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, foraminifera, 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 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.