910	4.110
Total			34.277	17.422	5.880	4.029	61.608
SD			4.904	2.228	1.723	0.738	5.940
Mean			5.713	2.904	0.980	0.672	10.268

Table 6.2b. 50m depth range Southwest coast

Transect	St.No.	Depth (m)	Polychaetes	Crustaceans	Molluscs	Others	Total
knr	15b	50	1.515	0.780	0.600	0.205	3.100
kzh	2	46.27	22.600	1.500	3.850	2.250	30.200
vad	6	54	10.800	2.750	2.700	4.500	20.750
kch	10	48	8.450	2.100	2.400	4.375	17.325
klm	14	52	6.350	1.500	3.800	5.625	17.275
tvm	19	58.3	4.275	3.700	2.775	2.175	12.925
cape	22	50.11	1.775	4.450	0.400	4.775	11.400
Total			54.250	16.000	15.925	23.700	109.875
SD			7.287	1.313	1.386	1.916	8.411
Mean			9.042	2.667	2.654	3.950	18.313

Table 6.2c: 100m depth range Southwest coast

Transect	St.No.	Depth (m)	Polychaetes	Crustaceans	Molluscs	Others	Total
knr	15a	100	0.755	1.065	0.110	0.075	2.005
kzh	3	110	5.010	0.955	0.000	0.432	6.397
vad	7	105	0.825	1.840	0.000	0.270	2.935
kch	11	115	1.895	0.625	0.500	0.240	3.260
klm	16	95	4.255	0.365	0.530	0.225	5.375
cape	23	123	1.775	0.857	0.190	0.945	3.767
Total			14.515	5.707	1.330	2.187	23.739
SD			1.794	0.502	0.238	0.306	1.633
Mean			2.419	0.951	0.222	0.365	3.957

Table 6.2d: 200m depth range Southwest coast

Transect	St.No.	Depth (m)	Polychaetes	Crustaceans	Molluscs	Others	Total
kzh	4	208	21.525	1.100	0.000	0.125	22.750
vad	8	190	3.225	0.375	0.000	0.375	3.975
kch	12	229	3.125	1.850	0.000	0.250	5.225
klm	17	186	3.450	2.375	0.775	0.000	6.600
cape	24	216	2.100	0.350	5.525	0.000	7.975
Total			33.425	6.050	6.300	0.750	46.525
SD			8.312	0.897	2.408	0.163	7.663
Mean			6.685	1.210	1.260	0.150	9.305

Table 6.3. Group-wise biomass (wet weight g/sq.m) of macrobenthic fauna along the continental shelf of southeast coast at different depth ranges

Table 6.3a. 30m depth range Southeast coast

Transect	St.No.	Depth (m)	Polychaetes	Crustaceans	Molluscs	Others	Total
naga	25	29	7.775	5.030	0.640	0.075	13.520
cudd	29	30.8	5.085	5.045	3.792	8.885	22.807
chen	33	34	0.855	1.300	0.672	0.092	2.919
krish	37	31.7	5.800	5.425	3.940	16.005	31.170
Total			19.515	16.800	9.044	25.057	70.416
SD			2.914	1.942	1.854	7.706	12.158
Mean			4.879	4.200	2.261	6.264	17.604

Table 6.3b. 50m depth range Southeast coast

Transect	St.No.	Depth (m)	Polychaetes	Crustaceans	Molluscs	Others	Total
naga	26	43.1	2.000	3.100	2.675	1.075	8.850
cudd	30	52.3	4.750	1.750	0.300	1.900	3.950
chen	34	57.5	2.500	0.400	2.050	4.225	9.175
krish	38	55	4.500	0.375	0.925	10.225	16.025
Total			13.750	5.625	5.950	17.425	38.000
SD			1.390	1.299	1.073	4.134	4.963
Mean			3.438	1.406	1.488	4.356	10.688

Table 6.3c. 100m depth range Southeast coast

Transect	St.No.	Depth (m)	Polychaetes	Crustaceans	Molluscs	Others	Total
naga	27	102	0.665	1.060	0.660	1.815	4.200
cudd	31	95	2.885	0.335	0.000	0.650	3.870
chen	35	99.5	1.392	0.295	0.827	3.470	5.984
krish	39	107	6.140	1.120	2.300	0.402	9.962
Total			11.082	2.810	3.787	6.337	24.016
SD			2.429	0.448	0.970	1.400	2.797
Mean			2.771	0.703	0.947	1.584	6.004

Table 6.3d. 200m depth range Southeast coast

Transect	St.No.	Depth (m)	Polychaetes	Crustaceans	Molluscs	Others	Total
naga	28	188.7	12.925	1.950	1.025	1.100	17.000
cudd	32	169	3.075	1.850	2.000	2.725	9.650
chen	36	200	2.900	2.375	1.650	0.225	7.150
krish	40	203	2.550	1.000	14.400	0.150	18.100
Total			21.450	7.175	19.075	4.200	51.900
SD			5.046	0.576	6.433	1.197	5.399
Mean			5.363	1.794	4.769	1.050	12.975

Table 6.4a. Average group-wise biomass (wet weight g/sq.m) of macrobenthos along the shelf waters of the Southwest coast of India

Depth (m)	Polychaetes	Crustaceans	Molluscs	Others	Total
30m	5.713	2.904	0.980	0.672	10.268
50m	9.042	2.667	2.654	3.950	18.313
100m	2.419	0.951	0.222	0.365	3.957
200m	6.685	1.210	1.260	0.150	9.305
Total	23.859	7.732	5.116	5.136	41.842
SD	2.746	0.995	1.016	1.790	5.925
Mean	5.965	1.933	1.279	1.284	10.461

Table 6.4b. Average group-wise biomass (wet weight g/sq.m) of macrobenthos along the shelf waters of the Southeast coast of India

Depth (m)	Polychaetes	Crustaceans	Molluscs	Others	Total
30m	4.88	4.20	2.26	6.26	17.60
50m	3.438	1.41	1.49	4.36	10.688
100m	2.77	0.70	0.95	1.58	6.004
200m	5.36	1.79	4.77	1.05	12.98
Total	16.45	8.10	9.46	13.25	46.08
SD	1.212	1.518	1.690	2.443	4.827
Mean	4.11	2.03	2.37	3.31	11.52

Table 6.5. Numerical abundance (No/sq.m) of macrobenthic fauna along the continental shelf of southwest and southeast coast of India.

Transect	St.No.	Depth(m)	Polychaetes	Crustaceans	Molluscs	Others	Total
knr	15b	50	930	418	88	203	1638
	15a	100	1468	413	50	130	2060
kzh	1	32	90	63	3	5	160
	2	46.27	3478	440	160	383	4460
	3	110	983	93	0	58	1133
	4	208	1963	185	0	3	2150
vad	5	30	1578	210	0	18	1805
	6	54	1720	1580	390	3645	7335
	7	105	423	220	0	63	705
	8	190	448	285	0	48	780
kch	9	29.6	508	65	13	610	1195
	10	48	1535	530	193	1780	4038
	11	101	512	115	108	93	828
	12	229	530	63	0	18	610
klm	13	33.8	1038	323	50	78	1488
	14	52	2515	725	150	390	3780
	15	75	100	60	20	542.5	722.5
	16	95	1235	43	17	33	1328
	17	186	1350	3440	3	3	4795
tvm	18	37.6	1580	335	0	78	1993
	19	58.3	1975	838	125	288	3225
cape	21	32.1	205	438	3	33	678
	22	50.11	525	1000	75	770	2370
	23	122.8	865	490	23	23	1401
	24	216	970	13	78	13	1073
naga	25	30	655	838	13	28	1533
	26	43.1	468	395	108	160	1130
	27	102	323	25	48	20	416
	28	188.7	2165	253	85	70	2573
cudd	29	30.9	738	1648	33	105	2524
	30	52.3	775	543	85	253	1655
	31	110	1340	180	203	58	1780
	32	169	800	278	18	28	1123

Transect	St.No.	Depth(m)	Polychaetes	Crustaceans	Molluscs	Others	Total
	33	33.4	100	170	23	10	303
	34	57.5	138	40	95	68	340
	35	99.5	280	100	88	33	500
chen	36	200	2378	228	90	73	2768
	37	31.7	568	543	105	98	1313
	38	55	95	63	83	110	350
krish	39	98.6	1733	858	388	18	2995
	40	203	453	98	30	8	588

Table 6.6 Numerical abundance (No/sq.m) of macrofauna groups along the continental shelf of southwest coast of India at different depth ranges.

Table 6.6a. 30m depth range Southwest coast

Transect	St.No.	Depth(m)	Polychaetes	Crustaceans	Molluscs	Others	Total
kzh	1	32	90	63	3	53	160
vad	5	30	1578	210	0	18	1805
kch	9	29.6	508	65	13	610	1195
klm	13	33.8	1038	323	50	78	1488
tvm	18	37.6	1580	335	0	78	1993
cape	21	32.1	205	438	3	33	678
Total			4998	1433	68	820	7318
SD			664	154	20	229	683
Mean			833	239	11	145	1220

Table 6.6b. 50m depth range Southwest coast

Transect	St.No.	Depth(m)	Polychaetes	Crustaceans	Molluscs	Others	Total
knr	15b	50	930	418	88	203	1638
kzh	2	46.27	3478	440	160	335	4460
vad	6	54	1720	1580	390	3645	7335
kch	10	48	1535	530	193	1780	4038
klm	14	52	2515	725	150	390	3780
tvm	19	58.3	1975	838	125	288	3225
cape	22	50.11	525	1000	75	770	2370
Total			12678	5530	1180	7458	26845
SD			984	409	106	1264	1825
Mean			1811	790	169	1059	3835

Table 6.6c. 100m depth range Southwest coast

Transect	St.No.	Depth(m)	Polychaetes	Crustaceans	Molluscs	Others	Total
knr	15a	100	1468	413	50	130	2060
kzh	3	110	983	93	0	58	1133
vad	7	105	423	220	0	63	705
kch	11	101	512	115	108	93	828
klm	16	95	1235	43	17	33	1328
cape	23	122.8	865	490	23	23	1401
Total			5484	1373	198	400	7455
SD			405	183	41	40	484
Mean			914	229	33	67	1243

Table 6.6d. 200m depth range Southwest coast

Transect	St.No.	Depth(m)	Polychaetes	Crustaceans	Molluscs	Others	Total
kzh	4	208	1963	185	0	3	2150
vad	8	190	448	285	0	48	780
kch	12	229	530	63	0	18	610
klm	17	186	1350	3440	3	3	4795
cape	24	216	970	13	78	13	1073
Total			5260	3985	80	83	9408
SD			625	1481	34	19	1735
Mean			1052	797	16	17	1882

Table 6.7. Numerical abundance (No/sq.m) of macrofauna groups along the continental shelf of southeast coast of India at different depth ranges.

Table 6.7a. 30m depth range Southeast coast

Transect	St.No.	Depth(m)	Polychaetes	Crustaceans	Molluscs	Others	Total
naga	25	30	655	838	13	28	1533
cudd	29	30.9	738	1648	33	105	2524
chen	33	33.4	100	170	23	10	303
krish	37	31.7	568	543	105	98	1313
Total			2061	3198	173	240	5672
SD			285	628	42	48	911
Mean			515	800	43	60	1418

Table 6.7b. 50m depth range Southeast coast

Transect	St.No.	Depth(m)	Polychaetes	Crustaceans	Molluscs	Others	Total
naga	26	43.1	468	395	108	160	1130
cudd	30	52.3	775	543	85	253	1655
chen	34	57.5	138	40	95	68	340
krish	38	55	95	63	83	110	350
Total			1475	1040	370	590	3475
SD			318	249	11	80	642
Mean			369	260	93	148	869

Table 6.7c. 100m depth range Southeast coast

Transect	St.No.	Depth(m)	Polychaetes	Crustaceans	Molluscs	Others	Total
naga	27	102	323	25	48	20	416
cudd	31	110	1340	180	203	58	1780
chen	35	99.5	280	100	88	33	500
krish	39	98.6	1733	858	388	18	2995
Total			3676	1163	725	128	5691
SD			731	383	152	18	1220
Mean			919	291	181	32	1423

Table 6.7d. 200m depth range Southeast coast

Transect	St.No.	Depth(m)	Polychaetes	Crustaceans	Molluscs	Others	Total
naga	28	188.7	2165	253	85	70	2573
cudd	32	169	800	278	18	28	1123
chen	36	200	2378	228	90	73	2768
krish	40	203	453	98	30	8	588
Total			5795	855	223	178	7050
SD			964	80	37	32	1073
Mean			1449	214	56	44	1763

Table 6.8. Average numerical abundance (No. /sq.m) of macrobenthos along the shelf waters of the Southwest coast of India

Depth(m)	Polychaetes	Crustaceans	Molluscs	Others	Total
30m	833	239	11	145	1220
50m	1811	790	169	1059	3835
100m	914	229	33	67	1243
200m	1052	797	16	17	1882
Total	4610	2055	229	1285	8179
SD	448	323	75	494	1227
Mean	1153	514	57	321	2045

Table 6.9. Average numerical abundance (No. /sq.m) of macrobenthos along the shelf waters of the Southeast coast of India

Depth(m)	Polychaetes	Crustaceans	Molluscs	Others	Total
30m	515	800	43	60	1418
50m	369	260	93	148	869
100m	919	291	181	32	1423
200m	1449	214	56	44	1763
Total	3252	1564	373	284	5472
SD	1168	576	136	105	1863
Mean	813	391	93	71	1368

Table.6.10a. Faunal Composition of Macrobenthos Along the Continental Shelf of Southwest Coast of India

30M depth range SW coast (in no. per sq.m)							
Transect	**kzh**	**vad**	**kch**	**klm**	**tvm**	**cape**	**Total**
Depth(m)	**32**	**30**	**29.6**	**33.8**	**37.6**	**32.1**	
Station No.	**1**	**5**	**9**	**13**	**18**	**21**	
Foraminiferans	0	0	603	0	0	0	603
Nemerteans	3	0	0	18	0	3	23
Nematodes	0	3	2	0	3	0	7
Spadella sp.	0	0	0	3	0	0	3
Echiuroids	48	0	0	0	0	0	48
Pogonophora	3	0	0	0	0	3	5
Oligochaetes	0	0	3	3	68	0	73

Transect	kzh	vad	kch	klm	tvm	cape	Total
POLYCHAETES							
Errantia							
Aphroditidae							
Lepidonotus carinulatus	0	0	0	0	0	3	3
Other Aphroditids	0	3	5	0	3	15	25
Palmyridae							
Palmyrid sp.	0	0	0	3	0	0	3
Amphinomidae							
Eurythoe parvecarunculata	0	453	3	0	0	0	455
Eurythoe sp.1	0	0	0	0	0	5	5
Other Amphinomids	0	0	0	0	0	3	3
Phyllodocidae							
Phyllodoce sp.1	0	13	3	0	0	0	15
Phyllodoce sp.2	0	3	0	0	0	0	3
Other Phyllodocids	0	0	0	0	23	8	30
Pilargidae							
Ancistrosyllis parva	3	155	13	8	8	0	185
Hesionidae							
Syllidia armata	5	0	0	3	0	0	8
Gyptis capensis	0	0	3	3	0	3	8
Other Hesionids	0	0	0	8	3	0	10
Syllidae							
Syllis spongicola	0	3	0	0	8	3	13
Syllis gracilis	0	10	0	0	0	5	15
Syllis amica	0	0	0	0	0	18	18
Syllis sp.1	0	0	3	8	0	3	13
Syllis sp.2	0	0	0	0	0	3	3
Exogone clavator	0	5	0	0	0	0	5
Exogone sp.1	0	0	3	0	0	0	3
Sphaerosyllis capensis	0	5	0	0	0	0	5
Sphaerosyllis sp.1	0	0	0	3	0	0	3
Other Syllids	0	0	0	3	0	0	3
Nereidae							
Nereis persica?	0	0	0	0	0	8	8
Nereis sp.1	0	0	0	0	0	3	3
Nereis sp.2	0	0	0	0	0	5	5
Leonnates sp.	0	0	0	0	0	3	3

Transect	kzh	vad	kch	klm	tvm	cape	Total
Nephtyidae							
Nephtys dibranchis	0	3	10	0	20	8	40
Nephtys sp.	0	0	0	0	15	0	15
Lacydoniidae							
Paralacydonia paradoxa	0	8	0	3	8	0	18
Glyceridae							
Glycera longipinnis	0	8	8	8	68	0	90
Glycera natalensis	3	0	0	0	0	0	3
Glycera convoluta	0	3	0	0	0	0	3
Glycera sp.1	6	5	10	0	3	0	24
Goniada emerita	0	3	0	48	0	0	50
Goniada maculata	0	0	0	0	3	0	3
Glycinde kameruniana	0	0	0	0	0	3	3
Eunicidae							
Eunice antennata	0	0	0	0	3	0	3
Eunice australis	0	5	0	0	8	3	15
Eunice indica	0	3	0	0	8	0	10
Eunice sp.1	10	5	3	0	3	3	23
Eunice sp.2	0	0	0	0	5	0	5
Eunice sp.3	0	0	0	0	3	0	3
Hayalonoecia tubicola	0	5	0	0	0	0	5
Diopatra neapolitana neapolitana	0	0	0	5	0	0	5
Onuphis sp.	0	3	0	0	113	25	140
Lumbrineris laterilli	3	0	0	0	0	0	3
Lumbrineris aberrans	0	0	3	8	5	0	15
Lumbrineris sp.1	0	0	8	3	3	0	13
Arabella iricolor	0	13	0	0	0	0	13
Arabella sp.	0	3	0	0	0	0	3
Driloneris falcata	0	13	0	0	8	0	20
Dorvellia rudolphi	0	10	3	0	5	0	18
Sedentaria							
Spionidae							
Spiophanes bombyx	20	0	0	0	5	5	30
Spoiphanes sp.1	0	3	28	0	0	0	30
Malacoceros indicus	5	0	0	0	0	0	5
Rhynchospio sp.	0	0	3	0	0	0	3

Transect	kzh	vad	kch	klm	tvm	cape	Total
Aonides oxycephala	0	0	0	0	25	3	28
Laonice cirrata	3	0	0	0	0	0	3
Scolelepis branchia	0	0	190	0	15	0	205
Scololepis lefebvrei	0	75	0	0	0	0	75
Scololepis sp.	0	0	5	0	0	0	5
Prionospio cirrifera	5	0	0	0	0	3	8
Prionospio pinnata	0	0	0	48	0	0	48
Prinospio cornuta	0	25	0	0	0	0	25
Prinospio membranacea	0	3	0	0	0	0	3
Prionospio(M) andamanensis	6	68	0	0	1138	5	1217
Prionospio ehlersi	0	5	0	0	0	0	5
Prionospio(minospio) pulchra	0	3	0	0	0	0	3
Prionospio sp.1	5	3	88	33	0	0	128
Other Spionids	0	0	0	3	0	0	3
Magelonidae							
Magelona cincta	0	538	0	713	0	0	1250
Cirratulidae							
Tharyx dorsobranchialis	0	35	28	30	3	0	95
Caulleriella bioculatus	0	0	8	0	0	3	11
Cirratulus sp.	0	0	0	0	3	0	3
Other cirratulids	0	8	20	0	0	0	28
Heterospionidae							
Heterospionid sp.	3	0	0	0	0	0	3
Poecilochaetidae							
Poecilochaetus serpens	0	3	10	0	0	0	13
Chaetopteridae							
Chaetopterus varieopedatus	0	18	0	0	8	0	25
Chaetopterus sp.	0	0	0	0	3	0	3
Orbiniidae							
Naineris laevigata	0	0	0	13	0	0	13
Scholoplos uniramus	0	5	0	0	0	0	5
Scoloplos sp.	0	3	0	0	0	0	3
Other Orbinids	0	0	18	28	18	3	65
Paraonidae							
Aricidea fauveli	0	15	0	0	0	0	15
Aricidea longobranchiata	0	8	0	8	0	0	15

Transect	kzh	vad	kch	klm	tvm	cape	Total
Aricidea capensis	0	0	15	3	0	3	20
Aricidea sp.	0	0	5	0	0	0	5
Aedicira sp.	3	0	0	0	0	0	3
Paraonis gracilis gracilis	0	0	0	3	0	0	3
Paraonis sp.	0	0	0	0	3	0	3
Ophelidae							
Armandia intermedia	0	0	0	0	3	0	3
Armandia leptocirrus	3	0	0	0	0	0	3
Polyophthalmus pictus	3	0	0	0	0	3	5
Cossuridae							
Cossura coasta	0	0	0	33	0	0	33
Capitellidae							
Notomastus fauveli	0	3	0	0	3	0	5
Notomastus aberrans	0	10	0	10	0	0	20
Other Capitellids	8	0	3	0	0	3	13
Arenicolidae							
Arenicolid sp.	0	0	5	0	0	0	5
Maldanidae							
Other Maldanids	3	0	0	8	0	0	10
Ampharetidae							
Melinna cristata	0	5	0	0	5	3	13
Melinna sp.	0	0	3	0	0	0	3
Isolda pulchella	0	0	0	0	3	0	3
Amphicteis gunneri	0	5	0	0	3	8	15
Ampharete acutiforns	0	0	0	3	13	0	15
Ampharete sp.	0	0	3	0	0	0	3
Other Ampharetids	0	3	3	0	0	20	25
Terebellidae							
Terebellides stroemi	0	0	0	0	8	3	10
Streblosoma persica	0	0	0	0	0	3	3
Pista cristata	0	0	0	0	0	3	3
Other Terebellids	0	0	0	0	5	8	13
Sabellidae							
Chone filicaudata	0	0	0	0	3	0	3
Euchone rosea	0	0	0	0	0	3	3
Megalomma vesiculosum	0	0	0	0	0	3	3
Other Sabellids	0	0	0	0	3	0	3
Unidentified polychaete sp.3	0	3	0	0	0	0	3

Transect	kzh	vad	kch	klm	tvm	cape	Total
Unidentified polychaete sp.5	0	0	5	0	0	0	5
Unidentified polychaete sp.6	0	0	0	0	0	5	5
CRUSTACEANS							
Amphipods	45	118	23	123	203	240	750
Isopods	3	13	23	3	30	28	98
Herpacticoid copepods	0	0	0	73	30	138	240
Campylaspis sp.	0	0	0	30	8	0	38
Eocuma sp.	0	0	0	0	0	3	3
Eurodella sp.	0	0	3	0	0	0	3
Mysids	0	0	5	85	0	0	90
Pinnixa sp	10	0	0	0	3	0	13
Portunus sp.	3	0	0	5	0	0	8
Portunus pelagicus	0	45	0	0	0	0	45
Xanthids	0	0	0	0	3	0	3
Ethusa sp.	0	0	0	0	0	3	3
Goneplax sp.	0	0	0	0	23	0	23
Other decapod crabs	0	28	5	3	18	8	60
Hermit crabs	0	0	0	0	3	0	3
Sand lobster	3	0	3	0	0	0	5
Stomatopods	0	0	0	0	3	8	10
Other crustaceans	0	3	0	0	3	5	10
MOLLUSCS							
Anadara sp.	3	0	0	0	0	0	3
Chione isabellina?	0	0	0	3	0	0	3
Dentalium spp.	0	0	0	5	0	0	5
Telinna sp.	0	0	0	3	0	0	3
Portlandia sp.	0	0	0	3	0	0	3
Spondylus sp.	0	0	0	0	0	3	3
Bivalves	0	0	8	10	0	0	18
Babylonia zeylanica	0	0	3	0	0	0	3
Conus sp.	0	0	0	10	0	0	10
Gastropods	0	0	3	18	0	0	20
ECHINODERMS							
Other Brittle stars	0	0	0	0	0	15	15
CEPHALOCHORDATES							
Branchiostoma lanceolatum	0	0	0	0	0	3	3
FISHES							
Other fishes	0	3	0	0	0	3	5
Unidentified organisms	0	13	2	55	5	8	82

50M depth range SW coast (in no. per sq.m)								
Transect	**knr**	**kzh**	**vad**	**kch**	**klm**	**tvm**	**cape**	**Total**
Depth(m)	**50**	**46.27**	**54**	**48**	**52**	**58.3**	**50.11**	
Station No.	**15b**	**2**	**6**	**10**	**14**	**19**	**22**	
Foraminiferans	25	253	3530	1530	40	30	613	6020
Nemerteans	98	5	13	145	80	5	5	350
Nematodes	3	13	0	0	15	60	3	93
Other Bryozoans	0	0	0	0	0	5	28	33
Cupuladria sp.	0	0	0	0	25	3	3	30
Lampshells	0	0	0	0	0	0	8	8
Sipunculids	0	10	0	0	18	0	0	28
Spadella sp.	3	45	10	23	13	55	0	148
Pogonophora	0	3	0	0	0	0	0	3
Oligochaetes	5	0	0	10	5	13	3	35
POLYCHAETES								
Errantia								
Aphroditidae								
Harmothoe antilopis	0	3	3	0	0	0	0	5
Other Aphroditids	0	0	3	0	8	8	3	20
Amphinomidae								
Euphrosine myrtosa?	0	0	0	0	3	0	0	3
Eurythoe parvecarunculata	0	0	5	0	0	0	0	5
Eurythoe sp.1	0	3	0	3	918	78	0	1000
Pherecardia striata	0	0	0	3	0	0	0	3
Other Amphinomids	3	0	3	8	0	255	3	270
Phyllodocidae								
Eteone sp.	0	0	0	0	3	0	0	3
Mystides sp.?	0	0	0	0	3	0	0	3
Phyllodoce sp.1	8	10	0	0	0	13	0	30
Other Phyllodocids	18	0	0	0	0	3	18	38
Typhloscolecidae								
Travisiopsis dubia	0	0	0	0	0	3	0	3
Pilargidae								
Ancistrosyllis parva	18	280	23	60	13	15	20	428
Ancystrosyllis sp.	0	8	8	18	0	0	0	34

Transect	knr	kzh	vad	kch	klm	tvm	cape	Total
Hesionidae								
Syllidia armata	0	0	0	3	0	0	0	3
Hesione splendida	0	3	0	0	0	0	0	3
Hesione sp.	0	0	5	0	0	0	0	5
Kefersteinia cirrata	0	0	0	5	0	0	0	5
Leocrates claparedii	0	0	0	3	0	0	3	5
Gyptis capensis	0	18	18	23	5	5	3	70
Other Hesionids	3	0	0	0	0	0	3	5
Syllidae								
Syllis spongicola	0	0	0	0	5	10	13	28
Syllis gracilis	0	0	0	3	8	0	0	10
Syllis amica	0	0	0	0	0	0	3	3
Syllis cornuta	0	0	0	3	0	0	0	3
Syllis sp.1	43	5	5	5	10	18	8	93
Syllis sp.2	0	3	0	10	3	0	3	18
Syllis sp.3	0	0	0	3	0	0	5	8
Eusyllis blomstrandi	0	0	3	0	0	0	5	8
Brania sp.	0	0	0	3	0	0	0	3
Exogone clavator	0	10	0	0	5	5	0	20
Exogone verugera	0	0	0	0	50	0	0	50
Exogone gemmifera	0	0	0	3	3	3	0	8
Exogone sp.1	25	5	0	5	16	30	10	91
Sphaerosyllis sp.1	0	5	0	0	0	0	0	5
Sphaerosyllis sp.2	0	0	0	0	0	0	3	3
Other Syllids	0	0	0	8	8	0	0	15
Nereidae								
Platyneris sp.	0	0	3	0	0	0	0	3
Nereis persica?	0	0	0	0	3	0	3	5
Nereis sp.1	0	3	0	0	0	0	0	3
Ceratoneris mirabilis	0	0	0	0	0	5	0	5
Nephtyidae								
Nephtys dibranchis	10	0	48	3	33	35	5	133
Nephtys lyrochaeta	0	0	3	0	0	0	0	3
Nephtys capensis	0	0	3	0	0	0	0	3
Nephtys paradoxa	0	28	0	0	0	0	0	28

Transect	knr	kzh	vad	kch	klm	tvm	cape	Total
Nephtys sp.	0	3	15	10	5	0	0	33
Lacydoniidae								
Paralacydonia paradoxa	3	20	13	10	48	163	10	265
Glyceridae								
Glycera longipinnis	3	8	3	5	68	43	8	135
Glycera papillosa	0	0	0	0	0	3	0	3
Glycera convoluta	0	23	0	0	0	0	0	23
Glycera alba	0	0	5	0	0	0	0	5
Glycera sp.1	3	13	18	0	0	0	13	45
Goniada emerita	13	0	10	0	15	20	0	58
Goniada sp.	0	0	0	0	0	3	0	3
Glycinde kameruniana	0	0	0	0	0	8	0	8
Eunicidae								
Eunice antennata	0	0	0	0	0	3	0	3
Eunice australis	0	10	3	0	0	3	0	15
Eunice vittata	0	3	0	0	0	3	0	5
Eunice indica	0	0	10	0	0	5	0	15
Eunice norvegica?	0	0	5	0	0	0	0	5
Eunice tentaculata	0	0	5	0	0	0	0	5
Eunice sp.1	30	3	3	10	5	0	5	55
Eunice sp.2	0	5	0	18	3	0	3	28
Eunice sp.3	0	3	0	3	0	0	0	5
Hayalonoecia tubicola	0	0	0	0	0	15	0	15
Diopatra neapolitana capensis	0	3	0	0	0	0	0	3
Diopatra neapolitana neapolitana	0	18	0	0	3	0	0	20
Onuphis emerita	0	0	0	0	10	0	0	10
Onuphis sp.	0	0	0	0	10	18	13	40
Lumbrineris meteorana	0	3	0	0	0	0	0	3
Lumbrinereis albidentata	0	0	0	3	0	0	0	3
Lumbrineris laterilli	0	0	8	0	0	3	0	10
Lumbrineris aberrans	0	55	48	8	0	5	3	118
Lumbrineris heteropoda	0	0	20	18	0	0	0	38
Lumbrineris sp.1	280	3	43	40	5	5	3	378

Transect	knr	kzh	vad	kch	klm	tvm	cape	Total
Lumbrineris sp.2	0	3	23	23	0	0	0	48
Lumbrineris sp.3	0	0	30	40	0	0	0	70
Arabella iricolor	0	20	10	0	0	5	0	35
Arabella sp.	0	5	5	0	0	0	0	10
Driloneris falcata	30	3	5	3	0	0	0	40
Driloneris monroi	0	0	5	0	0	0	0	5
Notocirrus australis	0	20	5	0	0	0	0	25
Protodorvillea biarticulata	0	0	0	0	3	0	0	3
Protodorvillea egena	0	0	0	0	3	5	3	10
Dorvellia gardineri	0	0	0	0	0	3	0	3
Dorvellia rudolphi	3	55	33	13	10	8	0	120
Dorvellia rubrovittata	0	5	0	0	0	0	0	5
Other Eunicids	0	0	0	0	5	0	0	5
Sedentaria								
Spionidae								
Polydora capensis	5	0	0	0	0	0	0	5
Polydora sp.1	0	0	0	3	0	0	5	8
Polydora sp.2	0	0	0	0	0	0	10	10
Spiophanes bombyx	3	5	0	5	0	8	10	30
Spoiphanes sp.1	0	3	0	3	0	0	0	5
Malacoceros indicus	0	3	20	10	35	0	3	70
Aonides oxycephala	0	0	0	0	18	5	0	23
Aonidella dayi	0	0	8	0	0	0	0	8
Dispio oculata	0	0	0	0	0	3	0	3
Scolelepis branchia	0	0	0	0	38	0	0	38
Prionospio cirrifera	20	28	5	3	0	0	0	56
Prionospio pinnata	5	1228	100	100	5	0	0	1438
Prionospio(M) andamanensis	0	138	55	28	0	375	0	596
Prionospio ehlersi	0	3	20	0	3	0	0	25
Prionospio(minospio) elegantula	0	0	50	10	0	0	0	60
Prionospio(minospio) pulchra	0	0	3	3	8	0	0	13
Prionospio sp.1	20	110	75	3	83	3	0	293

Transect	knr	kzh	vad	kch	klm	tvm	cape	Total
Prionospio sp.2	0	53	0	3	3	3	0	60
Prionospio sp.3	0	0	0	0	28	0	0	28
Other Spionids	0	0	15	23	0	0	0	38
Magelonidae								
Magelona cincta	15	271	28	8	3	10	3	337
Magelona sp.	0	0	0	0	0	3	0	3
Cirratulidae								
Tharyx filibranchia	0	0	15	0	0	0	0	15
Tharyx dorsobranchialis	10	135	188	53	135	40	0	560
Tharyx annnulosus	0	0	3	15	13	18	0	48
Tharyx sp.1	0	0	0	0	38	3	0	40
Tharyx sp.2	0	0	0	0	20	0	0	20
Caulleriella bioculatus	0	0	0	0	103	55	3	160
Chaetozone setosa	0	0	5	0	0	0	0	5
Chaetozone sp.	3	0	0	0	0	0	0	3
Cirratulus cirratus	0	0	0	0	90	8	3	100
Cirratulus sp.	0	31	10	0	0	3	0	44
Cirrformia sp.	0	0	23	0	0	0	0	23
Other cirratulids	60	115	69	46	18	36	8	352
Heterospionidae								
Heterospionid sp.	3	8	0	0	0	0	0	10
Poecilochaetidae								
Poecilochaetus serpens	5	0	3	3	0	0	0	10
Chaetopteridae								
Chaetopterus varieopedatus	15	0	0	0	0	3	8	25
Orbiniidae								
Haploscoloplos kerguelensis	15	3	0	0	0	0	0	18
Scolaricia dubia?	0	0	0	0	5	0	0	5
Scholoplos marsupialis	0	0	0	0	5	0	0	5
Scholoplos uniramus	0	0	5	0	0	0	0	5
Scoloplos sp.	0	0	0	0	3	0	0	3
Other Orbinids	0	8	0	0	6	40	15	69
Paraonidae								
Aricidea curviceta	0	3	3	0	0	0	0	5
Aricidea suecia simplex	0	0	0	5	3	0	0	8

Transect	knr	kzh	vad	kch	klm	tvm	cape	Total
Aricidea fauveli	10	25	8	0	5	55	0	103
Aricidea longobranchiata	3	3	5	13	63	23	0	108
Aricidea capensis	0	5	0	0	13	5	3	25
Aricidea sp.	13	5	43	28	15	33	3	139
Cirrophorus branchiatus	0	5	5	5	0	30	0	45
Cirrophorus sp.	15	0	0	3	5	0	0	23
Paraonis gracilis gracilis	20	31	35	5	23	10	3	127
Paraonis sp.	0	0	0	3	0	0	3	5
Other Paraonids	5	0	5	105	55	5	8	183
Ophelidae								
Ophelia sp.	0	0	0	0	5	3	0	8
Travisia forbesii	0	5	0	0	0	3	0	8
Travisia arborifera	0	0	0	0	3	0	0	3
Armandia longicaudata	0	0	0	0	0	25	0	25
Armandia intermedia	0	0	0	0	3	5	0	8
Armandia sp.	0	0	0	0	5	0	0	5
Polyophthalmus pictus	0	0	0	0	0	3	0	3
Cossuridae								
Cossura coasta	3	360	68	10	3	0	0	443
Cossura sp.1	0	0	0	0	0	0	3	3
Capitellidae								
Capitella capitata	0	10	28	3	0	0	0	40
Notomastus fauveli	0	15	123	365	165	60	5	733
Notomastus aberrans	0	93	18	85	38	5	3	240
Notomastus sp.	0	30	5	10	3	0	0	48
Other Capitellids	95	10	63	83	28	8	3	288
Maldanidae								
Axiothella jarli	0	3	0	0	0	0	0	3
Euclymene cf. oerstedii	0	0	3	0	0	0	0	3
Euclymene lombricoides	0	0	20	0	0	0	0	20
Other Maldanids	33	16	20	23	18	15	13	136
Sternaspidae								
Sternaspis scutata	5	0	5	0	0	20	3	33
Flabelligeridae								
Flabelligera sp.	0	0	0	3	0	0	0	3

Transect	knr	kzh	vad	kch	klm	tvm	cape	Total
Phreusa monroi	0	0	0	3	0	0	3	5
Pherusa sp.	0	0	0	5	0	0	0	5
Priomis arenosus	0	10	0	0	0	3	0	13
Diplocirrus capensis	13	15	10	3	0	0	0	40
Other Flabelligerids	0	0	0	3	0	0	0	3
Ampharetidae								
Melinna cristata	3	0	3	0	0	5	5	15
Melinna sp.	0	0	3	0	0	0	0	3
Isolda pulchella	3	3	8	0	20	8	0	40
Amphicteis gunneri	0	6	8	5	8	63	15	104
Ampharete acutiforns	0	0	0	3	18	3	0	23
Amparete capensis	0	0	0	0	13	8	0	20
Ampharete sp.	0	0	36	25	15	68	36	180
Other Ampharetids	5	0	10	13	3	8	5	43
Terebellidae								
Trichobranchus glacialis	0	0	0	0	38	0	3	40
Trichobranchus sp.	0	0	3	0	0	0	0	3
Terebellides stroemi	0	0	8	20	5	3	3	38
Terebellides sp.	0	0	0	0	0	3	0	3
Polycirrus sp.	13	0	0	0	0	0	0	13
Streblosoma persica	0	0	0	3	5	10	13	30
Streblosoma sp.	0	0	0	3	0	0	0	3
Pista unibranchia	0	8	0	0	3	3	0	13
Pista brevibranchia	0	8	8	0	0	0	0	15
Pista cristata	5	0	0	0	0	3	0	8
Pista macrolobata	0	0	0	0	0	3	0	3
Pista quadrilobata	0	0	3	0	0	0	0	3
Terebella sp.	3	0	0	0	0	0	0	3
Other Terebellids	8	0	5	0	0	0	0	13
Sabellidae								
Chone filicaudata	0	3	0	3	3	33	85	125
Euchone rosea	0	0	0	3	0	10	53	65
Euchone capensis?	0	0	0	0	0	3	0	3
Fabricia filamentosa	8	0	0	0	3	0	10	20
Hypsicomus capensis	0	0	0	0	0	3	0	3

Transect	knr	kzh	vad	kch	klm	tvm	cape	Total
Jasmineria elegans	0	0	0	3	0	0	3	5
Megalomma vesiculosum	0	0	5	0	0	0	0	5
Other Sabellids	3	3	0	3	5	25	23	60
Serpulidae								
Hydroides heteroceros	0	0	8	0	0	0	0	8
Hydroides sp.	3	0	0	0	0	0	0	3
Unidentified polychaete sp.1	3	0	0	0	0	0	0	3
Unidentified polychaete sp.2	0	15	0	0	0	0	0	15
Unidentified polychaete sp.4	0	0	13	0	0	0	0	13
Unidentified polychaete sp.5	0	0	0	10	0	0	0	10
Unidentified polychaete sp.6	0	0	0	0	0	5	0	5
CRUSTACEANS								
Amphipods	28	75	140	138	55	160	358	953
Caprellids	0	25	0	0	0	0	0	25
Isopods	155	33	33	10	45	113	128	515
Tanaids	3	0	0	3	0	5	0	10
Herpacticoid copepods	40	0	3	0	50	193	348	633
Campylaspis sp.	0	0	45	180	10	88	0	323
Oxyurostylis sp.	3	8	3	0	0	8	0	20
Eocuma carinocurvum	0	3	0	0	0	0	0	3
Heterocuma sp.	0	0	8	0	0	3	0	10
Leptocuma sp.	0	0	0	3	0	0	0	3
Iphione sp.	3	0	0	0	0	0	0	3
Leptostylis sp.	0	0	3	0	0	0	0	3
Diastylis granulata?	0	0	3	0	0	3	3	8
Eurodella sp.	0	0	0	0	3	10	0	13
Cumella sp.	0	0	0	3	0	0	0	3
Other Cumaceans	0	0	0	0	0	38	0	38
Pycnogonids	3	0	28	15	3	28	0	75
Ostracods	110	153	1260	58	470	80	110	2240
Prawns	0	8	3	0	3	3	0	15
Pinnixa sp	0	0	0	3	0	0	0	3
Pinnotherids	0	3	0	3	3	0	0	8
Portunus sp.	0	3	0	0	3	0	0	5
Portunus pelagicus	0	8	15	13	0	5	13	53

Transect	knr	kzh	vad	kch	klm	tvm	cape	Total
Leucosia sp.	0	0	3	0	0	0	0	3
Leucosids	0	0	3	0	0	0	0	3
Charybdis sp.	0	0	3	0	3	3	0	8
Podochela sp.	0	0	0	0	0	0	15	15
Porcellanids	0	0	0	0	0	13	3	15
Xanthids	0	0	0	0	3	0	0	3
Ethusa sp.	0	0	0	0	3	0	0	3
Euryplax sp.	0	0	0	0	3	0	0	3
Goneplax sp.	15	0	0	0	0	0	0	15
Other decapod crabs	13	28	13	10	10	8	8	88
Hermit crabs	0	0	0	0	0	8	3	10
Sand lobster	33	13	0	0	0	0	3	48
Squilla sp.	0	0	5	18	0	5	8	35
Stomatopods	0	0	3	5	0	0	3	10
Barnacles	0	50	5	0	0	0	0	55
Other crustaceans	0	3	3	5	0	0	0	10
MOLLUSCS								
Anadara sp.	0	0	10	5	0	3	3	20
Chione sp.	0	5	0	0	0	5	0	10
Antalis longitrorsum	8	3	0	0	0	0	0	10
Dentalium elph	0	0	53	0	0	0	0	53
Dentalium spp.	0	3	0	15	3	0	5	25
Terebra affinis	3	0	0	0	0	0	0	3
Terebra spp.	3	3	5	0	0	3	0	13
Aloides bifrons	25	75	0	15	3	3	10	130
Cardium flavum	0	0	25	5	8	5	3	45
Cardium aciaticum?	0	0	20	0	0	0	0	20
Cardium sp.	0	10	3	38	3	8	0	60
Donax sp.	13	0	5	38	25	3	3	85
Telinna sp.	0	0	5	13	20	0	8	45
Mactra sp.	0	0	5	0	3	0	0	8
Pecten sp.	0	0	25	48	5	0	0	78
Chlamys sp.	0	0	0	0	3	0	0	3
Lima sp	0	0	0	0	5	0	0	5
Pitar sp.	3	0	0	0	0	0	0	3
Codakia punctata	5	0	0	0	0	0	0	5
Divaricella ornatissima	3	0	0	0	0	0	0	3

Transect	knr	kzh	vad	kch	klm	tvm	cape	Total
Cymatium sp.	3	0	0	0	0	0	0	3
Glycymeris spurca	0	0	3	3	0	0	0	5
Bivalves	13	38	198	5	55	33	13	353
Cupulus dilatatus	0	0	0	0	3	0	0	3
Ellobium sp	3	0	0	0	0	0	0	3
Babylonia zeylanica	0	0	0	0	3	0	0	3
Bassina sp.	0	0	0	3	0	0	0	3
Tornus planus	0	0	0	0	0	5	0	5
Tornus sp.	0	0	0	3	0	0	0	3
Natica vitellus	0	5	0	0	0	0	0	5
Natica sp.	5	0	0	0	0	3	0	8
Nassarius sp.	0	0	3	0	0	3	0	5
Conus textile	0	0	0	0	3	0	0	3
Conus acutangulus	0	0	0	0	0	3	0	3
Conus sp.	0	0	3	0	0	0	0	3
Ancilla spp.	5	0	0	0	0	0	0	5
Oliva sp.	0	0	0	0	3	0	0	3
Pila dolioides	0	0	0	0	5	5	0	10
Gastrana polygona	0	0	0	0	3	0	0	3
Latiaxis sp.	0	0	0	0	0	0	3	3
Gastropods	0	20	30	5	3	48	30	135
ECHINODERMS								
Other Brittle stars	10	0	0	10	0	18	60	98
Ophiothrix exigua	0	15	0	0	0	0	0	15
Ophiothrix sp.	0	0	0	3	0	0	0	3
Sand dollars	0	0	0	0	0	0	3	3
Clypeaster rarispinus	0	3	3	0	0	0	0	5
Clypeaster sp.	0	0	0	0	13	0	0	13
Lovenia sp.	0	0	0	0	0	25	8	33
Holothuria sp	0	3	0	0	20	5	3	30
Balanoglossus	0	0	0	3	0	0	0	3
CEPHALOCHORDATES								
Branchiostoma lanceolatum	0	0	0	0	15	30	3	48
FISHES								
Other fishes	8	0	0	0	3	0	3	13
Unidentified organisms	53	35	90	58	145	40	33	453

100M depth range SW coast (in no. per sq.m)							
Transect	**knr**	**kzh**	**vad**	**kch**	**klm**	**cape**	**Total**
Depth(m)	**100**	**110**	**105**	**101**	**95**	**122.8**	
Station No.	**15a**	**3**	**7**	**11**	**16**	**23**	
Foraminiferans	0	0	0	0	2	0	2
Nemerteans	38	0	0	0	0	0	38
Nematodes	0	0	15	0	0	0	15
Sipunculids	0	0	3	0	0	0	3
Spadella sp.	18	0	0	0	0	5	23
Oligochaetes	10	50	15	67	7	7	155
POLYCHAETES							
Errantia							
Aphroditidae							
Harmothoe lagiscoides serrata	0	0	0	2	0	0	2
Other Aphroditids	0	0	3	2	0	10	14
Palmyridae							
Paleanotus chrysolepis	0	0	3	0	0	0	3
Amphinomidae							
Eurythoe parvecarunculata	0	0	3	5	0	0	8
Eurythoe sp.1	0	0	0	2	55	138	194
Phyllodocidae							
Phyllodoce longipes	0	0	0	2	0	0	2
Phyllodoce sp.1	0	0	3	0	0	3	5
Phyllodoce sp.2	0	0	3	0	0	0	3
Notophyllum splendens?	0	0	0	0	3	0	3
Other Phyllodocids	0	0	3	0	3	13	18
Typhloscolecidae							
Travisiopsis sp.	0	0	3	0	0	0	3
Pilargidae							
Ancistrosyllis parva	33	3	3	20	0	0	58
Hesionidae							
Gyptis capensis	0	0	3	0	0	0	3
Other Hesionids	3	0	3	0	0	0	5
Syllidae							
Syllis spongicola	0	0	0	0	3	8	10
Syllis gracilis	0	0	10	0	0	0	10

Transect	knr	kzh	vad	kch	klm	cape	Total
Syllis amica	0	0	0	0	0	3	3
Syllis benguellana	0	0	5	0	0	0	5
Syllis sp.1	0	0	8	0	3	3	13
Exogone sp.1	0	0	3	0	0	3	5
Sphaerosyllis sublaevis	0	0	0	0	0	10	10
Sphaerosyllis sp.1	0	0	0	0	3	0	3
Other Syllids	0	0	3	0	3	0	5
Nereidae							
Ceratoneris mirabilis	0	5	3	3	3	0	13
Ceratoneris sp.	0	0	3	0	0	0	3
Other Nereids	8	0	0	0	0	0	8
Nephtyidae							
Nephtys dibranchis	23	0	0	0	0	0	23
Lacydoniidae							
Paralacydonia paradoxa	0	0	0	2	0	0	2
Glyceridae							
Glycera longipinnis	15	10	8	13	20	3	68
Glycera convoluta	5	0	0	3	0	0	8
Gycera subaenea	5	0	0	0	0	0	5
Glycera sp.1	3	0	10	8	0	0	21
Goniada emerita	3	0	0	10	38	15	65
Goniada maculata	0	0	0	0	8	0	8
Goniada sp.	0	0	0	2	0	0	2
Goniadella gracilis	0	3	0	0	0	0	3
Glycinde kameruniana	0	0	0	10	0	18	28
Glycinde sp.	0	0	0	2	0	0	2
Eunicidae							
Eunice australis	0	0	0	0	0	5	5
Eunice vittata	0	3	0	0	0	0	3
Eunice indica	0	0	0	0	8	10	18
Eunice sp.1	0	5	5	2	0	35	47
Eunice sp.2	0	0	0	3	0	20	23
Eunice sp.3	0	0	0	3	0	55	58
Marphysa purcellana	0	0	0	0	5	0	5
Marphysa adenensis	0	0	3	0	0	0	3
Marphysa sp.	0	0	5	0	0	0	5

Transect	knr	kzh	vad	kch	klm	cape	Total
Epidiopatra sp.	0	0	0	2	0	0	2
Hayalonoecia tubicola	0	28	5	0	0	0	33
Diopatra monroi	0	0	0	0	3	0	3
Onuphis sp.	0	0	5	0	0	0	5
Lumbrineris meteorana	0	0	0	0	0	3	3
Lumbrinereis albidentata	0	0	0	0	0	3	3
Lumbrineris laterilli	0	3	0	0	0	0	3
Lumbrineris aberrans	25	3	3	8	0	0	38
Lumbrineris sp.1	0	0	0	63	3	0	66
Lumbrineris sp.2	13	0	0	5	0	0	18
Lumbrineris sp.3	5	0	0	2	0	0	7
Driloneris falcata	10	0	15	2	0	0	27
Dorvellia rudolphi	0	0	0	0	3	8	10
Sedentaria							
Spionidae							
Polydora sp.1	3	0	0	0	0	0	3
Spiophanes bombyx	0	3	3	0	3	0	8
Spoiphanes sp.1	0	0	23	0	0	0	23
Malacoceros indicus	0	0	0	2	0	3	4
Aonides oxycephala	0	0	3	0	5	0	8
Aonidella dayi	3	0	0	0	0	0	3
Aonida sp.	0	0	0	0	3	0	3
Laonice cirrata	0	3	0	0	0	0	3
Prionospio cirrifera	500	0	8	0	0	0	508
Prionospio cirrobranchiata	0	10	0	2	0	0	12
Prionospio pinnata	3	38	0	2	0	8	49
Prinospio cornuta	0	0	0	3	0	0	3
Prinospio membranacea	0	0	3	0	0	0	3
Prionospio(M) andamanensis	0	798	10	7	993	88	1895
Prionospio ehlersi	0	0	0	4	0	0	4
Prionospio(minospio) pulchra	0	0	3	0	0	0	3
Prionospio sp.1	20	5	53	2	0	105	185
Prionospio sp.2	0	0	23	5	0	0	28
Prionospio (M) sp.	0	0	0	28	3	0	31

Transect	knr	kzh	vad	kch	klm	cape	Total
Other Spionids	175	3	15	2	13	3	209
Magelonidae							
Magelona cincta	113	23	0	50	8	20	213
Magelona sp.	0	0	0	2	0	0	2
Cirratulidae							
Tharyx filibranchia	0	3	0	0	0	0	3
Tharyx dorsobranchialis	183	3	10	12	8	35	249
Tharyx annnulosus	5	0	0	8	0	0	13
Tharyx sp.1	10	8	0	0	0	0	18
Caulleriella bioculatus	0	0	3	0	0	8	10
Chaetozone setosa	0	0	3	0	0	0	3
Chaetozone sp.	8	0	0	0	0	0	8
Cirratulus cirratus	5	0	0	68	3	15	91
Cirratulus sp.	0	0	3	12	3	0	17
Other cirratulids	0	0	8	7	0	5	20
Poecilochaetidae							
Poecilochaetus serpens	5	0	0	0	0	0	5
Orbiniidae							
Naineris laevigata	0	0	0	2	0	0	2
Phylo foetida foetida	0	3	0	0	0	0	3
Haploscoloplos kerguelensis	0	0	0	7	0	0	7
Scholoplos uniramus	0	3	0	0	0	0	3
Other Orbinids	5	0	3	0	5	3	15
Paraonidae							
Aricidea fauveli	0	0	3	7	10	10	29
Aricidea longobranchiata	13	0	3	8	0	0	23
Aricidea capensis	0	0	0	5	0	3	8
Aricidea sp.	0	0	0	13	3	0	16
Cirrophorus branchiatus	0	5	0	0	0	0	5
Cirrophorus sp.	8	0	3	0	0	0	10
Paraonis gracilis gracilis	35	8	25	57	5	3	132
Paraonis sp.	6	0	8	0	0	0	14
Paraonides lyra lyra	0	0	0	0	0	10	10
Other Paraonids	10	3	3	5	3	0	23
Cossuridae							
Cossura coasta	113	0	0	3	0	3	118

Transect	knr	kzh	vad	kch	klm	cape	Total
Capitellidae							
Notomastus fauveli	0	3	10	3	0	0	16
Notomastus aberrans	0	0	13	2	0	0	14
Notomastus sp.	0	0	3	0	3	0	5
Other Capitellids	33	3	15	0	5	0	56
Maldanidae							
Other Maldanids	18	0	20	0	3	3	43
Sternaspidae							
Sternaspis scutata	0	0	0	0	0	3	3
Ampharetidae							
Melinna cristata	0	0	3	0	0	0	3
Isolda pulchella	0	3	3	2	0	0	7
Amphicteis gunneri	0	0	8	2	0	3	12
Amphicteis sp.	8	0	0	0	0	0	8
Ampharete sp.	0	0	5	2	0	0	7
Other Ampharetids	13	3	5	0	3	103	126
Terebellidae							
Terebellides stroemi	10	0	0	0	0	0	10
Terebellides sp.	0	0	0	0	3	0	3
Polycirrus sp.	8	0	0	0	0	0	8
Pista unibranchia	0	0	3	0	0	0	3
Pista quadrilobata	0	0	3	0	0	0	3
Other Terebellids	8	0	0	0	0	0	8
Sabellidae							
Chone filicaudata	0	0	0	0	0	5	5
Megalomma sp.	0	0	0	2	0	0	2
Other Sabellids	0	0	0	0	0	10	10
Unidentified polychaete sp.4	0	0	8	0	0	0	8
CRUSTACEANS							
Amphipods	8	43	60	52	5	450	617
Isopods	115	3	20	14	11	2	165
Herpacticoid copepods	90	0	33	2	12	0	136
Campylaspis sp.	0	8	93	0	0	15	115
Oxyurostylis sp.	0	0	0	0	2	0	2
Heterocuma sp.	0	0	0	0	0	7	7
Leptostylis sp.	0	0	0	0	0	3	3

Transect	knr	kzh	vad	kch	klm	cape	Total
Pycnogonids	3	0	0	0	0	8	11
Mysids	45	0	0	0	7	0	52
Pinnixa sp	10	0	0	0	0	0	10
Pinnotherids	0	0	3	0	0	0	3
Other decapod crabs	33	3	0	30	5	0	70
Hermit crabs	0	0	5	0	0	0	5
Sand lobster	13	0	0	2	0	0	14
Squilla sp.	0	0	0	5	2	2	8
Stomatopods	3	0	0	5	0	0	8
Other crustaceans	0	0	3	0	0	0	3
MOLLUSCS							
Anadara sp.	0	0	0	2	0	0	2
Cardium sp.	0	0	0	25	0	5	30
Donax cuneatus	3	0	0	0	0	0	3
Donax sp.	0	0	0	2	0	0	2
Telinna sp.	0	0	0	0	2	0	2
Portlandia sp.	5	0	0	68	2	0	75
Bivalves	35	0	0	0	3	3	41
Cupulus dilatatus	0	0	0	2	0	0	2
Xenophora sp.	0	0	0	2	0	3	4
Cavolina sp	0	0	0	0	2	0	2
Gastropods	8	0	0	8	8	13	37
ECHINODERMS							
Holothuria sp	0	0	0	0	0	2	2
CEPHALOCHORDATES							
Branchiostoma lanceolatum	0	0	0	12	25	0	37
FISHES							
Eel	0	3	0	0	0	0	3
Other fishes	60	3	0	5	0	**2**	69
Unidentified organisms	5	3	30	10	0	8	56

200M depth range SW coast (in no. per sq.m)						
Transect	**kzh**	**vad**	**kch**	**klm**	**cape**	**Total**
Depth(m)	**208**	**190**	**229**	**186**	**216**	
Station No.	**4**	**8**	**12**	**17**	**24**	
Nemerteans	3	0	5	0	0	8
Nematodes	0	0	8	0	0	8
Spadella sp.	0	23	5	0	0	28
Oligochaetes	0	13	0	3	13	28
POLYCHAETES						
Errantia						
Aphroditidae						
Other Aphroditids	0	3	0	0	0	3
Amphinomidae						
Eurythoe parvecarunculata	3	0	0	0	0	3
Eurythoe sp.1	0	0	0	3	5	8
Phyllodocidae						
Phyllodoce sp.1	3	0	0	0	0	3
Pilargidae						
Ancistrosyllis parva	13	0	0	0	0	13
Hesionidae						
Hesione splendida	0	3	0	0	0	3
Leocrates claparedii	0	5	0	0	0	5
Gyptis capensis	5	0	3	0	0	8
Other Hesionids	3	0	0	0	0	3
Syllidae						
Syllis spongicola	3	13	0	0	3	18
Syllis gracilis	0	5	0	0	0	5
Syllis benguellana	0	3	0	0	0	3
Sphaerodoridae						
Sphaerodorid sp.	0	0	8	0	0	8
Nereidae						
Ceratoneris mirabilis	0	0	0	0	3	3
Nephtyidae						
Nephtys dibranchis	10	5	0	0	5	20
Nephtys lyrochaeta	3	0	0	0	0	3

Transect	kzh	vad	kch	klm	cape	Total
Glyceridae						
Glycera longipinnis	5	0	0	0	5	10
Glycera convoluta	0	0	5	3	0	8
Gycera subaenea	0	0	3	0	0	3
Glycera sp.1	3	0	0	0	0	3
Goniada emerita	0	0	3	0	0	3
Goniada maculata	0	0	3	3	0	5
Eunicidae						
Eunice indica	0	0	0	3	0	3
Eunice sp.1	0	3	0	0	0	3
Onuphis sp.	0	0	0	0	3	3
Dorvellia rudolphi	0	0	0	3	0	3
Sedentaria						
Spionidae						
Spiophanes bombyx	0	0	0	3	0	3
Spiophanes urceolata?	8	0	0	0	0	8
Aonidella dayi	0	0	0	5	43	48
Scololepis sp.	3	0	0	0	0	3
Prionospio cirrifera	15	0	0	0	0	15
Prionospio pinnata	1455	68	65	0	0	1588
Prionospio(M) andamanensis	0	218	0	660	0	878
Prionospio(minospio) elegantula	0	0	5	0	0	5
Prionospio(minospio) pulchra	38	0	8	0	0	45
Prionospio sp.1	18	3	3	0	10	33
Other Spionids	8	0	0	0	0	8
Magelonidae						
Magelona cincta	3	65	5	30	13	115
Magelona sp.	0	0	3	0	0	3
Cirratulidae						
Tharyx dorsobranchialis	50	0	10	220	163	443
Tharyx annnulosus	10	0	3	0	0	13
Tharyx sp.1	8	0	5	0	0	13
Cirratulus cirratus	0	0	0	0	3	3
Cirratulus sp.	0	13	0	0	0	13
Chaetopteridae						
Chaetopterus sp.	0	0	8	0	0	8

Transect	kzh	vad	kch	klm	cape	Total
Orbiniidae						
Other Orbinids	0	0	0	0	3	3
Paraonidae						
Aricidea curviceta	23	0	0	0	0	23
Aricidea fauveli	3	0	0	0	0	3
Aricidea longobranchiata	25	0	0	0	0	25
Aricidea capensis	0	0	0	228	0	228
Aricidea sp.	0	0	0	10	85	95
Cirrophorus branchiatus	0	3	0	13	0	15
Paraonis gracilis gracilis	145	8	143	0	375	670
Paraonis sp.	10	0	3	8	0	20
Other Paraonids	3	0	0	3	143	148
Cossuridae						
Cossura coasta	15	0	123	0	0	138
Capitellidae						
Notomastus fauveli	20	8	25	58	3	113
Notomastus aberrans	18	13	28	43	0	100
Notomastus sp.	3	0	0	0	0	3
Other Capitellids	0	5	10	30	8	53
Maldanidae						
Axiothella jarli	0	0	3	0	0	3
Euclymene cf. oerstedii	20	0	0	0	0	20
Other Maldanids	3	10	55	30	15	113
Sternaspidae						
Sternaspis scutata	0	0	5	0	0	5
Ampharetidae						
Isolda pulchella	0	0	0	0	8	8
Amphicteis sp.	3	0	0	0	0	3
Ampharete sp.	5	0	0	0	0	5
Other Ampharetids	0	0	0	0	10	10
Terebellidae						
Pista cristata	0	0	0	0	3	3
Other Terebellids	0	0	0	0	3	3
Sabellidae						
Other Sabellids	3	0	0	0	0	3

Transect	kzh	vad	kch	klm	cape	Total
Serpulidae						
Other Serpulids	0	0	0	0	3	3
Unidentified polychaete sp.3	8	0	0	0	0	8
CRUSTACEANS						
Amphipods	125	38	50	13	10	235
Isopods	10	15	0	0	3	28
Herpacticoid copepods	0	0	0	45	0	45
Campylaspis sp.	0	118	0	60	0	178
Leucon sp.	0	3	0	0	0	3
Pycnogonids	0	3	0	0	0	3
Ostracods	5	98	3	3308	0	3413
Prawns	18	0	0	3	0	20
Pinnotherids	0	3	0	0	0	3
Mycrophrys sp.	0	0	3	0	0	3
Other decapod crabs	0	3	0	10	0	13
Sand lobster	3	5	0	3	0	10
Other crustaceans	5	0	0	0	0	5
MOLLUSCS						
Chione sp.	0	0	0	0	25	25
Dentalium spp.	0	0	0	0	28	28
Donax sp.	0	0	0	3	10	13
Pitar sp.	0	0	0	0	5	5
Siliqua sp.	0	0	0	0	5	5
Bivalves	0	0	0	0	3	3
Gastropods	0	0	0	0	3	3
Unidentified organisms	0	13	0	0	0	13

Table.6.10b. Faunal Composition of Macrobenthos Along the Continental Shelf of Southeast Coast of India

30M depth range SE coast (in no. per sq.m)					
Transect	**naga**	**cudd**	**chen**	**krish**	**Total**
Depth(m)	**30**	**30.9**	**33.4**	**31.7**	
Station No.	**25**	**29**	**33**	**37**	
Foraminiferans	0	5	0	0	5
Corals	0	2	0	0	2
Nemerteans	5	12	0	8	24
Nematodes	8	7	0	8	22
Sipunculids	0	2	3	3	7
Spadella sp.	0	0	0	5	5
Oligochaetes	10	5	3	3	20
Polygordius sp.	0	2	0	0	2
POLYCHAETES					
Errantia					
Aphroditidae					
Psammolyce articulata	0	3	0	0	3
Other Aphroditids	10	7	0	8	24
Amphinomidae					
Eurythoe sp.1	13	20	0	0	33
Other Amphinomids	0	0	0	10	10
Phyllodocidae					
Other Phyllodocids	18	20	0	0	38
Pilargidae					
Ancistrosyllis parva	0	10	0	8	18
Hesionidae					
Ohiodromus spinosus	0	0	0	3	3
Ophiodromus sp.	0	0	0	3	3
Syllidia armata	0	2	0	0	2
Other Hesionids	3	2	0	13	17
Syllidae					
Syllis spongicola	0	18	0	0	18
Syllis gracilis	0	12	0	0	12
Syllis(Langerhansia) anops	3	0	0	0	3
Syllis sp.1	3	2	3	13	19

Transect	naga	cudd	chen	krish	Total
Syllis sp.2	3	0	0	0	3
Pionosyllis sp.	0	2	0	0	2
Brania pusilla	0	2	0	0	2
Exogone clavator	0	2	0	0	2
Exogone sp.1	3	7	0	0	10
Other Syllids	0	65	0	0	65
Nereidae					
Nereis sp.1	0	3	0	0	3
Nereis sp.2	0	3	0	0	3
Nereis sp.3	0	5	0	0	5
Ceratoneris mirabilis	5	0	0	3	8
Other Nereids	0	0	0	3	3
Nephtyidae					
Nephtys dibranchis	85	47	13	38	182
Lacydoniidae					
Paralacydonia paradoxa	10	0	0	20	30
Glyceridae					
Glycera longipinnis	13	0	0	13	25
Glycera natalensis	0	2	0	0	2
Glycera benguellana	0	2	0	0	2
Glycera convoluta	3	2	0	0	4
Glycera sp.1	3	0	0	0	3
Goniada emerita	3	0	0	13	15
Goniada sp.	0	2	0	0	2
Goniadella gracilis	0	5	0	0	5
Glycinde kameruniana	3	0	0	0	3
Eunicidae					
Eunice indica	10	0	0	0	10
Eunice sp.1	5	18	0	23	46
Eunice sp.2	30	3	0	3	36
Eunice sp.3	8	2	0	0	9
Marphysa purcellana	8	0	0	0	8
Marphysa sp.	0	18	0	0	18
Lysidice natalensis or capensis	3	17	0	0	19
Lysidice sp.	0	2	0	0	2
Nematonereis unicornis	0	27	0	0	27

Transect	naga	cudd	chen	krish	Total
Diopatra sp.	0	0	0	5	5
Onuphis sp.	30	28	3	5	66
Lumbrineris aberrans	0	10	20	5	35
Lumbrineris sp.1	18	23	5	15	61
Lumbrineris sp.2	3	0	3	0	5
Lumbrineris sp.3	3	0	0	0	3
Driloneris falcata	0	8	0	10	18
Drilonereis sp.	0	2	0	5	7
Protodorvillea biarticulata	0	2	0	0	2
Protodorvillea egena	0	3	0	0	3
Dorvellia rudolphi	3	5	0	0	8
Other Eunicids	0	27	3	3	32
Sedentaria					
Spionidae					
Spiophanes bombyx	5	2	0	0	7
Spoiphanes sp.1	0	15	0	28	43
Malacoceros indicus	3	0	0	10	13
Aonides oxycephala	3	5	0	0	8
Spiogalea sp.	0	2	0	0	2
Scolelepis branchia	3	0	0	0	3
Prionospio cirrifera	3	0	3	3	9
Prionospio sp.1	58	17	3	15	92
Other Spionids	15	8	0	5	28
Magelonidae					
Magelona cincta	10	12	0	15	37
Cirratulidae					
Tharyx dorsobranchialis	5	3	0	13	21
Tharyx annnulosus	0	5	0	8	13
Tharyx sp.1	5	2	3	8	17
Caulleriella bioculatus	0	8	0	0	8
Chaetozone brunnea	0	0	0	3	3
Cirratulus cirratus	5	7	0	3	14
Other cirratulids	3	0	0	3	5
Heterospionidae					
Heterospionid sp.	0	0	0	10	10
Poecilochaetidae					
Poecilochaetus serpens	3	2	0	5	9

Transect	naga	cudd	chen	krish	Total
Chaetopteridae					
Chaetopterus varieopedatus	0	2	0	0	2
Orbiniidae					
Other Orbinids	25	12	0	8	44
Paraonidae					
Aricidea fauveli	0	2	0	18	19
Aricidea longobranchiata	0	2	0	0	2
Aricidea capensis	23	5	0	0	28
Aricidea sp.	23	2	0	15	39
Cirrophorus sp.	0	0	0	3	3
Aedicira sp.	0	3	0	0	3
Paraonis gracilis gracilis	65	3	0	5	73
Paraonis sp.	0	0	0	3	3
Other Paraonids	5	3	3	15	26
Ophelidae					
Ophelia sp.	0	2	0	0	2
Armandia leptocirrus	5	0	0	0	5
Other Ophelids	0	0	0	3	3
Cossuridae					
Cossura coasta	0	0	0	13	13
Capitellidae					
Notomastus fauveli	18	3	0	0	21
Notomastus aberrans	23	13	5	0	41
Notomastus sp.	0	0	5	0	5
Other Capitellids	3	30	25	113	170
Maldanidae					
Other Maldanids	0	18	3	8	29
Flabelligeridae					
Priomis arenosus	0	2	0	0	2
Ampharetidae					
Amphicteis gunneri	18	32	0	0	49
Amphicteis sp.	0	0	3	0	3
Other Ampharetids	20	13	0	10	43
Terebellidae					
Trichobranchus glacialis	5	0	0	0	5
Terebellides stroemi	5	3	0	3	11

Transect	naga	cudd	chen	krish	Total
Terebellides sepultura	0	2	0	0	2
Terebellides sp.	0	0	0	8	8
Polycirrus sp.	0	5	0	5	10
Streblosoma persica	3	2	0	0	4
Pista unibranchia	0	5	0	0	5
Pista cristata	3	3	0	0	6
Pista macrolobata	0	2	0	0	2
Amphitrite cirrata	3	0	0	0	3
Amphitrite sp.	0	5	0	0	5
Other Terebellids	3	3	0	0	6
Sabellidae					
Chone filicaudata	0	5	0	0	5
Euchone rosea	0	15	0	0	15
Fabricia filamentosa	0	5	0	0	5
Jasmineria elegans	0	2	0	0	2
Other Sabellids	0	2	3	3	7
Unidentified polychaete sp.7	0	8	0	0	8
CRUSTACEANS					
Amphipods	725	1333	20	208	2286
Isopods	3	75	5	10	93
Tanaids	0	8	0	0	8
Herpacticoid copepods	60	153	0	28	241
Campylaspis sp.	0	0	135	60	195
Diastylis granulata?	0	8	0	5	13
Leucon sp.	0	2	0	0	2
Ceratocuma sp.	0	2	0	0	2
Eurodella sp.	15	5	0	10	30
Ostracods	3	0	0	0	3
Pycnogonids	3	0	0	3	5
Mysids	0	2	0	18	19
Pinnixa sp	0	2	0	0	2
Pinnotherids	3	0	0	93	95
Portunus pelagicus	0	0	0	5	5
Podochela sp.	0	2	0	0	2
Porcellanids	0	0	3	0	3
Ocypode sp.	0	2	0	0	2

Transect	naga	cudd	chen	krish	Total
Albunea symnista	0	0	3	0	3
Other decapod crabs	15	23	3	73	113
Lobsters	0	2	0	0	2
Squilla	0	7	0	13	19
Gohst shrimp	0	2	0	0	2
Other crustaceans	3	2	3	5	12
MOLLUSCS					
Chione sp.	3	0	0	0	3
Aloides bifrons	3	0	0	3	5
Cardium sp.	0	3	0	0	3
Donax sp.	3	0	0	0	3
Telinna sp.	0	3	0	10	13
Siliqua radiata	0	0	0	3	3
Paphia alapapilionis	0	0	0	3	3
Dosinia rustica	0	0	23	0	23
Bivalves	0	15	0	20	35
Corculum monstrosum	5	5	0	68	78
Gastropods	0	8	0	0	8
ECHINODERMS					
Star fishes	0	5	0	0	5
Other Brittle stars	3	2	0	40	44
Holothuria sp	0	0	0	23	23
CEPHALOCHORDATES					
Branchiostoma lanceolatum	0	43	0	5	48
Ascidians	0	2	0	0	2
FISHES					
Other fishes	0	**2**	0	**3**	4
Unidentified organisms	3	18	5	3	28

50M depth range SE coast (in no. per sq.m)					
Transect	**naga**	**cudd**	**chen**	**krish**	**Total**
Depth(m)	**43.1**	**52.3**	**57.5**	**55**	
Station No.	**26**	**30**	**34**	**38**	
Foraminiferans	133	38	0	0	170
Phoronids	0	3	0	0	3
Other Bryozoans	0	10	0	0	10
Cupuladria sp.	8	0	0	0	8
Spadella sp.	5	5	0	23	33
Oligochaetes	0	3	0	0	3
POLYCHAETES					
Errantia					
Aphroditidae					
Harmothoe antilopis	0	5	0	0	5
Harmothoe sp.	0	8	0	0	8
Other Aphroditids	3	5	0	3	10
Palmyridae					
Paleanotus chrysolepis	0	5	0	0	5
Amphinomidae					
Eurythoe sp.1	3	5	0	0	8
Phyllodocidae					
Other Phyllodocids	0	5	0	0	5
Pontodoridae					
Pontodora pelagica	0	3	0	0	3
Pilargidae					
Ancistrosyllis parva	3	98	0	0	100
Ancystrosyllis sp.	3	0	0	0	3
Loandalia sp.	0	3	0	0	3
Other Pilargids	0	3	0	0	3
Hesionidae					
Ophiodromus sp.	0	3	0	0	3
Syllidae					
Syllis spongicola	8	0	0	0	8

Transect	naga	cudd	chen	krish	Total
Syllis gracilis	13	0	0	0	13
Syllis sp.1	0	13	0	0	13
Syllis sp.2	0	15	0	0	15
Lamellisyllis comans	0	3	0	0	3
Exogone clavator	3	3	0	0	5
Exogone gemmifera	0	5	0	0	5
Exogone sp.1	0	18	0	0	18
Other Syllids	0	3	0	0	3
Nereidae					
Ceratoneris mirabilis	3	3	0	0	6
Other Nereids	0	3	5	0	8
Nephtyidae					
Nephtys dibranchis	28	40	10	10	88
Lacydoniidae					
Paralacydonia paradoxa	3	5	0	13	20
Glyceridae					
Glycera longipinnis	5	3	0	0	8
Glycera natalensis	0	3	0	0	3
Glycera convoluta	0	3	0	3	5
Glycera alba	3	0	0	0	3
Glycera sp.1	0	5	3	0	8
Glycera sp.2	0	0	3	0	3
Goniada emerita	5	5	0	0	10
Eunicidae					
Eunice indica	3	0	0	0	3
Eunice tubifex?	3	0	0	0	3
Eunice sp.1	15	13	8	3	38
Eunice sp.2	3	3	18	0	23
Eunice sp.3	20	3	0	0	23
Marphysa sp.	0	20	0	0	20
Nematonereis unicornis	0	3	0	0	3
Onuphis sp.	28	20	0	0	48
Lumbrineris aberrans	5	18	18	8	48

Transect	naga	cudd	chen	krish	Total
Lumbrineris sp.1	20	5	15	25	65
Lumbrineris sp.2	0	5	5	0	10
Lumbrineris sp.3	0	0	3	0	3
Driloneris falcata	0	5	3	0	8
Other Eunicids	0	0	0	3	3
Sedentaria					
Spionidae					
Polydora capensis	0	3	0	0	3
Spiophanes bombyx	0	20	0	0	20
Malacoceros indicus	0	5	0	0	5
Aonides oxycephala	0	0	0	5	5
Prionospio pinnata	0	18	0	0	18
Prionospio bocki?	0	3	0	0	3
Prionospio(minospio) elegantula	0	3	0	0	3
Prionospio sp.1	23	60	10	3	95
Prionospio sp.2	0	5	0	0	5
Prionospio sp.3	0	13	0	0	13
Other Spionids	0	3	0	0	3
Magelonidae					
Magelona cincta	5	30	0	0	35
Cirratulidae					
Tharyx dorsobranchialis	15	28	0	0	43
Tharyx annnulosus	0	5	3	0	8
Tharyx sp.1	3	0	0	0	3
Caulleriella bioculatus	3	0	0	0	3
Chaetozone setosa	0	3	0	0	3
Chaetozone brunnea	0	3	0	0	3
Cirratulus cirratus	3	0	0	0	3
Poecilochaetidae					
Poecilochaetus serpens	0	5	0	0	5
Orbiniidae					
Haploscoloplos kerguelensis	0	0	3	0	3
Other Orbinids	8	18	0	0	25

Transect	naga	cudd	chen	krish	Total
Paraonidae					
Aricidea fauveli	10	5	0	0	15
Aricidea capensis	8	0	0	0	8
Aricidea sp.	10	8	0	0	18
Cirrophorus branchiatus	8	3	0	0	11
Cirrophorus sp.	0	13	0	0	13
Paraonis gracilis gracilis	33	15	0	5	53
Paraonides lyra lyra	8	0	0	0	8
Paraonides sp.	0	0	3	0	3
Other Paraonids	3	5	0	8	15
Ophelidae					
Armandia intermedia	3	15	0	0	18
Armandia sp.	0	3	0	0	3
Cossuridae					
Cossura coasta	0	5	3	0	8
Capitellidae					
Capitella capitata	0	3	0	0	3
Notomastus fauveli	20	8	0	0	28
Notomastus aberrans	18	0	0	0	18
Other Capitellids	8	43	18	0	69
Maldanidae					
Other Maldanids	8	3	3	0	13
Sternaspidae					
Sternaspis scutata	3	0	0	0	3
Oweniidae					
Owenia fusiformis	0	5	0	0	5
Flabelligeridae					
Priomis arenosus	0	3	0	0	3
Diplocirrus capensis	3	0	3	0	5
Sabellariidae					
Phalacrostemma sp.	0	3	0	0	3
Ampharetidae					
Amphicteis gunneri	28	10	0	3	40

Transect	naga	cudd	chen	krish	Total
Amphicteis sp.	0	15	0	0	15
Ampharete acutiforns	3	0	0	0	3
Ampharete sp.	13	0	0	0	13
Other Ampharetids	0	3	0	0	3
Terebellidae					
Terebellides stroemi	15	3	3	5	25
Polycirrus sp.	0	3	0	0	3
Streblosoma persica	3	0	5	0	8
Pista unibranchia	3	0	0	0	3
Pista brevibranchia	10	0	0	0	10
Pista cristata	13	3	0	0	15
Pista quadrilobata	3	0	0	0	3
Loimia medusa	3	0	0	0	3
Sabellidae					
Chone filicaudata	3	3	0	0	5
Fabricia filamentosa	0	5	0	0	5
Fabricia capensis	3	0	0	0	3
Hypsicomus capensis	0	5	0	0	5
Other Sabellids	5	3	0	0	8
Serpulidae					
Hydroides sp.	0	5	0	0	5
Unidentified polychaete sp.7	0	3	0	3	6
CRUSTACEANS					
Amphipods	173	333	18	28	550
Isopods	33	13	10	3	58
Tanaids	0	5	0	3	8
Herpacticoid copepods	100	83	3	15	200
Campylaspis sp.	65	0	5	0	70
Oxyurostylis sp.	0	8	0	0	8
Pseudosympodomma sp.	0	3	0	0	3
Eurodella sp.	3	10	0	0	13
Ostracods	0	3	0	0	3
Mysids	10	5	3	0	18

Transect	naga	cudd	chen	krish	Total
Pinnixa sp	0	3	0	0	3
Pinnotherids	3	5	0	3	10
Portunus pelagicus	3	0	3	5	10
Xanthids	3	0	0	0	3
Hippa sp.	0	13	0	0	13
Other decapod crabs	0	28	0	5	33
Squilla sp.	0	5	0	0	5
Other crustaceans	5	3	0	0	8
MOLLUSCS					
Antalis longitrorsum	0	0	10	0	10
Dentalium spp.	3	0	0	0	3
Terebra spp.	8	0	0	0	8
Aloides bifrons	0	0	5	0	5
Cardium sp.	8	0	0	0	8
Donax sp.	5	0	0	0	5
Telinna sp.	8	0	0	0	8
Mactra cornea	0	3	0	0	3
Spondylus sp.	3	0	0	0	3
Siliqua radiata	0	3	0	0	3
Dosinia rustica	0	10	58	70	138
Macoma sp.	0	0	3	0	3
Bivalves	73	65	18	13	168
Nassarius sp.	0	0	3	0	3
Ancilla spp.	0	3	0	0	3
Gastropods	3	3	0	0	5
ECHINODERMS					
Other Brittle stars	5	63	3	3	73
Sand dollars	0	0	13	8	20
Laganum sp.	3	0	0	0	3
FISHES					
Trichonotus setiger	0	0	0	48	48
Other fishes	3	3	0	0	5
Unidentified organisms	5	15	5	3	28

100M depth range SE coast (in no. per sq.m)					
Transect	**naga**	**cudd**	**chen**	**krish**	**Total**
Depth(m)	**102**	**110**	**99.5**	**98.6**	
Station No.	**27**	**31**	**35**	**39**	
Foraminiferans	2	3	5	0	9
Sponges	2	0	0	0	2
Nemerteans	3	0	0	0	3
Nematodes	2	5	0	0	7
Other Bryozoans	0	0	8	0	8
Oligochaetes	0	28	0	18	45
POLYCHAETES					
Errantia					
Aphroditidae					
Harmothoe antilopis	0	5	8	0	13
Other Aphroditids	22	0	8	35	64
Amphinomidae					
Eurythoe sp.1	0	5	0	0	5
Other Amphinomids	0	0	0	5	5
Phyllodocidae					
Other Phyllodocids	12	3	0	0	14
Pilargidae					
Ancistrosyllis parva	0	18	15	65	98
Hesionidae					
Syllidia sp.	2	0	0	0	2
Other Hesionids	0	0	3	0	3
Syllidae					
Syllis sp.1	28	0	13	13	53
Sphaerosyllis semiverucosa	2	0	0	0	2
Other Syllids	7	0	0	0	7
Sphaerodoridae					
Sphaerodorid sp.	0	3	0	0	3
Nereidae					
Nereis sp.1	0	3	0	0	3
Ceratoneris mirabilis	0	3	0	0	3
Nephtyidae					
Nephtys dibranchis	3	0	18	8	28

Transect	naga	cudd	chen	krish	Total
Glyceridae					
Glycera longipinnis	22	0	3	5	29
Glycera convoluta	0	5	0	0	5
Gycera subaenea	0	0	0	3	3
Glycera sp.1	0	23	0	0	23
Goniada emerita	2	5	3	15	24
Eunicidae					
Eunice indica	2	0	0	0	2
Eunice sp.1	2	18	15	13	47
Eunice sp.2	2	3	3	0	7
Marphysa purcellana	0	15	0	10	25
Marphysa sp.	0	3	3	0	5
Hayalonoecia tubicola	2	0	0	0	2
Onuphis sp.	5	3	3	13	23
Lumbrineris aberrans	0	3	0	0	3
Lumbrineris heteropoda	2	0	0	0	2
Lumbrineris sp.1	2	8	0	18	27
Driloneris falcata	2	0	0	3	4
Protodorvillea biarticulata	0	3	0	0	3
Sedentaria					
Spionidae					
Spiophanes sp.2	2	0	0	0	2
Spiophanes sp.3	2	0	0	0	2
Malacoceros indicus	0	0	0	85	85
Aonides oxycephala	38	0	0	0	38
Scolelepis branchia	2	0	0	0	2
Scololepis sp.	0	5	0	0	5
Prionospio cirrifera	0	0	0	3	3
Prionospio cirrobranchiata	0	10	0	0	10
Prionospio pinnata	0	3	0	8	10
Prionospio(M) andamanensis	0	400	0	520	920
Prionospio sp.1	33	10	5	25	73
Prionospio sp.2	0	3	3	0	5
Other Spionids	2	220	0	5	227
Magelonidae					
Magelona cincta	12	33	0	33	77

Transect	naga	cudd	chen	krish	Total
Cirratulidae					
Tharyx dorsobranchialis	3	43	5	65	116
Tharyx annnulosus	0	5	13	3	20
Tharyx sp.2	0	3	0	0	3
Caulleriella bioculatus	0	0	0	3	3
Chaetozone brunnea	0	3	0	0	3
Chaetozone sp.	0	0	0	25	25
Cirratulus cirratus	2	0	3	0	4
Cirratulus sp.	0	3	0	0	3
Other cirratulids	2	18	0	70	89
Poecilochaetidae					
Poecilochaetus serpens	0	0	0	3	3
Chaetopteridae					
Chaetopterus varieopedatus	0	0	0	3	3
Orbiniidae					
Haploscoloplos kerguelensis	2	0	0	0	2
Other Orbinids	0	3	0	0	3
Paraonidae					
Aricidea fauveli	0	8	0	0	8
Aricidea longobranchiata	0	0	0	3	3
Aricidea capensis	0	3	0	0	3
Aricidea sp.	2	0	0	0	2
Paraonis gracilis gracilis	2	13	0	23	37
Paraonis sp.	2	0	0	0	2
Other Paraonids	2	0	0	345	347
Cossuridae					
Cossura coasta	0	0	3	0	3
Capitellidae					
Notomastus fauveli	8	50	0	0	58
Notomastus aberrans	3	13	0	5	21
Notomastus sp.	3	5	0	5	13
Other Capitellids	2	3	10	13	27
Maldanidae					
Maldane sarsi?	0	0	3	0	3
Other Maldanids	5	3	3	0	10
Flabelligeridae					
Phreusa monroi	0	3	0	0	3

Transect	naga	cudd	chen	krish	Total
Priomis arenosus	2	0	0	0	2
Diplocirrus capensis	2	0	3	0	4
Ampharetidae					
Melinna cristata	0	0	10	0	10
Isolda pulchella	0	5	0	0	5
Amphicteis gunneri	68	160	0	0	228
Amphicteis posterobranchiata	0	5	0	0	5
Amphicteis sp.	0	0	3	0	3
Other Ampharetids	0	33	128	253	413
Terebellidae					
Trichobranchus glacialis	0	8	0	0	8
Terebellides stroemi	0	8	3	0	10
Polycirrus sp.	0	0	0	3	3
Streblosoma persica	0	3	0	0	3
Pista unibranchia	2	8	0	0	9
Pista cristata	2	13	0	3	17
Other Terebellids	2	5	0	0	7
Sabellidae					
Chone filicaudata	0	15	0	13	28
Euchone rosea	3	40	0	15	58
Euchone capensis?	0	53	0	0	53
Other Sabellids	2	10	0	5	17
CRUSTACENS					
Amphipods	3	70	38	395	506
Isopods	0	5	3	18	25
Tanaids	3	3	0	0	6
Herpacticoid copepods	7	5	5	30	47
Campylaspis sp.	0	38	23	365	425
Oxyurostylis sp.	0	8	0	0	8
Eocuma trvancoricum	0	0	3	0	3
Heterocuma sp.	0	0	0	13	13
Iphione sp.	0	5	0	0	5
Leptostylis sp.	2	0	0	0	2
Diastylis granulata?	0	5	0	0	5
Pycnogonids	0	20	5	5	30
Mysids	3	10	10	5	28

Transect	naga	cudd	chen	krish	Total
Pinnixa sp	0	5	3	0	8
Pinnotherids	0	3	0	5	8
Porcellanids	0	0	3	0	3
Uca sp.	2	0	0	3	4
Other decapod crabs	0	3	0	3	5
Squilla sp.	2	3	3	0	7
Stomatopods	3	0	3	0	6
MOLLUSCS					
Terebra spp.	3	0	3	0	5
Aloides bifrons	3	0	0	0	3
Donax sp.	3	3	0	3	8
Telinna perrieri	0	20	3	0	23
Telinna sp.	8	0	0	8	15
Portlandia sp.	0	75	63	300	438
Dosinia rustica	0	68	0	38	105
Macoma sp.	0	18	0	0	18
Codakia punctata	0	0	3	3	5
Nuculata sp.	0	0	0	15	15
Bivalves	5	18	8	3	33
Xenophora sp.	3	0	3	0	5
Natica sp.	3	0	0	0	3
Ancilla ampla	3	0	0	0	3
Ancilla spp.	5	3	0	0	8
Trochus tentorium	13	0	0	0	13
Umbonium vestiarium	3	0	3	0	5
Corculum monstrosum	0	0	0	18	18
Gastropods	0	0	0	3	3
Ischnochiton comptus	0	0	5	0	5
ECHINODERMS					
Other Brittle stars	5	15	20	0	40
Echinometra mathaei	2	0	0	0	2
Laganum sp.	2	0	0	0	2
Holothuria sp	2	0	0	0	2
Unidentified organisms	2	8	0	0	9

200M depth range SE coast (in no. per sq.m)					
Transect	**naga**	**cudd**	**chen**	**krish**	**Total**
Depth(m)	**188.7**	**169**	**200**	**203**	
Station No.	**28**	**32**	**36**	**40**	
Foraminiferans	13	10	13	0	35
Corals	0	3	0	0	3
Nematodes	8	0	0	0	8
Spadella sp.	8	5	23	8	43
Oligochaetes	5	0	5	0	10
POLYCHAETES					
Errantia					
Aphroditidae					
Other Aphroditids	10	3	15	0	28
Amphinomidae					
Hipponoa sp.	0	3	0	0	3
Eurythoe matthaii	3	0	0	0	3
Other Amphinomids	5	0	8	0	13
Phyllodocidae					
Phyllodoce sp.1	8	0	0	0	8
Pilargidae					
Ancistrosyllis parva	5	33	13	8	58
Syllidae					
Exogone sp.1	0	0	3	0	3
Nereidae					
Ceratoneris mirabilis	3	0	0	0	3
Other Nereids	0	3	0	0	3
Nephtyidae					
Nephtys dibranchis	0	55	0	10	65
Glyceridae					
Glycera longipinnis	5	0	0	0	5
Glycera convoluta	0	5	0	0	5
Goniada emerita	10	5	28	0	43
Glycinde kameruniana	10	3	0	0	13
Eunicidae					
Eunice sp.1	3	0	0	0	3
Eunice sp.2	3	0	0	0	3
Onuphis sp.	3	5	0	0	8
Lumbrineris sp.2	0	3	0	0	3

Transect	naga	cudd	chen	krish	Total
Lumbrineris sp.3	0	10	0	0	10
Driloneris falcata	5	3	0	0	8
Other Eunicids	20	0	0	0	20
Sedentaria					
Spionidae					
Spiophanes bombyx	0	8	0	0	8
Rhynchospio foliosa	0	3	0	0	3
Prionospio cirrifera	3	0	18	0	21
Prionospio pinnata	10	0	0	0	10
Prionospio(minospio) elegantula	3	48	0	0	50
Prionospio(minospio) pulchra	0	10	0	0	10
Prionospio sp.1	13	13	0	13	38
Prionospio sp.2	5	0	3	0	8
Prionospio sp.4	0	0	55	0	55
Other Spionids	3	8	0	0	10
Magelonidae					
Magelona cincta	0	0	3	0	3
Cirratulidae					
Tharyx marinoi	0	3	0	0	3
Tharyx dorsobranchialis	545	3	383	0	930
Tharyx annnulosus	5	3	3	0	10
Tharyx sp.1	0	55	0	0	55
Caulleriella bioculatus	15	0	0	0	15
Chaetozone sp.	0	0	40	0	40
Cirratulus cirratus	20	0	0	0	20
Cirratulus sp.	8	0	0	0	8
Other cirratulids	28	3	388	0	418
Poecilochaetidae					
Poecilochaetus serpens	0	0	3	0	3
Chaetopteridae					
Chaetopterus varieopedatus	3	0	0	0	3
Mesochaetopterus capensis	3	0	0	0	3
Orbiniidae					
Other Orbinids	0	0	0	3	3
Paraonidae					
Aricidea fauveli	5	0	0	0	5

Transect	naga	cudd	chen	krish	Total
Aricidea capensis	3	0	0	0	3
Aricidea sp.	175	0	0	0	175
Cirrophorus branchiatus	3	0	0	0	3
Paraonis gracilis gracilis	225	300	260	0	785
Cossuridae					
Cossura coasta	5	28	348	18	398
Capitellidae					
Notomastus fauveli	25	3	0	0	28
Notomastus aberrans	13	0	3	0	15
Other Capitellids	0	38	148	0	185
Maldanidae					
Euclymene lombricoides	3	0	0	0	3
Other Maldanids	15	0	3	0	18
Sternaspidae					
Sternaspis scutata	0	10	0	0	10
Ampharetidae					
Isolda pulchella	150	0	3	0	153
Amphicteis gunneri	505	3	0	0	508
Amphicteis posterobranchiata	3	0	0	0	3
Amphicteis sp.	0	3	0	0	3
Ampharete sp.	0	0	3	0	3
Other Ampharetids	15	135	645	0	795
Terebellidae					
Pista cristata	8	0	0	0	8
Other Terebellids	8	0	0	0	8
Sabellidae					
Euchone rosea	153	3	5	0	160
Euchone capensis?	3	0	0	0	3
Fabricia filamentosa	3	0	0	0	3
Hypsicomus capensis	5	0	0	0	5
Jasmineria elegans	10	0	0	0	10
Other Sabellids	83	0	3	0	85
CRUSTACEANS					
Amphipods	145	70	93	0	308
Isopods	5	20	20	3	48
Tanaids	3	3	3	0	8
Herpacticoid copepods	30	50	23	10	113
Campylaspis sp.	0	18	0	70	88

Transect	naga	cudd	chen	krish	Total
Oxyurostylis sp.	3	0	3	0	5
Leucon sp.	5	0	0	0	5
Eurodella sp.	18	0	3	0	20
Ostracods	0	0	5	0	5
Pycnogonids	10	0	5	0	15
Mysids	15	0	18	0	33
Prawns	0	0	3	0	3
Pinnixa sp	0	5	0	0	5
Pinnotherids	0	0	3	0	3
Euclosia sp.	3	0	0	0	3
Hexapus sp.	3	0	0	0	3
Other decapod crabs	0	0	0	13	13
Squilla sp.	5	0	0	0	5
Other crustaceans	3	3	0	0	5
MOLLUSCS					
Chione squamosa	0	5	0	0	5
Cardium sp.	0	0	3	0	3
Donax cuneatus	0	0	0	30	30
Donax sp.	3	0	0	0	3
Telinna perrieri	53	0	0	0	53
Paphia malabarica	5	0	3	0	8
Dosinia rustica	0	0	3	0	3
Macoma sp.	0	13	0	0	13
Codakia punctata	0	0	40	0	40
Bivalves	18	0	33	0	50
Cuspidaria sp.	0	0	3	0	3
Periglypta sp.	8	0	0	0	8
Gastropods	0	0	8	0	8
ECHINODERMS					
Other Brittle stars	23	0	0	0	23
Sand dollars	0	5	0	0	5
Holothuria sp	3	0	0	0	3
CEPHALOCHORDATES					
Branchiostoma lanceolatum	0	0	3	0	3
FISHES					
Eel	0	5	3	0	8
Unidentified organisms	13	0	28	0	40

Table 6.11 Polychaete species occurrence during 2001 and 2005 along SW coast

Species	2005	2001
Harmothoe antilopis	√	A
Harmothoe lagiscoides serrata	√	A
Sthenelais boa	A	√
Sthenelais sp.	A	√
Lepidonotus carinulatus	√	A
Other Aphroditids	√	√
Paleanotus chrysolepis	√	A
Palmyrid sp.	√	A
Paramphinome indica	A	√
Pseudeurythoe sp.	A	√
Euphrosine spp.	A	√
Euphrosine myrtosa?	√	A
Eurythoe parvecarunculata	√	A
Eurythoe sp.1	√	A
Pherecardia striata	√	A
Other Amphinomids	√	A
Eteone sp.	√	A
Mystides sp.?	√	A
Pision oerstedi	A	√
Phyllodoce longipes	√	A
Phyllodoce dissotyla	A	A
Phyllodoce spp.	A	√
Phyllodoce sp.1	√	A
Phyllodoce sp.2	√	A
Notophyllum splendens?	√	A
Other Phyllodocids	√	√
Travisiopsis dubia	√	A
Travisiopsis sp.	√	A
Alciopids	A	√
Ancistrosyllis parva	√	√
Ancistrosyllis constricta	A	√
Ancistrosyllis spp.	A	√
Ancystrosyllis sp.	√	A

Species	2005	2001
Syllidia armata	√	A
Hesione splendida	√	A
Hesione sp.	√	A
Kefersteinia cirrata	√	A
Leocrates clapredii	√	A
Gyptis capensis	√	A
Other Hesionids	√	√
Syllis ferrugina	A	√
Syllis spongicola	√	√
Syllis gracilis	√	A
Syllis amica	√	A
Syllis cornuta	√	A
Syllis benguellana	√	A
Syllis sp.1	√	A
Syllis sp.2	√	A
Syllis sp.3	√	A
Syllis spp.	A	√
Eusyllis blomstrandi	√	A
Brania sp.	√	A
Exogone clavator	√	A
Exogone verugera	√	A
Exogone gemmifera	√	A
Exogone sp.1	√	√
Sphaerosyllis capensis	√	A
Sphaerosyllis sublaevis	√	A
Sphaerosyllis sp.1	√	A
Sphaerosyllis sp.2	√	A
Other Syllids	√	√
Sphaerodorid sp.	√	A
Platyneris sp.	√	A
Nereis persica?	√	A
Nereis sp.1	√	√
Nereis sp.2	√	A
Ceratoneris mirabilis	√	A

Species	2005	2001
Ceratoneris sp.	√	A
Leonnates sp.	√	A
Other Nereids	√	√
Nephtys inermis	A	√
Nephtys dibranchis	√	√
Nephtys polybranchia	A	√
Nephtys lyrochaeta	√	A
Nephtys capensis	√	A
Nephtys paradoxa	√	A
Nephtys sp. 1	√	√
Nephtys sp.2	A	√
Nephtys sp.3	A	√
Paralacydonia paradoxa	√	√
Glycera longipinnis	√	√
Glycera natalensis	√	A
Glycera papillosa	√	A
Glycera convoluta	√	A
Glycera alba	√	A
Gycera subaenea	√	A
Glycera sp.1	√	√
Glycera sp2	A	√
Glycera spp	A	√
Goniada emerita	√	√
Goniada maculata	√	A
Goniada sp.	√	√
Goniadella gracilis	√	A
Glycinde kameruniana	√	A
Glycinde sp.	√	A
Eunice cincta	√	A
Eunice antennata	√	A
Eunice australis	√	A
Eunice vittata	√	A
Eunice indica	√	√
Eunice coccinea	A	√

Species	2005	2001
Eunice spp.	A	√
Nematonereis unicornis	A	√
Diopatra sp	A	√
Onuphis holobranchiata	A	√
Onuphis investigatoris	A	√
Eunice norvegica?	√	**A**
Eunice tentaculata	√	**A**
Eunice sp.1	√	**A**
Eunice sp.2	√	**A**
Eunice sp.3	√	**A**
Marphysa purcellana	√	**A**
Marphysa adenensis	√	**A**
Marphysa sp.	√	**A**
Epidiopatra sp.	√	**A**
Hayalonoecia tubicola	√	**A**
Diopatra neapolitana capensis	√	**A**
Diopatra neapolitana neapolitana	√	**A**
Diopatra monroi	√	**A**
Onuphis emerita	√	**A**
Onuphis sp.	√	√
Lumbrineris meteorana	√	**A**
Lumbrinereis albidentata	√	**A**
Lumbrineris laterilli	√	√
Lumbrineris aberrans	√	√
Lumbrineris simplex	A	√
Lumbrineris heteropoda	√	√
Lumbrineris sp.1	√	**A**
Lumbrineris sp.2	√	**A**
Lumbrineris sp.3	√	**A**
Lumbrineris spp.	A	√
Arabella iricolor	√	√
Arabella sp.	√	**A**
Driloneris falcata	√	**A**
Driloneris monroi	√	**A**

Species	2005	2001
Notocirrus australis	√	A
Protodorvillea biarticulata	√	A
Protodorvillea egena	√	√
Dorvellia gardineri	√	A
Dorvellia rudolphi	√	√
Dorvellia rubrovittata	√	A
Other Eunicids	√	A
Polydora capensis	√	A
Polydora sp.1	√	√
Polydora sp.2	√	A
Spiophanes bombyx	√	√
Spoiphanes sp.1	√	A
Spiophanes urceolata?	√	A
Malacoceros indicus	√	√
Rhynchospio sp.	√	A
Aonides oxycephala	√	√
Aonidella dayi	√	A
Aonida sp.	√	A
Laonice cirrata	√	√
Laonice sp.	A	√
Dispio oculata	√	A
Scolelepis branchia	√	A
Scololepis lefebvrei	√	A
Scololepis sp.	√	√
Prionospio cirrifera	√	√
Prionospio cirrobranchiata	√	√
Prionospio pinnata	√	√
Prinospio cornuta	√	A
Prinospio membranacea	√	A
Prionospio(M) andamanensis	√	A
Prionospio ehlersi	√	A
Prionospio(minospio) elegantula	√	A
Prionospio(minospio) pulchra	√	A
Prionospio krusadensis	A	√

Species	2005	2001
Prionospio spp.	A	√
Prionospio sp.1	√	A
Prionospio sp.2	√	A
Prionospio sp.3	√	A
Prionospio (M) sp.	√	A
Other Spionids	√	√
Magelona cincta	√	√
Magelona sp.	√	A
Tharyx filibranchia	√	A
Tharyx dorsobranchialis	√	A
Tharyx annnulosus	√	A
Dodecaceria capensis	A	√
Tharyx marioni?	A	√
Tharyx sp.1	√	√
Tharyx sp.2	√	A
Caulleriella bioculatus	√	A
Chaetozone setosa	√	A
Chaetozone sp.	√	A
Cirratulus cirratus	√	A
Cirratulus dasylophius	A	√
Cirratulus sp.	√	√
Cirrformia sp.	√	√
Other cirratulids	√	√
Heterospionid sp.	√	A
Poecilochaetus serpens	√	√
Chaetopterus varieopedatus	√	A
Chaetopterus sp.	√	√
Scoloplella sp	A	√
Naineris laevigata	√	A
Phylo foetida foetida	√	√
Scoloplos johnestonei	A	√
Scoloplos chavaliem	A	√
Haploscoloplos kerguelensis	√	A
Scolaricia dubia?	√	A

Species	2005	2001
Scholoplos marsupialis	√	A
Scholoplos uniramus	√	A
Scoloplos sp.	√	√
Other Orbinids	√	√
Aricidea curviceta	√	A
Aricidea suecia simplex	√	A
Aricidea fauveli	√	√
Aricidea longobranchiata	√	A
Aricidea capensis	√	A
Aricidea sp.	√	√
Aricidea sp2	A	√
Cirrophorus branchiatus	√	A
Cirrophorus sp.	√	√
Aedicira sp.	√	A
Paraonis gracilis gracilis	√	√
Paraonis sp.	√	A
Paraonides lyra lyra	√	A
Paraonides sp.	A	√
Other Paraonids	√	A
Ophelia sp.	√	A
Travisia forbesii	√	A
Travisia arborifera	√	A
Armandia longicaudata	√	A
Armandia intermedia	√	√
Armandia leptocirrus	√	A
Armandia sp.	√	√
Polyophthalmus pictus	√	√
Cossura coasta	√	√
Cossura sp.1	√	A
Capitella capitata	√	A
Notomastus fauveli	√	A
Notomastus aberrans	√	√
Notomastus giganteus	A	√
Dasybranchus cadacus?	A	√

Species	2005	2001
Dasybranchus sp	A	√
Notomastus sp.	√	A
Other Capitellids	√	A
Arenicolid sp.	√	A
Axiothella jarli	√	A
Euclymene cf. oerstedii	√	A
Euclymene lombricoides	√	A
Other Maldanids	√	√
Sternaspis scutata	√	√
Flabelligera sp.	√	A
Phreusa monroi	√	A
Pherusa sp.	√	A
Priomis arenosus	√	A
Diplocirrus capensis	√	A
Other Flabelligerids	√	A
Pectinaria(pectinaria) papillosa	√	A
Pectinaria sp.	A	√
Melinna cristata	√	√
Melinna sp.	√	√
Isolda pulchella	√	A
Amphicteis gunneri	√	√
Amphicteis sp.	√	√
Ampharete acutiforns	√	A
Amparete capensis	√	A
Ampharete sp.	√	A
Other Ampharetids	√	√
Trichobranchus glacialis	√	A
Trichobranchus sp.	√	√
Terebellides stroemi	√	√
Terebellides sp.	√	A
Polycirrus sp.	√	A
Streblosoma persica	√	A
Streblosoma sp.	√	A
Pista unibranchia	√	√

Species	2005	2001
Pista brevibranchia	√	√
Pista cristata	√	**A**
Pista indica	A	√
Pista macrolobata	√	**A**
Pista quadrilobata	√	**A**
Pista sp1	A	√
Pista sp2	A	√
Pista spp.	A	√
Terebella sp.	√	**A**
Other Terebellids	√	√
Chone filicaudata	√	**A**
Euchone rosea	√	**A**
Euchone capensis?	√	**A**
Fabricia filamentosa	√	**A**
Hypsicomus capensis	√	**A**
Jasmineria elegans	√	√
Megalomma vesiculosum	√	√
Potamila ehleri	A	√
Potamila sp.	A	√
Megalomma sp.	√	**A**
Other Sabellids	√	√
Pomatoleios crosslandi	A	√
Portula tublaria	A	√
Hydroides norvegica	A	√
Hydroides aldicipes	A	√
Hydroides heteroceros	√	**A**
Hydroides sp.	√	**A**
Other Serpulids	√	**A**
Unidentified polychaete sp.1	√	√
Unidentified polychaete sp.2	√	√
Unidentified polychaete sp.3	√	**A**
Unidentified polychaete sp.4	√	**A**
Unidentified polychaete sp.5	√	√
Unidentified polychaete sp.6	√	**A**

Table 6.12a. List of polychaetes species and its occurrence in various depths along Southwest coast

S=sand, SSi= sandy silt, CSi= clayey silt; A=abundant, M= moderately present, R=rare

Species	Occurrence	Depth(m)	Substratum Preference
Harmothoe antilopis	**M**	50M	S
Harmothoe lagiscoides serrata	**R**	100M	S
Lepidonotus carinulatus	**R**	30M	S
Other Aphroditids	**A**	30,50,75,100,200M	S
Paleanotus chrysolepis	**R**	100M	S
Palmyrid sp.	**R**	30M	SSi
Euphrosine myrtosa?	**R**	50M	S
Eurythoe parvecarunculata	**M**	30,50,100,200M	S
Eurythoe sp.1	**M**	30,50,75,100,200M	S
Pherecardia striata	**R**	50M	S
Other Amphinomids	**M**	30,50M	S
Eteone sp.	**R**	50M	S
Mystides sp.?	**R**	50M	S
Phyllodoce longipes	**R**	100M	S
Phyllodoce sp.1	**M**	30,50,100,200M	S
Phyllodoce sp.2	**M**	30, 100M	S
Notophyllum splendens?	**R**	100M	S
Other Phyllodocids	**M**	30,50,75,100,200M	S
Travisiopsis dubia	**R**	50M	S
Travisiopsis sp.	**R**	100M	S
Ancistrosyllis parva	**A**	30,50,100,200M	S,SSi,CSi
Ancystrosyllis sp.	**M**	50M	S
Syllidia armata	**M**	30, 50M	CSi,S, SSi
Hesione splendida	**M**	50, 200M	S
Hesione sp.	**M**	50M	S
Kefersteinia cirrata	**M**	50M	S
Leocrates clapredii	**M**	50,200M	S
Gyptis capensis	**M**	30,50,100,200M	S, SSi
Other Hesionids	**M**	30,50,100,200M	S, SSi
Syllis spongicola	**M**	30,50,100,200M	S
Syllis gracilis	**M**	30,50,100,200M	S

Species	Occurrence	Depth(m)	Substratum Preference
Syllis amica	**M**	30,50,100M	S
Syllis cornuta	**R**	50M	S
Syllis benguellana	**M**	100, 200M	S
Syllis sp.1	**A**	30,50,100M	S, SSi
Syllis sp.2	**M**	30,50M	S
Syllis sp.3	**M**	50M	S
Eusyllis blomstrandi	**M**	50M	S
Brania sp.	**R**	50M	S
Exogone clavator	**M**	30,50,75M	S
Exogone verugera	**M**	50M	S
Exogone gemmifera	**M**	50M	S
Exogone sp.1	**M**	30,50,100M	S
Sphaerosyllis capensis	**M**	30M	S
Sphaerosyllis sublaevis	**M**	100M	S
Sphaerosyllis sp.1	**M**	30,50, 100M	S, SSi
Sphaerosyllis sp.2	**R**	50M	S
Other Syllids	**M**	30,50,100	S, SSi
Sphaerodorid sp.	**M**	200M	S
Platyneris sp.	**R**	50M	S
Nereis persica?	**M**	30,50M	S
Nereis sp.1	**M**	30,50M	S
Nereis sp.2	**M**	30M	S
Ceratoneris mirabilis	**M**	50,100,200M	S
Ceratoneris sp.	**R**	100M	S
Leonnates sp.	**R**	30M	S
Other Nereids	**M**	100M	SSi
Nephtys dibranchis	**A**	30,50,100,200M	S, SSi
Nephtys lyrochaeta	**M**	50, 200M	S
Nephtys capensis	**R**	50M	S
Nephtys paradoxa	**M**	50M	S
Nephtys sp.	**M**	30,50,75M	S
Paralacydonia paradoxa	M	30,50,100M	S, SSi
Glycera longipinnis	**A**	30,50,100,200M	S, SSi
Glycera natalensis	**R**	30M	CSi
Glycera papillosa	**R**	50M	S

Species	Occurrence	Depth(m)	Substratum Preference
Glycera convoluta	**M**	30,50,100,200M	S, SSi
Glycera alba	**R**	50M	S
Gycera subaenea	**M**	100,200M	S, SSi
Glycera sp.1	**M**	30,50,100,200M	S,SSi,CSi
Goniada emerita	**M**	30,50,100,200M	S, SSi
Goniada maculata	**M**	30,75,100,200M	S
Goniada sp.	**M**	50,100M	S
Goniadella gracilis	**R**	100M	S
Glycinde kameruniana	**M**	30,50,100	S
Glycinde sp.	**R**	100M	S
Eunice cincta	**R**	75M	S
Eunice antennata	**M**	30,50M	S
Eunice australis	**M**	30,50,100M	S
Eunice vittata	**M**	50,100M	S
Eunice indica	**M**	30,50,100,200M	S
Eunice norvegica?	**M**	50M	S
Eunice tentaculata	**M**	50M	S
Eunice sp.1	**A**	30,50,100,200M	CSi,S
Eunice sp.2	**M**	30,50,100M	S
Eunice sp.3	**M**	30,50,100M	S
Marphysa purcellana	**M**	100M	S
Marphysa adenensis	**R**	100M	S
Marphysa sp.	**M**	100M	S
Epidiopatra sp.	**R**	100M	S
Hayalonoecia tubicola	**M**	30,50,100M	S
Diopatra neapolitana capensis	**R**	50M	S
Diopatra neapolitana neapolitana	**M**	30,50M	S, SSi
Diopatra monroi	**R**	100M	S
Onuphis emerita	**M**	50M	S
Onuphis sp.	**M**	30,50,100,200M	S
Lumbrineris meteorana	**M**	50,100M	S
Lumbrinereis albidentata	**M**	50, 100M	S
Lumbrineris laterilli	**M**	30,50,100	S,CSi
Lumbrineris aberrans	**M**	30,50,100M	S, SSi
Lumbrineris heteropoda	M	50M	S

Species	Occurrence	Depth(m)	Substratum Preference
Lumbrineris sp.1	**M**	30,50,100M	S, SSi
Lumbrineris sp.2	**M**	50,100M	S, SSi
Lumbrineris sp.3	**M**	50,100M	S, SSi
Arabella iricolor	**M**	30,50M	S
Arabella sp.	**M**	30,50,75M	S
Driloneris falcata	**M**	30,50,75,100M	S, SSi
Driloneris monroi	**M**	50M	S
Notocirrus australis	**M**	50M	S
Protodorvillea biarticulata	**R**	50M	S
Protodorvillea egena	M	50M	S
Dorvellia gardineri	**R**	50M	S
Dorvellia rudolphi	**M**	30,50,100,200M	S
Dorvellia rubrovittata	**M**	50M	S
Other Eunicids	**M**	50M	S
Polydora capensis	**M**	50M	S
Polydora sp.1	**M**	50,100M	S, SSi
Polydora sp.2	**M**	50M	S
Spiophanes bombyx	**M**	30,50,100,200M	S,CSi
Spoiphanes sp.1	**M**	30,50,100M	S
Spiophanes urceolata?	**M**	200M	S
Malacoceros indicus	**M**	30,50,75,100M	S,CSi
Rhynchospio sp.	**R**	30M	S
Aonides oxycephala	**M**	30,50,100	S
Aonidella dayi	**M**	50,100,200M	SSi,S
Aonida sp.	**M**	100M	S
Laonice cirrata	**M**	30,100M	S,CSi
Dispio oculata	**M**	50M	S
Scolelepis branchia	**M**	30,50M	S
Scololepis lefebvrei	**M**	30M	S
Scololepis sp.	**M**	30,200M	S
Prionospio cirrifera	**M**	30,50,100,200M	S,SSi,CSi
Prionospio cirrobranchiata	M	100M	S
Prionospio pinnata	**A**	30,50,100,200M	S, SSi
Prinospio cornuta	**M**	30,100M	S
Prinospio membranacea	**M**	30,100M	S

Species	Occurrence	Depth(m)	Substratum Preference
Prionospio(M) andamanensis	**A**	30,50,100,200M	S,CSi
Prionospio ehlersi	**M**	30,50,100	S
Prionospio(minospio) elegantula	**M**	50,200M	S
Prionospio(minospio) pulchra	**M**	30,50,100,200M	S
Prionospio sp.1	**A**	30,50,75,100,200M	S,SSi,CSi
Prionospio sp.2	**M**	50,100M	S
Prionospio sp.3	**M**	50M	S
Prionospio (M) sp.	**M**	100M	S
Other Spionids	**M**	30,50,100,200M	S, SSi
Magelona cincta	**A**	30,50,100,200M	S, SSi
Magelona sp.	**M**	50,100,200M	S
Tharyx filibranchia	**M**	50,100M	S
Tharyx dorsobranchialis	**A**	30,50,75,100,200M	S, SSi
Tharyx annnulosus	**M**	50,100,200M	S, SSi
Tharyx sp.1	**M**	50,100,200M	S, SSi
Tharyx sp.2	**M**	50M	S
Caulleriella bioculatus	**M**	30,50,100M	S
Chaetozone setosa	**M**	50,100M	S
Chaetozone sp.	**M**	50,100M	S, SSi
Cirratulus cirratus	**M**	50,100,200M	S, SSi
Cirratulus sp.	**M**	30,50,100,200M	S
Cirrformia sp.	**M**	50M	S
Other cirratulids	**A**	30,50,100,200M	S
Heterospionid sp.	**M**	30,50M	S,CSi
Poecilochaetus serpens	**M**	30,50,75,100M	S, SSi
Chaetopterus varieopedatus	**M**	30,50M	S
Chaetopterus sp.	**M**	30,200M	S
Naineris laevigata	**M**	30,100M	S, SSi
Phylo foetida foetida	**R**	100M	S
Haploscoloplos kerguelensis	M	50,100M	S
Scolaricia dubia?	**M**	50,75M	S
Scholoplos marsupialis	M	50M	S
Scholoplos uniramus	**M**	30,50,100M	S
Scoloplos sp.	M	30,50M	S
Other Orbinids	A	30,50,100,200M	S, SSi

Species	Occurrence	Depth(m)	Substratum Preference
Aricidea curviceta	M	50,200M	S
Aricidea suecia simplex	M	50M	S
Aricidea fauveli	M	30,50,100,200M	S
Aricidea longobranchiata	A	30,50,75,100,200M	S, SSi
Aricidea capensis	M	30,50,100,200M	S, SSi
Aricidea sp.	A	30,50,75,100,200M	S
Cirrophorus branchiatus	M	50,100,200M	S
Cirrophorus sp.	M	50,100M	S, SSi
Aedicira sp.	R	30M	CSi
Paraonis gracilis gracilis	A	30,50,100,200M	S, SSi
Paraonis sp.	M	30,50,100,200M	S, SSi
Paraonides lyra lyra	M	100M	S
Other Paraonids	A	50,100,200M	S, SSi
Ophelia sp.	M	50M	S
Travisia forbesii	M	50M	S
Travisia arborifera	R	50M	S
Armandia longicaudata	M	50,75M	S
Armandia intermedia	M	30,50M	S
Armandia leptocirrus	R	30M	CSi
Armandia sp.	M	50M	S
Polyophthalmus pictus	M	30,50,75M	S,CSi
Cossura coasta	M	30,50,100,200M	S, SSi
Cossura sp.1	M	50M	S
Capitella capitata	M	50M	S
Notomastus fauveli	A	30,50,100,200M	S
Notomastus aberrans	A	30,50,100,200M	S, SSi
Notomastus sp.	M	50,100,200M	S
Other Capitellids	A	30,50,100,200M	S,SSi,CSi
Arenicolid sp.	M	30M	S
Axiothella jarli	M	50,200M	S
Euclymene cf. oerstedii	M	50,200M	S
Euclymene lombricoides	M	50M	S
Other Maldanids	A	30,50,75,100,200M	S,SSi,CSi
Sternaspis scutata	M	50,100,200M	S
Flabelligera sp.	R	50M	S

Species	Occurrence	Depth(m)	Substratum Preference
Phreusa monroi	M	50M	S
Pherusa sp.	M	50M	S
Priomis arenosus	M	50M	S
Diplocirrus capensis	M	50,100M	S, SSi
Other Flabelligerids	M	50,100M	S
Pectinaria(pectinaria) papillosa	M	100M	S
Melinna cristata	M	30,50,100M	S
Melinna sp.	M	30,50M	S
Isolda pulchella	M	30,50,75,100,200M	S
Amphicteis gunneri	M	30,50,100M	S
Amphicteis sp.	M	100,200M	S, SSi
Ampharete acutiforns	M	30,50M	S, SSi
Amparete capensis	M	50M	S
Ampharete sp.	M	30,50,100,200M	S
Other Ampharetids	A	30,50,100,200M	S, SSi
Trichobranchus glacialis	M	50M	S
Trichobranchus sp.	R	50M	S
Terebellides stroemi	M	30,50,100M	S, SSi
Terebellides sp.	M	50,100M	S
Polycirrus sp.	M	50,100M	S, SSi
Streblosoma persica	M	30,50M	S
Streblosoma sp.	R	50M	S
Pista unibranchia	M	50,100M	S
Pista brevibranchia	M	50M	S
Pista cristata	M	30,50,200M	S
Pista macrolobata	R	50M	S
Pista quadrilobata	M	30,50,100M	S
Terebella sp.	R	50M	S
Other Terebellids	M	30,50,100,200M	S, SSi
Chone filicaudata	M	30,50,100M	S
Euchone rosea	M	30,50M	S
Euchone capensis?	R	50M	S
Fabricia filamentosa	M	50M	S
Hypsicomus capensis	R	50M	S
Jasmineria elegans	M	50M	S

Species	Occurrence	Depth(m)	Substratum Preference
Megalomma vesiculosum	M	30,50M	S
Megalomma sp.	R	100M	S
Other Sabellids	M	30,50,100,200M	S
Hydroides heteroceros	M	50M	S
Hydroides sp.	R	50M	S
Other Serpulids	R	200M	S
Unidentified polychaete sp.1	R	50M	S
Unidentified polychaete sp.2	M	50M	S
Unidentified polychaete sp.3	M	30,200M	S
Unidentified polychaete sp.4	M	50,100M	S
Unidentified polychaete sp.5	M	30,50M	S
Unidentified polychaete sp.6	M	30,50M	S

Table 6.12b. List of polychaetes species and its occurrence in various depths along Southeast coast

S=sand, SSiC= sand-silt-clay, CSi= clayey silt; A=abundant, M= moderately present, R=rare

Species	Occurrence	Depth (m)	Substratum Preference
Harmothoe antilopis	**M**	50,100M	S
Harmothoe sp.	**M**	50M	S
Psammolyce articulata	**R**	30M	S
Other Aphroditids	**A**	30,50,100,200M	S,SSiC,Csi
Paleanotus chrysolepis	**M**	50M	S
Hipponoa sp.	**R**	200M	SSiC
Eurythoe matthaii	**R**	200M	S
Eurythoe sp.1	**M**	30,50,100M	S
Other Amphinomids	**M**	30,100,200M	S
Phyllodoce sp.1	**M**	200M	S
Other Phyllodocids	**M**	30,50,100M	S
Pontodora pelagica	**R**	50M	S
Ancistrosyllis parva	**A**	30,50,100,200M	S,SSiC,Csi
Ancystrosyllis sp.	**R**	50M	S
Loandalia sp.	**R**	50M	S
Other Pilargids	**R**	50M	S

Species	Occurrence	Depth (m)	Substratum Preference
Ohiodromus spinosus	**R**	30M	S
Ophiodromus sp.	**M**	50,30M	S
Syllidia armata	**R**	30M	S
Syllidia sp.	**R**	100M	S
Other Hesionids	**M**	30,100M	S
Syllis spongicola	**M**	30,50M	S
Syllis gracilis	**M**	50,30M	S
Syllis(Langerhansia) anops	**R**	30M	S
Syllis sp.1	**A**	30,50,100M	S,Csi
Syllis sp.2	**M**	30,50M	S
Lamellisyllis comans	**R**	50M	S
Pionosyllis sp.	**R**	30M	S
Brania pusilla	**R**	30M	S
Exogone clavator	**M**	30,50M	S
Exogone gemmifera	**M**	50M	S
Exogone sp.1	**M**	30,50,200	S
Sphaerosyllis semiverucosa	**R**	100M	S
Other Syllids	**M**	30,50,100M	S
Sphaerodorid sp.	**R**	100M	S
Nereis sp.1	**M**	30,100M	S
Nereis sp.2	**R**	30M	S
Nereis sp.3	**M**	30M	S
Ceratoneris mirabilis	**M**	30,50,100,200M	S
Other Nereids	**M**	30,50,200M	S,SSiC,Csi
Nephtys dibranchis	**A**	30,50,100,200M	S,SSiC,Csi
Paralacydonia paradoxa	**M**	30,50M	S,Csi
Glycera longipinnis	**A**	30,50,100,200M	S
Glycera natalensis	**M**	30,50M	S
Glycera benguellana	**R**	30M	S
Glycera convoluta	**M**	30,50,100,200M	S,SSiC,Csi
Glycera alba	**R**	50M	S
Gycera subaenea	**R**	100M	S
Glycera sp.1	**M**	30,50,100M	S,Csi
Glycera sp.2	**R**	50M	Csi
Goniada emerita	**A**	30,50,100,200M	S,SSiC

Species	Occurrence	Depth (m)	Substratum Preference
Goniada sp.	**R**	30M	S
Goniadella gracilis	**M**	30M	S
Glycinde kameruniana	**M**	30,200M	S,SSiC
Eunice indica	**M**	30,50,100M	S
Eunice tubifex?	**R**	50M	S
Eunice sp.1	**A**	30,50,100,200M	S,Csi
Eunice sp.2	**A**	30,50,100,200M	S,Csi
Eunice sp.3	**M**	30,50M	S
Marphysa purcellana	**M**	30,100M	S
Marphysa sp.	**M**	30,50,100M	S
Lysidice natalensis or capensis	**M**	30M	S
Lysidice sp.	**R**	30M	S
Nematonereis unicornis	**M**	30,50M	S
Hayalonoecia tubicola	**R**	100M	S
Diopatra sp.	**M**	30M	S
Onuphis sp.	**A**	30,50,100,200M	S,SSiC,Csi
Lumbrineris aberrans	**A**	30,50,100M	S,Csi
Lumbrineris heteropoda	**R**	100M	S
Lumbrineris sp.1	**A**	30,50,100M	S,Csi
Lumbrineris sp.2	**M**	30,50,200M	S,SSiC,Csi
Lumbrineris sp.3	**M**	30,50,200M	S,SSiC,Csi
Driloneris falcata	**A**	30,50,100,200M	S,SSiC,Csi
Drilonereis sp.	**M**	30M	S
Protodorvillea biarticulata	**M**	30,100M	S
Protodorvillea egena	**R**	30M	S
Dorvellia rudolphi	**M**	30M	S
Other Eunicids	**M**	30,50,200	S,Csi
Polydora capensis	**R**	50M	S
Spiophanes bombyx	**M**	30,50,200M	S,SSiC
Spoiphanes sp.1	**M**	30M	S
Spiophanes sp.2	**R**	100M	S
Spiophanes sp.3	**R**	100M	S
Malacoceros indicus	**M**	30,50,100M	S
Rhynchospio foliosa	**R**	200M	SSiC
Aonides oxycephala	**M**	30,50,100M	S,Csi

Species	Occurrence	Depth (m)	Substratum Preference
Spiogalea sp.	**R**	30M	S
Scolelepis branchia	**M**	30,100M	S
Scololepis sp.	**M**	100M	S
Prionospio cirrifera	**M**	30,100,200M	S,Csi
Prionospio cirrobranchiata	**M**	100M	S
Prionospio pinnata	**M**	50,100,200M	S
Prionospio bocki?	**R**	30M	S
Prionospio(M) andamanensis	**M**	100M	S
Prionospio(minospio) elegantula	**M**	50,200M	S,SSiC
Prionospio(minospio) pulchra	**M**	200M	SSiC
Prionospio sp.1	**A**	30,50,100,200M	S,SSiC,Csi
Prionospio sp.2	**M**	50,100,200M	S
Prionospio sp.3	**M**	50M	S
Prionospio sp.4	**M**	200M	S
Other Spionids	**A**	30,50,100,200M	S,SSiC
Magelona cincta	**A**	30,50,100,200M	S
Tharyx marinoi	**R**	200M	SSiC
Tharyx dorsobranchialis	**A**	30,50,100,200M	S,SSiC
Tharyx annnulosus	**A**	30,50,100,200M	S,SSiC,Csi
Tharyx sp.1	**M**	30,50,200M	S,SSiC,Csi
Tharyx sp.2	**R**	100M	S
Caulleriella bioculatus	**M**	30,50,100,200M	S
Chaetozone setosa	**R**	50M	S
Chaetozone brunnea	**M**	30,50,100	S
Chaetozone sp.	M	100,200M	S
Cirratulus cirratus	**M**	30,50,100,200M	S
Cirratulus sp.	**M**	100,200M	S
Other cirratulids	**A**	30,100,200M	S,SSiC
Heterospionid sp.	**M**	30M	S
Poecilochaetus serpens	**M**	30,50,100,200M	S
Chaetopterus varieopedatus	**M**	30,100,200M	S
Mesochaetopterus capensis	**R**	200M	S
Haploscoloplos kerguelensis	**M**	100,50M	S,Csi
Other Orbinids	**M**	30,50,100,200M	S,Csi
Aricidea fauveli	**M**	30,50,100,200M	S

Species	Occurrence	Depth (m)	Substratum Preference
Aricidea longobranchiata	**M**	30,100M	S
Aricidea capensis	**M**	30,50,100,200M	S
Aricidea sp.	**M**	30,50,100,200M	S
Cirrophorus branchiatus	**M**	50,200M	S
Cirrophorus sp.	**M**	30,50M	S
Aedicira sp.	**R**	30M	S
Paraonis gracilis gracilis	**A**	30,50,100,200M	S,SSiC,Csi
Paraonis sp.	**M**	30,100M	S
Paraonides lyra lyra	**M**	50M	S
Paraonides sp.	**R**	50M	Csi
Other Paraonids	**A**	30,50,100M	S,Csi
Ophelia sp.	R	30M	S
Armandia intermedia	**M**	50M	S
Armandia leptocirrus	**M**	30M	S
Armandia sp.	**M**	50M	S
Other Ophelids	**R**	30M	S
Cossura coasta	**A**	30,50,100,200M	S,SSiC,Csi
Capitella capitata	**R**	50M	S
Notomastus fauveli	**A**	30,50,100,200M	S,SSiC
Notomastus aberrans	**A**	30,50,100,200M	S,Csi
Notomastus sp.	**M**	30,100M	S,Csi
Other Capitellids	**A**	30,50,100,200M	S,SSiC,Csi
Euclymene lombricoides	**R**	200M	S
Maldane sarsi?	**R**	100M	S
Other Maldanids	**A**	30,50,100,200M	S,Csi
Sternaspis scutata	**M**	50,200M	S,SSiC
Owenia fusiformis	**M**	50M	S
Phreusa monroi	**R**	100M	S
Priomis arenosus	**M**	30,50,100M	S
Diplocirrus capensis	**M**	50,100M	S,Csi
Phalacrostemma sp.	**R**	50M	S
Melinna cristata	**M**	100M	S
Isolda pulchella	**M**	100,200M	S
Amphicteis gunneri	**A**	30,50,100,200M	S,SSiC,Csi
Amphicteis posterobranchiata	**M**	100,200M	S

Species	Occurrence	Depth (m)	Substratum Preference
Amphicteis sp.	**M**	30,50,100,200M	S,SSiC,Csi
Ampharete acutiforns	**R**	50M	S
Ampharete sp.	**M**	50,200M	S
Other Ampharetids	**A**	30,50,100,200M	S,SSiC
Trichobranchus glacialis	**M**	30,100M	S
Terebellides stroemi	**A**	30,50,100M	S,Csi
Terebellides sepultura	**R**	30M	S
Terebellides sp.	**M**	30M	S
Polycirrus sp.	**M**	30,50,100M	S
Streblosoma persica	M	30,50,100M	S,Csi
Pista unibranchia	**M**	30,50,100M	S
Pista brevibranchia	M	50M	S
Pista cristata	**A**	30,50,100,200M	S
Pista macrolobata	R	30M	S
Pista quadrilobata	R	50M	S
Loimia medusa	R	50M	S
Amphitrite cirrata	R	30M	S
Amphitrite sp.	M	30M	S
Other Terebellids	M	30,100,200M	S
Chone filicaudata	M	30,50,100M	S
Euchone rosea	M	30,100,200M	S,SSiC
Euchone capensis?	M	100,200M	S
Fabricia filamentosa	M	30,50,200M	
Fabricia capensis	R	50M	S
Hypsicomus capensis	M	50,200M	S
Jasmineria elegans	M	30,200M	S
Other Sabellids	A	30,50,100,200M	S,Csi
Hydroides sp.	M	50M	S
Unidentified polychaete sp.7	M	30,50M	S,Csi

Table 6.13a. Similarity index between stations with respect to polychaetes along the southwest coast of India.

30m depth range sw coast						
	kzh	vad	kch	klm	tvm	cape
kzh						
vad	9.45					
kch	13.70	23.57				
klm	9.51	31.63	27.50			
tvm	10.22	27.70	22.65	15.58		
cape	18.02	15.01	19.52	6.61	27.44	

50m depth range sw coast							
	knr	kzh	vad	kch	klm	tvm	cape
knr							
kzh	31.03						
vad	38.88	50.21					
kch	36.19	42.76	56.10				
klm	30.06	33.32	38.39	43.81			
tvm	32.67	34.69	37.80	37.68	49.50		
cape	34.86	23.44	26.65	36.26	34.35	42.84	

100m depth range sw coast						
	knr	kzh	vad	kch	klm	cape
knr						
kzh	21.19					
vad	31.56	27.92				
kch	33.40	26.74	33.52			
klm	19.04	46.71	29.06	26.69		
cape	20.52	24.31	28.02	32.17	38.22	

200m depth range sw coast					
	kzh	vad	kch	klm	cape
kzh					
vad	23.46				
kch	41.83	33.40			
klm	17.85	37.69	29.38		
cape	27.61	22.11	28.75	31.64	

Table 6.13b. Similarity index between stations with respect to polychaetes along the Southeast coast of India.

30m depth range se coast				
	naga	cudd	chen	krish
naga				
cudd	48.03			
chen	20.48	22.05		
krish	44.53	43.83	28.84	

50m depth range se coast				
	naga	cudd	chen	krish
naga				
cudd	43.03			
chen	26.56	25.81		
krish	26.38	20.58	34.28	

100m depth range se coast			
	naga	cudd	chen
naga			
cudd	30.65		
chen	29.73	26.18	
krish	31.50	46.33	32.88

200m depth range se coast			
	naga	cudd	chen
naga			
cudd	28.74		
chen	36.83	37.76	
krish	6.87	20.66	7.77

Table 6.14a. Similarity index between stations with respect to groups along the southwest coast of India.

30m depth range sw coast						
	kzh	vad	kch	klm	tvm	cape
kzh						
vad	27.23					
kch	20.20	30.25				
klm	23.32	32.92	27.98			
tvm	23.76	52.42	29.66	40.81		
cape	27.20	49.76	23.68	41.69	57.78	

50m depth range sw coast							
	knr	kzh	vad	kch	klm	tvm	cape
knr							
kzh	45.01						
vad	31.04	44.35					
kch	40.91	43.98	58.26				
klm	49.33	47.05	45.89	44.88			
tvm	46.76	47.24	45.04	46.08	51.52		
cape	47.01	46.89	45.19	50.79	43.51	59.45	

100m depth range sw coast						
	knr	kzh	vad	kch	klm	cape
knr						
kzh	23.20					
vad	28.41	45.27				
kch	40.21	46.32	35.17			
klm	38.66	27.49	28.32	42.99		
cape	27.17	41.06	36.26	39.75	27.21	

200m depth range sw coast					
	kzh	vad	kch	klm	cape
kzh					
vad	33.93				
kch	46.94	29.01			
klm	16.08	38.07	9.99		
cape	17.10	20.59	13.52	11.07	

Table 6.14b. Similarity index between stations with respect to groups along the southeast coast of India.

30m depth range SE coast				
	naga	cudd	chen	krish
naga				
cudd	56.80			
chen	23.94	18.05		
krish	50.48	48.88	29.70	

50m depth range SE coast				
	naga	cudd	chen	krish
naga				
cudd	55.99			
chen	32.25	29.21		
krish	31.61	36.57	57.80	

100m depth range SE coast				
	naga	cudd	chen	krish
naga				
cudd	29.04			
chen	36.05	54.88		
krish	17.27	49.29	36.63	

200m depth range SE coast				
	naga	cudd	chen	krish
naga				
cudd	38.16			
chen	57.35	42.82		
krish	13.95	31.19	14.92	

Table 6.15. Species diversity indices of polychaetes along the continental shelf of SW and SE coast of India

Table 6.15a. 30m depth range SW

Transect	St. no.	Sp. No.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
		S	N	d	J'	H'(log2)	Lambda'
kzh	1	18	93	3.76	0.92	3.82	0.08
vad	5	47	1574	6.25	0.56	3.12	0.21
kch	9	32	508	4.98	0.70	3.48	0.18
klm	13	28	1038	3.89	0.45	2.15	0.48
tvm	18	42	1580	5.57	0.38	2.04	0.53
cape	21	39	207	7.13	0.91	4.80	0.05
SD		11	663	1.33	0.23	1.05	0.20
Mean		34	833	5.26	0.65	3.24	0.25

Table 6.15b. 50m depth range SW

Transect	St. no.	Sp. No.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
		S	N	d	J'	H'(log2)	Lambda'
knr	15b	51	931	7.31	0.76	4.29	0.12
kzh	2	77	3481	9.32	0.63	3.92	0.15
vad	6	89	1724	11.81	0.85	5.50	0.04
kch	10	82	1529	11.05	0.76	4.83	0.08
klm	14	84	2519	10.60	0.68	4.33	0.15
tvm	19	88	1977	11.46	0.76	4.92	0.07
cape	22	60	527	9.41	0.86	5.05	0.05
SD		15	986	1.57	0.08	0.54	0.05
Mean		76	1812	10.14	0.75	4.69	0.09

Table 6.15c. 100m depth range SW

Transect	St. no.	Sp. No.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
		S	N	d	J'	H'(log2)	Lambda'
knr	15a	40	1462	5.35	0.67	3.57	0.16
kzh	3	29	984	4.06	0.30	1.47	0.66
vad	7	61	422	9.93	0.89	5.30	0.04
kch	11	56	508	8.83	0.80	4.67	0.06
klm	16	36	1235	4.92	0.30	1.55	0.65
cape	23	42	803	6.13	0.77	4.18	0.09
SD		12	407	2.33	0.26	1.61	0.30
Mean		44	902	6.54	0.62	3.46	0.28

Table 6.15d. 200m depth range SW

Transect	St. no.	Sp. No.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
		S	N	d	J'	H'(log2)	Lambda'
kzh	4	37	1963	4.75	0.36	1.88	0.56
vad	8	19	448	2.95	0.62	2.62	0.28
kch	12	25	528	3.83	0.70	3.27	0.16
klm	17	19	1350	2.50	0.56	2.39	0.30
cape	24	23	908	3.23	0.60	2.69	0.24
SD		7	628	0.87	0.13	0.50	0.15
Mean		25	1039	3.45	0.57	2.57	0.31

Table 6.15e.30m depth range SE

Transect	St. no.	Sp. No.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
		S	N	d	J'	H'(log2)	Lambda'
naga	25	57	656	8.63	0.85	4.96	0.05
cudd	29	85	737	12.72	0.88	5.63	0.03
chen	33	17	101	3.47	0.85	3.47	0.12
krish	37	52	568	8.04	0.87	4.95	0.06
SD		28	285	3.79	0.01	0.91	0.04
Mean		53	515	8.22	0.86	4.75	0.06

Table 6.15f.50m depth range SE

Transect	St. no.	Sp. No.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
		S	N	d	J'	H'(log2)	Lambda'
naga	26	55	469	8.78	0.91	5.24	0.03
cudd	30	82	773	12.18	0.86	5.49	0.04
chen	34	21	138	4.06	0.90	3.94	0.07
krish	38	15	96	3.07	0.89	3.46	0.11
SD		31	317	4.25	0.02	0.99	0.04
Mean		43	369	7.02	0.89	4.53	0.06

Table 6.15g.100m depth range SE

Transect	St. no.	Sp. No.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
		S	N	d	J'	H'(log2)	Lambda'
naga	27	45	324	7.61	0.77	4.23	0.09
cudd	31	56	1341	7.64	0.68	3.93	0.14
chen	35	26	280	4.44	0.70	3.30	0.22
krish	39	39	1733	5.10	0.65	3.46	0.16
SD		13	731	1.67	0.05	0.43	0.06
Mean		42	919	6.20	0.70	3.73	0.15

Table 6.15h. 200m depth range SE

Transect	St. no.	Sp. No.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
		S	N	d	J'	H'(log2)	Lambda'
naga	28	50	2164	6.38	0.62	3.51	0.15
cudd	32	32	800	4.64	0.66	3.28	0.19
chen	36	24	2376	2.96	0.64	2.95	0.16
krish	40	5	50	1.02	0.91	2.12	0.23
SD		19	1111	2.29	0.14	0.61	0.04
Mean		28	1347	3.75	0.71	2.97	0.18

Table 6.15i. Average species diversity indices of polychaetes along the SW coast of India

Depth	Sp. No.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
	S	N	d	J'	H'(log2)	Lambda'
30m	34	833	5.26	0.65	3.24	0.25
50m	76	1812	10.14	0.75	4.69	0.09
100m	44	902	6.54	0.62	3.46	0.28
200m	25	1039	3.45	0.57	2.57	0.31
SD	22	452	2.83	0.08	0.89	0.10
Mean	45	1147	6.35	0.65	3.49	0.23

Table 6.15j. Average species diversity indices of polychaetes along the SE coast of India

Depth	Sp. No.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
	S	N	d	J'	H'(log2)	Lambda'
30m	53	515	8.22	0.86	4.75	0.06
50m	43	369	7.02	0.89	4.53	0.06
100m	42	919	6.20	0.70	3.73	0.15
200m	28	1347	3.75	0.71	2.97	0.18
SD	10	440	1.89	0.10	0.81	0.06
Mean	41	788	6.30	0.79	4.00	0.12

Table 6.16. Species diversity indices of groups along the continental shelf of SW and SE coast of India

Table 6.16a.30m depth range SW

Transect	St. no.	Sp. No.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
		S	N	d	J'	H'(log2)	Lambda'
kzh	1	9	118	1.68	0.65	2.07	0.31
vad	5	8	223	1.30	0.67	2.01	0.34
kch	9	13	683	1.84	0.23	0.86	0.78
klm	13	18	448	2.79	0.74	3.07	0.16
tvm	18	14	398	2.17	0.63	2.39	0.30
cape	21	15	466	2.28	0.53	2.06	0.36
SD		4	198	0.52	0.18	0.72	0.21
Mean		13	389	2.01	0.57	2.08	0.38

Table 6.16b.50m depth range SW

Transect	St. no.	Sp. No.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
		S	N	d	J'	H'(log2)	Lambda'
knr	15b	32	693	4.74	0.76	3.78	0.11
kzh	2	33	950	4.67	0.75	3.78	0.12
vad	6	40	5610	4.52	0.35	1.88	0.45
kch	10	36	2435	4.49	0.46	2.40	0.41
klm	14	45	1203	6.20	0.65	3.59	0.18
tvm	19	45	1180	6.22	0.78	4.31	0.08
cape	22	36	1843	4.65	0.58	3.01	0.19
SD		5	1701	0.78	0.16	0.86	0.15
Mean		38	1988	5.07	0.62	3.25	0.22

Table 6.16c.100m depth range SW

Transect	St. no.	Sp. No.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
		S	N	d	J'	H'(log2)	Lambda'
knr	15a	18	498	2.74	0.81	3.38	0.13
kzh	3	8	113	1.48	0.64	1.92	0.34
vad	7	11	278	1.78	0.79	2.73	0.19
kch	11	18	311	2.96	0.77	3.21	0.14
klm	16	15	93	3.09	0.86	3.36	0.12
cape	23	16	533	2.39	0.29	1.18	0.72
SD		4	185	0.65	0.21	0.90	0.23
Mean		14	304	2.41	0.69	2.63	0.27

Table 6.16d. 200m depth range SW

Transect	St. no.	Sp. No.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
		S	N	d	J'	H'(log2)	Lambda'
kzh	4	7	167.5	1.17	0.49	1.38	0.57
vad	8	12	330	1.90	0.71	2.54	0.23
kch	12	6	73	1.17	0.61	1.58	0.49
klm	17	9	3445	0.98	0.10	0.32	0.92
cape	24	10	103	1.94	0.86	2.85	0.16
SD		2	1469	0.45	0.29	1.00	0.30
Mean		9	824	1.43	0.55	1.73	0.48

Table 6.16e 30m depth range SE

Transect	St. no.	Sp. No.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
		S	N	d	J'	H'(log2)	Lambda'
naga	25	18	868	2.51	0.28	1.15	0.70
cudd	29	35	1766	4.55	0.32	1.65	0.58
chen	33	11	203	1.88	0.52	1.81	0.47
krish	37	29	730	4.25	0.75	3.63	0.13
SD		11	650	1.30	0.22	1.09	0.25
Mean		23	891	3.30	0.47	2.06	0.47

Table 6.16f 50m depth range SE

Transect	St. no.	Sp. No.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
		S	N	d	J'	H'(log2)	Lambda'
naga	26	25	663	3.69	0.69	3.20	0.15
cudd	30	29	738	4.24	0.63	3.06	0.24
chen	34	15	155	2.78	0.79	3.10	0.18
krish	38	14	225	2.40	0.78	2.96	0.17
SD		7	297	0.84	0.08	0.10	0.04
Mean		21	445	3.28	0.72	3.08	0.19

Table 6.16g 100m depth range SE

Transect	St. no.	Sp. No.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
		S	N	d	J'	H'(log2)	Lambda'
naga	27	28	92.5	5.96	0.94	4.53	0.04
cudd	31	26	440	4.11	0.81	3.83	0.10
chen	35	22	215	3.91	0.78	3.49	0.14
krish	39	20	1245	2.67	0.57	2.47	0.25
SD		4	518	1.36	0.15	0.86	0.09
Mean		24	498	4.16	0.78	3.58	0.13

Table 6.16h 200m depth range SE

Transect	St. no.	Sp. No.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
		S	N	d	J'	H'(log2)	Lambda'
naga	28	25	400	4.01	0.75	3.49	0.17
cudd	32	14	213	2.43	0.77	2.95	0.18
chen	36	24	338	3.95	0.79	3.63	0.12
krish	40	6	133	1.02	0.74	1.92	0.34
SD		9	121	1.42	0.02	0.78	0.10
Mean		17	271	2.85	0.76	2.99	0.20

Table 6.16i. Average species diversity indices of groups along the SW coast of India

Depth	Sp. No.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
	S	N	d	J'	H'(log2)	Lambda'
30m	13	389	2.01	0.57	2.08	0.38
50m	38	1988	5.07	0.62	3.25	0.22
100m	14	304	2.41	0.69	2.63	0.27
200m	9	824	1.43	0.55	1.73	0.48
SD		775	1.61	0.06	0.66	0.11
Mean		876	2.73	0.61	2.42	0.34

Table 6.16j. Average species diversity indices of groups along the SE coast of India

Depth	Sp. No.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
	S	N	d	J'	H'(log2)	Lambda'
30m	23	891	3.30	0.47	2.06	0.47
50m	21	445	3.28	0.72	3.08	0.19
100m	24	498	4.16	0.78	3.58	0.13
200m	17	271	2.85	0.76	2.99	0.20
SD		262	0.55	0.15	0.63	0.15
Mean		526	3.40	0.68	2.93	0.25

Table. 7.1. Biomass (wet weight in mg/10sq.cm) of meiofauna groups along the continental shelf of southwest and southeast coast of India.

Transect	St.No	Depth(m)	Nematodes	Foraminiferans	Copepods	Polychaetes	Others	Total
kzh	1	32	0.401	0.058	0.015	0.020	0.056	0.550
	2	46.27	1.643	0.009	0.020	0.327	0.132	2.131
	3	110	0.074	0.012	0.000	0.020	0.112	0.219
	4	208	0.057	0.000	0.000	0.031	0.011	0.099
vad	5	30	1.371	0.089	0.013	0.694	0.231	2.398
	6	54	0.704	0.092	0.002	0.286	0.154	1.237
	7	105	0.354	0.141	0.012	0.163	0.056	0.726
	8	190	0.566	0.006	0.000	0.031	0.056	0.659
kch	9	29.6	1.244	1.617	0.074	1.020	0.325	4.280
	10	48	0.219	0.006	0.001	0.061	0.123	0.411
	11	101	0.465	0.003	0.000	0.102	0.073	0.643
	12	229	0.141	0.000	0.001	0.041	0.045	0.228
klm	13	33.8	2.211	1.788	0.050	0.210	0.259	4.517
	14	52	0.721	0.018	0.038	0.286	0.292	1.354
	15	75	0.593	0.021	0.007	0.194	0.121	0.936
	16	95	0.259	0.000	0.004	0.122	0.168	0.554
	17	186	0.222	0.006	0.006	0.122	0.067	0.424
tvm	18	37.6	2.261	1.548	0.223	0.150	0.682	4.863
	19	58.3	0.354	0.012	0.020	0.214	0.099	0.699
cape	22	50.11	0.391	0.012	0.052	0.490	0.209	1.154
	23	122.8	0.428	0.006	0.001	0.224	0.143	0.802
	24	216	0.111	0.003	0.001	0.010	0.034	0.159
naga	25	30	0.756	0.381	0.007	0.070	0.611	1.824
	26	43.1	0.707	0.000	0.018	0.602	0.132	1.460
	28	188.7	0.195	0.024	0.005	0.214	0.237	0.675
cudd	29	30.9	0.809	0.921	0.064	0.330	0.501	2.624
	30	52.3	0.141	0.003	0.004	0.112	0.072	0.333
	31	110	0.300	0.104	0.009	0.265	0.185	0.863
	32	169	0.189	0.000	0.000	0.051	0.034	0.273
chen	33	33.4	0.409	0.288	0.013	0.030	0.039	0.778
	34	57.5	0.155	0.000	0.010	0.276	0.123	0.564
	36	200	0.040	0.003	0.002	0.051	0.028	0.125
krish	37	31.7	0.916	0.006	0.029	0.224	0.123	1.299
	38	55	0.101	0.012	0.004	0.010	0.017	0.145
	39	98.6	0.441	0.003	0.003	0.194	0.062	0.703
	40	203	0.239	0.024	0.001	0.173	0.191	0.628

Table.7.2. Biomass (wet weight in mg/10sq.cm) of meiofauna groups along the continental shelf of southwest and southeast coast of India at different depth ranges.

Table.7.2a. 30m depth range Southwest coast

Transect	St.No	Depth(m)	Nematodes	Foraminiferans	Copepods	Polychaetes	Others	Total
kzh	1	32	0.401	0.058	0.015	0.020	0.056	0.550
vad	5	30	1.371	0.089	0.013	0.694	0.231	2.398
kch	9	29.6	1.244	1.617	0.074	1.020	0.325	4.280
klm	13	33.8	2.211	1.788	0.050	0.210	0.259	4.517
tvm	18	37.6	2.261	1.548	0.223	0.150	0.682	4.863
Total			7.487	5.100	0.375	2.094	1.552	16.608
SD			0.770	0.869	0.086	0.422	0.230	1.821
Mean			1.497	1.020	0.075	0.419	0.310	3.322

Table.7.2b. 50m depth range Southwest coast

Transect	St.No	Depth(m)	Nematodes	Foraminiferans	Copepods	Polychaetes	Others	Total
kzh	2	46.27	1.643	0.009	0.020	0.327	0.132	2.131
vad	6	54	0.704	0.092	0.002	0.286	0.154	1.237
kch	10	48	0.219	0.006	0.001	0.061	0.123	0.411
klm	14	52	0.721	0.018	0.038	0.286	0.292	1.354
tvm	19	58.3	0.354	0.012	0.020	0.214	0.099	0.699
cape	22	50.11	0.391	0.012	0.052	0.490	0.209	1.154
Total			4.031	0.150	0.133	1.663	1.009	6.986
SD			0.516	0.033	0.020	0.140	0.071	0.593
Mean			0.672	0.025	0.022	0.277	0.168	1.164

Table.7.2c. 100m depth range Southwest coast

Transect	St.No	Depth(m)	Nematodes	Foraminiferans	Copepods	Polychaetes	Others	Total
kzh	3	110	0.074	0.012	0.000	0.020	0.112	0.219
vad	7	105	0.354	0.141	0.012	0.163	0.056	0.726
kch	11	101	0.465	0.003	0.000	0.102	0.073	0.643
klm	16	95	0.259	0.000	0.004	0.122	0.168	0.554
cape	23	122.8	0.428	0.006	0.001	0.224	0.143	0.802
Total			1.579	0.162	0.017	0.633	0.553	2.944
SD			0.156	0.061	0.005	0.076	0.047	0.227
Mean			0.316	0.032	0.003	0.127	0.111	0.589

Table.7.2d. 200m depth range Southwest coast

Transect	St.No	Depth(m)	Nematodes	Foraminiferans	Copepods	Polychaetes	Others	Total
kzh	4	208	0.057	0.000	0.000	0.031	0.011	0.099
vad	8	190	0.566	0.006	0.000	0.031	0.056	0.659
kch	12	229	0.141	0.000	0.001	0.041	0.045	0.228
klm	17	186	0.222	0.006	0.006	0.122	0.067	0.424
cape	24	216	0.111	0.003	0.001	0.010	0.034	0.159
Total			1.098	0.015	0.007	0.235	0.213	1.568
SD			0.203	0.003	0.002	0.044	0.022	0.228
Mean			0.220	0.003	0.001	0.047	0.043	0.314

Table.7.3. Biomass (wet weight in mg/10sq.cm) of meiofauna groups along the continental shelf of southeast coast of India at different depth ranges.

Table.7.3a: 30m depth range Southeast coast

Transect	St.No	Depth(m)	Nematodes	Foraminiferans	Copepods	Polychaetes	Others	Total
naga	25	30	0.756	0.381	0.007	0.070	0.611	1.824
cudd	29	30.9	0.809	0.921	0.064	0.330	0.501	2.624
chen	33	33.4	0.409	0.288	0.013	0.030	0.039	0.778
krish	37	31.7	0.916	0.006	0.029	0.224	0.123	1.299
Total			2.889	1.596	0.112	0.654	1.273	6.525
SD			0.219	0.383	0.026	0.139	0.280	0.787
Mean			0.722	0.399	0.028	0.164	0.318	1.631

Table.7.3b: 50m depth range Southeast coast

Transect	St.No	Depth(m)	Nematodes	Foraminiferans	Copepods	Polychaetes	Others	Total
naga	26	43.1	0.707	0.000	0.018	0.602	0.132	1.460
cudd	30	52.3	0.141	0.003	0.004	0.112	0.072	0.333
chen	34	57.5	0.155	0.000	0.010	0.276	0.123	0.564
krish	38	55	0.101	0.012	0.004	0.010	0.017	0.145
Total			1.104	0.015	0.037	1.000	0.344	2.501
SD			0.288	0.006	0.007	0.259	0.053	0.582
Mean			0.276	0.004	0.009	0.250	0.086	0.625

Table.7.3c: 100m depth range Southeast coast

Transect	St.No	Depth(m)	Nematodes	Foraminiferans	Copepods	Polychaetes	Others	Total
cudd	31	110	0.300	0.104	0.009	0.265	0.185	0.863
krish	39	98.6	0.441	0.003	0.003	0.194	0.062	0.703
Total			0.741	0.107	0.012	0.459	0.247	1.566
SD			0.100	0.071	0.004	0.051	0.087	0.113
Mean			0.370	0.054	0.006	0.230	0.123	0.783

Table.7.3d. 200m depth range Southeast coast

Transect	St.No	Depth(m)	Nematodes	Foraminiferans	Copepods	Polychaetes	Others	Total
naga	28	188.7	0.195	0.024	0.005	0.214	0.237	0.675
cudd	32	169	0.189	0.000	0.000	0.051	0.034	0.273
chen	36	200	0.040	0.003	0.002	0.051	0.028	0.125
krish	40	203	0.239	0.024	0.001	0.173	0.191	0.628
Total			0.663	0.052	0.008	0.490	0.489	1.702
SD			0.087	0.013	0.002	0.084	0.107	0.269
Mean			0.166	0.013	0.002	0.122	0.122	0.426

Table.7.4a. Average biomass (wet weight in mg/10sq.cm) of meiobenthos along the shelf waters of the Southwest coast of India

Depth(m)	Nematodes	Foraminiferans	Copepods	Polychaetes	Others	Total
30m	1.497	1.020	0.075	0.419	0.310	3.322
50m	0.672	0.025	0.022	0.277	0.168	1.164
100m	0.316	0.032	0.003	0.127	0.111	0.589
200m	0.220	0.003	0.001	0.047	0.043	0.314
Total	2.705	1.080	0.102	0.870	0.632	5.388
SD	0.581	0.500	0.034	0.165	0.114	1.363
Mean	0.676	0.270	0.026	0.217	0.158	1.347

Table.7.4b. Average biomass (wet weight in mg/10sq.cm) of meiobenthos along the shelf waters of the Southeast coast of India

Depth(m)	Nematodes	Foraminiferans	Copepods	Polychaetes	Others	Total
30m	0.722	0.399	0.028	0.164	0.318	1.631
50m	0.276	0.004	0.009	0.250	0.086	0.625
100m	0.370	0.054	0.006	0.230	0.123	0.783
200m	0.166	0.013	0.002	0.122	0.122	0.426
Total	1.535	0.469	0.045	0.766	0.650	3.465
SD	0.241	0.189	0.012	0.059	0.105	0.531
Mean	0.384	0.117	0.011	0.191	0.162	0.866

Table.7.5. Numerical abundance (No/10sq.cm) of meiofauna groups along the continental shelf of southwest and southeast coast of India.

Transect	St.No	Depth(m)	Nematodes	Foraminiferans	Copepods	Polychaetes	Others	Total
kzh	1	32	121	19	24	2	10	178
	2	46.27	498	3	34	33	24	591
	3	110	22	4	0	2	20	49
	4	208	17	0	0	3	2	22
vad	5	30	415	30	22	69	42	579
	6	54	213	31	3	29	28	304
	7	105	107	47	20	16	10	201
	8	190	171	2	0	3	10	187
kch	9	29.6	377	539	124	102	59	1201
	10	48	66	2	2	6	22	99
	11	101	141	1	0	10	13	165
	12	229	43	0	1	4	8	56
klm	13	33.8	670	596	83	21	47	1417
	14	52	218	6	63	29	53	369
	15	75	180	7	11	19	22	239
	16	95	79	0	6	12	31	128
	17	186	67	2	9	12	12	103
tvm	18	37.6	685	516	371	15	124	1711
	19	58.3	107	4	33	21	18	183
cape	22	50.11	118	4	87	49	38	296
	23	122.8	130	2	2	22	26	182
	24	216	34	1	2	1	6	44
naga	25	30	229	127	11	7	111	485
	26	43.1	214	0	31	60	24	329
	28	188.7	59	8	8	21	43	140
cudd	29	30.9	245	307	106	33	91	782
	30	52.3	43	1	7	11	13	75
	31	110	91	35	14	27	34	200
	32	169	57	0	0	5	6	68
chen	33	33.4	124	96	21	3	7	251
	34	57.5	47	0	17	28	22	114
	36	200	12	1	4	5	5	28
krish	37	31.7	278	2	49	22	22	373
	38	55	31	4	7	1	3	46
	39	98.6	134	1	5	19	11	170
	40	203	72	8	1	17	35	134

Table 7.6. Numerical abundance (No./10sq.cm) of meiofauna groups along the continental shelf of southwest coast of India at different depth ranges.

Table 7.6a. 30m depth range Southwest coast

Transect	St.No	Depth(m)	Nematodes	Foraminiferans	Copepods	Polychaetes	Others	Total
kzh	1	32	121	19	24	2	10	178
vad	5	30	415	30	22	69	42	579
kch	9	29.6	377	539	124	102	59	1201
klm	13	33.8	670	596	83	21	47	1417
tvm	18	37.6	685	516	371	15	124	1711
Total			2269	1700	625	209	282	5085
SD			233	290	144	42	42	627
Mean			454	340	125	42	56	1017

Table 7.6b. 50m depth range Southwest coast

Transect	St.No	Depth(m)	Nematodes	Foraminiferans	Copepods	Polychaetes	Others	Total
kzh	2	46.27	498	3	34	33	24	591
vad	6	54	213	31	3	29	28	304
kch	10	48	66	2	2	6	22	99
klm	14	52	218	6	63	29	53	369
tvm	19	58.3	107	4	33	21	18	183
cape	22	50.11	118	4	87	49	38	296
Total			1221	50	221	166	183	1843
SD			156	11	33	14	13	169

Table 7.6c. 100m depth range Southwest coast

Transect	St.No	Depth(m)	Nematodes	Foraminiferans	Copepods	Polychaetes	Others	Total
kzh	3	110	22	4	0	2	20	49
vad	7	105	107	47	20	16	10	201
kch	11	101	141	1	0	10	13	165
klm	16	95	79	0	6	12	31	128
cape	23	122.8	130	2	2	22	26	182
Total			479	54	29	63	100	725
SD			47	20	9	8	9	60
Mean			96	11	6	13	20	145

Table 7.6d. 200m depth range Southwest coast

Transect	St.No	Depth(m)	Nematodes	Foraminiferans	Copepods	Polychaetes	Others	Total
kzh	4	208	17	0	0	3	2	22
vad	8	190	171	2	0	3	10	187
kch	12	229	43	0	1	4	8	56
klm	17	186	67	2	9	12	12	103
cape	24	216	34	1	2	1	6	44
Total			333	5	12	23	39	412
SD			61	1	4	4	4	65
Mean			67	1	2	5	8	82

Table 7.7. Numerical abundance (No./10sq.cm) of meiofauna groups along the continental shelf of southeast coast of India at different depth ranges.

Table 7.7a: 30m depth range Southeast coast

Transect	St.No	Depth(m)	Nematodes	Foraminiferans	Copepods	Polychaetes	Others	Total
naga	25	30	229	127	11	7	111	485
cudd	29	30.9	245	307	106	33	91	782
chen	33	33.4	124	96	21	3	7	251
krish	37	31.7	278	2	49	22	22	373
Total			876	532	187	65	231	1891
SD			66	128	43	14	51	227
Mean			219	133	47	16	58	473

Table 7.7b: 50m depth range Southeast coast

Transect	St.No	Depth(m)	Nematodes	Foraminiferans	Copepods	Polychaetes	Others	Total
naga	26	43.1	214	0	31	60	24	329
cudd	30	52.3	43	1	7	11	13	75
chen	34	57.5	47	0	17	28	22	114
krish	38	55	31	4	7	1	3	46
Total			335	5	62	100	63	565
SD			87	2	11	26	10	128
Mean			84	1	16	25	16	141

Table 7.7c: 100m depth range Southeast coast

Transect	St.No	Depth(m)	Nematodes	Foraminiferans	Copepods	Polychaetes	Others	Total
cudd	31	110	91	35	14	27	34	200
krish	39	98.6	134	1	5	19	11	170
Total			224	36	19	46	45	370
SD			30	24	6	5	16	21
Mean			112	18	10	23	22	185

Table 7.7d: 200m depth range Southeast coast

Transect	St.No	Depth(m)	Nematodes	Foraminiferans	Copepods	Polychaetes	Others	Total
naga	28	188.7	59	8	8	21	43	140
cudd	32	169	57	0	0	5	6	68
chen	36	200	12	1	4	5	5	28
krish	40	203	72	8	1	17	35	134
Total			201	17	13	49	89	370
SD			26	4	4	8	19	54
Mean			50	4	3	12	22	92

Table 7.8a. Average numerical abundance (No./10sq.cm) of meiobenthos along the shelf waters of the Southwest coast of India

Depth(m)	Nematodes	Foraminiferans	Copepods	Polychaetes	Others	Total
30m	454	340	125	42	56	1017
50m	204	8	37	28	31	307
100m	96	11	6	13	20	145
200m	67	1	2	5	8	82
Total	820	360	170	87	115	1552
SD	176	167	57	16	21	430
Mean	205	90	43	22	29	388

Table 7.8b. Average numerical abundance (No./10sq.cm) of meiobenthos along the shelf waters of the Southeast coast of India

Depth(m)	Nematodes	Foraminiferans	Copepods	Polychaetes	Others	Total
30m	219	133	47	16	58	473
50m	84	1	16	25	16	141
100m	112	18	10	23	22	185
200m	50	4	3	12	22	92
Total	465	156	75	77	118	892
SD	73	63	19	6	19	171
Mean	116	39	19	19	30	223

Table No.7.9. Diversity indices of meiofauna groups along the continental shelf of Southwest coast of India at different depth ranges

Table No.7.9a.30m depth range SW coast

Stations	Sp. No.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
	S	N	d	J'	H'(log2)	Lambda'
kzh	5	178	0.77	0.62	1.43	0.50
vad	7	580	0.94	0.52	1.47	0.53
kch	5	693	0.61	0.83	1.92	0.31
klm	5	1417	0.55	0.66	1.53	0.40
tvm	5	1711	0.54	0.80	1.86	0.30
SD	1	631	0.17	0.13	0.23	0.11
Mean	5	916	0.68	0.69	1.64	0.41

Table No.7.9b.50m depth range SW coast

Stations	Sp. No.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
	S	N	d	J'	H'(log2)	Lambda'
kzh	9	592	1.25	0.31	0.99	0.71
vad	6	303	0.88	0.55	1.41	0.52
kch	5	99	0.87	0.58	1.35	0.50
klm	9	369	1.35	0.58	1.83	0.40
tvm	6	184	0.96	0.67	1.74	0.39
cape	6	296	0.88	0.77	1.98	0.29
SD	2	169	0.22	0.15	0.37	0.15
Mean	7	307	1.03	0.58	1.55	0.47

Table No.7.9c. 100m depth range SW coast

Stations	Sp. No.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
	S	N	d	J'	H'(log2)	Lambda'
kzh	4	49	0.77	0.77	1.53	0.38
vad	5	201	0.75	0.78	1.82	0.35
kch	4	165	0.59	0.39	0.78	0.73
klm	4	128	0.62	0.73	1.46	0.44
cape	6	183	0.96	0.52	1.35	0.53
SD	1	60	0.15	0.17	0.38	0.15
Mean	5	145	0.74	0.64	1.39	0.49

Table No.7.9d. 200m depth range SW coast

Stations	Sp. No.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
	S	N	d	J'	H'(log2)	Lambda'
kzh	3	22	0.64	0.63	0.99	0.61
vad	4	187	0.57	0.26	0.51	0.85
kch	4	56	0.74	0.54	1.08	0.60
klm	5	103	0.86	0.67	1.55	0.46
cape	5	44	1.06	0.49	1.15	0.60
SD	1	65	0.19	0.16	0.37	0.14
Mean	4	82	0.78	0.52	1.06	0.62

Table No.7.10. Diversity indices of meiofauna groups along the continental shelf of Southeast coast of India at different depth ranges

Table No.7.10a.30m depth range SE coast

Stations	Sp. No.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
	S	N	d	J'	H'(log2)	Lambda'
naga	9	485	1.29	0.65	2.08	0.32
cudd	8	792	1.05	0.73	2.20	0.27
chen	8	251	1.27	0.53	1.60	0.40
krish	5	373	0.68	0.53	1.22	0.58
SD	2	232	0.29	0.10	0.45	0.14
Mean	8	475	1.07	0.61	1.77	0.39

Table No.7.10b. 50m depth range SE coast

Stations	Sp. No.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
	S	N	d	J'	H'(log2)	Lambda'
naga	6	330	0.86	0.60	1.54	0.47
cudd	6	76	1.16	0.69	1.79	0.37
chen	4	114	0.63	0.95	1.90	0.28
krish	5	46	1.05	0.65	1.50	0.47
SD	1	129	0.23	0.16	0.19	0.09
Mean	5	141	0.92	0.72	1.68	0.40

Table No.7.10c. 100m depth range SE coast

Stations	Sp. No.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
	S	N	d	J'	H'(log2)	Lambda'
cudd	5	200	0.75	0.88	2.05	0.28
krish	5	170	0.78	0.47	1.09	0.63
SD	0	21	0.02	0.29	0.68	0.25
Mean	5	185	0.77	0.67	1.57	0.46

Table No.7.10d. 200m depth range SE coast

Stations	Sp. No.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
	S	N	d	J'	H'(log2)	Lambda'
naga	6	140	1.01	0.78	2.03	0.29
cudd	3	68	0.47	0.51	0.81	0.71
chen	5	28	1.21	0.86	2.01	0.26
krish	5	134	0.82	0.72	1.67	0.38
SD	1	54	0.31	0.15	0.57	0.20
Mean	5	92	0.88	0.72	1.63	0.41

Table No.7.11a. Average diversity indices of meiofauna along the southwest coast of India at different depth ranges.

Depth	Sp. No.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
	S	N	d	J'	H'(log2)	Lambda'
30m	5	916	0.68	0.69	1.64	0.41
50m	7	307	1.03	0.58	1.55	0.47
100m	5	145	0.74	0.64	1.39	0.49
200m	4	82	0.78	0.52	1.06	0.62

Table No.7.11b. Average diversity indices of meiofauna along the southeast coast of India at different depth ranges

Depth	Sp. No.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
	S	N	d	J'	H'(log2)	Lambda'
30m	8	475	1.07	0.61	1.77	0.39
50m	5	141	0.92	0.72	1.68	0.40
100m	5	185	0.77	0.67	1.57	0.46
200m	5	92	0.88	0.72	1.63	0.41

Table No 7.12. Similarity index between stations with respect to meiofauna groups along the southwest coast of India.

Table No.7.12a.30m depth range SW coast

	kzh	vad	kch	klm	tvm
kzh					
vad	66.95				
kch	62.82	74.25			
klm	52.16	66.53	82.50		
tvm	46.22	59.26	74.41	88.88	

Table No.7.12b. 50m depth range SW coast

	kzh	vad	kch	klm	tvm	cape
kzh						
vad	70.48					
kch	52.91	70.59				
klm	80.04	78.93	59.06			
tvm	73.01	78.08	76.53	78.17		
cape	70.43	74.72	66.44	83.92	86.47	

Table No.7.12c. 100m depth range SW coast

	kzh	vad	kch	klm	cape
kzh					
vad	54.64				
kch	66.75	72.94			
klm	64.61	73.11	78.34		
cape	63.29	74.98	84.93	81.13	

Table No.7.12d. 200m depth range SW coast

	kzh	vad	kch	klm	cape
kzh					
vad	54.78				
kch	74.26	69.93			
klm	54.38	74.52	77.48		
cape	69.26	66.03	85.24	74.71	

Table No 7.13. Similarity index between stations with respect to meiofauna groups along the southeast coast of India

Table No.7.13a.30m depth range SE coast

	naga	cudd	chen	krish
naga				
cudd	77.33			
chen	72.67	63.08		
krish	59.37	63.33	59.55	

Table No.7.13b. 50m depth range SE coast

	naga	cudd	chen	krish
naga				
cudd	77.33			
chen	72.67	63.08		
krish	59.37	63.33	59.55	

Table No.7.13c. 100m depth range SE coast

	cudd	krish
cudd		
krish	77.94	

Table No.7.13d. 200m depth range SE coast

	naga	cudd	chen	krish
naga				
cudd	64.45			
chen	59.88	68.70		
krish	89.53	70.80	59.96	

Table 8.1. BIO-ENV analysis of infaunal macrobenthos along SW and SE coast of India

Table 8.1a. Bioenv analysis of infaunal macrobenthos along SW coast

Number of Variables	Best Selections	Correlations
4	Depth, Temperature, Sand and Silt	0.997
4	Depth, DO, Sand and Silt	0.996
4	Depth, Sand, Silt and Clay	0.995
4	Depth, OM, Sand and Silt	0.994
4	Depth, Salinity, Sand and Silt	0.994

Table 8.1b. BIO-ENV analysis of infaunal macrobenthos along SE coast

Number of Variables	Best Selections	Correlations
4	Depth, OM, Sand and Silt	0.996
4	Depth, Sand, Silt and Clay	0.996
4	Depth, Temperature, Sand and Silt	0.995
4	Depth, Salinity, Sand and Silt	0.995
4	Depth, DO, Sand and Silt	0.995

Table 8.2. BIO-ENV analysis of meiobenthos along SW and SE coast of India

Table No.8.2a. BIO-ENV of meiofauna groups along the SW coast of India

Number of Variables	Best Selections	Correlations
4	Depth , Temperature, Sand and Silt	0.995
4	Depth, DO, Sand and Silt	0.993
4	Depth, Sand, Silt and Clay	0.991
4	Depth , OM, Sand and Silt	0.990
3	Depth ,Sand and Silt	0.989

Table No.8.2b. BIO-ENV of meiofauna groups along the SE coast of India

Number of Variables	Best Selections	Correlations
4	Depth, Sand, Silt and Clay	0.988
4	Depth, Temperature, Sand and silt	0.985
4	Depth, Salinity, Sand and Silt	0.985
4	Depth, DO, Sand and Silt	0.985
4	Depth, OM, Sand and Silt	0.984

…..ഇൻ…..

FIGURES

Fig.3.1. Map showing the study area

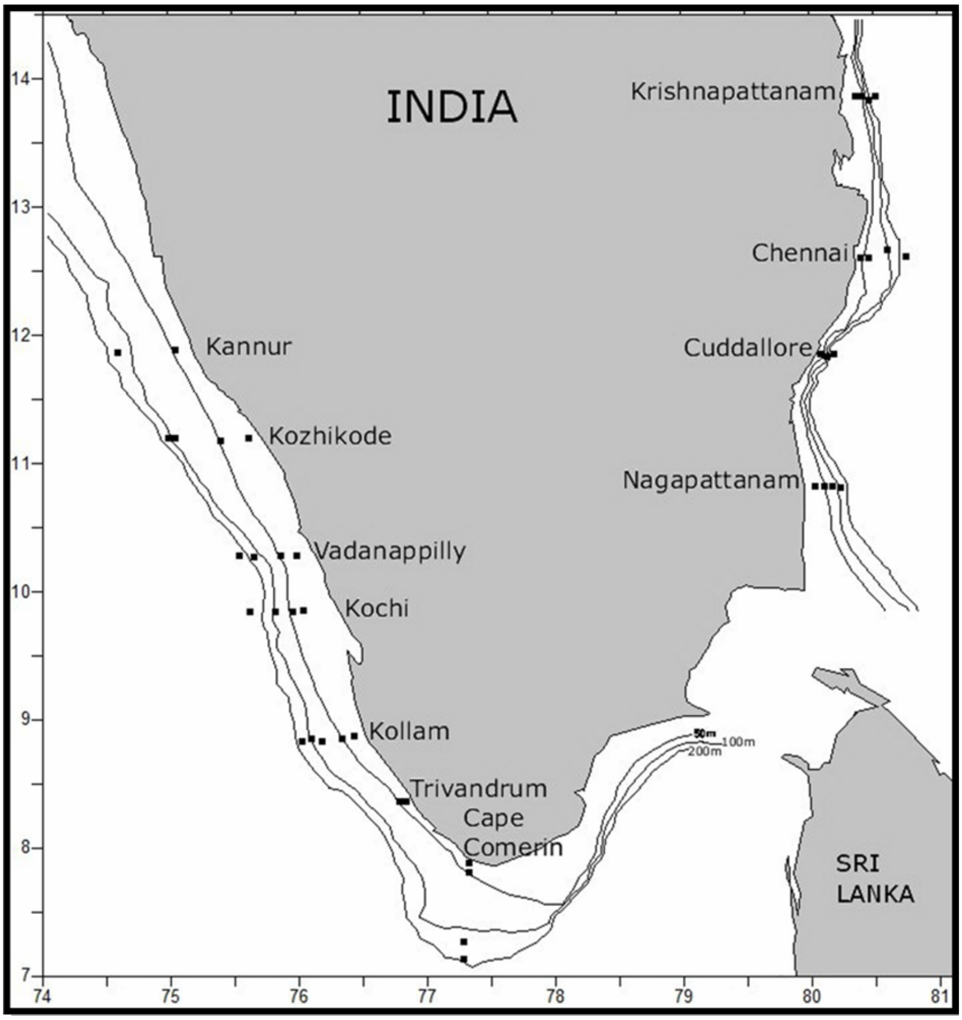


Fig.3.2. FORV *Sagar Sampada* (Sampling Vessel)

Fig.3.3. Sea-Bird CTD (Deck Unit)

Fig.3.4. Sea-Bird CTD (Underwater unit)

Fig.3.5. Smith McIntyre grab-ready to deploy

Fig.3.6. Smith McIntyre grab-hauling up

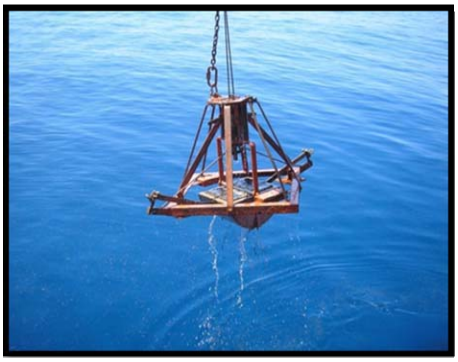


Fig.3.7. Undisturbed grab sample

Fig.3.8. Core sample for meiobenthos

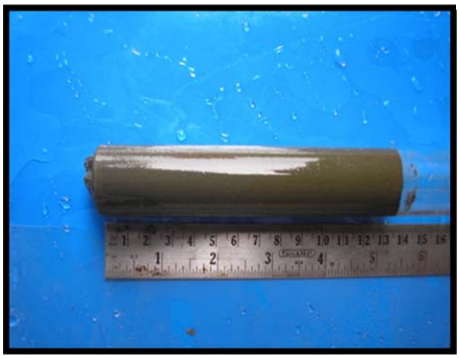


Fig.3.9. Sediment sample sieving for macrobenthos

Fig.3.10. Sieved sediment sample for macrobenthos

Fig.3.11. Naturalist's Dredge with sample

Fig.4.1. Variation of bottom temperature in each depth ranges along the southwest coast of India

Fig.4.1a: 30m depth range

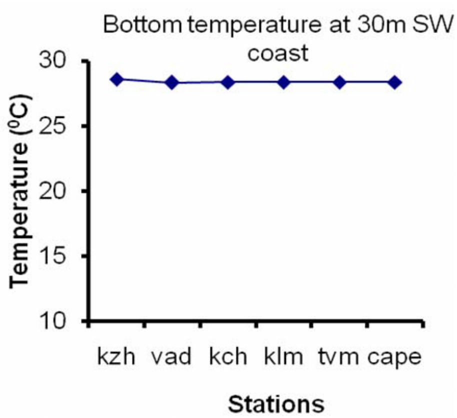


Fig.4.1b: 50m depth range

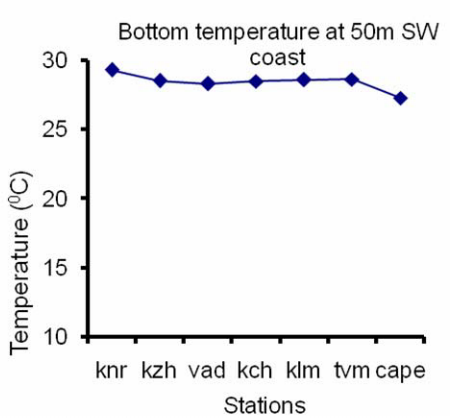


Fig 4.1c: 100m depth range

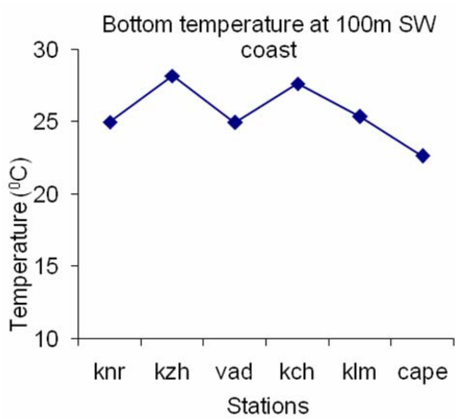


Fig. 4.1d: 200m depth range

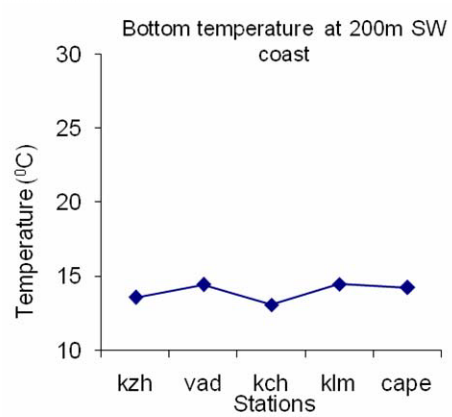


Fig.4.2 Variation of bottom temperature in each depth ranges along the southeast coast of India

Fig.4.2a: 30m depth range

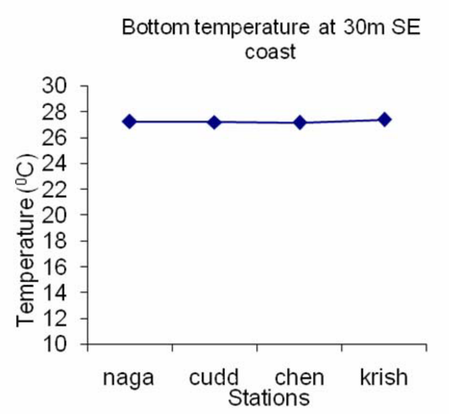


Fig.4.2b: 50m depth range

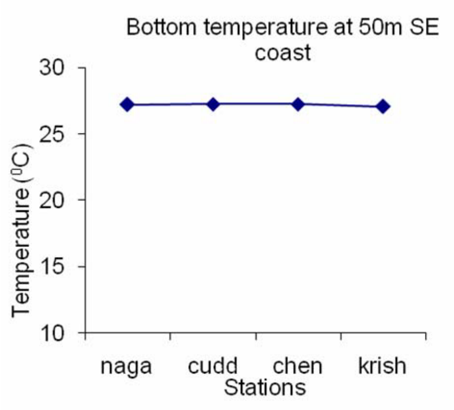


Fig.4.2c: 100m depth range

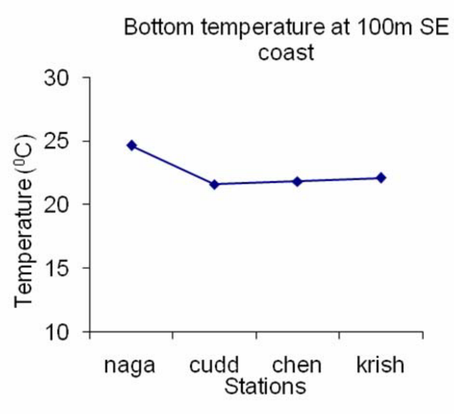


Fig. 4.2d: 200m depth range

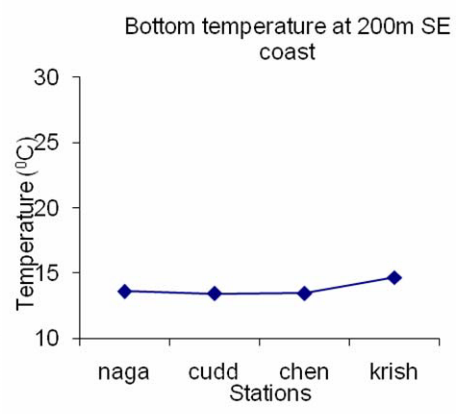


Fig.4.3. Variation of bottom salinity in each depth ranges along the southwest coast of India

Fig.4.3a: 30m depth range

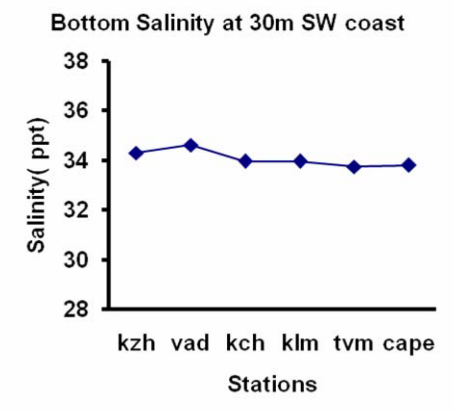


Fig.4.3b: 50m depth range

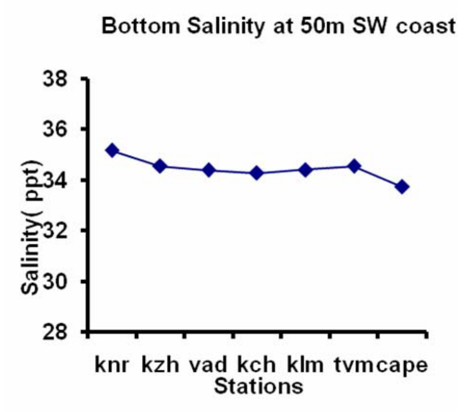


Fig.4.3c: 100m depth range

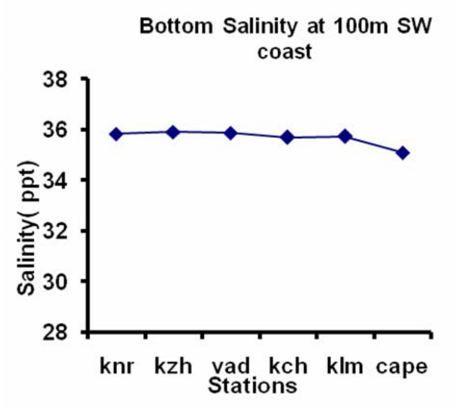


Fig.4.3d: 200m depth range

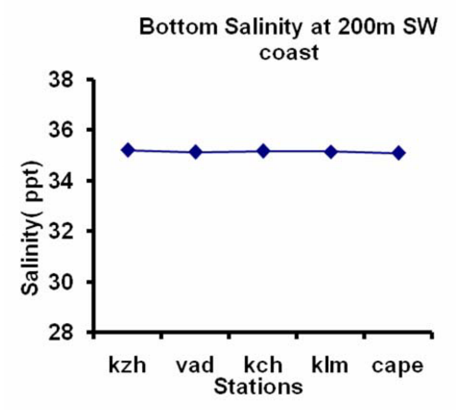


Fig.4.4. Variation of bottom salinity in each depth ranges along the southeast coast of India

Fig.4.4a: 30m depth range

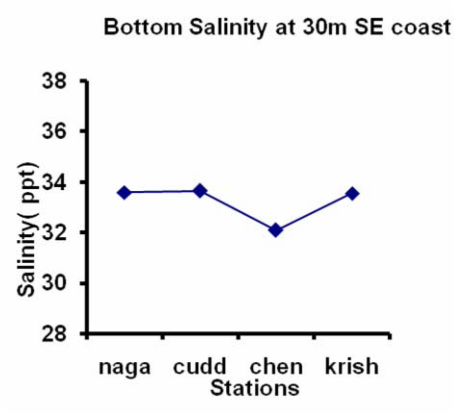


Fig.4.4b: 50m depth range

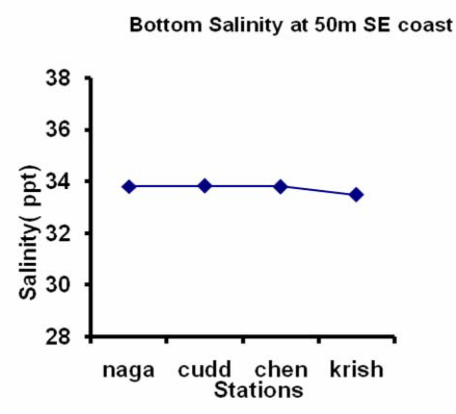


Fig.4.4c: 100m depth range

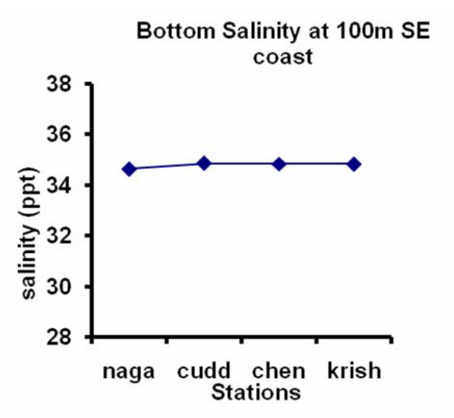


Fig.4.4d: 200m depth range

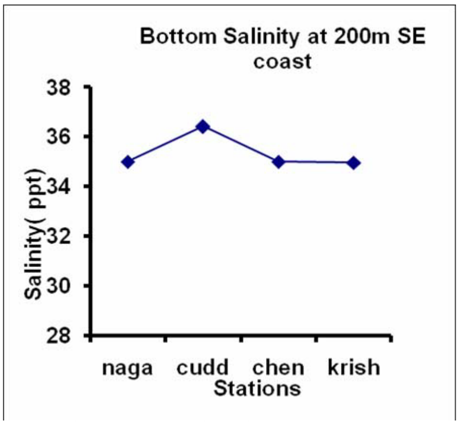


Fig.4.5. Variation of bottom dissolved oxygen in each depth ranges along the Southwest coast of India.

Fig.4.5a: 30m depth range

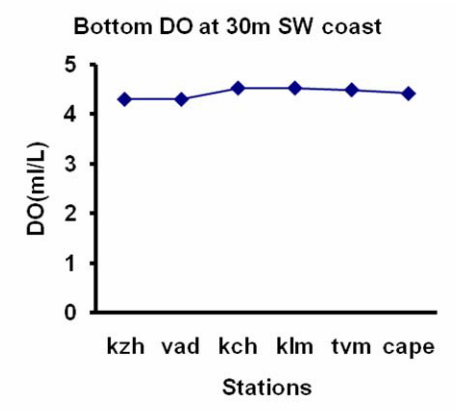


Fig.4.5b: 50m depth range

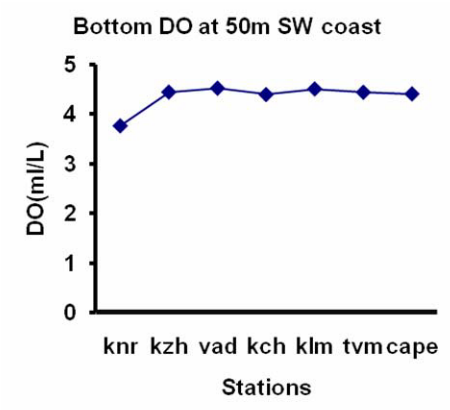


Fig.4.5c: 100m depth range

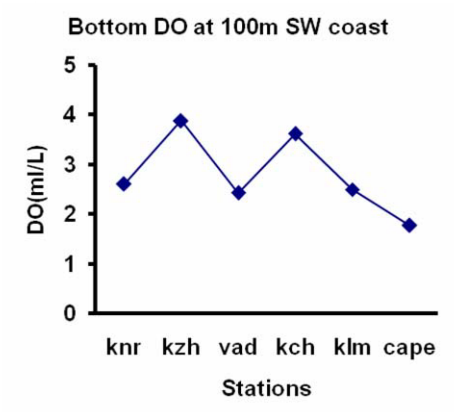


Fig.4.5d: 200m depth range

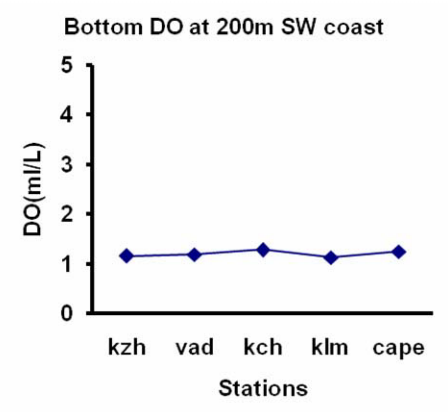


Fig.4.6. Variation of bottom dissolved oxygen in each depth ranges along the southeast coast of India

Fig.4.6a: 30m depth range

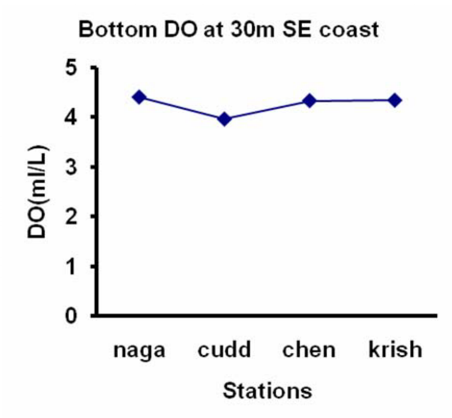


Fig.4.6b: 50m depth range

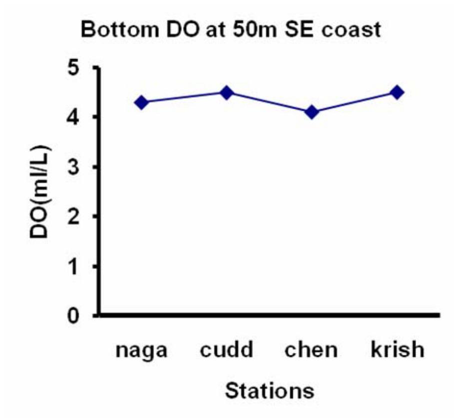


Fig.4.6c: 100m depth range

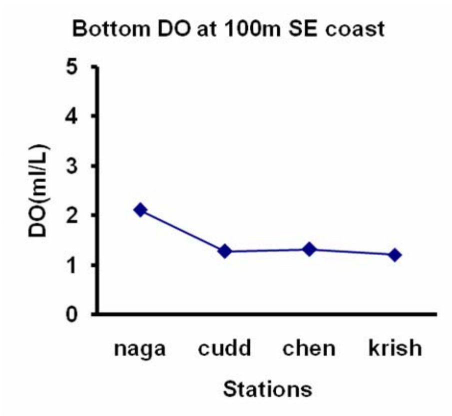


Fig.4.6d: 200m depth range

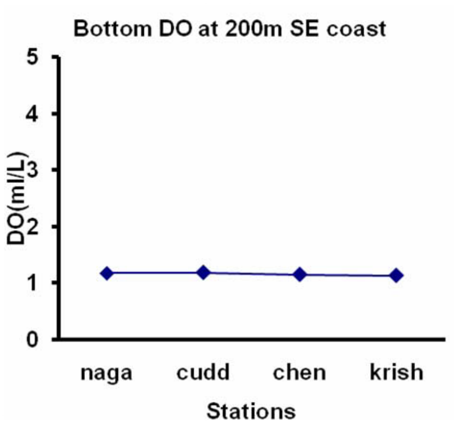


Fig. 5.1. Sediment characteristics (sand, silt, clay) along the southwest coast of India at different depth ranges

Fig.5.1a. 30m depth range

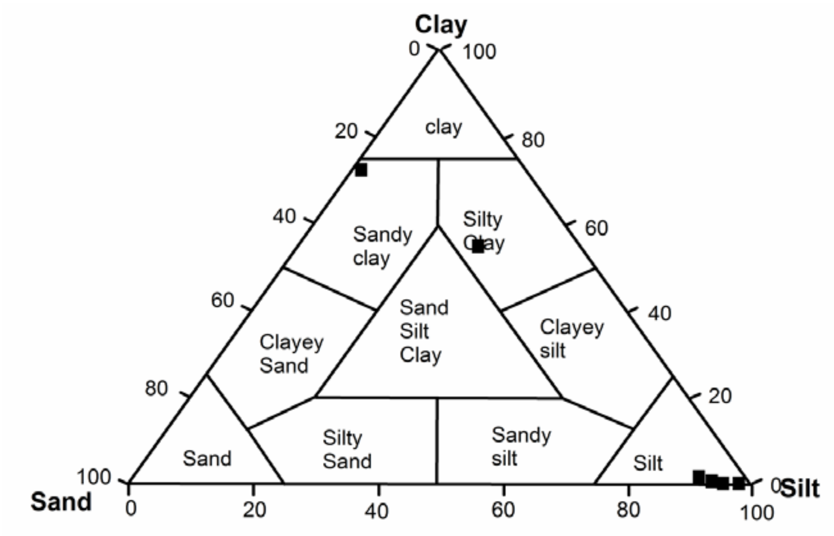
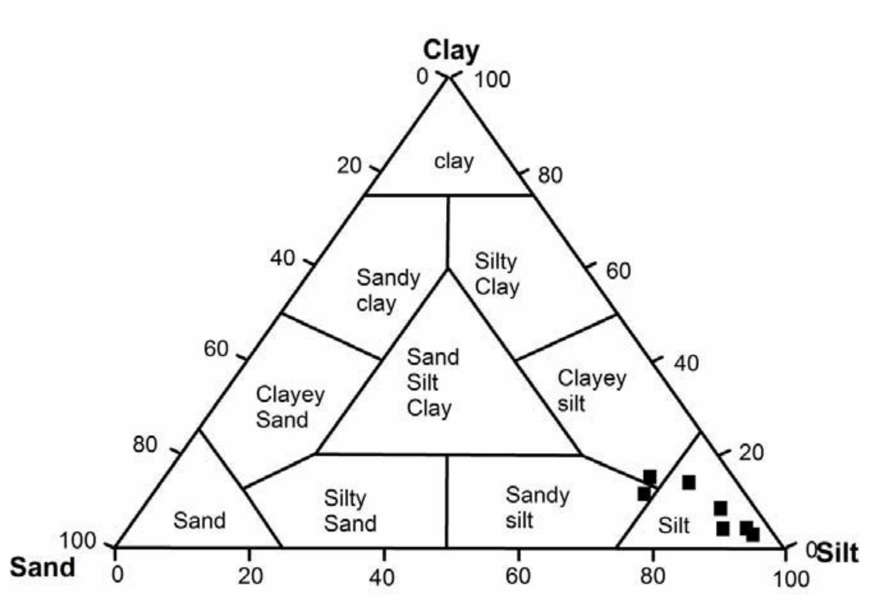


Fig.5.1b 50m depth range



Sediment characteristics (sand, silt, clay) along the southwest coast of India at different depth ranges

Fig.5.1c 100m depth range

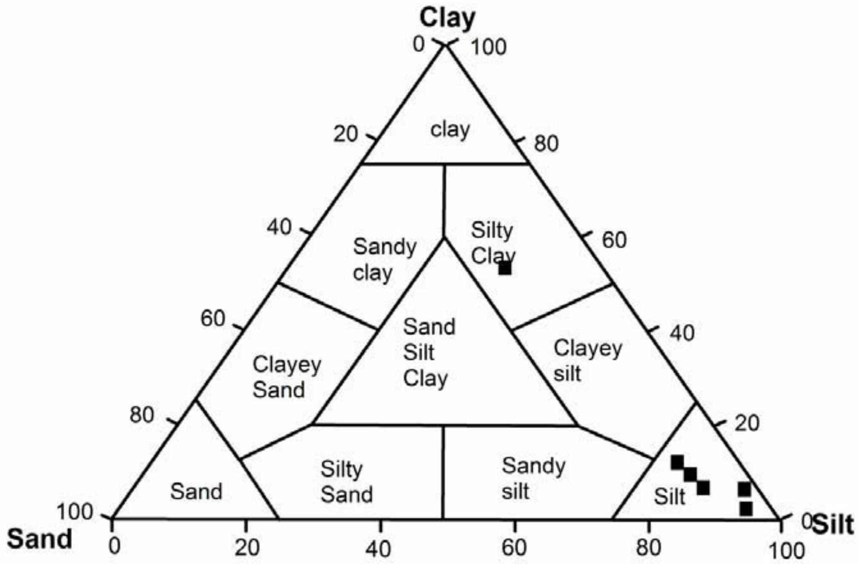


Fig.5.1d 200m depth range

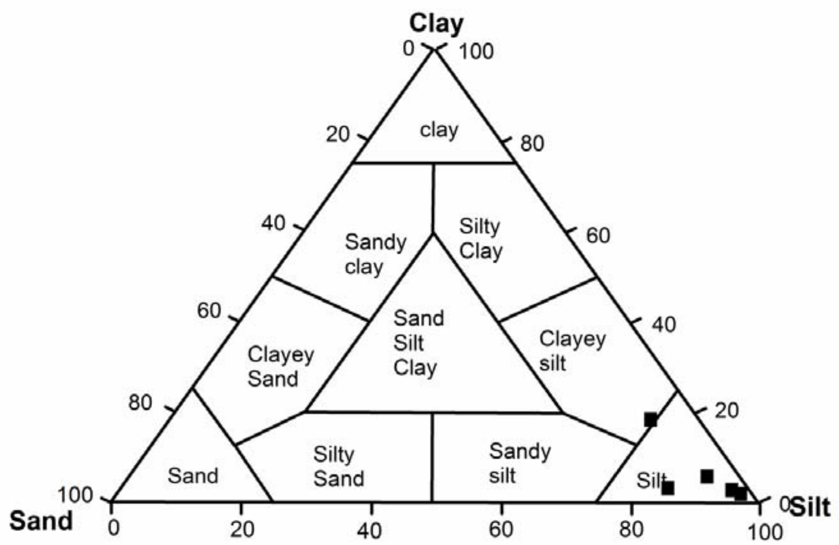


Fig. 5.2 Sediment characteristics (sand, silt, clay) along the southeast coast of India at different depth ranges

Fig.5.2a 30m depth range

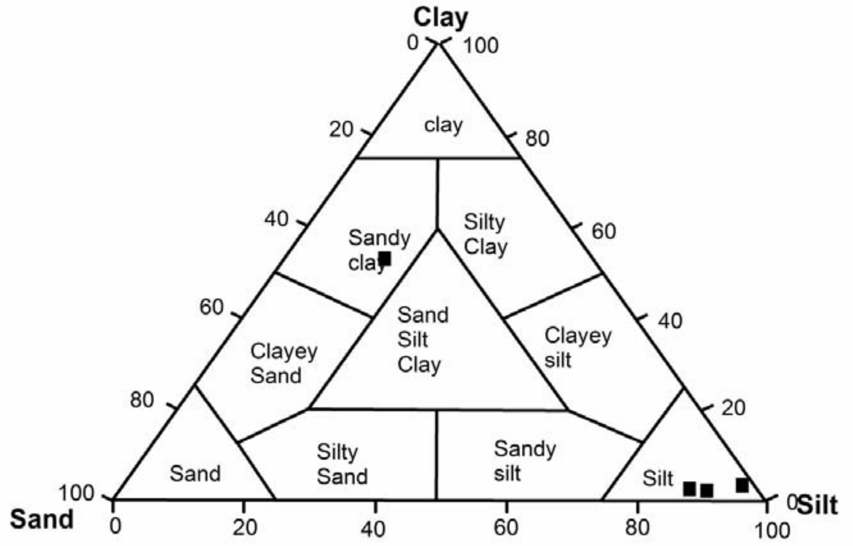
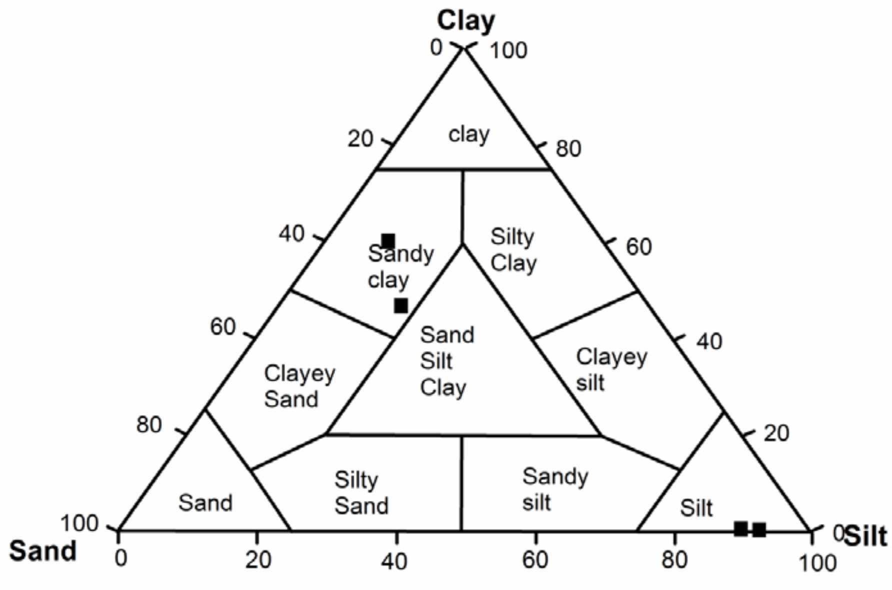


Fig.5.2b 50m depth range



Sediment characteristics (sand, silt, clay) along the southeast coast of India at different depth ranges

Fig.5.2c 100m depth range

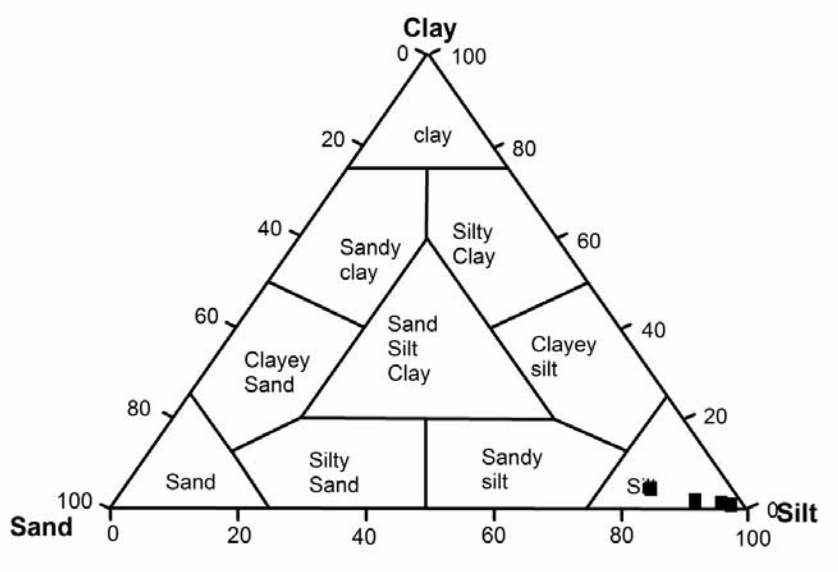


Fig.5.2d 200m depth range

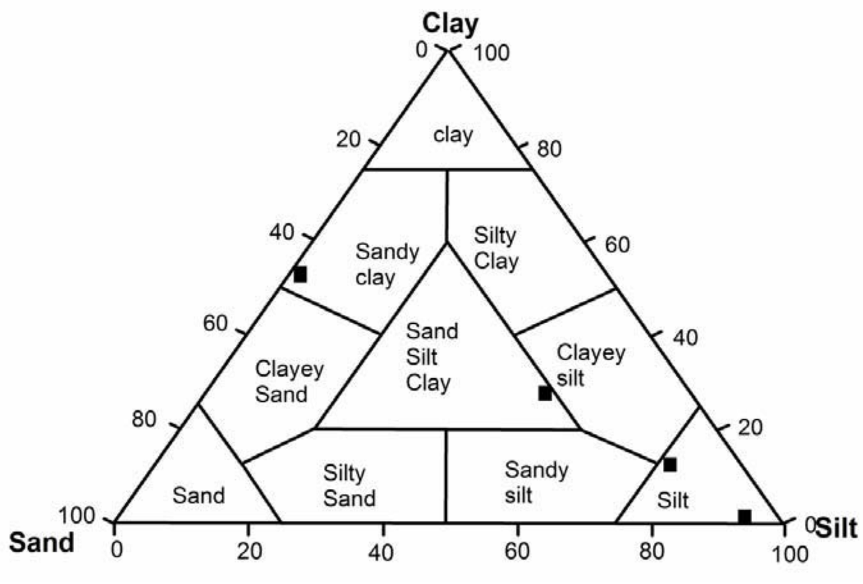


Fig.5.3a. Average sediment texture (sand, silt, clay) along the southwest coast of India at different depth ranges

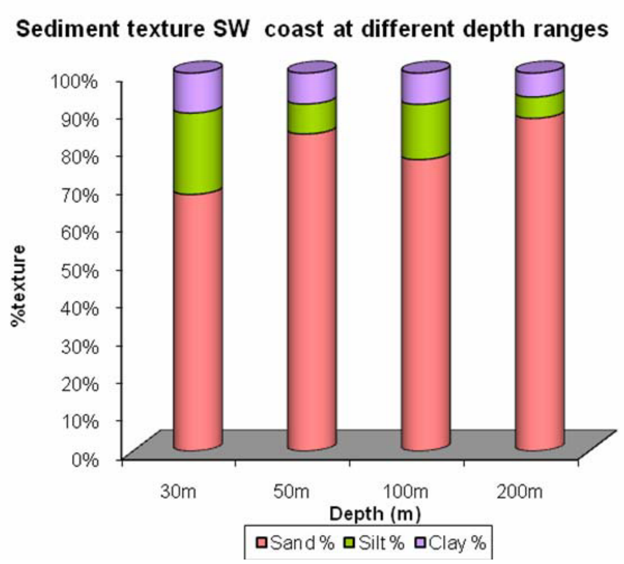


Fig.5.3b. Average sediment texture (sand, silt, clay) along the southeast coast of India at different depth ranges

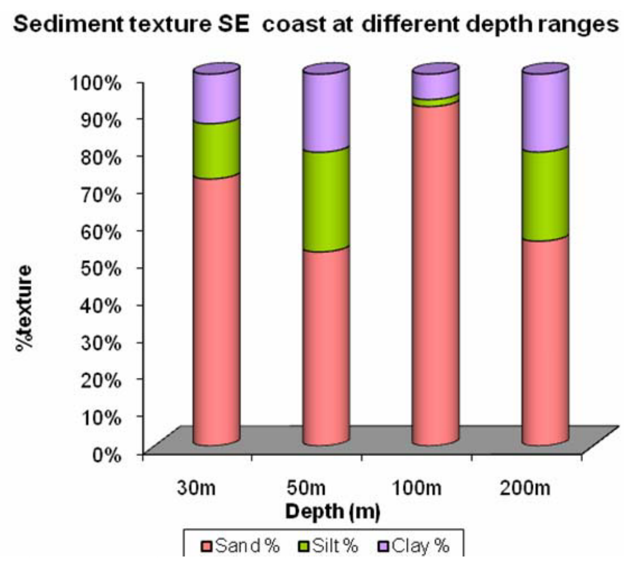


Fig. 5.4. Sediment organic matter along the southwest coast of India at different depth ranges

Fig.5.4a 30m depth range

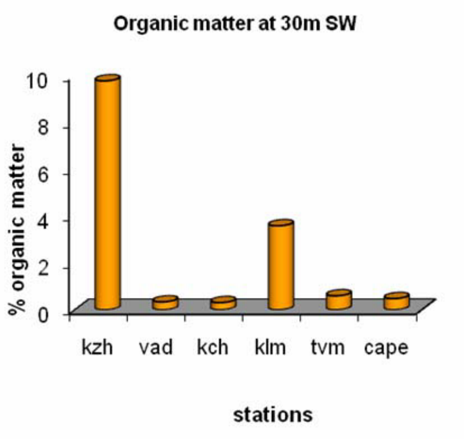


Fig.5.4b 50m depth range

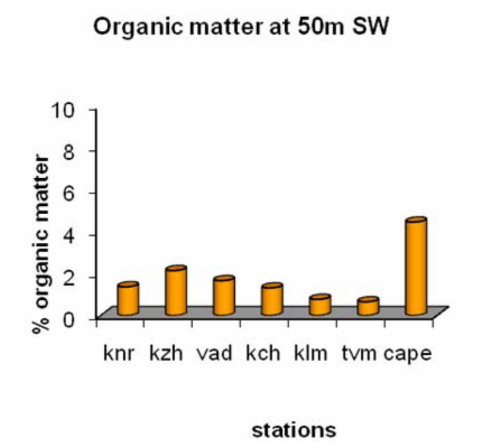


Fig.5.4c 100m depth range

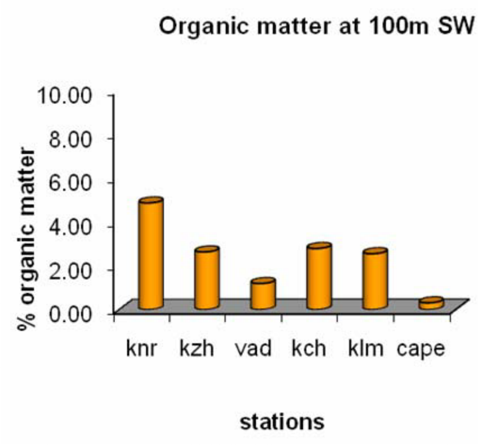


Fig.5.4d 200m depth range

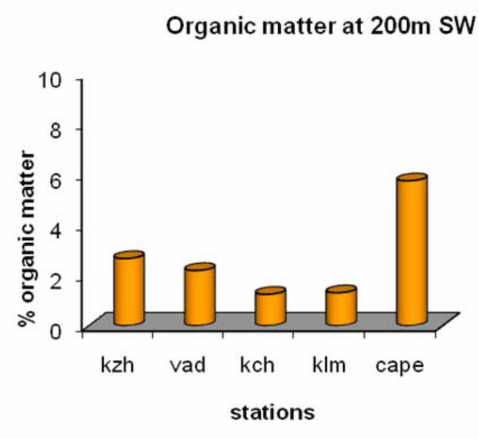


Fig. 5.5. Sediment organic matter along the southeast coast of India at different depth ranges

Fig.5.5a 30m depth range

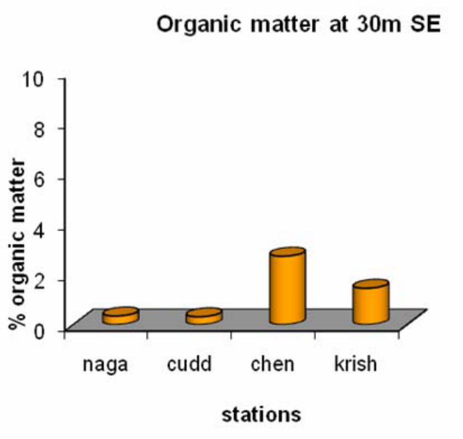


Fig.5.5b 50m depth range

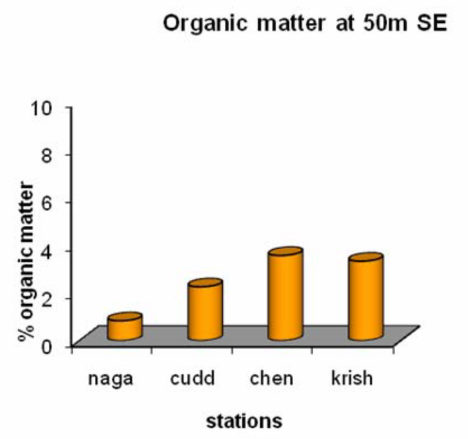


Fig.5.5c 100m depth range

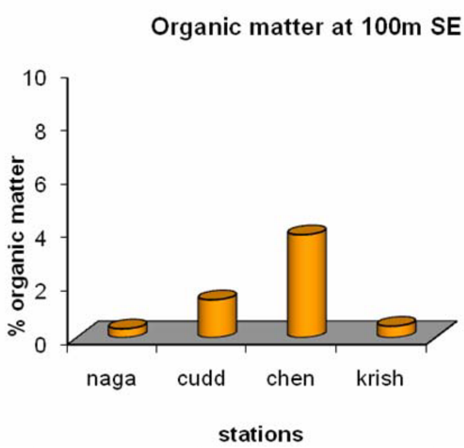


Fig.5.5d 200m depth range

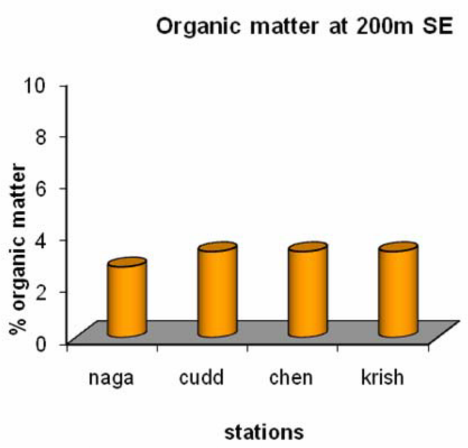


Fig.5.6a. Average sediment organic matter along the southwest coast of India at different depth ranges

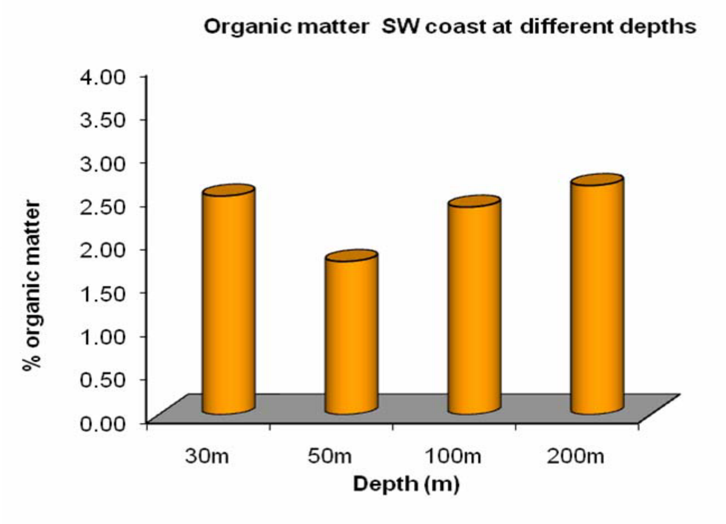


Fig.5.6b. Average sediment organic matter along the southeast coast of India at different depth ranges

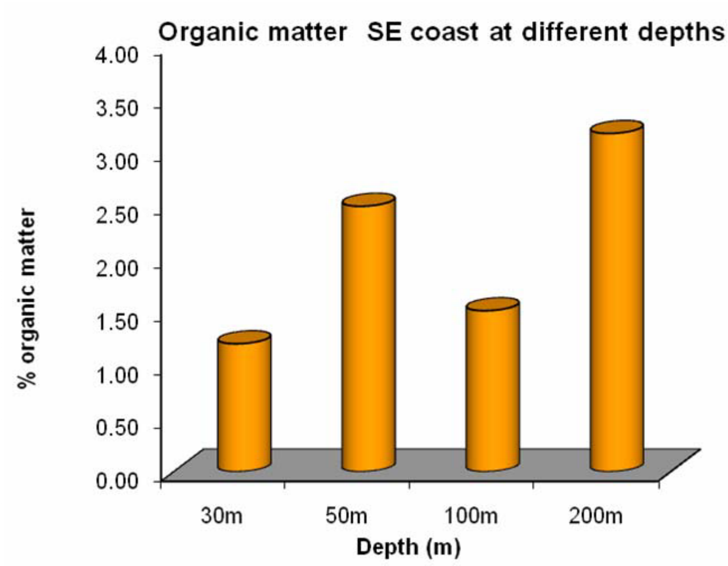


Fig.6.1. Group-wise biomass (wet weight g/sq.m) of macrobenthic fauna along the continental shelf of southwest at different depth ranges

Fig.6.1a: 30m depth range Southwest coast

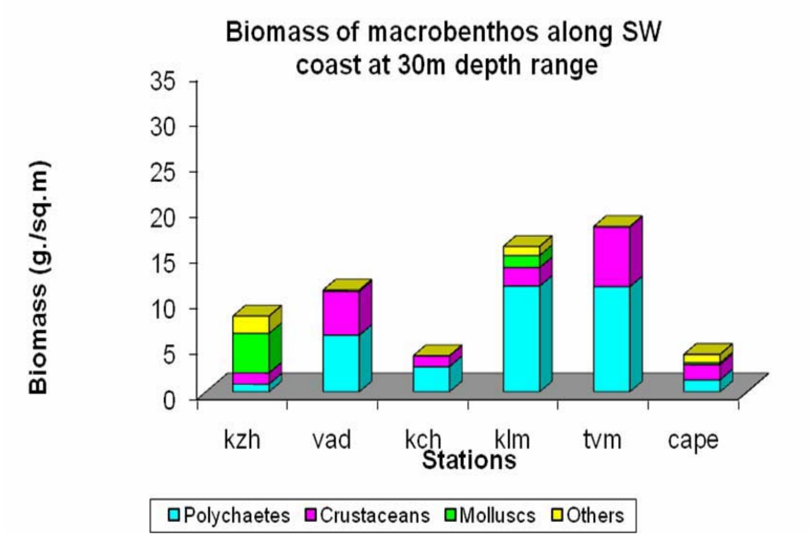
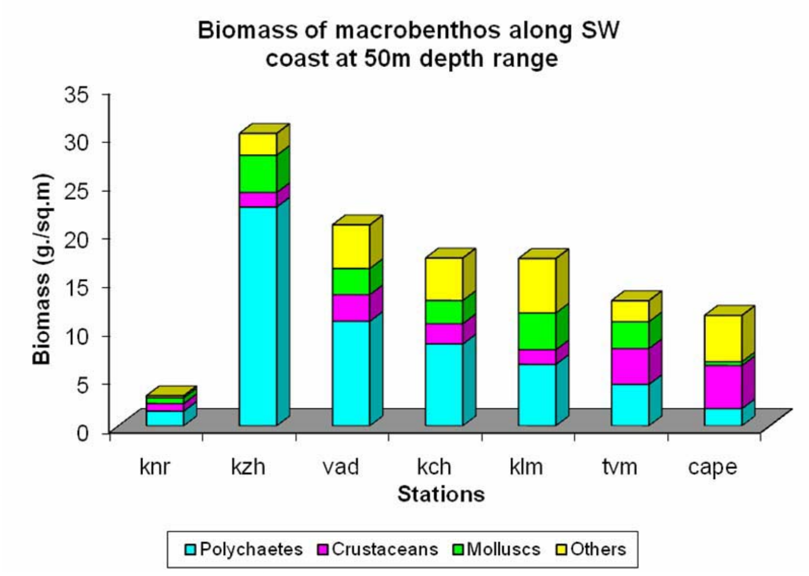


Fig.6.1b: 50m depth range Southwest coast



Group-wise biomass (wet weight g/sq.m) of macrobenthic fauna along the continental shelf of southwest at different depth ranges

Fig.6.1c: 100m depth range Southwest coast

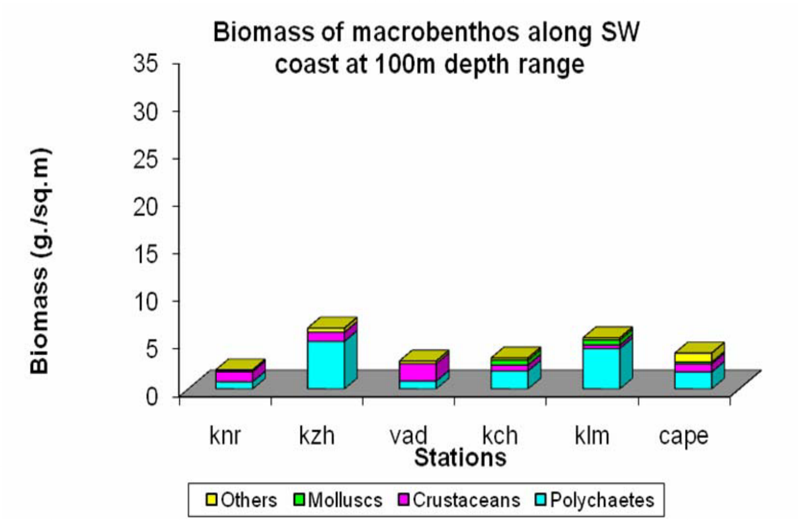


Fig.6.1d: 200m depth range Southwest coast

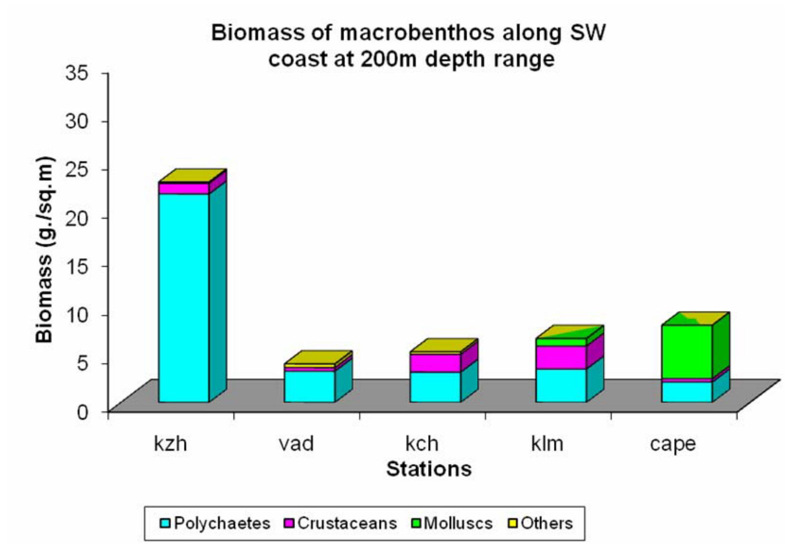


Fig.6.2. Group-wise biomass (wet weight g/sq.m) of macrobenthic fauna along the continental shelf of southeast at different depth ranges

Fig.6.2a: 30m depth range Southeast coast

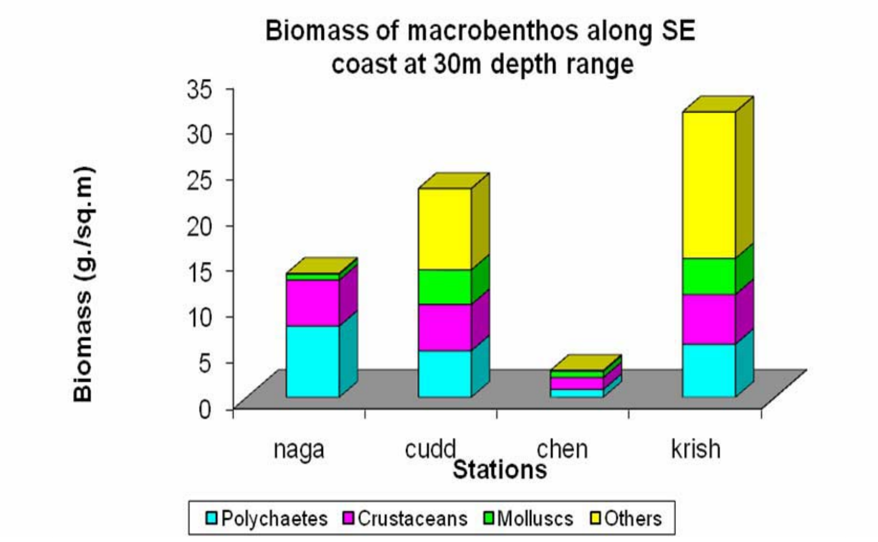
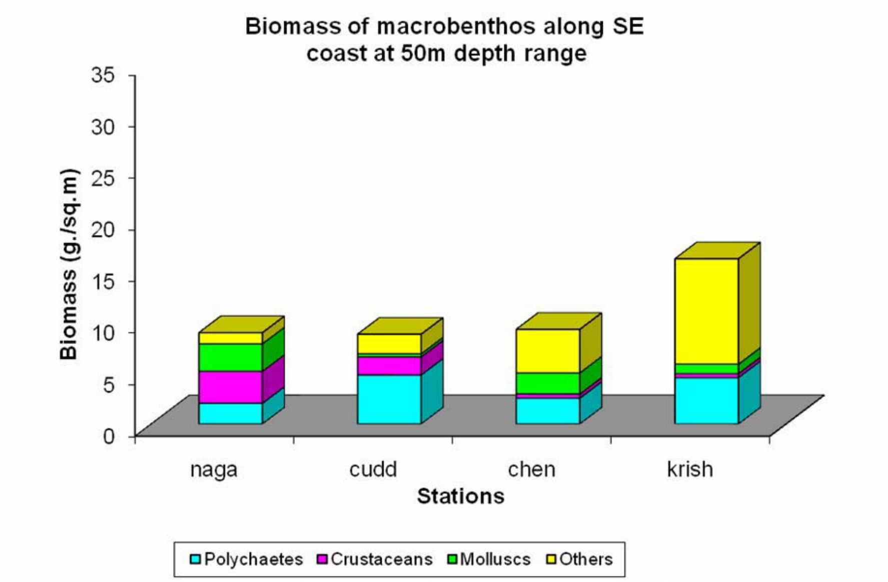


Fig.6.2b: 50m depth range Southeast coast



Group-wise biomass (wet weight g/sq.m) of macrobenthic fauna along the continental shelf of southeast at different depth ranges

Fig.6.2c: 100m depth range Southeast coast

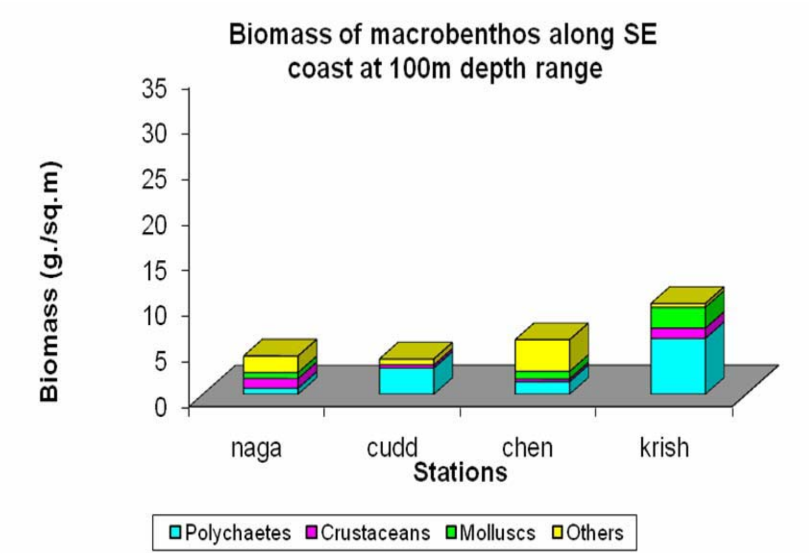


Fig.6.2d: 200m depth range Southeast coast

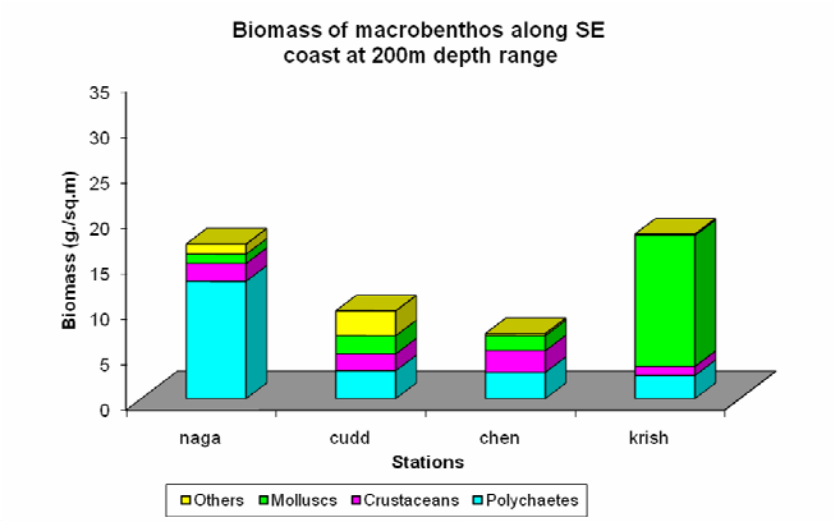


Fig.6.3a: Average group-wise biomass (wet weight g/sq.m) of macrobenthos along the shelf waters of the Southwest coast of India

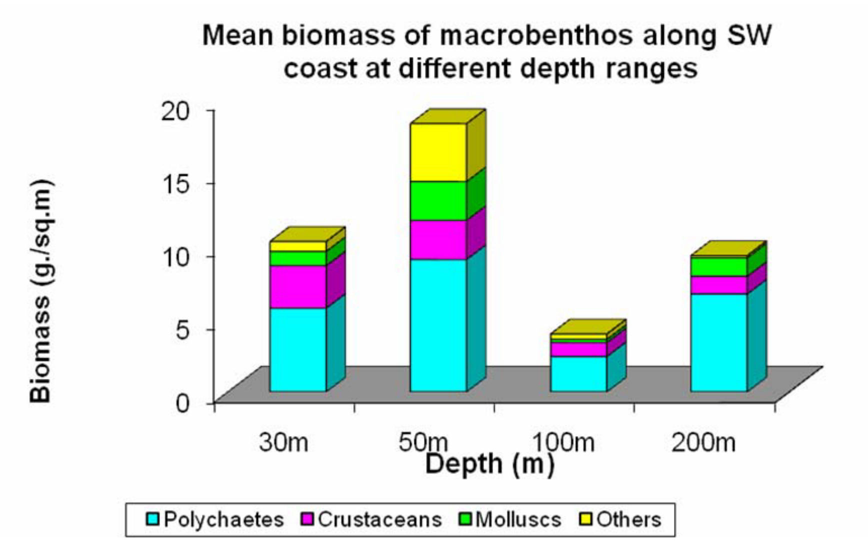


Fig.6.3b. Average group-wise biomass (wet weight g/sq.m) of macrobenthos along the shelf waters of the Southeast coast of India

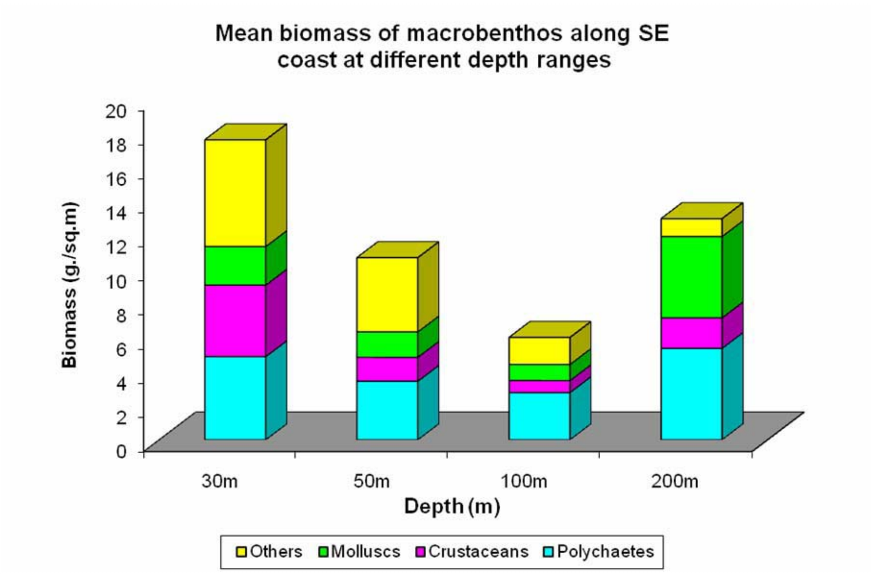


Fig.6.4. Numerical abundance (No/sq.m) of macrofauna groups along the continental shelf of southwest coast of India at different depth ranges.

Fig.6.4a. 30m depth range Southwest coast

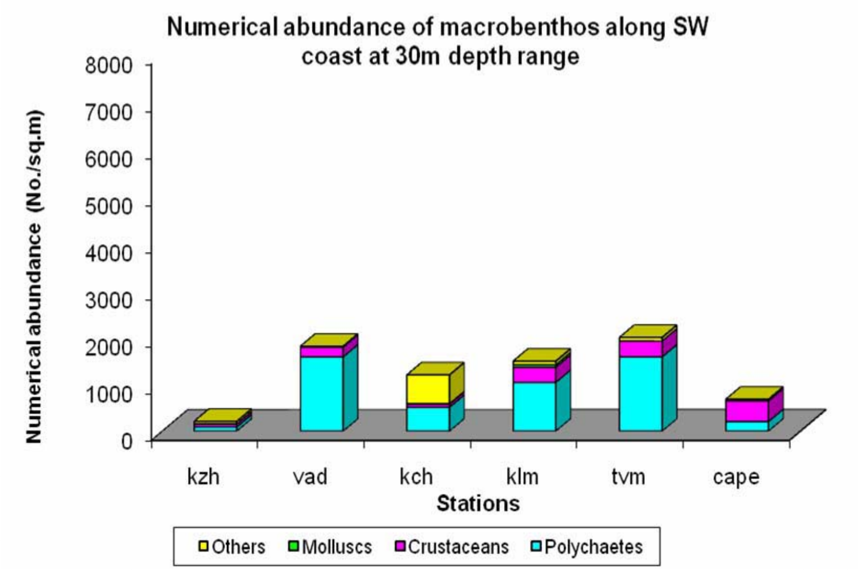
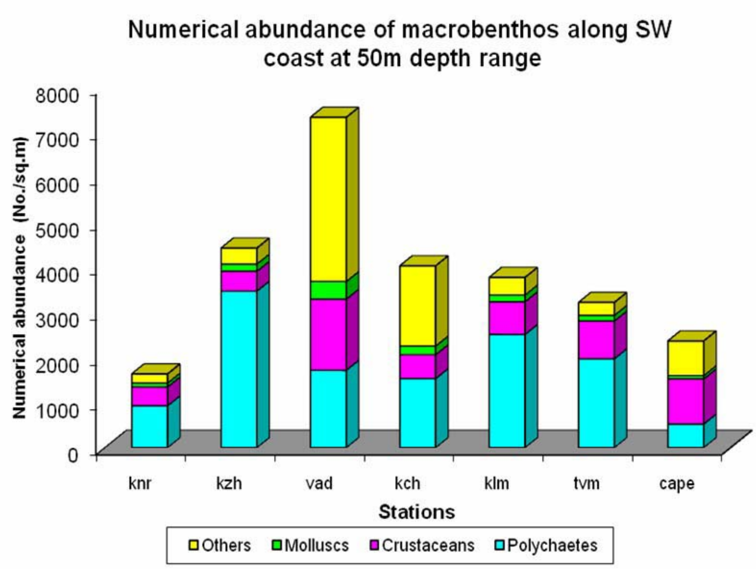


Fig.6.4b. 50m depth range Southwest coast



Numerical abundance (No/sq.m) of macrofauna groups along the continental shelf of southwest coast of India at different depth ranges.

Fig.6.4c.100m depth range Southwest coast

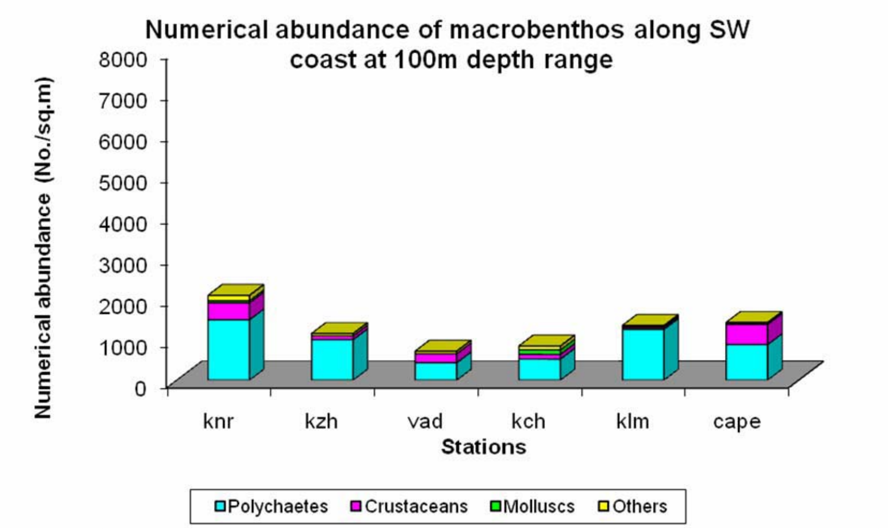


Fig.6.4d.200m depth range Southwest coast

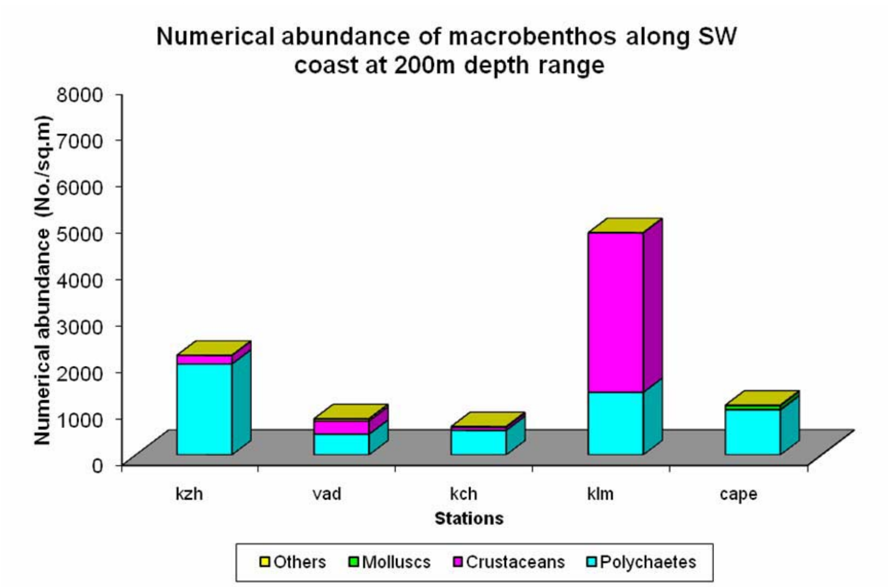


Fig.6.5. Numerical abundance (No/sq.m) of macrofauna groups along the continental shelf of southeast coast of India at different depth ranges.

Fig.6.5a. 30m depth range Southeast coast

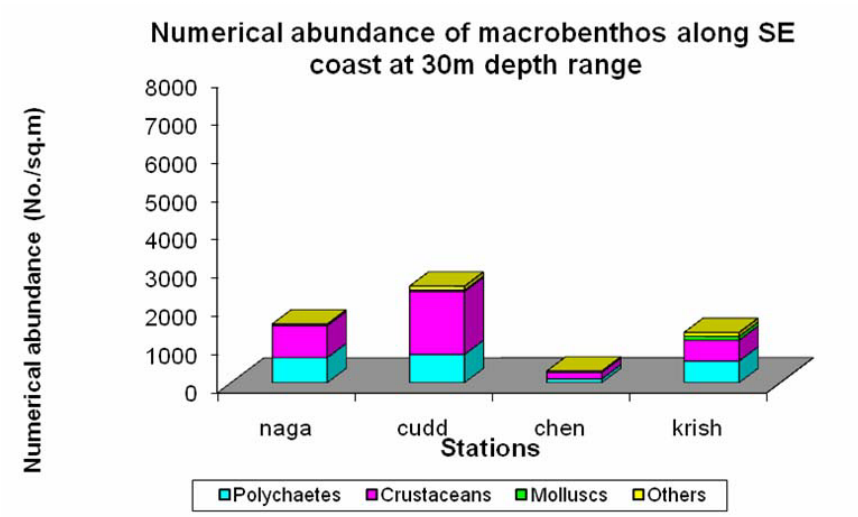
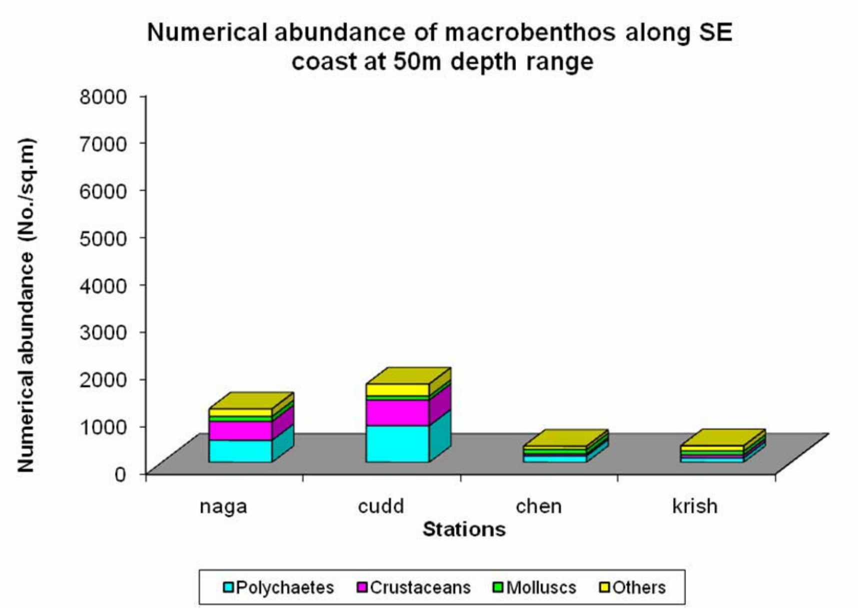


Fig.6.5b. 50m depth range Southeast coast



Numerical abundance (No/sq.m) of macrofauna groups along the continental shelf of southeast coast of India at different depth ranges.

Fig.6.5c. 100m depth range Southeast coast

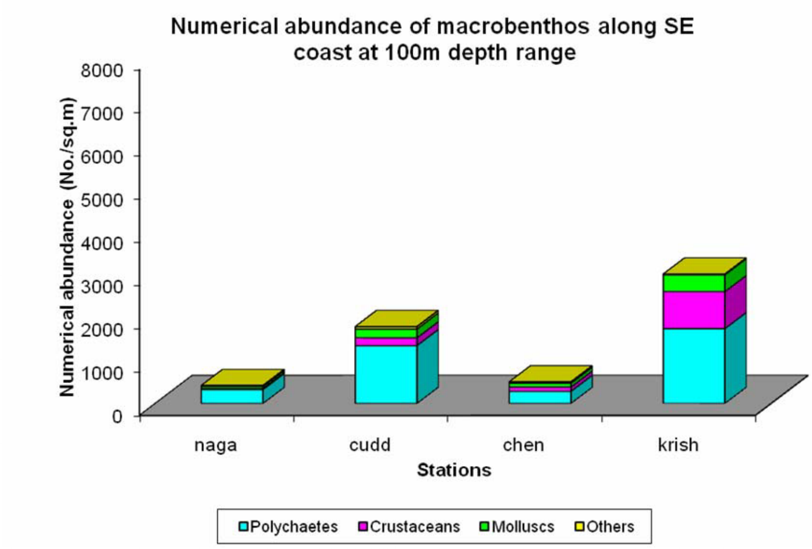


Fig.6.5d. 200m depth range Southeast coast

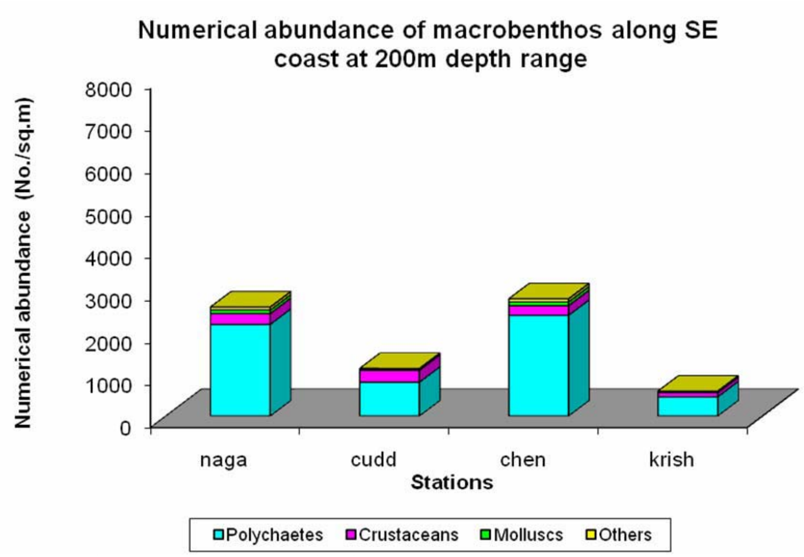


Fig.6.6.a. Average numerical abundance (No./sq.m) of macrobenthos along the shelf waters of the Southwest coast of India

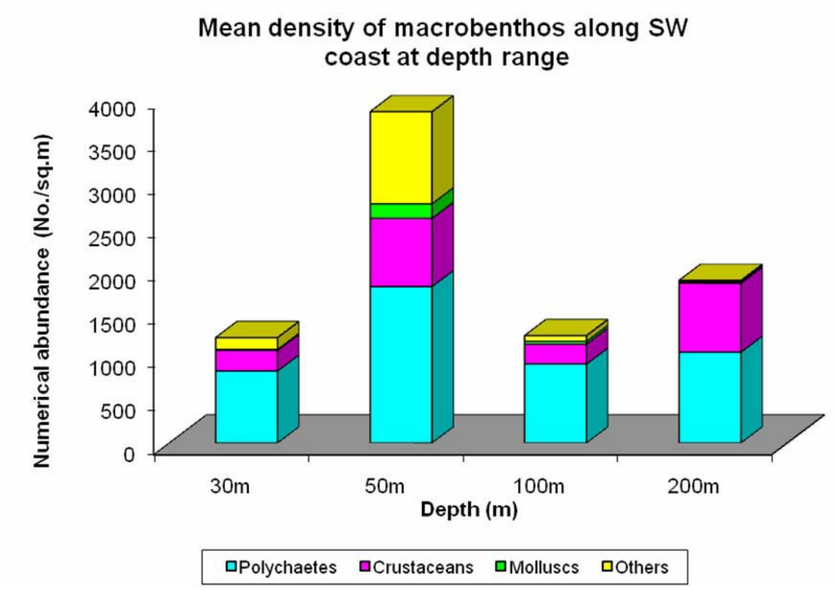


Fig.6.6b. Average numerical abundance (No./sq.m) of macrobenthos along the shelf waters of the Southeast coast of India

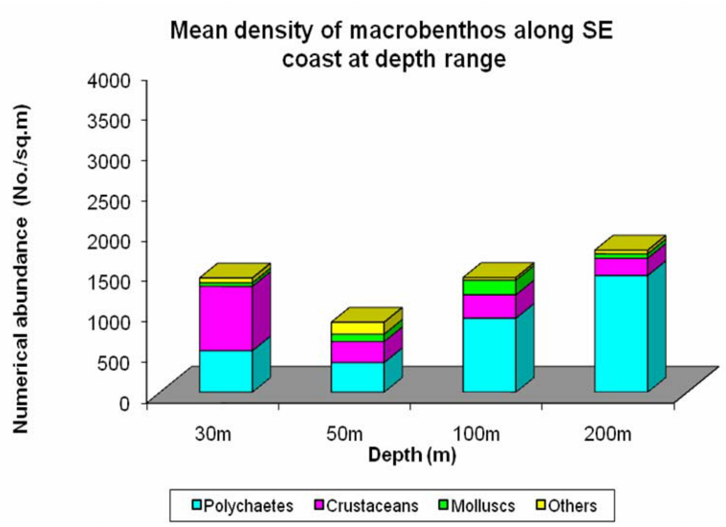


Fig. 6.7. Dendrogram of polychaetes along southwest coast of India at different depth ranges

Fig. 6.7a 30m depth range SW coast

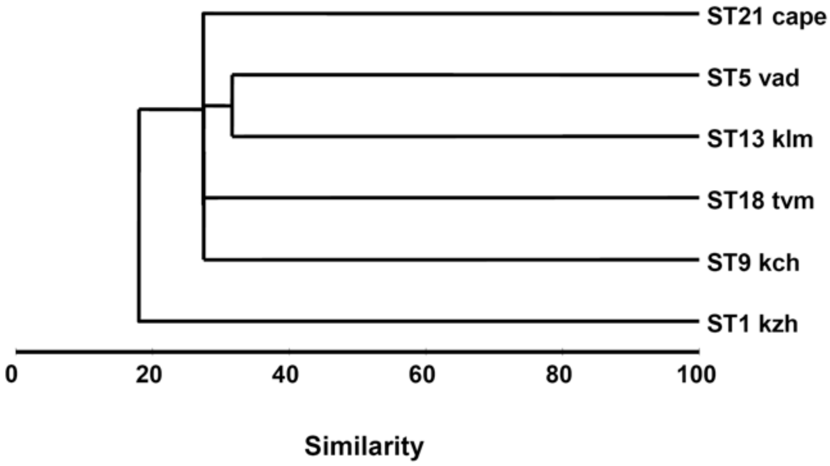
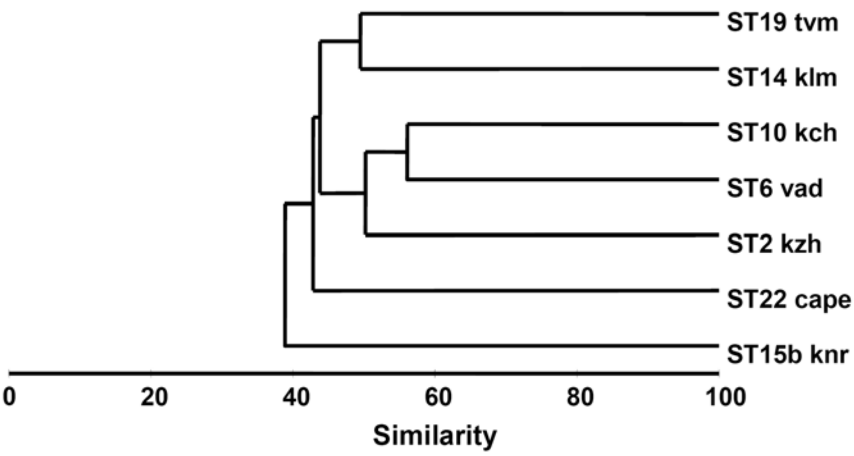


Fig. 6.7b. 50m depth range SW coast



Dendrogram of polychaetes along southwest coast of India at different depth ranges

Fig. 6.7c. 100m depth range SW coast

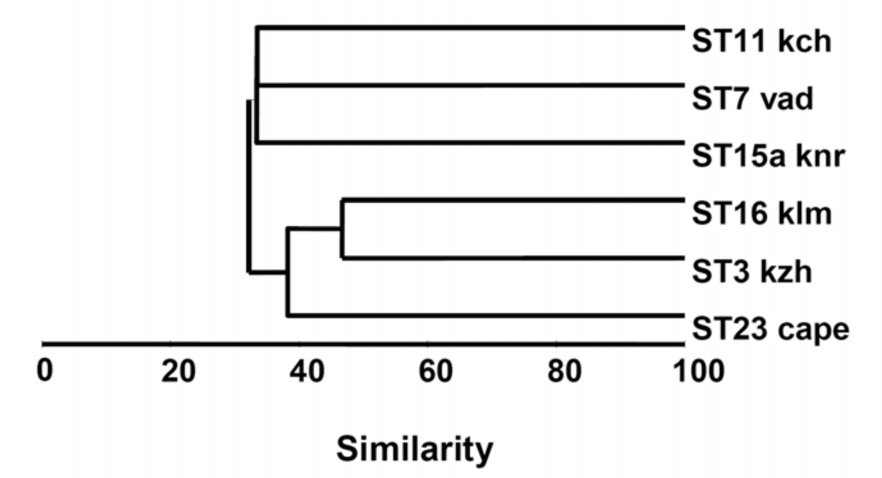


Fig.6.7d 200m depth range sw coast

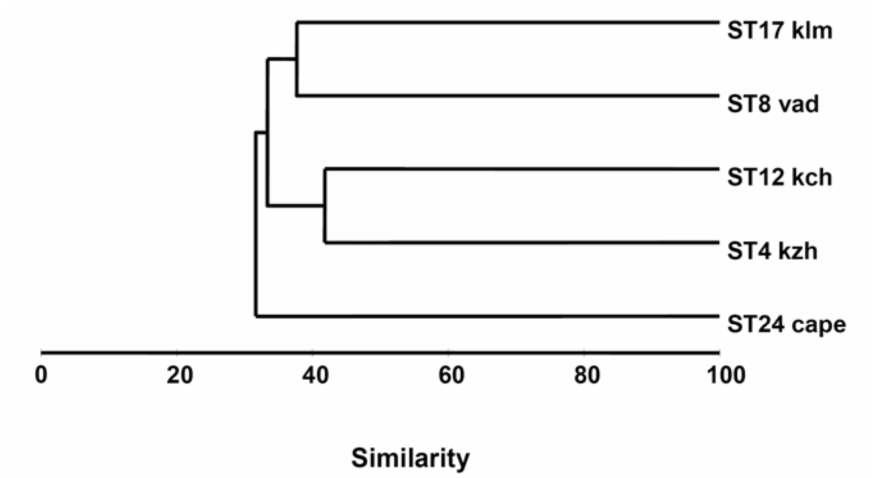


Fig.6.8. Dendrogram of polychaetes along southeast coast of India at different depth ranges

Fig.6.8a 30m depth range SE coast

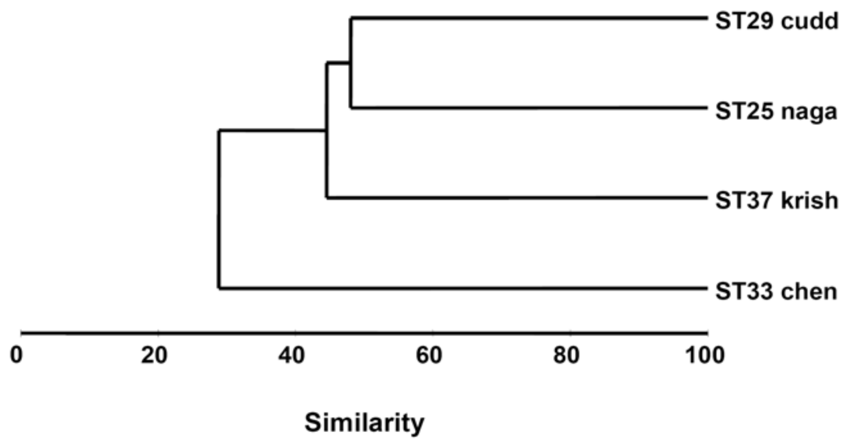
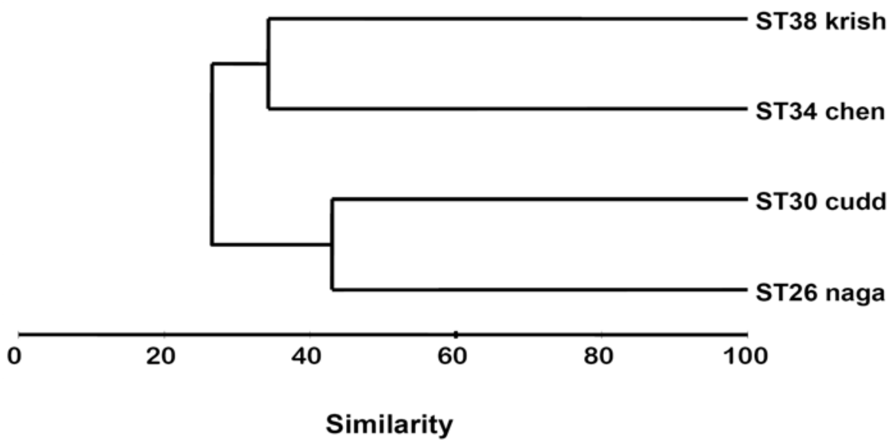


Fig.6.8b. 50m depth range SE coast



Dendrogram of polychaetes along southeast coast of India at different depth ranges

Fig.6.8c. 100m depth range SE coast

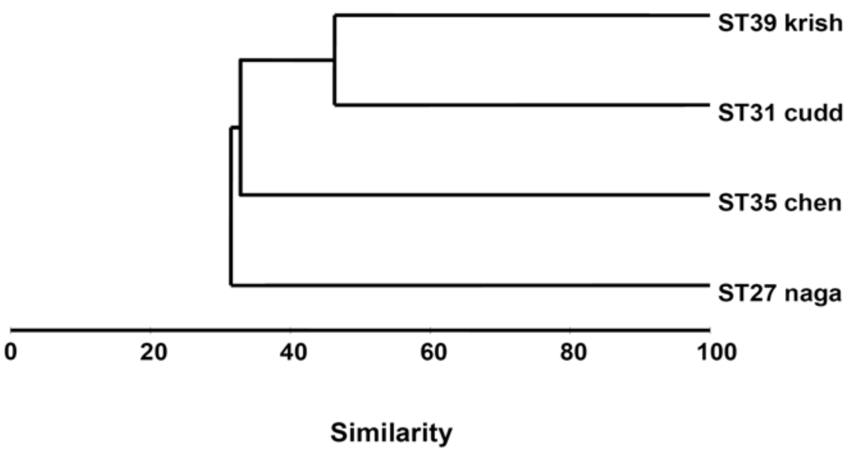


Fig.6.8d. 200m depth range SE coast

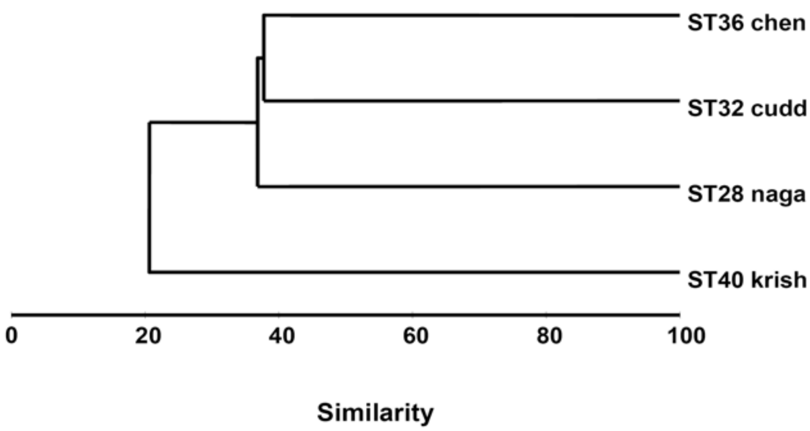


Fig.6.9. MDS ordination of polychaetes along southwest coast of India at different depth ranges

Fig.6.9a.30m depth range SW coast

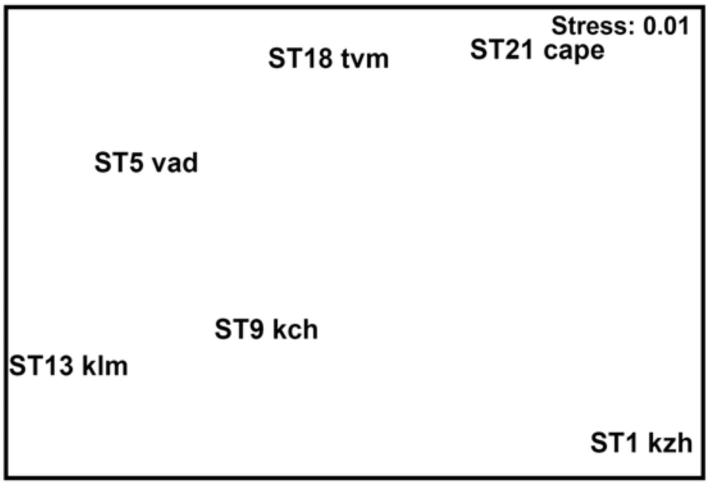
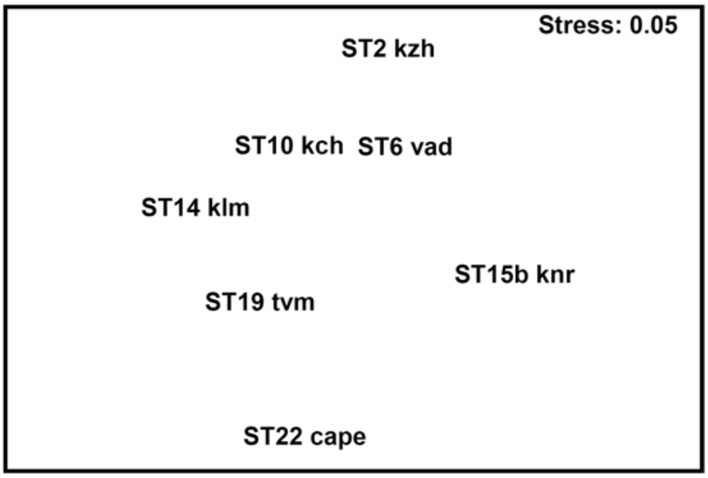


Fig.6.9b. 50m depth range SW coast



MDS ordination of polychaetes along southwest coast of India at different depth ranges

Fig.6.9c. 100m depth range SW coast

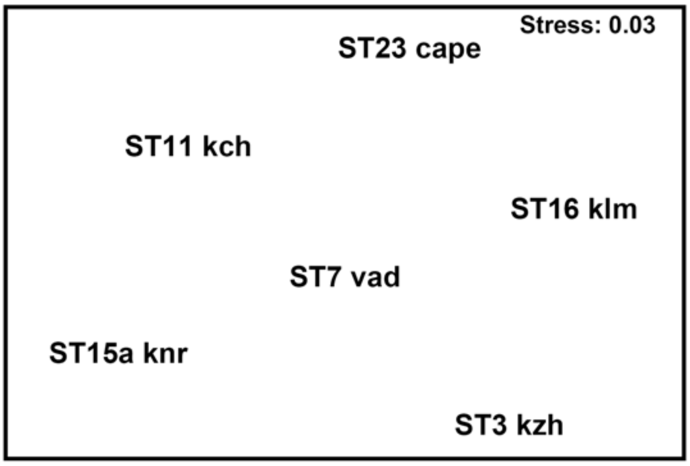


Fig.6.9d. 200m depth range SW coast

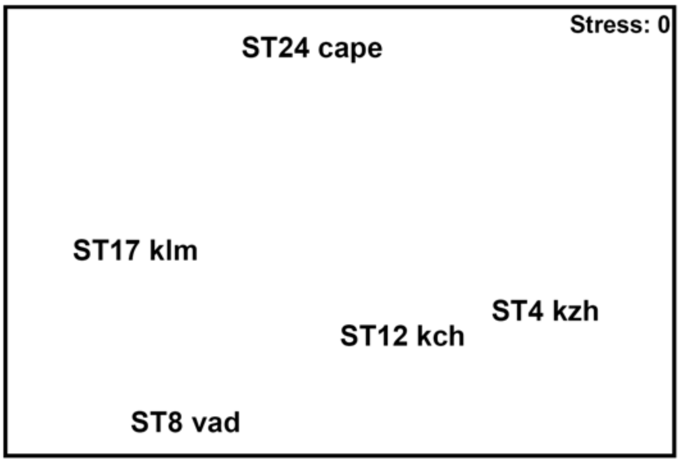


Fig.6.10. MDS ordination of polychaetes along southeast coast of India at different depth ranges

Fig.6.10a. 30m depth range SE coast

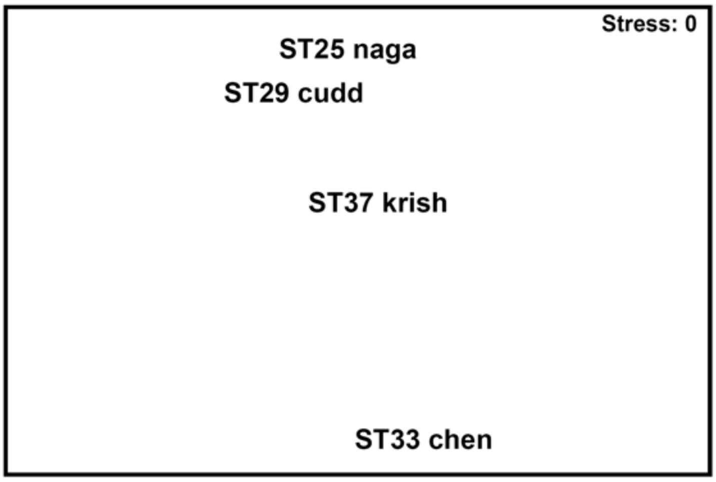


Fig.6.10b. 50m depth range SE coast

MDS ordination of polychaetes along southeast coast of India at different depth ranges

Fig.6.10c. 100m depth range SE coast

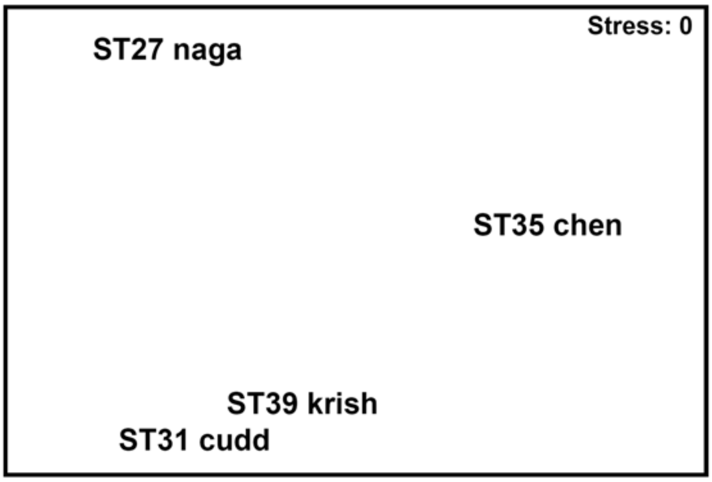


Fig.6.10d. 200m depth range SE coast

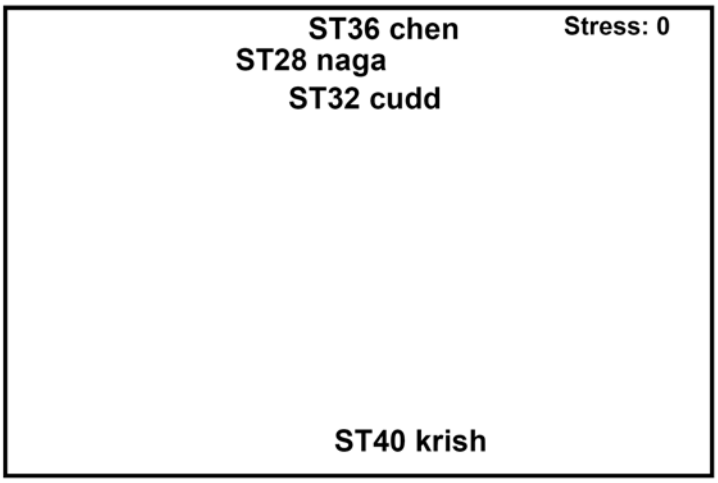


Fig. 6.11. Dendrogram of groups along southwest coast of India at different depth ranges

Fig. 6.11a. 30m depth range SW coast

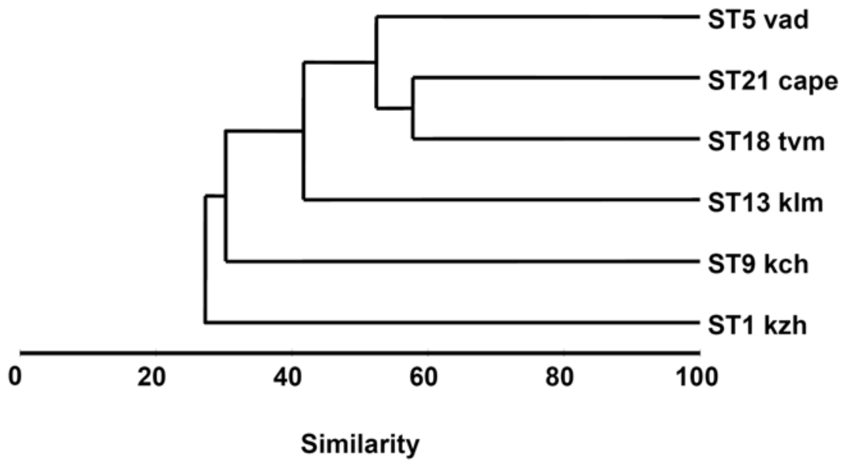
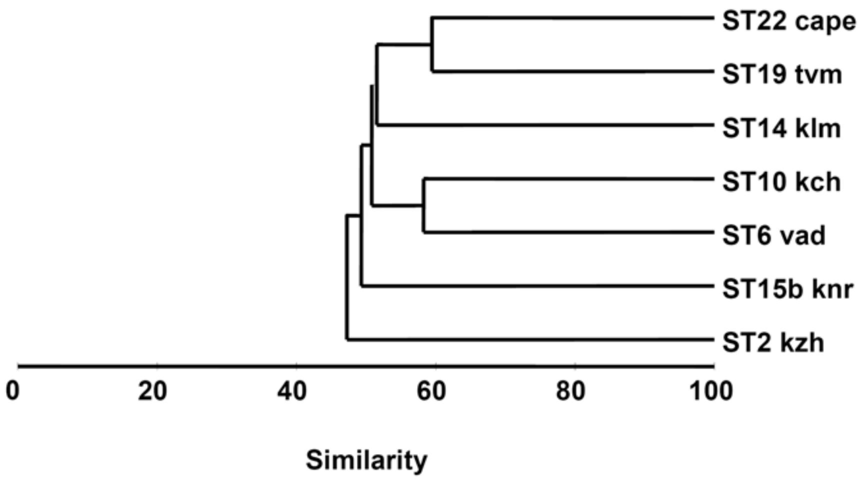


Fig. 6.11b. 50m depth range SW coast



Dendrogram of groups along southwest coast of India at different depth ranges

Fig. 6.11c. 100m depth range SW coast

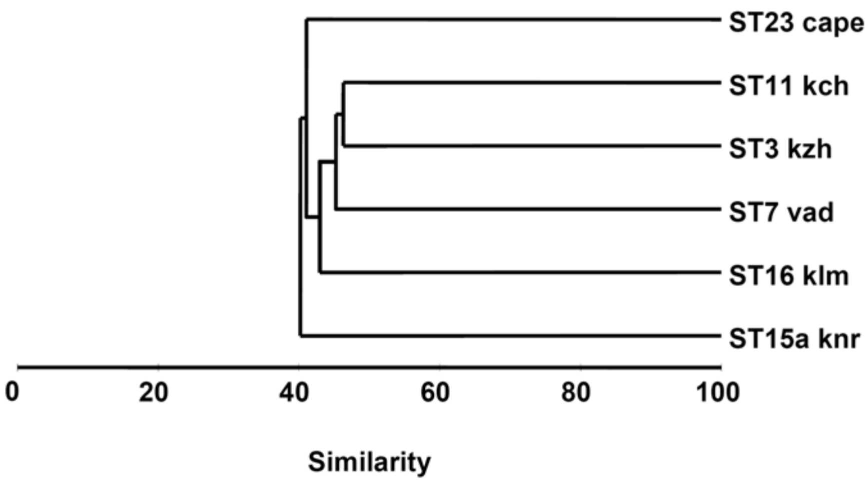


Fig. 6.11d. 200m depth range SW coast

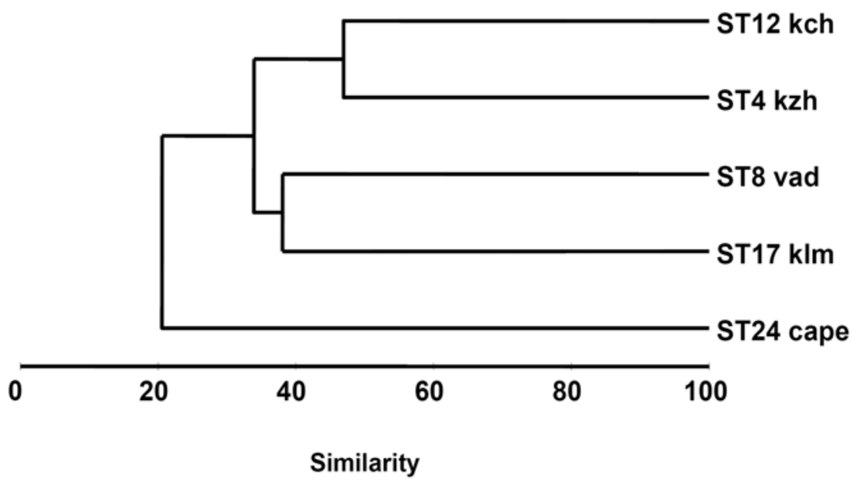


Fig.6.12. Dendrogram of groups along southeast coast of India at different depth ranges

Fig.6.12a. 30m depth range SE coast

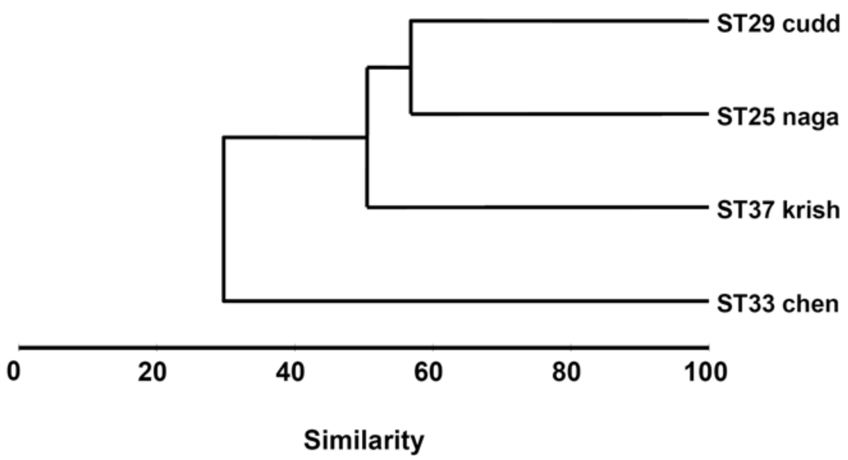
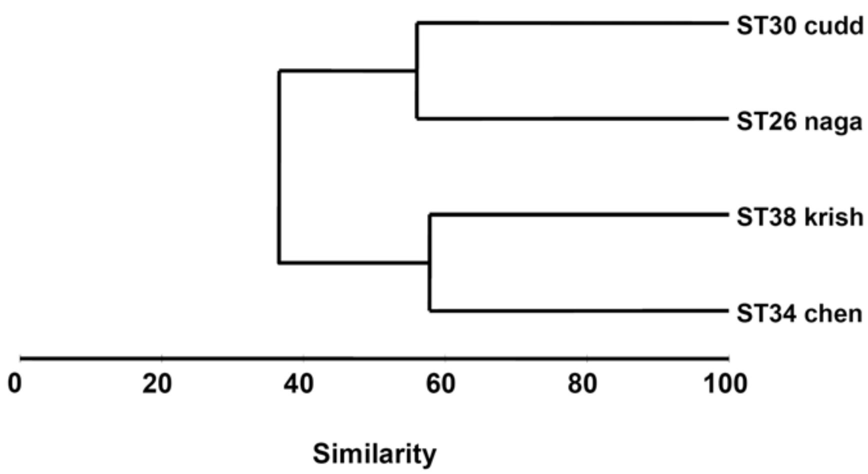


Fig.6.12b. 50m depth range SE coast



Dendrogram of groups along southeast coast of India at different depth ranges

Fig.6.12c. 100m depth range SE coast

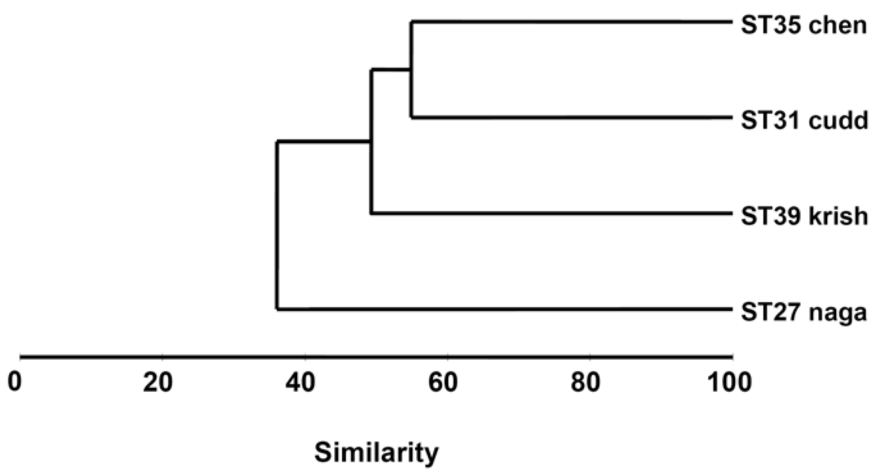


Fig.6.12d. 200m depth range SE coast

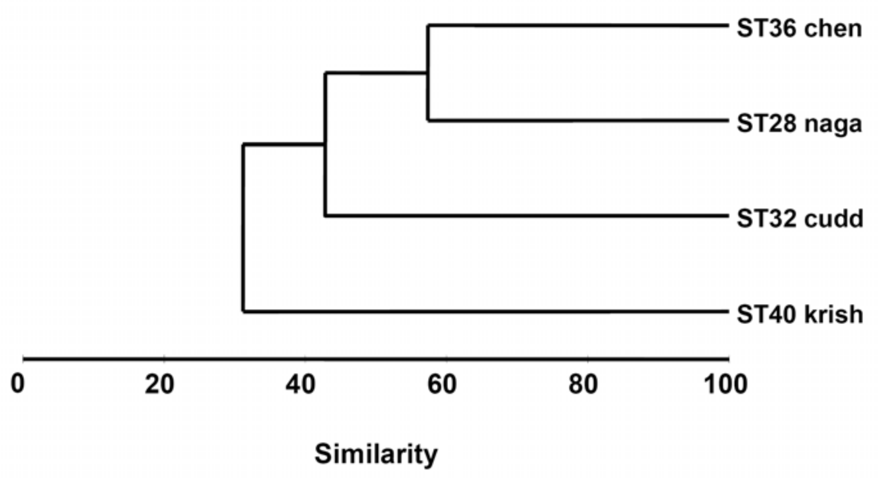


Fig.6.13. MDS ordination of groups along southwest coast of India at different depth ranges

Fig.6.13a.30m depth range SW coast

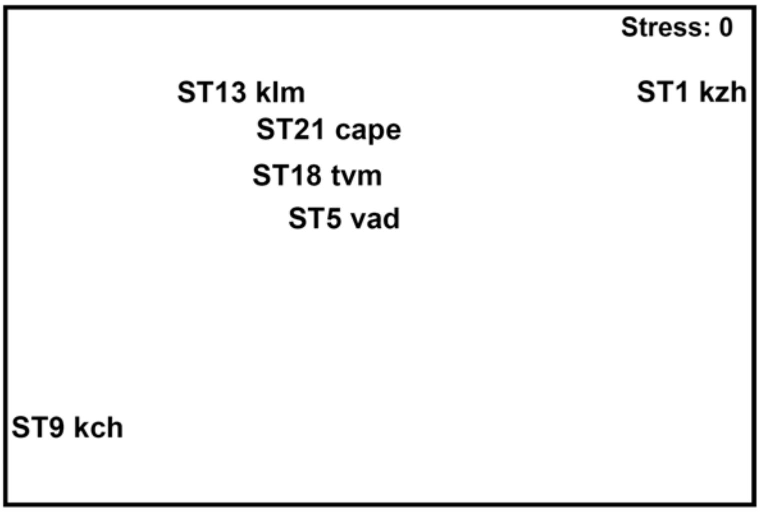
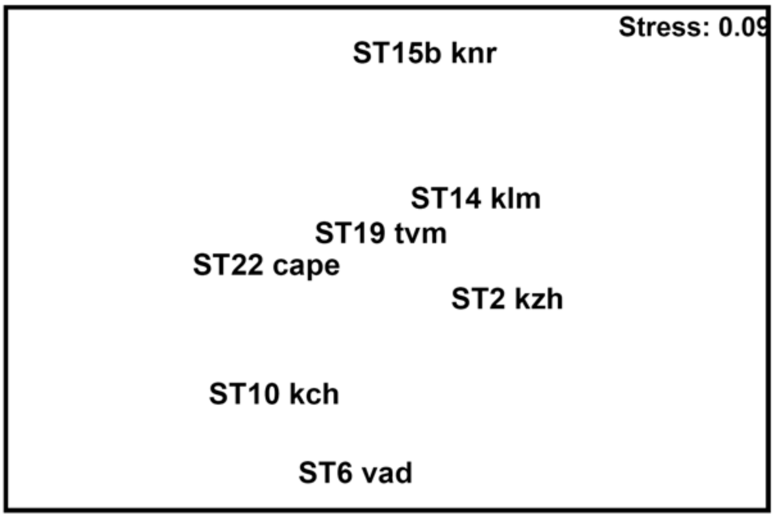


Fig.6.13b. 50m depth range SW coast



MDS ordination of groups along southwest coast of India at different depth ranges

Fig.6.13c. 100m depth range SW coast

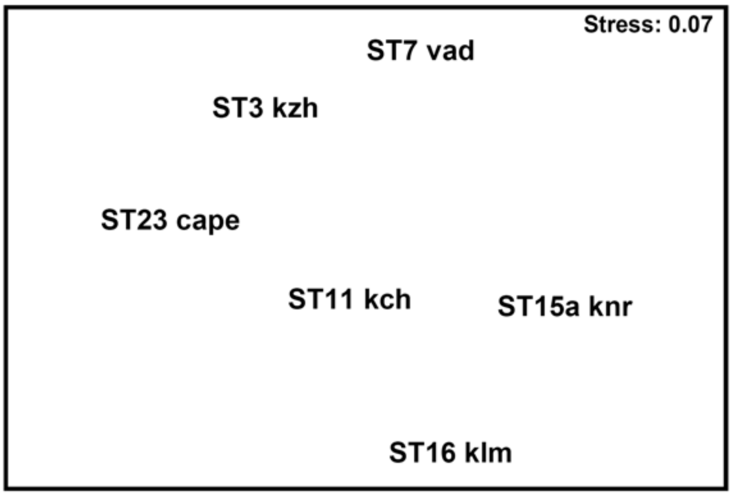


Fig.6.13d.200m depth range SW coast

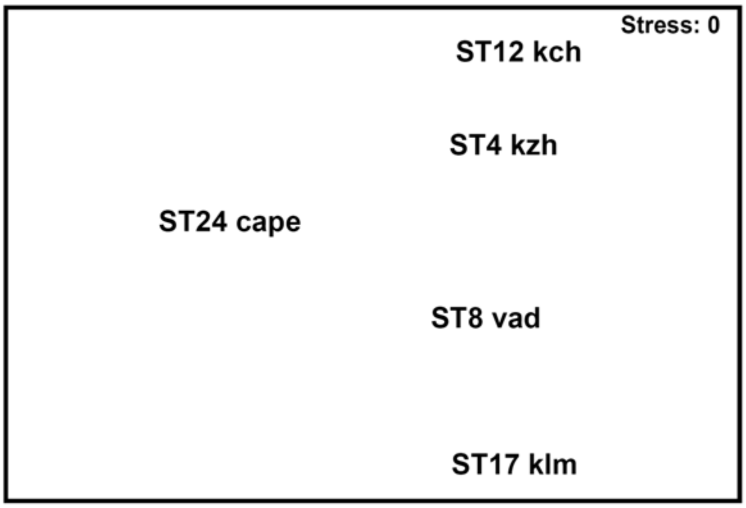


Fig.6.14. MDS ordination of groups along southeast coast of India at different depth ranges

Fig.6.14a. 30m depth range SE coast

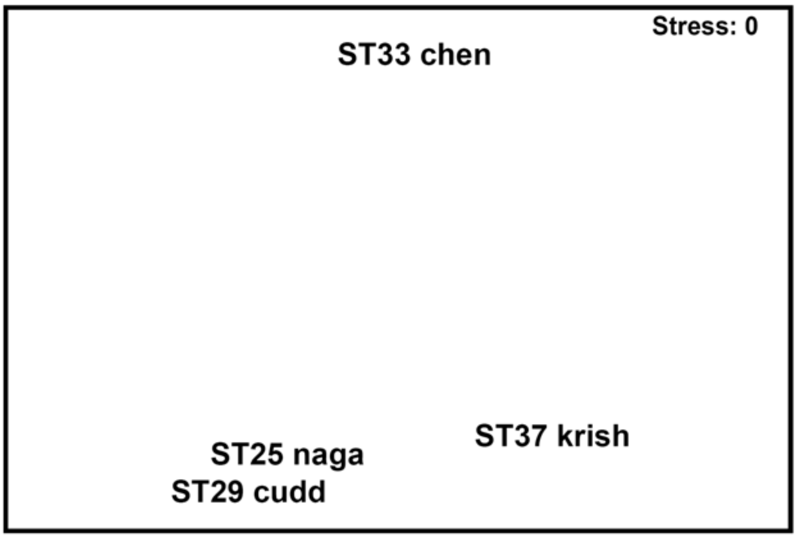
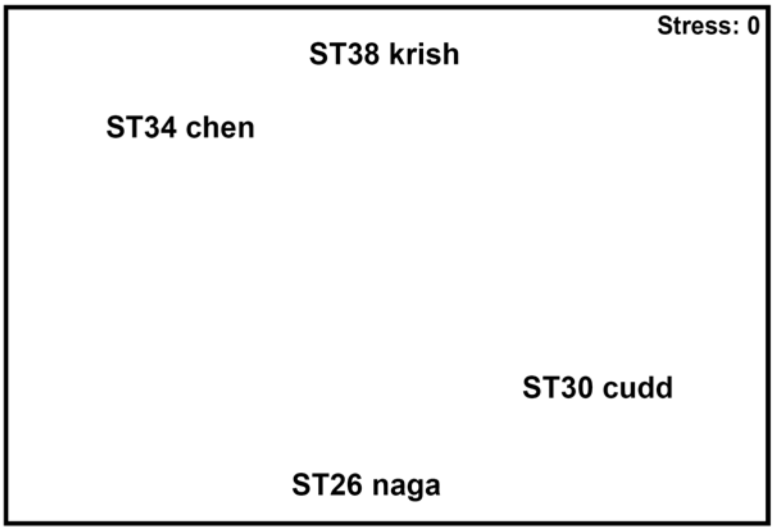


Fig.6.14b. 50m depth range SE coast



MDS ordination of groups along southeast coast of India at different depth ranges

Fig.6.14c.100m depth range SE coast

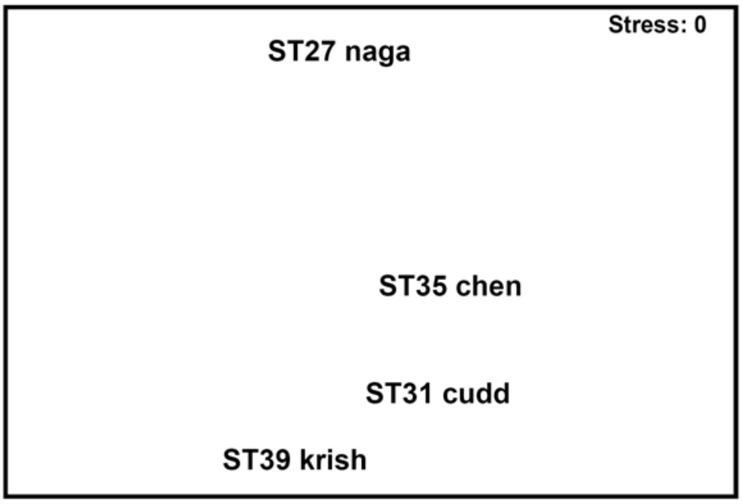


Fig.6.14d. 200m depth range SE coast

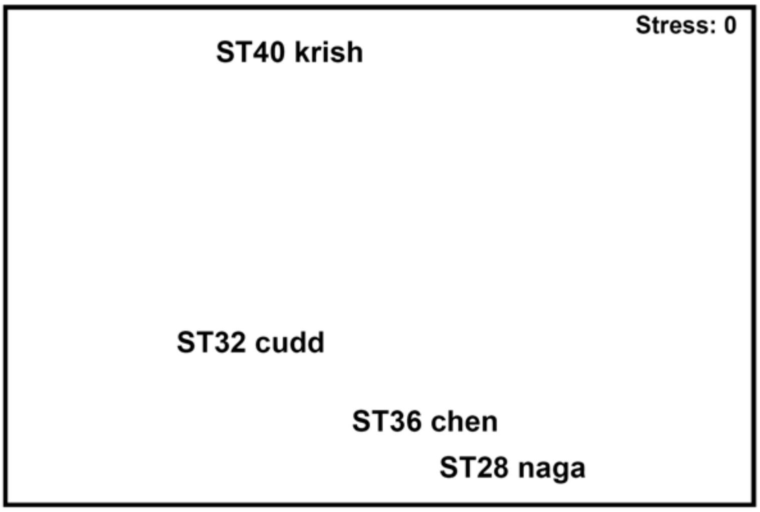


Fig. 6.15. Diversity indices of macrobenthic infaunal polychaetes along southwest and southeast coast of India

Fig 6.15a 30m depth range SW coast

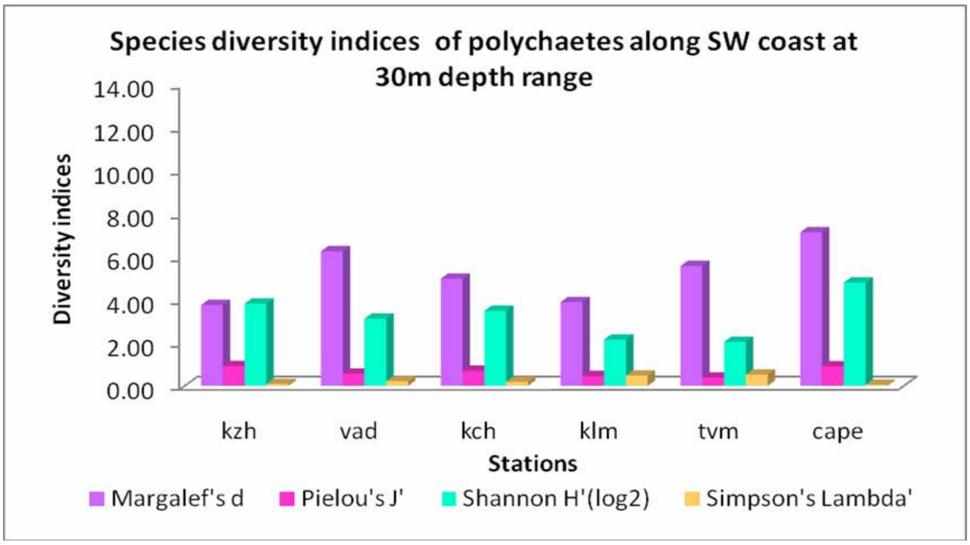
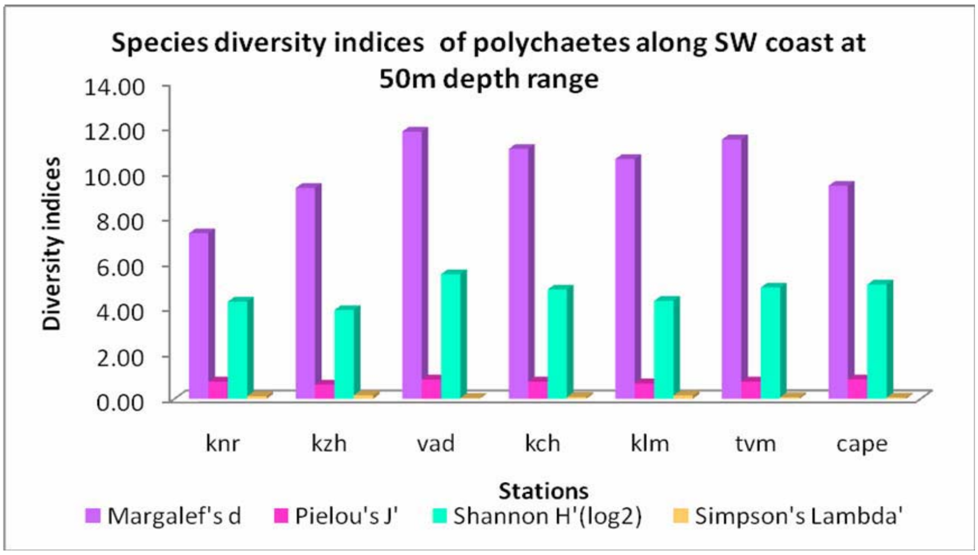


Fig 6.15b 50m depth range SW coast



Diversity indices of macrobenthic infaunal polychaetes along southwest and southeast coast of India

Fig 6.15c 100m depth range SW coast

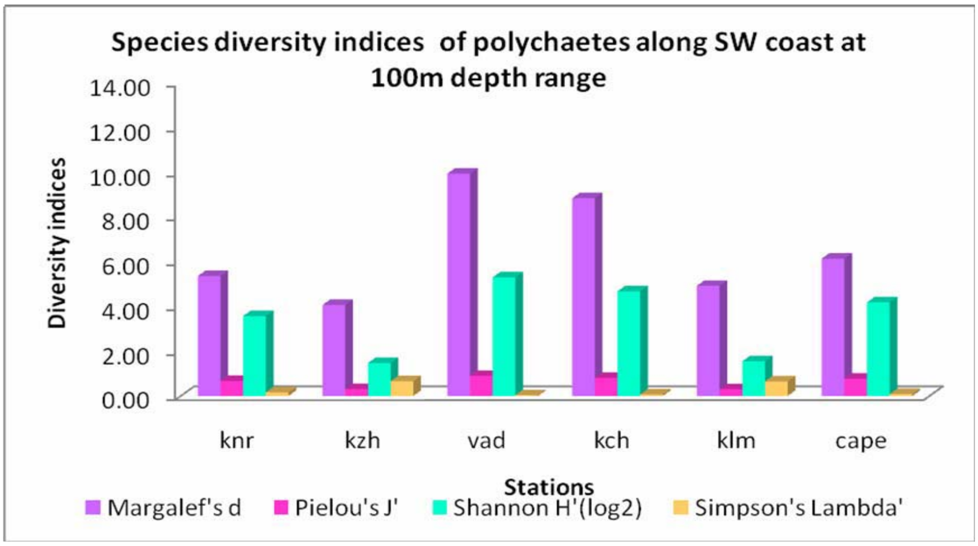
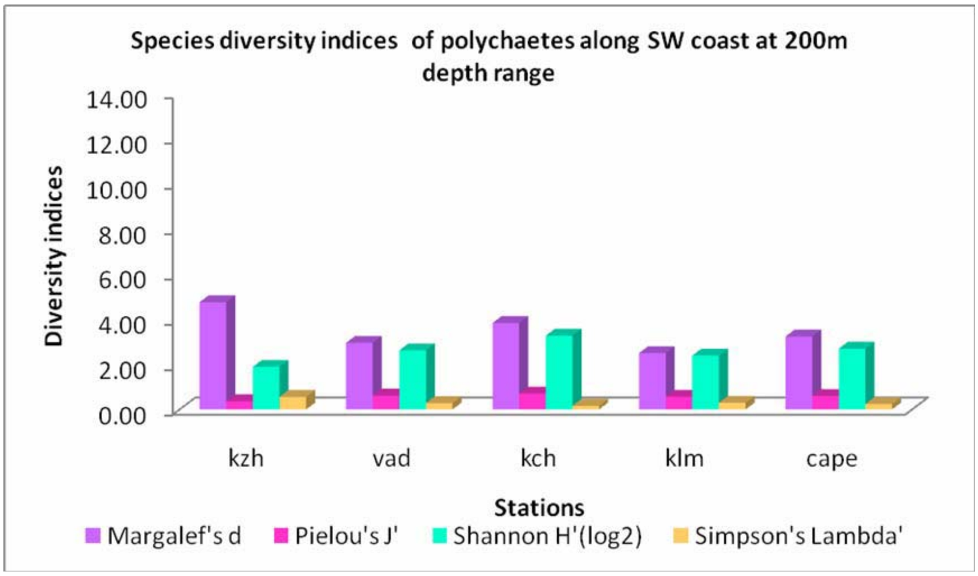


Fig 6.15d 200m depth range SW coast



Diversity indices of macrobenthic infaunal polychaetes along southwest and southeast coast of India

Fig 6.15e 30m depth range SE coast

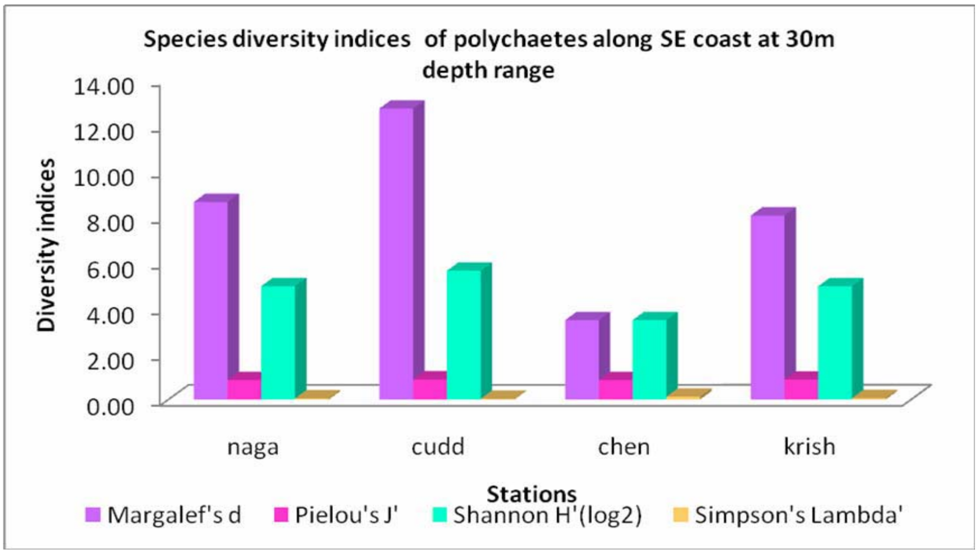
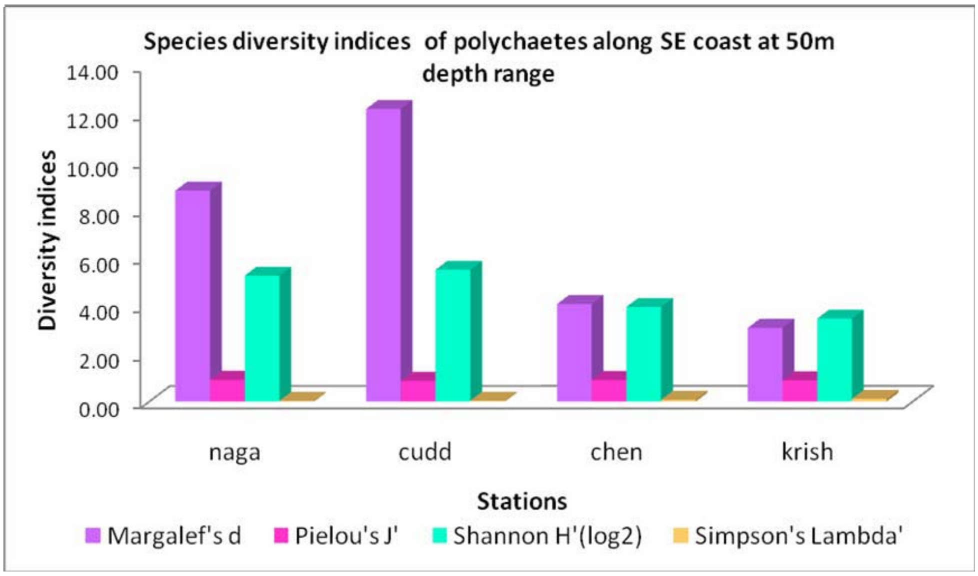


Fig 6.15f 50m depth range SE coast



Diversity indices of macrobenthic infaunal polychaetes along southwest and southeast coast of India

Fig 6.15g 100m depth range SE coast

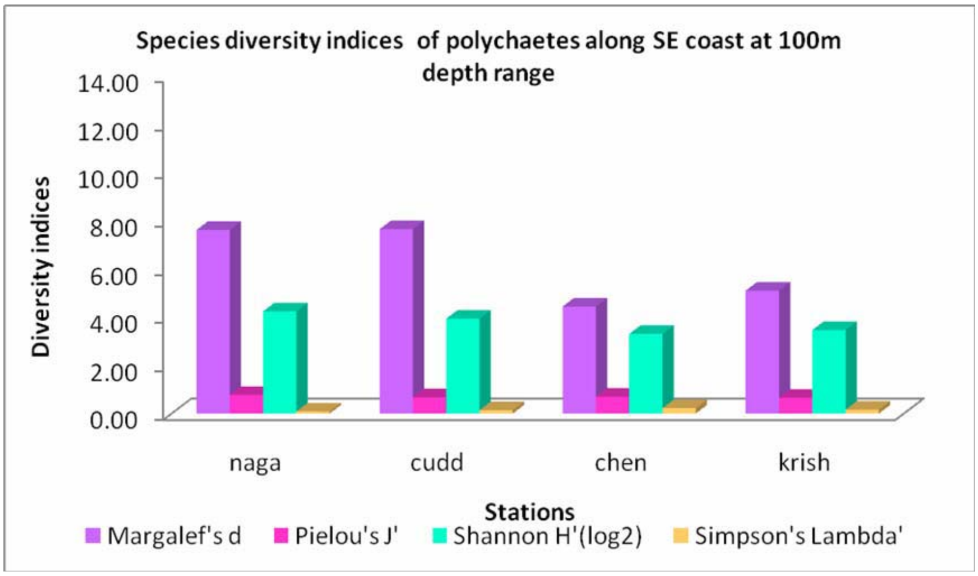


Fig 6.15h 200m depth range SE coast

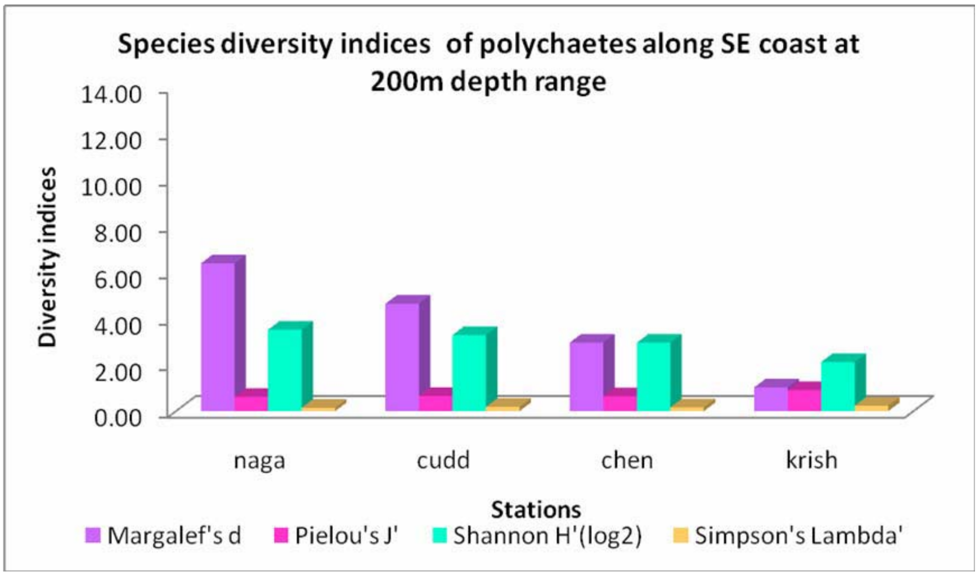


Fig.6.15i Average diversity indices of macrobenthic infaunal polychaetes along southwest coast of India

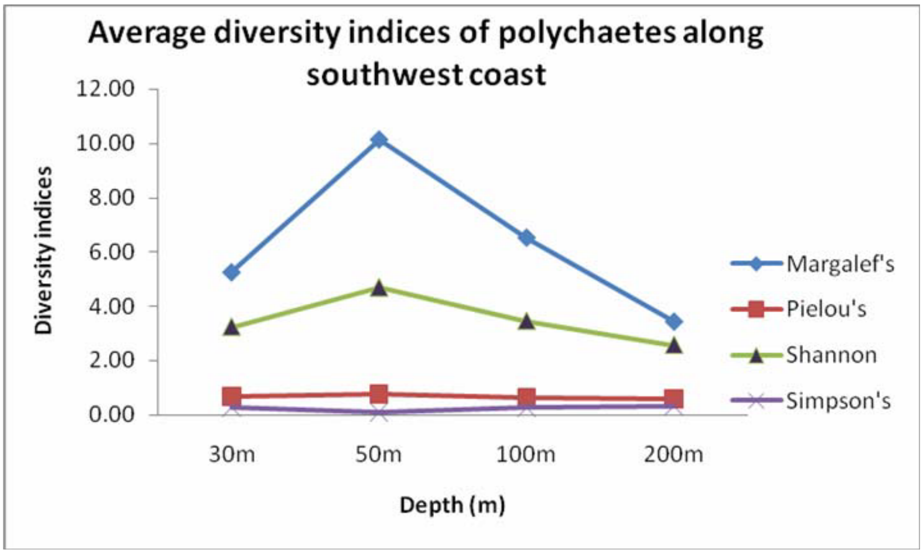


Fig.6.15j Average diversity indices of macrobenthic infaunal polychaetes along southeast coast of India

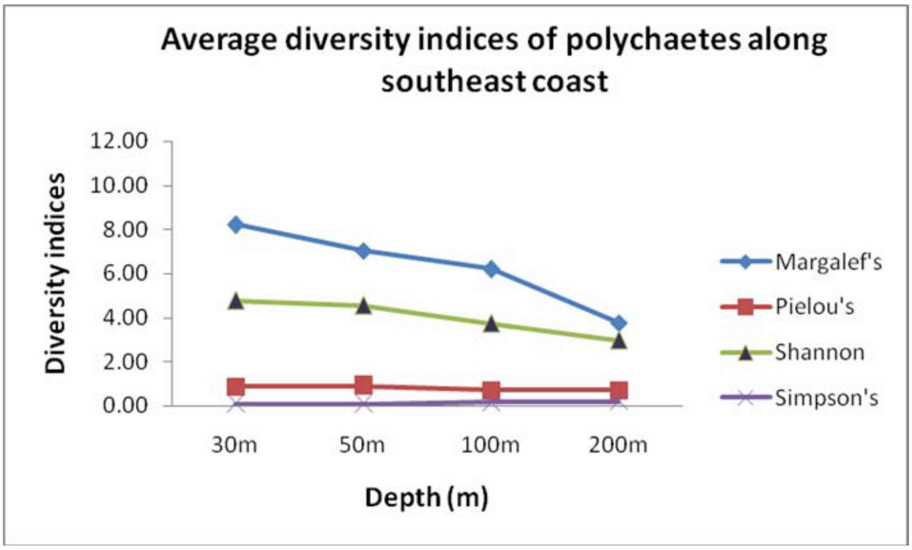


Fig. 6.16. Diversity indices of macrobenthic groups along southwest and southeast coast of India

Fig. 6.16a 30m depth range SW coast

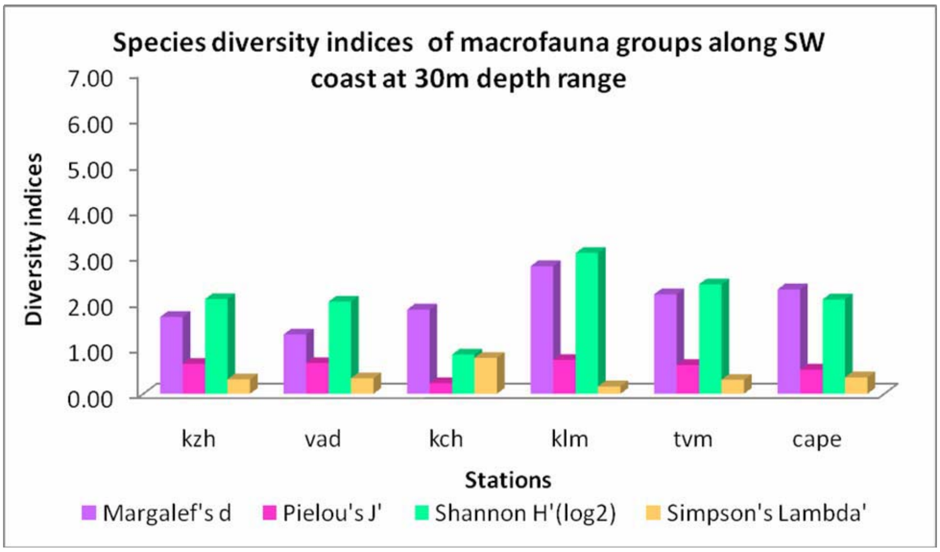
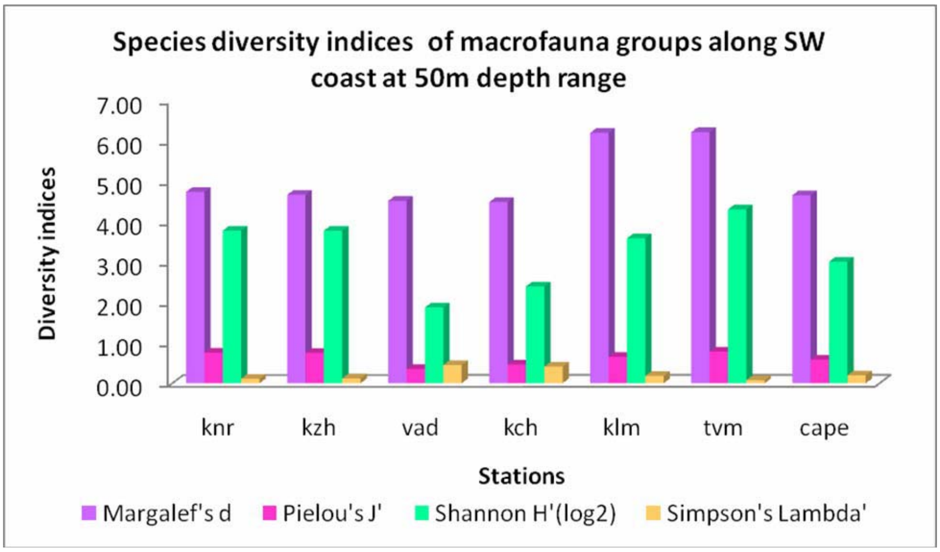


Fig. 6.16b 50m depth range SW coast



Diversity indices of macrobenthic groups along southwest and southeast coast of India

Fig. 6.16c 100m depth range SW coast

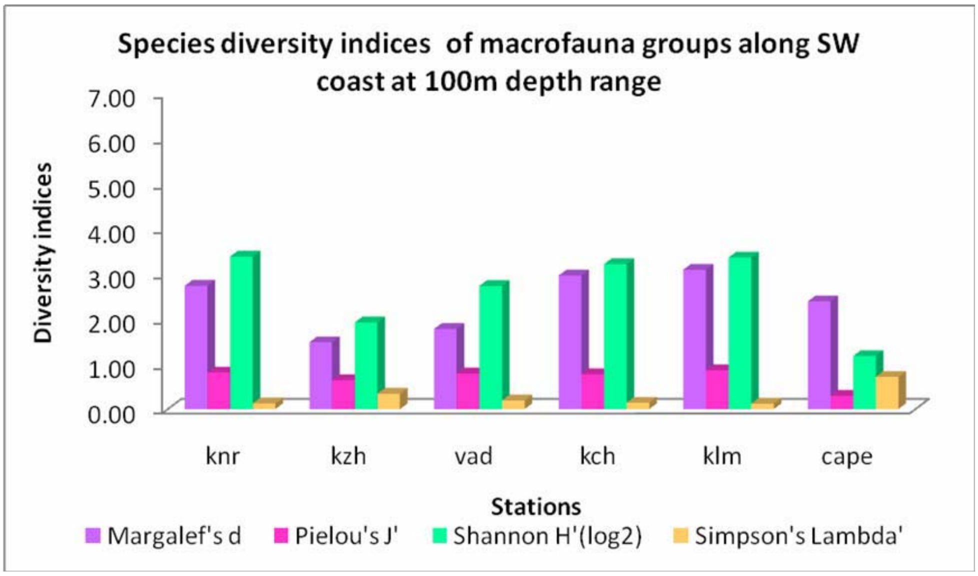
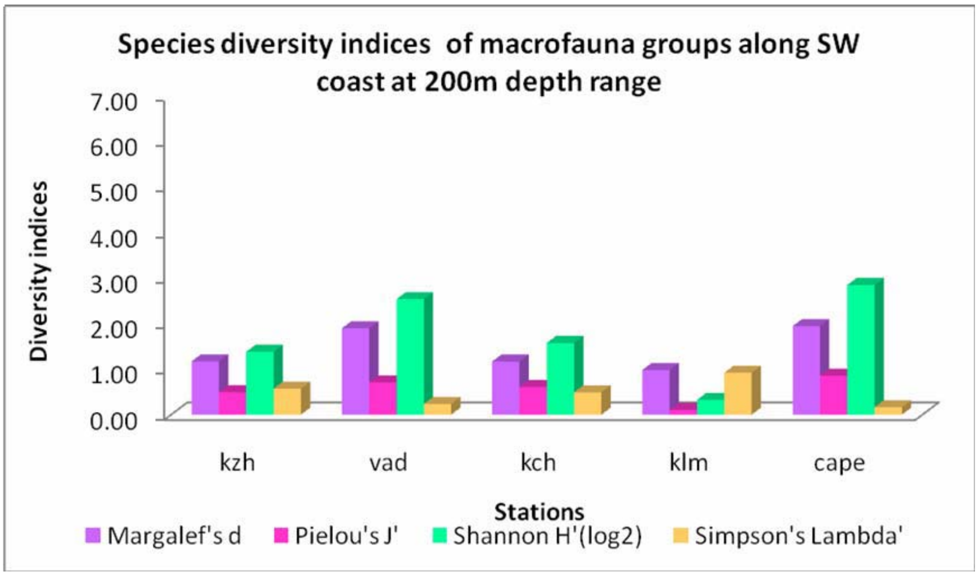


Fig. 6.16d 200m depth range SW coast



Diversity indices of macrobenthic groups along southwest and southeast coast of India

Fig. 6.16e 30m depth range SE coast

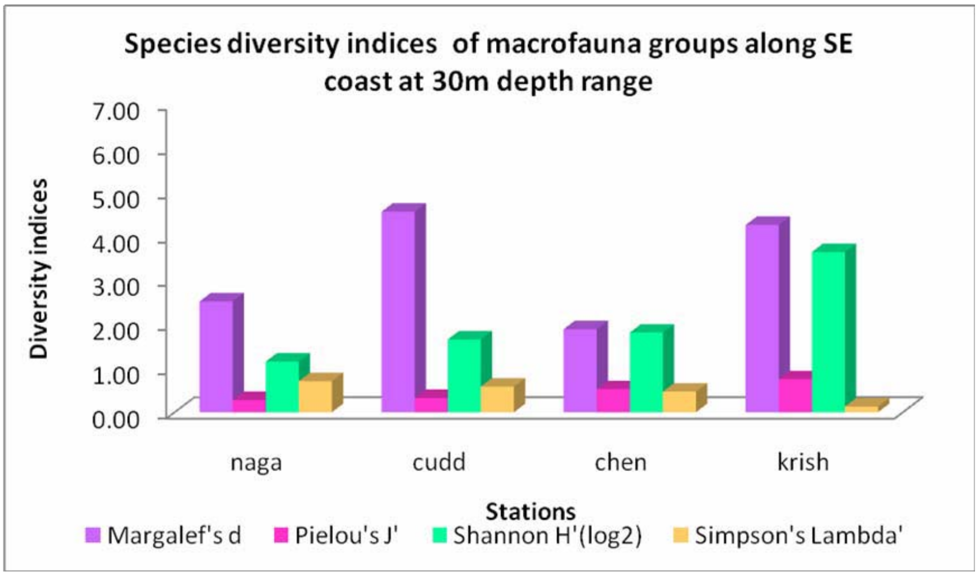
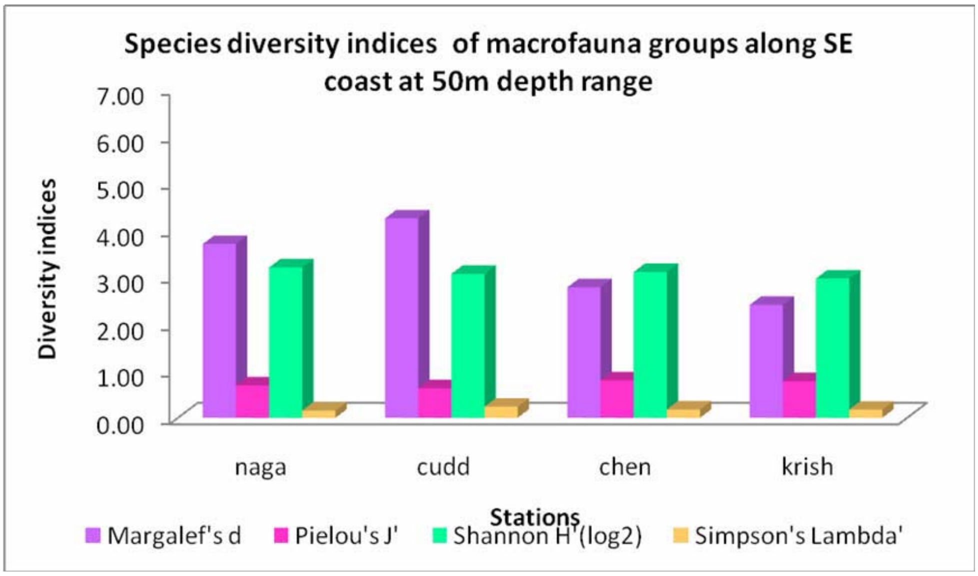


Fig. 6.16f 50m depth range SE coast



Diversity indices of macrobenthic groups along southwest and southeast coast of India

Fig. 6.16g 100m depth range SE coast

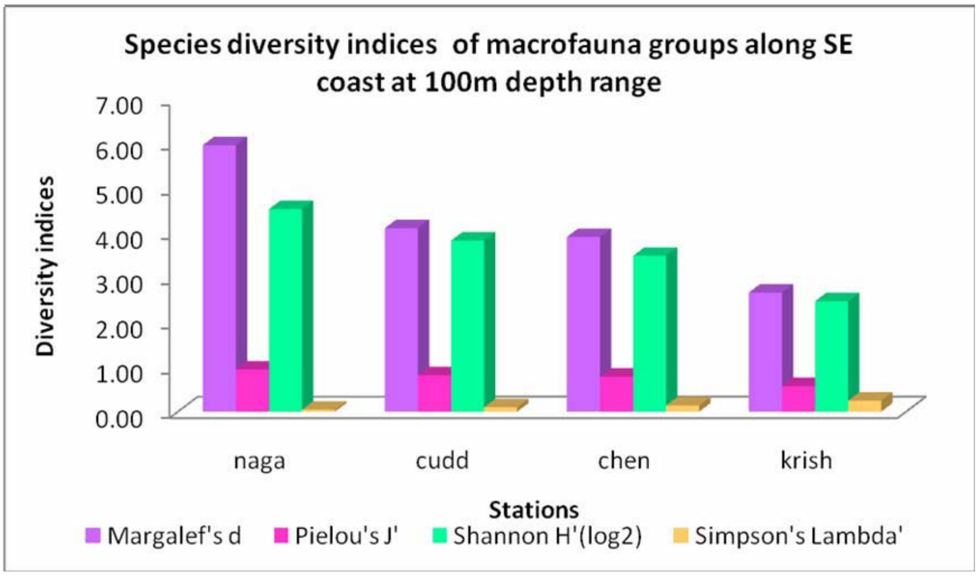


Fig. 6.16h 200m depth range SE coast

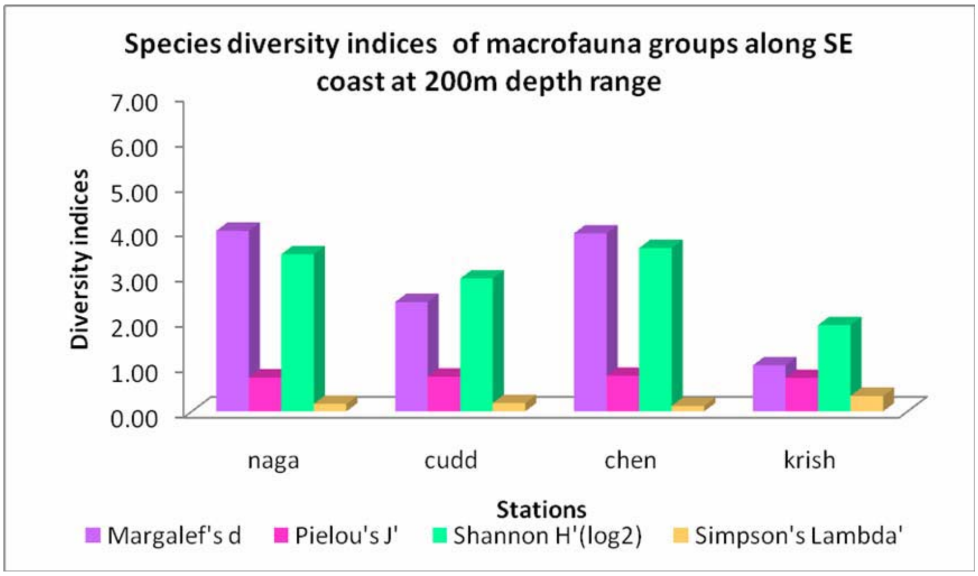


Fig. 6.16 i Average diversity indices of macrobenthic groups along southwest coast of India

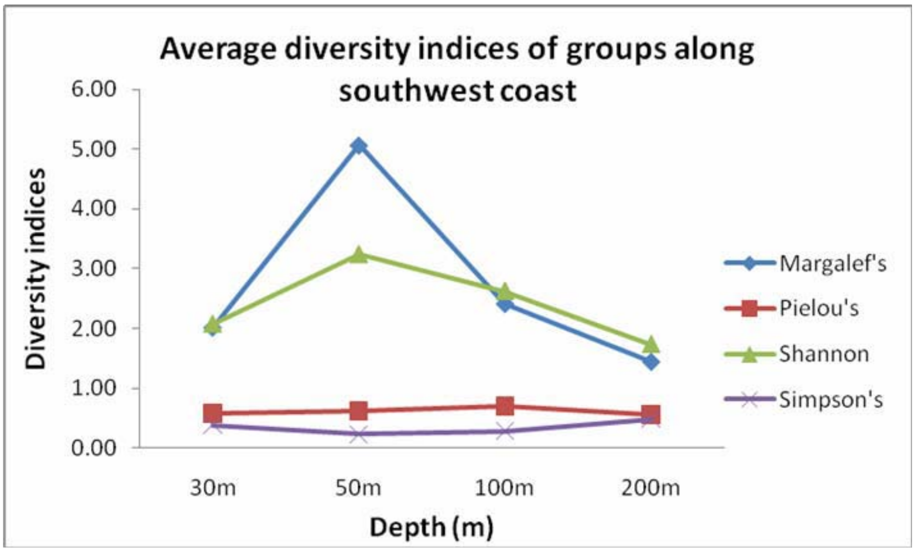


Fig. 6.16 j Average diversity indices of macrobenthic groups along southeast coast of India

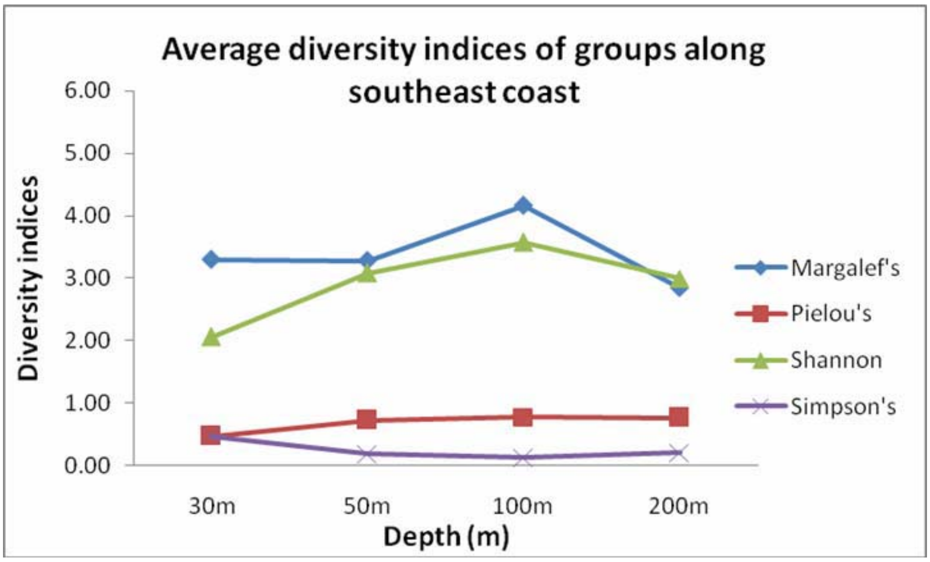


Fig.6.17. K-dominance of polychaetes along southwest and southeast coast of India

Fig.6.17a. K-dominance of polychaete species

Dominance plot for polychaete species along SW coast (2005)

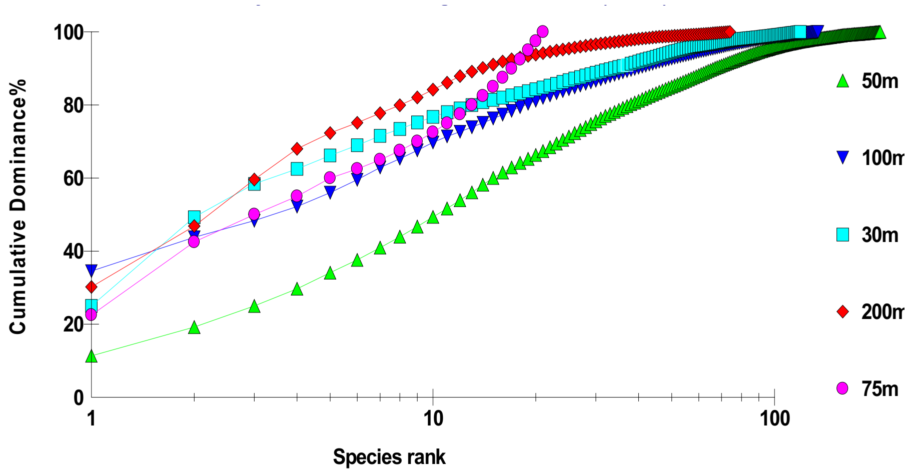
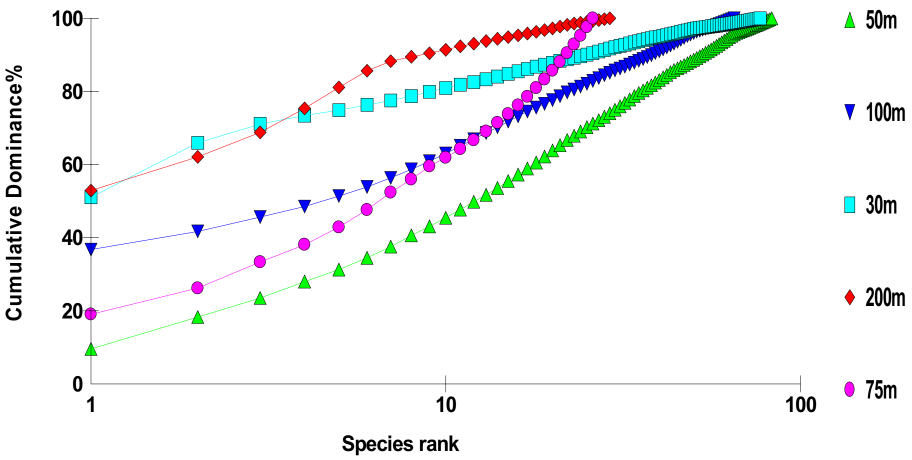


Fig.6.17b. Dominance plot for polychaete species along SW coast (2001)



K-dominance of polychaetes along southwest and southeast coast of India

Fig.6.17c. Dominance plot for polychaete species along SE coast (2005)

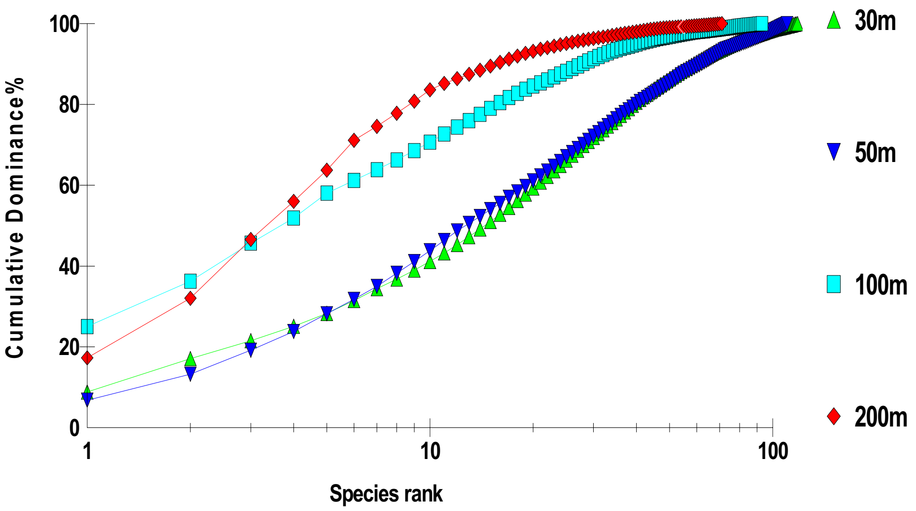


Fig.6.18. Biomass of macrofauna along southwest and southeast continental shelf of India during 2001 and 2005

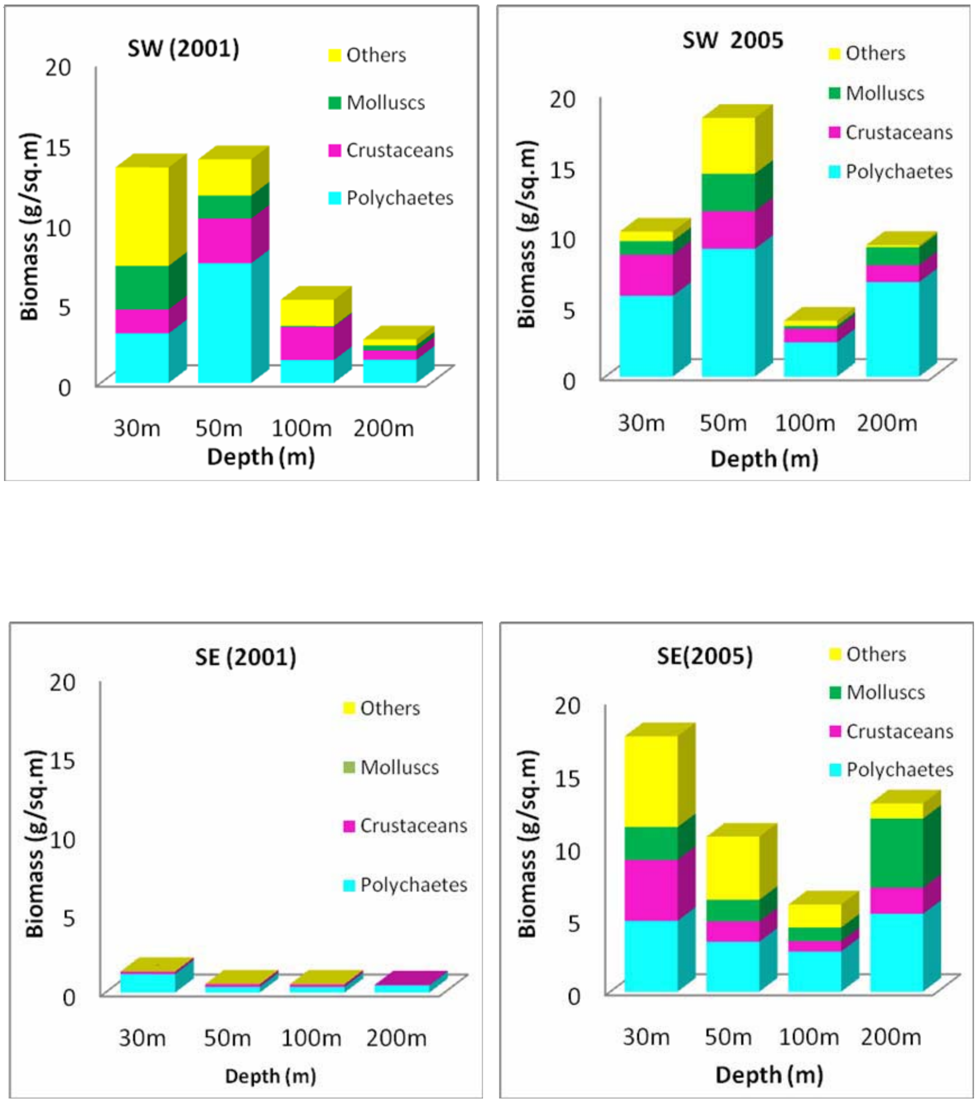


Fig.6.19. Numerical abundance of macrofauna along southwest and southeast continental shelf of India during 2001 and 2005

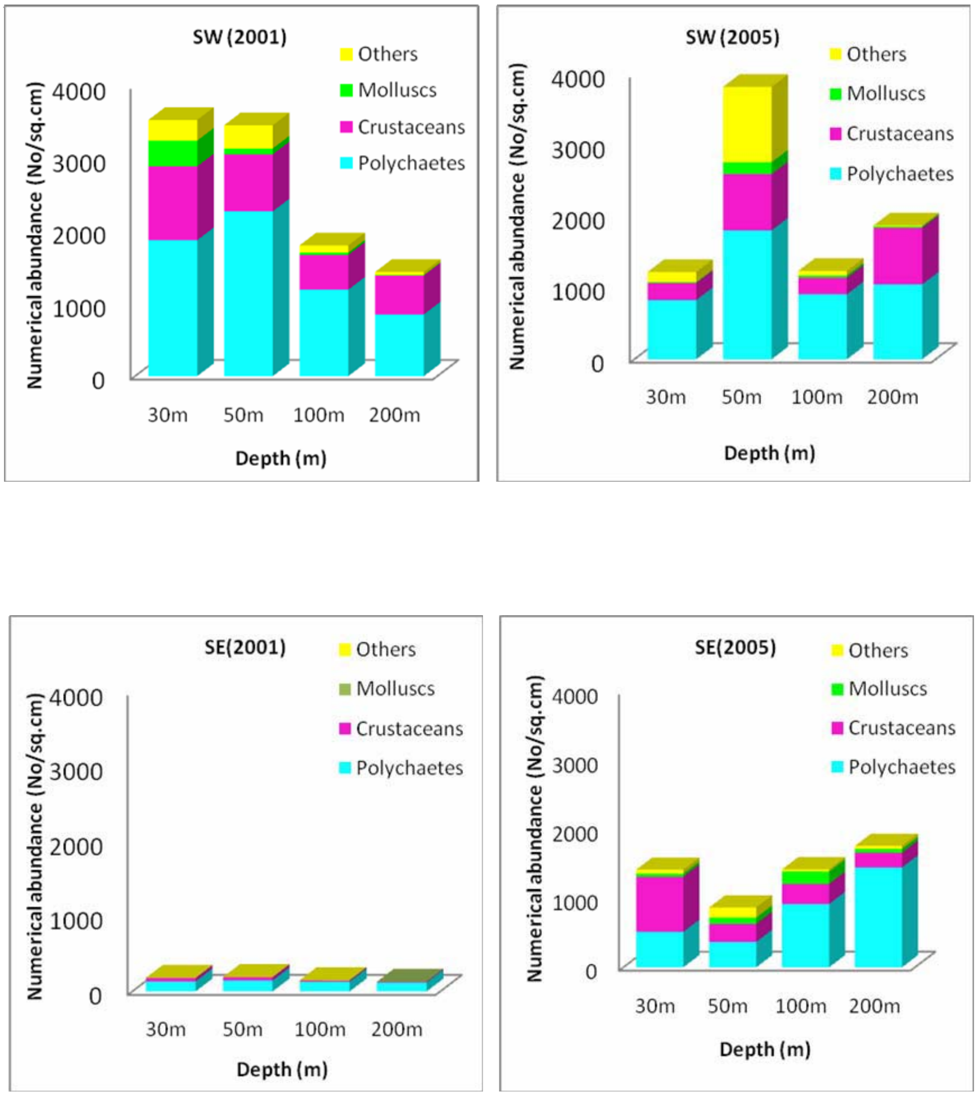


Fig.7.1: Biomass (wet weight in mg/10sq.cm) of meiofauna groups along the continental shelf of southwest of India at different depth ranges.

Fig.7.1a: 30m depth range Southwest coast

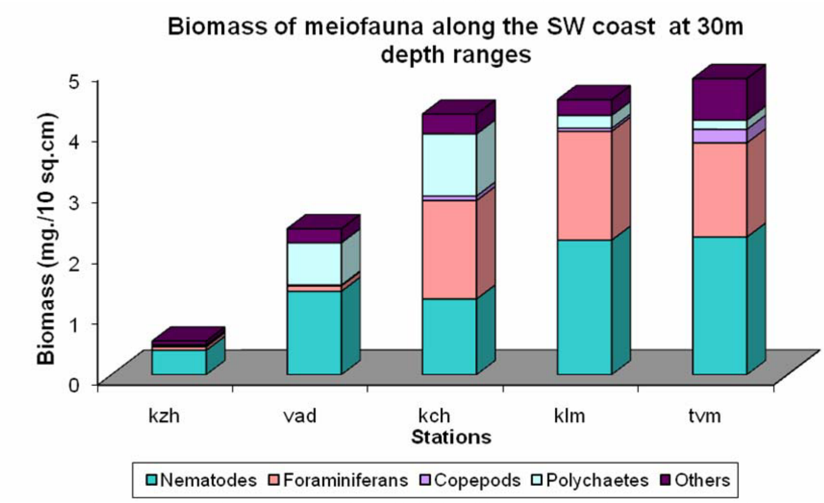
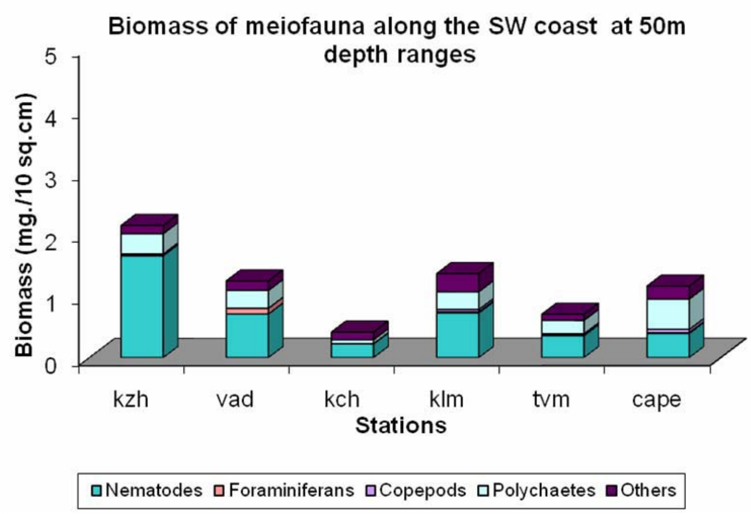


Fig.7.1b: 50m depth range Southwest coast



Biomass (wet weight in mg/10sq.cm) of meiofauna groups along the continental shelf of southwest of India at different depth ranges.

Fig.7.1c: 100m depth range Southwest coast

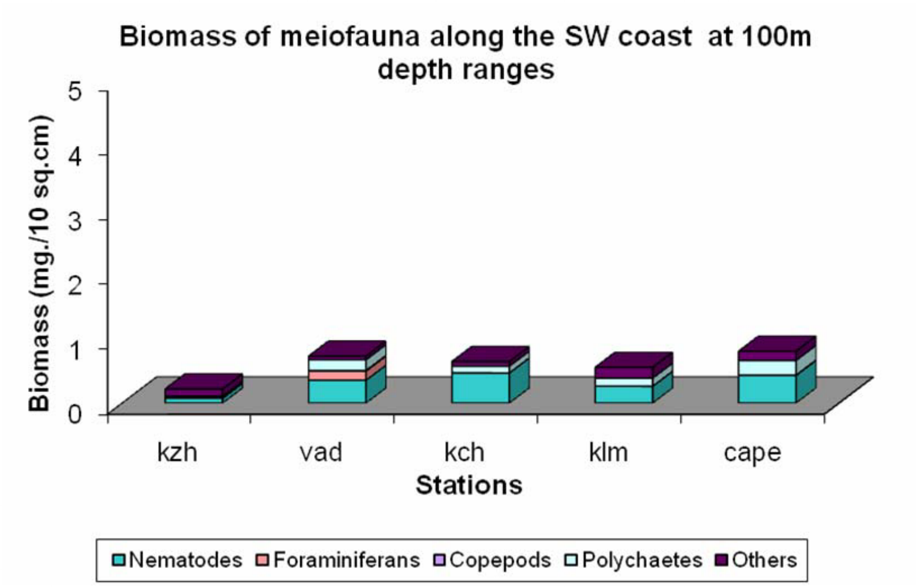


Fig.7.1d: 200m depth range Southwest coast

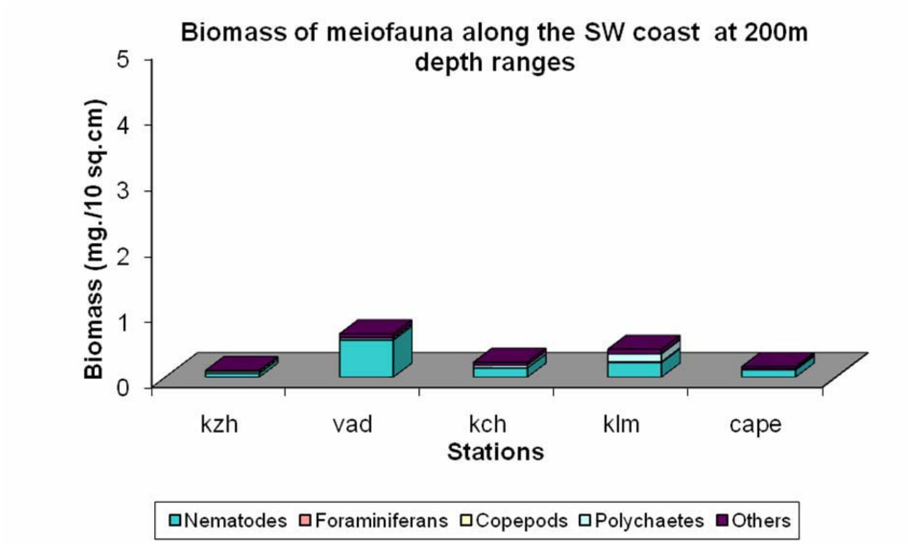


Fig.7.2: Biomass (wet weight in mg/10sq.cm) of meiofauna groups along the continental shelf of southeast coast of India at different depth ranges.

Fig.7.2a: 30m depth range Southeast coast

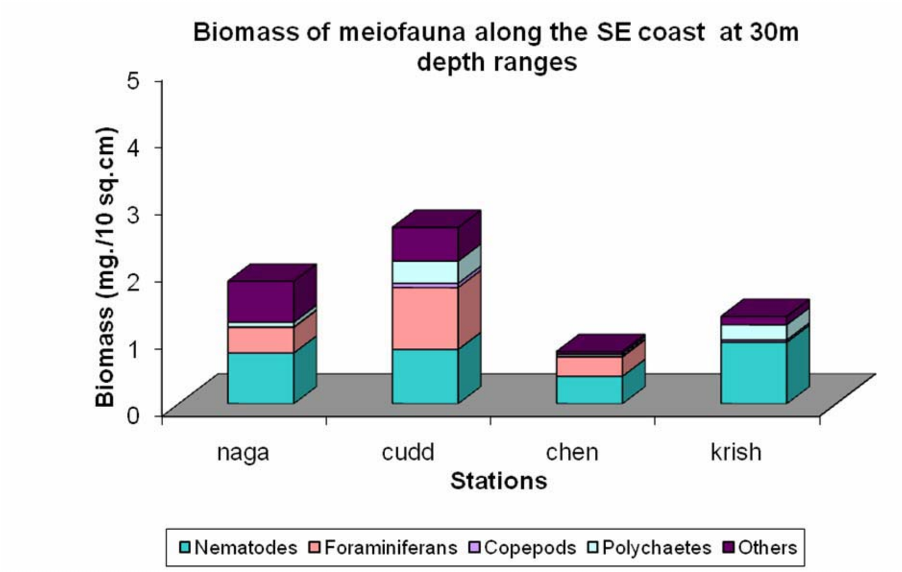
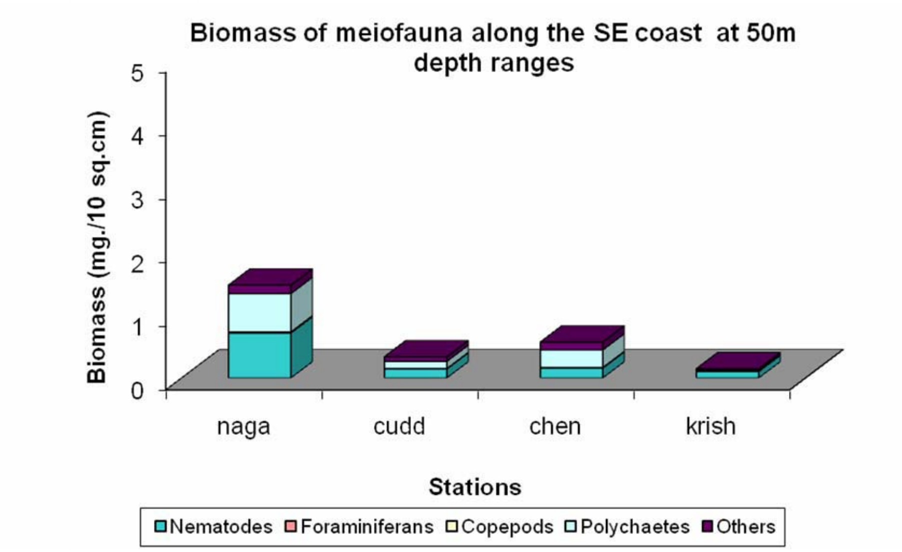


Fig.7.2b: 50m depth range Southeast coast



Biomass (wet weight in mg/10sq.cm) of meiofauna groups along the continental shelf of southeast coast of India at different depth ranges.

Fig.7.2c: 100m depth range Southeast coast

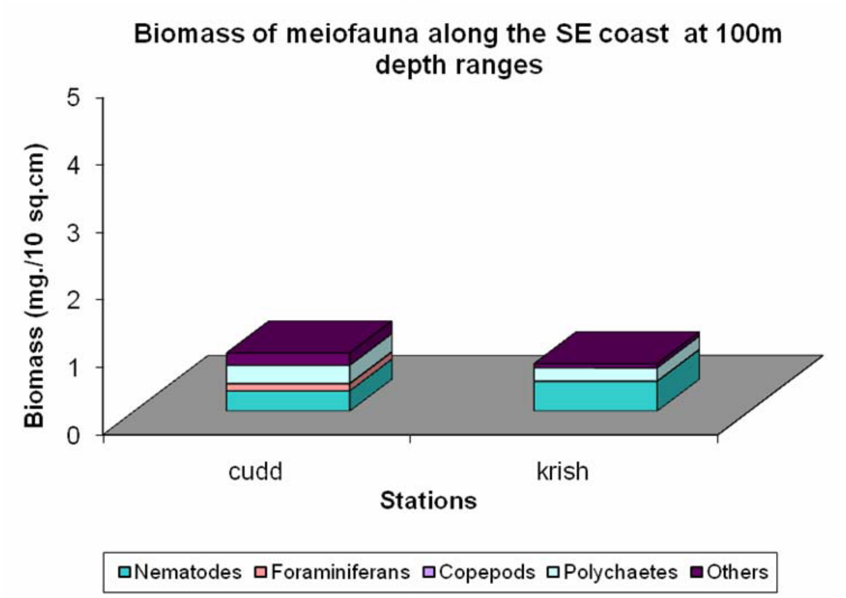


Fig.7.2d: 200m depth range Southeast coast

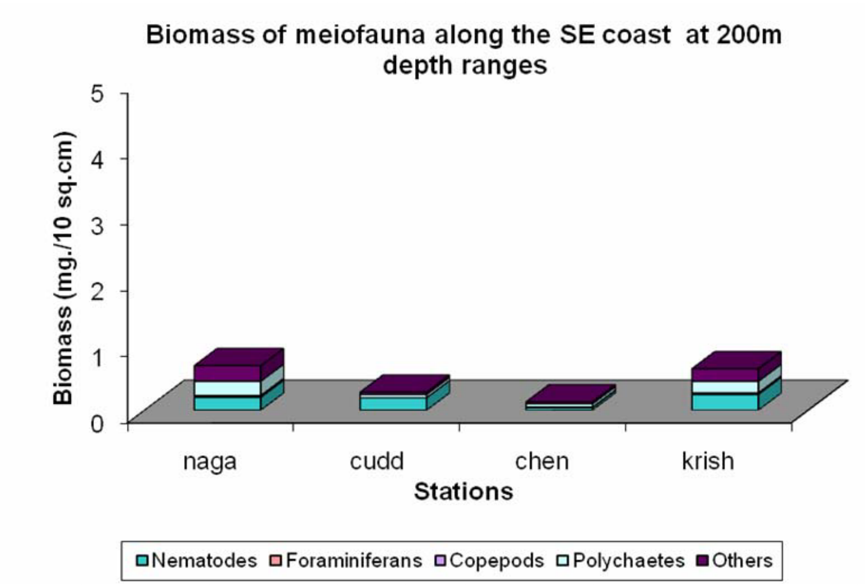


Fig.7.3a. Average biomass (wet weight in mg/10sq.cm) of meiobenthos along the shelf waters of the Southwest coast of India

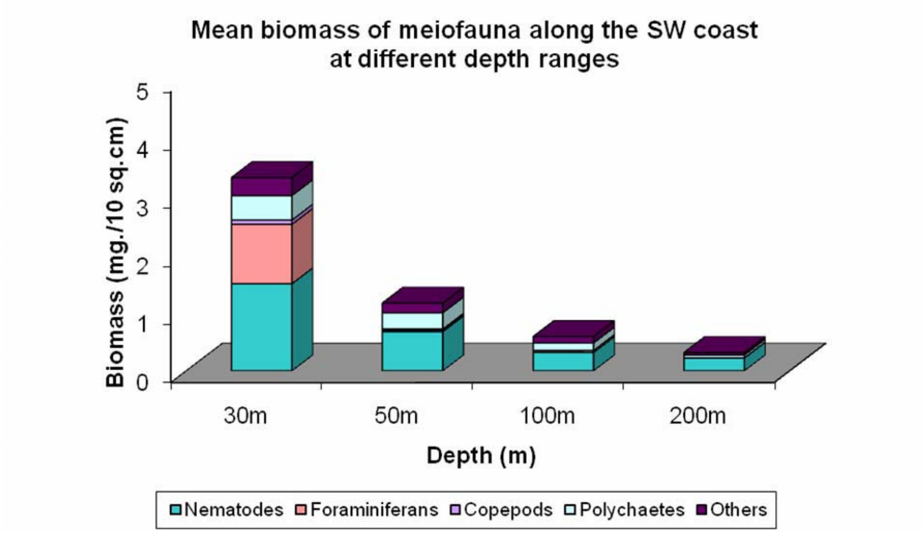


Fig.7.3b. Average biomass (wet weight in mg/10sq.cm) of meiobenthos along the shelf waters of the Southeast coast of India

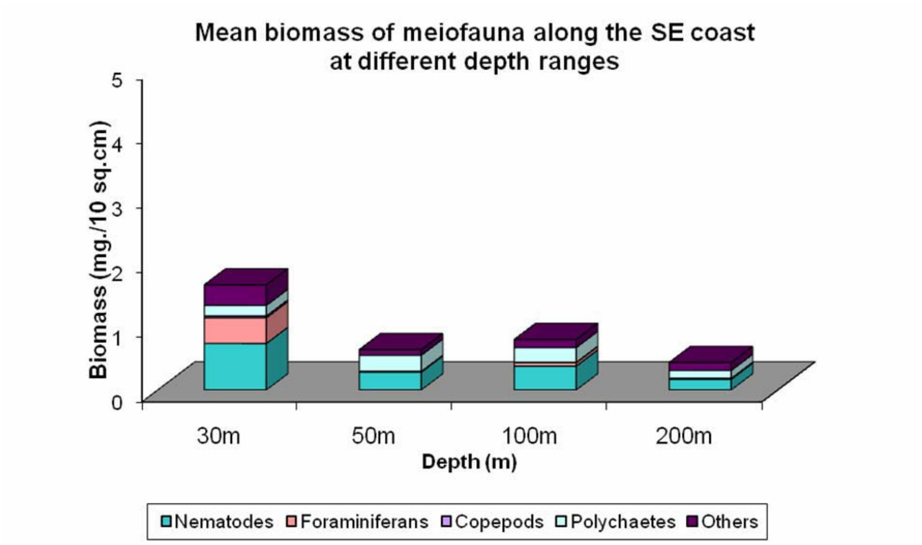


Fig.7.4. Numerical abundance (No./10sq.cm) of meiofauna groups along the continental shelf of southwest coast of India at different depth ranges.

Fig.7.4a: 30m depth range Southwest coast

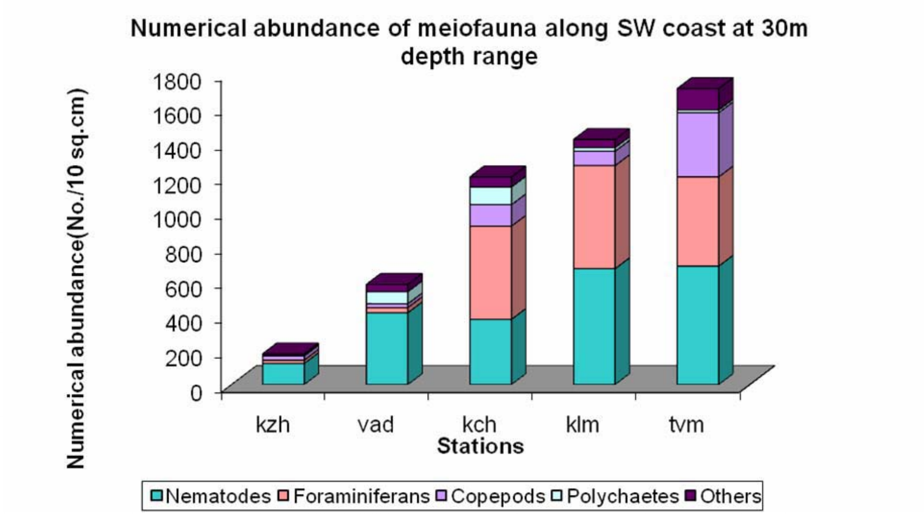
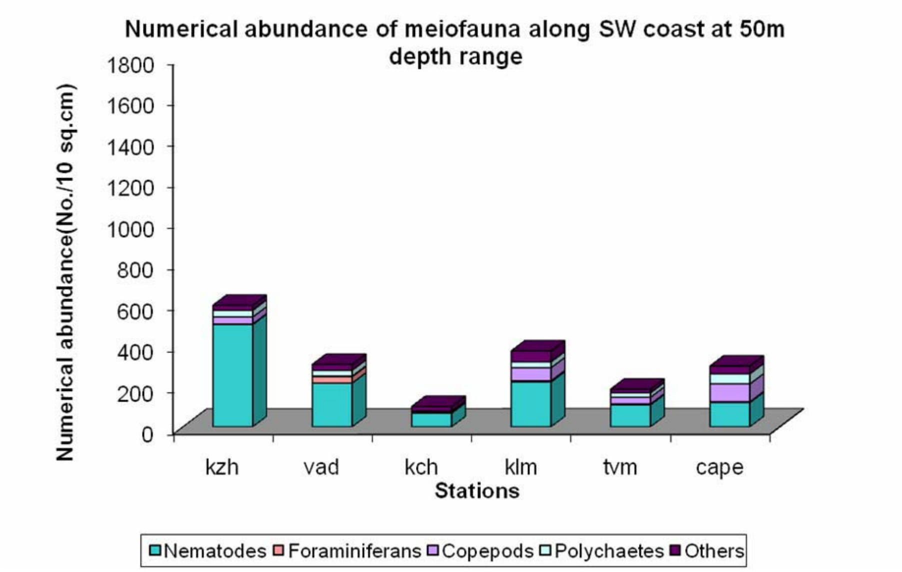


Fig.7.4b: 50m depth range Southwest coast



Numerical abundance (No./10sq.cm) of meiofauna groups along the continental shelf of southwest coast of India at different depth ranges.

Fig.7.4c: 100m depth range Southwest coast

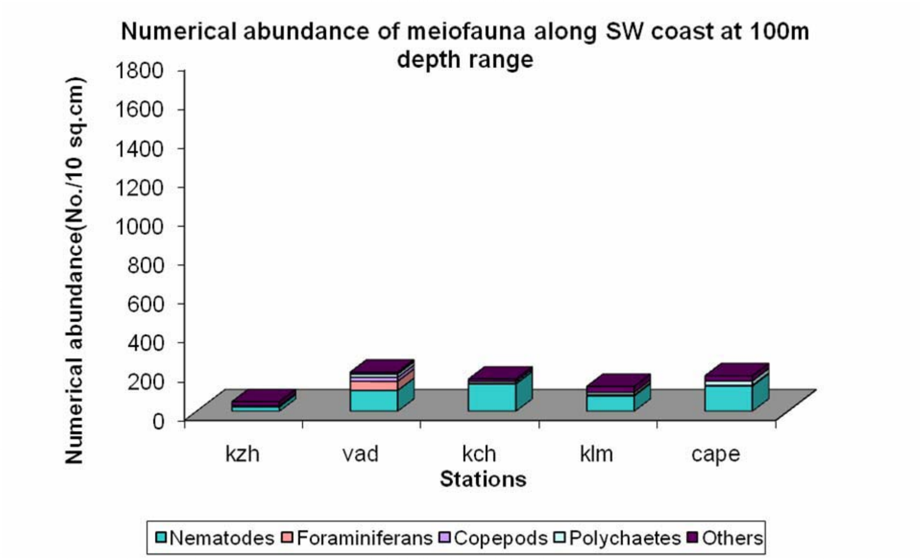


Fig.7.4d: 200m depth range Southwest coast

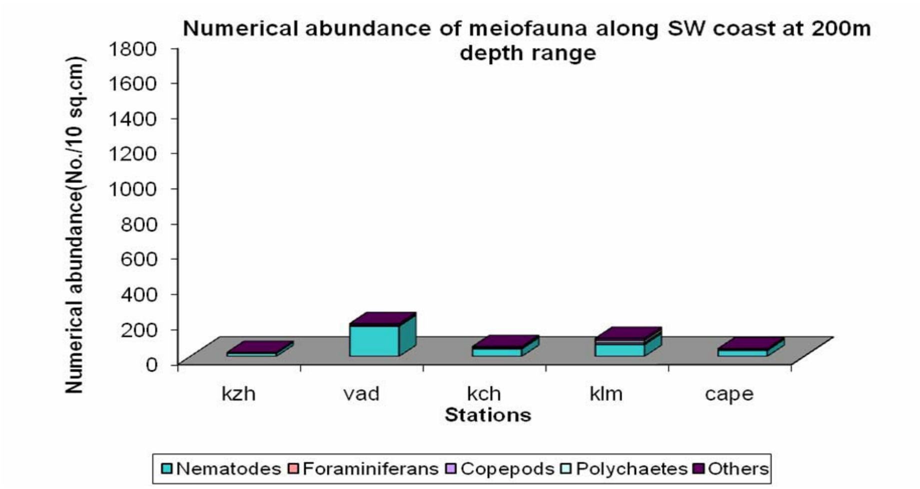


Fig.7.5. Numerical abundance (No./10sq.cm) of meiofauna groups along the continental shelf of southeast coast of India at different depth ranges.

Fig.7.5a: 30m depth range Southeast coast

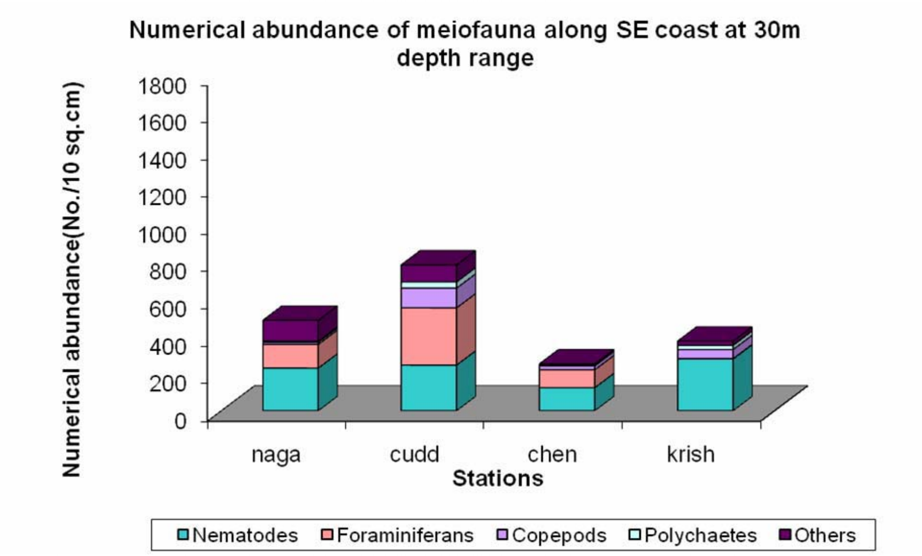
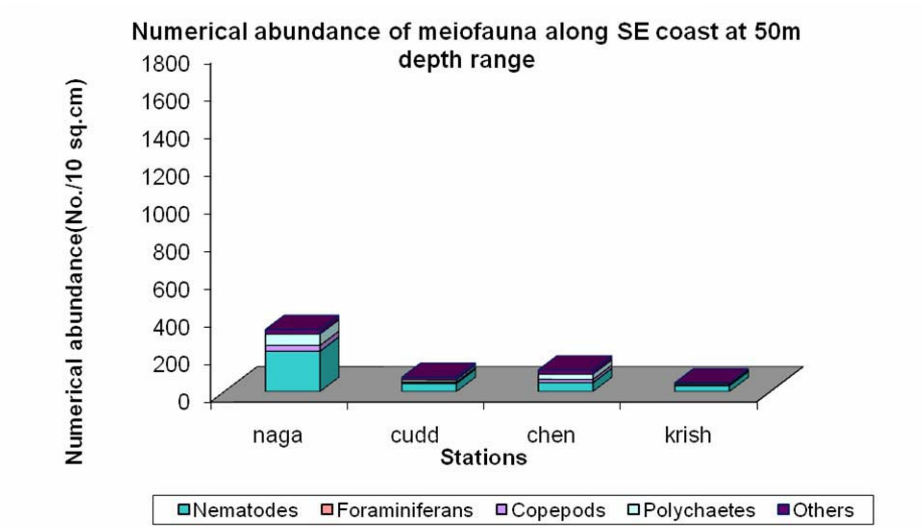


Fig.7.5b: 50m depth range Southwest coast



Numerical abundance (No./10sq.cm) of meiofauna groups along the continental shelf of southeast coast of India at different depth ranges.

Fig.7.5c: 100m depth range Southeast coast

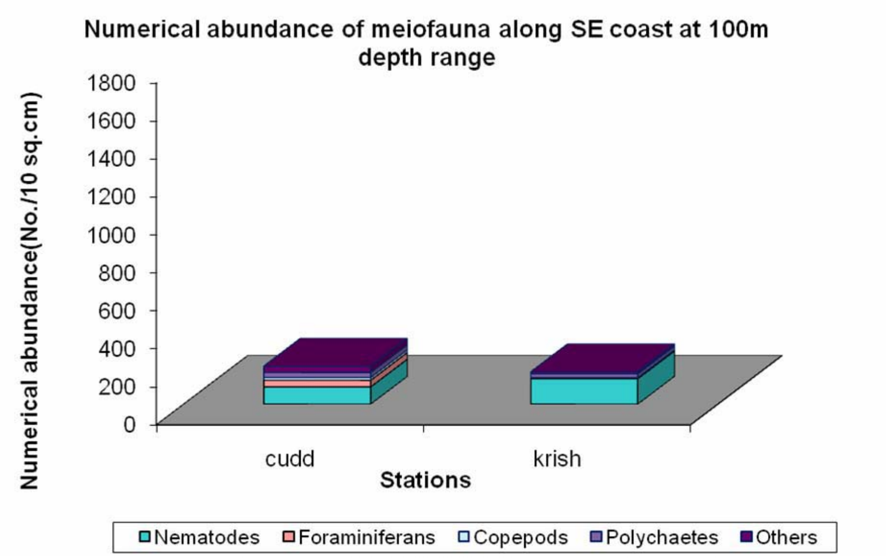


Fig.7.5d: 200m depth range Southeast coast

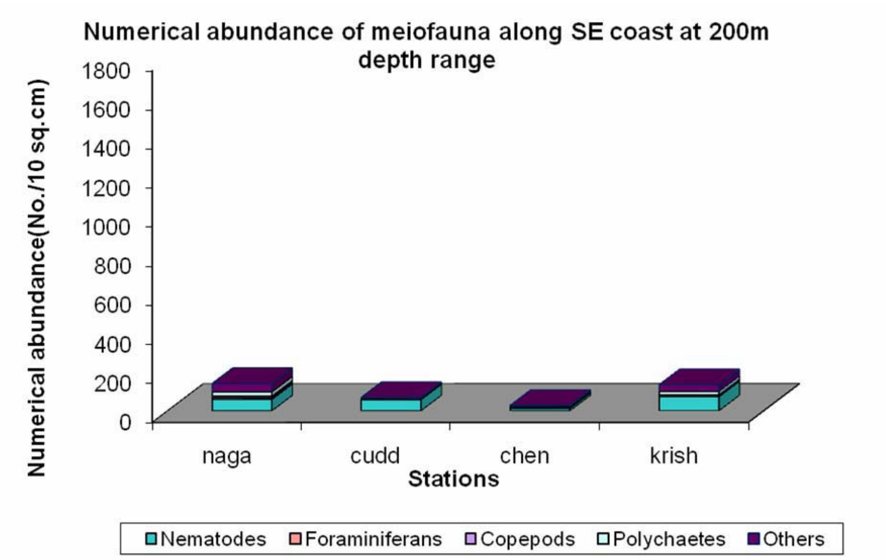


Fig.7.6a. Average numerical abundance (No./10sq.cm) of meiobenthos along the shelf waters of the Southwest coast of India

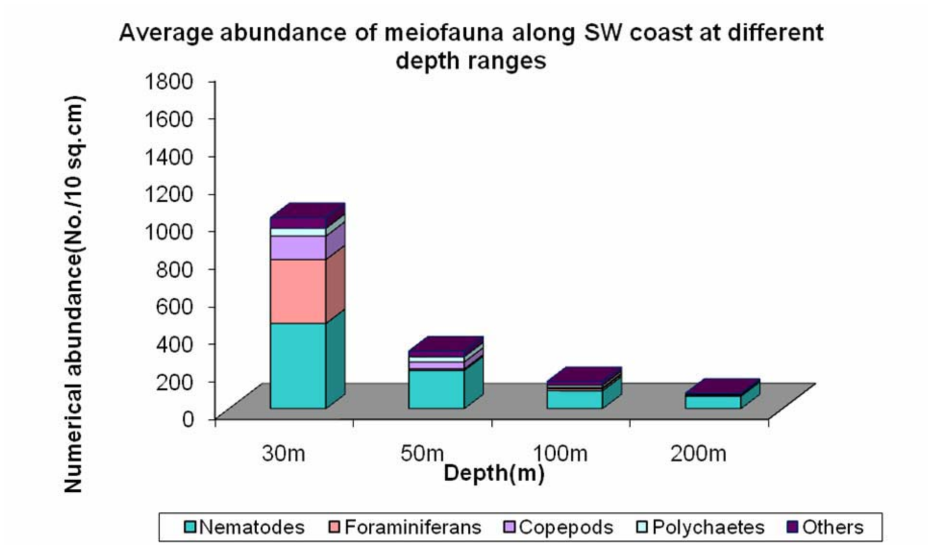


Fig.7.6b. Average numerical abundance (No./10sq.cm) of meiobenthos along the shelf waters of the Southwest coast of India

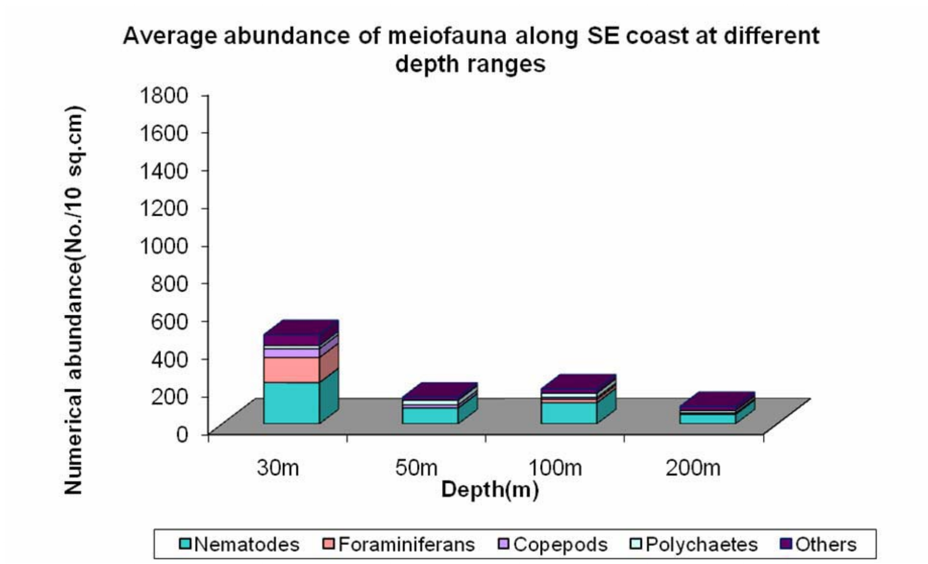


Fig.7.7. Species diversity indices of meiofauna groups along the continental shelf of Southwest coast of India at different depth ranges

Fig.7.7a 30m depth range SW coast

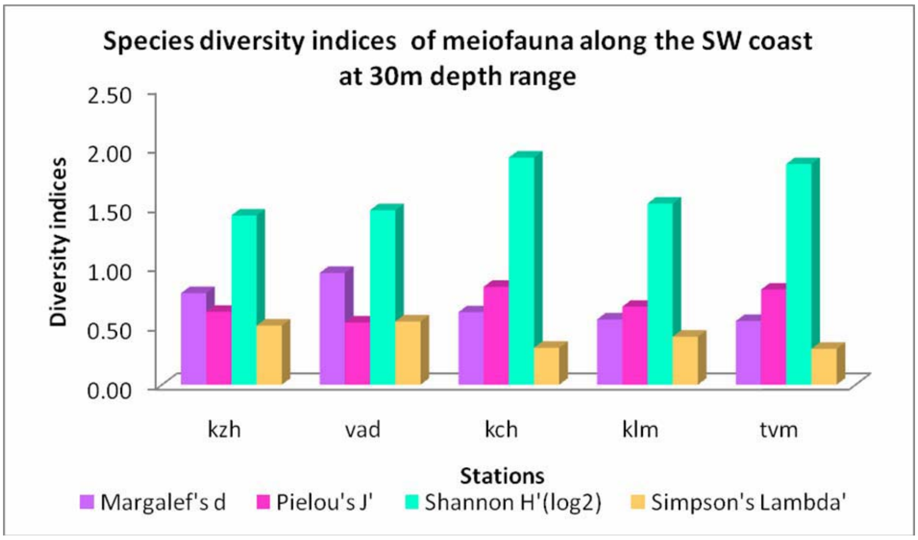
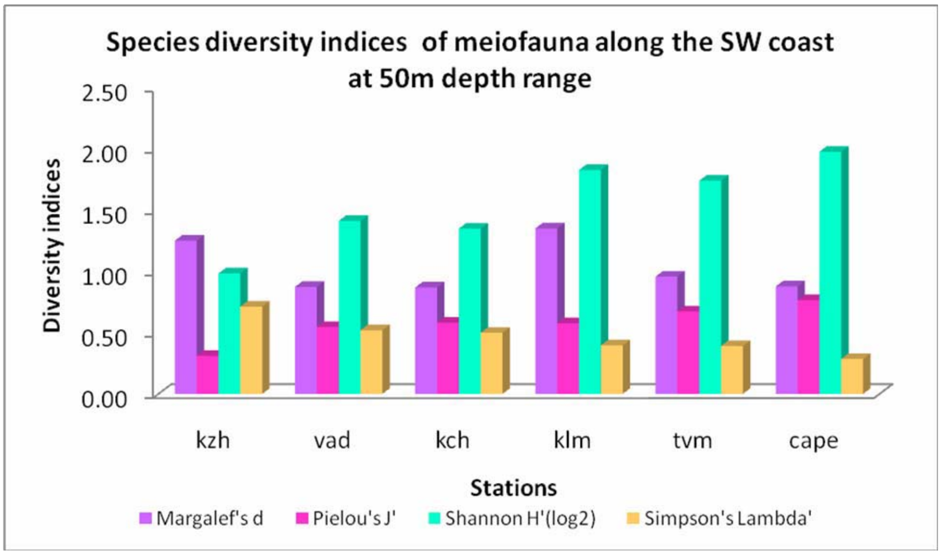


Fig.7.7b 50m depth range SW coast



Species diversity indices of meiofauna groups along the continental shelf of Southwest coast of India at different depth ranges

Fig.7.7c 100m depth range SW coast

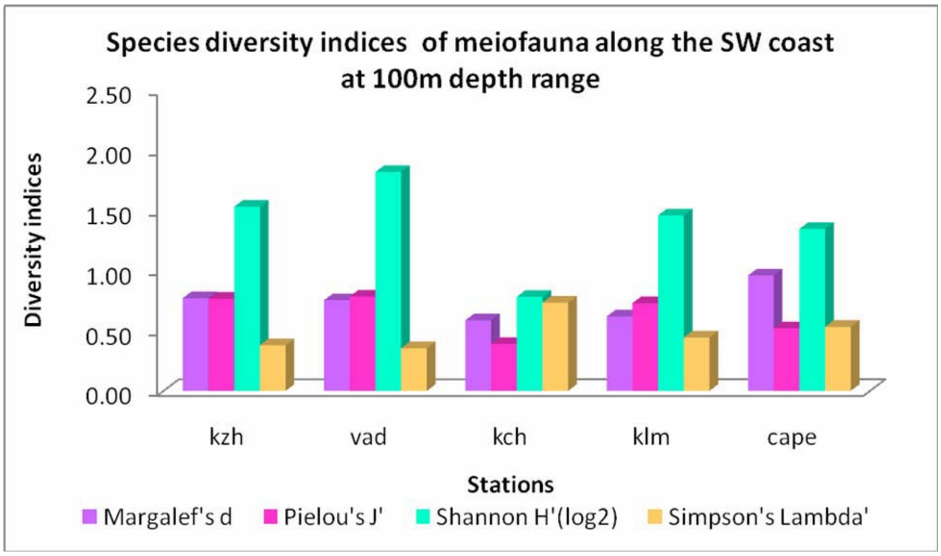
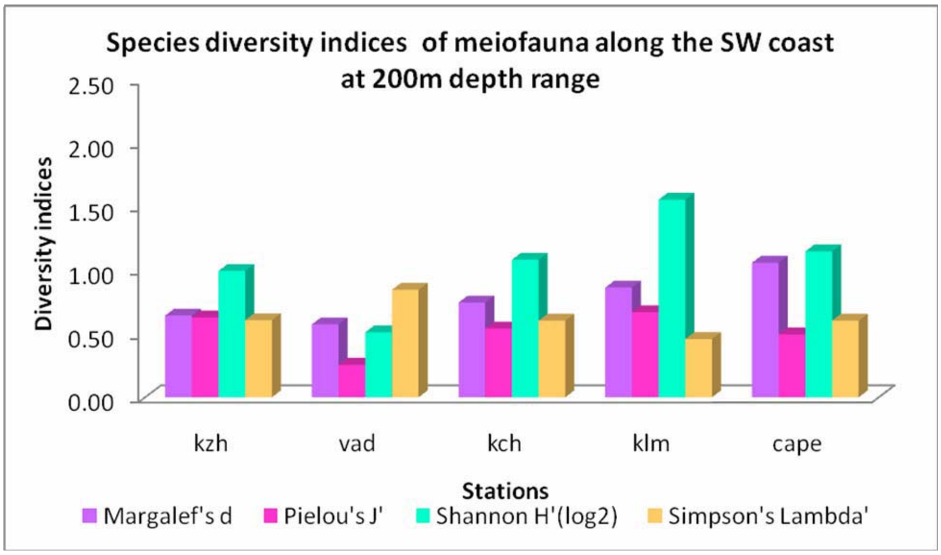


Fig.7.7d 200m depth range SW coast



Species diversity indices of meiofauna groups along the continental shelf of Southeast coast of India at different depth ranges

Fig.7.7e 30m depth range SEcoast

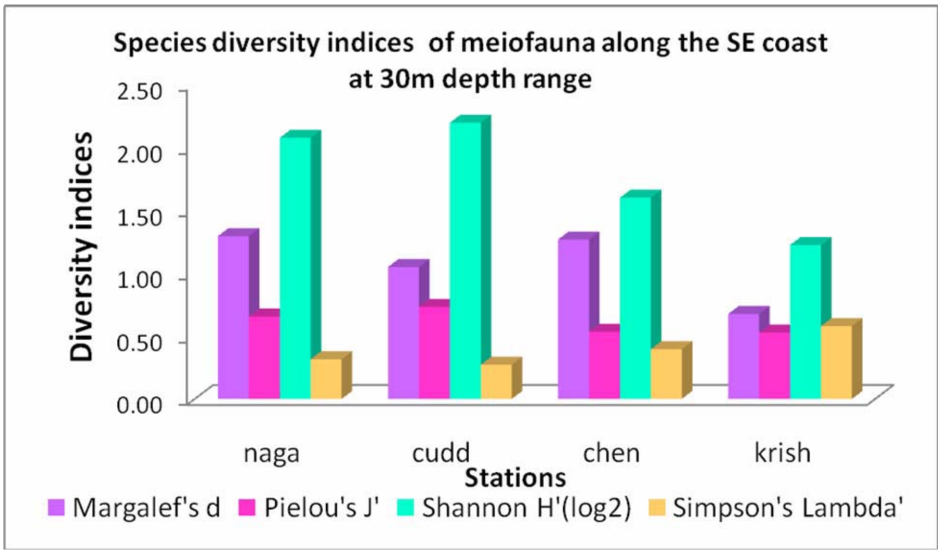
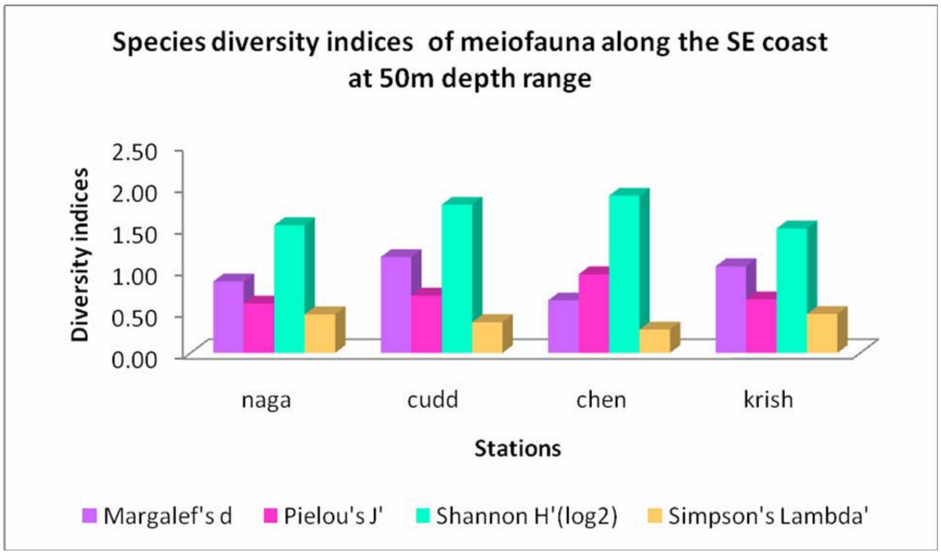


Fig.7.7f 50m depth range SEcoast



Species diversity indices of meiofauna groups along the continental shelf of Southeast coast of India at different depth ranges

Fig.7.7g 100m depth range SEcoast

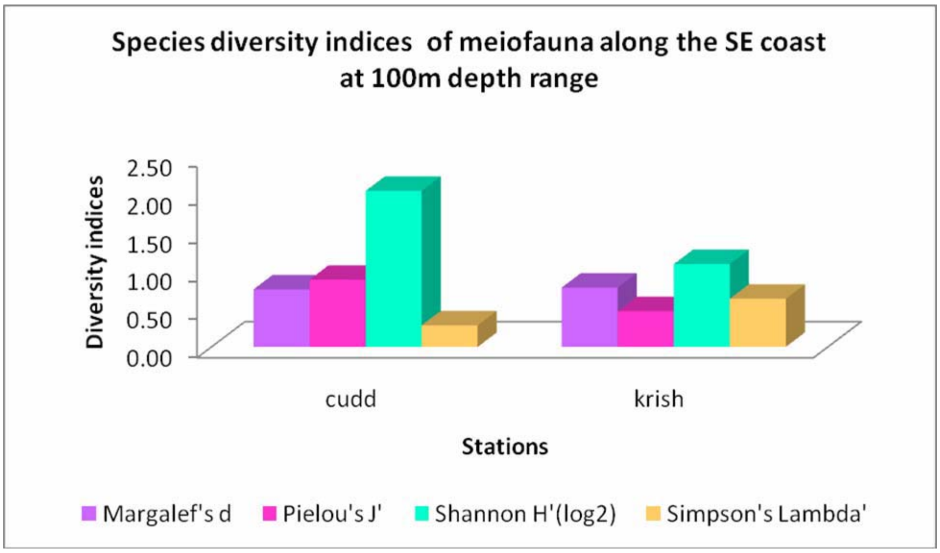


Fig.7.7h 200m depth range SEcoast

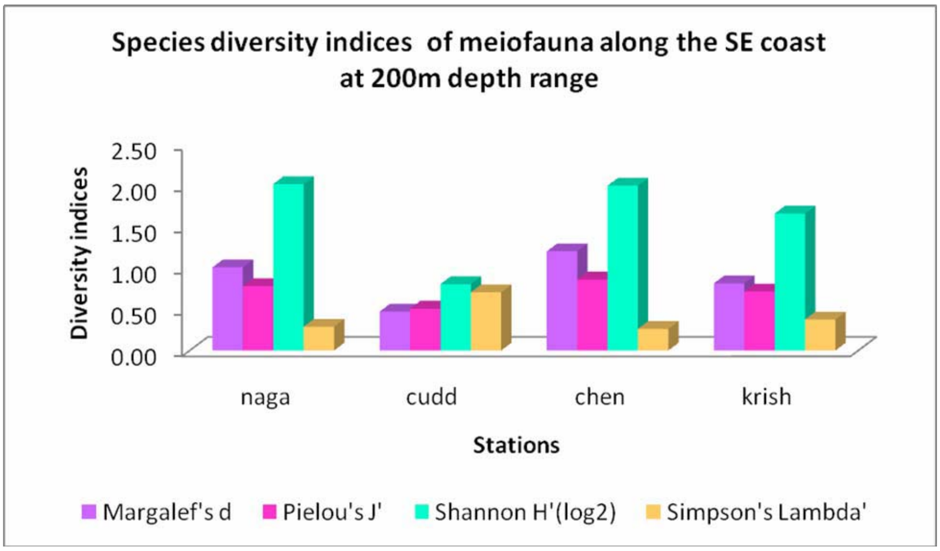


Fig. 7.7 iAverage Species diversity indices of meiofauna groups along the continental shelf of Southwest coast of India at different depth ranges

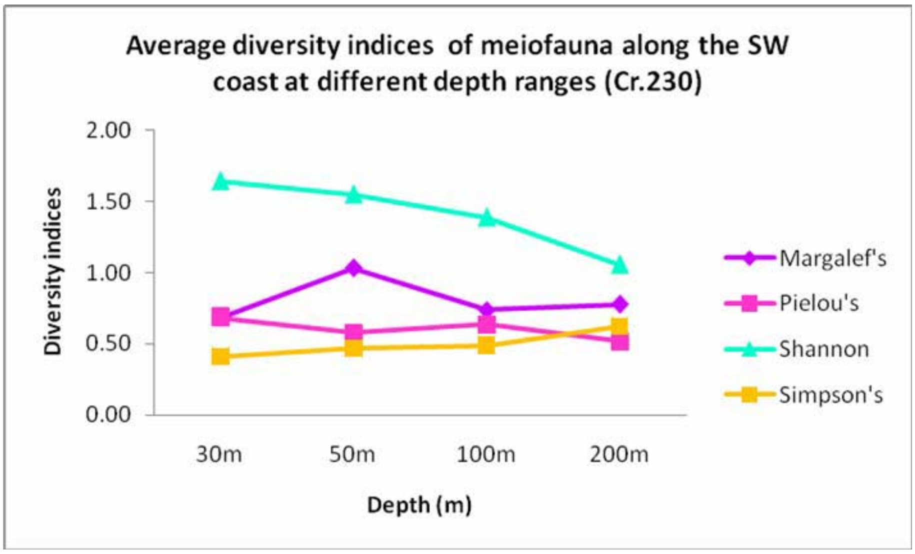


Fig. 7.7 j Average Species diversity indices of meiofauna groups along the continental shelf of southeast coast of India at different depth ranges

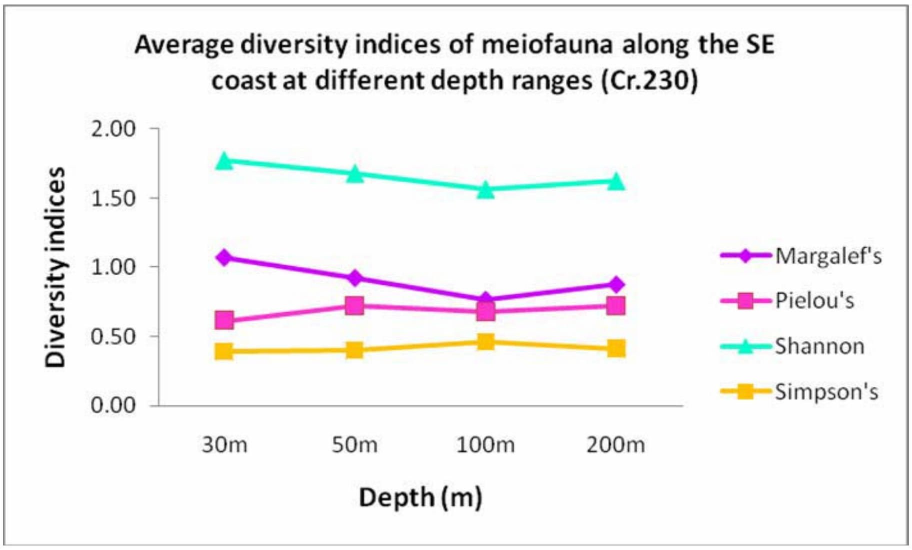


Fig.7.8. Dendrogram (hierarchial clustering) of meiofauna groups at different depth ranges along the SW coast of India

Fig.7.8a. Dendrogram (hierarchial clustering) of meiofauna groups along the SW coast at 30m depth range

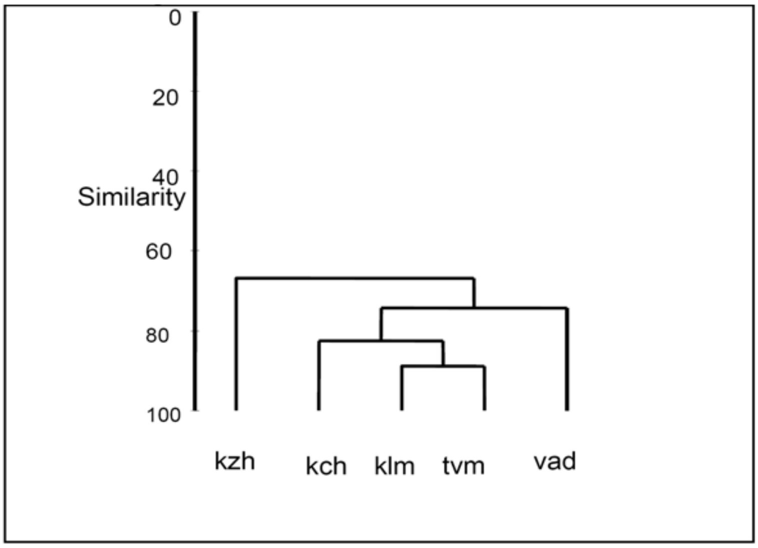


Fig.7.8b. Dendrogram (hierarchial clustering) of meiofauna groups along the SW coast at 50m depth range

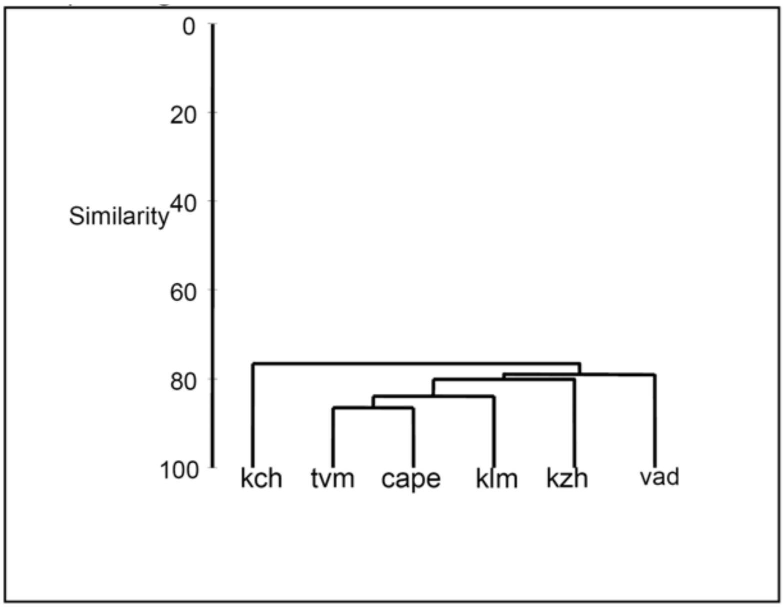


Fig.7.8c. Dendrogram (hierarchial clustering) of meiofauna groups along the SW coast at 100m depth range

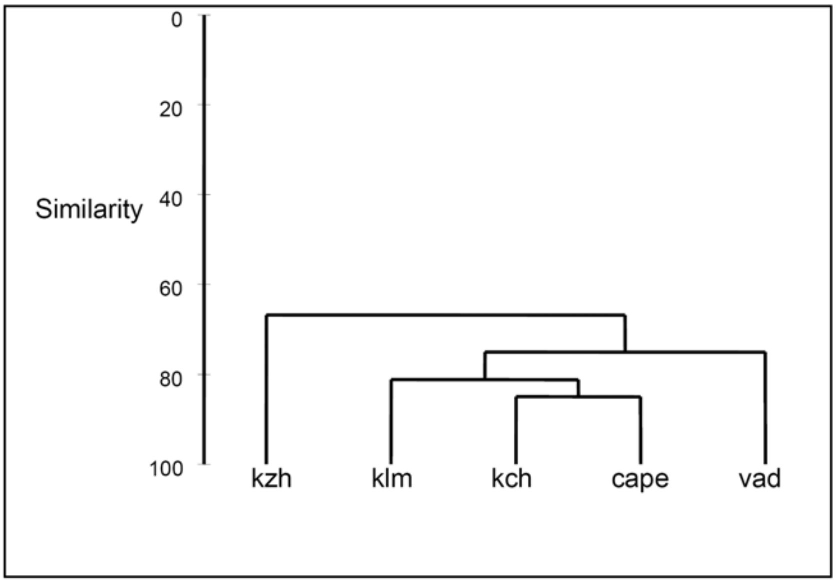


Fig.7.8d. Dendrogram (hierarchial clustering) of meiofauna groups along the SW coast at 200m depth range

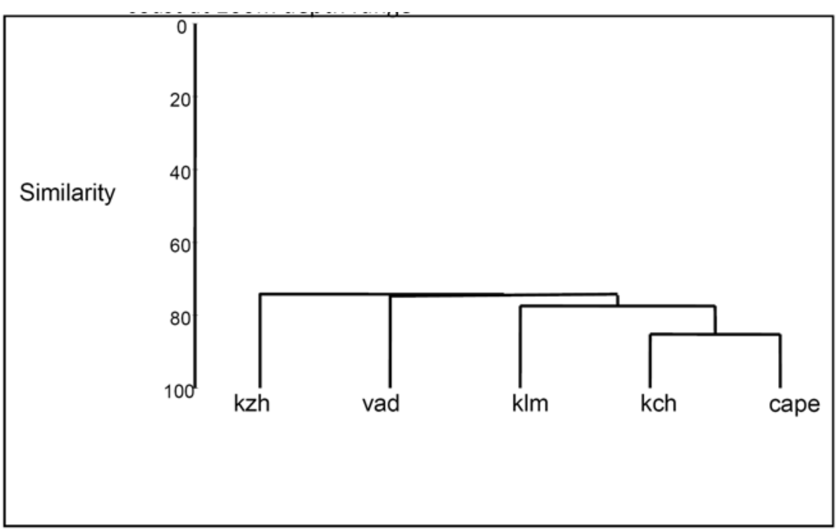


Fig.7.9. Dendrogram (hierarchial clustering) of meiofauna groups at different depth ranges along the SE coast of India

Fig.7.9a. Dendrogram (hierarchial clustering) of meiofauna groups along the SE coast at 30m depth range

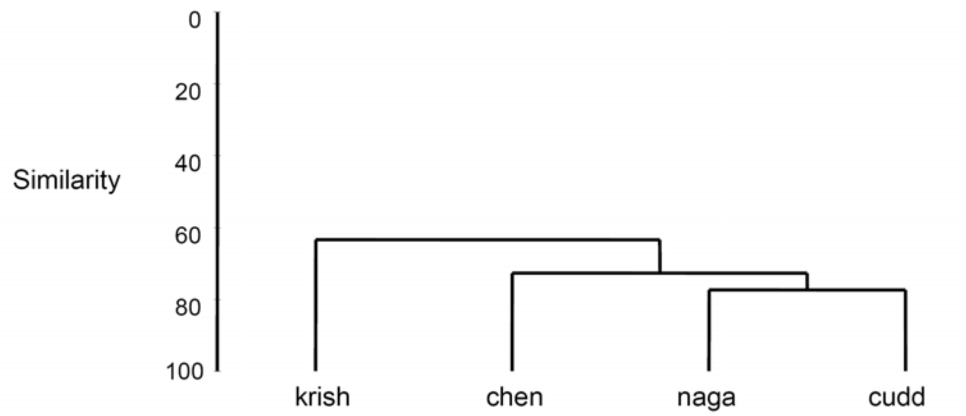


Fig.7.9b. Dendrogram (hierarchial clustering) of meiofauna groups along the SE coast at 50m depth range

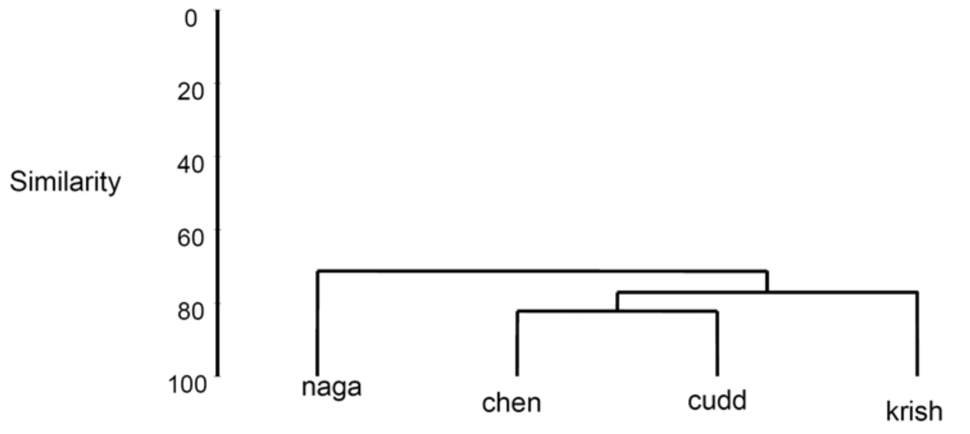


Fig.7.9c. Dendrogram (hierarchial clustering) of meiofauna groups along the SE coast at 100m depth range

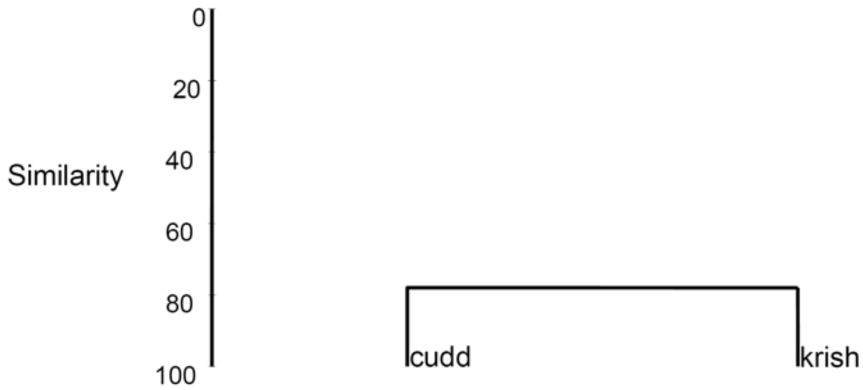
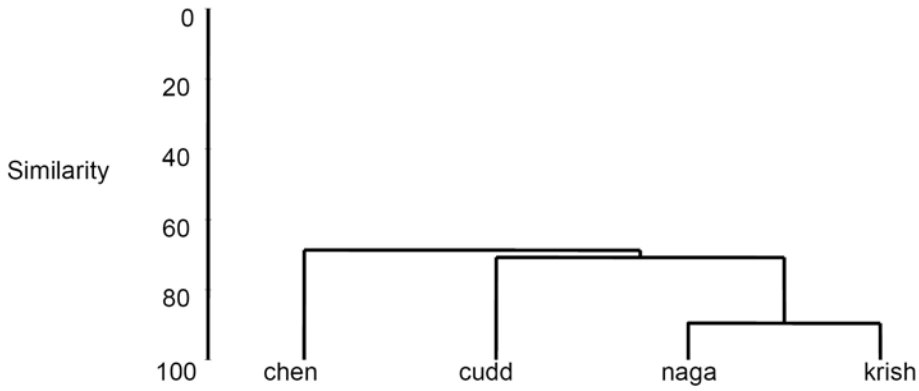


Fig.7.9d. Dendrogram (hierarchial clustering) of meiofauna groups along the SE coast at 200m depth range



.....ꕥꕥ.....

REFERENCES

Abdul Aziz, P.K. and Nair, B.N. ,1983. Meiofauna of the Edava nadayara, Paravur, backwater system, south west coast of India. *Mahasagar Bullentin of the National Institute of Oceanography*, **16(1):** 55-65.

Aguado, M. A., and Lopez, E., 2003. Paraonidae (Annelida: Polychaeta) from Coiba National Park (Pacific Ocean, Panama), with the description of a new species of *Aricidea* Webster, 1879. *Revisita chilena de Historia Natural,* **76**: 363-370.

Aguado, M.T. and San Martin, G., 2004. Pisionidae (Polychaeta) from Coib National Park with the description of a new species and two new reports of *Pisione*. *Journal of the Marine Biological Association of the United Kingdom*, **84**: 73-79.

Aguado, M.T., Martin, G.S. and Nishi, E., 2006. Two new species of Syllidae (Polychaeta) from Japan. In: Scientific Advances in Polychaete Research *R. Sardá, G. San Martín, E. López, D. Martin and D. George (eds.). Scientia Marina,* **70S3:** 9-16, Barcelona (Spain).

Aguirrezabalaga, F. and Ceberio, A., 2005. Spionidae (Annelida: Polychaeta) from the Capbreton Canyon (Bay of Biscay, NE Atlantic) with description of a new genus and three new species. *Mar. Biol. Res*., **1**: 267-280.

Ajmal Khan, S., Murugesan, P., Lyla, P. and Jaganathan, S., 2004. A new indicator macro-invertebrate of pollution and utility of graphical tools and diversity indices in pollution monitoring studies. *Current Science*, **87**: 1508-1510.

Alagarsamy, R., 2009. Environmental magnetism and application in the continental shelf sediments of India. *Mar. Environ. Res*., **68(2)**: 49-58.

Albertelli, G., Cattaneo-Vietti, R., Chiantore, M., Pusceddu, A. and Fabiano, M., 1998. Food availability to an *Adamussium* bed during the austral Summer 1993/94 (Terra Nova Bay, Ross Sea). *Journal of Marine Systems,* **17**: 425-34.

Alcantara, H. P. and Solis-Weiss, V., 2005. Seasonal variations of the Spionida (Palpata: Canalipalpata) in the sub-littoral zone of the Gulf of California. *Mar. Ecol*., **26**: 273–285

Al-Hakim, I. and Glasby, C.J., 2004. Polychaeta (Annelida) of the Natuna Islands, South China Sea. *The Raffles Bulletin of Zoology,* 2004 supplement, **11**:25-45.

Aller, R.C. and Aller, J.Y., 1992. Meiofauna and solute transport in marine muds. *Limnol. Oceanogr.*, 37:1018-1033.

Aller, J. Y., R. C. Aller, and M. A. Green., 2002. Benthic faunal assemblages and carbon supply along the continental shelf/shelf break-slope off Cape Hatteras, North Carolina. *Deep-Sea Research II*, **49**:4599-4625.

Alongi, D.M., 1990. The ecology of tropical soft-bottom benthic ecosystems. *Oceanogr. Mar. Biol. Annu. Rev.*, **28:** 381-496.

Alongi, D.M. and Christoffersen, P., 1992. Benthic infauna and organism- sediment relations in a shallow, tropical coastal area; influence of outwelled mangrove detritus and physical disturbance. *Mar. Ecol. Progr. Ser.*, **81**: 229-245.

Altaff, K., Sugumaran, J. and Naveed, S., 2005. Impact of tsunami on meiofauna of Marina beach, Chennai, India. *Current Science,* **89**: 34-38.

Albani, A. D., Favero, V. M. and Serandrei-Barbero, R., 1998. The distribution of sediment and benthic foraminifera in the Gulf of Venice, Italy. *Estuarine, Coastal and Shelf Science,* **46**: 251-265.

Anbuchezhian, R.M., Rameshkumar, G. and Ravichandran, S., 2009. Macrobenthic Composition and Diversity in the Coastal Belt of Thondi, Southeast Coast of India. *Global Journal of Environmental Research,* **3 (2)**: 68-75.

Annandale, N., 1907. The fauna of the brackish water ponds at Port Canning, Lower Bengal, I. Introduction and preliminary account of the fauna. *Rec.Indian Mus.,* **1(4)**: 46-74.

Annandale, N. and Kemp, S., 1915. Fauna of Chilka Lake. *Mem. Indian Mus.*, **5**:1-28.

Ansari, Z.A., Parulekar, A.H. and Jagtap, T.G., 1980. Distribution of sub-littoral meiobenthos off Goa coast, India. *Hydrobiologia,* **74**: 209-214.

Ansari, Z. A., Ingole, B.S. and Parulekar, A. H., 1986. Effect of high organic enrichment of benthic polychaete population in an estuary. *Marine Pollution Bulletin,* **17(8)**:361-365.

Ansari, Z.A. and Gauns, M.U., 1996. A quantitative analysis of fine scale distribution of intertidal meiofauna in response to food resources. *Indian Journal of Marine Sciences,* **25**: 259–263.

Ansari, Z. A., Rivonkar, C.U. and Sangodakar, U.M.X., 2001. Population fluctuation and vertical distribution of meiofauna in a tropical mud flat at Mandovi estuary, west coast of India. *Indian Journal of Marine Sciences*, **30(4)**: 237-245.

Ansari, Z. A., Sreepada, R. A., and Kanti, A., 1994. Macrobenthic assemblage in the soft sediment of Mormugao harbour, Goa (Central west coast of India). *Indian Journal of Marine Science,* **23**: 225-231.

Ansari, Z.A and Parulekar, A.H., 1981. Meiofauna of the Andaman Sea. *Indian Journal of Marine Science,* **10(3)***:*285- 288.

Ansari, Z. A. and Parulekar, A.H., 1993. Distribution, abundance and ecology of the meiofauna, in a tropical estuary along the west coast of India. *Hydrobiologia,* **262(115)**: 47-56.

Ansari, Z.A., Rodrigues, C.L., Chatterji, A. and Parulekar, A. H., 1982. Distribution of meiobenthos and macrobenthos at the mouth of some rivers of the east coast of India. *Indian J. Mar. Sci*., **11**: 341-343.

Anzari, Z.A and Parulekar, A.H., 1994. Ecological energetics of benthic communities of an estuarine system of the west coast of India. *Proceedings of Indian National Science Academy*, **B60 (1)**:99-106.

Ansari, Z.A. and Parulekar, A.H., 1998. Community structure of meiobenthos from a tropical estuary. *Indian Journal of Marine Sciences*, **27**:362-366.

Anzari, Z.A., Ingole, B.S., and Parulekar, A.H., 1996. Benthos of the EEZ of India. In: Qasim, S.Z. and Roonwal (Eds.), India's Exclusive Economic Zone, G.S. *Omega scientific Publishers*, New Delhi, pp. 74-86.

Ansari, Z.A, Harkantra, S.N., Nair, S.A., and Parulekar, A. H., 1977. Benthos of the Bay of Bengal:a preliminary account. *Mahasagar,* Bulletin of the National Institute of Oceanography, **10 (1&2)**: 55-60.

Ansari, Z. A., Parulekar, A. H., Harkantra, S. N. and Ayyappan Nair, 1977b. Shallow-water macrobenthos along the central west coast of India. *Mahasagar,* **10 (3&4):**123-127.

Archambault, P. and Bourget, E., 1996. Scales of coastal heterogeneity and benthic intertidal species richness, diversity and abundance. *Mar. Ecol. Prog. Ser.,* **136**:111-121.

Austen, M. C., Warwick, R. M. and Rosado, M. C., 1989. Meiobenthic and macrobenthic community structure along a putative pollution gradient in Southern Portugal. *Mar. Pollut. Bull***. 20**: 398-405.

Austen, M.C. and McEvoy, A.J., 1997a. Experimental effects of Tributyltin (TBT) contaminated sediment on a range of meiobenthic communities. *Environmental Pollution*, **96:** 435-444.

Austen, M.C. and McEvoy, A.J., 1997b. The use of offshore meiobenthic communities in laboratory microcosm experiments: Response to heavy metal contamination. *Journal of Experimental Marine Biology and Ecology,* **211**: 247-261.

Austen, M.C. and Somerfield, P.J., 1997. A community level sediment bioassay applied to an estuarine heavy metal gradient. *Marine Environmental Research*, **43**: 315-328.

Austen, M.C., Widdicombe, S. and Villano-Pitacco, N., 1998. Effects of biological disturbance on diversity and structure of meiobenthic nematode communities. *Marine Ecology Progress Series,* **174**: 233-246.

Austen, M.C. and Widdicombe, S., 1998. Experimental evidence of effects of the heart urchin *Brissopsis lyrifera* on associated subtidal nematode communities. *Journal of Experimental Marine Biology and Ecology*, 222: 219-238.

Bader, R.G., 1954. The role of organic matter in determining the distribution of Pelecypods in marine sediments. *J. Mar. Res.,* **13**: 32-47.

Babu, R.V., Varkey, M.J., Kesava Das, V. and Gouveia, A.D., 1980. Water masses and general hydrography along the west coast of India during early March. *Indian Journal of Marine Sciences,* **9**: 82-89.

Babu, N., Suresh, B.D.S., and Mohan Das, P.N., 2007. Impact of tsunami on texture and mineralogy of a major placer deposits in southwest coast of India. *Environ. Geol.***, 52**:71-80.

Basford, D.J., Eleftheriou, A., and Raffaelli,D .,1990. The infauna and epifauna of the northern North Sea. *Neth. J. Sea. Res.,* **25 (1/2)**: 165-173.

Banta, G.T., Holmer, M., Jensen, M.H. and Kristensen, E., 1999. Effects of two polychaete worms, *Nereis diversicolor* and *Arenicola marina*, on aerobic and anaerobic decomposition in sandy marine sediment. *Aquat. Microb. Ecol.,* **19**:189-204.

Bahlburg, H. and Weiss, R., 2007. Sedimentology of the December 26, 2004, Sumatra tsunami deposits in eastern India (Tamil Nadu) and Kenya. *International Journal of Earth Sciences*, **96**: 1195-1209.

Barnes, D. K.A. and Conlan, K. E., 2007. Disturbance, colonization and development of Antarctic benthic communities. *Philosophical Transactions of the Royal Society* **(B), 362 (1477)**:11-38.

Bell, S.S., and Coull, B.C., 1978. Field evidence that shrimp predation regulates meiofauna. *Oecologia*,**35:** 141-148.

Bhadury, P., Austen, M.C., Bilton, D.T., Lambshead, P.J.D., Rogers, A.D. and Smerdon, G.R., 2005. Combined morphological and molecular analysis of individual nematodes through short-term preservation in formalin. *Molecular Ecology Note,* **5:** 965-968.

Bhadury, P., Austen, M.C., Bilton, D.T., Lambshead, P.J.D., Rogers, A.D. and Smerdon, G.R., 2006. Molecular detection of marine nematodes from environmental samples: overcoming eukaryotic interference. *Aquatic Microbial Ecology,* **44:** 97-103.

Bhadury, P., Austen, M.C., Bilton, D.T., Lambshead, P.J.D., Rogers, A.D., Smerdon, G.R., 2007. Exploitation of archived marine nematodes - a hot lysis DNA extraction protocol for molecular studies. *Zoologica Scripta*, **36**: 93-98.

Bhadury, P., Austen, M.C., Bilton, D.T., Lambshead, P.J.D., Rogers, A.D. and Smerdon, G.R., 2008. Evaluation of combined morphological and molecular techniques for marine nematode (*Terschellingia* spp.) identification. *Marine Biology,* **154**: 509-518.

Bhat, U.G. and Neelakantan, B., 1991. Distribution of meiobenthos in relation to environmental parameters in the Kali estuary, Karwar. *Comp. Physiol. Ecol.,* **16**:60-68.

Blaxter, M.L., De Ley, P., Garey, J.R., Liu, L.X., Scheldeman, P., Vierstraete, A., Vanfleteren, J.R., Mackey, L.Y., Dorris, M., Frisse, L.M., Vida, J.T. and Thomas, W.K., 1998. A molecular evolutionary framework for the phylum Nematoda. *Nature,* **392**: 71-75.

Boaden, P.J.S, 1962. Colonization of graded sand by an interstitial fauna. *Cah. Boil. Mar.*, **T.3**:245- 248.

Boesch, D.F., 1973. Classification and community structure of macrobenthos in the Hampton Roads Area, Virginia. *Mar. Biol.*, **21**: 226-244.

Bogdanos, C. and. Satsmadjis, J., 1985. The benthic fauna of different soft substrata in the Pagassitikos Gulf (Greece). *Thalassographica*, **8**: 43-69.

Bongers, T., 1990. The maturity index: an ecological measure of environmental disturbance based on nematode species composition. *Oecologia*, **83:14**-19.

Bongers, T., Alkemade, R., Yeates, G.W., 1991. Interpretation of disturbance-induced maturity decrease in marine nematode assemblages by means of the Maturity Index. *Marine Ecology Progress Series,* **76**: 135-142.

Bongers, T., Ferris, H., 1999. Nematode community structure as a bioindicator in environmental monitoring. *Trends in Ecology and Evolution,* **14**: 224-228.

Bouillon, S., Koedam, N., Raman, A. V. and Dehairs, F., 2002. Primary producers sustaining macro-invertebrate communities in intertidal mangrove forests. *Oecologia*, **130**: 441-448.

Bourget, E., DeGuise, J., Daigle, G., 1994. Scales of substratum heterogeneity, structural complexity and the early establishment of a marine epibenthic community. *J. Exp. Mar. Biol. Ecol.,* **181**:31-51.

Boyd, S.E., Rees, H.L. and Richardson, C.A., 2000. Nematodes as sensitive indicators of change at dredged material disposal sites. *Estuarine, Coastal and Shelf Science,* **51**:805-819.

Boyle, E. E., Zardus, J. D., Chase, M.R., Etter, R. J., and Rex, M.A., 2004. Strategies for molecular genetic studies of preserved deep-sea macrofauna. *Deep-Sea Research*, Part I: Oceanographic Research Papers, **51(10)**: 1319-1336.

Brandt, A., De Broyer, C., De Mesel, I., Ellingsen, K.E., Gooday, A.J., Hilbig, B., Linse, K., Thomson, M.R.A. and Tyler, P.A., 2007a. The biodiversity of the deep Southern Ocean benthos. *Philosophical Transactions of the Royal Society of London Biological Sciences*, **362**: 39-66.

Bray, J.R., and Curtis, J.J., 1957. An ordination of the upland forest communities of southern Wisconsin. *Ecology Monograph,* **27**: 325-349.

Briggs, K.B., Tenore, K. R. and Hanson, R. B., 1979. The role of microfauna in detrital utilization by the polychaete, *Nereis succinea* (Frey and Leuckart). *J. Exp. Mar. Biol.Eco*., **36**: 225-234.

Brotskaja, V. A., and Zenkevich, L. A.,1939. Quantitative evaluation of the bottom fauna of the Barents Sea. Summary. *Trans. Inst. Mar. Fish. Oceanog. U. S. S. R.*, **4 (8)**: 99-126.

Bryant, E., 2001. Tsunami- the Underrated Hazard. Cambridge, University Press, Cambridge, 320 pp.

Buchanan, J. B., Sheader, M., and Kingston, P. F. 1978. Sources of variability in the benthic macrofauna off the south Northumberland coast. *Journal of the Marine Biological Association*, *UK,* **58**: 191-209.

Buchanan, J.B., 1984. Sediment analysis. In: Holme, N.A., McIntyre, A.D. (Eds.), Methods for the Study of Marine Benthos. *Blackwell Scientific Publications*, Oxford and Edinburgh, pp. 41-65.

Butman, C.A., Grassle, J.P., and Webb, C.M., 1988. Substrate choice made by marine larvae settling in still waters and in a flume flow. *Nature* (London), **333**:771-773.

Butman, C.A. and Grassle, J.P., 1992. Active habitat selection by *Capitella* sp. Larvae. I. Two choice experiments in still water and flume flows. *J.Mar.Res.,* **50**:669-715.

Cammen, L.M., 1989. The relationship between ingestion and rate of deposit feeders and sediment nutritional value. In : G. Lopez *et al.,* (eds.), Ecology of marine deposit feeders. *Lecture Notes on Coastal and Estuarine Studies*, **31**, Springer, New York, p.201-222.

Cammen, L.M., Rublee, P., and Hobbie, J., 1978. The significance of microbial carbon in the nutrition of the polychaete *Nereis succinea* and other aquatic deposit feeders. *University of North Carolina Sea Grant Publication,* **UNC-SG-78-12**:1-84.

Chakraborty, B., Mahale, V., Navelkar, G., Ramalingeswara Rao, R. G., Ingole, P.B., and Janakiraman , G., 2007. Acoustic characterization of sea-floor habitats on the western continental shelf of India. *ICES Journal of Marine Science*, **64(3)**: 551-558.

Chase, M.C., Etter, R.J., Rex, M.A., and Quattro, J.M., 1998b. Extraction and amplification of mitochondrial DNA from formalin-fixed deep-sea molluscs. *BioTechniques*, **2**: p. 243.

Cheriyan, P.V., 1967. Hydrographical studies in and around the Cochin Harbor. *Bulletin of the Department of Marine Biology and Oceanography*, **3**:9-17.

Chatterji, A., Ansari, Z.A., Mishra, J.K. and Parulekar, A.H., 1995. Seasonality in meiofaunal distribution on a tropical beach at Balramgari, north east coast of India. *Indian J. Mar. Sci.*, **24**: 49-55.

Chinnadurai, G., and Fernando, O.J., 2003. Meiofauna of Pichavaram mangroves along southeast coast of India. *J. Mar. Biol. Ass. India*, **45(2):** 158-165.

Clarke, K.R., and Warwick, R.M., 1994. Changes in marine communities: an approach to statistical analysis and interpretation, *Plymouth Marine Laboratory, Natural Environmental Research Council,* Plymouth, p.859.

Clarke, K.R. and Gorley, R.N., 2001. PRIMER v5: user manual. PRIMER-E, Plymouth.

Cobb, N.A., 1914. North American free-living fresh-water nematodes. (Contribution to a Science on Nematology II). *Transactions of the American Microscopical Society,* **33**: 35-99.

Cobb, N.A., 1920. One hundred new Nemas (type species of 100 new genera). *Contributions to the Science of Nematology,* **9:** 217-343.

Cocito, S., Fanucci, S., Niccolai, I., Morri, C. and Bianchi, C.N., 1990. Relationships between trophic organization of benthic communities and organic matter content in Tyrrhenian Sea sediments. *Hydrobiologia*, **207**: 53-60.

Colwell, R.K. and Coddington, J.A., 1994. Estimating terrestrial bio-diversity through extrapolation. *Phil. Trans. R. Soc. Lond. Ser. B,* **345**:101-118.

Cook, A. A., Lambshead, P.J.D., Hawkins, L.E., Mitchell, N., and Levin, L.A., 2000. Nematode abundance at the oxygen minimum zone in the Arabian Sea, *Deep-Sea Research II,* **47**:75-85.

Coull, B.C., 1988. Ecology of the marine meiofauna. In: Introduction to the study of meiofauna, Higgins, R.P., Thiel, H. (Eds.), *Smithsonian Institution Press*, Washington DC, USA, p. 18-38.

Coull, B.C., 1990. Are members of the meiofauna food for higher trophic levels? *Transaction of American Microscopic Society*, **109**: 233-246.

Coull, B.C., 1999. Role of meiofauna in estuarine soft-bottom habitats. *Australian Journal of Ecology,* **24**: 327-343.

Coull, B.C., and Chandler, G.T., 1992. Pollution and meiofauna: field, laboratory and mesocosm studies. *Oceanography and Marine Biology: An Annual Review,* **30**: 191-271.

Coull, B.C., Greenwood, J.G., Donald, R.F., and Coull, B.A., 1995. Subtropical Australian juvenile fish eat meiofauna: experiments with Winter Whiting *Sillago maculata* and observations on other species. *Mar. Ecol. Prog. Ser.*, **125**: 13-19.

Coull, B.C. and Giere, O., 1988. The history of meiofaunal research. In: Higgins, R.P., Thiel, H. (Eds.), Introduction to the Study of Meiofauna, *Smithsonian Institution Press*, Washington DC, USA, p. 14-17.

Crisp, D.J. and William, R., 1971. Direct measurement of pore size distribution on artificial and natural deposits and prediction of pore space assessable to interstitial organisms. *Mar. Biol.*, **10**:214-226.

Damodaran, R., 1973. Studies on the benthos of the mud banks of Kerala coast. *Bulletin of Department of Marine Sciences*, University of Cochin, **6:** 1-126.

Darbyshire, M., 1967. The surface waters off the coast of Kerala. *Deep Sea Res.,* **14:** 295–320.

Davis, F. M., 1925. Quantitative studies on the fauna of the sea-bottom. No.2. Results of the investigations of southern North Sea, 1921- 24. *Fisheries Investigations*, Series II (8): 1-50.

Delamare deboulteville, C., 1960. Biologie Des Eaux Souterraimes littorals et contin entals (vie milieu suppl. 9). *Herman*. Paris: p. 740.

De Lange, W.P. and Healy, T.R., 2001. Tsunami hazard for the Auckland region and Hauraki Gulf, New Zealand. *Natural Hazards*, **24:** 267-284.

Demopoulos, A.W.J., Smith, C. R. and Tyler, P.A., 2003. The deep Indian Ocean floor. *In (ed.) Ecosystems of the deep oceans*. By Paul A. Tyler. p. 569.

Derycke, S., Remerie, T., Vierstraete, A., Backeljau, T., Vanfleteren, J., Vincx, M. and Moens, T., 2005. Mitochondrial DNA variation and cryptic speciation within the free-living marine nematode *Pellioditis marina*. *Marine Ecology Progress Series,* **300**: 91-103.

Desai, B. N. and Krishnan Kutty., 1966. Studies on the benthic fauna of Cochin back waters. *PYoc. India. Acad.Sci.,* **66(B)**: 123-142.

Desai, B. N. and Krishnan Kutty., 1967a. Studies on the benthic fauna of Cochin back waters. *PYoc. India. Acad.Sci.,* **65**: 123-142.

Desai, B. N. and Krishnan Kutty., 1967b. A comparison of the marine and estuarine benthic fauna of the near shore regions of the Arabian Sea. *Bull. N.I.S.I.*, **38**: 677- 683.

Desai, B. N. and Krishnan Kutty., 1969. A comparison of the marine and estuarine benthic fauna of the near shore regions of the Arabian Sea. *Bull. Natl. Inst. Sci., India,* **38(2)**:677- 683.

Diaz and Rosenberg., 1995. Marine benthic hypoxia: A review of its ecological effects and the behavioral responses of benthic macrofauna. *Oceanogr. Mar. Biol.*, **33**: 245-303.

Dileep Kumar, M., Sarma, V.V.S.S., Ramaih, N., Gauns, M., and De Souza, S.N., 1998. Biogeochemical significance of transport exopolymer particles in the Indian Ocean. *Geophysical Research Letters,* **25;** 81-84.

DOD, Annual report 2005-06. Ministry of Ocean Development. Government of India.

Dora, Y.L., Damodaran, R and Jos Anto, V., 1968. Texture of the Narakal mud bank sediments. *Bulletin of the Department of Marine Sciences, University of Cochin,* **4**:1-10.

Dujardin, F., 1851. Sur un petit animal marin, Echinodère, formant un type intermédiaire entre les Crustacés et les Vers. *Annales des Sciences Naturelles, Zoologie*, series 3, **15**:158-160.

Dwivedi, S. N., 1973. Some biological problems of the west coast of India. *Mahasagar,* **6(2)**: 112-119.

Eleftheriou, A. and Basford, D.J., 1989. The macrobenthic infauna of the off shore northern North Sea. *J.Mar. Biol. Ass. U.K.,* **69**: 123- 143.

Ellingsen, K.E., 2001. Biodiversity of a continental shelf soft sediment macrobenthos community. *Mar.Ecol. Prog. Ser.*, **218**:1-15.

Ellis, M.L. and Coull, B.C., 1989. Fish predation on meiobenthos - field experiments with juvenile spot *Leiostomus xanthurus* Lacépède. *Journal of Experimental Marine Biology and Ecology,* **130**, 19-32.

Emson, R. H., and Faller-Fritsch, R. J., 1976: An experimental investigation into the effect of crevice availability on abundance and size structure in a population of *Littorina rudis*: Gastropoda; Prosobranchia. *J. Exp. Marine Bio. Ecol.* , **23**: 285-297.

El-Wakeel, S.K. and Riley, J.P., 1957. The determination of organic carbon in marine muds. *J. Cons.Perm.Int.Explor.Mer.*, **22**:180-183.

Etter, R.J., Rex, M.A., Chase, M.R. and Quattro, J.M., 1999. A genetic dimension to deep-sea biodiversity. *Deep-Sea Research*, Part I, **46**, 1095-1099.

Feebarani, J., 2009. Meiobenthos of Cochin back waters in relation to macrobenthos and environmental parameters. Ph.D thesis, Cochin university of Science and Technology, p. 238.

Fenchel, T., 1970. Studies on the decomposition of organic detritus derived from the turtle grass *Thalassia testudinum. Limnol and Oceanogr.*, **15**:14-20.

Feller, R.J. and Warwick, R.M., 1988. Energetics. In: Higgins, R.P., Thiel, H. (Eds.), Introduction to the Study of Meiofauna. *Smithsonian Institution Press*, Washington, D.C., p. 18-38.

Field, J.G., 1971. A numerical analysis of changes in the soft bottom fauna of along a transect across False bay, South Africa. *J. Exp. Mar. Biol. and Ecol.*, **7**: 215 -53.

Ford, E., 1923. Animal communities of the level sea bottom in the waters adjacent to Plymouth. *J. Mar. Biol.Ass. U. K.*, **13**:164- 224.

Franz, D.R., and Harris, W.H., 1988. Seasonal and spatial variability in macrobenthos communities in Jamaica Bay, New York - an urban estuary. *Estuaries*, **11(1)**: 15-28.

Ganapati, P.N., Lakshmana Rao, M.V., 1959. Preliminary observations on the bottom fauna of the continental shelf of the north-east coast of India. *Proc of the First All-India Congress of Zoology, Part 3.* The Zoological Society of India, Kolkata, p. 8–13.

Ganapati P.N., and Lakshmana Rao, M.V.,1962. Preliminary observations on the bottom fauna of the continental shelf of the north east coast of India. *Proceedings of the first All India Congress of Zoology, 1959, part -3, symposium*, 8-13.

Ganapati, P. N. and Chandrasekhara Rao, G. 1962. Ecology of the interstitial fauna inhabiting the sandy beaches of Waltair coast. *J. Mar. biol.Ass. India*, **4**: 44-57.

Ganapati, P.N., and Raman, A.V., 1973. Pollution in Vishakhapatnam Harbour. *Current Science,* **42**: 490-492.

Ganapati, P.N., and Sarma, A.L.N., 1973. The meiofauna and pollution in Vishakhapatnam Harbour. *Current Science,* **42 (20):** 724- 725.

Gandhi, S., Rajamanickam, G.V.M, and R. Nigam., 2002. Taxonomy and distribution of benthic foraminifera from the sediments off Palk strait, Tamil Nadu, East coast of India. *Journal of the Paleontological Society of India*, **47**: 47-64.

Ganesh, T., and Raman, A.V., 2007. Macrobenthic community structure of the northeast Indian shelf, Bay of Bengal. *Marine Ecology Progress Series*, **341**: 59-73.

Gaston, G.R. 1987. Benthic Polychaeta of the mid Atlantic Bight: feeding and distribution. *Mar. Ecology Progr. Ser.*, 36: 251-262.

Gaston, K.J and Williams, P.H., 1996. Spatial patterns in taxonomic diversity. In: Gaston K.J. (ed.) Biodiversity: a biology of numbers and difference. *Blackwell Science*, Oxford, p. 202–229.

Gee, J.M., 1989. An ecological and economical review of meiofauna as food for fish. *Zoological Journal of the Linnaean Society,* **96**, 243-261.

Genin, A., Dayton, P.K., Lonsdale, P., and Spiess, F., 1986. Corals on Seamount Peaks Provide Evidence of Current Acceleration over Deep-Sea Topography. *Nature,* 322: 59-61.

Gerlach, S.A., 1962. Freilebende Meeresnematoden von den Malediven. *Kieler Meeresforsch*, **18**: 81-108

Gerlach, S.A., 1971. On the importance of marine meiofauna for benthos communities. *Oeconogia., (Berl)* ,**6**:176-190.

Gerlach, S.A., 1978. Food-chain relationships in subtidal silty-sand marine sediments and the role of meiofauna in stimulating bacterial growth. *Oecologia* (Berl), **33**:55-69.

Gheskiere, T., Hoste, E., Vanaverbeke, J., Vincx, M. and Degraer, S., 2004. Horizontal zonation patterns and feeding structure of marine nematodes assemblages on a marotidal, ultra-dissipative sandy beach (De Panne, Belgium). *Journal of Sea Research*, **52**: 211-226.

Gheskiere, T., Vincx, M., Weslawski, J.M., Scapini, F. and Degraer, S., 2005. Meiofauna as descriptor of tourism-induces changes at sandy beaches. *Marine Environmental Research,* **60**: 245-265.

Giard, A., 1904. Sur Une faunele characteristique des sables a diatomees d'A mbleteuse. C.R. *Seances soc. Boil.* , Paris. **56**: 107-165.

Giere, O., 1993. Meiobenthology: the Microscopic Fauna in Aquatic Sediments. *Springer-Verlag*, Hamburg, Germany, p.328.

Giere, O., 1975. Population structure, food relations and ecological role of marine oligochaetes. With special reference to meiobenthic species. *Mar.Biol.*, **31**:139-156.

GopalaKrishnan, T.C., and Chandrasekharan Nair, K.K., 1998. Subtidal benthic macrofuana of the Mangalore coast West coast of India. *Indian J. Mar. Sci.***27,** 351-355.

Gosselin, L.A. and Bourget, E., 1989. The performance of an intertidal predator *Thais lapillus,* in relation to structural heterogeneity. *J. Anim. Ecol*. **58**:287-303.

Govindankutty, A. G., and Nair, B. N., 1966. Preliminary observations on the interstitial fauna of the South-west coast of India. *Hydrobiologia*, **28**:101-122.

Govindankutty, A. G., 1967. Studies on the interstial fauna of south west coast of India with special reference to nematods. *Ph.D Thesis.* University of Kerala. p. 360.

Graf, G., 1992. Benthic-pelagic coupling: A benthic view. *Ocean.Mar. Biol. Ann. Rev*. **30**:149-190.

Grant, W.D., and Butman, C.A., 1987. The effects of size class and bioturbation in fine - grained transport in coastal systems: specific application to biogeochemistry of PCB transport in New Bedford Harbour. *In: Woods Hole Oceanographic Institution Sea Grant Programme Report*, *1984- 1987,* Woods Hole Oceanographic Institution, Woods Hole , p. 15- 17.

Ganesh,T. and Raman, A.V., 2007. Macrobenthic community structure of the Northeast Indian shelf, Bay of Bengal. *Mar. Ecol. Prog. Ser.,* **341**: 59-73.

Grassle, J.P., Butman, C.A., and Millis, S.W., 1992a. Active habitat selection by *Capitella* sp. larvae. II- Multiple choice experiments in still water and flume flows. *J.Mar. Res.*, **50**: 717 -743.

Grassle, J.P., Snelgrove, P.V.R., and Butman, C.A., 1992b. Larval habitat choice in still water and flume flows by the opportunistic bivalve *Mullina lateralis*. *Netherlands Journal of Sea Research*, **30**: 33-44.

Grassle, J.F., Grassle , J.P., Brown-Leger, L.S., Petrecca, R.F. and Copley, N.J. , 1985. Subtidal Macrobenthos of Narragansett Bay. Field and mesocosm studies of the effects of eutrophication and organic input on benthic populations. In: Marine Biology of Polar Regions and Effects of Stress on Marine Organisms. *Proceedings of the 18th European Marine Biology Symposium*, (Eds.) Gray, J.S. and Christiansen, M.E., John Wiley, Chichester, England, p. 421-434.

Gray, J.S., 1966. The attractive factor of intertidal sands to *Protodrilus symbioticus* Giard. *J. Mar .Biol. Assoc. U.K.*, **46**: 627-645.

Gray, J.S., 1967. Substrate selection by the Archiannelid, *Protodrilus Hypoleucus* Armenante. *J. Experimental Biology and Ecology*, **1**: 47-54.

Gray, J.S., 1968. An experimental approach to the ecology of the Harpacticoid *Leptastacus constricus* Lang. *J.Exp. Mar. Boil. Ecol.*, **2**: 1 - 15.

Gray, J.S., 1974. Animal-sediment relationships. *Oceanography Marine Biology Annual Review,* **12**: 223-261.

Gray, J. S., 2002. Species richness of marine soft sediments. *Marine Ecology Progress Series*, **244**: 285-297.

Gray, J. S., McIntyre, A.D., and Štirn, J.,1992. Manual of methods in aquatic environment research. Part II. Biological assessment of marine pollution with particular reference to benthos. *FAO Fisheries Technical Paper,* **324**:p. 49.

Gray, J. S., Wu, R. S., and Or, Y. Y., 2002. Effects of hypoxia and organic enrichment on the coastal marine environment. *Marine Ecology Progress Series,* **238**: 249-279.

Gray, J.S., 1981. The ecology of marine sediments: an introduction to the structure and function of marine communities. *Cambridge University Press.* Cambridge, p.185.

Gray, J.S., 1997. Marine biodiversity: patterns, threats and conservation needs. *Biodiv. Conserv*. **6**:153-175.

Haeckel, E., 1890. Plankton-Studien: Vergleichende Untersuchungen über die Bedeutung und Zusammensetzung der pelagischen Fauna und Flora. *Gustav Fischer*, p.105.

Haiming, W., Ruxing, C., Diagang, Z., Deide, S. and Mingsheng, F., 1996. Ecology of macro benthos in subtidal zone (0-5 meter of Northern Zhejiang. Donghai. *Mar. Sci.*, **14(4)**: 67-77.

Hall, J.S., 2002. The continental shelf benthic ecosystem: current status, agents for change and future prospects. *Environmental Conservation,* **29 (3)**: 350-374.

Hamilton, D. J., 2000. Direct and indirect effects of predation by common eiders and abiotic disturbance in an intertidal community. *Ecological Monographs*, **70**:21-43.

Hargrave, B.T., 1970. The utilization of benthic microflora by *Hyalella azteca* (Amphipoda). *J. Animal. Ecol*., **39**: 427-437.

Harkantra S.N., 1975 Benthos of the kali estuary, Karwar, *Bulletin Natn.Inst.Oceanogr*, **8(1&2)**: 53-58.

Harkantra, S.N., Nair, A, Ansari, Z.A. and Parulekar, A.H., 1980. Benthos of the shelf region along the West coast of India. *Indian J. Mar. Sci.,* **9**:106-110.

Harkantra, S. N., and Paulekar, A. H., 1981. Ecology of benthic production in the coastal zone of Goa. *Mahasagar-Bulletin of National Institute of Oceanography,* **14:** 135-139.

Harkantra, S. N., Rodrigues, C.L., and Parulekar A.H., 1982. Macrobenthos of the shelf off Northeastern Bay of Bengal. *Indian J.Mar. Sci.,* **11:115**-121.

Harkantra, S.N., and Parulekar, A.H., 1985. Community structure of sand-dwelling macrofauna of an estuarine beach in Goa, India. *Marine Ecology Progress Series,* **30**: 291-294.

Harkantra, S.N., and Parulekar, A.H., 1987. Benthos off Cochin, Southwest coast of India. *Indian J. Mar. Sci.*, **16**: 57- 59.

Harkantra S.N., and Parulekar, A. H.., 1989. Population distribution of meiofauna in relation to some environmental features in sandy intertidal region of Goa, West coast of India. *Indian Journal of Marine Sciences*, **18:** 259-264.

Harkantra, S.N., and Parulekar, A.H., 1991. Interdependence of environmental parameters and sand dwelling benthic species abundance: a multivariate approach. *Indian Journal of Marine Science,* **20**: 232-234.

Harkantra, S.N. and Parulekar, A. H., 1994. Soft sediment dwelling macro-invertebrates of Rajapur Bay, Central west coast of India. *Indian Journal of Marine Sciences*, **23**: 31-34.

Harkantra, S.N. and Rodrigues, N.R., 2003. Pattern of species succession of soft-bottom macrofauna in the estuaries of Goa, west coast of India. *Current Science,* **85(10):** 1458-1474.

Harkantra, S.N and Rodrigues, N., 2004. Numerical analyses of soft bottom macroinvertebrates to diagnose the pollution in tropical coastal waters. *Environmental monitoring and assessment*, **93**:251-275.

Harkantra,S.N., and Nagvenkar, S.S., 2006. Do gas seepage sites support distinct macrofaunal community? – An observation in the tropical shelf region of Goa, Arabian Sea, India. *Current Science*, **91(2)**: 217-221.

Harper, J.L. and Hawksworth, D.L., 1994. Biodiversity: measurement and estimation. *Preface. Phil. Trans. R. Soc. Lond. Ser.* B. **345**: 5-12.

Hashimi, N.H., Kidwai, R.M., and Nair, R.R., 1978. Grain size and coarse fraction studies of sediments between Vengurla and Mangalore on the western continental shelf of India. *Indian J.Mar.Sci*., **7**:231-238.

Hashimi, N.H., Kidwai, R.M., and Nair, R.R., 1981. Comparative study of the Topography and sediments of the western and eastern continental shelf around Cape Comorin. *Indian Journal of Marine Sciences*., **10**:45- 50.

Hashimi, N.H., 1981. Comparative study of the moment and graphic size parameters of the sediments of the western continental shelf of India. *Mathematical Geology*, **13(4)**: 291-301.

Hashimi, N.H., and Nair, R.R., 1981. Surficial sediments of the continental shelf off Karnataka. *Journal of Geological Society of India*. **22**: 266-273.

Heip, C., Warwick, R and D'Ozouville, L., 1998. A European science plan on marine biodiversity. *European Marine and Polar Science (EMaPS)*, European Science Foundation (ESF), Strasbourg Cedex.

Hewitt, J.E., Thrush, S.F., Halliday, J. and Duffy, C., 2005. The importance of small-scale habitat structure for maintaining beta diversity. *Ecology,* **86**:1619-1626.

Heywood, V.H and Watson, R.T., 1995. Global biodiversity assessment. *Cambridge University Press,* Cambridge, 282-285.

Higgins, R.P. and Thiel, H., 1988. Introduction to the Study of Meiofauna. *Smithsonian Institution Press*, Washington DC, USA, p. 488.

Hixon, M. A., and Beets, J. P., 1993. Predation, prey refuges and the structure of coral-reef fish assemblages. *Ecological Monographs,* **63**:77-101.

Hobbs, C.H., 1982. Organic carbon and sulphur in the sediments of the Virginia Chesapeake bay. *Jour. Sed. Pet.***, 52**: 383- 393.

Holme, N.A., and McIntyre, A.D., 1971. Methods for the study of Marine benthos. *Blackwell Scientific Publications*, Oxford. p. 346.

Holte, B., Oug, E., and Cochrane, S., 2004. Depth - related benthic macrofaunal biodiversity patterns in three undisturbed north Norwegian fjords. *Sarsia,* **89**:91-101.

Houthoofd, W., Jacobsen, K. and Mertens, C., 2003. Embryonic cell lineage of the marine nematode *Pellioditis marina*. *Developmental Biology,* **258**: 57-69.

Huang, Y. and Zhang, Z.N., 2004. A new genus and three new species of free-living marine nematodes (Nematoda: Enoplida: Enchelidiidae) from the Yellow Sea, China. *Cahiers de Biologie Marine,* **45**: 343-354.

Hulings, N.C. and Gray, J.S., 1971. A Manual for the Study of Meiofauna. *Smithsonian Contributions to Zoology*, No. **78**, Washington DC, USA, p. 83.

Hussain, S. M., Krishnamurthy, R., Suresh Gandhi, M., Ilayaraja, K., Ganesan, P. and Mohan, S. P., 2006. Micropalaeontological investigations on tsunamigenic sediments of Andaman Islands. *Current Science,* **91**:1655-1667.

Huys, R. and Mu, F.H., 2008. Description of a new species of *Onychostenhelia* it (o) over-cap (Copepoda, Harpacticoida, Miraciidae) from the Bohai Sea, China. *Zootaxa,* **1706**: 51-68.

ICES, 1994. Quality assurance of guidelines for benthos studies. *International council for the exploration of the seas,* Report of the Benthos Ecology Working Group, p. 92-94.

Ingole, B. S., Ansari, Z. A. and Parulekar, A. H., 1992. Benthic fauna around Mauritius Island, Southwest Indian Ocean. *Indian Journal of Marine Science*, **21**:268-273.

Ingole, B. S., Ansari, Z. A., Rathod, V. and Rodrigues, N., 2000. Response of meiofauna to immediate benthic disturbance in the Central Indian Ocean. *Mar. Geo. Geotech*., **18:** 263-272.

Ingole, B, and Koslow, A.J., 2005. Deep-sea ecosystems of the Indian Ocean. *Indian Journal of Marine Sciences*, **34(1):** 27-34.

Ingole, B., 2003. Macrobenthic abundance in the vicinity of spreading ridge environment in Central Indian Ocean. *Current Science*, **85(3)**:328-333.

Ingole, B., 2007. Biodiversity of benthic polychaetes from the coastal waters of Paradip, Bay of Bengal. *Bionano Frontier*, **1**:32-45.

Ingole, B., Rodrigues, N., and Ansari, Z.A., 2002. Macrobenthic communities of coastal waters off Dhabol, west coast of India. *Indian Journal of Marine Sciences,* **31(2):**93-99.

Ingole, B.S, Pavithran, S and Ansari, Z. A., 2005. Restoration of deep-sea macrofauna after simulated benthic disturbance in the Central Indian Basin. *Marine Georesources and Geotechnology*, **23**: 267-288.

Ingole, B.S, and Paruleakar, A.H., 1998. Role of salinity in structuring the intertidal meiofauna of a tropical estuarine beach: Field evidence. *Indian J. Mar. Sci.*, **27**:356-361.

Ingole, B.S, Sivadas, S., Nanajkar, M., Soutya, S., and Nag, A., 2009. A comparative study of macrobenthic community from harbours along the central west coast of India. *Environ Monit Assess*, 154:135-146.

Ishikawa, K., 1989. Relationship between bottom characteristics and benthic organisms in the shallow waters of Oppa bay, Miyagi. *Mar. Biol.,* **102**: 265- 273.

Izsak, C. and Price, A.R.G., 2001. Measuring β-diversity using a taxonomic similarity index, and its relation to spatial scale. *Mar Ecol Progr Ser* 215: 69-77.

Jacob, J., Chandramohanakumar, N., Jayaraj, K.A., Raveendran, T.V., Balachandran, K.K., Joseph,T., Nair,M., Achuthankutty, C.T., Nair, K.K.C., George, R., and Zeena P. R., 2008. Biogeochemistry of the Surficial Sediments of the Western and Eastern Continental Shelves of India. *Journal of Coastal Research*, **24(5):** 1240-1248.

Jacob, J., Jayaraj, K.A., Habeeb Rehman, H., Chandramohanakumar, N., Balachandran, K.K. Raveendran, T.V., Thresiamma Joseph, Maheswari Nair and Achuthankutty, C.T., 2009. Biogeochemical characteristics of the surface sediments along the western continental shelf of India. *Chemistry and Ecology.* **25(2):**135-149.

Jansson, B.O., 1967. The significance of grain size and pore- water content for the interstitial fauna of sandy beaches. *Oikos*., **18**: 311-322.

Jayalakshmy, K.V., and K. Kameswara Rao., 2003. Multivariate statistical study with a factor analysis of foraminiferal fauna from the Chilka Lake, India. *J. Mar. Biol. Ass. India,* **45 (2)**:133- 143.

Jayaraj, K. A., Jayalakshmi, K. V., and Saraladevi, K., 2007. Influence of environmental properties on macrobenthos in the northwest Indian shelf. *Environmental Monitoring and Assessment*, **127**: 459-475.

Jayaraj, K.A., Josia, J. and Dinesh Kumar, P.K., 2008a. Infaunal macrobenthic community of soft bottom sediment in a tropical shelf. *Journal of Coastal Research*, **24**:708-718.

Jayaraj, K.A., Sheeba, P., Jacob, J., Revichandran, C., Arun, P.K., Praseeda, K.S., Nisha, P.A. and Rasheed, K.A., 2008b. Response of infaunal macrobenthos to the sediment granulometry in a tropical continental margin-southwest coast of India. *Estuarine, Coastal and Shelf Science,* **77**: 743-754.

Jayaraj, K.A., Jayalakshmi, K.V. and Saraladevi, K., 2007. Influence of the environmental properties on macrobenthos in the northwest Indian shelf. *Environmental Monitoring and Assessment*, **127**: 459- 475.

Johnson, R.G. 1974. Particulate matter at the sediment water interface in coastal environments. *J.Mar.Res. ,* **35**: 313-330.

Joice, V. T. and Madhusoodana Kurup., 2006. Impact of bottom trawling and its closure period on infaunal macrobenthic population along the inshore waters off Kerala (India). *Journal of Marine Biological Association of India*, **48(1):**51-55.

Jones, N.S., 1950. Marine bottom Communities. *Biol.Rev*., **25**: 283-313.

Johnson, R.G., 1977. Vertical migration in particulate matter in the upper twenty centimeters of marine sediments. *J.Mar. Res*., **35**: 273-282.

Jos Anto,V., 1971. On the grain size distribution of the Cochin back-water sediments. *Bulletin of the Department of Marine Biology and Oceanography,* University of Cochin, **5**:109-122.

Joydas, T.V., 2002. Macrobenthos of the shelfwaters of the west coast of India. *Ph.D Thesis* submitted to Cochin University of Science and Technology.

Joydas, T.V. and Damodaran, R., 2009. Infaunal macrobenthos along the shelfwaters of the west coast of India, Arabian Sea. *Indian Journal of Marine Sciences*, **38**:191-204.

Karlson, K., Rosenberg, R. and Bonsdorf, E. 2002. Temporal and spatial large-scale effects of eutrophication and oxygen deficiency on benthic fauna in Scandinavian and Baltic waters - a review. *Oceanography and Marine Biology: an Annual Review*, **40**: 427-489.

Kemp., 1971. Organic carbon and Nitrogen in the surface sediments of Lake Ontario, Eric and Huron., *Jour. Sed. Pet.*, **4**: 537- 548.

Kennedy, A.D. and Jacoby, C.A., 1999. Biological indicators of marine environmental health: meiofauna - a neglected benthic component? *Environmental Monitoring and Assessment* **54**:47-68.

Khan, S. A., and Murugesan, P., 2005. Polychaete diversity in Indian estuaries. *Indian Journal of Marine Sciences,* **34(1):** 114-119.

Kim, D. and Shirayama, Y., 2001. Respiration rates of free-living marine nematodes in the subtidal coarse-sand habitat of Otsuchi Bay, northeastern Honshu, *Japan. Zoological Science,* **18:** 969-973.

Kinne, O., 1963. The effects of temperature and salinity on marine and brackish water animals. *I. Temp. Oceanogr. Mar. Biol. Ann. Rev.,* **1**: 301-340.

Kneib, R. T., 1988. Ecology testing for indirect effects of predation in an intertidal soft-bottom community. *Ecology*, **69**:1795-1805.

Kolla, V., Kostecki, J. A., Robinson, F., Biscaye, P. E. and Kray, P. K., 1981. Distribution and origin of clay minerals and quartz in surface sediments of the Arabian Sea. *J. Sed.Petrol.*, **51**: 563-569.

Kowalesky, A., 1901. Les Hédylides, études anatomiques. *Mémoires de l'Académie des Sciences St. Pétersburg (Sciences Mathematiques, Physique Naturelle)* **12**: 1-32.

Krishnankutty, N., 2006. Effects of 2004 tsunami on marine ecosystems - A perspective from the concept of disturbance. *Current Science,* **90(6):** 772-773.

Krogh, A. and Spärck R., 1936. On a new bottom-sampler for investigation of the microfauna of the sea bottom. *Kongelige Danske Videnskabernes Selskab Skrifter, Biologiske Meddelelser,* **13**:1-12.

Kumar, B.M., Katti,R.J., Moorthy, K.S.V. and D`Souza, R.K., 2004. Macrobenthos in relation to the sediment characteristics of near shore waters of Chitrapur, west coast of India. *Asian Fisheries Science*, **17**:21-28.

Kurien, C.V. 1953. A preliminary survey of the bottom fauna and bottom deposits of the Travancore coast within the 15-fathom line. *Proceedings of the National Institute of Sciences of India,* **19(6):** 746-775.

Kurien, C. V., 1967. Studies on the Benthos of the southwest coast of India. *Bull. Natn. Inst. Sci. India,* **38**: 649.

Kurien, C.V., 1971. Distribution of benthos on the southwest coast of India. *In: Fertility of the Sea (Ed.: J.D. Cost Low)*. **Vol. 1**, Gardern and Breach Science Publishers, New York. p. 225.

Kurien, C.V., 1972. Ecology of benthos in a tropical estuary. *Proceedings of the Indian National Science Academy,* **38**: 156-163.

Kurian N. P., Prakash, T. N. Baba, M. and N. Nirupama, 2006. Observations of Tsunami Impact on the Coast of Kerala, India. *Marine Geodesy*, **29**: 135–145.

Kurian, C.V., Damodarn, R., and Antony, A., 1975. Bottom fauna of the Vembanad Lake. *Bulletin of the Department of Marine Sciences, University of Cochin*. **7(4):** 987-994.

Kurian, N. P., Rajith, K., Murali Krishnan, B. T., Kalairasan, P. and Abilash, P.P., 2005. December 2004 tsunami: Run-up level and impact along the Kerala Coast. In: S. M. Rasmasway and C. J. Kumanan (Eds.), *Tsunami: The India Context*. Allied Publishers Private Ltd., Chennai, India. p. 111–127.

Kurian, N.P., and Praveen, S.S., 2010. Tsunami wave propagation in the Arabian Sea and its implications on run-up/inundation characteristics along the Kerala coast. *Indian Journal of Marine Sciences*, **39**: 531-540.

Levin, L. A., Guage, J.D., Martin, C. and Lamont, P.A., 2000. Macrobenthic community structure within and beneath the oxygen minimum zone, NW Arabian Sea. *Deep-Sea Research*, **2 (47)**: 189-226.

Levinton, J.S., 1979. Particle feeding by deposit feeders: models, date and prospectus. In: *Marine Benthic Dynamics. K.R. Tenore nad B.C. Coull (Eds.) Columbia:* University of South Carollina Press. p. 423-439.

Levinton, J.S., 1982. Marine Ecology. *Prentice- hall Inc.,* New Jersey, 526 p.

Liu, X.S., Zhang, Z.N., Wu, Y.P., Huang, Y. and Zhang, Y., 2005. Distribution of sediment Chloroplast pigments in the southern Yellow Sea, China. *Journal of Ocean University of China*. **4**: 163-172.

Longbottom, M.R., 1970. The distribution of *Arenicola marina* (L.) with particular resonance to the effects of particle size and organic matter of the sediments. *J. Exp. Mar. Biol. Ecol.*, **5**: 138- 157.

Lomghurst, A.R. and Pauly, D., 1987. Ecology of tropical oceans. *Academic press, Inc*. p. 407.

Lopez, G.R., Levinton, J.S. and Slobotkin, L.B., 1977. The effect of gracing by the detritivores Orchestiagrillis on Spartina Litter and its associated microbial community. *Oecologia*., **30:**111-127.

Lopez, G.R. and Levinton, J.S., 1987. Ecology of deposit feeding animals in marine sediments. *Quarterly Review of Biology*, **62**: 235- 260.

Lopez G, Taghon G. and Levinton J. (eds) (1989) Ecology of marine deposit feeders. *Lecture Notes on Coastal and Estuarine Studies,* **31,** Springer, New York.

Macarthur, R., Macarthur, J.W., 1961. On bird species-diversity. *Ecology,* **42**:594-598.

Mackie, G.L. 2001. *Applied Aquatic Ecosystem Concepts*. Dubuque: Kendall-Hunt Publishing.

Madhupratap, M., Gauns, M., Ramaiah, N., Prasanna Kumar, S., Muraleedharan, P. M., de Souza, S. N., Saradesai, S., and Muraleedharan, U., 2003. Biogeochemistry of the Bay of Bengal: Physical, Chemical and Primary Productivity characteristics of the central and western Bay of Bengal during Summer Monsoon 2001. *Deep-Sea Res.*, II **50:**881–896.

Magurran, A.E. 1988. Ecological diversity and its measurement. *University Press,* Cambridge.

Mallik, T.K., 1976. Grain-size variation in the Kavaratti lagoon sediments, Lakshadweep, Arabian Sea. *Marine Geology*, **20**:57-75.

Mare, M.F., 1942. A study of a marine benthic community with special reference to the micro-organisms. *Journal of the Marine Biological Association of the United Kingdom,* **25**:517-554.

Margalef, R., 1958. Information theory in Ecology. *General Systems.* , **3**: 36-71.

Marion, A.F., 1883a. Considerations sur les faunes profondes de la Mediterranee. *Ann. Mus. His. Nat. Marseille*., **1(2):** 1-50.

Marion, A.F., 1883b. Esquisse d'une topographie zoologique du Gloge de Marseille. *Ann.Mus. His. Nat. Marseille*., **1(1):**1-108.

Mathew, A. and Govindan, K.,1995. Macrobenthos in the Nearshore Coastal System of Bombay. *Proc. Natl.Acae. Sci. India (B Biol. Soc.)*, **65**: 411-430.

May, R. M., 1994. Biological diversity: differences between land and sea. *Phil. Trans. R. Soc. Lond. Biol. Sci.,* **343**:105-111.

Mayer, L.M., 1989. The nature and determination of non -living sedimentary organic matter as food for deposit feeders. In: G. Lopez *et al*. (Eds.). Ecology of marine deposit feeders. *Lecture notes on coastal and estuarine studies*, **31**, Springer, New York, p.98-113.

Mayer, L.M. and Rice, D.L., 1992. Early diagenesis of protein: a seasonal study. *Limnol. Oceanog*., **37**: 280-295.

Mohan, S.P., Ravi, G., Hussain, S.M. and Rajeshwara Rao, N. 2002. Distribution of recent benthic Ostracoda off Karikkattukuppam (near Chennai) south east coast of India. *Ind. Journal of Mar. Sci.* **31**:315-320.

McIntyre, A.D., 1961. Quantitative difference in the fauna of boreal mud associations. *J.mar. boil. Ass. U.K***., 41**:599-616.

McIntyre A.D., 1962. The class Kinorhyncha (Echinoderida) in British waters. *Journal of Marine Biological Association of United Kingdom*, **42**:503-509.

McIntyre, A.D., 1968. The meiofauna and macrofauna of some tropical beaches. *J.Zool.,* London,**156**:377-392.

McIntyre, A.D., 1969. Ecology of marine meiobenthos. *Biological Review of the Cambridge Philosophical Society,* **44**:245-290.

McIntyre, A.D. and Murison, D.J. 1973. The meiofauna of a flatfish nursery ground. *J.Mar. Biol. Ass. U.K.*, **50**: 93-118.

Menge, J.A., Raski, D.J., Lider, L.A., Johnson, E.L.V., Jojes, N.O., Kissler, J.J. and Hemstreet, C.L., 1983. Interactions between Mycorrhizal fungi, soil fumigation and growth of grapes in California. *Am. J. Enol. Vitic*., **34:**117-121.

Menge, B. A., Lubchenco, J. and Ashkenas, L. R., 1985. Diversity heterogeneity and consumer pressure in a tropical rocky intertidal community. *Oecologia* (Berl.) **65**: 394-405.

Moens, T., Bouillon, S. and Gallucci, F., 2005. Dual stable isotope abundances unravel trophic position of estuarine nematodes. *Journal of the Marine Biological Association of the United Kingdom*, **85**: 1401-1407.

Moens, T., Luyten, C., Middelburg, J.J., Herman, P.M.J. and Vincx, M., 2002. Tracing organic matter sources of estuarine tidal flat nematodes with stable carbon isotopes. *Marine Ecology Progress Series*, **234**: 127-137.

Moens, T., and Vincx, M., 1997. Observations on the feeding ecology of estuarine nematodes. *Journal of the Marine Biological Association of the United Kingdom*, **77**: 211-227.

Moens, T., and Vincx, M., 1998. On the cultivation of free-living marine and estuarine nematodes. *Helgoländer wissenschaftliche Meeresuntersuchungen*, **52**: 115-139.

Moens, T., and Vincx, M., 2000. Temperature and salinity constraints on the life cycle of two brackish-water nematode species. *Journal of Experimental Marine Biology and Ecology*. **243**:115-135.

Mohana Rao, K., Murthy, K.S.R., Reddy, N.P.C., Subrahmanyam, A.S., Lakshminarayana, S., Rao, M.M.M., Sarma, K.V.L.N.S., Premkumar, M.K., Sree, A., and M. Bapuji., 2001. Submerged beach ridge lineation and associated sedentary fauna in the inner shelf of Gopalpur coast, Orissa, Bay of Bengal. *Current Science*, **81(7)**: 828-833.

Montagna, P.A., Bauer, J.E., Hardin, D., Spies, R.B., 1995. Meiofaunal and microbial trophic interactions in a natural submarine hydrocarbon seep. *Vie et Milieu*, **45**: 17-25.

Moore, H.D., 1931. The muds of the Clyde Sea area. III. Chemical and physical conditions; rate and nature of sedimentation; and fauna. *Journal of the Marine Biological Association of the United Kingdom*, **17**: 325-358.

Murray, J. and Hjort, J., 1965. The depths of the ocean. Reprint by Cramer, Beinheim. *Weldon and Wesley Ltd.* New York, p.821.

Murty, P.S.N., Reddy, C.V.G. and Varadachari, V.V.R., 1968. Distribution of organic matter in the marine sediments off the west coast of India. Paper presented at the *Symposium on Process and Products of Sedimentation held at Waltair* in December 1966, **35 B (5):** 377-384.

Murty, K.V.M and Rao, B.K., 1987. On some ecological aspects of meiofauna from an estuarine environment. *Proceedings of the National Seminar on Estuarine Management, 4-5 June 1987, Trivandrum. Nair, M.B (Ed.) State Comm.on Sci., Technol. and Environ.,* Trivandrum, India. p.433-448.

Murthy, P.S.N. and Rao, K.S.R., 1989. Clay mineralogy of Visakhapatnam shelf sediments, east coast of India. *Marine Geology,* **88**: 153- 165.

Murthy, K., Subrahmanyam, A., Murty, G., Sarma, K., Subrahmanyam,V. K. R., Rani, P., Anuradha, A., Adilakshmi, B., and Devi, T., 2006. Factors guiding tsunami surge at the Nagapattinam-Cuddalore shelf, Tamil Nadu, east coast of India. *Current Science*, **90**:1535-1538,

Nagendra, R., Kamalak Kannan, B.V., Sajith, C. Sen, G., Reddy, A.N. and Srinivasalu, S., 2005. A record of foraminiferal assemblage in tsunamigenic sediments along Nagapattinam coast, Tamil Nadu: *Current Science*, **89:** 1947-1952.

Nair, R.R. and Pylee, A. 1968. Size distribution and carbonate content of sediments of the western shelf of India. *Bulletin of the National Institute of Sciences*, India, **38**: 411-420.

Nair, R.R., 1974. Holocene sea-levels on the western continental part of India. *Proceed. Indian Acad. Sci.*, **79**:197-203.

Nair, R.R., 1975. On the nature and origin of small scale topographic prominence of the western continental shelf of India. *Indian. J. Mar. Sci.*, **4**:25-29

Nair, R.R., Hashimi, N.H. and Guptha, M.V.S. , 1979. Holocene lime-stone part of the western continental shelf of India. *Jour. Geol. Soc. India*., **20**: 17-23.

Nair, R.V., Mustafa, S., Pratik Mehta, Govindan, K., Jiyalal Ram, M. and Gajbhiye, S.N., 1998. Biological characteristics of Vashishti estuary, Maharashtra, west coast of India. *Indian Journal of Marine Sciences*, **27**:310-316.

Nair, R.R. and Hashimi, N.H., 1986. Influence of estuaries on shelf sediment texture. *Journal of Coastal Research,* **2(2):** 199-203.

Nair, R.R., Hashimi, N.H and Purnachandra Rao,V., 1982. Distribution and dispersal of clay minerals on the western continental shelf of India. *Marine Geology*, **50**:M1-M9.

Nakao, S., 1982. Community structure of macro benthos in the shallow waters in northern Japan. *Mem.Fac. Fish.Hokkaido Univ*, **28**: 225-304.

Nanajkar, M.R and Ingole, B.S., 2007. Nematode species diversity as indicator of stressed benthic environment along the central west coast of India. *Diversity and Life Processes from Ocean and Land*, 42-52.

Narayan, J.P., Sharma, M.L., and Maheshwari, B.K., 2005. Run-up and inundation pattern developed during the Indian Ocean tsunami of December 26, 2004 along the coast of Tamil Nadu (India). *Gondwana Research*, **8(4):**611-616.

Narayana, A.C., and Venkatesh Prabhu., 1993. Textural and geochemical studies of relict and modern sediments of the continental shelf off Honavar, west coast of India. *Journal Geological Society of India*, **41**:299-305.

Narayana, A. C., Shakdipe, M. and Tatavarti, R. 2005. Tsunami of 26 December 2004: Observations on Kerala coast. *J. of Geol. Soc. of India,* **65**:239-246.

Narayana, A.C., Tatavarti, R., Shinu, N. and Subeer, A., 2007. Tsunami of December 26, 2004 on the southwest coast of India: Post-tsunami geomorphic and sediment characteristics. *Marine Geology,* **242**: 155-168.

Narayana, A.C. and Suresh Kumar. 1994. Sedimentological and clay mineral studies of Kumbla –Shriya estuary, West coast of India. *Journal Geological Society of India*, **44**: 185 -192.

Neyman, A.A., 1969. Some data on the benthos of the shelves in the northern part of the Indian Ocean. *Oceanology*, **9**:861-866.

Newell, R., 1965. The role of detritus in the nutrition of two marine deposit feeders. The Prosobrnach *Hydrosbia ulvae* and the bivalve *Macoma balthica*. *Proceedings of the zoological Society of London*, **144**:25-45.

Nicholls, A. G. 1935. Copepods from the Interstitial Fauna of a Sandy Beach. *Journal of the Marine Biological Association of the United Kingdom (New Series)*, **20**: 379-406.

Palacin, C., Martin, D. and Gilli, J.M., 1991. Features of spatial distribution of benthic infauna in Mediterranean shallow water Bay. *Mar. Biol.*, **110**:315-320.

Panikkar, N.K. and Aiyar, R.C., 1937. The brackish water fauna of Madras coast. *Proc.Ind. Acad. Sci.* **6**:284-337.

Pancucci-Papadopoulou, M. A., Simboura, N., Zenetos, A., Thessalou-legaki, M. and A. Nicolaidou, 1999. Benthic invertebrate communities of NW Rodos (Rhodes) island (SE Aegean Sea) as related to hydrological regime and geographical location. *Isr. J. Zool*, **45**: 371-393.

Pankajakshan, T. and Ramaraju, D.V., 1987. Intrusion of Bay of Bengal water into Arabian sea along the west coast of India during north-east monsoon. *In Contribution in Marine Sciences, Dr. SZ Quasim Sastyabdapurthi Felicitation volume,* edited by TSS Rao, R. Natarajan, B.N. Desai, G.N. Goswami, and S.R. Bhat. National Institute of Oceanography, Dona Paula, p. 237-244.

Papageorgiou, N., Moreno, M., Valentina Marin, V., Baiardo, S., Arvanitidis, C., Fabiano, M., Eleftheriou, A., 2007. Interrelationships of bacteria, meiofauna and macrofauna in a Mediterranean sedimentary beach (Maremma Park, NW Italy). *Helgoland Marine Research,* **61**: 31-42.

Paropkari, A.L., Rao,C.H.M and Murthy, P.S.N., 1987. Environmental control of the distribution of organic matter in recent sediments of the western continental margin of India. In: Kumar *et al* (Eds.) Petroleum geochemistry and exploitation in the Afro-Asian region. *Balankana Press*. Rotterdam, p. 347-361.

Parulekar, A.H. and Ansari, S.A., 1981. Benthic Macro Fauna of the Andaman Sea. *Indian J.Mar. Sci.,* **10**: 280-284.

Parulekar, A.H., Rajamanickam G.V., Dwivedi, S.N., 1975. Benthic studies in Goa estuaries Biomass and faunal composition in the Zuari estuary. Indian Journal of Marine Sciences, **4**: 202-205.

Parulekar, A. H., Nair S.A., Harkantra, S.N and Anzari, Z.A., 1976. Some quantitative studies on the benthos off Bombay. *Mahasagar*, **9(1 & 2):** 51-56.

Parulekar, A. H., Dhargalkar,V. K. and Singbal, S.Y. S., 1980. Benthic studies in Goa estuaries. 3. Annual cycle of Macrofaunal distribution, production and trophic relation; *Indian Journal of Marine Sciences,* **9:** 189-200.

Parulekar, A.H., Harkantra, S.N. and Ansari, Z.A., 1982. Benthic production and assessment of demersal fishery resources of the Indian Seas. *Indian J. Mar. Sci.* **11**:107.

Pascal, P.Y., Dupuy, C., Richard, P., Rzeznik-Orignac, J., Niquil, N., 2008. Bacterivory of a mudflat nematode community under different environmental conditions. *Marine Biology,* **154**: 671-682.

Paul, S.K., 2001. Geochemistry of bottom sediments from a river-estuary-shelf mixing zone on the tropical southwest coast of India. *Bull. Geol. Surv. Japan*, **52 (8)**: 371-382.

Pavithran, S and Ingole, B.S., 2005. Macrobenthic standing stock in the nodule areas of central Indian Ocean basin. *National Seminar on Polymetallic Nodules*, Regional Research Laboratory, 29-30 September, 1261-1266.

Pavithran, S, B. Ingole, M. Nanajkar and B.N. Nath., 2007. Macrofaunal diversity in the Central Indian Ocean Basin. *Biodiversity*, **8(3):**11-16.

Pearson, T.H. and Rosenberg R., 1978. Macrobenthic succession in relation to organic enrichment and pollution of the marine environment. *Oceanogr. Mar. Biol. Annu. Rev.* **16**:229-311.

Pennak, R.W. and Zinn, D.J., 1943. Mystacocarida, a new order of Crustacea from intertidal Beaches in Massachussetts and Connecticut. *Smithsonian Miscellaneous Collections*. **103**: 1-11.

Peres, J.M., 1982. General features of oceanic assemblages in pelagial and benthal. In: Kinne, O.(Ed.), *Marine Ecology*., 591). John Wiley and Sons Ltd. New York, 119-186.

Petersen ,C.G.J., 1911. Valuation of the Sea I. Animal life of the sea bottom its food and quantity. *Report of the Danish Biological Station to the Board of Agriculture (Ministry of Fisheries) Copenhagen*. **20**, p.81.

Petersen, C.G.J., 1913. Valuation of the Sea II. The animal communities of the sea-bottom and their importance for marine zoogeography. *Report of the Danish Biological Station to the Board of Agriculture (Ministry of Fisheries) Copenhagen,* **21**:1-44.

Petersen, C.G.J., 1914. The animal associations of the sea-bottom in the North Atlantic. Kobenhavn Ber. *Bio.Sta.,* 22: 89-98.

Petersen, C. G. J., 1915. On the animal communities of the sea bottom in the Skagerak, the Christiania Fjord and the Danish waters. *Report of the Danish Biological Station to the Board of Agriculture (Ministry of Fisheries) Copenhagen,* **23**: 3-28.

Petersen, C. G. J., 1918. The sea-bottom and its production of fish-food. A survey of the work done in connection with the valuation of the Danish waters from 1883-1917. *Report of the Danish Biological Station to the Board of Agriculture (Ministry of Fisheries) Copenhagen*, **25**: 1-62.

Pohle G.W. and Thomas M.L.H., 2001. Monitoring protocol for marine benthos: Intertidal and subtidal macrofauna. *Report for Atlantic Maritime Ecological Science Cooperative,* St Andrews, New Brunswick.

Pielou, E.C. ,1975. A general book on ecological diversity Entropy-based diversity measures. (Models for distribution of species). *Ecological Diversity. New York: Wiley.*

Pillai, M.G., 1977. Distribution and seasonal abundance of marco benthos of the Cochin back waters. *Indian Journal of Marine Sciences.* **6**:1-5.

Platt, H.M. and Warwick, R.M., 1980. The significance of free-living nematodes to the littoral ecosystem. In: Price, J.H., et al. (Eds.), *The Shore Environment: 2. Ecosystem.* New York, NY: Academic Press, p. 729-759.

Prabha Devi, L., Natarajan, P., Saraswathy Ammal, G. and Abdul Azis, P. K., 1996. Water quality and benthic fauna of the Kayamkulam backwaters and Arattupuzha coast along southwest coast of India. *Indian Journal of Marine Sciences*, **25**: 264-267.

Prabhu, V. H. and Reddy, M.P.M., 1987. Macrobenthos and sediment distribution in relation to demersal fish catches off Baikampady -Surathkal, South Kanara coast. *Indian J. Mar. Sci.,* **16**: 60-64.

Prakash, T.N., 2000. Sediment distribution and placer mineral enrichment in the inner shelf of Quilon, South West Coast of India. *Ind. Jour. Mar. Sci*., **29:**120-127.

Qasim, S.Z., 1977. Biological productivity of the Indian Ocean. *Indian Journal of Marine Sciences*, **6:** 122-137.

Qasim, S.Z., 1982.Oceanography of the northern Arabian Sea. *Deep-Sea Res*., **29**:1041-1068.

Qasim, S.Z., 1998. Glimpses of the Indian Ocean. *Universities press (India) Ltd*. pp.206.

Quattro, J.M., Chase, M.R., Rex, M.A., Greig, T.W. and Etter, R.J., 2001. Extreme mitochondrial DNA divergence of the deep-sea gastropod *Frigidoalvania brychia*. *Marine Biology*, **139**: 1107-1113.

Queiros, A. M., Hiddink, J. G. and Kaiser, M. J., *et al*., (2006). Effects of chronic bottom trawling disturbance on benthic biomass, production and size spectra in different habitats. *Journal of Experimental Marine Biology and Ecology,* **335 (1):** 91-103.

Radhakrishna, K., 1978. Primary productivity of the Bay of Bengal during March-April 1975. *Indian Journal of Marine Sciences*, **7:** 58-60.

Raffaelli, D. G., and Hughes, R. N., 1978: The effects of crevice size and availability on populations *of Littorina rudis* and *Littorina neritoides*. *J. Anim. Ecol*. **47**: 71-83.

Rajan, K.C., 1972. Studies on the interstitial fauna of the south west coast of India, *Ph. D Thesis,* University of Kerala.

Rajeshwara Rao, N. and Charles, D., 2005. Provenance of tsunami sheet deposit along North Chennai coast, India - a sedimentological and micropaleontological approach. I*n: International Union of Geodesy and Geophysics: Crete, Nebraska, U.S.A, XXII International Tsunami Symposium, Proceedings,* 191-197.

Raghunathan,C., Tewari,A., Joshi,V., Sravan Kumar,V.G., Trivedi,R.H., and Yasmin Khambhaty., 2003. Impact of turbidity on intertidal macrofauna at Gopnath, Mahuva and Veraval coasts (west coast of India). *Indian Journal of Marine Sciences,* **32(3):** 214-221.

Ramakrishnan,D., Ghosh, S.K., Raja, V.K.M., Chandran, R. V. and Jeyram, A. 2005. Trails of the killer tsunami: A preliminary assessment using satellite remote sensing technique. *Current Science,* **88 (5):** 709-711.

Raman, A. V., and Adiseshasai, K., 1989. Macrobenthos from littoral areas off Visakhapatnam, east coast of India. *Indian Journal of Marine Science*, **18**: 265-269.

Raman, C.V., Krishna Rao, G., Reddy, K.S.N and Ramesh, M.V., 1995. Clay mineral distributions in the continental shelf sediments between the Ganges mouths and Madras, east coast of India. *Continental Shelf Research*, **15(14)**: 1773-1793.

Rao, B.K. and Murthy, K.V.R., 1988. Ecology of interdial meiofauna of the Kakinada bay (Gautami- Godavari estuarine system), east coast of India. *Indian Journal of Marine Science*., **17(1)** : 40-47.

Rao , G.C. and Ganapati, P.N, 1968.Interstitial fauna inhabiting the beach of sands of waltair coast .*Proc. nantn . Inst. Sci.,* India, **34(2):** 82-125.

Rao G.S., and Sarma, D.V. R., 1999. Patterns of variation in the numerical abundance of meiofauna in relation to the nature of the sediment during different seasons in a tropical estuary. *Visakha Sci. J.*, **3(1):** 45- 52.

Rao, C.H.M., 1985. Distribution of suspended particulate matter in the waters of eastern continental margin of India. *Indian Journal of Marine Sciences,* **14**: 15-19.

Rao,G.C., 1987b. Effects of exploitation and pollution on littoral fauna in bay Islands. *Symp. On management of coastal eco systems and oceanic resources of the Andamans.* Andamans, Port Blair, India, 17-18.

Rao, G.C., 1987b. Effects of pollution of meiofauna in a sandy beach at Great Nicobar. *J. Andaman Sci. Assoc.*, **3 (1):** 19-23.

Rao, G.C., 1986. Meiofauna of the mangrove sediments of south Andaman. *J. Andaman Sci. Assoc.*, **2 (2):** 23-32.

Rao, S.D. and Sarma, D.V.R., 1982. Sediment-polychaete relationship in the Vasishta Godavary estuary. *Proc.Indian Acad. Sci. (Anim. Sci.),* **91(2)**: 199-206.

Raut, D., Ganesh T., Murty N.V.S.S. and Raman A.V., 2005. Macro benthos of Kakinada bay in the Godavari delta, east coast of India: comparing decadal changes. *Estuarine, Coastal and Shelf Science*, **62**: 609-620.

Reddy, K.R.,1995 . Distribution of organic matter in the substrate of the Penner river estuary, Andhra Pradesh. *Jour. Geol. Soc. India*. **46**: 83 -86.

Reddy, H.R.V. and Hariharan, V., 1985. Meiofauna of Natravathi- Gurpur estuary(Manglaore), west coast of India. Indian *Journal of Marine Science,* **14(3):** 163- 164.

Reddy, H.R.V. and Hariharan, V., 1986. Observationsof meiobenthosfrom the manglaore region (west coast of India). *Current Science*, **55(5)**: 262-264.

Rees, C.B., 1940. A preliminary study of the ecology of a mud-flat. *Journal of the Marine Biological Association of the United Kingdom* 24, 185-199.

Reiss,H., and Kroncke, I., 2004. Seasonal variability of epibenthic communities in different areas of the southern North Sea. *ICES Journal of Marine Sciences*, **61**:882-905.

Remane, A., 1932. Archiannelida. In: Die Tierwelt der Nord- und Ostsee, part VIa. Grimpe and Wagler, (Eds), *Leipzig: Akademische Verlagsgesellschaft*. pp. 1-36.

Rodrigues, C.L., Harkantra, S.N. and Parulekar, A.H. 1982. Sublittoral meobenthos of the north eastern bay of Bengal. *Indian Journal of Marine Sciences*, **11**: 239- 242.

Rumohr, H., 1995. Monitoring the marine environment with imaging methods. *Scientia Marina*, **59**: 129-138.

Rzeznik-Orignac, J., Boucher, G., Fichet, D. and Richard, P., 2008. Stable isotope analysis of food source and trophic position of intertidal nematodes and copepods. *Marine Ecology Progress Series,* **359**:145-150.

Sajan, S. and Damodaran, R., 2005. On the vertical distribution of marine nematodes from the shelf sediments off west coast of India with focus on their community structure. *Journal of the Marine Biological Association of India*, **47(2):** 133- 138.

Sajan, S. and Damodaran, R., 2007. Faunal composition of meiobenthos from the shelf regions off the west coast of India. *Journal of Marine Biological Association of India*, **49(1):** 19-26.

Sajan, S., Joydas, T.V. and Damodaran, R., 2010a. Meiofauna of the western continental shelf of India, Arabian Sea. *Estuarine, Coastal and Shelf Science,* **86**: 665-674.

Sajan,S., Joydas ,T.V. and Damodaran,R. 2010b. Depth-related patterns of meiofauna on the Indian continental shelf are conserved at reduced taxonomic resolution. *Hydrobiologia***, 652(1):** 39-47**.**

Samuel, M., 1944. Preliminary observations on the animal communities of the level sea bottom of Madras coast. *J. Madras Univ*., **15**: 45-71.

Sanders, H.L., 1958. Benthic Studies in Buzzards Bay, I. Animal sediment relationship. *Limnol. Oceanography*, **3**:245-258.

Sanders, H.L., 1960. Benthic Studies in Buzzards Bay, III. The structure of the soft bottom community. *Limnol. Oceanography*, **5**: 138-153.

Sanders, H.L., 1968. Marine Benthic Diversity: A comparative study. *Am.Nat*., **102(925):** 243-282.

Sanders, H.L., 1969. Sediments and the structure of bottom communities. In: Mary Sears, (Ed.) International Oceanographic reprints, p. 583- 584. *American Assoc. for the advancement of Science*, Washington D.C.

Sarala Devi, K. and Venugopal, P., 1989. Benthos of Cochin backwaters receiving industrial effluents. *Indian Journal of Marine Sciences*, **18**:165-169.

Sarala Devi, K, Jayalakshmi, K.V. and P. Venugopal., 1991. Communities and coexistence of benthos in northern limb of Cochin backwaters. India. *Indian Journal of Marine Sciences,* **20**:249-254.

Sarala devi, K., Balasubramanian, T., Venugopal, P. and Sankaranarayanan, V. N. 1996. Benthic fauna of Southwest and Southeast coast of India. *The Fourth Ind. Fisheries Forum Proceedings*, p. 9-12.

Sarma, A.L.N. and Ganapti, P.N, 1975. Meiofauna of the Vishakhapatnam Harbour in relation to pollution. *Bull. Dep. Mar. Sci. Univ. Cochin*, **7(2):** 243- 255.

Schratzberger, M., Dinmore, T.A. and Jennings, S., 2002a. Impacts of trawling on the diversity, biomass and structure of meiofauna assemblages. *Marine Biology,* **140**: 83-93.

Schratzberger, M., Gee, J.M., Rees, H.L., Boyd, S.E. and Wall, C.M., 2000. The structure and taxonomic composition of sublittoral meiofauna assemblages as an indicator of the status of marine environments. *Journal of the Marine Biological Association of the United Kingdom*, **80**: 969-980.

Schratzberger, M., and Jennings, S., 2002. Impacts of chronic trawling disturbance on meiofaunal communities. *Marine Biology,* **141**: 991-1000.

Schratzberger, M., Wall, C.M., Reynolds, W.J., Reed, J., and Waldock, M.J., 2002b. Effects of paint-derived tributyltin on structure of estuarine nematode assemblages in experimental microcosms. *Journal of Experimental Marine Biology and Ecology*, **272**: 217-235.

Schratzberger, M., Bolam, S., Whomerseley, P. and Warr, K., 2006. Differential response of nematode colonist communities to the intertidal placement of dredged material. *Journal of Experimental Marine Biology and Ecology*, **334**: 244-255.

Schratzberger, M. and Warwick, R.M., 1998a. Effects of physical disturbance on nematode communities in sand and mud: a microcosm experiment. *Marine Biology*, **130**: 643-650.

Schratzberger, M. and Warwick, R.M., 1998b. Effects of the intensity and frequency of organic enrichment on two estuarine nematode communities. *Marine Ecology Progress Series*. **164**:83-94.

Schratzberger, M. and Warwick, R.M., 1999a. Differential effects of various types of disturbances on the structure of nematode assemblages: an experimental approach. *Marine Ecology Progress Series,* **181:** 227-236.

Schratzberger, M. and Warwick, R.M., 1999b. Impact of predation and sediment disturbance by *Carcinus maenas* (L.) on free-living nematode community structure. *Journal of Experimental Marine Biology and Ecology,* **235:** 255-271.

Seetharamaiah, J., and Swamy, A.S.R., 1997. Distribution of organic matter and calcium carbonate in the shelf sediments off Penner River, east coast of India. *Indian Geological Society of India*, **49**: 699- 703.

Sengupta, R., De Sousa, S.N. and Joseph, T., 1977. On nitrogen and phosphorous in the western Bay of Bengal. *Indian Journal of Marine Sciences*, **6**: 107-110.

Service, S. K., Feller, R. J.,Coull ,B. C. and Woods, R. E. ,1992. Predation effect of three fish species and a shrimp on macrobenthos and meiobenthos in microcosms. *Estuar., Coast. Shelf Sci.*, **34**: 277-293.

Seshappa, G., 1953. Observations on the physical and biological features of the inshore sea bottom along the Malabar Coast. *Proc. Nat. Inst. Sci. India,* **19**: 257-279.

Service, S.K., and Feller, R.J., 1992. Longterm trends of sub-tidal macrobenthos in north inlet, South Carolina. *Hydrobiologia*, **231**:13-40.

Shannon, C.E., 1949. The mathematical theory of communication. *Univ. of Illinois press*. Urvana,

Sheeba, P. 2000. Distribution of benthic infauna in the Cochin backwaters in relation to environmental parameters. *Ph.D. Thesis*. Cochin University of Science and Technology, Cochin, p.241.

Sheeba, P., Jayalakshmy, K.V. and Devi, S.K., 2004. Bottom fauna of dredging and dredge spoil disposal sites of a tropical estuary. *International Journal of Ecology and Environmental Sciences*, **30**:225-238.

Shen, X.Q., Yang, G.P. and Liu, Y.J., 2007. Nematode diversity of Qingdao coast inferred from the 18S ribosomal RNA gene sequence analysis. *Journal of Ocean University of China,* **6:**132-136.

Shetye, S. R., S. S. C. Shenoi, A. D. Gouveia, G. S. Michael, D. Sundar, and G. Nampoothiri, 1991. Wind-driven coastal upwelling along the western boundary of the Bay of Bengal during the southwest monsoon. *Cont. Shelf Res.*, **11**: 1397-1408.

Shirayama, Y.1984. The abundance of deep sea meiobenthos in the western pacific in relation to environmental factors. *Oceanol*., **7(1)**: 113 - 121.

Siddique, H.N., 1967. Recent sediments of Bay of Bengal. *Marine Geology,* **5**: 249-291.

Sikora, J.P., Sikora, W.B., Erkenbrecher, C.W., and Coull, B.C., 1977. Significance of ATP, carbon and caloric content of meiobenthic nematods in portioning benthic biomass. *Mar. Biol*., **44**: 7-14.

Simpson, E. H. 1949. Measurement of diversity. *Nature*, **163**:688.

Simpson, G. G. 1964. Species density of North American recent mammals. *Syst. Zool*. **13**: 57-73.

Singarasubramanian. S.R., Mukesh, M.V, Manoharan, K., Murugan, S., Bakkiaraj, D. John Peter, A. and Seralathan, P., 2006. Sediment characteristics of the M-9 tsunami event between Rameswaram and Thoothukudi, Gulf of Mannar, Southeast coast of India. *Int. Jour. Sci. of Tsunami Hazards*, **25(3)**:160-173.

grove, P.V.R., 1998. The biodiversity of macrofaunal organisms in marine sediments. *Biodiversity and Conservation,* 7: 1123-1132.

Snelgrove, P.V.R., Grassle, J.F., and Petrecca, R.F., 1992. The role of food patches in maintaining high deep sea diversity: field experiments with hydro dynamically unbiased colonization trays. *Limnol. Oceanog*., **39**: 1543-1550.

Snelgrove, P.V.R and Butman, C.A., 1994. Animal-Sediment relationship revisited: cause versuses effect. *Oceanography and Marine Biology: an Annual Review*, **32**: 111- 177.

Soetaert, K., and Heip, C., 1990. Sample size dependence of diversity indices and the determination of sufficient sample size in a high diversity deep sea environment. *Marine Ecology Progress Series,* **59**: 305-307.

Sommer, S. and Pfannkuche, O., 2000. Metazoan meiofauna of the deep Arabian Sea: standing stocks, size spectra and regional variability in relation to monsoon induced enhanced sedimentation regimes of particulate organic matter. *Deep- Sea Research II,* **47**: 2957-2977.

Srinivasalu, S., Thangadurai, N., Jonathan, M. P., Armstrong-Altrin, J. S., Ayyamperumal, T., Ram-Mohan, V., 2008. Evaluation of trace-metal enrichments from the 26 December 2004 tsunami sediments along the southeast coast of India. *Environmental Geology*, **53**: 1711–1721.

Srinivasalu, S., Rajeshwara Rao, N., Thangadurai, N., Jonathan, M. P., Roy, P. D., Ram Mohan, V., Saravanan, P., 2009. Characteristics of 2004 tsunami deposits of the northern Tamil Nadu coast, southeastern India. *Boletín de la Sociedad Geológica Mexicana*, **61 (1):**111-118.

Sriram., Sreedhara Murthy, T.R., Rajesh Reghunath, B.S., Maddodo and B.R. Raghavan., 1998. Textural behavior of innershelf sediments off Mangalore, west coast of India. *Indian J. Mar. Sci. India.*, **27**:259-261.

Suderman, K., Thistle, D., 2003. Spills of fuel oil #6 and orimulsion can have indistinguishable effects on the benthic meiofauna. *Marine Pollution Bulletin*, **46**:49-55.

Sundararajan, M. and Natesan, U., 2010. Environmental Significance in Recent Sediments along Bay of Bengal and Palk Strait, East Coast of India: A Geochemical Approach. *Int. J. Environ. Res.*, **4(1):**99-120.

Sunil Kumar R. 1993. Studies on the benthic fauna of the mangrove swamps of Cochin area. *Ph.D Thesis,* Cochin University of Science and Technology.

Sunil Kumar, 1999. New record of five Annelids (Class: Polychaeta) from the mangrove habitat of the South West Coast of India. *J. Mar. Biol. Assoc. India.* **41(1-2)**: 116-118.

Sutherland, T.F., Levings, C.D., Petersen, S.A., Poon, P., Piercey, B., 2007. The use of meiofauna as an indicator of benthic organic enrichment associated with salmonid aquaculture. *Marine Pollution Bulletin*, **54**: 1249-1261.

Sverdrup, K.A and Armbrust, E.V., 2008. An introduction to the world's oceans. 9th edition. Mc Graw Hill, New York, p.521.

Swedmark, B., 1964. The Interstitial fauna of marine sand. *Biological Reviews of the Cambridge Philosophical Society.* **39**: 1-42.

Swedmark, B., 1971. A Review of Gastropoda, Brachiopoda, and Echinodermata in Marine Meiobenthos. In: HULINGS, N.C. (ed.), *Proceedings of the First International Conference on Meiofauna*. Smithsonian Contr. Zool., **76**: 41-45.

Tatavarti, R., Narayana, A.C., Manoj Kumar, P. and Shyam Chand, 1999. Mudbank regime off the Kerala coast during monsoon and non-monsoon seasons. *Proc. Indian Acad. Sci. (Earth Planet. Sci.),* **108(1)**: 57-68.

Tenore, K.R., Cammen, L., Findlay, S.E.G. and Phillips, N., 1982. Perspectives of research on detritus: Do factors controlling the availability of detritus of macro consumers depend on its source? *J. Mar. Res.*, **40**: 473- 490.

Tenore, K.R., 1977. Food chain pathways in detrital feeding benthic communities: a review, with new observations on sediment re-suspension and detrital recycling. In: Coull, B.C. (EDS.) Ecology of marine benthos. *University of South Carolina press*, Columbia, SC, p. 37-54.

Thamban, M., Purnachandra Rao, V., and Raju, S.V., 1997. Controls on organic carbon distribution in sediments from the eastern Arabian Sea Margin. *Geo-Marine Letters,* **17**: 220-227.

Thangadhurai, N., Srinivasalu, S., Jonathan M.P., Rajeswara Rao, N., and Santhosh Kumar, R., 2005. Pre-tsunami chemistry of sediments along the inner continental shelf off Ennore, Chennai, South east coast of India. *Indian Journal of Marine Sciences*, **34(3)**: 274-278.

Thiel, H., 1966. Quantitative Untersuchungen iibcr die Meiofauna des Tiefseebodens. VerSff. *Inst. NIeeresforsch. Bremerh. Sonderband*, **2**: 131-148.

Thorson, G. 1957. Bottom communities (sublittoral and shallow shelf). In: Treatise on Marine ecology and Paleoecology. *Geol. Soc. Amer. Memoir,* **67**: 461-534.

Thrush, S.F., Hewitt, J.E, Gibbs, M., Lundquist, C. and Norkko, A. (2006). Functional role of large organisms in intertidal communities: community effects and ecosystem function. *Ecosystems,* **9***:*1029-1040.

Timm, R.W., 1961. The marine nematodes of the Bay of Bengal. *Proceedings of Pakistan Academy of Sci.*, **1**: 1-88.

Timm, R.W., 1967a. New marine nematodes of the family Linhomoeidae from East Pakistan. *Proceedings of Pakistan Academy of Sci*, **4:** 15-22.

Timm, R.W., 1967b. Some estuarine nematodes from the Sunderbans. *Proceedings of Pakistan Academy of Sci.*, **4**: 1-13.

Tipton, K. and Bell, S.S., 1988. Foraging patterns of two Syngnathid fishes: importance of harpacticoid copepods. *Mar. Ecol.Prog. Ser.*, 47: 31- 43.

Tunnicliffe, V. and Risk, M.J. 1977. Relationship between the bivalve *Macoma balthica* and bacteria in intertidal sediments: Minas Basin, Basin, Bay of Fundy. *J. Mar. Res.*, **35**: 499 -507.

Vangestel, S., Houthoofd, W., Bert, W. and Borgonie, G., 2008. The early embryonic development of the satellite organism *Pristionchus pacificus*: differences and similarities with *Caenorhabditis elegans*. *Nematology,* **10**:301-312.

Varshney, P.K., 1985. Meiobenthic study off Mahim (Bombay) in relation to prevailing organic pollution. *Mahasagar*., **18 (1)**:27-35.

Varshney, P.K. and Govindan, K., 1995. Macrobenthos off Mahim (Bombay), west coast of India in relation to coastal pollution and aquaculture. *Journal of Indian Fisheries Association*, **25**: 47-56.

Vasudevan, S., Arumugam., M., Srinivasamoorthy, K., Anandan, P., Chidambaram, S., 2007. Morphological changes in the beaches caused by tsunami in between Pondicherry and Portonova, east coast of India. *Journal of Geosciences*, **50(7)**: 83-91.

Venkatesh Prabhu, H., 1992. Sedimentological and biological studies of sediments off Honavar, North Kanara, west coast of India. *Ph.D Thesis.* Dept. of Marine Geology, Mangalore University.

Venkatesh Prabhu, H., Narayana, A.C. and Katti, R.J. 1993. Macrobenthic fauna in the nearshore sediments off Gangolli, west coast of India. *Indian J. Mar. Sci*., **22**: 168-171.

Veerayya, M., and Murthy, P.S.N., 1974. Studies on the sediments of Vemband Lake: Part III - distribution and interpretation of bottom sediments. *Indian Journal of Marine Science,* India, **3**: 16-27.

Verlecar, X.N., Desai, S.R., Sarkar A., and Dalal, S.G., 2006. Biological indicators in relation to coastal pollution along Karnataka coast, India. *Water Research*, **40(17):** 3304- 3312.

Vijayakumar, R., Ansari, Z.A. and Parulekar, A.H., 1991. Benthic fauna of Kakinada Bay and back waters east coast of India. *Indian Journal of Marine Sciences*, **20**:195-199.

Vijayakumar, R., Chatterji, A. and Das, S., 1997. The role of meiofauna on the shallow coastal areas of Balaramgari, Orissa, east coast of India. *National Symposium on oceanography and coastal zone management 23 -24, April 1997, Souvenir,* p.83.

Vincx, M., Meire, P., Heip, C., 1990. The distribution of nematodes communities in the Southern Bight of the North Sea. *Cahiers de Biologie Marine,* **31**:107-129.

Vizakat Lathika, Harkantra, S.N., and Parulekar, A.H., 1991. Population ecology and community structure of sub-tidal soft sediment dwelling macro-invertebrates of Konkan, West coast of India. *Indian Journal of Marine Science,* **20(1):**40-42.

Wang, S.H. and Zhang, Z.N., 1994. Experimental culture and life cycle of marine nematodes from prawn cultivation pond. *Journal of Ocean University of Qingdao,* **12** (suppl.): 206-213. (In Chinese with English abstract).

Ward,T.M., Sorokin, S.J., Currie, S.J., Rogers, P.J., and McLeay, L.J., 2006. Epifaunal assemblages of the eastern Great Australian Bight: effectiveness of a benthic protection zone in representing regional biodiversity. *Continental Shelf Research*, **26**:25-40.

Warwick, R.M., 1989. The role of meiofauna in the marine ecosystem - evolutionary considerations. *Zoological Journal of the Linnean Society,* **96:** 229-241.

Warwick, R.M., Clarke, K.R., 1995. New 'biodiversity' measures reveal a decrease in taxonomic distinctness with increasing stress. *Mar. Ecol. Prog. Ser*., **129**:301-305.

Weston, D.P., 1990. Quantitative examination of Macro benthic community changes along an organic enrichment gradient. *Mar. Ecol. Prog. Ser.*, **61**: 233-244.

Whanpetch, N., Nakaoka, M., Mukai,H., Suzuki,T., Nojima,S., Kawai, T., and Aryuthaka, C., 2006. Tsunami Impacts on Biodiversity of Seagrass Communities in the Andaman Sea, Thailand: (2) Abundance and Diversity of Benthic Animals. *The Nagisa World Congress*: 57-66.

Whitlatch , R.B. and Johnson ,J.R.,1974 Methods for staining organic matter in marine sediments. *Journal of Sedimentary Petrology* , **44:**1310-1312

Widdicombe, S. and Austen, M.C., 2001. The interaction between physical disturbance and organic enrichment: An important element in structuring benthic communities. *Limnology and Oceanography,* **46**: 1720-1733.

Wiseman, J.D.H., and Bennette, H.E., 1960. Distibution of organic matter anfd nitrogen in the sediments from the Arabian Sea. *John Murray Expedition*. **3**: 221p.

Wieser, W., 1953b. Free-living marine nematodes.I. Enoploidea. *Acta Universitatis Lund (N.F.2)* **49(6):**1-155.

Wieser, W., 1959c. The effect of grain size on the distribution of small invertebrates inhabiting the beaches of Puget Sound. *Limnology and Oceanography,* **4**: 181-194.

Wieser, W., 1959b. Free-living nematodes. VI. General part. Lunds. *Univer.Arsskr.* N.F.Avd.2. Bd.55.Nr.5.

Wieser, W., 1960. Benthic studies in Buzzards Bay II. The meiofauna. *Limnology and Oceanography*, **5**:121-137.

Wyrtki, K., 1971. Oceanographic atlas of the International Indian Ocean Expedition. *Washington D.C.: National Science Foundation*, U.S. Government of Printing Office, P.531.

Yushin, V.V., 2007. Spermatogenesis in a species of *Paralinhomoeus* (Nematoda, Monhysterida, Linhomoeidae). *Russian Journal of Nematology,* **15**: 109-116.

Yushin, V.V., 2008. Sperm dimorphism in the free-living marine nematode *Terschellingia glabricutis* (Nematoda: Monhysterida: Linhomoeidae). *Nematology,* **10**: 189-205.

Zhang, Z.N., 2005. Three new species of free-living marine nematodes from the Bohai Sea and Yellow Sea, *China. Journal of Natural History,* **39**: 2109-2123.

Zimmermann, M. 2006. Benthic fish and invertebrate assemblages within the National Marine Fisheries Service US west coast triennial bottom trawl survey. *Continental Shelf Research,* **26**:1005–1027.

Zograf, J.K., Yushin, V.V. and Malakhov, V.V., 2004. Ultrastructure of spermatogenesis in the free-living marine nematode *Halichoanolaimus sonorus* (Chromadorida: Selachinematidae). *Nematology,* **6:** 797-809.

.....ଛଔ.....

Appendix

COMPOSITION OF EPIFAUNA

Introduction

About 80% of the benthic animals belong to the epifauna. There are about 120,000 species of epifauna reported till now (Sverdrup and Armbrust, 2008). The contribution of epifaunal animals to the benthic biodiversity is very significant (Reiss & Kroncke (2004). Epifauna are the benthic organisms living upon the sea floor and they can be divided into two categories ie, i) sessile or non-moving and ii) mobile or moving forms. Suspension feeders like barnacles and mussels were includes in the sessile forms. The epifauna also includes organisms that move across the sea floor like polychaetes, crabs, prawns, molluscs, echinoderms etc.

The epifaunal macro-invertebrate assemblages of the continental shelf in the eastern Great Australian Bight was studied by Ward *et al.* (2006) in relation to environmental factors, including water depth and sediment type. They reported that species richness showed a general decline with increasing depth and percentage of mud in sediments.

The studies of epifaunal communities have been limited in Indian continental shelf. Neyman (1969) made a detailed study on epifauna of the shelves along the northern part of the Indian Ocean. Ganesh and Raman (2007) studied epifauna along the northeast continental shelf of India. The present study focused on the post-tsunami condition of epifaunal distribution along southwest and southeast continental shelf of India.

Results

Faunal Composition of Epifauna:

Altogether 104 species of epifauna were identified from the continental shelf of southwest and southeast coast of India. Major groups were coelenterates, crustaceans, molluscs and polychaetes. *Heterocyanthus sp., Heterocyanthus aequicostatus, Caryophillia inornata* etc. were the dominant species.

Southwest coast

Samples were taken from four stations (Vadanapilly, 105m; Kochi, 115m; Kollam, 95m and Trivandrum, 37m) only along the southwest coast. From these samples 43 species of epifauna were identified. Faunal composition of epifauna along the southwest coast at different depth ranges were presented in the Appendix Table No.1and 2.

30m depth range: - Samples were taken from Trivandrum transect only. A total of 9 species were reported from this station and major groups were echinoderms, crustaceans and fishes. The dominant species were *Clypeaster rarispinus, Portunus pelagicus, Echinodiscus auritus and Clypeaster* sp. 4 species of echinoderms, 2 species of crustaceans, 1 species of molluscs, 1 species of fish and 2 unidentified species were reported from this station.

100m depth range: - Altogether 37 epifauna species were identified from this depth range. Common groups were coelenterates, crustaceans and molluscs. *Heterocyanthus aequicostatus, Caryophillia inornata, Caryophillia* spp., *Telinna* sp. were dominating. In this depth range, 11 species of crustaceans, 10 species of coelenterates, 8 species of molluscs, 5 species of fishes, 2 polychaetes and 1 species of echinoderms were reported.

Southeast coast

Samples were taken from only eight stations (from four transects) along the southeast coast (Nagapatnam, 30m and 100m; Cuddallore, 30m, 100m and 200m; Chennai, 30m and Krishnapatnam, 30m and 100m) of India. From these samples 83 species of epifauna were identified. Faunal composition of epifauna along the southeast coast at different depth ranges were presented in the Appendix Table No. 3 to 5.

30m depth range: - Altogether 61 species of epifauna species were identified from this depth range and major groups were polychaetes, crustaceans and molluscs. *Heterocyanthus sp.* was dominant species. In this depth range, 1 species of foraminifera, 2 species of sponges, 5 species of coelenterates, 16 species of polychaetes, 13 species of crustaceans, 11 species of molluscs, 7 species of echinoderms, 4 species of fishes, 1 species of ascidians and 8 unidentified species were recorded.

100m depth range: - Altogether 33 species of epifauna species were identified from this depth range and major groups were crustaceans, coelenterates and molluscs. Gorgonids, *Persephona aquilonaris* and *Antisabia foliacea* were common in this depth range. 7 species of coelenterates, 3 species of polychaetes, 11 species of crustaceans, 6 species of molluscs, 3 species of echinoderms, 1 species of fish, 1 species of ascidians, 2 species of unidentified species were recorded.

200m depth range: - Samples taken from Cuddallore transect only. 3 species of crustaceans were observed. Prawns and *Scylla serrata* were common in this depth range. Only crustaceans were reported here.

Discussion

Along the southwest coast, 43 species of epifauna were identified. In the 30m depth range, echinoderms were common in samples and *Clypeaster rarispinus* was the dominant species. In the 100m depth range, coelenterates, crustaceans and molluscs were the common components and dominating species were *Heterocyanthus aequicostatus* and *Caryophillia inornata*.

Along the southeast coast, 83 species of epifauna were isolated from the samples. In the 30m depth range, common groups were polychaetes, crustaceans and molluscs and *Heterocyanthus* sp. was dominating species. In the 100m depth range, major groups were crustaceans, coelenterates and molluscs and Gorgonids were common in samples. In the 200m depth range, only crustaceans were recorded and prawns were common.

Appendix Table No.1

Faunal composition of epifauna along the continental shelf of southwest coast of India at 30m depth range in No./haul

Transect	tvm
Depth(m)	37
Station No	18
Crustaceans	
Portunus pelagicus	7
Other Crabs	1
Molluscs	
Terebra affinis	4
Echinoderms	
Echinodiscus auritus	5
Clypeaster rarispinus	9
Clypeaster sp.	5
Leganellum sp	2
Fishes	
Eleotris fusca	1
Unidentified species	2

Appendix Table No.2
Faunal composition of epifauna along the continental shelf of southwest coast of India at100m depth range in No./haul

Transect	vad	kch	klm	Total
Depth(m)	**105**	**115**	**95**	
Station No	**7**	**11**	**16**	
Coelenterates				
Desmophyllum sp.	1	0	1	2
FLabellum stokesi	0	0	5	5
Flabellum sp.	0	1	4	5
Fungia fungites	0	5	0	5
Caryophillia inornata	0	0	85	85
Caryophillia spp.	0	0	35	35
Heterocyanthus aequicostatus	0	0	99	99
Heterocyanthus sp.	0	0	4	4
Acropora sp.	0	0	1	1
Other Corals	0	44	0	44
Polychaetes	0	0	0	0
Eunice sp.	8	0	0	8
Prionospio sp.	1	0	0	1
Crustaceans				
Prawns	6	2	0	8
Squilla sp.	1	0	0	1
Hermit crabs	1	3	1	5
Hippa sp.	0	3	11	14
Persephona aquilonaris	0	8	0	8
Calappa spp.	0	1	0	1
Other Lobsters	0	2	0	2
Portunus pelagicus	0	0	3	3
Portunus sp.	0	1	0	1
Spider crabs	0	0	11	11
Molluscs				
Spondylus sp.	1	0	0	1
Lophiotoma indica	0	2	1	3
Natica vitellus	0	1	0	1
Turricula javana	0	1	0	1
Nassarius sp.	0	1	0	1
Telinna sp	0	25	0	25
Donax sp.	0	4	0	4
Conus amadis	0	0	1	1
Echinoderms				
Other Brittle stars	1	0	0	1
Fishes				
Eleotris fusca	0	5	11	16
Eel	0	1	0	1
Sole fishes	0	0	8	8
Trichonotus setiger	0	0	1	1
Other fishes	0	2	2	4

Appendix Table No.3
Faunal composition of epifauna along the continental shelf of southeast coast of India at 30m depth range in No./haul

Transect	naga	cudd	chen	krish	Total
Depth(m)	**29**	**30.8**	**34**	**31.7**	
Station No	**25**	**29**	**33**	**37**	
Foraminifera	0	1	0	0	1
Sponges					
Antenella sp.	0	11	0	0	11
Other Sponges	0	1	0	0	1
Coelenterates					
Fungia granulosa	0	1	0	0	1
Fungia spp.	0	3	0	0	3
Heterocyanthus sp.	0	100	0	0	100
Heteropsammia michelini	0	4	0	0	4
Other Corals	0	3	0	0	3
Polychaetes					
Eunice indica	5	0	0	0	5
Eunice sp.	0	0	1	0	1
Diopatra cuprea	16	0	0	0	16
Chaetopterus sp.	1	0	0	0	1
Owenia fusiformis	1	2	0	0	3
Harmothoe antilopis	1	8	0	0	9
Lumbrineris aberrans	1	0	0	0	1
Lumbrineris sp.	2	0	0	0	2
Polycirrus sp.	1	0	0	0	1
Maldanid sp.	2	0	1	0	3
Nephtys dibranchis	6	0	0	0	6
Diplocirrus capensis	1	0	0	0	1
Eurythoe parvecarenculata	1	0	0	0	1
Terebellides stroemi	1	0	1	0	2
Syllis spongicola	1	0	0	0	1
Syllis gracilis	0	1	0	0	1
Crustaceans					
Prawns	1	4	0	1	6
Scyllarids	0	1	0	0	1
Squilla sp.	1	0	0	0	1
Hermit crabs	2	1	0	1	4
Calappa calappa	0	0	0	1	1

Other Lobsters	0	1	0	0	1
Portunus pelagicus	1	2	0	0	3
Spider crabs	0	6	0	0	6
Stone crabs	0	3	0	0	3
Other Crabs	8	9	1	2	20
Isopods	1	0	0	0	1
Amphipods	19	0	0	0	19
Other crustaceans	0	0	0	1	1
Molluscs					
Lophiotoma indica	0	0	0	2	2
Terebra sp.	0	0	0	1	1
Marginella angustata	0	2	0	0	2
Marginella sp.	0	1	0	0	1
Chiton sp.	0	1	0	0	1
Varicospira cancellata	0	2	0	0	2
Turris sp	0	1	0	0	1
Pitar sp.	0	1	0	1	2
Anadara tricenicosta	0	0	0	1	1
Conus sp.	0	0	0	1	1
Perna indica	0	0	0	1	1
Echinoderms					
Astropecten indicus	0	1	0	0	1
Astropecten monocanthus	0	1	0	0	1
Pentaceraster mammillatus	0	1	0	0	1
Lovenia elongata	0	1	0	0	1
Ophiorachnilla gorgonia	0	2	0	0	2
Unidentified starfish	0	2	0	0	2
Holothuria sp	0	2	0	0	2
Fishes					
Eleotris fusca	0	0	0	1	1
Trypauchen vagina	0	0	1	0	1
Lutianus gibbus	0	0	0	1	1
Other fishes	0	2	0	0	2
Ascidians					
Other ascidians	0	17	0	0	17
Unidentified species	0	8	0	0	8

Appendix Table No.4
Faunal composition of epifauna along the continental shelf of southeast coast of India at 100m depth range in No./haul

Transect	**naga**	**cudd**	**krish**	**Total**
Depth(m)	**102**	**95**	**107**	
Station No	**27**	**31**	**39**	
Coelenterates				
Heterocyanthus aequicostatus	0	0	1	1
Gorgonia sp.	1	0	0	1
Other Gorgonids	1	8	0	9
Radianthus ritteri	1	0	0	1
Rhizotrochus typus	0	1	0	1
Errina sp.	0	1	0	1
Other Corals	0	0	1	1
Polychaetes				
Eunice indica	0	1	0	1
Glycera convoluta	0	1	0	1
Arenicola sp.	0	0	2	2
Crustaceans				
Prawns	3	0	2	5
Squilla sp.	0	0	1	1
Hermit crabs	3	0	1	4
Hippa sp.	1	0	0	1
Persephona aquilonaris	8	0	0	8
Calappa spp.	1	0	0	1
Portunus pelagicus	0	0	1	1
Stone crabs	1	0	0	1
Other Crabs	0	5	1	6
Isopods	0	2	0	2
Gohst shrimp	0	0	2	2
Molluscs				
Spondylus imperialis	0	1	0	1
Natica vitellus	1	0	0	1
Nassarius sp.	0	0	1	1
Antisabia foliacea	3	0	3	6
Marginella angustata	0	0	2	2
Tibia delicatula	0	0	2	2
Echinoderms				
Laganum depressum	1	0	0	1
Ophiorachnilla gorgonia	0	1	0	1
Other Brittle stars	0	4	0	4
Fishes				
Eel	0	0	1	1
Ascidians				
Prostheceraeus ?vittatus	1	0	0	1
Unidentified species	2	0	0	2

Appendix Table No.5
Faunal composition of epifauna along the continental shelf of southeast coast of India at 200m depth range in No./haul

Transect	cudd
Depth(m)	**169**
Station No	**32**
Crustaceans	
Prawns	31
Squilla sp.	3
Scylla serrata	6

…..ഇൽ…..

ABBREVIATIONS

%	:	Percentage
^{0}C	:	Degree Celsius
i.e.	:	That is
et al.	:	And others
knr	:	Kannur
kzh	:	Kozhikode
vad	:	Vadanapilly
kch	:	Kochi
klm	:	Kollam
Tvm	:	Thiruvananthapuram/ Trivandrum
Cape	:	Cape Comorin
Lat.	:	Latitude
Long.	:	Longitude
SW	:	Southwest
SE	:	Southeast
FORV	:	Fishery and Oceanographic Research Vessel
SCUBA	:	Self Contained Underwater Breathing Apparatus
ICES	:	International Conference on Environmental Science
Sp.	:	Species
Spp.	:	More than one species
Fig.	:	Figures
S	:	Sand
Si	:	Silt
SSi	:	Sandy silt
CSi	:	Clayey silt
SSiC	:	Sand-silt-clay
A	:	Abundant
M	:	Moderately present
R	:	Rare

No.	:	Number
St.	:	Station
DO	:	Dissolved oxygen
OC	:	Organic carbon
OM	:	Organic matter
µ	:	Micron
mg.	:	Milli gram
Cm^2	:	Centimeter square
µ	:	Micrometer
m	:	Meter
ppt.	:	Parts per thousand
mm	:	Millimeter
g.	:	Gram
kg.	:	Kilogram
wt.	:	Weight
ml	:	Milliliter
L	:	Liter
Sq.cm	:	Square centimeter
SD	:	Standard deviation
Loc cit.	:	In the place cited
ANOVA	:	Analysis of variance
√ / A	:	Present or absent
MDS	:	Multi-dimensional Scaling

…..ꙮꙮ…..