MEIOBENTHOS OF THE SHELF WATERS OF WEST COAST OF INDIA WITH SPECIAL REFERENCE TO FREE - LIVING MARINE NEMATODES

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…To my ever loving Parents

CERTIFICATE

This is to certify that the thesis entitled **MEIOBENTHOS OF THE SHELF WATERS OF WEST COAST OF INDIA WITH SPECIAL REFERENCE TO FREE-LIVING MARINE NEMATODES** is an authentic record of the research work carried out by Mr. Sajan Sebastian, 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.

24.09.2003.

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DECLARATION

I hereby declare that the thesis entitled ***MEIOBENTHOS OF THE SHELF WATERS OF WEST COAST OF INDIA WITH SPECIAL REFERENCE TO FREE-LIVING MARINE NEMATODES*** 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.

(Sajan Sebastian)

Kochi
24.09.2003

Abbreviations used

% : Percentage
^{0}C : Degree Celsius
i.e. : That is
et al. : And others
cape : Cape Comorin
tvm : Thiruvananthapuram
klm : Kollam
klm1 : Kollam, 30.6m depth
klm2 : Kollam, 50m depth
kch : Cochin
vad : Vadanappally
kzh : Kozhikode
Kzh1 : Kozhikode, 31m depth
Kzh1 : Kozhikode, 50m depth
knr : Kannur
Knr1 : Kannur, 51.2m depth
Knr2 : Kannur, 67m depth
Mngr : Mangalore
Cnpr : Coondapore
Btkl : Bhatkal
Btkl1 : Bhatkal, 54.4m depth
Btkl2 : Bhatkal, 68m depth
Rtngr : Ratnagiri
Dbhl : Dabhol
dbhl1 : Dabhol, 95.7m depth
dbhl2 : Dabhol, 94.3m depth
ofmb1 : Off Mumbai, 96m depth
ofmb2 : Off Mumbai, 89m depth
almb1 : Along Mumbai, 95m depth
almb2 : Along Mumbai, 91m depth
almb3 : Along Mumbai, 85.3m depth
almb4 : Along Mumbai, 79m depth
prbn : Porbandar
dwrk : Dwarka
lat. : Latitude
long. : Longitude
N : North
E : East
FORV : Fishery and Oceanographic Research Vessel
SCUBA : Self Contained Underwater Breathing Apparatus
lbs : Pound

ICES	:	International Conference on Environmental Science
Sp.	:	Species
Spp.	:	More than one species
Fig.	:	Figure
S	:	Sand
SiS	:	Silty sand
SSi	:	Sandy silt
Si	:	Silt
CSi	:	Clayey silt
SiC	:	Silty Clay
SSiC	:	Sand silt clay
No.	:	Number
St.	:	Station
DO	:	Dissolved oxygen
OC	:	Organic Carbon
OM	:	Organic matter
DOM	:	Dissolved organic matter
c.b.d	:	Corresponding body diameter
c.d.	:	Corresponding diameter
h.d.	:	Head diameter
a.b.d	:	Anal body diameter
µ	:	Micron
Mg	:	Milli gram
Cm^2	:	Centimeter square
µm	:	Micro meter
m	:	Meter
mm	:	Millimeter
g	:	Gram
kg	:	Kilogram
wt.	:	Weight
ml	:	Milli litre
L	:	Litre
m/s	:	Meter per second
Sq.cm	:	Square centimeter
SW	:	South west
NW	:	North west
SD	:	Standard deviation
CI	:	95% Confidence interval
CV	:	Coefficient of variation
Loc cit.	:	In the place cited

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Chapter 1

Introduction

The continental shelves of the world's oceans represent only about 10% of the total oceanic area, but account for 99% of the global fish harvest. These are generally shallow ocean areas that promote nutrient recycling and provide feeding opportunities for fish and shellfish populations. Benthic organisms form a vital component in the marine environment and play an important role in the ecology both as consumers of plankton and as food for demersal fishes and shellfishes. They provide key linkage between primary producers and higher trophic level animals in the marine food web. Thus benthic productivity of the adjacent seas of any maritime country is of pivotal interest to access the total fishery potential pertaining to that area.

Research into the benthic ecosystems of the world's continental shelves has been most comprehensive in temperate rather than tropic latitudes (Alongi, 1990). In comparison to other tropical areas, work on the east and west coasts of India and along the west coast of Africa are to be mentioned.

The name 'benthos' is derived from the Greek, meaning "depths of the sea". The benthos are a group of organisms living in or on the bottom of a body of water. The benthic community is composed of a wide range of plants, animals and bacteria from all levels of the food web. Three functional groups of benthos could be recognized. They are the infauna, epifauna and hyper-fauna i.e. organisms living within the substratum, on the surface of the substratum, and just above it respectively. Based on the habitat, benthos are categorized into soft ``bottom and hard bottom benthos. Benthic communities comprise of species differing in terms of their ecology, life strategies and body size. Benthic organisms are also grouped by their size. Generally, organisms larger than 500 µm are called macrofauna; meiofauna are between 500µm and 63µm; organisms smaller than 63 µm are microfauna. The microfauna are unicellular organisms that include bacteria, fungi, protozoans and blue-green algae and occur in every square millimeter of the sediment and water environment. Meiofauna consists of a broad taxonomic grouping that includes nematodes, harpacticoid copepods, kinorhynchs, tardigrades, and some of the micro invertebrate species living within the sediment grains temporarily as part of their life cycles. Macrofauna are organisms larger than 0.5mm, which are visible by naked eye, mainly invertebrate animals, polychaetes, bivalves and echinoderms living either on the sea floor (Epifauna) or buried in the bottom (Infauna).

The purpose of quantifying benthos of the sea includes their quantitative and qualitative aspects and their importance in nourishing demersal fish stocks. Generally benthic communities are much more diverse in terms of species richness than those of the surface and mid water layers (the so called pelagic realm).

Approximately 98% of all marine species are supposed to belong to the benthos (Peres, 1982).

Benthic organisms link the primary producers, such as phytoplankton with the higher trophic levels, such as finfish, by consuming phytoplankton and then being consumed by larger organisms. They also play a major role in breaking down organic material. Many of the benthic organisms have pelagic larvae, a component of planktonic community and influence considerably in the planktonic food web. 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. Thus, 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).

The study of meiofauna is a late component in benthic research, despite the fact that meiobenthic animals have been known since the early days of microscopy. While the terms macrofauna and microfauna had been established, it was not until 1942 that the term "meiofauna" was used by Mare to define an assemblage of mobile benthic invertebrates (meiobenthos) distinguished from macrofauna and microfauna by their small size. Derived from the Greek word *μειος* meaning smaller, members of the meiofauna are mobile and smaller than macrofauna but larger than microfauna (a term now restricted mostly to protozoa and bacteria). Today the size boundaries of meiobenthos are based on the standardized mesh width of sieves with 500µm as upper and 42µm as lower limits: all fauna passing the coarse sieve, but retained by the finer sieve during sieving is considered meiofauna. In a recent move a lower size limit of 31µm has been suggested by deep-sea meiobenthologists in order to quantitatively retain even the smallest meiofaunal organisms (mainly nematodes). International Association of Meiobenthologists (IAM) on the other hand, defines its range from 63µm to 500µm. Currently, 20 Phyla of the 34 recognized phyla of the Kingdom Animalia have meiobenthic representatives; five of those are exclusively meiofaunal (Gnathostomulida, Kinorhyncha, Loricifera, Gastrotricha and Tardigrada); 2 Phyla of the Kingdom Protictista (Sarcomastigophora and Ciliophora) also have meiofaunal representatives. Some individual species also are meiofaunal during some stages of their lives, forms the temporary meiofauna. "Permanent meiofauna" are species of meiofaunal size throughout their lives, while "temporary meiofauna" are of this size only when they are immature.

Significance of the study:

The 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 worms, molluscs and crustaceans and they feed on organic matter and in turn form food of demersal fishes. Meiofauna form a direct food of macrobenthos, juveniles of demersal fishes and also of shrimps (Coull, 1973).

Most of the meiofaunal organisms are having a very short generation time, thus contributing to the total benthic production significantly. It has been long suspected that bacteria and diatoms are the principal microbial foods of meiofauna (Brown and Sibert, 1977; Gerlach, 1978; Tietjen, 1980). Macro and meiobenthos are primary consumers and found to feed on organic matter. This consumption of organic matter in turn goes through a cycle of ingestion and ejection and colonized by bacteria and fungi (Hylenberg, 1975; Riemann and Schrage, 1978). Thus the interaction between meio and macrobenthos species allows an efficient utilization of detritus. Such processes are likely 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 / 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).

Meiofauna are also known to be sensitive indicators of environmental disturbances and have great potential as pollution indicators, by giving attention to their species diversity, abundance and biomass. The reasons which makes them a potential indicators are that they live in very high numbers in small areas, have high diversity, have limited mobility whereby more consistently and intimately exposed to what is in their immediate environment, and have short life cycles.

Despite a number of investigations on benthos from Indian subcontinent no serious efforts have been made till date on the meiobenthos from shelves of the east and west coasts of India. India, an old maritime nation is endowed with a coastline of about 8129Km. Scattered attempts have been made to understand the quantitative nature and community structure of benthos from different regions of the country. A number of benthic studies in Indian seas were published; most of them were pertaining to studies on major estuaries or backwaters and shallow coastal regions. Meiobenthos part were a neglected component, even in most studies and attention was given to macrobenthos. Attempts have been made to study the entire shelf region of west coast, so far by 3 workers viz. Neyman, (1969); Harkantara *et al.* (1980) and Parulekar *et al.* (1982). Since these studies were carried out with different methodologies and objectives, their utility is limited in understanding of the benthic community. Even in these studies attempt was restricted to macrofauna and no attention was made to account for meiofaunal production. This was mainly because of the difficulty in analysing the meiobenthos. This lacuna in the information regarding meiobenthos led to embark upon the present study. Earlier studies on meiofauna showed nematodes as the most dominant group representing meiofaunal samples worldwide. Therefore the present study was focused on free living marine nematode taxonomy and their ecology. The present study is the first ever-comprehensive attempt to screen the entire shelf region of west coast extending from off Cape Comorin to off Dwarka with sampling upto a depth of 200 meters.

The main challenges were as follows:

- To understand the relationship of meiofauna to hydrography and sediment characteristics of the west coast.
- To understand the numerical abundance of meiobenthos and to understand their spatial variation.
- To obtain the standing crop of meiobenthos with respect to depth and latitude.
- To understand trophic relationships of meiobenthos
- To know the species composition of free-living marine nematodes of the shelf waters of the west coast of India.
- To know the distribution and ecology of free-living marine nematodes.

To pursue the above challenges, two dedicated cruises were conducted along the continental shelf waters of the west coast of India as part of the Department of Ocean Development's (Government of India) efforts towards conducting Marine Living Resources related research in India's Exclusive Economic Zone (EEZ). 74 stations were covered, falling under 17 transects, extending from off Cape Comorin to off Dwarka, 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.

Chapter 2

Review of literature

Human settlement through time have often flourished near the sea, partly due to the abundance of the food resources that can be found there and partly due to ease of transportation of people and cargo. Observations about various organisms and environments were a major part of human activities since these settlements and the very survival of them depended on the knowledge to obtain food and provide defence against dangerous plants and animals.

The major oceanographic efforts to study the organisms and their environments initiated as expeditions under the leadership of different investigators and also by using different Research Vessels from time to time. Italians, Marsigli and Donati were the first to study benthos by using dredge around the year 1750 (Murray and Hjort, 1965). By the end of the century O.F Muller in 1799 modified this dredge in the form as naturalist dredge. British Antarctic expedition in H.M.S. *Erebus* and H.M.S *Terror* (1839-43) under the leadership of Sir James Clark Ross, used a dredge, showing that there was abundant and varied fauna down to 730 meters. Further, Prof W. Thomson and W.B Carpenter used H.M.S. *Porcupine* during 1868, 69 and 70 to carry out dredging surveys of the deep waters of the British Isles and off Spain. With this study they proved the existence of life on the deep sea floor. From 1895-96, the Danes sent out the *Ingolf* to study the hydrology, the pelagic and benthic life of the northerly parts of the Atlantic. From

1898-99, the German deep sea expedition in the *Valdivia* worked in the Atlantic and Indian Oceans. At the end of the century in 1899 Dutch expedition on the *Siboga,* investigated the flora and fauna of seas round the Dutch East Indies.

The major expeditions of the earlier part of 20th century include Norwegian Michael Sar's in North Atlantic, in 1910, Danish Dana from 1920–22 and 1928-1930. Great Britain took up large-scale oceanographic studies once more in 1925, and in 1930 by using *Discovery*. After the war, the Swedish Expedition (1947-1948) on the *Albatross*, worked over three oceans, sampling the great accumulations of sediment on the deep sea floor by means of piston corer, designed by Kullenberg. During 1950-51 the RRR *Discovery II* again concentrated in Antarctic area, filling in some of the gaps she had left before the war. Finally the Danish *Galathea* made a round-the-world expedition concentrating on dredging and trawling in the deepest parts of the ocean. The main stress of Galathea expedition, though pelagic and oceanographic studies attention was given to benthic studies.

One of the classic studies on benthos is that of C.G.J. Petersen (1914-18), who thoroughly investigated the neritic waters of the fishing grounds between Denmark and Norway. Studies of benthic populations were continued on a worldwide basis and Thorson (1955) proposed the concept of "parallel level bottom communities" inhabiting the same type of bottom at similar depths in widely scattered geographical areas. The smaller components of the benthos have became better known and their importance appreciated as a result of the investigations of the 1960's. Sanders (1960, 1968) found that the use of improved dredges and finer screens for sieving revealed a diversity of smaller infaunal polychaetes, crustaceans, bivalves, and other invertebrates, which was overlooked, in the previous studies. The density of benthos in the soft sediments decreased with increasing depth as might be expected because of declining productivity with depth, but the species diversity proved to be grater in the abyssal than in the shelf habitat (Sanders *et al.*, 1969) This major finding supports the theory that diversity is related to stability and is not depended on productivity (Sanders, 1968).

Some 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 (Gastropoda) in the eastern Mediterranean, and in 1904, Giard described the first archiannelid, *Protodrilus*, from the coast of Normandy. These pioneers of meiofauna studies considered only isolated taxa, often the exceptional species of known invertebrate groups, not the ecological relations and the community aspect. Since then the emphasis for field investigation has been biased towards the commercially more important macrofauna.

Adolph Remane used fine meshed plankton nets for the first time to filter beach "ground water". He studied the microscopic fauna of (Eulittoral) muddy bottoms ("*Pelos*") and of the small organisms associated with surfaces of aquatic plants ("*aufwuchs*" or 'phyton") using dredges. With the development of effective grabs (Petersen, 1913) and dredges (Mortensen, 1925) for sampling subtidal bottoms, the abundance and complexity of the smaller benthos became apparent. Remane summarized his work in a monograph "*Verteilung und Organisation der benthonischen Mikrofauna der Kieler Bucht*" (1933), where he first used the word "*Sandluckenfauna*", later termed by Nicholls (1935) "interstitial fauna". Remane's works resulted in depicting mesobenthic (interstitial) fauna of sand as a biocoenosis different not only in species number and occurrence, but also in characteristics of form and function. This concept in his paper Remane (1952) embodied in the word "Lebensformtypus" which has became incorporated into the terminology of general ecology.

The stimulus given by Remane's work intensified the meiobenthic research in Germany. Studies on smaller benthos soon emerged from all parts of the world with improved methods (e.g. Moore and Neill, 1930; Krogh and Sparck 1936).

From Britain, Moore (1931), Nicholls (1935) and Mare (1942) is worth mentioning as the pioneers in benthic studies. Boaden and Gray in the beginning of the 1960's were the first to perform experiments with marine meiofauna. In 1969, McIntyre compiled the first review on the ecology of marine meiobenthos, still a valuable source of information on meiobenthic research. 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 hitherto unknown species. His review on the interstitial fauna of marine sand is considered a classic work among the meiofaunal literature.

Delamare Deboulteville (1960) was the first to conduct meiofauna research along the African shores. His book *Biologie des eaux souterraines littorales et continentals* is another esteemed compendium of meiofauna research. 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 on the interstitial meiofauna and their abiotic ecological factors.

In North America, one of the major centres of meiofauna research, the early studies were associated with Pennak, Sanders and Zinn, who discovered important new crustacean groups. The studies of the Austrians, Wieser and Riedl in the 1950s and 1960s stimulated meiobenthologists to work in this field of research along the American coasts. The focus of the work was directed primarily towards ecology, along the Atlantic coast of the USA. During 1970s, the meiobenthic field experimentation works of Coull, on the soft bottom meiofauna drew attention of marine benthologists to meiofauna.

During 1970s the major meiofaunal studies were concentrated on their ecological importance. The studies include the importance of meiofauna, and its dispersal (Gerlach, 1971; 1977); brief review of sampling methods (Wells, 1971; Uhlig *et al.*, 1973); factors controlling distribution, migration of meiofaunal community (Boaden and Platt, 1971; Hulings and Gray, 1976); studies on the shallow water meiobenthos (Coull, 1975) and deep sea (Coull *et al.*, 1977); on the ecology of micro (Fenchel, 1978) and meiobenthos (Gray, 1978; Elmgren, 1978). Overall, the 1970s proved as an exciting period for meiofauna research.

In 1980s major efforts were to study the meiofauna and its ecological importance. The major works were, meiofauna-macrofauna interaction in a high salt marsh habitat (Bell, 1980); development of a method for the extraction of marine and estuarine benthos from clays and resistant mud (Barnett, 1980); meiobenthos as tool in the assessment of marine environmental quality (Heip, 1980; Raffaeli and Mason, 1981; Warwick, 1981; Moore and Bett, 1989; Austen and Warwick, 1989); uptake of organic matter by meiofauna organisms and their interrelationships with bacteria (Reil and Faubel, 1980; Tietjen, 1980); dispersal and distribution of benthic meiofauna (Hagermann and Rieger, 1981; Arlt *et al.*, 1982; Alongi, 1985; Palmer, 1988; Murrel and Fleeger, 1989); determination of individual meiofauna dry weight values and productivity of marine meiobenthos (Faubel, 1982; Heip *et al.*, 1982; Grelet, 1985); Loricifera, a new phylum with characters of Aschelminthes from the meiobenthos (Kristensen, 1983); compendium of meiofauna study (Higgins and Thiel, 1988); role of meiofauna in the marine ecosystem evolutionary considerations (Warwick, 1989; Gee, 1989); comparison of the benthic size structure between sublittoral, upper slope and deep sea areas of the western Pacific (Shirayama and Horikoshi, 1989); meiofauna and the origins of the metazoa (Boaden, 1989). Thus during 1980s the studies were attempted even to use meiofauna as an effective indicator of water quality.

During 1990s and early part of this decade the major efforts were to study various ecological aspects. The studies in this direction include, distribution and the meiobenthic community structure in relation to pollution (Warwick *et al.*, 1990; Austen and Wibdom, 1991; Warwick and Clarke, 1991 and Gourbault *et al.*, 1998); studies of meiobenthos in the deep sea and other biotypes (Tietjen, 1992; Huys *et al.*, 1992; Aller and Aller, 1992; Vanreusel *et al.*, 1995; Jan Vanuverbeke *et al.*, 1997; Li. *et al.*, 1997; Vanhove *et al.*, 1997; Colangelo *et al.*, 1998; Papadopoulou *et al.*, 1998 and Soltwedel, 2000); deep water meiobenthos (Shirayama and Ohta, 1990; Schewel and Soltwedel, 2000); role in nitrogen cycle (Parent, 1999); use of modern techniques in meiofaunal study for estimation of biomass (Thomsen, 1991; Schizas *et al.*, 1997); predation effect on macrobenthos and meiobenthos in microcosms (Service *et al.*, 1992) detritus-bacteria-meiofauna interaction (Danovaro, 1996; Buffan-Duban and Carman, 2000 and Shimanaga *et al.*, 2000).

Meiobenthic studies in recent years concentrated on unraveling of meiobenthos from different geographical area and also using them in pollution research with the help of modern statistical approaches. The major attempts are also to acquire the baseline data on meiobenthos where it is demanding (Zhang *et al.*, 2001; Mc Arthur *et al.*, 2001; De Troch *et al.*, 2001; Burgess, 2001).

The Indian Scenario:

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. Later Kurien (1953, 1967,1972) made extensive survey of the bottom fauna along the south west coast of India. Seshappa (1953) and Ganapati and Rao (1959) made quantitative efforts along Malabar Coast and north east coast of India respectively for studying benthos. During International Indian Ocean Expedition (IIOE), Soviet Research Vessel "*Vityaz*" carried out the studies on bottom fauna, which was published, by Beljaev and Vinogradova (1961) and Sokolova and Pasternak (1962). Ganapati and Rao (1962) studied the interstitial fauna of Andhra coast, south east coast of India.

Quantitative studies have been made on meiofauna from West and East coasts of India (McIntyre, 1968, Thiel, 1966, Sanders, 1968); and Central Indian Ocean (Sommer and Pfannkuche, 2000, Ingole et al., 2000). Studies on the interstitial fauna of the Southwest coast of India were attempted by Govindan Kutty and Nair, 1966, 1967; Desai and Kutty, 1967a, 1967b,1969; Rajan, 1972. Kurein (1972) in his study on the ecology of benthos of the Cochin backwaters showed that meiofauna are more numerous in the finer sediments and their abundance is not affected by the tidal changes. Numerous workers studied Meiofauna of different coastal areas and backwaters of east coast of India (Ganapati and Sarma, 1973;

Sarma and Ganapati, 1975; Ansari and Parulekar, 1981; Ansari *et al.,* 1982; Rao, 1986; Rao and Murthy, 1988; Vijayakumar *et al.*, 1991, 1997; Chatterji *et al.*, 1995;) and west coast (Damodaran, 1973, Ansari *et al.*, 1977, Ansari *et al.*, 1980, Abdulaziz and Nair, 1983, Reddy and Hariharan, 1985, 1986, Ingole *et al.*, 1992, Ansari and Parulekar, 1993) respectively. Pollution and its impact with meiofauna were recognised by many workers (Varshney, 1985; Rao, 1987a; Ingole *et al.*, 2000).

Many workers attempted to study the ecology of meiofauna from different estuaries or backwaters. The major workers in this direction include Murthy and Rao (1987); Rao (1987b); Harkantra and Parulekar (1989); Bhat and Neelakantan (1991); Ansari and Gauns (1996); Ansari and Parulekar (1998); Ingole and Parulekar (1998); Rao and Sarma (1999).

Sampling and sorting are considered to be the major impediment in meiofaunal investigations. Gray (1974) and Vitiello (1968) have approached this problem of sampling from the viewpoint of determining the most suitable core size and the optimal frequency of sampling for meiobenthos. McIntyre (1971) has evaluated the effects of sampling techniques especially coring devices. Many types of cores were later devised or modified (Hope's corer; "Ring-Lined' corers by Jansson, 1967a,b; '*Meiostecher*' a modified coring device by Thiel, 1966, Haps corer and Kraib corer etc.). The most satisfactory samples from the sublittoral are without doubt those collected by divers. While SCUBA techniques provide the best sublittoral samples they have limitations, one being depth as the operational range is only 30-50m. At greater depths, remote core device must be used or sub samples taken from a grab. There is no single instrument that can be recommended as a quantitative tool. Several grabs including the Petersen, Van Veen, Smith-MacIntyre, Campbell and Ocean (Holme, 1964) have been used with variable success in deep water. Grabs are not entirely satisfactory for meiobenthos work. Even in the ideal conditions, water drains out during hauling, washing away the animals on or near surface of the sample. Another disadvantage is the disturbance that may cause to the sediment surface while the grab bites on the sediment and when it is hauled up. This problem can be alleviated by fitting a gauze cover to top of the bucket as in the Smith McIntyre grab (Smith and McIntyre, 1954). Thus the sampling device with which truly quantitative soft bottom samples taken must have a definite sampling area, which encloses the correspondingly underlying sediment column, retains the sample and minimizes the disturbances of the sediment during sampling and recovery.

Review on ecological aspects of meiobenthos.

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 types 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). In general mesobenthic species prefer coarse sands, while endo and epibenthic ones are mostly encountered in fine to silty sediments. It is often observed that fine sediments were preferred by nematodes and coarser often by harpacticoids (Coull, 1985). Within the nematodes, preference for a specific grain size was found to relate to certain ecological types (Wieser, 1959c). So the shape of the particles, interstitial water content, and permeability conditions are decisive for meiofauna colonization of the sediment.

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 supralittoral fringes. It seems that in most environments, temperature does not prevent meiofaunal colonisation. Nevertheless temperature can have a structuring impact on meiofauna. In the sublittoral bottoms, the influence of temperature on meiofauna distribution is negligible. As in the case of temperature, meiofaunal organisms exists under all salinity regimes from freshwater to brackish shores, from oceanic bottoms to brine seep areas. Alongi (1990) reports a drastic decline in tropical soft bottom meiofauna abundance after monsoon. 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). In the natural environment, all factors will interact with each other in many ways, often synergistically enhancing the effects. This interaction of intermingled factors creates the complex system that can be termed the abiotic environment of meiobenthic animals. Along with abiotic factors an array of biotic factors are also influencing meiobenthic habitat. They include the interactive factors like disturbance, competition and predation.

Meiofauna, once thought to be trophic dead end (McIntyre and Murison, 1973) are now known to be an important component in the diets of fish (Bell and Coull, 1978; Bell, 1980; Hodson *et al.*, 1981; Currin, *et al.*, 1984; Coull and Palmer, 1984; De Morais and Bodiou, 1984; Fitzhugh and Fleeger, 1985; Greg *et al.*, 1998; Coull *et al.*, 1995). There has been much controversy in the interaction between meiofauna and higher trophic levels. McIntyre and Murison (1973) and Heip and Smol (1975) suggested that meiobenthic prey species are consumed primarily by meiobenthic predators and thus were not available to higher trophic levels. McIntyre (1964) and Marshall (1970) concluded that there is competition for food between macro and meiofauna and that meiofauna serve primarily as rapid metazoan nutrient regenerators. However, Feller and Kaczynski (1975) and Sibert *et al.* (1977) showed quite conclusively that juveniles Salomon feed almost exclusively on meiobenthic copepods while Odum and Heald (1972) reported that meiobenthic copepods comprise 45% of North American Grey mullet gut contents. Also, Sikora (1977) has reported that nematodes provide a significant portion of the *insitu* food of the grazing grass shrimp *Palaeomonetes pugio*. At depths where light penetration is insufficient to stimulate plant growth, the organisms of the sea floor depend ultimately on the steady rain of food particles that descend from the upper layers of the ocean. Meiofaunal organisms play an important role in the cycling of nutrients in the world's oceans. The majorities of benthic invertebrates has no direct commercial or recreational value, but provides much of the food for the bottom feeding species that are themselves important in the region's commercial fisheries.

Historical background of the research on free-living marine nematodes

The free-living marine nematodes were the most abundant group among meiofaunal organisms, a much-neglected group of metazoans, mainly due to their small size and sampling difficulty. It was the legendary works of Bastian, Cobb, De Man, Buetschli, Leuckart and Linstow, which called the attention of marine biologists to this group. The nematology again saw a period of attention during the mid part of the 19th century, due to the works of the Micoletzky, Stekhoven, De Coninck, Allgen, Ditlevsen, Filipjev, Chitwood, Wieser, Gerlach and others.

Free-living marine nematodes of the Atlantic Ocean are perhaps the best known in the world, brought to lights through the works of Bastian in 1865 and Southern in 1914. Taxonomy of free-living marine nematodes of Atlantic Ocean was revealed from the studies of many workers. The major works are by Buetechli (1873,1874), De Man (1886), Ditlevsen (1923), Allgen (1927, 1928, 1929, 1930, 1951a, 1951b, 1952a, 1952b), Kreis (1929), Stekhoven (1931, 1933, 1935).

Many scientists studied Mediterranean Sea nematodes for a prolonged period. The works include that of Eberth (1863), Marion (1870, 1875), De Man

(1878), Zur Strassen (1894), Micoletzky (1922), Filipjev (1927,1928), De Coninck (1936), Stekhoven (1942, 1943), Allgen (1942), Gerlach (1952), Wieser (1952), Chitwood (1951), Wieser (1959a) and Hopper (1961,1962 1963).

Many workers studied the free-living nematodes of the Pacific Ocean in detail. Among them the works of Bastian (1865), Allgen (1935), Stekhoven and Mawson (1955), and Wieser (1953a&b, 1954, 1956, 1958 and 1959a,b&c) are noteworthy.

Studies of the nematodes in Artic Ocean began with the works of Leuckart, Menzel, Stenier and Filipjev. Later, several workers concentrated on nematodes of Artic and some of the Sub Antartic Islands. The major contributors were Leuckart (1849), Linstow (1900), Filipjev (1929), Kreis (1963), Steiner (1916), Gerlach (1965), Allgen (1956, 1959) and Mawson (1956).

The nematode became the key subject of interest for more meiobenthologists in the later part of 1960s and 1970s. They described more and more new species of nematodes and studied their ecology in detail from various parts of the world contributing to nematology. The major contributors were Wieser and Hopper (1967), Murphy (1963, 1964), Riemann (1966), Lorenzen (1969), Warwick (1971), Ott (1972), Jensen (1978,1979), Jayasree and Warwick (1977), Heip *et al.* (1982, 1985), Platt (1982), Platt and Warwick (1983, 1988 and 1998), Tarjan and Khuong (1988), Cook *et al.* (2000), Lambshead *et al.* (2000), Lambshead *et al.* (2001).

In India the systematic work on aquatic nematodes is scanty, insufficient and inadequate. Apart from the works by Timm (1961, 1967a,b) from the seas around Indian Sub Continent and Gerlach (1962) from the Maldives Islands, no published work exists on the marine free-living nematodes. These workers described around 120 species of nematodes from Indian waters. From Indian waters, some preliminary knowledge of free-living nematodes is recorded hitherto from prominent estuaries and backwaters.

Chapter 3

Materials and Methods

3.1. Study Area

The present study was conducted in the western continental shelf of India that extended from 08.03.96 N and 77.21.96 E to 21.56.99 N and 67.57.69 E (Fig.1). Widest part of the continental shelf is off Mumbai, extending seaward up to about 300km and the narrowest part in about 60km off Cochin. Altogether 74 stations in 17 transects were covered extending from off Cape Comorin to off Dwarka. The transects were Cape Comorin, Thiruvananthapuram, Kollam, Kochi, Vadanappilly, Kozhikode, Kannur, Mangalore, Coondapore, Bhatkal, Goa, Ratnagiri, Dabhol, off Mumbai, along Mumbai, Porbandar and Dwarka. Samplings were made from 30, 50, 100 and 200m depths ~~from~~ at each station. Additional samplings from 75m depths were also taken in certain transects due to wider shelf pattern and those transects were, Kollam, Kannur, Bhatkal, Goa, Ratnagiri and Mumbai. Off Thiruvananthapuram, since the shelf was very steep beyond 100m, sampling from 200m was not possible. In Mumbai region, due to the restriction imposed for entering Mumbai High region, one transect was selected south of Mumbai High and was named 'off Mumbai' and another along this area, as 'along Mumbai'. Since this region has the maximum width in continental shelf sampling was restricted up to 100m depths only. For convenience of data presentation, the data from the above depths were pooled into specific depth ranges viz. 30-50 m, 51-75 m, 76–100 m, 101–150 m and >151 m. The details of sampling stations are presented in Table 3.1.

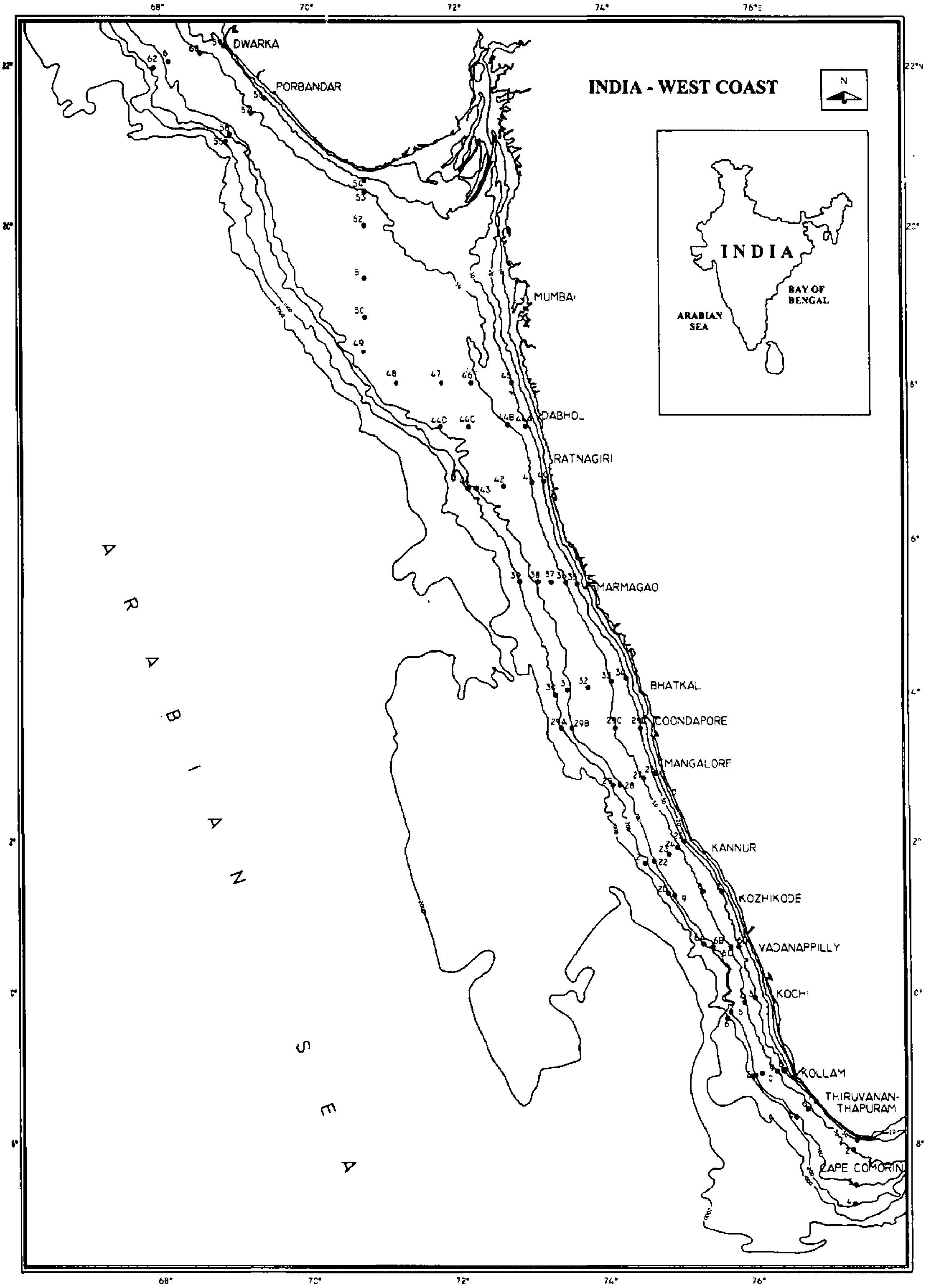


Fig. 3.1 Chart showing the location of sampling stations.

Table. 3.1. Details of sampling stations.

Transect	St. No	Latitude	Longitude	Depth (in m)
Cape Comorin	1	08.03.96 N	77.21.96 E	30.7
	2	07.54.75 N	77.20.67 E	50.6
	3	07.21.01 N	77.20.40 E	101
	4	07.10.37 N	77.20.09 E	208
Thiruvananthapuram	5	08.21.67 N	76.32.83 E	124
	6	08.27.89 N	76.42.53 E	59
	7	08.33.10 N	76.48.95 E	30
Kollam	8	09.00.40 N	76.23.92 E	30.6
	9	08.58.12 N	76.18.89 E	50
	10	08.55.33 N	76.05.70 E	73.7
	11	08.54.53 N	76.01.86 E	101
	12	08.54.70 N	75.58.56 E	238
Kochi	13	09.56.53 N	76. 00.85 E	33.3
	14	09.52.89 N	75.52.70 E	51
	15	09.45.80 N	75.41.18 E	101
	16	09.41.39 N	75.38.69 E	202
Vadanappilly	16D	10.27.25 N	75.51.45 E	36.2
	16C	10.28.98 N	75.42.60 E	52.6
	16B	10.28.97 N	75.31.57 E	103.4
	16A	10.28.45 N	75.25.52 E	197.3
Kozhikode	17	11.21.20 N	75.34.28 E	31
	18	11.19.50 N	75.21.28 E	50
	19	11.17.75 N	74.56.85 E	102
	20	11.18.97 N	74.51.83 E	219
Kannur	21	11.43.19 N	74.33.64 E	202
	22	11.44.97 N	74.40.81 E	102
	23	11.48.92 N	74.52.78 E	67
	24	11.56.14 N	75.00.86 E	51.2
	25	11.59.11 N	75.05.09 E	31
Mangalore	26	12.52.68 N	74.40.67 E	31
	27	12.49.20 N	74.32.49 E	50.8
	28	12.44.14 N	74.14.02 E	101
	29	12.43.89 N	74.6.45 E	205

Transect	St. No	Latitude	Longitude	Depth (in m)
Coondapore	29 D	13.29.52 N	74.30.04 E	33.9
	29 C	13.29.92 N	74.05.81 E	53
	29 B	13.30.22 N	73.31.63 E	104.3
	29 A	13.30.15 N	73.26.55 E	193
Bhatkal	30	13 .56.41 N	73.21.21 E	206
	31	14.00.09 N	73.31.57 E	101
	32	14. 04.36 N	73.48.61 E	68
	33	14.07.42 N	74. 04.67 E	54.4
	34	14.11.07 N	74.18.52 E	31
Goa	35	15.25.45 N	73.38.80 E	32
	36	15.25.74 N	73.30.49 E	52
	37	15.26.18 N	73.17.89 E	72
	38	15.25.74 N	73. 06.31 E	101
	39	15.26.09 N	72.52.51 E	206
Ratnagiri	40	16.44.02 N	73.12.27 E	32
	41	16.41.63 N	73. 02.94 E	51
	42	16.38.27 N	72.40.20 E	76
	43	16.37.90 N	72.17.39 E	101
	44	16.37.44 N	72.10.97 E	211
Dabhol	44A	17.29.39 N	72.57.22 E	35.3
	44B	17.27.74 N	72.43.09 E	57.1
	44C	17.28.27 N	72.16.25 E	95.7
	44D	17.28.42 N	71.49.11 E	94.3
Off Mumbai	45	18.00.04 N	72.47.01 E	33
	46	17.59.52 N	72.21.70 E	51
	47	17.59.98 N	71.50.42 E	96
	48	17.59.44 N	71.14.29 E	89
Along Mumbai	49	18.23.99 N	70.47.40 E	95
	50	18.49.71 N	70.48.11 E	91
	51	19.20.16 N	70.47.35 E	85.3
	52	20.00.02 N	70.47.65 E	79
	53	20.26.05 N	70.48.03 E	51
	54	20.34.05 N	70.44.69 E	32

PLATE 1

FORV SAGAR SAMPADA

Transect	St.No	Latitute	Longitude	Depth (m)
Porbandar	55	21.34.62 N	69.28.75 E	210
	56	21.24.75 N	69.18.83 E	101
	57	21.09.02 N	69.00.64 E	53
	58	21.05.63 N	68.56.72 E	33
Dwarka	59	22.14.51 N	68.53.48 E	33
	60	22.09.68 N	68.38.24 E	52
	61	22.00.72 N	68.09.74 E	100
	62	21.56.99 N	67.57.69 E	200

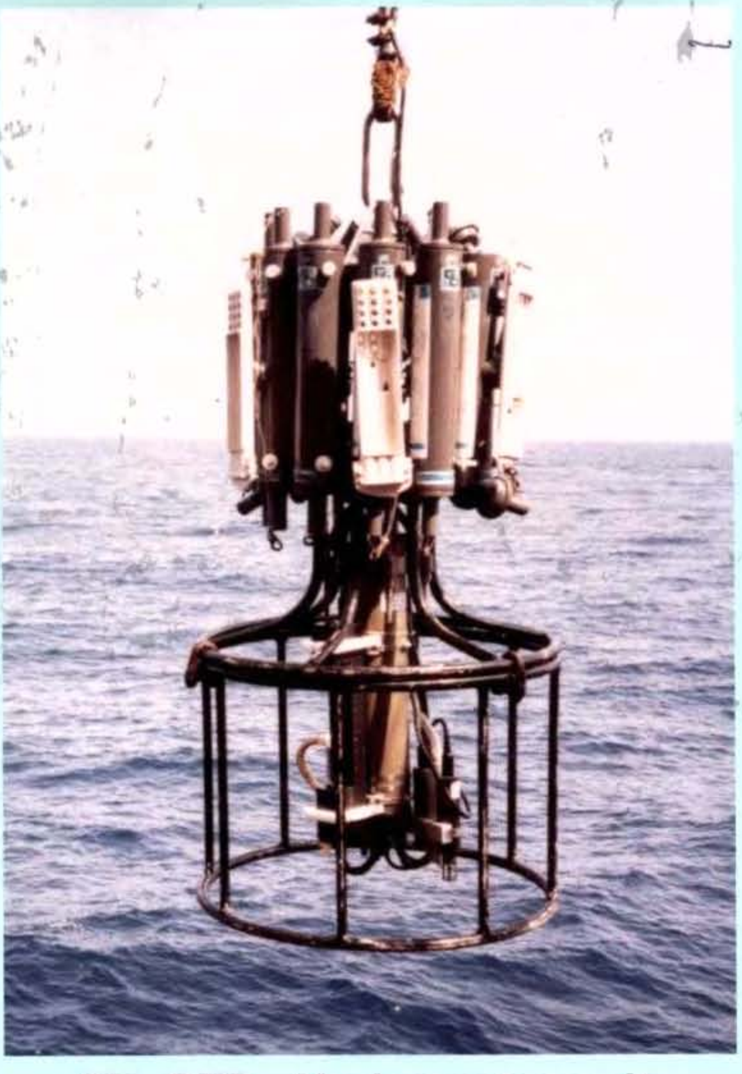
3.2. Methodology

Materials for the present study were collected onboard Fishery and Oceanographic Research Vessel (FORV) Sagar Sampada (Plate 1) from the shelf waters of the west coast of India. For obtaining data from every degree square of continental shelf, two cruises, cruise number 162 and 192A were conducted for the present study. The first cruise was from 16-02-1998 to 06-03-1998 and the second from 20-02-2001 to 28-02-2001. Cruise No. 162 covered 62 stations from 13 transects and cruise 192A covered 12 stations from 3 transects. The data from Cape comorin to off Bhatkal was taken as southwest coast and transects from off Bhatkal to off Dwarka was considered as northwest coast.

Hydrographical data for temperature, salinity and dissolved oxygen were collected from each station by using SeaBird CTD onboard Sagar Sampada. It consists of the SBE11 deck unit (for real time readout) (Plate 2A) and the SBE9 underwater unit (Plate 2B) The Kahlsico No. 214 WA250 modified Smith McIntyre grab was used for collecting sediment samples (Plate 3A and 3B). It traps a sediment volume of 0.1m^2. Immediately after the grab hauling and after

PLATE 2

2A. CTD - Deck unit



2B. CTD - Under water unit

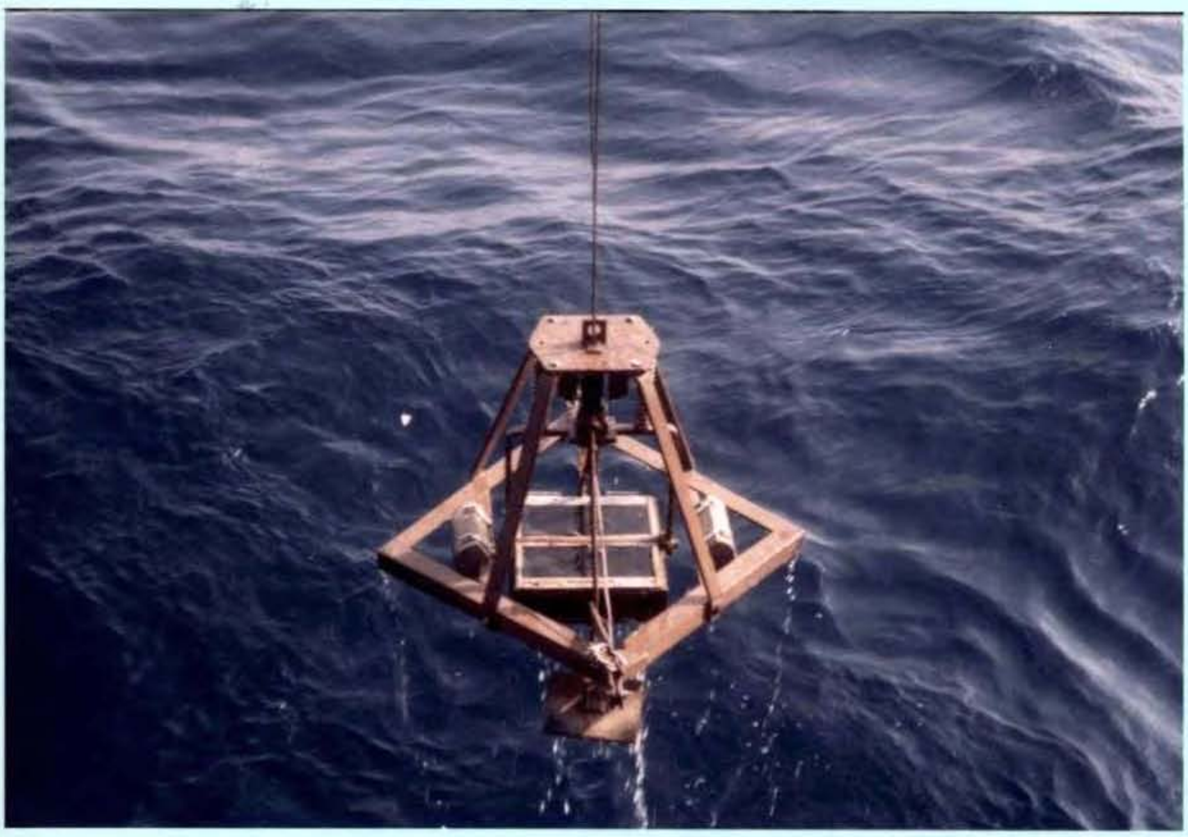
ascertained the undisturbed nature of the sediment, sub samples were taken for meiobenthos by using glass corer with an internal diameter of 2.6cm, and a length of 30cm. Duplicate sampling was made from each station to understand sampling variation. The core samples were later transferred to 250ml plastic bottles and fixed in 5% buffered formalin. Each sample was properly labelled with all necessary details. Vertical distributions of nematodes were studied from cruise 192A only. From 3 transects of cruise 192A viz. off Vadanapilly, off Coondapore and off Dhabol the core samples were taken and cut in to upper 4 cm and lower 4 cm immediately after the grab haul.

The details of analysis of sediment characteristics are discussed and provided in the studies on the macrobenthos of the shelf waters of the west coast of India (Joydas, 2002). In the present study the results of this analysis was utilised for obtaining a broad idea of the ecology of the realm. Additional sub sampling was made for the study of sediment characteristics. Approximately 150 gm of wet sediment from each station were taken for this purpose and dried onboard at 60^{O} C in an oven. The dried samples were taken to the laboratory for further analysis. The textural analysis of the sediment sample was carried out by the pipette method described by Carvar (1971) and prior to this; salt content of the sediment was removed by saturation with fresh water. Organic carbon was estimated by wet oxidation method (El–Wakeel and Riley, 1957) and later converted to organic matter using a conversion factor as described by Wiseman and Bennete (1960).

Prior to extraction, selective staining of the fauna for recognition and discriminations between dead shells and freshly dead animals were carried out.

PLATE 3

3A. Smith-Mc Intyre grab: ready to deploy



3B. Smith-Mc Intyre grab: during hauling up

For this, fixed sample were bulk-stained with Rose Bengal (Pfannkuche and Thiel, 1988). Stained meiobenthos were sorted within 1-2 hour since over staining would make it difficult to remove and would impair the structural analysis under the microscope.

3.2.1. Meiofauna extraction

Fixed sediment samples contain a mixture of formalin and sediment components such as silt, clay, sand grains and organic detritus, in addition to the fauna. ~~Meiofauna~~ P free tap water was used to extract various meiofaunal organisms from the original fixed sediment material using a 500 µm sieve nested on top of the 63 µm sieve. Washing was carried out till the clear sediment with meiofaunal organisms remain on the 63 µm sieve.

The classical method of decantation by hand, using a 63 µm sieve was used for separating meiofauna from sediment samples. The excess quantities of sand and silt fraction were removed by decantation extraction. The contents from the 63 µm sieve were transferred to a 1-litre wide-mouthed measuring cylinder and filled with fresh water till the one litre mark. To distribute the sediment evenly throughout the volume, the cylinder was inverted for 5-10 times. After 5 seconds, until most of the dense particles (mainly sand) were settled ~~dropped out~~, the supernatant was carefully poured onto a 63µm sieve. Repeated the process for 3-6 times, aliquot of the sediment remaining in the cylinder was examined under a stereomicroscope to ensure the loss of any meiofaunal organisms. The meiofauna samples retained on the 63 µm sieve was transferred to small petridish with minimum water.

The sorting of extracted meiofaunal samples was carried out, in water under a binocular microscope of higher magnification. Count was taken of all individuals of all groups represented. Organisms were identified to major taxa, i.e. foraminifera, nematoda, harpacticoida. All other taxa appearing in small numbers (e.g. ostracoda, polychaeta, halacarida, kinorhyncha, oligochaeta) were pooled in one category, categorized as the "Others". Nematodes were identified upto species level. For this, not less than 100 individuals were selected at random from sorted samples in each station as there were too many nematodes recovered to identify them all (Brown *et al.*, 2001). In the case of samples with low densities all the specimens were identified to species level. The rest of the meiofaunal organisms were identified upto group level.

3.2.2. Biomass and Number

Wet weight of nematodes, harpacticoid copepods and others were determined by direct weighing of larger numbers of individuals by using a high precision electronic balance as followed by Mare (1942). For comparison, wet weight of nematodes was again calculated from measurements of length and width assuming a specific gravity of 1.13 (Wieser, 1960). The wet weight value of nematodes and copepods was agreeing well with the earlier reports. (Mare, 1942, Tietjen, 1969) The numerical abundance of meiofaunal organisms was expressed in 10 cm^2.

For extended examination and identification the fixed animals were processed in anhydrous glycerine. Nematodes were transferred to a cavity block containing by volume 5% glycerine, 5% pure ethanol: 90% fresh water (Seinhorst, 1962), almost covering it with a cover glass and leaving it in a desiccater for few days. This allows the ethanol and water to evaporate slowly leaving the nematodes in pure glycerine. Finally the nematodes were transferred to a fresh drop of anhydrous glycerine on a slide and a cover glass added supported by glass rods of an appropriate diameter. The cover glass was mounted permanently by using DPX Mountant.

Using a high power (Nikon E600 series trinocular research) microscope equipped with a 100 X oil immersion lens, examination was carried out. Drawing tube was used for drawing. In order to measure the curved features of nematodes from the drawings a properly calibrated stage micrometer was used. For straight measurements a calibrated ocular micrometer was used. The oesophagus was measured from the anterior end of the body and the head diameter was measured at the level of first circle of cephalic setae. The morphology of the head structures of both sexes and copulatory organs of males were carefully examined, as they were essential for fixing the taxonomy (Wieser and Hopper, 1967). De Man's formula was adopted for species identification following Jensen (1978, 1979). The abbreviations used in De Man's formula are indicated below:

L = Body length

a = Body length / Maximum body diameter

b = Body length / Oesophagus length

c = Body length / Tail length.

Position of vulva (females) in percentage:

v = Body length from anterior end to vulva / Total body length.

Taxonomic fixing of free-living nematodes were carried out by using, Bremerhaven checklist of aquatic nematodes I and II (Gerlach and Riemann, 1973,1974); Lunds Chile expedition reports (Wieser, 1953a, 1954, 1956a, 1958b) and synopses of free living marine nematodes I, II and III (Platt and Warwick, 1983, 1988,1998). The checklist of Gerlach and Riemann (*loc cit.*) was used to place the species and to know its geographical range of distribution. The illustrated keys by different authors, CD's (Darwin nematode identification project - electronic nematode identification key) were also made use of species identification. Species from 69 stations were included in the analysis and the remaining 5 stations species identification was not possible due to the poor standard of the slide preparations.

3.3. Statistical analysis:

A suite of statistical approaches was carried out for the simplification and elucidation of the biological data. For convenience, statistical techniques like Univariate and multivariate analysis that is included in the PRIMER v.5 (Plymouth Routines In Multivariate Ecological Research) software package developed at the Plymouth Marine Laboratory (Clarke and Warwick, 1994; Clarke and Gorley, 2001) was followed.

1.The Univariate Methods.

The Univariate methods include a set of species coefficients or diversity Indices. The following diversity indices were carried out for the estimation of community structure of free-living nematodes. The species identification for other groups were not worked out in detail. Therefore community study was not attempted for other meiofaunal groups.

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)/ Log (N) *where N= total number of individuals; S= total number of species.*

Equitability or evenness was measured by Pielou's evenness index (Pielou, 1975) expressed as J' = H'/ Log (S) *where H' is the Shannon diversity; log S - maximum possible value of Shannon index.*

Species diversity was measured by Shannon–Wiener index (Shannon, 1949) expressed as species diversity H'= -SUM (P_i^X Log (P_i)) *where* P_i *is the proportion of the total count arising from the* i^{th} *species.*

Species dominance was measured by Simpson's index (Simpson, 1949) expressed as species dominance λ'= {SUM $_i$ N_i (N_i-1)} / {N (N-1)} *where* N_i *is the number of individuals of species* $_i$.

2. Multivariate Methods.

Multivariate analyses are conducted to determine whether biological assemblages respond to different types of disturbances by small, but consistent changes in the relative abundances 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. All these techniques are thus founded on similarity coefficients so as to facilitate clustering and ordination. Clustering analyses try to find species to groups, whereas ordinations attempt to place them spatially so that similar species are close and dissimilar ones are far. Commonly used classification method is cluster analysis. Ordination technique used in the present study was Multidimensional Scaling (MDS). The nematode species list was processed by group average cluster analysis and non-metric multidimensional Scaling (NMDS) ordination.

3.3.1. Cluster analysis

Cluster analysis was done to find out the similarities between groups. The most commonly used clustering technique is the hierarchical agglomerative method. The results of this 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 fourth root transformation was used to produce the dendrogram.

3.3.2. NMDS (Non - metric Multi Dimensional Scaling)

This method was proposed by Shepard (1962) and Kruskal (1964) and this was used to find out the similarities (or dissimilarities) between each pair of species to produce a 'map', which would ideally show the configuration of species in a specified number of dimensions, and attempts to satisfy all the conditions imposed by similarity matrix.

3.3.3. ANOSIM (Analysis of Similarities)

ANOSIM (1-way layout) permutation test was employed to test the differences between free-living nematodes among selected depth ranges. It is denoted by 'R' and calculated using the following formula:

$$R = (r_B - r_W) / (M/2)$$

Where, r_B = is the average of rank similarities arising from all pairs of replicates between different sites; r_W = is the average of all rank similarities among replicates within sites and M = n (n-1). n represents the total number of samples under consideration.

3.3.4. Draftsman Plot

The draftsman plot was used to check the interrelation between all variables in the present study. The most significant variables were later checked by BIOENV procedure. In draftsman plot the associated correlation matrix between all pairs of variables is calculated and it can provide the collinearity between variables indicated by a straight- line relationships with little scatter. Again it would help to reduce all subsets of variables, which have mutual standard product-moment correlations averaging more than 0.95 to a single representative.

3.3.5. BIO-ENV procedure

Insights into the causative factors governing species distributions were attained through computing correlations between environmental variables and faunal attributes like diversity and numerical abundance. In the present investigation, in order to depict the correlations of environmental parameters and biological entities, the procedure of BIO-ENV (Clarke and Ainsworth, 1993) was employed. The procedure is vouched on measuring the agreement between the rank correlations of the biological (Bray-Curtis similarity) and environmental (Eucledian distance) matrices. A weighted spearman rank correlation coefficient

(Pω) was used to determine the correlations between the nematode similarity matrix and all possible combinations of environmental parameters.

$$\rho\omega = \frac{6}{N\ (N-1)} \sum_{i=1}^{N} \frac{(ri - si)^2}{ri + sj}$$

The following environmental variables were used: Depth (m), sand (%), silt (%), clay (%), total organic carbon (%), temperature (°C), salinity (ppt), dissolved oxygen (ml/l).

3.3.6. SIMPER-procedure:

The similarities or dissimilarities were explained by using the SIMPER procedure in order to ascertain the species contributing to the similarity or dissimilarity.

Chapter 4

Hydrography

4.1. Introduction

The boundaries of niche of any organism are depended on the variation of physico chemical parameters. Either individually or together they influence the biology of the organisms (Kinne, 1963). The life of benthic organisms is also depended on the interaction of biotic and abiotic factors. The important abiotic factors such as temperature, salinity and dissolved oxygen play a key role in benthic environment. The composition of meiofauna in the aquatic environment is determined by the conditions of overlying water (Giere, 1993). These conditions in turn are responsible for the most chemical and physical factors in the sediment, for the supply of oxygen, dissolved and particulate organic matter, and thus controls the living conditions of meiobenthos in general (Giere, *loc cit.*).

Probably no other environmental factor is universally important as temperature. Any change in temperature is bound to affect many chemical processes taking place in plant or animal tissues, and so affects the organism as a whole (Moore, 1958). Because several properties of marine environment usually vary together, the effects of variation of a single factor is seldom evident in natural conditions. The continual circulation of the oceans and their enormous heat capacity ensure that the extent of temperature variation in the sea is small despite great geographical and seasonal differences in absorption and radiation of heat (Tait, 1968). In general, metabolic rates of organisms increase with an increase in the ambient temperature to the level of tolerance of the species.

Meiofauna exists in all types of aquatic environments with temperature extremes, but studies showed that their community structure is affected by temperature (Giere, 1993). Other than temperature, salinity is a major factor controlling meiofaunal existence in aquatic environments. Among meiobenthic organisms, large numbers of species are having wide range of salinity tolerances whereby they exit under all salinity regimes. Irregular salinity variations can determine occurrence and species composition of meiobenthos (Remane, 1934). Alongi (1990) reported a drastic reduction of meiobenthos in tropical monsoonal period, which lowers the salinity.

Oxygen is the next important factor among the abiotic parameters, determining the habitat conditions and presence of meiobenthos. Most meiobenthic organisms have relatively larger surface areas and high oxygen demands. Thus the distribution of meiobenthic communities can be correlated with the oxygen supply of the aquatic environment, especially in interstitial water. Meiofauna are present in anoxic conditions like thiobios, where hydrogen sulphide and other reduced substances are regularly dominating ecofactors. (Giere, 1992).

The present chapter consolidates the major observations on the hydrography of the West coast. A detailed description of the hydrography ~~was~~ already been attempted (Joydas, 2002). In this backdrop, a broad summary is presented here for obtaining a holistic picture of the benthic environment along the west coast of India.

4.2. Results

4.2.1: Temperature

4.2.1.1 Depth wise variation

Depth-wise variation of bottom temperature in each transect is presented in Table 4.1. The results showed a great variation with depth in each transect. The range of bottom water temperature was from a minimum of 12.9°C (off Kozhikode, 219m) to a maximum of 29.42°C (off Thiruvananthapuram, 30m). When bottom water temperature in each transect was taken into consideration, the decrease in temperature from 30 to 200m depth was less in higher latitudes than in lower latitudes. The maximum variation observed along the transects was off Kozhikode, where it was 16.34 °C. The minimum difference was noticed off Dwarka, where it was 5.71°C. The difference varied within the range of 11.3°C (off Vadanappilly) to 16.34°C (off Kozhikode) in the transects along southwest coast, whereas it was 13.18 °C to 5.71°C (off Dwarka) in northwest coast.

4.2.1.2 Latitudianl variation:

Within each depth range, there was difference in temperature along latitudes (Table 4.2 & Fig. 4.1). In general the temperature showed a progressive decrease from south to north upto 100m depth. In 30-50m depth ranges, maximum temperature was 29.42°C (off Thiruvananthapuram and off Kollam) and minimum was observed 22.64°C (off Dwarka). The average

Table 4.1: Depthwise variation in hydrographical parameters in each transect

Transects	St.no.	Depth (in m)	Temp (in ^{0}C)	Salinity (in ppt)	DO (in ml L^{-1})
⇓	⇓	⇓	⇓	⇓	⇓
cape	1	30.7	28.35	33.71	3.25
	2	50.6	28.07	33.74	3.14
	3	101	22.27	34.80	0.86
	4	208	13.92	35.06	0.14
‖					
tvm	7	30	29.42	34.10	3.28
	6	59	29.18	34.47	3.69
	5	124	17.36	35.05	0.26
‖					
klm	8	30.6	29.42	34.01	3.33
	9	50	29.13	34.19	3.08
	10	73.7	28.45	35.22	2.77
	11	101	22.45	35.33	1.45
	12	238	13.55	35.13	0.24
‖					
kch	13	33.3	29.29	34.07	3.30
	14	51	29.20	34.57	3.35
	15	101	23.12	35.60	1.50
	16	202	14.40	35.13	0.13
‖					
vad	16D	36.2	28.47	34.66	3.30
	16C	52.6	28.27	35.27	3.13
	16B	103.4	25.42	35.62	2.46
	16A	197.3	17.18	35.24	0.20
‖					
kzh	17	31	29.24	34.60	3.20
	18	50	29.06	34.48	3.07
	19	102	27.43	37.31	1.70
	20	219	12.90	35.21	0.15
‖					
knr	25	31	29.07	34.70	3.17
	24	51.2	29.12	34.83	3.10
	23	67	29.04	35.00	2.98
	22	102	27.73	36.31	2.92
	21	202	14.31	35.21	0.06
‖					
mngr	26	31	29.13	35.03	3.70
	27	50.8	29.15	35.10	3.11
	28	101	26.74	35.81	2.06
	29	205	13.75	35.27	0.04
‖					
cnpr	29D	33.9	28.48	34.60	3.87
	29C	53.6	28.34	35.56	3.54
	29B	104.3	25.90	35.83	2.26
	29A	193	16.04	35.30	0.11
‖					
btkl	34	31	28.16	35.07	3.02
	33	54.4	28.82	35.33	3.42
	32	68	28.80	35.85	2.29
	31	101	28.23	36.04	2.46
	30	206	13.78	35.31	0.04

Table 4.1: Continued.

Transects	**St.no.**	**Depth (in m)**	**Temp (in ^{0}C)**	**Salinity (in ppt)**	**DO (in ml L^{-1})**
⇓	⇓	⇓	⇓	⇓	⇓
goa	35	32	27.50	35.36	2.99
	36	52	27.82	35.40	3.00
	37	72	27.37	35.73	1.66
	38	101	24.84	35.84	1.52
	39	206	14.32	35.42	0.03
||					
rtngr	40	32	26.67	35.42	3.20
	41	51.4	27.23	35.53	3.20
	42	76	27.31	35.71	1.85
	43	100.7	24.55	35.99	0.75
	44	211	15.06	35.49	0.04
||					
dbhl	44A	35.3	26.70	35.68	3.87
	44B	57.1	26.66	35.60	3.72
	44C	95.7	25.69	35.68	2.03
	44D	94.3	26.10	36.00	3.43
||					
ofmb	45	33	25.75	35.55	3.39
	46	51	26.49	35.74	3.35
	47	96	26.26	35.96	2.07
	48	89	25.81	36.06	1.98
||					
almb	49	95	25.28	36.22	2.01
	50	91	25.60	36.34	2.62
	51	85.3	24.98	35.84	3.31
	52	79	25.39	35.95	3.35
	53	51	23.68	35.47	3.36
	54	32	23.39	35.40	3.46
||					
prbn	58	33	24.05	36.11	3.59
	57	53	23.59	36.04	3.60
	56	101	24.12	36.46	2.94
	55	210	15.79	35.96	0.02
||					
dwrk	59	33	22.64	36.12	3.56
	60	52	22.72	36.19	3.57
	61	100	23.64	36.44	3.10
	62	200	16.93	36.06	0.03

Table 4.2 : Latitudinal variation of hydrographical parameters in each depth range

4.2a: 30 - 50m depth range

St.no.	Transect	Depth	Temp	Salinity	DO
		(in m)	(in ^{0}C)	(in ppt)	(in ml L^{-1})
1	cape	30.7	28.35	33.71	3.25
7	tvm	30.0	29.42	34.10	3.28
8	klm 1	30.6	29.42	34.01	3.33
9	klm 2	50.0	29.13	34.19	3.08
13	kch	33.3	29.29	34.07	3.30
16D	vad	36.2	28.47	34.66	3.30
17	kzh1	31.0	29.24	34.60	3.20
18	kzh2	50.0	29.06	34.48	3.07
25	knr	31.0	29.07	34.70	3.17
26	mngr	31.0	29.13	35.03	3.70
29D	cnpr	33.9	28.48	34.60	3.87
34	btkl	31.0	28.16	35.07	3.02
35	goa	32.0	27.50	35.36	2.99
40	rtngr	32.0	26.67	35.42	3.20
44A	dbhl	35.3	26.40	35.68	3.87
45	ofmb	33.0	25.75	35.55	3.39
54	almb	32.0	23.39	35.40	3.46
58	prbn	33.0	24.05	36.11	3.59
59	dwrk	33.0	22.64	36.12	3.56
Mean			27.55	34.88	3.34
SD			2.16	0.72	0.27

Table 4.2b: 51 -75m depth range

St.no.	Transect	Depth (in m)	Temp (in ^{0}C)	Salinity (in ppt)	DO (in ml L^{-1})
2	cape	50.6	28.07	33.74	3.14
6	tvm	59.0	29.18	34.47	3.69
10	klm	73.7	28.45	35.22	2.77
14	kch	51.0	29.20	34.57	3.35
16C	vad	52.6	28.27	35.27	3.13
24	knr 1	51.2	29.12	34.83	3.10
23	knr 2	67.0	29.04	35.00	2.98
27	mngr	50.8	29.15	35.10	3.11
29C	cnpr	53.6	28.34	35.56	3.54
33	btkl 1	54.4	28.82	35.33	3.42
32	btkl 2	68.0	28.80	35.85	2.29
36	goa 1	52.0	27.82	35.40	3.00
37	goa 2	72.0	27.37	35.73	1.66
41	rtngr	51.4	27.23	35.53	3.20
44B	dbhl	57.1	26.66	35.60	3.73
46	ofmb	51.0	26.49	35.74	3.35
53	almb	51.0	23.68	35.47	3.36
57	prbn	53.0	23.59	36.04	3.60
60	dwrk	52.0	22.72	36.19	3.57
Mean			27.47	35.58	3.40
SD			2.02	0.59	0.50

Table 4.2c: 76 -100m depth range

St.no.	Transect	Depth (in m)	Temp (in °C)	Salinity (in ppt)	DO (in ml L^{-1})
42	rtngr	76.0	27.31	35.71	1.85
44C	dbhl 1	95.7	25.69	35.68	2.30
44D	dbhl 2	94.3	26.10	36.00	3.43
47	ofmb 1	96.0	26.26	35.96	2.07
48	ofmb 2	89.0	25.81	36.06	1.98
49	almb 1	95.0	25.28	36.22	2.01
50	almb 2	91.0	25.60	36.34	2.62
51	almb 3	85.3	24.98	35.84	3.31
52	almb 4	79.0	25.39	35.95	3.35
61	dwrk	100.0	23.64	36.44	3.10
Mean			25.606	36.20	2.60
SD			0.945	0.25	0.64

Table 4.2d: 101 - 150m depth range

St.no.	Transect	Depth (in m)	Temp (in °C)	Salinity (in ppt)	DO (in ml L^{-1})
3	cape	101.0	22.27	34.80	0.86
5	tvm	124.0	17.36	35.05	0.26
11	klm	101.0	22.45	35.33	1.45
15	kch	101.0	23.12	35.60	1.50
16B	vad	103.4	25.42	35.62	2.46
19	kzh	102.0	27.43	37.31	1.70
22	knr	102.0	27.73	36.31	2.92
28	mngr	101.0	26.74	35.81	2.06
29B	cnpr	104.3	25.90	35.83	2.26
31	btkl	101.0	28.23	36.04	2.46
38	goa	101.0	24.84	35.84	1.52
43	rtngr	100.7	24.55	35.99	0.75
56	prbn	101.0	24.12	36.46	2.94
Mean			24.62	35.84	1.78
SD			2.92	0.639	0.835

Table 4.2e: >150m depth

St.no.	Transect	Depth (In m)	Temp (in °C)	Salinity (in ppt)	DO (in ml L^{-1})
4	cape	208.0	13.92	35.06	0.14
12	klm	238.0	13.55	35.13	0.24
16	kch	202.0	14.40	35.13	0.13
16A	vad	197.3	17.18	35.24	0.20
20	kzh	219.0	12.90	35.21	0.15
21	knr	202.0	14.31	35.21	0.06
29	mngr	205.0	13.75	35.27	0.04
29A	cnpr	193.0	16.04	35.30	0.11
30	btkl	206.0	13.78	35.31	0.04
39	goa	206.0	14.32	35.42	0.03
44	rtngr	211.0	15.06	35.49	0.04
55	prbn	210.0	15.79	35.96	0.02
62	dwrk	200.0	16.93	36.06	0.03
Mean			14.76	35.36	0.095
SD			1.33	0.31	0.07

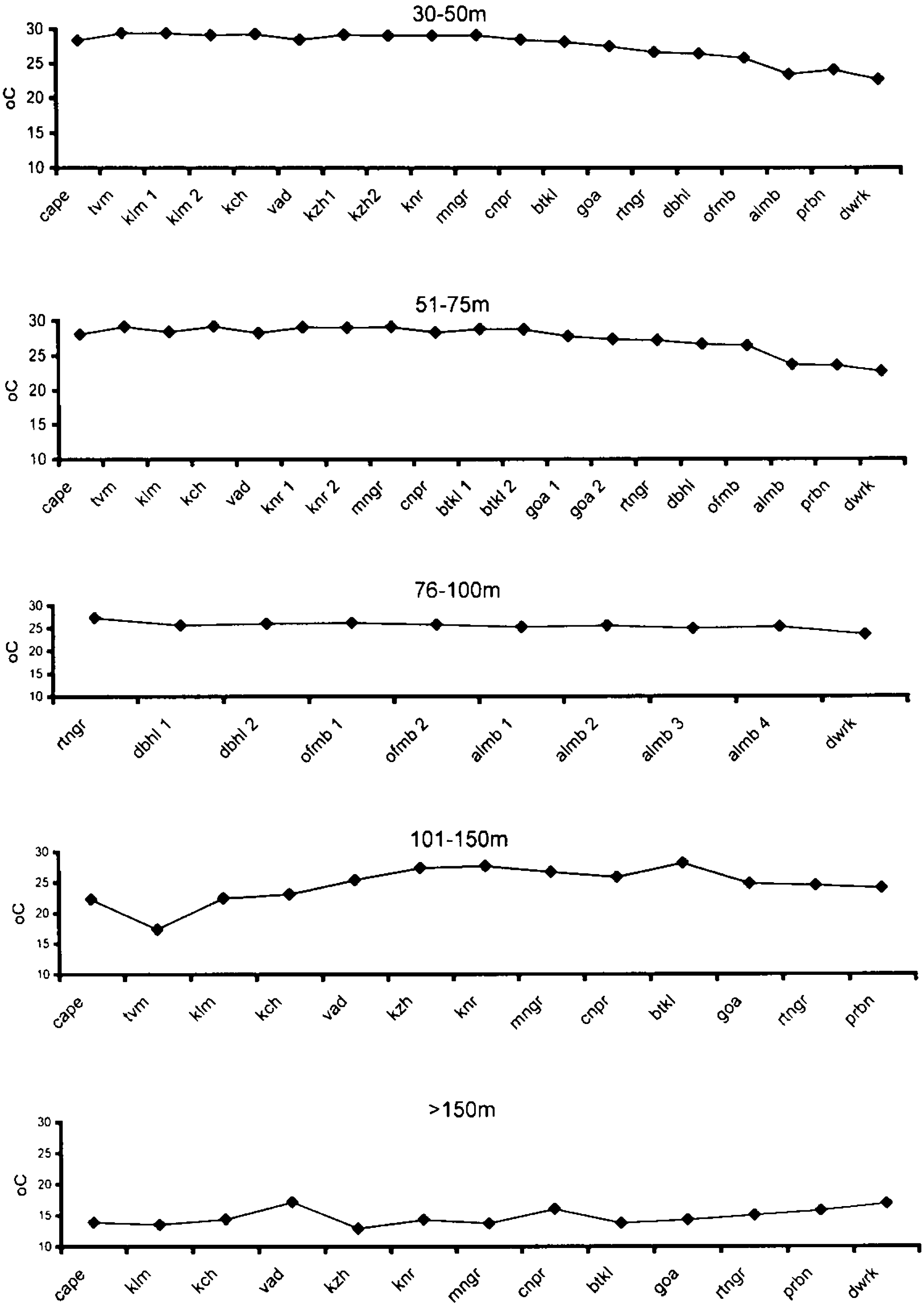


Fig.4.1.Variation in bottom temperature at different depth ranges, west coast of India

bottom temperature of this depth range was observed to be 27.57^{0}C. The situation within the 51-75m depth range was also more or less similar. Here the highest temperature was 29.2^{0}C, recorded off Kochi and the lowest was 22.72^{0}C, recorded off Dwarka, with an average value of 27.47^{0}C. In 76-100m, the maximum temperature noted was 27.31^{0}C (off Ratnagiri) and the lowest was 23.64^{0}C (off Dwarka), the average being 25.61^{0}C. Within 101-150m depth range the central area extending from off Vadanappilly to off Bhatkal showed high values. Here the temperature ranged between 25.42^{0}C (off Vadanappilly) and 28.23^{0}C (off Bhatkal). The region on either side of this area exhibited comparatively less temperature and the minimum values were noted in south-west region. The average temperature in this depth range was 24.63^{0}C. Beyond 150m, it showed a decreasing trend from south to north except off Vadanappilly and off Coondapore. The mean temperature recorded in this depth range was 14.87^{0}C.

4.2.2: Salinity

4.2.21: Depth wise variation

Depth-wise variation of bottom salinity in each transect is presented in Table 4.1. Salinity varied from a minimum of 33.71ppt (off Cape Comorin, 31m) to a maximum of 37.31ppt (off Kozhikode, 102m). Salinity showed only slight fluctuation with depth. In each transect, there was an increase in salinity towards deeper stations by a magnitude of 0.38–2.8ppt. Maximum difference in salinity within a transect was 2.83ppt noticed off Kozhikode, while 100m depth salinity showed abnormally high values of 37.31ppt. The minimum difference in

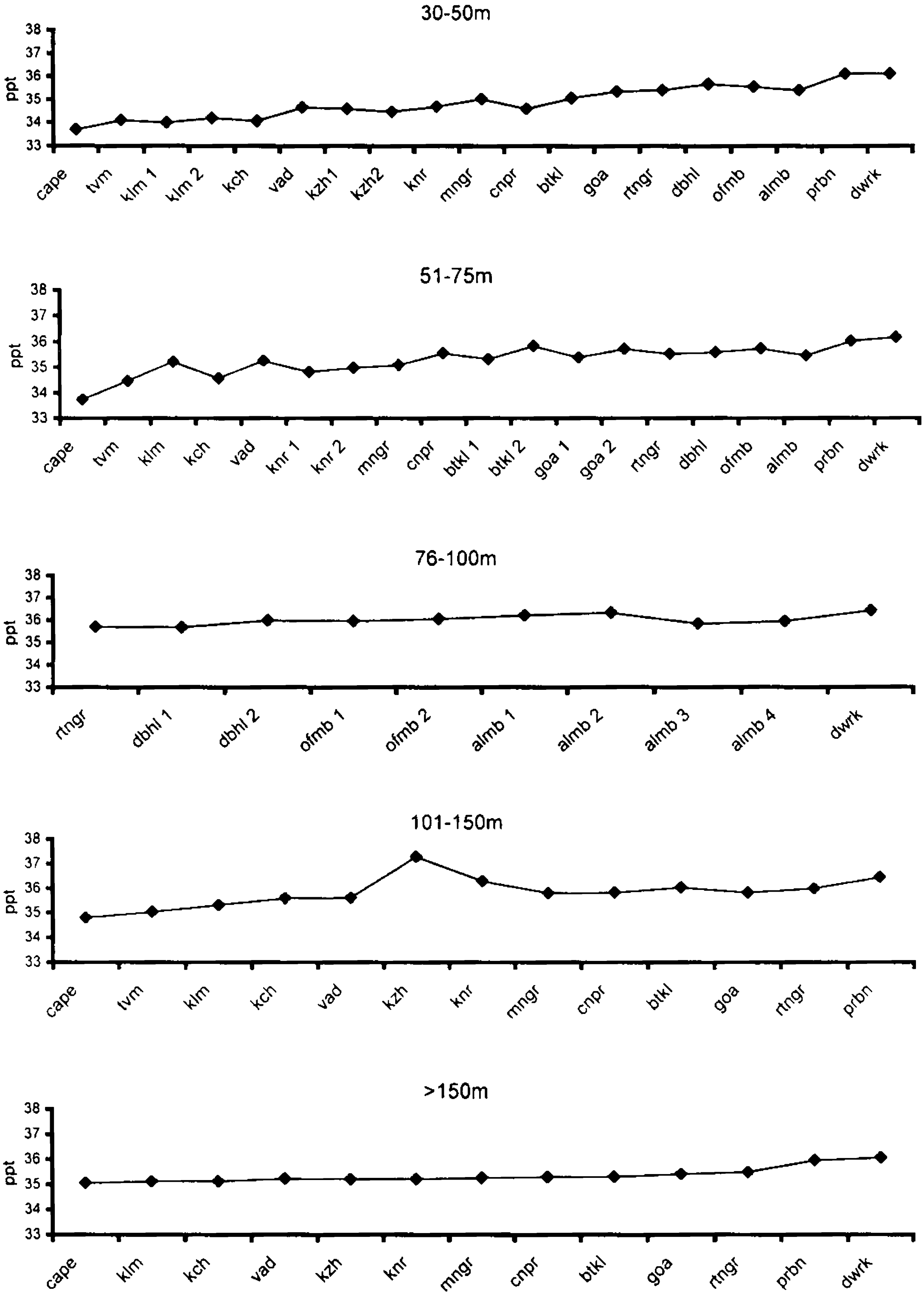


Fig.4.2. Variation in bottom salinity at different depth ranges, west coast of India.

salinity observed was 0.38ppt, off Dwarka. The difference was within the range of 0.78ppt (off Mangalore) and 2.83ppt (off Kozhikode) in south-west coast, whereas it was 0.38ppt (off Dwarka) and 0.57ppt (off Ratnagiri) in north west coast.

4.2.2.2. Latitudinal variation

Salinity variations in different latitudes and at different depth ranges were not apparently high (Table 4.2 & Fig. 4.2). Within the 30-50m depth, salinity ranged between 33.71 (off Cape Comorin) and 36.12ppt (off Dwarka) with an average of 34.89ppt. Within 51-75m, it ranged between 33.74 (off Cape Comorin) and 36.19ppt (off Dwarka) with an average of 35.30ppt. Within the 76-100m, it varied from 35.71 (off Ratnagiri) to 36.44ppt (off Dwarka) with an average of 36.02ppt. Within the 101-150m, salinity varied between 34.80 (off Cape Comorin) and 37.31ppt (off Kozhikode), the average being 35.85ppt. In the depth beyond 150m, the range was between 35.06 (Off Cape Comorin) and 36.06ppt (off Dwarka). Thus a progressive increase in salinity was observed from south to north in the shelf as whole.

4.2.3. Dissolved Oxygen

4.2.3.1. Depth wise variation.

Depth-wise variation of dissolved oxygen in each transect is presented in Table 4.1. There was a sharp decrease in dissolved oxygen values with increase in depth. Along the shelf, it ranged between 0.0005 (off Dabhol, 191m) and 3.87ml l^{-1} (off Coondapore, 30m). The decrease in oxygen from 30 to 200m ranged between 92.1% (Off Thiruvananthapuram) and 99.99% (off

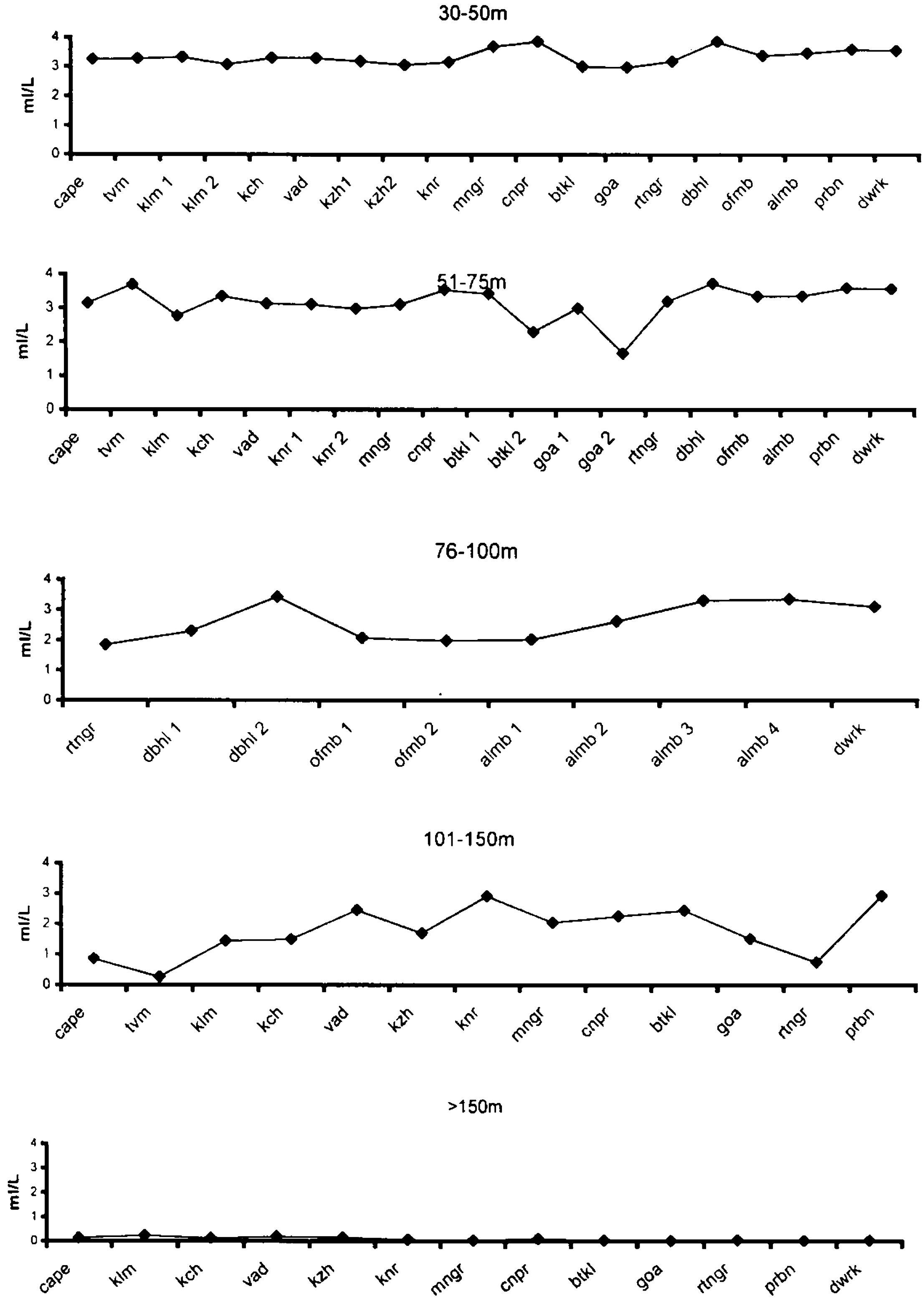


Fig.4.3. Variation in dissolved oxygen at different depth ranges, west coast of India.

Dabhol). In general, the percentage of decrease increased from south to north. Near anoxic values were observed in the shelf edge of northwest coast.

4.2.3.2. Latitudinal variation

There was no significant difference noticed in the values of dissolved oxygen among latitudes within each depth range (Table 4.2 & Fig. 4.3). Within 30-50m, it varied from 2.99 (off Goa) to 3.87ml l^{-1} (off Coondapore and off Dabhol) with an average of 3.35ml l^{-1}. Within the 51-75m, it ranged between 1.66 (off Goa, 72m) and 3.6 ml l^{-1} (off Thiruvananthapuram, 59m) and the average was 3.16ml l^{-1}. Within 76-100m, the range was between 1.85 (off Ratnagiri) and 3.35ml l^{-1} (Along Mumbai, 79m) and the average was 2.6ml l^{-1}. Within the depth of 101-150m, the dissolved oxygen varied between 0.26 (off Thiruvananthapuram) and 2.94ml l^{-1} with an average of 1.78ml l^{-1}. Beyond the depth of 150m, it ranged between 0.04 (off Mangalore) and 0.24ml l^{-1} (off Kollam) and the average was 0.09ml l^{-1}.

Chapter 5

Sediment Characteristics

5.1 Introduction

The nature of substratum determines the morphology, dominance pattern, feeding and interaction of benthic species (Snelgrove and Butman, 1994). As the benthic organisms are living on or in the various substratum types there exists a direct relation between substratum and benthos. The distribution of benthic organisms is controlled to certain extent by substratum characteristics and the organisms in turn profoundly influence the properties of the substratum. Many studies have correlated infaunal invertebrate distributions (abundance and diversity) leading to the generalization of distinct associations between animals and specific sediment types (Gray, 1974; Snelgrove and Butman, *loc cit.*).

Studies of the sediment characteristics were an obligatory part of benthic studies. Since the relation between benthos and sediment was revealed long ago by the classic study of Sanders (1958), several workers were indulged in understanding the temporal and spatial variation of sediment dwelling benthos along the various geographical regions. In Indian waters, large quanta of works related to sediment properties and bottom topography have been carried out (Harkantra *et al.*, 1980, Hashimi, 1981, Nair and Hashimi, 1986). Since most of these studies were localised, a synoptic representation of the entire shelf sediments is lacking.

The topography of the Indian western continental shelf upto 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 covered with three different types of sediments (Hashimi, 1981) of different origin. A nearshore 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 cited coastal sediment zones are originated as a result of geological processes of weathering and erosion on the coastal rocks. The age of calcareous sands of the outer shelf is of late Pleistocene origin, when the sea level stood 60-90m below the present level. The radio-carbon age of the calcareous sediments are between 9,000 and 11,000 years before the present, and is termed as relict (Nair, 1974; Nair *et al.*, 1979).

Various studies have been conducted to understand the substrata of the western continental shelf of India. Most of the works were regional and only few studies were attempted in the shelf area as a whole. Parulekar *et al.* (1976) found, the substrata off Mumbai upto 60km to be of a uniformly muddy nature. Ansari *et al.* (1977) studied the sediment nature in nearshore regions of five bays viz. Vengurla, Goa, Karwar, Malpe and Mangalore, and noticed that the sediment characteristics varied from region to region. 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 off Karnataka. Hashimi (1981) made a comparative study of the western and eastern continental shelves around Cape Comorin upto a depth of 50m and found a higher proportion of sand from Kollam to south.

Different workers attempted to study the sediment nature of the various regions of the west coast (Vizakat *et al.*, 1991; Purnachandra Rao, 1991; Pandarinath and Narayana, 1991b; Ansari *et al.*, 1994; Harkantra and Parulekar, 1994; Venkatesh Prabhu *et al.*, 1997; Sriram *et al.*, 1998).

Besides texture, the chemical composition i.e. organic content of bottom sediments may be a more causative factor than 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 of 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 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 course substrata had low organic carbon content. Harkantra and Parulekar (1981) noticed high organic carbon content in muddy bottom in the coastal zones of Goa.

Different workers studied the organic deposits of sediments from various coastal and estuarine areas of the west coast and substantiated a general fact that finer sediments retained more organic matter than coarser one. The major studies were in the Konkan region (Vizakat *et al.*, 1991); off Gangolli (Pandarinath and Narayana 1991a); off Honavar (Narayana and Venkatesh Prabhu,, 1993); Goa (Ansari *et al.*, 1994) and Rajapur Bay (Harkantra and Parulekar, 1994).

Particle size of sediments has also been shown by many workers to have a profound effect on the meiofauna (Wieser, 1959 b; Boaden, 1962; Gray, 1966; 1967; Jansson, 1967a). Gray and Rieger (1971) emphasized the importance of grain size in affecting the overall biomass on boreal sandy beaches. Wieser (1959c) stated that 200µm (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 meiobenthos (McIntyre, 1969; Peres, 1982). 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). In Indian waters, Ansari and Parulekhar (1998) studied the relation between particle size and meiofauna off Goa and pointed out a significant relation between meiofaunal abundance and sediment size.

Table 5.1: Depthwise variation of sediment characters in each transect.

Transects	St.no.	Depth (in m)	OM (%)	Sand (%)	Silt (%)	Clay (%)	Nomenclature
⇓	⇓	⇓	⇓	⇓	⇓	⇓	⇓
cape	1	30.7	2.18	98.63	1.05	0.33	sand
	2	50.6	0.44	99.00	0.86	0.14	sand
	3	101	1.74	96.37	2.97	0.66	sand
	4	208	2.73	86.09	11.18	2.73	sand
‖							
tvm	7	30	0.99	99.69	0.11	0.20	sand
	6	59	3.96	96.74	1.97	1.21	sand
	5	124	1.50	98.46	0.81	0.76	sand
‖							
klm	8	30.6	2.85	9.53	72.56	18.55	clayey silt
	9	50	1.19	96.89	1.83	1.28	sand
	10	73.7	1.31	97.53	1.64	0.83	sand
	11	101	2.73	85.80	11.05	3.05	sand
	12	238	2.26	92.85	5.61	1.54	sand
‖							
kch	13	33.3	1.35	95.47	1.69	1.84	sand
	14	51	5.46	82.36	12.63	5.02	sand
	15	101	3.44	68.69	25.34	5.97	silty sand
	16	202	2.57	84.45	12.16	3.39	sand
‖							
vad	16D	36.2	1.03	85.18	10.23	4.59	sand
	16C	52.6	1.78	72.23	20.66	7.12	silty sand
	16B	103.4	1.35	71.71	20.47	7.83	silty sand
	16A	197.3	1.62	71.99	21.20	6.81	silty sand
‖							
kzh	17	31	5.54	0.53	58.11	41.37	clayey silt
	18	50	2.53	79.39	15.16	5.45	sand
	19	102	3.13	87.22	9.12	3.66	sand
	20	219	4.95	88.94	7.45	3.62	sand
‖							
knr	25	31	6.71	0.40	47.69	51.91	silty clay
	24	51.2	4.95	50.13	36.47	13.40	silty sand
	23	67	3.64	84.64	10.12	5.25	silty sand
	22	102	4.00	53.92	38.76	7.32	silty sand
	21	202	4.11	60.46	31.27	8.26	silty sand
‖							
mngr	26	31	4.99	0.29	47.13	52.59	silty clay
	27	50.8	3.40	75.76	18.31	6.00	sand
	28	101	3.36	73.73	21.86	4.41	silty sand
	29	205	4.59	80.52	12.09	7.40	sand
‖							
cnpr	29D	33.9	4.27	1.55	69.99	28.46	clayey silt
	29C	53.6	0.47	97.17	2.44	0.39	sand
	29B	104.3	0.87	93.61	5.06	1.32	sand
	29A	193	1.58	83.39	11.56	5.06	sand
‖							
btkl	34	31	4.95	12.07	63.77	24.16	clayey silt
	33	54.4	2.29	94.67	4.21	1.28	sand
	32	68	1.74	97.47	1.58	0.95	sand
	31	101	4.04	29.20	65.69	5.11	sandy silt
	30	206	4.87	0.74	72.91	26.35	clayey silt

Table 5.1: Continued.

Transects	St.no.	Depth (in m)	OM (%)	Sand (%)	Silt (%)	Clay (%)	Nomenclature
⇓	⇓	⇓					
	35	32	5.28	0.72	48.73	50.56	silty clay
	36	52	4.43	22.25	45.66	32.10	sand silt clay
goa	37	72	4.99	65.41	27.61	6.98	silty sand
	38	101	5.06	80.39	16.99	2.62	sand
	39	206	2.91	85.62	10.55	3.83	sand
‖							
	40	32	3.24	0.38	44.69	53.35	slty clay
	41	51.4	4.62	1.03	53.90	45.07	clayey silt
rtngr	42	76	2.97	74.26	23.23	2.51	silty sand
	43	100.7	4.15	91.11	6.91	1.98	sand
	44	211	6.23	28.55	56.09	15.36	sandy silt
‖							
	44A	35.3	3.76	0.86	38.02	61.12	silty clay
	44B	57.1	4.87	0.54	44.01	55.45	silty clay
dbhl	44C	95.7	4.75	53.32	33.91	12.76	silty sand
	44D	94.3	0.67	95.15	3.41	1.44	sand
‖							
	45	33	2.67	1.09	35.23	63.68	silty clay
ofmb	46	51	2.49	13.83	49.58	36.59	clayey silt
	47	96	3.03	86.79	9.47	3.74	sand
	48	89	2.49	78.50	14.62	6.88	sand
‖							
	49	95	0.87	99.60	0.29	0.11	sand
	50	91	0.91	99.74	0.19	0.08	sand
almb	51	85.3	1.31	88.16	6.91	3.41	sand
	52	79	1.78	4.87	63.01	32.16	clayey silt
	53	51	0.65	0.80	45.18	53.88	silty clay
	54	32	0.48	4.03	53.49	42.47	clayey silt
‖							
	58	33	0.24	0.17	51.62	48.21	clayey silt
prbn	57	53	1.25	1.42	47.59	50.99	silty clay
	56	101	2.08	8.58	90.58	0.84	silt
	55	210	2.79	1.46	47.70	50.85	silty clay
‖							
	59	33	0.59	80.08	8.30	11.61	sand
dwrk	60	52	0.48	0.12	45.29	54.59	silty clay
	61	100	1.90	79.53	13.77	6.17	sand
•	62	200	3.48	2.29	54.64	43.08	clayey silt

Nevertheless, in the earlier studies of Mclachlan, 1977; Crisp and William, 1971; Jansson, 1967a; Hulings and Gray, 1976, no direct relation between the particle size and meiofaunal abundance was noticed. In addition, all these studies showed that medium particle size has little relationship to the abundance of meiofauna.

A detailed study on the sediment characteristics of west coast of India, collected from cruise 162 and 192A are documented in the study, macrobenthos of the shelf waters of the west coast of India (Joydas, 2002). Therefore in the present study a general summary is presented for obtaining a holistic picture of the substratum along the west coast of India.

5.2 Result

5.2.1. Texture:

Studies of the sediment characteristics were carried out from the same grab sample as those collected for meiobenthos. This allowed the meiofaunal data to be accurately referenced against variations in sediment texture and chemistry. Visual observation of the sediment nature was made during the collection. The colour of sediments was also noted. The colour ranged from greenish, greenish black, black or cream.

5.2.1.1. Depth-wise variation in each transect:

The depth-wise variation of the texture in each transect is presented in Table 5.1.

5.2.1.2. Latitudinal variation in different depth ranges:

Latitudinal variation of texture in different depth ranges is presented in Table 5.2.

30-50m depth range: In general, muddy sediment predominated this depth range due to the combinations of silt and clay, except for certain transects of south west coast. Those transects were, off Cape Comorin, Thiruvananthapuram, Kollam, Kochi and Vadanappilly. Again off Dwarka, sediment was sandy with pebbles and corals.

51-75m depth range: Sand was the major sediment upto Goa. Significant percentage of silt was also noticed with sand off Vadanappilly, Kannur and Goa. The sediment was muddy in nature, either silty clay or clayey silt from North off Goa upto off Dwarka.

76-100m depth range: Generally, substrata in this range were sandy with an exception of Along Mumbai at 79m, where it was clayey silt. Silty sand was observed off Ratnagiri and Dabhol.

101-150m depth range: Sand was dominant in this depth range also. But incidence of silt admixture was also noticed in lesser percentage off Kochi, Vadanappilly, Kannur and Mangalore and greater percentage off Bhatkal and Porbandar. Clay was not dominant in sediments from this depth range.

>150m depth: In general, sand was the dominant sediment upto Goa with an exception, off Bhatkal and Ratnagiri, where sediment were clayey silt and sandy

Table 5.2: Latitudinal variation of sediment characters in each depth range

Table 5.2a: 30 - 50m depth range

St.no.	Transect	Depth (in m)	OM (%)	Sand (%)	Silt (%)	Clay (%)	Nomenclature
1	cape	30.7	2.18	98.63	1.05	0.33	sand
7	tvm	30.0	0.99	99.69	0.11	0.20	sand
8	klm 1	30.6	2.85	8.89	72.56	18.55	clayey silt
9	klm 2	50.0	1.19	96.89	1.83	1.28	sand
13	kch	33.3	1.35	95.47	1.69	2.84	sand
16D	vad	36.2	1.03	85.18	10.23	4.59	sand
17	kzh1	31.0	5.54	0.52	58.11	41.37	clayey silt
18	kzh2	50.0	2.53	79.39	15.16	5.45	sand
25	knr	31.0	6.71	0.40	47.69	51.91	silty clay
26	mngr	31.0	4.99	0.28	47.13	52.59	silty clay
29D	cnpr	33.9	4.27	1.55	69.99	28.46	clayey silt
34	btkl	31.0	4.95	12.07	63.77	24.16	clayey silt
35	goa	32.0	5.28	0.71	48.73	50.56	silty clay
40	rtngr	32.0	3.24	1.96	44.69	53.35	silty clay
44A	dbhl	35.3	3.76	0.86	38.02	61.12	silty clay
45	ofmb	33.0	2.67	1.09	35.23	63.68	silty clay
54	almb	32.0	0.48	4.03	53.49	42.47	clayey silt
58	prbn	33.0	0.24	0.17	51.62	48.21	clayey silt
59	dwrk	33.0	0.59	80.08	8.31	11.61	sand
Mean			2.89	35.15	35.23	29.62	
SD			1.971	44.04	25.29	23.28	

Table 5.2b: 51 - 75m depth range

St.no.	Transect	Depth (in m)	OM (%)	Sand (%)	Silt (%)	Clay (%)	Nomenclature
2	cape	50.6	0.44	99.00	0.86	0.14	sand
6	tvm	59.0	3.96	96.74	1.97	1.29	sand
10	klm	73.7	1.31	97.53	1.64	0.83	sand
14	kch	51.0	5.46	82.36	12.63	5.02	sand
16C	vad	52.6	1.78	72.23	20.66	7.12	silty sand
24	knr1	51.2	4.95	50.13	36.47	13.40	silty sand
23	knr2	67.0	3.64	84.64	10.12	5.24	sand
27	mngr	50.8	3.40	75.69	18.31	6.00	sand
29C	cnpr	53.6	0.47	97.17	2.44	0.39	sand
33	btkl1	54.4	2.29	94.67	4.21	1.12	sand
32	btkl2	68.0	1.74	97.47	1.58	0.95	sand
36	goa1	52.0	4.43	22.25	45.65	32.10	sand silt clay
37	goa2	72.0	4.99	65.41	27.61	6.98	silty sand
41	rtngr	51.4	4.62	1.03	53.90	45.07	clayey silt
44B	dbhl	57.1	4.87	0.54	44.01	55.45	silty clay
46	ofmb	51.0	2.49	13.83	49.58	36.59	clayey silt
53	almb	51.0	0.653	0.8	45.18	53.88	silty clay
57	prbn	53.0	1.25	1.42	47.59	50.99	silty clay
60	dwrk	52.0	0.48	0.12	45.29	54.59	silty clay
Mean			2.80	55.42	24.72	19.85	
SD			1.78	41.22	20.11	22.16	

Table 5.2c: 76 - 100m depth range

St.no.	Transect	Depth (in m)	OM (%)	Sand (%)	Silt (%)	Clay (%)	Nomenclature
42	rtngr	76.0	2.97	74.26	23.23	2.51	silty sand
44C	dbhl1	95.7	4.75	53.32	33.91	12.76	silty sand
44D	dbhl2	94.3	0.67	95.15	3.41	1.44	sand
47	ofmb1	96.0	3.03	86.79	9.47	3.74	sand
48	ofmb2	89.0	2.49	78.50	14.62	6.88	sand
49	almb1	95.0	0.87	99.6	0.29	0.11	sand
50	almb2	91.0	0.91	99.74	0.19	0.08	sand
51	almb3	85.3	1.305	88.16	6.91	3.41	sand
52	almb4	79.0	1.78	4.87	63.01	32.16	clayey silt
61	dwrk	100.0	1.90	79.53	13.77	6.70	sand
Mean			2.06	75.99	16.88	6.97	
SD			1.27	28.57	19.32	9.63	

Table 5.2d: 101 - 150m depth range

St.no.	Transect	Depth (in m)	OM (%)	Sand (%)	Silt (%)	Clay (%)	Nomenclature
3	cape	101.0	1.74	96.37	2.97	0.66	sand
5	tvm	124.0	1.50	98.46	0.81	0.73	sand
11	klm	101.0	2.73	85.80	11.05	3.15	sand
15	kch	101.0	3.44	68.69	25.34	5.97	silty sand
16B	vad	103.4	1.35	71.71	20.47	7.83	silty sand
19	kzh	102.0	3.13	87.22	9.12	3.66	sand
22	knr	102.0	4.00	53.92	38.76	7.32	silty sand
28	mngr	101.0	3.36	73.73	21.86	4.41	silty sand
29B	cnpr	104.3	0.87	93.61	5.06	1.32	sand
31	btkl	101.0	4.04	29.20	65.69	5.11	sandy silt
38	goa	101.0	5.06	80.39	16.99	2.62	sand
43	rtngr	100.7	4.15	91.11	6.91	1.98	sand
56	prbn	101.0	2.08	8.58	90.58	0.84	silt
Mean			2.881	72.21	24.27	3.50	
SD			1.28	27.21	26.57	2.47	

Table 5.2e: >150m depth

St.no.	Transect	Depth (in m)	OM (%)	Sand (%)	Silt (%)	Clay (%)	Nomenclature
4	cape	208.0	2.73	86.09	11.18	2.73	sand
12	klm	238.0	2.26	92.85	5.61	1.54	sand
16	kch	202.0	2.57	84.45	12.16	3.39	sand
16A	vad	197.3	1.62	71.99	21.20	6.81	silty sand
20	kzh	219.0	4.95	88.94	7.45	3.61	sand
21	knr	202.0	4.11	60.46	31.27	8.27	silty sand
29	mngr	205.0	4.59	80.52	12.09	7.39	sand
29A	cnpr	193.0	1.58	83.39	11.56	5.06	sand
30	btkl	206.0	4.87	0.74	72.91	26.35	clayey silt
39	goa	206.0	2.91	85.62	10.55	3.83	sand
44	rtngr	211.0	6.23	28.55	56.09	15.36	sandy silt
55	prbn	210.0	2.79	1.45	47.70	50.85	silty clay
62	dwrk	200.0	3.48	2.28	54.64	43.08	clayey silt
Mean			3.43	59.02	27.26	13.71	
SD			1.41	36.75	22.80	16.25	

silt respectively. Off Porbandar and Dwarka, the sediment was silty clay and clayey silt.

5.2.2. Organic matter:

Organic matter distribution was found to related with substratum type. In general, finer sediments like clay and silt retained more organic matter than sand.

5.2.2.1. Depth-wise variation in each transect:

Depth-wise variation in percentage of organic matter in each transect is presented in Table 5.1.

5.2.2.2. Latitudinal variation in different depth ranges:

Latitudinal variation in percentage of organic matter is presented in Table 5.2 and Fig. 5.2.

30-50m depth range: In general, higher values were noticed in the areas off Kozhikode to Dabhol, where it ranged between 2.53 to 6.71%. Either side of this area showed low values. The lowest value noticed was 0.24% off Porbandar. The average organic matter percentage of this depth range was 2.88.

51-75m depth range: In this range, higher values were observed in two regions viz. off Kochi to Mangalore, where organic matter ranged between 3.4% and 5.46% with an exception at Vadanappilly (1.78%) and off Goa to Dabhol, where the percentage ranged between 4.43 to 4.99%. The lowest value was 0.44 % off Cape Comorin and the average for this depth range was 2.80%.

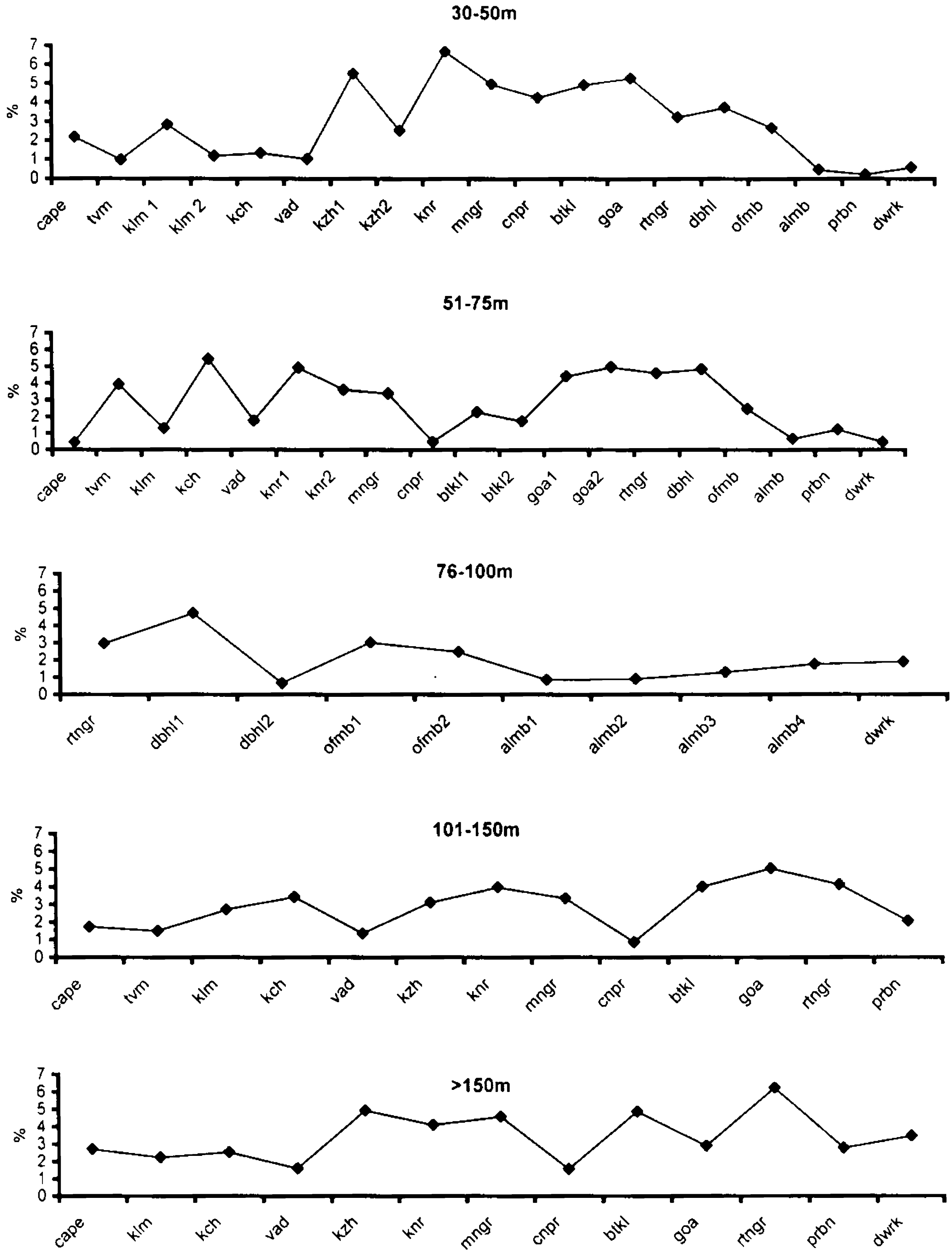


Fig.5.2. Variation in % of organic matter in sediments at different depth ranges, west coast of India

76-100m depth range: In this range, comparatively low values were noticed. The highest value of 3.03 was noticed off Mumbai and the lowest was 0.67% off Dabhol. The average value for this transect was 2.07%.

101-150m depth range: In this depth range, more or less higher values were noticed off Kochi to Ratnagiri (3.13 - 5.06%) with two exceptions, one off Vadanappilly (1.35%) and another off Coondapore (0.87%). The highest value for this transect was 5.06% off Goa. The lowest of 0.87% was observed off Coondapore. The average for this transect was 2.88%.

>150m depth: Higher values were noticed off Kozhikode to Ratnagiri (4.11 and 6.23%) with two exceptions, at off Vadanappilly (1.58%) and off Goa (2.91%). Lower values were observed elsewhere. The highest value in this depth range was 6.23% recorded off Ratnagiri and lowest was 1.58% off Coondapore. The average value for this transect was 3.43.

Chapter 6

Meiobenthos

6.1. Introduction

The oceans are home to an incredible variety of living organisms, 29 animal phyla, of which 14 are exclusively marine (Grassle, 2001). It might harbour some 10 million species, and has higher ecosystem diversity than that of land (Norse, 1995). Because of the inaccessibility and enormity of the world's oceans, our knowledge of marine biodiversity is limited than that of terrestrial diversity.

Meiobenthos are earlier considered as the apex of trophic end McIntyre and Murison, 1973). Recent studies showed their potential role in the ecology of benthic realm (Coull *et al.*,1995). In this backdrop quantitative attempts were begin to understand the potential role of meiofauna. However along the Indian coast, the history of meiofauna is rather recent.

From Indian water the first quantitative work of subtidal meiofauna (Damodaran, 1973) was conducted in early 1970s. The major works include that of Parulekar *et al.* (1976,1982), Ansari, (1978), Ansari, (1989), Harkantra and Parulekar, (1981), Ansari and Parulekar, (1998). Harkantra *et al.* (1980) recorded the major fauna of the shelf region of west coast up to a depth of 75m. These studies highlighted the general tendency of decreasing densities and biomass of meiofauna as the depth increases and nematodes were the dominant metazoans in meiofaunal samples studied.

Table. 6.2a Classified list of meiobenthic organisms identified from shelf waters of west coast of India.

Phylum	**Sarcomastigophora**
Class	Granuloreticulata
Order	Foraminiferida
Family	Rotalidae
Species	*Discorbis* sp
Species	*Discorbis allomorphinoides*
Species	D.globularis
Family	Buliminidae
Species	*Bulimina* sp
Species	*Bolivina nobilis*
Species	*Laxostomum limbatum*
Species	*Bulimina fijiensis*
Species	*Bolivinia interjuncta*
Species	*Bulivina marginata*
Family	Anomalinidae
Species	*Cibicides lobatulusa*
Species	*Planulina* sp
Species	*P. weullerstorfi*
Family	Trochamminaida
Species	*Trochammina nitida*
Family	Camerinidae
Species	*Operculina* sp
Family	Silicinidae
Species	*Miliammina* sp.
Family	Polymorphinidae
Species	*Nonion scaphum*
Family	Rhizamminidae
Species	*Marsipella* sp
Phylum	***Arthropoda***
Class	Crustacea
Order	*Copepoda*
Sub Order	Harpacticoida
Family	Ectinosomatidae
Species	*Arenosetella* sp
Species	*Pseudobradya* sp
Family	Harpacticidae
Species	*Harpacticus* sp
Family	Diosaccidae
Species	*Stenhelia* sp
Family	Ameridae

Table.6.2a contd.

		Species	*Ameira* sp
	Family		Paramesochridae
		Species	Apodopsyllus sp
	Family		Canthocamptidae
		Species	*Orthopsyllus* sp
	Family		Cylindropsyllidae
		Species	Leptostacus sp
Phylum			**Annelida**
	Family		Dinophilidae
		Species	*Trilobodrilus* sp
	Family		Neriidae
		Species	*Mesonerilla* sp
		Species	*Paranerilla* sp
	Class		Polychaeta
		Species	*Syllis sp*
		Species	*Magelona* sp
		Species	*Maldanis* sp
		Species	*Lumbrineris* sp
Phylum			**Kinorhyncha**
	Class		Cyclorhagia
	Order		Nomosomatidae
	Family		Echiniderida
		Species	*Cateria* sp
		Species	*Echinoderilla* sp

Table 6.2b. List of free-living marine nematodes identified from shelf waters of west coast of India.

Class **Adenophorea**
Subclass **Enoplia**

	Species	**Order**	**Family**
1	*Oncholaimus dujardini*	Enoplida	Oncholaimidae
2	*Oncholaimium vesicarium*	Enoplida	Oncholaimidae
3	*Oncholaimellus carlbergi*	Enoplida	Oncholaimidae
4	*Metoncholaimus* spp	Enoplida	Oncholaimidae
5	*Filoncholaimus filicaudatus*	Enoplida	Oncholaimidae
6	*Oncholaimus* spp	Enoplida	Oncholaimidae
7	*Viscosia macramphida*	Enoplida	Oncholaimidae
8	*Viscosia carynleyensis*	Enoplida	Oncholaimidae
9	*Viscosia viscosa*	Enoplida	Oncholaimidae
10	*Viscosia elagans*	Enoplida	Oncholaimidae
11	*Viscosia* spp.	Enoplida	Oncholaimidae
12	*Enoplus* spp	Enoplida	Enoplidae
13	*Halalaimus isaitshikovi*	Enoplida	Oxystominidae
14	*Halalaimus meyersi*	Enoplida	Oxystominidae
15	*Halailaimus gracilis*	Enoplida	Oxystominidae
16	*Halalaimus longicoudatus*	Enoplida	Oxystominidae
17	*Halalaimus* spp	Enoplida	Oxystominidae
18	*Oxystomina clavicoudata*	Enoplida	Oxystominidae
19	*Oxystomina elongata*	Enoplida	Oxystominidae
20	*Ledovitia phanertrata*	Enoplida	Oxystominidae
21	*Weiseria* spp	Enoplida	Oxystominidae
22	*Eurystomina* spp.	Enoplida	Enchelididae
23	*Tripyloides marinus*	Enoplida	Tripyloididae
24	*Bathylaimus* spp	Enoplida	Tripyloididae
25	*Anoplostoma* spp	Enoplida	Anoplostomatidae
26	*Trefusia longicoudata*	Enoplida	Trefusiidae
27	*Pseudocella* spp	Enoplida	Leptosomatidae
28	*Rhabdonemania* spp.	Enoplida	Rhabdodemaniidae
29	*Crenopharynx marioni*	Enoplida	Phanodermatidae
30	*Laimella filipjevi*	Enoplida	Comesomatidae
31	*Laimella longicaudata*	Chromadorida	Comesomatidae
32	*Laimella* spp	Chromadorida	Comesomatidae
33	*Dorylaimopsis* spp	Chromadorida	Comesomatidae
34	*Comesoma* spp	Chromadorida	Comesomatidae
35	*Sabatieria paracupida*	Chromadorida	Comesomatidae
36	*Sabatieria* spp	Chromadorida	Comesomatidae
37	*Setosebatieria hilarula*	Chromadorida	Comesomatidae
38	*Hopperia* spp	Chromadorida	Comesomatidae
39	*Actarjania* spp	Chromadorida	Comesomatidae
40	*Paracomesoma longispiculum*	Chromadorida	Comesomatidae
41	*Cervonema macramphis*	Chromadorida	Comesomatidae
42	*Richtersia inaequalis*	Chromadorida	Selachinematidae
43	*Richtersia* spp	Chromadorida	Selachinematidae
44	*Gamanema* spp	Chromadorida	Selachinematidae
45	*Choniolaimus papillatus*	Chromadorida	Selachinematidae
46	*Halichoanolaimus dolichurus*	Chromadorida	Selachinematidae
47	*Halichoanolaimus consimilis*	Chromadorida	Selachinematidae
48	*Synonchiella riemanni*	Chromadorida	Selachinematidae
49	*Latronema piratica*	Chromadorida	Selachinematidae
50	*Latronema orcina*	Chromadorida	Selachinematidae
51	*Latronema* sp	Chromadorida	Selachinematidae
52	*Cherionchus* spp	Chromadorida	Selachinematidae

Table 6.2b contd.

53	*Tricoma brevirostris*	Chromadorida	Desmoscolecidae
54	*Tricoma filipjevi*	Chromadorida	Desmoscolecidae
55	*Tricoma* spp	Chromadorida	Desmoscolecidae
56	*Greeffiella* spp.	Chromadorida	Desmoscolecidae
57	*Quadricoma scanica*	Chromadorida	Desmoscolecidae
58	*Quadricoma* spp.	Chromadorida	Desmoscolecidae
59	*Spirinia similis*	Chromadorida	Desmodoridae
60	*Spirinia parasitifera*	Chromadorida	Desmodoridae
61	*Spirinia* spp	Chromadorida	Desmodoridae
62	*Desmodora tenuispiculum*	Chromadorida	Desmodoridae
63	*Desmodora* spp	Chromadorida	Desmodoridae
64	*Desmodora brachypharynx*	Chromadorida	Desmodoridae
65	*Desmodora scaldensis*	Chromadorida	Desmodoridae
66	*Catanema macintyrei*	Chromadorida	Desmodoridae
67	*Chromaspirina* spp	Chromadorida	Desmodoridae
68	*Chromaspirina inaurita*	Chromadorida	Desmodoridae
69	*Metachromadora pulvinata*	Chromadorida	Desmodoridae
70	*Metachromadora* spp	Chromadorida	Desmodoridae
71	*Acanthopharyngoides chitwoodi*	Chromadorida	Desmodoridae
72	*Leptonemella aphanothecae*	Chromadorida	Desmodoridae
73	*Perspira* spp.	Chromadorida	Desmodoridae
74	*Acanthopharynx* spp	Chromadorida	Desmodoridae
75	*Parapinnanema harveyi*	Chromadorida	Chromadoridae
76	*Actinonema pachydermatum*	Chromadorida	Chromadoridae
77	*Spilophorella euxina*	Chromadorida	Chromadoridae
78	*Spilophorella candida*	Chromadorida	Chromadoridae
79	*Spilophorella tollenifera*	Chromadorida	Chromadoridae
80	*Spilophorella* spp	Chromadorida	Chromadoridae
81	*Dichromodora geophila*	Chromadorida	Chromadoridae
82	*Neochromadora* spp	Chromadorida	Chromadoridae
83	*Paraeuchromadora longicaudata*	Chromadorida	Chromadoridae
84	*Trochamus* spp	Chromadorida	Chromadoridae
85	*Longicyatholaimus quadriseta*	Chromadorida	Cyatholaimidae
86	*Longicyatholaimus* spp	Chromadorida	Cyatholaimidae
87	*Paralongicyatholaimus minutus*	Chromadorida	Cyatholaimidae
88	*Metacyatholaimus spatiosus*	Chromadorida	Cyatholaimidae
89	*Metacyatholaimus* spp.	Chromadorida	Cyatholaimidae
90	*Pomponema segregata*	Chromadorida	Cyatholaimidae
91	*Pselionema longiseta*	Chromadorida	Ceramonematidae
92	*Pselionema* spp	Chromadorida	Ceramonematidae
93	*Ceramonema carinatum*	Chromadorida	Ceramonematidae
94	*Dasynemoides albaensis*	Chromadorida	Ceramonematidae
95	*Dasynemella* spp	Chromadorida	Ceramonematidae
96	*Cyartonema* spp	Chromadorida	Aegialoalaimidae
97	*Southernia zosterae*	Chromadorida	Aegialoalaimidae
98	*Cyartonema germanicum*	Chromadorida	Aegialoalaimidae
99	*Filitonchus filiformis*	Chromadorida	Ethmolaimidae
100	*Rhinema* spp	Chromadorida	Ethmolaimidae
101	*Bolbolaimus teutonicus*	Chromadorida	Microlaimidae
102	*Calomicrolaimus spirifer*	Chromadorida	Microlaimidae
103	*Nudora crepidata*	Chromadorida	Monoposthiidae
104	*Nudora* spp.	Chromadorida	Monoposthiidae

Table 6.2b contd.

105	*Notochaetosoma killieri*	Chromadorida	Draconematidae
106	*Dracognomus simplex*	Chromadorida	Draconematidae
107	*Antomicron elegans.*	Chromadorida	Leptolaimidae
108	*Sphaerolaimus pacifica*	Monhysterida	Sphaerolaimidae
109	*Sphaerolaimus hirsutus*	Monhysterida	Sphaerolaimidae
110	*Sphaerolaimus islandicus*	Monhysterida	Sphaerolaimidae
111	*Sphaerolaimus penicillus var. Pugetensis*	Monhysterida	Sphaerolaimidae
112	*Sphaerolaimus macrocirculus*	Monhysterida	Sphaerolaimidae
113	*Sphaerolaimus* spp	Monhysterida	Sphaerolaimidae
114	*Monhystera* spp	Monhysterida	Xyalidae
115	*Theristus acer*	Monhysterida	Xyalidae
116	*Theristus fistulatus*	Monhysterida	Xyalidae
117	*Theristus exutus*	Monhysterida	Xyalidae
118	*Theristus alternus*	Monhysterida	Xyalidae
119	*Theristus* spp	Monhysterida	Xyalidae
120	*Paramonohystera* spp	Monhysterida	Xyalidae
121	*Paramonohystera buetschlii*	Monhysterida	Xyalidae
122	*Promonhystera* spp.	Monhysterida	Xyalidae
123	*Metadesmolaimus aduncus*	Monhysterida	Xyalidae
124	*Metadesmolaimus* spp	Monhysterida	Xyalidae
125	*Linhystera* spp	Monhystrida	Xyalidae
126	*Elzalia* spp	Monhystrida	Xyalidae
127	*Rhynchonema cinctum*	Monhystrida	Xyalidae
128	Promonhystera faber	Monhystrida	Xyalidae
129	*Cobbia* spp	Monhystrida	Xyalidae
130	*Daptonema* spp	Monhysterida	Xyalidae
131	*Daptonema oxycerca*	Monhysterida	Xyalidae
132	*Linhomoeus* spp	Monhysterida	Xyalidae
133	*Xenolaimus striatus*	Monhysterida	Xyalidae
134	*Axonolaimus* spp	Monhysterida	Axonolaimidae
135	*Axonolaimus spinosus*	Monhysterida	Axonolaimidae
136	*Ascolaimus elongatus*	Monhysterida	Axonolaimidae
137	*Parodontophora brevamphida*	Monhysterida	Axonolaimidae
138	*Parodontophora breviseta*	Monhysterida	Axonolaimidae
139	*Paralinhomoeus tenuicaudatus*	Monhysterida	Linhomoeidae
140	*Paralinhomoeus pachyamphis*	Monhysterida	Linhomoeidae
141	*Paralinhomoeus lepturus*	Monhysterida	Linhomoeidae
142	*Paralinhomoeus* spp	Monhysterida	Linhomoeidae
143	*Terschellingia communis*	Monhysterida	Linhomoeidae
144	*Terschellingia longicoudatus*	Monhystrida	Linhomoeidae
145	*Metalinhomoeus longiseta*	Monhystrida	Linhomoeidae
146	*Eumorpholaimus subulicolus*	Monhystrida	Linhomoeidae
147	*Metalinhomoeus* spp	Monhystrida	Linhomoeidae
148	*Eleutherolaimus stenosoma*	Monhystrida	Linhomoeidae
149	*Amphimonhysterella anechma*	Monhysterida	Linhomoeidae
150	*Disconema alaima*	Monhysterida	Linhomoeidae
151	*Didelta scutata*	Monhysterida	Diplopeltidae
152	*Diplopeltula asetosa*	Monhysterida	Diplopeltidae
153	*Siphonolaimus pachyderma*	Monhysterida	Siphonolaimidae
154	*Siphonolaimus auratus*	Monhysterida	Siphonolaimidae
155	*Siphonolaimus* spp	Monhysterida	Siphonolaimidae

In Indian waters there is no quantitative work is available, covering the entire shelf, and it is the intention of the present work to fill this gap. Besides meiofauna the studies on macrobenthos were also conducted simultaneously (Joydas, 2002). Thus the present work is expected to give a clear picture of the benthic standing crop along the west coast of India. The present chapter provides the details of the faunal composition, the standing stock and trophic relations of meiofauna.

6:2 Faunal composition:

A total of eight taxonomic groups were represented in the meiofaunal samples. Among these, Nematoda and Copepoda were the most dominant and abundant groups occurred in all selected depth ranges. The other groups ~~were~~ recorded in lower densities are Foraminifera, Polychaeta, Halacarida (acarids) Ostracoda, Oligochaetes and Kinorhyncha. Maximum density of fauna occurred in 30 m depths and it showed a decline in abundance towards the edge of the shelf (200m).

The details of other groups of meiofaunal organisms, which were collected during the present study, are given below. The checklist of identified meiofaunal organisms is presented in Table 6. 2a and 6.2b

6.2.1: Foraminifera:

They form the only protozoan group, which are abundant in the meiofaunal samples. In the present study they were present in comparatively higher densities in northern part of the west coast. Study of this group was limited to its quantitative aspect rather than qualitative aspect. This group was not included in the estimation of biomass as it may bias the total quantum significantly. Some of the major species that had identified among foraminiferans include *Discorbis* sp; *Discorbis globularis, D. allomorphinoids, Bulimina* sp, *B. fijiensis, Bolivinia nobilis, B. marginata, B. interjuncta, Cibicides lobatulus, Planulina* sp, *P. weullerstorfi, Trochammina nitida, Operculina* sp, *Miliammina* sp, *Nonion scaphum and Marsiepella* sp.

6.2.2: Polychaeta and Oligochaeta

Polychaeta are included as temporary meiofauna since most of them have a larval life. Their density was poor and often not occurred in all stations. The young ones of the following macrobenthic polychaetes were identified (*Syllis* sp, *Magelona* sp, *Lumbrineris* sp) since they were the common forms present. The meiobenthic polychaetes identified were *Triolobodrillus* sp, *Mesonerilla* sp *and Paranerilla* sp. They occur in few stations in relatively few numbers. Oligochaeta was represented in few numbers and their study was limited to the quantitative aspect.

6.2.3: Copepoda:

This group represented the second important group in meiofauna samples, the first being nematoda. Copepods are represented in two orders viz. Harpacticoida and Cyclopoida. They were present in almost all studied depths, and contributed to the total biomass significantly. Comparatively fewer densities of specimens were recorded from deeper stations. It was not possible to make a study of this group in any detail except a general observation regarding their occurrence in the various samples from different stations. The systematic part of this group is reserved for future studies. Some of the species that was identified during the present study were *Arenosetella* sp, *Pseudobradya* sp. *Harpacticus* sp, *Stenhelia* sp, *Ameira* sp, *Apodopsyllus* sp, *Orthopsyllus sp. and Leptostacus* sp.

6.2.4: Kinorhyncha:

Kinorhynchs are not often encountered in meiofaunal samples. They usually occur in fine sandy to muddy sediments from the eulittoral down to deep sea. In the present study, they were recorded in few numbers among certain stations only. The species that could be identified were *Cateria* sp, *Pycnophyes* sp. and *Echinoderilla* sp.

6.2.5: Halacarida (Acari)

The family Halacaridae represented this group. Despite their clear-cut diagnostic characters halacarids have been little investigated. They represent as a common group among meiofaunal samples. In the present study halacarids were present in 22 stations with a few numbers of individuals. This group was not studied in detail apart from the general observation of their occurrence in samples from different stations.

6.2.6: Ostracoda:

Ostracods were usually found in shallower stations. Their density was rather poor in most of the stations particularly in deeper waters. Except a general observation regarding their quantitative aspects in different stations, details of this group were not attempted.

The group diversities of meiofauna were not attempted since more than 80% of the fauna was represented by nematodes. Community structure of nematodes was discussed in Chapter 7.

6.3. Biomass and Numerical abundance

Ecological and trophic significance of meiobenthos in different aquatic ecosystems is well documented (Krishnamurthy *et al.*, 1984; Gee 1987; Coull, 1990; Coull *et al.*, 1995 and Greg *et al.*, 1998). Meiobenthic organisms serve as food for some invertebrates and fishes (Fitzhugh and Fleeger, 1985, Nelson and Coull, 1989, Service *et al.*, 1992). Nematodes are the most abundant meiofauna in benthic system (Coull, 1988), and consist primarily of organic detritus and diatom feeders (Montagna, 1980; Findlay and Tenore, 1982; Alkemade *et al.*, 1993). Nematodes are consumed by other meiobenthos such as protohydra (Heip and Smol, 1975; Elmgren, 1976), other large nematodes (Wieser, 1953b) or epibenthos such as goby (Hamerlynck and Vanreussel, 1993). The nematodes hence play an important role in the energy pathway by transferring energy from detritus standing stock to higher trophic levels. Thus the earlier concept of meiofauna as a trophic dead end (McIntyre and Murison, 1973) may not be true.

Estimation of benthic standing stock is essential for the assessment of demersal fishery resources, as benthos form an important source of food for demersal fishes (Damodaran, 1973; Parulekar *et al.*, 1982). Meiofauna has been the subject for intense quantitative study due to the important role it plays in the marine food chain (Gerlach, 1971; Coull and Bell, 1979 and McIntyre,

Table 6.1. Biomass (Wet weight in mg.10sq.cm) of the meiobenthic groups in each transect.

Transect	St.No	Depth	Nematodes	Copepods	Others	Total
cape	1	30.7	0.182	0.401	1.760	2.343
	2	50.6	0.066	0.054	0.825	0.945
	3	101	0.026	0.027	0.660	0.714
	4	208	0.007	0.014	0.220	0.240
tvm	7	30	0.878	1.360	3.795	6.033
	6	59	0.089	0.054	0.385	0.529
	5	124	0.063	0.034	0.495	0.592
klm	8	30.6	1.383	0.054	0.770	2.207
	9	50	0.700	0.367	0.975	2.042
	10	73.7	0.274	0.088	0.260	0.622
	11	101	0.211	0.014	0.650	0.875
	12	238	0.125	0.184	1.300	1.609
kch	13	33.3	0.934	0.687	3.250	4.871
	14	51	0.667	0.476	1.690	2.833
	15	101	0.050	0.027	0.845	0.922
	16	202	0.165	0.041	0.585	0.791
vad	16A	197.3	0.898	0.211	0.780	1.888
	16B	103.4	0.706	0.041	0.390	1.137
	16C	52.6	1.907	0.150	0.845	2.902
	16D	36.2	3.689	0.340	2.080	6.109
kzh	17	31	0.040	0.027	0.000	0.067
	18	50	0.208	0.054	1.430	1.692
	19	102	0.201	0.020	0.585	0.807
	20	219	0.076	0.014	0.130	0.220
knr	25	31	0.663	0.027	0.260	0.951
	24	51.2	1.152	0.054	1.170	2.376
	23	67	0.941	0.109	1.495	2.544
	22	102	0.168	0.014	0.585	0.767
	21	202	0.099	0.020	0.000	0.119
mngr	26	31	0.224	0.020	0.520	0.765
	27	50.8	0.406	0.082	0.585	1.073
	28	101	0.238	0.054	0.325	0.617
	29	205	0.099	0.014	1.105	1.218
cnpr	29D	33.9	1.320	0.020	0.130	1.470
	29C	53.6	0.281	0.286	0.715	1.281
	29B	104.3	0.188	0.054	0.390	0.633
	29A	193	0.901	0.000	0.000	0.901

Table 6.1 contd.	St.No	Depth	Nematodes	Copepods	Others	Total
btkl	34	31	0.627	0.014	0.130	0.771
	33	54.4	0.135	0.143	0.520	0.798
	32	68	0.287	0.054	1.170	1.512
	31	101	0.116	0.075	0.325	0.515
	30	206	1.000	0.020	0.585	1.605
goa	35	32	0.746	0.000	0.130	0.876
	36	52	0.558	0.014	0.000	0.571
	37	72	0.640	0.075	1.365	2.080
	38	101	0.528	0.061	0.390	0.979
	39	206	0.254	0.000	0.390	0.644
rtngr	40	32	0.584	0.027	0.520	1.131
	41	51.4	1.257	0.054	0.585	1.897
	42	76	0.488	0.122	0.260	0.871
	43	100.7	0.152	0.020	0.455	0.627
	44	211	0.092	0.000	0.000	0.092
dbhl	44A	35.3	0.376	0.000	0.000	0.376
	44B	57.1	1.379	0.014	1.820	3.213
	44C	95.7	0.518	0.027	0.650	1.195
	44D	94.3	0.168	0.014	0.130	0.312
ofmb	45	33	3.419	0.061	0.000	3.480
	46	51	1.122	0.034	0.455	1.611
	47	96	0.208	0.027	1.105	1.340
	48	89	0.215	0.020	0.130	0.365
almb	54	32	3.524	0.428	0.910	4.863
	53	51	0.617	0.027	1.105	1.749
	52	79	0.224	0.136	0.715	1.075
	51	85.3	0.248	0.020	0.650	0.918
	50	91	0.089	0.122	0.325	0.537
	49	95	0.056	0.354	0.910	1.320
prbn	58	33	2.369	0.054	0.130	2.554
	57	53	0.244	0.014	0.260	0.518
	56	101	0.248	0.095	0.325	0.668
	55	210	0.046	0.000	0.260	0.306
dwrk	59	33	0.789	0.286	0.650	1.724
	60	52	0.974	0.000	0.195	1.169
	61	100	0.488	0.728	0.000	1.216
	62	200	0.125	0.054	0.130	0.310

Table 6.3. Biomass of the meiobenthic groups of the shelf waters of the west coast of India (Mg.10sq.cm)

30-50m depth

Transect	cape1	tvm	klm1	klm2	kch	vad	kzh1	kzh2	knr	mngr1	cnpr	btkl	goa	rtngr	dbhl	ofmb	almb	prbn	dwrk
Station No.	1	7	8	9	13	16D	17	18	25	26	29D	34	35	40	44A	45	54	58	59
Depth	30.7	30	30.6	50	33.3	36.2	31	50	31	31	33.9	31	32	32	35.3	33	32	33	33
Nematodes	0.18	0.88	1.38	0.70	0.93	3.69	0.04	0.21	0.66	0.22	1.32	0.63	0.75	0.58	0.38	3.42	3.52	2.37	0.79
Copepods	0.40	1.36	0.05	0.37	0.69	0.34	0.03	0.05	0.03	0.02	0.02	0.01	0.00	0.03	0.00	0.06	0.43	0.05	0.29
Others	1.76	3.80	0.77	0.98	3.25	2.08	0.00	1.43	0.26	0.52	0.13	0.13	0.13	0.52	0.00	0.00	0.91	0.13	0.65
Mean	0.78	2.01	0.74	0.68	1.62	2.04	0.02	0.56	0.32	0.25	0.49	0.26	0.29	0.38	0.13	1.16	1.62	0.85	0.57
SD	0.86	1.56	0.66	0.30	1.41	1.68	0.02	0.75	0.32	0.25	0.72	0.33	0.40	0.30	0.22	1.96	1.67	1.32	0.26
CV	1.09	0.78	0.90	0.45	0.87	0.82	0.91	1.34	1.02	0.99	1.47	1.27	1.36	0.81	1.73	1.69	1.03	1.55	0.45

51-75m depth

Transect	cape2	tvm	klm	kch	vad	knr1	knr2	cnpr	mngr2	btkl1	btkl2	goa1	goa2	rtngr	dbhl	ofmb	almb	prbn	dwrk
Station No.	2	6	10	14	16C	24	23	29C	27	33	32	36	37	41	44B	46	53	57	60
Depth	50.6	59	73.7	51	52.6	51.2	67	53.6	50.8	54.4	68	52	72	51.4	57.1	51	51	53	52
Nematodes	0.07	0.09	0.27	0.67	1.91	1.15	0.94	0.28	0.41	0.14	0.29	0.56	0.64	1.26	1.38	1.12	0.62	0.24	0.97
Copepods	0.05	0.05	0.09	0.48	0.15	0.05	0.11	0.29	0.08	0.14	0.05	0.01	0.07	0.05	0.01	0.03	0.03	0.01	0.00
Others	0.83	0.39	0.26	1.69	0.85	1.17	1.50	0.72	0.59	0.52	1.17	0.00	1.37	0.59	1.82	0.46	1.11	0.26	0.20
Mean	0.32	0.18	0.21	0.94	0.97	0.79	0.85	0.43	0.36	0.27	0.50	0.19	0.69	0.63	1.07	0.54	0.58	0.17	0.39
SD	0.44	0.18	0.10	0.65	0.89	0.64	0.70	0.25	0.26	0.22	0.59	0.32	0.65	0.60	0.94	0.55	0.54	0.14	0.52
CV	1.40	1.03	0.50	0.69	0.92	0.81	0.82	0.58	0.71	0.83	1.17	1.67	0.93	0.95	0.88	1.02	0.93	0.80	1.32

76-100m depth

Transect	rtngr	dbhl1	dbhl2	ofmb1	ofmb2	almb1	almb2	almb3	almb4	dwrk
Station No.	42	44C	44D	47	48	52	51	50	49	61
Depth	76	95.7	94.3	96	89	79	85.3	91	95	100
Nematodes	0.49	0.52	0.17	0.21	0.21	0.22	0.25	0.09	0.06	0.49
Copepods	0.12	0.03	0.01	0.03	0.02	0.14	0.02	0.12	0.35	0.73
Others	0.26	0.65	0.13	1.11	0.13	0.72	0.65	0.33	0.91	0.00
Mean	0.29	0.40	0.10	0.45	0.12	0.36	0.31	0.18	0.44	0.41
SD	0.18	0.33	0.08	0.58	0.10	0.31	0.32	0.13	0.43	0.37
CV	0.64	0.82	0.77	1.29	0.80	0.87	1.04	0.71	0.99	0.91

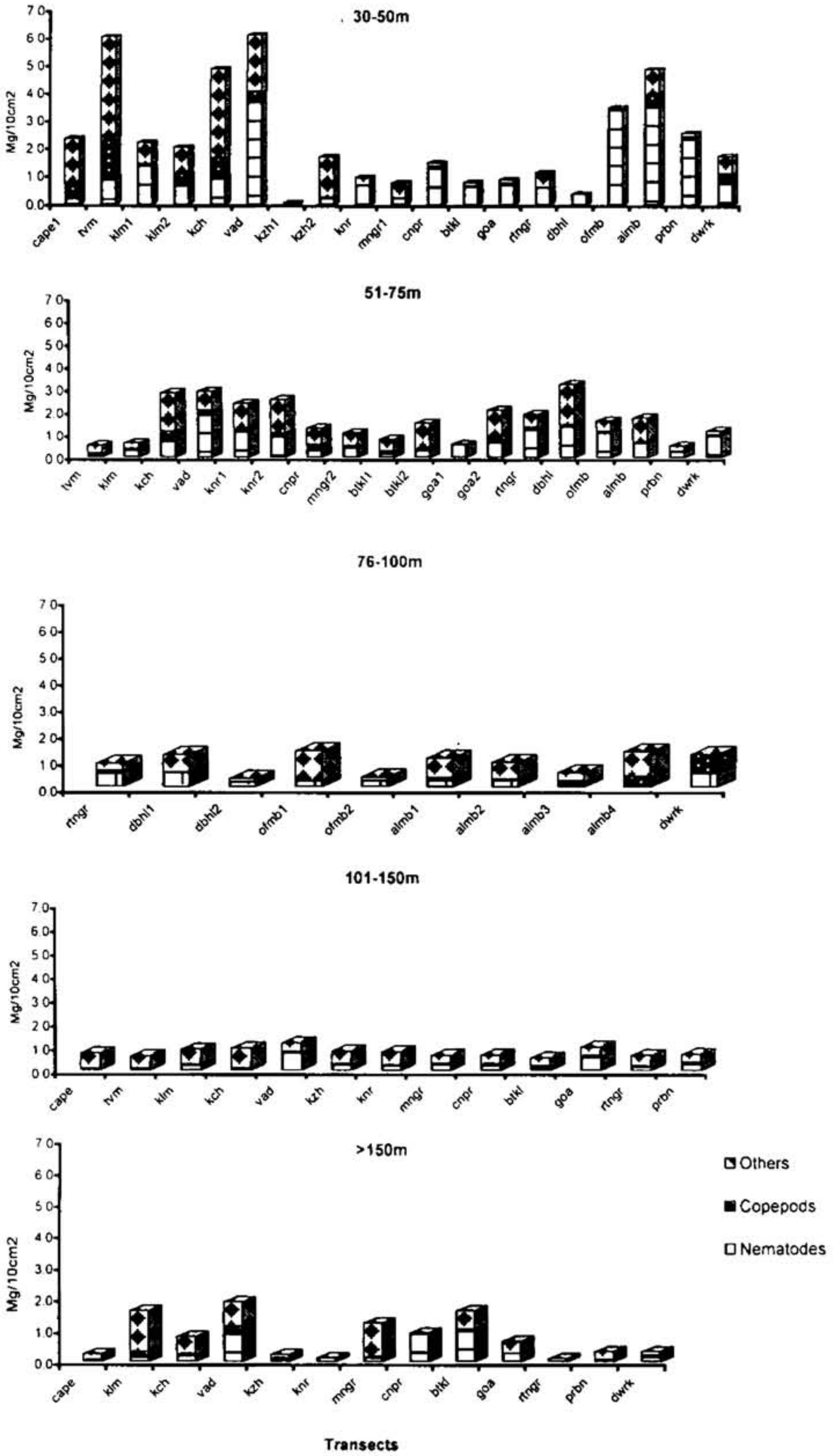
Table 6.3 contd.

101-150m depth

Transect	cape	tvm	klm	kch	vad	kzh	knr	mngr	cnpr	btkl	goa	rtngr	prbn
Station No.	3	5	11	15	16B	19	22	28	29B	31	38	43	56
Depth	101	124	101	101	103.4	102	102	101	104.3	101	101	100.7	101
Nematodes	0.03	0.06	0.21	0.05	0.71	0.20	0.17	0.24	0.19	0.12	0.53	0.15	0.25
Copepods	0.03	0.03	0.01	0.03	0.04	0.02	0.01	0.05	0.05	0.07	0.06	0.02	0.10
Others	0.66	0.50	0.65	0.85	0.39	0.59	0.59	0.33	0.39	0.33	0.39	0.46	0.33
Mean	0.24	0.20	0.29	0.31	0.38	0.27	0.26	0.21	0.21	0.17	0.33	0.21	0.22
SD	0.37	0.26	0.33	0.47	0.33	0.29	0.30	0.14	0.17	0.13	0.24	0.22	0.12
CV	1.54	1.31	1.12	1.52	0.88	1.07	1.16	0.67	0.80	0.78	0.73	1.07	0.53

>151m depth

Transect	cape	klm	kch	vad	kzh	knr	mngr	cnpr	btkl	goa	rtngr	prbn	dwrk
Station No.	4	12	16	16A	20	21	29	29A	30	39	44	55	62
Depth	208	238	202	197.3	219	202	205	193	206	206	211	210	200
Nematodes	0.01	0.13	0.17	0.90	0.08	0.10	0.10	0.90	1.00	0.25	0.09	0.05	0.13
Copepods	0.01	0.18	0.04	0.21	0.01	0.02	0.01	0.00	0.02	0.00	0.00	0.00	0.05
Others	0.22	1.30	0.59	0.78	0.13	0.00	1.11	0.00	0.59	0.39	0.00	0.26	0.13
Mean	0.08	0.54	0.26	0.63	0.07	0.04	0.41	0.30	0.54	0.21	0.03	0.10	0.10
SD	0.12	0.66	0.29	0.37	0.06	0.05	0.61	0.52	0.49	0.20	0.05	0.14	0.04
CV	1.51	1.23	1.08	0.58	0.80	1.31	1.50	1.73	0.92	0.92	1.73	1.36	0.41



Biomass of meiobenthos in selected depth ranges, west coast of India

(1987). The interactive relations of meiofauna to other faunal elements and the contribution of meiobenthos to the energy flux through the benthic ecosystem can be assessed by measuring numerical parameters such as population density (abundance, biomass), production and, for better comparison, turnover rate of meiobenthos. Recently studies from the Atlantic coast of France showed that meiofauna constituted a very active component when compared to macrofauna (Leguerrier *et al.*, 2003).

Results.

In general nematodes and harpacticoid copepods contribute to the numerical abundance. Whereas the biomass was shared between nematodes and 'Others'. Others include meiofaunal organisms such as polychaetes, oligochaetes, ostracods, halacarids and kinorhynchs and contributed to the biomass significantly in many stations by virtue of their higher individual weight.

6.3.1. Depth wise variation in different transects

Depth wise variation in different transects is given in the Tables 6.1 and 6.2. The Numerical abundance and biomass of meiofauna were found to vary between transects.

As a whole in the west coast the total biomass in each transects was considered, maximum biomass was recorded off Vadanapilly (12.037mg) followed by along Mumbai (10.462mg). In both the stations shallow inshore waters (30m) recorded the maximum biomass. In the case of southwest coast off Kochi (6.796mg) recorded higher biomass and in northwest coast off Mumbai (9.416mg) recorded higher biomass. The comparatively higher

Table 6.2. Numerical abundance(No./10sq.cm) of meiobenthic groups in each transect, west coast of India.

Transect	St.No.	Depth	Foraminiferans	Nematodes	Polychaetes	Ostracods	Copepods	Acari	Others	Total
cape	1	30.7	0	55	0	0	59	0	32	146
	2	50.6	0	20	2	0	8	2	11	43
	3	101	0	8	3	0	4	0	9	24
	4	208	0	2	0	0	2	0	4	8
tvm	7	30	0	266	5	0	200	0	64	535
	6	59	0	27	0	0	8	2	5	42
	5	124	0	19	2	0	5	0	7	33
klm	8	30.6	0	419	0	0	8	0	14	441
	9	50	0	212	0	0	54	0	15	281
	10	73.7	0	83	0	0	13	0	4	100
	11	101	2	64	0	0	2	0	10	78
	12	238	3	38	0	0	27	0	20	88
kch	13	33.3	0	283	8	3	101	3	36	434
	14	51	0	202	2	2	70	3	19	298
	15	101	0	15	0	0	4	0	13	32
	16	202	0	50	0	0	6	0	9	65
vad	16A	197.3	5	272	2	0	31	0	10	320
	16B	103.4	0	214	6	0	6	0	0	226
	16C	52.6	14	578	10	0	22	0	3	627
	16D	36.2	8	1118	22	6	50	0	4	1208
kzh	17	31	0	12	0	0	4	0	0	16
	18	50	6	63	0	0	8	2	20	99
	19	102	4	61	0	0	3	2	7	77
	20	219	0	23	0	2	2	0	0	27
knr	25	31	0	201	0	0	4	2	2	209
	24	51.2	0	349	2	0	8	2	14	375
	23	67	0	285	3	2	16	2	16	324
	22	102	0	51	0	0	2	2	7	62
	21	202	0	30	0	0	3	0	0	33

Table 6.2 contd.

		St.No.	Depth	Foraminiferans	Nematodes	Polychaetes	Ostracods	Copepods	Acari	Others
mngr	26	31	0	68	0	0	3	0	8	79
	27	50.8	0	123	4	0	12	2	3	144
	28	101	0	72	0	0	8	2	3	85
	29	205	0	30	0	0	2	2	15	49
cnpr	29D	33.9	6	400	2	0	3	0	0	411
	29C	53.6	3	85	2	3	42	2	4	141
	29B	104.3	6	57	6	0	8	0	0	77
	29A	193	11	273	0	0	0	0	0	284
btkl	34	31	2	190	0	0	2	0	2	196
	33	54.4	11	41	0	2	21	2	4	81
	32	68	0	87	0	0	8	2	16	113
	31	101	0	35	0	0	11	0	5	51
	30	206	5	303	0	0	3	0	9	320
goa	35	32	2	226	0	0	0	0	2	230
	36	52	4	169	0	0	2	0	0	175
	37	72	8	194	2	0	11	0	19	234
	38	101	2	160	0	2	9	2	2	177
	39	206	4	77	0	0	0	2	4	87
rtngr	40	32	2	177	0	0	4	6	2	191
	41	51.4	0	381	0	0	8	2	7	398
	42	76	4	148	0	0	18	2	2	174
	43	100.7	6	46	0	2	3	3	2	62
	44	211	7	28	0	0	0	0	0	35
dbhl	44A	35.3	4	114	0	0	0	0	0	118
	44B	57.1	70	418	2	2	2	0	24	518
	44C	95.7	69	157	8	0	4	0	2	240
	44D	94.3	2	51	2	0	2	0	0	57
ofmb	45	33	23	1036	0	0	9	0	0	1068
	46	51	19	340	0	0	5	0	7	371
	47	96	9	63	0	0	4	17	0	93
	48	89	5	65	0	0	3	0	2	75

Table 6.2 contd.		St.No.	Depth	Foraminiferans	Nematodes	Polychaetes	Ostracods	Copepods	Acari	Others
almb	54	32	20	1068	0	0	63	0	14	1165
	53	51	9	187	0	0	4	0	17	217
	52	79	3	68	0	0	20	0	11	102
	51	85.3	9	75	0	0	3	0	10	97
	50	91	3	27	0	0	18	0	5	53
	49	95	10	17	0	0	52	0	14	93
prbn	58	33	19	718	0	0	8	0	2	747
	57	53	10	74	0	0	2	0	4	90
	56	101	0	75	0	0	14	0	5	94
	55	210	2	14	0	0	0	0	4	20
dwrk	59	33	20	239	0	0	42	0	10	311
	60	52	26	295	0	0	0	0	3	324
	61	100	0	148	0	0	107	0	0	255
	62	200	3	38	0	0	8	0	2	51

Table 6.4. Numerical abundance (No.10sq.cm) of meiobenthos of the shelf waters of west coast of India.

30-50m depth

Transect	cape1	tvm	klm1	klm2	kch	vad	kzh1	kzh2	knr	mngr1	cnpr	btkl	goa	rtngr	dbhl	ofmb	almb	prbn	dwrk
Station No.	1	7	8	9	13	16D	17	18	25	26	29D	34	35	40	44A	45	54	58	59
Depth	30.7	30	30.6	50	33.3	36.2	31	50	31	31	33.9	31	32	32	35.3	33	32	33	33
Foraminiferans	0	0	0	0	0	8	0	6	0	0	6	2	2	2	4	23	20	19	20
Nematodes	55	266	419	212	283	1118	12	63	201	68	400	190	226	177	114	1036	1068	718	239
Polychaetes	0	5	0	0	8	22	0	0	0	0	2	0	0	0	0	0	0	0	0
Ostracods	0	0	0	0	3	6	0	0	0	0	0	0	0	0	0	0	0	0	0
Copepods	59	200	8	54	101	50	4	8	4	3	3	2	0	4	0	9	63	8	42
Acari	0	0	0	0	3	0	0	2	2	0	0	0	0	6	0	0	0	0	0
Others	32	64	14	15	36	4	0	20	2	8	0	2	2	2	0	0	14	2	10
Mean	20.86	76.43	63.00	40.14	62.00	172.57	2.29	14.14	29.86	11.29	58.71	28.00	32.86	27.29	16.86	152.57	166.43	106.71	44.43
SD	27.34	111.05	157.08	78.32	103.89	417.24	4.54	22.63	75.48	25.18	150.51	71.44	85.17	66.05	42.86	389.65	398.18	269.64	87.15
C.V	1.31	1.45	2.49	1.95	1.68	2.42	1.98	1.60	2.53	2.23	2.56	2.55	2.59	2.42	2.54	2.55	2.39	2.53	1.96

51-75m Depth

Transect	cape2	tvm	klm	kch	vad	knr1	knr2	mngr2	cnpr	btkl1	btkl2	goa1	goa2	rtngr	dbhl	ofmb	almb	prbn	dwrk
Station No.	2	6	10	14	16C	24	23	27	29C	33	32	36	37	41	44B	46	53	57	60
Depth	50.6	59	73.7	51	52.6	51.2	67	50.8	53.6	54.4	68	52	72	51.4	57.1	51	51	53	52
Foraminiferans	0	0	0	0	14	0	0	0	3	11	0	4	8	0	70	19	9	10	26
Nematodes	20	27	83	202	578	349	285	123	85	41	87	169	194	381	418	340	187	74	295
Polychaetes	2	0	0	2	10	2	3	4	2	0	0	0	2	0	2	0	0	0	0
Ostracods	0	0	0	2	0	0	2	0	3	2	0	0	0	0	2	0	0	0	0
Copepods	8	8	13	70	22	8	16	12	42	21	8	2	11	8	2	5	4	2	0
Acari	2	2	0	3	0	2	2	2	2	2	2	0	0	2	0	0	0	0	0
Others	11	5	4	19	3	14	16	3	4	4	16	0	19	7	24	7	17	4	3
Mean	6.14	6.00	14.29	42.57	89.57	53.57	46.29	20.57	20.14	11.57	16.14	25.00	33.43	56.86	74.00	53.00	31.00	12.86	46.29
SD	7.40	9.75	30.67	74.61	215.53	130.37	105.48	45.35	32.12	14.89	31.80	63.52	71.14	142.97	153.77	126.74	69.07	27.20	110.09
CV	1.21	1.62	2.15	1.75	2.41	2.43	2.28	2.20	1.59	1.29	1.97	2.54	2.13	2.51	2.08	2.39	2.23	2.12	2.38

Table 6.4 contd.

76-100m

Transect	rtngr	dbhl1	dbhl2	ofmb1	ofmb2	almb1	almb2	almb3	almb4	dwrk
Station No.	42	44C	44D	47	48	52	51	50	49	61
Depth	76	95.7	94.3	96	89	79	85.3	91	95	100
Foraminiferans	4	69	2	9	5	3	9	3	10	0
Nematodes	148	157	51	63	65	68	75	27	17	148
Polychaetes	0	8	2	0	0	0	0	0	0	0
Ostracods	0	0	0	0	0	0	0	0	0	0
Copepods	18	4	2	4	3	20	3	18	52	107
Acari	2	0	0	17	0	0	0	0	0	0
Others	2	2	0	0	2	11	10	5	14	0
Mean	24.86	34.29	8.14	13.29	10.71	14.57	13.86	7.57	13.29	36.43
SD	54.66	59.53	18.92	22.80	24.01	24.72	27.30	10.69	18.50	63.33
CV	2.20	1.74	2.32	1.72	2.24	1.70	1.97	1.41	1.39	1.74

101-150m

Transect	cape	tvm	klm	kch	vad	kzh	knr	mngr	cnpr	btkl	goa	rtngr	prbn
Station No.	3	5	11	15	16B	19	22	28	29B	31	38	43	56
Depth	101	124	101	101	103.4	102	102	101	104.3	101	101	100.7	101
Foraminiferans	0	0	2	0	0	4	0	0	6	0	2	6	0
Nematodes	8	19	64	15	214	61	51	72	57	35	160	46	75
Polychaetes	3	2	0	0	6	0	0	0	6	0	0	0	0
Ostracods	0	0	0	0	0	0	0	0	0	0	2	2	0
Copepods	4	5	2	4	6	3	2	8	8	11	9	3	14
Acari	0	0	0	0	0	2	2	2	0	0	2	3	0
Others	9	7	10	13	0	7	7	3	0	5	2	2	5
Mean	3.43	4.71	11.14	4.57	32.29	11.00	8.86	12.14	11.00	7.29	25.29	8.86	13.43
SD	3.82	6.87	23.58	6.63	80.18	22.18	18.75	26.55	20.57	12.91	59.47	16.48	27.64
CV	1.12	1.46	2.12	1.45	2.48	2.02	2.12	2.19	1.87	1.77	2.35	1.86	2.06

>151m

Transect	cape	klm	kch	vad	kzh	knr	mngr	cnpr	btkl	goa	rtngr	prbn	dwrk
Station No.	4	12	16	16A	20	21	29	29A	30	39	44	55	62
Depth	208	238	202	197.3	219	202	205	193	206	206	211	210	200
Foraminiferans	0	3	0	5	0	0	0	11	5	4	7	2	3
Nematodes	2	38	50	272	23	30	30	273	303	77	28	14	38
Polychaetes	0	0	0	2	0	0	0	0	0	0	0	0	0
Ostracods	0	0	0	0	2	0	0	0	0	0	0	0	0
Copepods	2	27	6	31	2	3	2	0	3	0	0	0	8
Acari	0	0	0	0	0	0	2	0	0	2	0	0	0
Others	4	20	9	10	0	0	15	0	9	4	0	4	2
Mean	1.14	12.57	9.29	45.71	3.86	4.71	7.00	40.57	45.71	12.43	5.00	2.86	7.29
SD	1.57	15.68	18.32	100.37	8.49	11.21	11.47	102.57	113.50	28.53	10.47	5.15	13.84

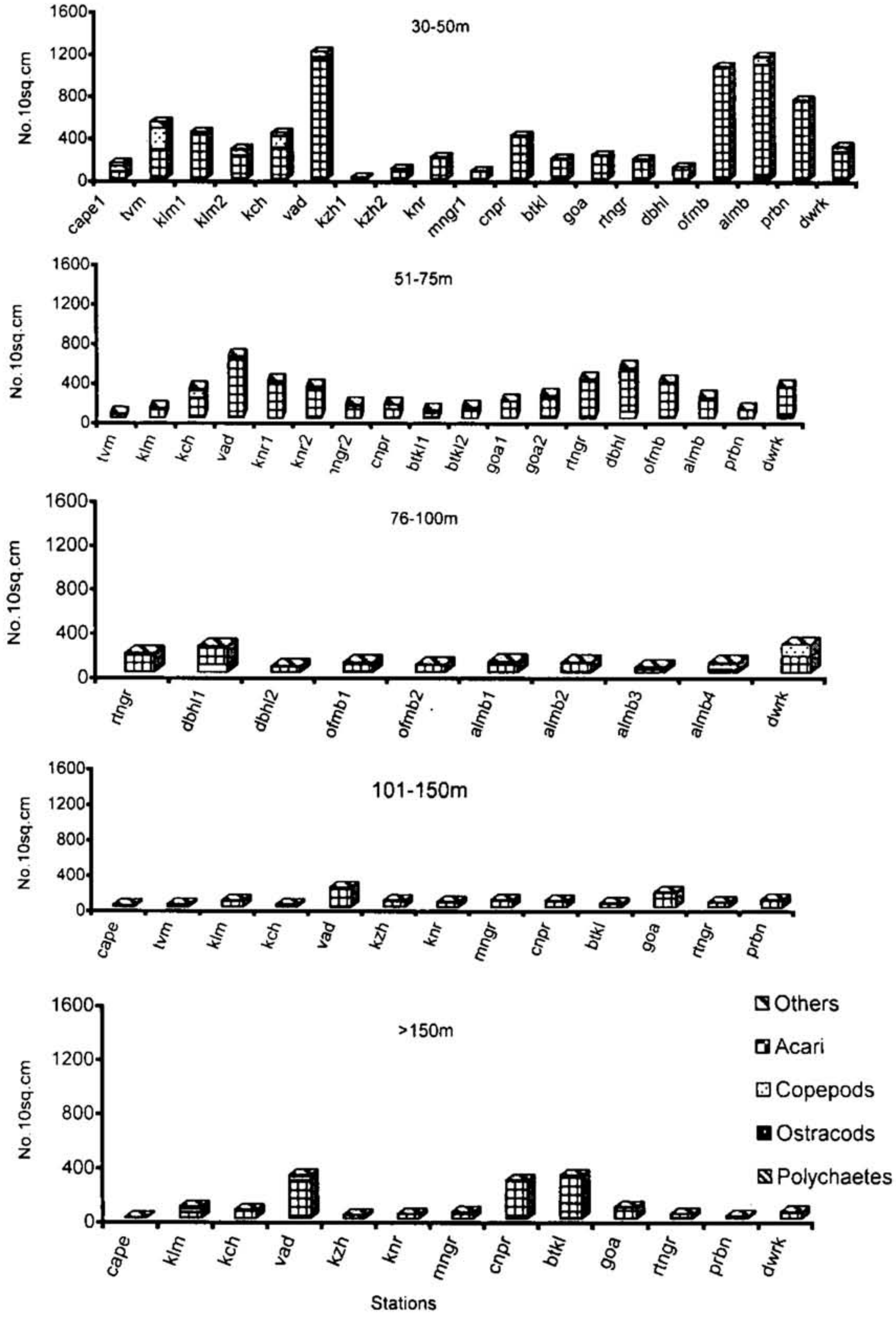


Fig.6.1 Numerical abundance of meiobenthos in selected depth ranges.

biomass recorded in these stations were contributed by nematodes except in off Kochi where 'others ' were the main contributors. The lowest biomass was recorded off Kozhikode (2.795mg) in southwest coast and off Porbandar (4.096mg) in north west coast.

In the case of numerical abundance when considering the total abundance in each transect, maximum was recorded off Vadanapilly (2381ind.) and the lowest recorded off (219 ind.) Kozhikode. From southwest coast higher densities were recorded from transects like Kannur (1003 ind.) and Coondapore (913ind.). In northwest coast the higher densities were recorded off along Mumbai (1727 ind.) and off Mumbai (1607 ind.). The higher densities of meiofauna in these stations were contributed by nematodes.

6.2.2. Latitudinal variation in different depth ranges.

Maximum biomass and numerical abundance of meiobenthos were recorded in shallow inshore (30m) stations. The present study showed a general trend of spatial variation in standing stocks of meiofauna from station to stations (Tables 6.3, 6.4 and Figs. 6.1. 6.2).

Latitudinal variation of meiofauna in different depth ranges showed dissimilar patterns. In 30-50m depth range, there was a pronounced difference in both biomass and numerical abundance. Maximum biomass (6.109 $mg.10cm^{-2}$) was recorded at Vadanapilly (Station 16D) where nematodes contributed chiefly to the biomass. Exceptionally high biomass was recorded off Trivananthapuram, Kochi in South west coast and off Mumbai and along Mumbai in North west coast. This higher biomass values in southwest was accounted by 'others' and in northwest by nematodes. Lowest biomass (0.06

Table 6.5. Average biomass in selected depth ranges, west coast of India

Depth range	Nematodes	Copepods	Others	Total
30-50	1.101	0.208	0.898	2.207
51-75	0.737	0.097	0.826	1.659
76-100	0.270	0.157	0.488	0.915
101-150	0.223	0.041	0.494	0.758
>151	0.299	0.044	0.422	0.765

Figure 6.3. Average biomass in different depth ranges

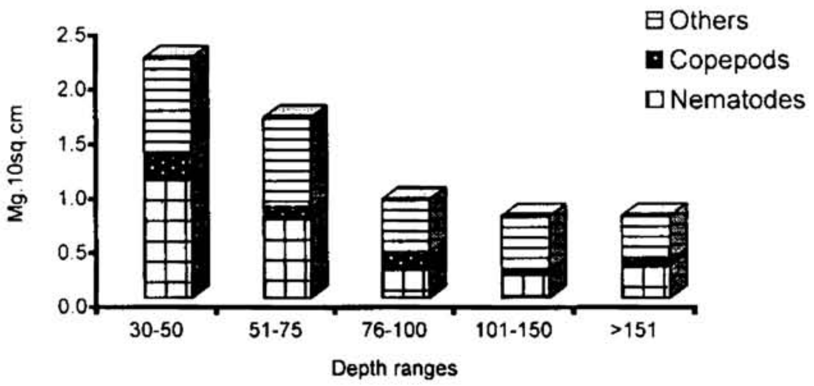
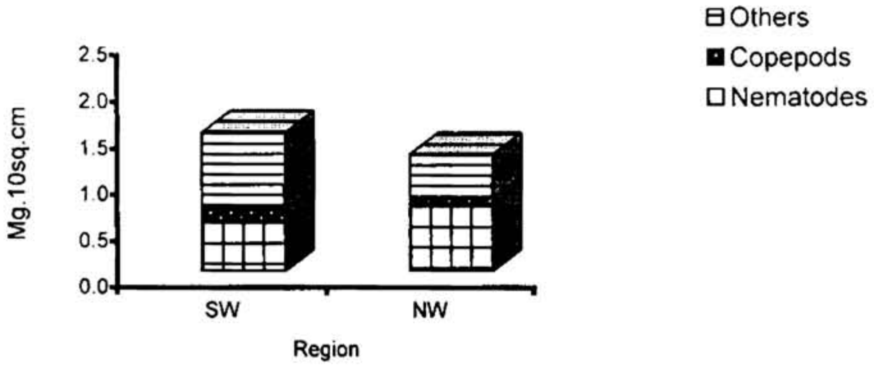


Table 6.6. Comparison of Meiobenthic biomass in SW and NW coast of India (mean:mg.10sq.cm)

Zone	Nematodes	Copepods	Others	Total
SW	0.533	0.138	0.827	1.498
NW	0.711	0.090	0.467	1.268

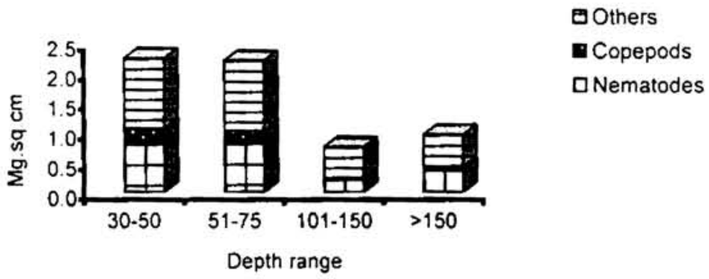
Fig 6.4. Meiobenthic biomass in SW and NW coast of India



Tab. 6.7 Average biomass of meiobenthos in selected depth ranges of south west coast of India

Depth range	Nematodes	Copepods	Others	Total
30-50	0.809	0.251	1.179	2.238
51-75	0.819	0.202	1.179	2.200
101-150	0.197	0.036	0.525	0.758
>150	0.374	0.057	0.523	0.955

Fig.6.5.Average biomass of meiobenthos in selected depth ranges of south west coast of India



Tab.6.8. Average biomass of meiobenthos in selected depth ranges of north west coast of India

Depth ranges	Nematodes	Copepods	Others	Total
30-50	1.687	0.122	0.334	2.143
51-75	0.849	0.029	0.723	1.601
76-100	0.270	0.157	0.488	0.915
101-150	0.309	0.059	0.390	0.758
>150	0.130	0.014	0.195	0.338

Fig.6.6. Average biomass of meiobenthos in selected depth ranges of north west coast of India

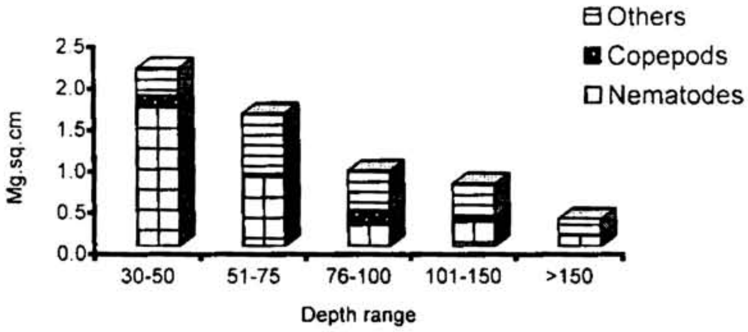


Table 6.9 Average biomass of meiobenthic groups in the western continental shelf of India

	Nematodes	copepods	others	total
West coast	0.610	0.117	0.671	1.399

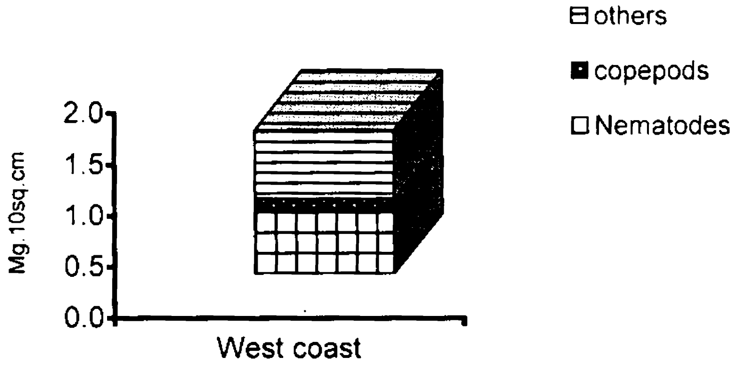


Fig .6.7 Average biomass of meiobenthos, west coast of India mg.10cm^{-2}) was recorded. off Kozhicode (Station 17). The average biomass 30-50m depth range was 2.207 mg.10cm^{-2}.

At this depth range the maximum numerical abundance (1208 ind.10cm^{-2}) was recorded off Vadanapilly, (Station 16D) which was due to higher densities of nematodes. Nematodes were dominated in most of stations of this depth range. Harpacticoid copepods and 'others' contributed to total number of meiofauna in other stations of this depth range. Higher densities of meiobenthos were recorded off Thiruvananthapuram, Kollam, Kochi, Vadanapilly and Coondapore in southwest coast and in stations like off Mumbai, along Mumbai and Porbandar in north west coast. This higher abundance was due to nematodes in both the regions. Minimum abundance was recorded off Kozhicode 16 ind.10cm^{-2} (Station 17). The average abundance of this depth range was 384.4 ind.10cm^{-2}.

In 51-75 m depth range, maximum biomass (3.21 mg.10cm^{-2}) was recorded off Dhabol (Station 44B) where nematodes surpass the average wet weight of all other groups. Dominance of nematodes was apparent in 35% of stations in this depth range. Rest of the stations the biomass of 'others' contributed substantially to the total meiobenthic biomass. Lowest biomass (0.52 mg.10 cm^{-2}) was recorded off Porbandar (Station 57). Comparatively higher biomass values were recorded from stations like off Kochi, Vadanapilly and Kannur in south west coast and off Goa and off Dhabol in north west coast. Others contributed in Kochi and Kannur whereas in Vadanapilly, nematodes were responsible for the higher biomass. In northwest coast the higher biomass was contributed by 'others'. The average biomass of 51-75m range was 1.66 mg. $10cm^{-2}$.

The maximum numerical abundance (627 ind.$10cm^{-2}$) was recorded off Vadanapilly (Station 16C) where nematodes surpass all other groups. This was the case in almost all stations of this depth range. Minimum abundance (42 ind.$10cm^{-2}$) was seen off Thiruvananthapuram (Station 6). Higher densities of meiofauna were recorded off Kochi and Kannur in south west coast and in stations like off Ratnagiri, Dhabol, off Mumbai and Dwarka in north west coast. The average abundance of this depth range was 260 ind.$10cm^{-2}$.

In 76-100m depth range the maximum biomass (1.34 mg.$10cm^{-2}$) was noticed off Mumbai (Station 47), where 'others' exceeded the average weight of nematodes and copepods. In about 60% stations the biomass of nematodes and copepods contributed substantially to the total meiobenthic biomass. While in other stations the major contribution was from 'others'. Higher biomass values were recorded off Dhabol, off Mumbai, along Mumbai and Dwarka in north west coast. Lowest biomass (0.312 mg.$10cm^{-2}$) was recorded off Dhabol, which was (Station 44D). The average biomass of this depth range was 0.914 mg. $10cm^{-2}$.

The maximum numerical abundance (255 ind.$10cm^{-2}$) was noticed off Dwarka (Station 61) where nematodes contributed more to the biomass followed by copepods. Similar trend was perceptible in some of the stations of this depth range while at along Mumbai, harpacticoids were the dominant group. Minimum abundance (53 ind.$10cm^{-2}$) was recorded off along Mumbai, (Station 50). Higher meiofaunal densities were recorded off Ratnagiri and Dhabol. The average abundance of this depth range was 124 ind.10cm^{-2}.

In 101-150 m depth range the maximum biomass (1.13 mg.10cm^{-2}) was recorded off Vadanapilly (Station 16B), where nematode biomass was above the average weight of all other groups. The biomass of 'others' contributed significantly to most of the station of this depth range. Higher biomass values were recorded off Kochi from south west coast and off Goa from north west coast. Lowest biomass (0.515 mg .10cm^{-2}) was noticed off Bhatkal (Station 31). The average biomass of this depth range was 0.76mg.10 cm^{-2}.

The maximum numerical abundance (226 ind.10cm^{-2}) was recorded off Vadanapilly (Station 16B) where nematode number exceed all other groups. Similar trend was apparent in all stations of this depth range. Minimum abundance (24 ind.10cm^{-2}) was recorded off Cape, (Station. 3). Except Vadanapilly, in southwest coast and Goa in north west coast the meiobenthic densities were comparatively poor. The average abundance of this depth range was 83 ind.10cm^{-2}.

Beyond 150 m depth range the maximum biomass (1.88 mg.10cm^{-2}) was recorded off Vadanapilly (Station 16A), where nematodes were key groups. The biomass of 'others' surpasses all major groups in nearly 60% stations of this depth range. Lowest biomass (0.092 mg.10cm^{-2}) was noticed off Ratnagiri, (Station 44). Higher biomass values were recorded off Kollam and Mangalore in west coast and Bhatkal in north west coast. The average biomass of this depth range was 0.764 mg cm^{-2}.

Table 6.10 Average numerical abundance of meiofauna in different depth ranges

Depth range	Foraminiferans	Nematodes	Polychaetes	Ostracods	Copepods	Acari	Others
30-50	5	332	2	0	31	1	11
51-75	10	223	1	1	14	1	9
76-100	11	82	1	0	23	2	5
101-150	2	67	1	0	6	1	5
>150	3	91	0	0	6	0	6

Figure 6.8 Average numerical abundance of meiofauna in different depth ranges

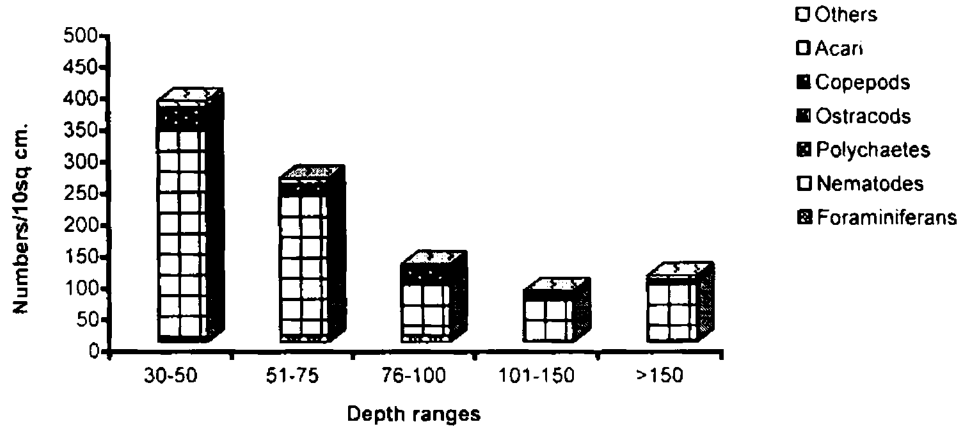


Table 6.11 Comparison of average meiofaunal abundance in South & North West coast of India.

Depth range	Foraminiferans	Nematodes	Polychaetes	Ostracods	Copepods	Acari	Others
SW	9	611	7	2	74	4	38
NW	49	983	2	2	56	5	30

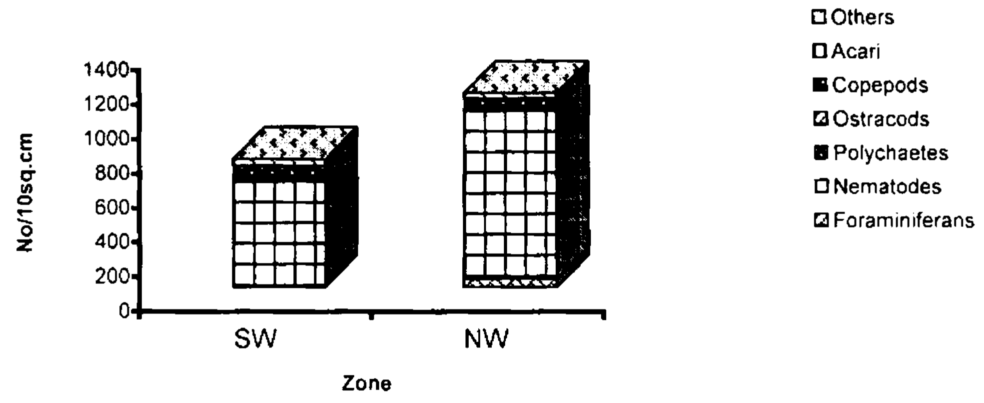
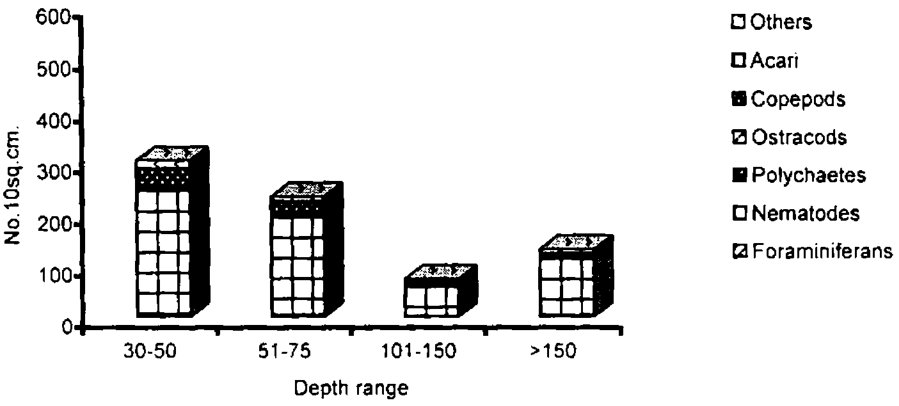


Figure 6.9 comparison of meiobenthic abundance in south west coast and north west coast of India

Tab. 6.12 Average numerical abundance of meiofauna in different depth ranges of south west coast of India.

Depth range	Foraminiferans	Nematodes	Polychaetes	Ostracods	Copepods	Acari	Others
30-50	2	245	3	1	37	1	15
51-75	3	193	2	1	23	2	9
101-150	1	60	2	0	5	1	6
>150	3	113	0	0	8	0	7

Fig. 6.10 Average numerical abundance of meiofauna in different depth ranges of south west coast of India.



Tab. 6.13 Average numerical abundance of meiofauna in different depth ranges of north west coast of India.

Depth range	Foraminiferans	Nematodes	Polychaetes	Ostracods	Copepods	Acari	Others
30-50	13	511	0	0	18	1	11
51-75	18	257	1	0	4	0	10
76-100	11	82	1	0	23	2	5
101-150	3	94	0	1	9	2	3
>150	4	39	0	0	2	1	2

Fig.6.11 Average numerical abundance of meiofauna in different depth ranges of north west coast of India.

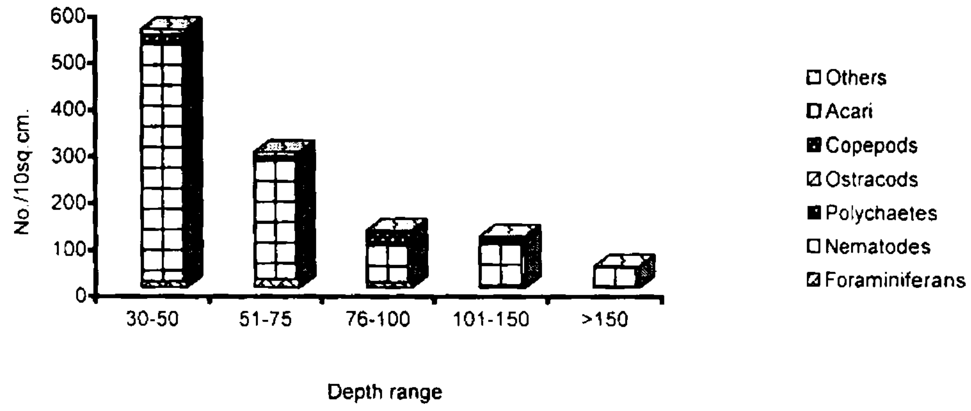
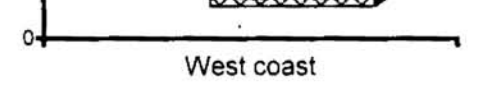


Table 6. 14 Average numerical abundance of meiobenthos, west coast of India.

	Foraminiferans	Nematodes	Polychaetes	Copepods	Acari	Others
West coast	6	159	1	16	1	7

Figure 6.12. Average abundance of meiobenthos, west coast of India



The maximum numerical abundance was recorded off Vadanapilly and Bhatkal 320 ind.10cm^{-2} (Station 16A & 30) where nematode numbers exceed all other groups. Similar trend was apparent in all stations of this depth range except off cape where 'others' outnumbered the nematodes and copepods. Minimum abundance was seen off Cape 8 ind.10cm^{-2} (Station 4). Among the deeper stations of this depth range only Coondapore recorded comparatively higher meiobenthic densities. The average abundance of this depth range was 106 ind.10cm^{-2}.

As a whole, there was a decrease of 65.3% from the 30-50 m-depth range to the edge of the continental shelf. In the case of numerical abundance the decrease was by 72.25% from shallow waters (30m) to the edge of the continental shelf.

The shelf as a whole, the wet weight of the meiobenthos ranged from 0.0668 mg.10cm^2 (Off Kozhikode, 31m) to 6.10mg.10cm^2 (Off Vadanapilly). The major groups contributing to the biomass were nematodes, copepods and 'Others'. Generally biomass was decreasing with increase in depth (Table 6.5 & figure 6.3). The average biomass for south west coast was 1.498 mg.10cm^2 and for north west coast it was 1.268 mg.10cm^2 (Tables 6.6,6.7,6.8 & figures 6.4, 6.5, 6.6). The average biomass of meiobenthos of the entire west coast was 1.398mg.10cm^2.

Likewise, the numerical abundance varied from 8 ind. 10cm2 (Cape, 208m) to 1208 ind.10cm2 (Vadanapilly, 36.2m). In accordance with biomass numerical abundance also showed a significant decline with increase in depth. (Table 6.10 & Figure 6.8). The average numerical abundance for south west coast was 186 ind. 10cm^2 and for north west coast, it was 225 ind.10 cm^2 (Tables 6.11,6.12, 6.13 & figures 6.9, 6.10, 6.11). The average numerical abundance of meiobenthos of the entire west coast of India was 219 ind. 10 cm^2 (Table 6.14 & figure 6.12).

6.4. Ecology of Meiobenthos.

In order to reveal the ecological interactions of meiobenthos to various abiotic variables, a suite of statistical procedures were carried out. Draftsman plot was also worked out to understand the interaction between environmental variables in the shelf waters. BIOENV procedure was carried out to study the linking of meiobenthic abundance and biomass to various environmental parameters.

6.4.1. Draftsman plot –analysis

The draftsman plot and the associated standard product moment correlation coefficient between all pairs of variables were calculated for the present study. This was attempted to examine the collinearity between variables indicated by a straight-line relationships with little scatter (Fig. 6.4.2). Again it would help to reduce all subsets of variables, which have mutual correlations averaging more than 0.95 to a single representative. These subsets were checked in BIOENV-procedure, which reveals the relation with biota. In the present study, the results of draftsman plot analysis are given in Table 6.4.1.

Table 6.4.1. Results of Draftsman plot analysis

Sl. No	Variable	Variable	Correlation
1	Temperature	Dissolved oxygen	0.929
2	Temperature	Depth	-0.928
3	Dissolved oxygen	Depth	-0.924
4	Organic matter	Silt	0.412
5	Sand	Clay	-0.810
6	Silt	Clay	0.908
7	Sand	Silt	-0.619

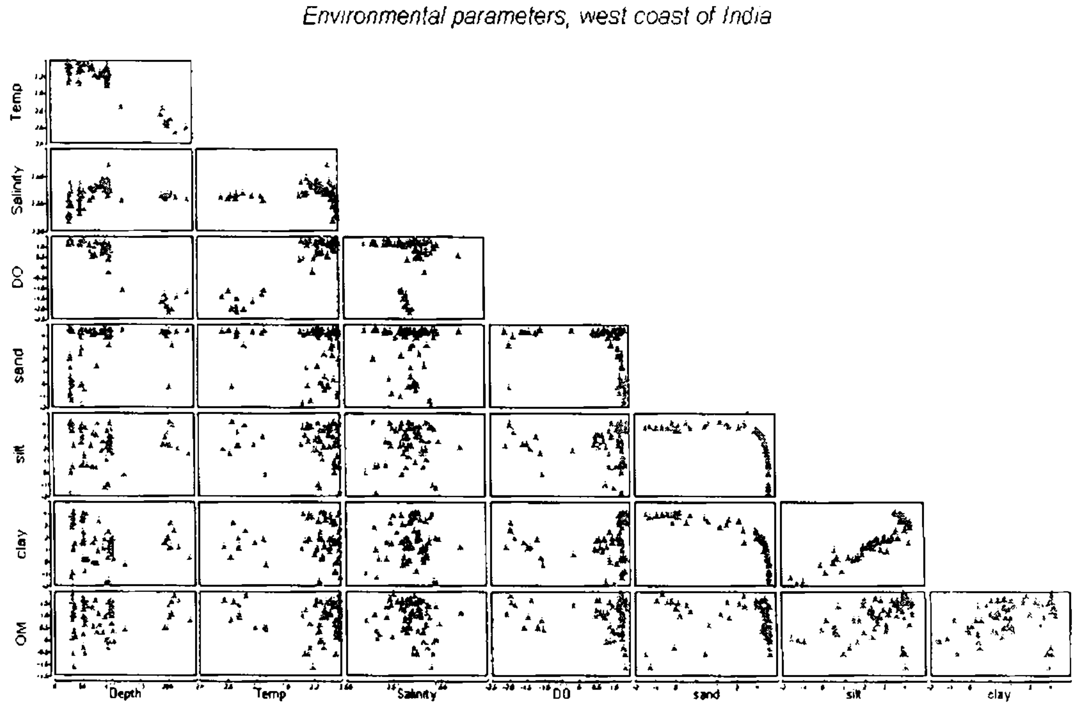


Fig. 6.4.2 Draftsman plot showing the collinearity between environmental variables

6.4.2. BIO-ENV procedure

Meiofaunal distribution patterns are controlled by the interactions of various hydrographical and sedimentary characteristics. To reveal which all parameters are accounting for their distribution BIO-ENV procedure was carried out. In the present study, the available set of environmental variables was as follows. (1) Depth, (2) Organic matter, (3) Sand, (4) Silt, (5) Clay, (6) Temperature, (7) Salinity and (8) Dissolved oxygen. The best 5 combinations are given in the table. 6.4.3.

Table 6.4.3. Combinations of environmental variables controlling meiofauna abundance.

Number of Variables	Best selection	Correlation
4	1,3,6,8	0.112
3	1,3,6	0.112
5	1,3,6,7,8	0.111
4	1,3,6,7	0.107
3	3,6,8	0.107

6.5. Discussion.

Meiofaunal composition in the present study includes 8 taxa viz. Nematoda, Harpacticoida, Foraminifera, Polychaeta, Halacarida, Oligochaeta, Ostracoda, and Kinorhyncha. Of the 8 taxonomic groups present, the most dominant and prevalent group was free-living marine nematodes followed by Harpacticoid copepods. Similar observations were earlier reported by Ansari *et* *al.* 1979, Rodrigues *et al.* 1982. However in their studies foraminiferans were ranked second followed by copepods. Numerically nematodes were contributing 84.47% of the total fauna where as Harpacticoids contributed only 7.88%. Foraminiferans and other taxa (e.g. ostracods, acarids, polychaetes, oligochaetes and kinorhynchs) contributed meagerly.

In the present study, the average meiobenthic biomass of the western continental shelf of India is 1.398 mg.10cm^{-2} (Fig. 6.7 and Table 6.9). The biomass of meiobenthos was 1.498 mg .10cm^{-2} from southwest and 1.268 mg.10 cm^{-2} from northwest region (Fig. 6.4, Table 6.6). Average population density of west coast of India was 219 ind.10cm^{-2} and that of southwest coast were 186 ind.10cm^{-2} and northwest was 225 ind.10cm$^{-2.}$

The numerical abundance and its relation to the sediment nature were not significantly evident from the BIOENV procedure. In the present study, the BIO-ENV- procedure provides the combinations of five environmental variables- depth, sand, temperature and dissolved oxygen as the most important factors defining the existing meiofauna abundance. However the coefficient of environmental parameters to nematode species similarity matrix was 0.112. There are not many studies, which are available to make a comparison with the present study.

In the west coast as a whole the numerical abundance was more in northern regions of the shelf and biomass showed more or less similar patterns between both regions. The coarser sediments present in the southern part of the shelf harbors richer fauna, while the finer sediment were relatively impoverished. Here in the present study the presence of nematodes in certain

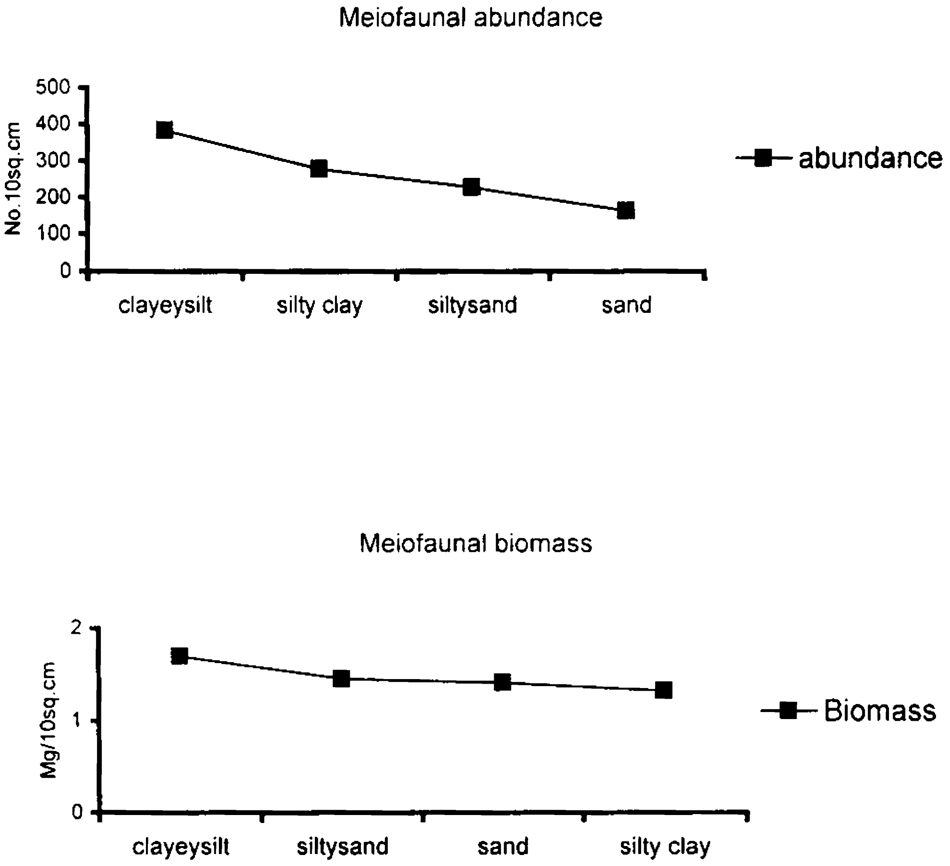


Fig. 6.2a Relation between fauna and substratum

stations of northwest coast was responsible for higher average. In the present study biomass was more in sandy stations owing to the contribution of 'other ' organisms in the south west coast. Whereas in northern regions of the shelf, biomass and abundance was more in stations of finer sediments, and nematodes was the main group contributing to this biomass. The richness of the fauna was present in south west coast and the northern region the most of the meiofaunal abundance was due to nematodes.

In the present study that highest average meiofaunal abundance was noticed in clayey silt substratum (Fig.6.2a). Next important substratum was silty clay followed by silty sand. Total faunal biomass decreased in the order from clayey silt, silty sand, sand and silty clay.

The correlation values between organic matter and the abundance or biomass (Table 6.4.3) does not show any significant relation. It does not mean that OM does not influence the fauna, rather, what portion of the OM is actually available for meiobenthic production is not known. This may be due to the relative proportion of the total organic matter, which is refractory to biological decomposition and exploitation. Ansari *et al.* (1994) did not observe any consistent pattern between organic carbon and benthic biomass. They argued that a moderate enrichment has a bio-stimulating effect on benthic community. So the quality of the organic matter present in the sediment is important. As a rule, densities of meiobenthos are poorly linked to organic compounds of sediments. The relationship between meiofaunal density and the ratio of labile organic matter/ total organic matter indicates that in deep waters meiofauna may be more nutritionally dependent upon the quality, rather than on the quantity, of sedimentary organic matter (Danovaro *et al.*, 1995).

Numerical abundance showed a decrease with increase in depth in all the groups. It was observed that 47% of nematodes ~~were~~ occurred in 30-50m depth range of their total abundance in the shelf whereas copepods were occurring in 48%. 84.17% of the total meiobenthos was contributed by nematodes, which was well in agreement to the study of Ansari and Parulekar, 1998 (80.7- 82.4%) in Goa coast. Polychaetes were also poorly represented often ranking fourth in meiobenthic samples in various depth ranges. Foraminiferans were recorded maximum from 51 to 75 m depth and noticeably towards the northern part of the western shelf. Ostracods are poorly represented throughout, as they prefer surface sandy sediments of shallow bottoms (Giere, 1993). Acari also were poorly represented, owing to their limited abundance in fine sand and muds and limited supply of oxygen (Giere, 1993).

In general, all the meiofaunal groups showed a decrease in biomass with increase in depth. At some stations an unexpectedly high density of meiobenthos has been recorded (off Vadanapilly, 36.2m and off and along Mumbai, 33m and 36m) and such exceptional cases have been considered to be related, in certain cases, to the high productivity of the surface water (Dinet, 1973), High benthic biomass and abundance in nearshore areas were attributed to the higher nearshore primary productivity as the supply of food to subtidal benthic environment depends on proximity to shore and water depth (Levinton, 1982). In the nearshore region, much of the primary production enters the food web as organic detritus and it diminishes with depth and distance from the shore. Similar observations was reported from the coastal waters of west coast of India (Rodrigues *et al.* 1982; Parulekar *et al.* 1982).

The relation between primary productivity and standing stocks are too complex with the influence of abiotic factors like pressure, water temperature, oxygen concentrations, sediment granulometry, and biological processes in water column (degradation of organic matter in the pelagic food web) and interactions with other faunal groups (competition and predation).

The other important parameters, which are playing a crucial role in the meiofaunal standing stocks, were temperature and dissolved oxygen. In the deeper area, the temporal variations are less pronounced. The seasonal variations in fauna were rarely observed in benthic realm (Sanders, 1960, Nakoa, 1982). Though there was slight variation in temperature and salinity with latitudes, it did not reflect much with the fauna. Dissolved oxygen showed near anoxic values in the depth >150m, especially in northern shelf edge. Neyman (1969) showed that benthos was sparse in the northern shelf of western India at depths of 75-200m. He attributed this low level of benthos due to the effect of waters with minimum oxygen content. In the present study, the low densities of total meiofauna can be attributed to low levels of oxygen. However in the present study beyond 150m about 87% of the total meiofauna represented were nematodes. In northwest region beyond 150m where oxygen values were nearly approaching zero nematode was present in comparatively higher densities. This can be explained by the observation that nematodes are more tolerant to such anoxic conditions (Gooday *et al.*, 2000; Bernhard *et al.*, 2000). Similar observations were have been reported from sub tidal meiobenthos (Damodaran, 1973).

The present study reveals that despite high abundance, meiofauna have relatively low standing stock biomass in comparison with macrobenthos. However, their production and hence biomass turnover rate are several orders greater than that of macrobenthos, thus resulting in higher annual biomass. Meiofauna with nematodes and harpacticoids have been calculated to consume twice the amount of carbon, produce four times as much as the ambient macrobenthos with only half its biomass (Warwick and price, 1979). In general in an average benthic biotype, meiofauna produces about one quarter of the total energetic budget, to which microfauna and microphytobenthos add at least the same portion (Munro *et al.*, 1978).

Trophic relationships.

A detailed understanding of the bottom fauna is essential to obtain a comprehensive picture of the fishery potential of an area (Damodaran, 1973). Benthos forms the basis for energy flow to many species in the benthic system (Parulekar *et al.*, 1980). 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). The benthic communities of the tropical oceans are of much importance in interpreting the ecology of tropical demersal communities (Ansari and gauns, 1996). The role of benthos in the food of the bottom feeding fishes is well understood, so an estimation of the benthic organic carbon can give some idea about its potential to demersal fisheries (Parulekar *et al.*, 1982). The efficiency of meiofauna in transferring trophic energy to the higher tropic levels was well documented (Coull *et al.*, 1995) clearing the assumptions that meiofauna was a trophic end (McIntyre and Murison, 1973).

The present study showed an average meiobenthic biomass of 1398 kg/km^{-2} along the continental shelf of west coast of India. Assuming that the average meiobenthic generation time is 3 months per annum, the meiobenthic production will be about 5592 kg/km^{2}. Parulekar *et al.*, (1982) give a value of 1.42 gm^{-2} as dry weight of meiobenthos of the Arabian Sea. Converting it into wet weight a value of 5680 kg/km^{-2} was obtained. Assuming the ratio of dry weight–wet weight as 1:4 (Gerlach, 1971, Wieser, 1960) the dry weight obtained from the wet weight is 349.5 kg km^{-2}. Since carbon content is found to be 34.5% of the dry weight we get a value of 120. 58 kg C km^{-2}. Most species of meiobenthos has got a life span of about three months; we get an annual meiobenthic production of about 482.3 kg C km^{-2} yr^{-1}. This will call for a demand of 4823kg C km^{-2} yr^{-1} for the production, considering an the ecological transfer efficiency of 10%. For this benthos mainly depend on primary ~~production of~~ overlying water.

Concurrent studies conducted along with the benthic biomass estimations of the continental shelf of west coast of India on primary production using C^{14} technique showed an annual primary production of around 2,44,185 kg C km^{-2}yr^{-1} (Madhu, personal communication). This shows that primary production is not a limiting factor for benthos. Contradictory

The present study showed an average meiobenthic biomass of 1398 kg km^{-2} along the continental shelf of west coast of India. The western continental shelf area is approximately 2,51,631.36 km^2. So the total meiobenthic production will be 1.4 million tones. The macrobenthic production is 1.4 million tonnes (Joydas, 2002). So the total benthic production in terms of wet weight will be 2.8 million tonnes. When considering the total benthic production the contribution of meiofauna is significant from the present study. This was earlier reported, that in Arabian Sea the contribution of meiofauna in the total benthic production is more significant than macrofauna (Rodrigues *et al.*, 1982). The total demersal fish production in the west coast of India in 1999 was 0.71 million tones (source: CMFRI, annual report 2000). Since the transfer of energy from one trophic level to another is about 10% (Slobodkin, 1962), this requires a trophic support of 7.1 million tonnes or more. Meiobenthos contribute 1.4 million tonnes. The rest 5.7 million tonnes may be contributed by (i) macrofaunal production, (ii) microfaunal production (iii) micro algal production and (iv) benthic production up to 30m.

Chapter 7

Systematics and taxonomy of free-living marine nematodes

7:1 Introduction:

Nematodes are the most abundant metazoan organisms in the world. The marine free-living forms inhabit all of the world's seabed habitats in great numbers. In any one habitat they usually have more species than any other major taxon, usually by an order of magnitude. This shows the importance of nematodes in the economy of the seabed (Platt and Warwick, 1980). Studies of nematodes from major coasts of developed countries are available and understood. Nevertheless, in Indian waters the studies are limited to their quantitative aspects only. Thus the systematics of aquatic nematodes became very scanty, insufficient and inadequate (Sulthan Ali *et al.*, 1998). Apart from some preliminary studies, (Timm, 1956, Govindankutty, 1967 and Rao and Ganapati, 1968) no other work was carried out in this aspect.

In the present investigation on meiofauna, by the far the most important group from the standpoint of numerical abundance was the nematoda. They occurred regularly from all stations and often represented more than 80% of the total meiofauna recorded. About 155 species of free-living marine nematodes are tentatively identified from which 100 species are described with certainty. New species are not described here, as it requires more taxonomic debate. However most of the species are reported for the first time from Indian territorial waters.

Being the most abundant group among meiofauna, free-living nematodes were taken into a detailed systematic study. Community structure of the major group was alone worked out since all other faunal groups were feebly represented or not studied upto species level.

The similarities of the stations were clustered by using a hierarchical agglomerative analysis. This was to understand the depth–segregated nematode assemblages in the shelf waters. For this the Bray-Curtis similarity matrix was constructed and represented by a tree-diagram or dendrogram. Superimposition of clusters on an ordination plot was carried out by a Nonmetric Multi Dimensional Scaling (NMDS). Analyses of species similarity between selected depths were also tested using ANOSIM (Analysis of Similarities) procedure. SIMPER procedure was employed to account for similarity or discrepancy of between species from selected depth ranges.

7:2:1 Systematic list of free-living marine nematodes, West Coast of India

The classification of free- living nematodes by Lorenzen (1981, 1994) was adopted in fixing the taxonomy and systematics of marine nematodes. The free- living nematodes are included in the class Adenophorea which include two subclasses viz. subclass I Enoplia and subclass II Chromodoria. The subclass Enoplia includes the order Enoplida. The subclass Chromodoria is divided in to two orders, Chromadorida and Monhysterida. The descriptions of 100 species are listed and described in detail. More emphasis was given on the detailed morphology of the specimen than on absolute or relative measurements, since variations in body size is prominent in nematodes from place to place (Platt and Warwick, 1998). Descriptions include the valid names, synonyms and taxonomy of either male or female in each species, geographic distribution and remarks. The sketches of mostly male or else female are given unless otherwise mentioned. Each species is described with their family and genus characters so as to have a full account of the individual specimen. The classified list of free-living nematodes and their systematics and taxonomy is given below.

Phylum:Aschelminthes

Class:Adenophorea

Subclass:Enoplia

Order	**Enoplida**
Family	Oncholaimidae
Genus	*Oncholaimus* Dujardini 1845a
Species	*Oncholaimus dujardini* de Man 1878
Genus	*Oncholaimium* Cobb 1930a
Species	*Oncholaimium vesicarium* Wieser 1954
Genus	*Viscosia* DeMan1890a
Species	*Viscosia viscosa* Bastian 1865
Species	*Viscosia elegans* Kreis 1924
Species	*Viscosia carnleyensis* Ditlevsen 1921a
Species	*Viscosia macramphida* Chitwood 1951
Genus	*Oncholaimellus* De Man 1890
Species	*Oncholaimellus carlbergi* Allgen 1947d
Genus	*Filoncholaimus* Filipjev 1927a
Species	*Filoncholaimus filicaudatus* Ditlevsen 1926a

Family	*Oxystominidae* Micoletzky 1924
Genus	*Halalaimus* De Man 1888a
Species	*Halalaimus isaitshikovi* Filipjev 1927
Species	*Halalaimus longicaudatus* Filipjev 1927
Species	*Halalaimus gracilis* De Man 1888
Species	*Halalaimus meyersi* Wieser & Hopper 1967
Genus	*Oxystomina* Filipjev 1921a
Species	*Oxystomina elongata* Butschli 1874a
Species	*Oxystomina clavicaudata* Filipjev
Genus	*Ledovitia* Filipjev 1927a
Species	*Ledovitia phanertrata* Wieser 1954
Family	*Tripylididae* de Coninck & Stekhoven 1933
Genus	*Tripyloides* DeMan 1886b
Species	*Tripyloides marinus* Butschli 1874
Family	*Phanodermatidae* Filipjev 1927
Genus	*Crenopharynx* Filipjev 1934
Species	*Crenopharynx marioni* Southern 1914
Family	*Trefusiidae*
Genus	*Trefusia* De Man 1893
Species	*Trefusia longicaudata* De Man 1893
Subclass **Order: I**	***Chromadoria*** ***Chromadorida***
Family	*Comesomatidae* Filipjev 1918
Genus	*Laimella* Cobb 1920
Species	*Laimella longicaudata* Cobb 1920
Species	*Laimella filipjevi* Jenson1979
Genus	*Paracomesoma* Hope & Murphy 1972
Species	*Paracomesoma longispiculum* Timm 1961; *Hopper* 1967
Genus	*Sabatieria* Rouville 1903a

Species	*Sabatieria paracupida* Filipjev, Wieser & Hopper 1967
Genus	*Setosabatieria* Platt 1985
Species	*Setosabatieria hilarula* DeMan 1922
Genus	*Cervonema* Wieser 1954
Species	*Cervonema macramphis* Stekhoven 1950; Cobb 1920
Family	*Selachinematidae* Cobb, 1915
Genus	*Richtersia* Steiner 1916
Species	*Richtersia inaequalis* Riemann 1966
Genus	*Choniolaimus* Ditlevsen 1918
Species	*Choniolaimus papillatus* Ditlevsen 1918
Genus	*Halichoanolaimus* De Man 1886a
Species	*Halichoanolaimus consimilis* Allgen 1933b
Species	*Halichoanolaimus dolichurus* Ssaveljev 1912
Genus	*Latronema* Wieser 1954a
Species	*Latronema orcina* Gerlach 1952
Species	*Latronema piratica* Wieser 1954a
Genus	*Leptonemella* Cobb 1898
Species	*Leptonemella aphanothecae* Gerlach 1950
Genus	*Synonchiella* Cobb 1933a
Species	*Synonchiella riemanni* Warwick 1970
Family	*Desmoscolecidae* Shipley 1896
Species	*Tricoma* Cobb 1894a
Genus	*Tricoma filipjevi* Chitwood 1951
Species	*Tricoma brevirostris* Southern 1914
Genus	*Quadricoma* Filipjev 1922
Species	*Quadricoma scanica* Allgen 1935
Family	*Desmodoridae* Filipjev 1922
Genus	*Catanema* Cobb, 1920

Species	*Catanema macintyrei* Platt& Zhang 1982
Genus	*Spirinia* Filipjev 1918; Gerlach 1963
Species	*Spirinia similis* Cobb 1898
Species	*Spirinia parasitifera* Bastian 1865
Genus	*Chromaspirina* Filipjev 1918
Species	*Chromaspirina inaurita* Wieser & Hopper 1967
Genus	*Desmodora* Filipjev 1922
Species	*Desmodora tenuispiculum* Allgen 1928
Species	*Desmodora scaldensis* De Man 1889
Species	*Desmodora brachypharynx* Allgen 1947d
Genus	*Metachromadora* Filipjev 1918
Species	*Metachromadora pulvinata* Wieser & Hopper 1967
Genus	*Acanthopharyngoides* Chitwood 1936b
Species	*Acanthopharyngoides chitwoodi*
Family	*Microlaimidae*
Genus	*Bolbolaimus* Cobb 1920a
Species	*Bolbolaimus teutonicus* Riemann 1966
Genus	*Calomicrolaimus* Lorenzen 1976
Species	*Calomicrolaimus spirifer* Warwick 1970
Family	*Chromadoridae* Filipjev 1917
Genus	*Actinonema* Cobb 1920a
Species	*Actinonema pachydermatum* Cobb 1920a
Genus	*Parapinnanema* Inglis 1969
Species	*Parapinnanema harveyi* Warwick & Coles 1975
Genus	*Spilophorella* Filipjev 1918a
Species	*Spilophorella euxina* Filipjev 1918a; Stekhoven 1950
Species	*Spilophorella candida* Gerlach 1951
Species	*Spilophorella tollenifera* Wieser
Genus	*Dichromadora* Kreis 1929a
Species	*Dichromadora geophila* De Man 1876

Genus	*Paraeuchromadora* Stekhoven & Adams 1931
Species	*Paraeuchromadora Longicaudata* Chitwood 1951
Family	*Cyatholaimidae*
Genus	*Longicyatholaimus* Micoletzky 1924b
Species	*Longicyatholaimus quadriseta* Wieser
Genus	*Pomponema* Cobb 1917
Species	*Pomponema segregata* Wieser 1959
Genus	*Paralongicyatholaimus* Stekhoven 1950a
Species	*Paralongicyatholaimus minutus* Warwick 1971
Genus	*Metacyatholaimus* Stekhoven 1942a
Species	*Metacyatholaimus spatiosus* Wieser 1954
Family	*Ceramonematidae* Cobb 1933
Genus	*Pselionema* Cobb 1933a
Species	*Pselionema longiseta* Ward 1974
Genus	*Ceramonema* Cobb 1929
Species	*Ceramonema carinatum* Wieser
Genus	*Dasynemoides* Chitwood 1936b
Species	*Dasynemoides albaensis* Warwick & Platt 1973
Family	*Ethmolaimidae* Filipjev & Stekhoven 1941
Genus	*Filitonchus* Platt 1982
Species	*Filitonchus filiformis* Warwick 1971
Family	*Aegialoalaimidae* Lorenzen 1981
Genus	*Cyartonema* Cobb 1920a
Species	*Cyartonema germanicum* Juario 1972
Genus	*Southernia* Allgen 1929
Species	*Southernia zosterae* Allgen 1921
Family	*Monoposthiidae* Filipjev 1934
Genus	*Nudora* Cobb 1920a
Species	*Nudora crepidata* Wieser
Family	*Draconematidae* Filipjev 1918
Genus	*Dracognomus* Allen &Noffsinger 1978

Species	*Dracognomus simplex* Gerlach 1954
Genus	*Notochaetosoma* Irwin-Smith 1918a
Species	*Notochaetosoma killieri* Warwick 1977
Family	*Leptolaimidae* Orley 1880
Genus	*Antomicron* Cobb 1920
Species	*Antomicron elegans* De Man 1922
Order II	***Monhysterida***
Family	*Sphaerolaimidae* Filipjev 1918
Genus	*Sphaerolaimus* Bastian 1865a
Species	*Sphaerolaimus pacifica* Allgen 1947d
Species	*Sphaerolaimus islandicus* Ditlevsen 1926
Species	*Sphaerolaimus hirsutus* Bastian 1865
Species	*Sphaerolaimus macrocirculus* Filipjev 1918
Species	*Sphaerolaimus penicillus var. pugetensis* Wieser 1959
Family	*Xyalidae* Chitwood 1951
Genus	*Theristus* Bastian 1865
Species	*Theristus acer* Bastian 1865
Species	*Theristus alternus* Wieser 1956
Species	*Theristus fistulatus* Wieser & Hopper 1967
Species	*Theristus exutus*
Genus	*Paramonohystera* Steiner 1916a
Species	*Paramonohystera buetschlii* Bresslau & Stekhoven *in* Stekhoven 1935
Genus	*Rhynchonema* Cobb 1920; Murphy 1964a
Species	*Rhynchonema cinctum* Cobb 1920
Genus	*Promonhystera* Wieser 1956a
Species	*Promonhystera faber* Wieser 1954
Genus	*Amphimonhystera* Allgen 1929c
Species	*Amphimonhystera anechma* Southern 1914
Genus	*Metadesmolaimus* Stekhoven 1935

Species	*Metadesmolaimus aduncus* Lorenzen 1972
Genus	*Xenolaimus* Cobb 1920a
Species	*Xenolaimus striatus* Cobb 1920
Genus	*Daptonema* Cobb 1920
Species	*Daptonema oxycerca* De Man 1888
Family	*Axonolaimidae* Filipjev 1918
Genus	*Axonolaimus* De Man 1889a
Species	*Axonolaimus spinosus* Butschli 1874
Genus	*Ascolaimus* Ditlevsen 1919
Species	*Ascolaimus elongatus* Butschli 1874
Genus	*Parodontophora* Timm 1963a
Species	*Parodontophora brevamphida* Timm 1952
Species	*Parodontophora breviseta* Stekhoven 1950; Timm, 1963
Family	*Linhomoeidae*
Genus	*Paralinhomoeus* DeMan 1907b
Species	*Paralinhomoeus tenuicaudatus* Butschli 1874
Species	*Paralinhomoeus pachyamphis* Wieser, 1956
Species	*Paralinhomoeus lepturus* De Man 1907
Genus	*Eumorpholaimus* Schulz 1932a
Species	*Eumorpholaimus subulicolus* Schulz 1952
Genus	*Terschellingia* De Man 1888a
Species	*Terschellingia communis* De Man 1888
Species	*Terschellingia longicaudatus* De Man 1907
Genus	*Eleutherolaimus* Filipjev 1922a
Species	*Eleutherolaimus stenosoma* De Man 1907
Genus	*Metalinhomoeus* De Man 1907
Species	*Metalinhomoeus longiseta* Kreis 1929
Genus	*Disconema*
Species	*Disconema alaima*
Family	*Diplopeltidae* Filipjev 1918

Genus	*Didelta* Cobb 1920
Species	*Didelta scutata* Wieser 1954
Genus	*Diplopeltula* Gerlach 1950a
Species	*Diplopeltula asetosa* Juario 1974
Family	*Siphonolaimidae* Filipjev 1918
Genus	*Siphonolaimus* DeMan 1893
Species	*Siphonolaimus auratus* Wieser 1954
Species	*Siphonolaimus pachyderma* Wieser 1954

7.2.2:Taxonomy of free- living nematodes

Order: Enoplida

Enoplids are characterized by cylindrical oesophagus, two parts cylindroid or conoid; amphids pocket-like and ovaries always refluxed.

Family: Oncholaimidae Baylis & Daubney, 1926

The following characters characterize Oncholaimidae. Stomatorhabdions heavily cuticularised; stoma somewhat capsuliform, only the posterior part surrounded by oesophageal tissue.

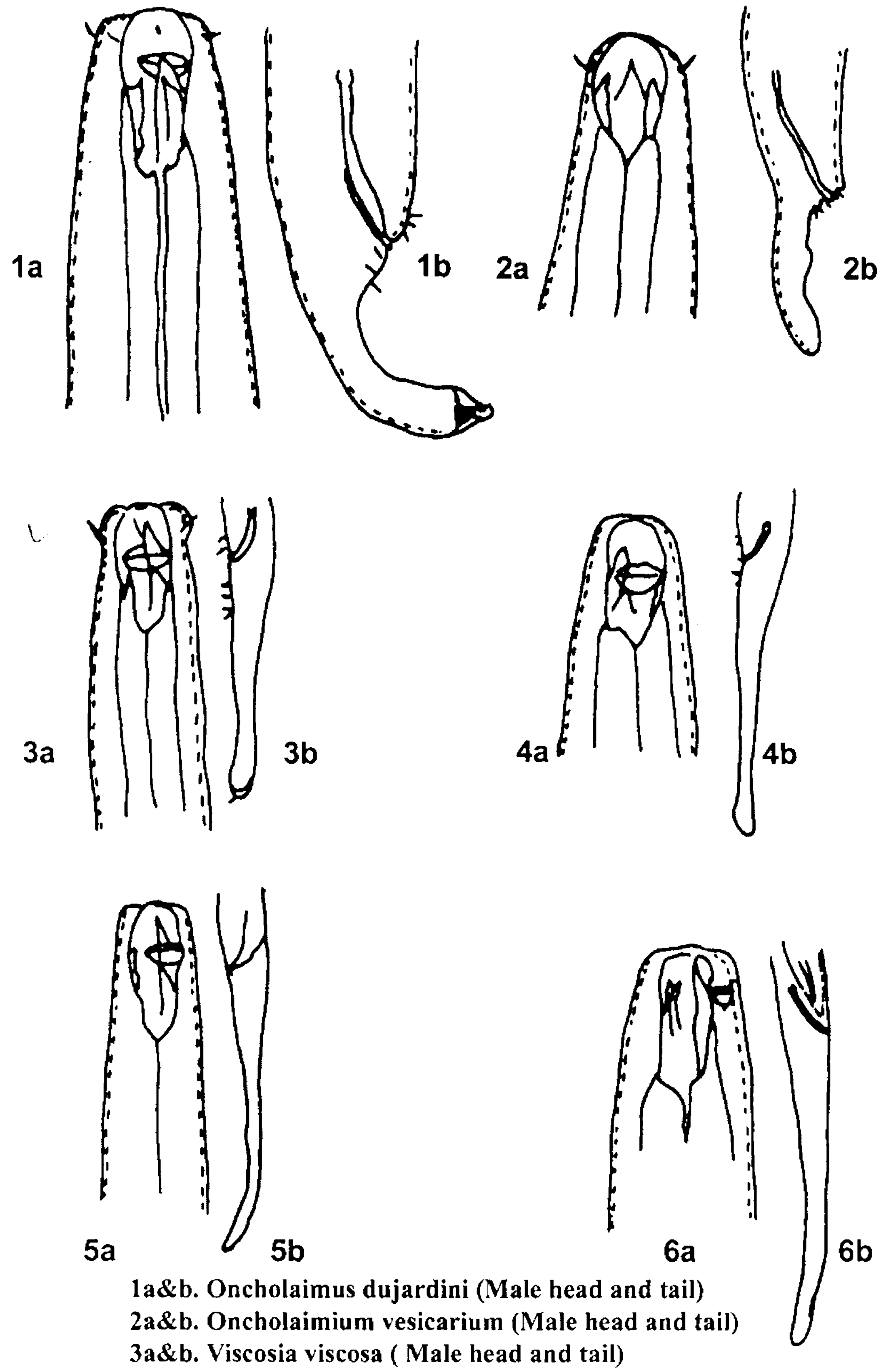
Genus: Oncholaimus Dujardin, 1845a.

Syn: *Oncholaimium* Cobb, 1930a

Syn: *Pseudoncholaimus* Kreis, 1932a.

The combination of large left ventrolateral tooth, single ovary and short spicules with no gubernaculum serves to distinguish *Oncholaimus* from other oncholaimid genera. The accessory papillae and circumcloacal setae associated with copulation in the male are useful characters for identification within this group.

plate 1



1a&b. Oncholaimus dujardini (Male head and tail)
2a&b. Oncholaimium vesicarium (Male head and tail)
3a&b. Viscosia viscosa (Male head and tail)
4a&b. Viscosia elegans (Male head and tail)
5a&b. Viscosia carnleyensis (Female head and tail)
6a&b. Viscosia macramphida (Male head and tail)

1. ***Oncholaimus dujardini*** De Man, 1878 (Plate 1. Fig. 1a & 1b).

=*O. dujardini* Rouville 1903a, 1904. Steiner, 1915, 1922a, Filipjev, 1918,1922a, Micoletzky, 1924a, Allgen, 1927c, 1933b, 1941,1942,1947d, 1951f. Kreis, 1928. Stekhoven, 1933d, 1942b, 1943,1950, Gerlach, 1951a & Wieser, 1951.

=*O.armatus* Daday, 1901.

=*O.bollonsi* Ditlevsen, 1930

=*O. exilis* Cobb 1889, 1891a

Recorded specimens were with an average body length of 2.1mm. (Male: a=48.8; b=7.2; c=34.4). Maximum body diameter 43µm. Head diameter 21µm. Six cephalic papillae are small; buccal cavity is armed with 3 strong teeth of which left sub ventral tooth larger than other two. Amphids 9µm wide and covering more than 45% of c.b.d. Tail strongly attenuated behind the anus, 2.1 a.b.d long with a typical ventral curve. Distal half of spicules are swollen. Gubernaculums are absent. Circum cloacal setae present.

Geographical distribution: British waters, Isles of Scilly, Artic, Norway, Red Sea, Mediterranean and Adriatic.

Remarks: The material in the present collection is closely related to *O. dujardini* De Man 1878 in the nature of buccal cavity, teeth and the tail. The body dimensions are well in agreement with the species described by DeMan. The aforesaid details are taken in to account for placing the present specimens as *O. dujardini De Man 1878.*

***Genus:* Oncholaimium.** Cobb 1930a

Syn: *Oncholaimus* Dujardin 1845a

This genus is characterized by the presence of demanian system and preanal papillae with two setae.

2. ***Oncholaimium vesicarium*** Wieser, 1959 (Plate 1, Fig 2a & 2b)

Body length is 3.52mm (Male: a= 44.6; b= 8.9; c= 62.2). Head bears short cervical setae; cuticle is relatively thick. Head diameter 36µm. Lips and labial papillae are indistinct in specimens. Cephalic setae measure 7.3µm. Amphids 8.3µm wide. Buccal cavity, length and width proportion is 31 x 20µm. Larger tooth measures 26.4µm from the base of buccal cavity. Excretory pore is with large ampulla. Spicules are 37µm long with no gubernaculums. 6 circumanal setae present. Tail is strongly attenuated right behind the anus so that its greater portion is cylindrical. Middle of tail, a large ventral papilla is present.

Geographical distribution: Chile, Puget Sound.

Remarks: The material is closely related to *Oncholaimium vesicarium* Wieser 1959 in the nature of the buccal cavity, size and disposition of the amphids, in the nature of the oesophagus and in the structure of the spicular apparatus. The body length is varied from the original descriptions. The tail region, the small ventral papilla is absent, which is present in the original descriptions of Wieser. Despite these differences, the present specimens are closely allied to *Oncholaimium vesicarium* Wieser 1959 so they are referred to as *Oncholaimium vesicarium* Wieser 1959.

Genus*:* *Viscosia* De Man 1890a.

Syn: *Steineria* Ditlevsen 1928a

Syn: *Steineriella* Allgen 1932b

Cephalic setae are reduced to papillae or even to barely visible shallow pits in the cuticle. The spicula offer hardly any distinguishing characters, renders classification particularly difficult. The size of amphids, shape of buccal cavity and teeth, arrangement of male circumanal organs like papillae and bursa, and shape of tail are distinguishing characters.

3. ***Viscosia viscosa*** Bastian 1865. (Plate 1. Fig. 3a & 3b)

Specimens having a body length of 1.67mm (Male: a=52; b=7.2; c=16.7). Cuticle is smooth. Mouth is with rounded lips. 6 labial papillae are present. Head bears six longer cephalic setae, 4µm long and four shorter setae. Constricted head positioned to cephalic setae. Buccal cavity with large sub ventral tooth, left sub ventral tooth double tipped, dorsal tooth small. Amphids 8µm wide, pocket like with elliptical openings. Oesophagus is cylindrical. Body setae short and sparsely scattered. Tail two-thirds conical, distal third cylindrical.

Geographical distribution: Recorded from British waters (Muddy and coarser sediments), Bay of Bengal.

Remarks: The present material is closely related to *Viscosia viscosa* Bastian 1865 in the nature of the buccal cavity, disposition of the amphids, in the nature of the oesophagus and in the structure of the spicular apparatus. The absence of body setae was a major difference from the original description. The nerve ring was also not noticed. The size of amphids, there is a minor variation. Despite these differences, the present specimens are closely allied to *Viscosia viscosa* Bastian 1865 in many respects and hence they are referred as to *Viscosia viscosa* Bastian 1865.

4.*Viscosia elegans* Kreis 1924. (Plate1. Fig. 4a & 4b)

Body length is 2.350mm (Male: a=94; b=9.4; c=18.8). Six labial papillae are present. Six 3µm longer cephalic setae are present. Lateral cervical setae are placed at the base of the buccal cavity. Amphids are 10µm wide. Large right and smaller double tipped left sub ventral teeth; dorsal tooth represented by slight ridge only. Tail is tapering, with a bulbous tip. Sub dorsal terminal setae absent. Spicules are 23µm long, slightly curved and cephalate proximally. Cloaca is not surrounded by paired setae.

Geographical distribution: Isles of Scilly.

Remarks: The present specimens are closely related to *Viscosia elegans* Kreis 1924 in the nature of the buccal cavity, size and location of the amphids, nature of the oesophagus and in the structure of the spicular apparatus. However the absence of sub-dorsal terminal setae and cloaca not surrounded by paired setae are the main similarities to distinguish it from other species of Viscosia. As the major distinguishing characters of this species are in close agreement with the present specimens they are referred to as *Viscosia elegans* Kreis 1924.

5.*Viscosia carnleyensis* Ditlevsen 1921a (Plate 1. Fig. 5a & 5b)

=Oncholaimus c. Ditlevsen.

=V. carnleyensis *va. tropica Kreis 1932*

=V. carnleyensis: *Kreis 1932, 1934a.*

Body length is 1.125mm (Female: a=30.6; b=5.8; c=9.8). Head diameter is 17µm. Cephalic papillae absent or reduced. Amphids are 8µm wide. Excretory pore is placed on level with the nerve ring. Buccal cavity dimensions are 22 x

11µm. Teeth 22µm and 16µm long from the base of the buccal cavity. Tail is 8 a.b.d long with a swollen tip.

Geographical distribution: Auckland Islands, Sunda Islands, Chilean coast, Puget Sound (In muddy sands and sandy substratum), Bay of Bengal and Arabian Sea.

Remarks: The material is closely related to *Viscosia carnleyensis* Ditlevsen 1921a in the nature of the buccal cavity and structure of teeth. The features of tail and cuticle are also similar to Chilean materials described by Wieser 1959. Therefore they are referred to as *Viscosia carnleyensis* Ditlevsen1921a.

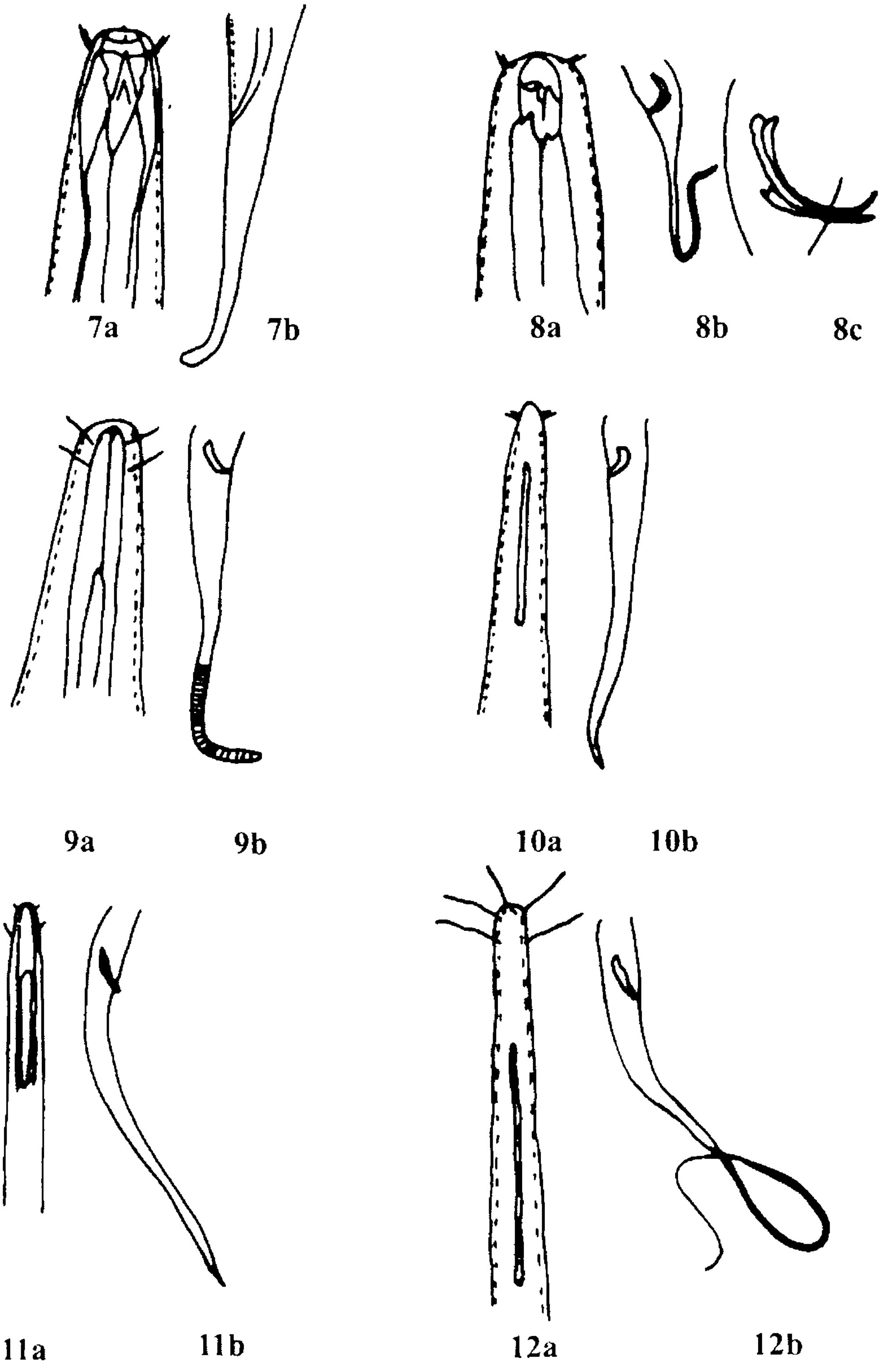
6. ***Viscosia macramphida*** Chitwood 1951(Plate 1.Fig. 6a & 6b)

Body length is 1.52mm (Male: a=32; b=7; c=8.1). Mouth is surrounded by six inconspicuous lips bearing an internal circle of six papillae and an external circle of more than four distinct papilla. Buccal cavity is 17µm long and 7µm wide. Amphids measures nearly as wide as the cavity. Mouth equipped with a large right sub ventral tooth, small digitiform right sub ventral teeth and dorsal teeth. Spicula are 23µm long. Tail is attenuated.

Geographical distribution: Mud Island, Aransas Bay, Texas and Bay of Bengal.

Remarks: The present specimens are closely related to *V. macramphida,* to the original descriptions and also to that of Wieser and Hopper, 1967. The similarity was showed in the details of stoma, teeth and the cephalic papillae. The difference noticed was in the length of buccal cavity from that of Wieser and Hopper's materials (where it is 20-21µm). The aforesaid details enables it be placed under the species *V. macramphida* Chitwood, 1951.

Plate 2



7a&b. Oncholaimellus carlbergi (Female head and tail)
8a,&b,c. Filoncholaimus filicaudatus (Male head, tail and spicular region)
9a&b. Halalaimus isaitshikovi (Male head and tail)
10a&b. Halalaimus longicaudatus (Male head and tail)
11a&b. Halalaimus gracilis (Male head and tail)
12a&b. Halalaimus meyersi (Male head and tail)

Genus: Oncholaimellus De Man 1890.

Syn: *Oncholaimeelus* Timm, 1967b

Syn: *Onchelaimellus* Timm, 1967b

A massive right sub ventral tooth and a transverse band dividing the buccal cavity in to two halves characterize this genus.

7. Oncholaimellus carlbergi Allgen 1947d (Plate.2. Fig 7a & 7b).

Body length is 1.550mm (Female: a=43; b=6.3; c=14). Oesophagus length 245µm. Head diameter 24µm. Maximum diameter 85µm. Strong sub ventral tooth measures 21µm. Dorsal tooth small, hook shaped and projecting from the wall of the buccal cavity. The latter attenuated in the middle and there provided with a cuticular band. Excretory pore placed 171µm from the anterior end.

Geographical distribution: Panama and Chile.

Remarks: The material is closely related to *Oncholaimellus carlbergi* Allgen 1947d in the nature of the buccal cavity, in the nature of the oesophagus. The body measurements were also in comparison with that of Allgen's specimens. Therefore they are referred to as *Oncholaimellus carlbergi* Allgen 1947d.

Genus: Filoncholaimus Filipjev 1927a

Syn: ***Pseudoparoncholaimus*** Kreis 1932a

8. ***Filoncholaimus filicaudatus.*** Ditlevsen 1926a; Filipjev 1927a

(Plate 2. Fig. 8a & 8b,c).

Syn: *Oncholaimus filicaudatus* Ditlevsen 1926a.

Body length is 4.33mm (Male: a=57.7; b=9.4; c=5.5). Head diameter 25.6µm. Cephalic setae in two circles, longer cephalic setae are 9.5µm long. Cuticular striations are not evident or absent. Buccal cavity is cup-shaped, 20µm deep.

Large dorsal tooth and two ventral teeth are present. Amphids cup shaped and placed around the middle of the buccal cavity (17µm from anterior). Oesophagus is with no buccal enlargement. Spicula are 66.3µm long, curved and cephalate proximally. Gubernaculums is 42µm long and placed close to spicules. Tail is long and filiform.

Geographical distribution: Danish waters and Pacific Ocean.

Remarks: The material is closely related to *Filoncholaimus filicaudatus* Ditlevsen 1926a in the nature of the buccal cavity and teeth. The shape of spicula and its size are also treated for distinguishing this species from other species of *Filoncholaimus*. So they are considered as *Filoncholaimus filicaudatus* Ditlevsen 1926a.

Family: Oxystominidae Micoletzky 1924

Amphids usually elongate, often tuboid internally, stoma unarmed; oesophagus conoid, musculature weak; cephalic setae usually 6, post cephalic 4; male without pre-anal supplement.

Genus: Halalaimus De Man 1888a

Syn: ***Halalaimoides*** Cobb 1933a.

Syn: ***Nuada*** Southern 1914a.

The characteristic feature of *Halalaimus* is the long slit-like amphid and the strongly attenuated anterior end. Cuticle may be striated or not.

9. ***Halalaimus isaitshikovi***: Filipjev 1927(Plate 2. Fig. 9a & 9b).

Body length is 1.530mm (Male: a=52.9; b=8.3 c=9.7) Maximum diameter 27µm. Head distinctly set off. Both circles of cephalic setae are equal in length. Amphids 37µm long, about 4.5 times distance from anterior of body. Spicula

19μm long. Tail is with posterior third filiform and swollen tip. Striations are present on anterior part of the tail.

Geographical distribution: Northumberland and England (Fine sublittoral sand).

Remarks: The present specimens are bigger in body length to that of Filipjev's materials. But the features of cephalic setae, amphid size and its position from the anterior end and also the lateral striations of the tail are demarcating features to identify. Hence they are referred to as *H. Isaitshikovi* Filipjev 1921.

10. *Halalaimus longicaudatus* Filipjev 1927 (Plate 2. Fig. 10a & 10b).

Body length is 1.890mm (Male: a=75.2; b=4.8; c=13.5). Four posterior cephalic setae are shorter than but situated close to the six 0.8 h.d long anterior cephalic setae. Amphids 45μm long and placed about 3.5 times distance from the anterior end of body. Spicula are 16μm long. Tail is long and tapering to a fine tip.

Geographical distribution: Northumberland, England (Fine Sublittoral sand).

Remarks: The material before me is closely related to *H. longicaudatus* Filipjev, 1927 in the details of cephalic setae, amphid size and its position from the anterior end. The above-cited details enabled it to be placed under *H. longicaudatus* Filipjev, 1927.

11._*Halalaimus gracilis* De Man,1888. (Plate 2.Fig. 11a & 11b)

Body length is 1.1mm (Male: a=48; b=5; c=7.7). Cuticle is smooth and body setae are not visible. Cervical region is long and, attenuated. Six anterior cephalic setae are 0.8 h.d. long; four posterior cephalic setae slightly longer and situated about 2 h.d long from the anterior. Buccal cavity is absent. Amphids are long; narrow slit-like and length about equal to the distance from the anterior end of body. Oesophagus length about 0.3 times body length with small posterior dilation. Tail long tapers in to a slightly swollen tip. Spicules 16µm long, with a faint ventral ala. Gubernaculum surrounds tip of spicules. Vulva placed in middle of the body.

Geographical distribution: California, North Sea, Kiel Bay, British waters, Panama, Coasts of Northern Europe, Mediterranean and Red Sea and Bay of Bengal.

Remarks: Except the absence or unnoticeable ventral spine anterior to cloaca and opposed testes, all the descriptions of type species agrees well with the present specimens. Thus the present specimens are referred as *H. gracilis* De Man 1888.

12. *Halalaimus meyersi* Wieser & Hopper, 1967 (Plate 2. Fig. 12a & 12b)

Body length is 2.15mm (Male: a=96.1; b=8.8; c=7.8). Head 5µm wide, 7µm high, cephalic setae are 18µm long and arranged in two circles. Outer labial and cephalic sensilla are in two circles of 6 and 4. Cephalic setae are long and measures 21µm. Cuticle is without coarse longitudinal striations. Amphids are 36µm long, beginning 26µm from the anterior end. Caudal alae are absent. Spicules are 19µm long. Gubernaculum is with lateral lining pieces. Precloacal sensillum and pre cloacal pore absent. Tail tip narrow, not bifurcate. Cylindrical part of the tail is without coarse transverse striations.

Geographical distribution: Florida, N. America.

Remarks: The specimens are closely related to *H. meyersi* Wieser & Hopper, 1967 in the cephalic structures, spicular structure and the descriptions of the tail. The body dimensions are also in comparison with that of author's specimens. So they are placed as *H. meyersi* Wieser & Hopper, 1967.

Genus*: *Oxystomina. Filipjev, 1921a

Syn: *Asymmetrica* Kreis, 1929a

Syn: Oxystoma Butschli 1874a

Syn: Oxystomatina Stekhoven, 1935a

Syn: Oxystomella, Filipjev, 1946a

Syn: Oxystomina, Baylis & Daubney, 1926a

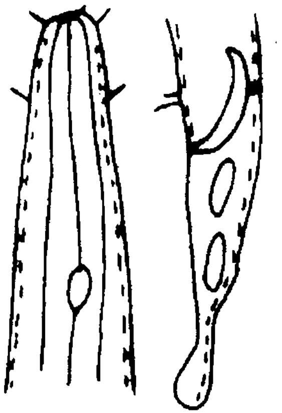
Syn: Schistodera Cobb, 1920a

Characteristic oval shaped amphid, with a curved structure round the anterior margin extending backwards as two projections. There is no buccal cavity. Typically there are six cephalic setae and four cervical setae. Tail is clavate. Species are separated by the size and position of the amphids and the cephalic and cervical setae.

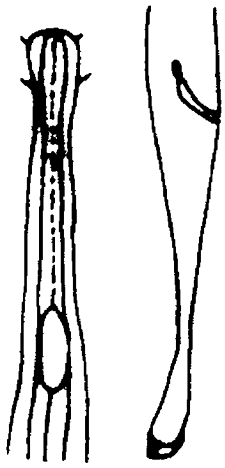
13. ***Oxystomina elongata*.** Butschli 1874a (Plate 3. Fig. 13a & 13b)

Body length is 1.230mm (Male: a=50; b=3.7; c=14.1). Cuticle is smooth. Six cephalic setae are 2.2µm long. Four cervical setae having the same length as cephalic setae situated 2.75 h.d from the anterior end. Buccal cavity is absent or reduced. Amphids typical of genus, 3.5 wide and placed 28µm from anterior end in male. Oesophagus is 0.26 times body length, slender with a small posterior bulb. Excretory pore placed one third of way down oesophagus length, surrounded by circular ring. Tail is long and clavate. Spicules are 34µm long with a straight bump ventrally just before the proximal tip. Gubernaculum are

Plate 3

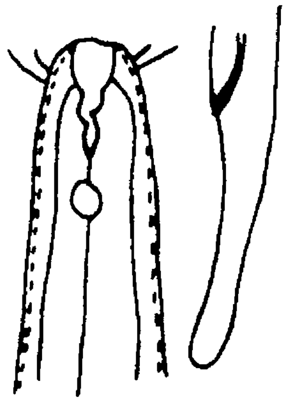


13a 13b

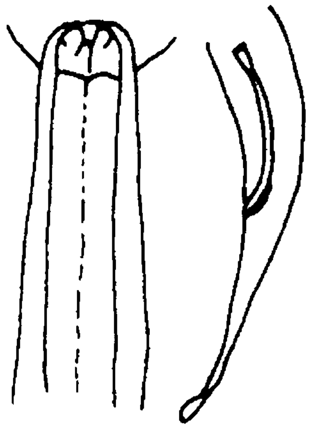


14a 14b

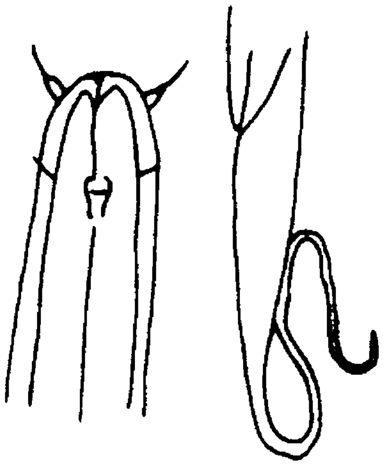
15a 15b



16a 16b



17a 17b



18a 18b

13a&b. Oxystomina elongata (Male head and tail)
14a&b. Oxystomina clavicaudata (Male head and tail)
15a&b. Ledovitia phanertrata (Female head and tail)
16a&b. Tripyloides marinus (Male head and tail)
17a&b. Crenopharynx marioni (Male head and tail)
18a&b. Trefusia longicaudata (Female head and tail)

small and curved. One long and one short seta in front of the cloaca are also visible.

Geographical distribution: British waters (Intertidal mud and muddy sand).

Remarks: The present specimens showed close resemblance to the features of the species described by Butschli, 1874. The only difference is in the size of body. Besides this difference, the material is in close similarity with the type species. So they are referred to as *Oxystomina elongta* Butschli 1874.

14. *Oxystomina clavicaudata* Filipjev, 1921 (Plate.3. Fig. 14a & 14b)

Body length is 1.65mm (Male: a=25.3;b=5.6;c=12.8). Cuticle is smooth. Head diameter is 6µm. Six cephalic setae are about 2.1µm long. Four cervical setae the same length as cephalic setae are present 2.5 h.d from the anterior end. Buccal cavity is reduced or absent. Amphids are typical of the genus, 3.5µm wide and placed 32µm from anterior end in male. Oesophagus is 290µm long, slender with a small posterior bulb. Excretory pore is placed one third of way down oesophagus length, surrounded by circular ring. Spicules are with a bump vemtrally. Tail is long and clavate.

Geographical distribution: Sebastopol, Russia.

Remarks: The material is similar to the other species of *Oxystomina* mentioned above but differs from it by larger body size and structure of the spicules. The details of the head, cephalic setae and also the amphids, it showed close similarity to O. clavicaudata Filipjev 1921. Hence the present specimens are considered as *O. clavicaudata* Filipjev, 1921.

Genus: Ledovitia Filipjev, 1927a

15. *Ledovitia phanertrata* Wieser, 1954 (Plate 3. Fig 15a & 15b)

Body length is 2.3mm (Female: a=57.5; b=5.6; c=33.8). Head diameter is 11µm. Labial papillae are conspicuous and cephalic setae not seen. Amphid is 8µm wide and oval. Cervical setae are 17.5µm long, which is more than the c.b.d. Buccal cavity, 16µm deep and 9µm wide. Anterior and posterior regions are separated by a transverse band of two rings and a row of small denticles. Tail is 4.3 a.b.d long with setae on its posterior end.

Geographical distribution: Chile (sandy substratum).

Remarks: The material is closely related to *Ledovitia phanertrata* Wieser, 1954 in the size and disposition of the amphids and nature of the oesophagus. Most of the morphological features are well in conformity with the species described by Wieser. Therefore they are considered as *Ledovitia phanertrata* Wieser, 1954.

Family:Tripyloididae deConinck & Stekhoven,1933

In this family the shape of the buccal cavity serves as the most valuable taxonomic character. Buccal cavity narrower; lips not deeply incised. Amphids 1-2 spire, more or less post-stomatal; 6 cephalic papillae and 10 cephalic setae in one circle; cuticle minutely punctuate; stoma surrounded by oesophageal tissue, wide , more or less conoid, subdivided in to two or more cavities.

Genus*: *Tripyloides De Man, 1886b.

Buccal cavity is divided in to several sections with small sub-ventral teeth in posterior sections. Amphids are circular.

Syn: *Nannonchus* Cobb, 1913b

16.*Tripyloides marinus*; Butschli, 1874. (Plate 3.Fig. 16a & 16b)

Body length is 1.452mm (Male: a=26.2; b=7.3; c=15.1) Cuticle is smooth. Six longer cephalic setae 6µm long and two jointed; shorter four are 4µm long and unjointed. Buccal cavity is in four separate sections, fairly heavily cuticularised, and posterior most cavities with two sub ventral teeth. Amphids circular, 4.7µm in diameter, placed level with the base of buccal cavity. Spicules are 21µm long. Tail is 4.3 a.b.d. long.

Geographical distribution: Campbell islands, Sweden, Finland, Belgium coast, British waters .

Remarks: The present material is closely allied to *Trypyloides marinus* Butschli, 1874 in the nature of the buccal cavity and size and disposition of the amphids. Body dimensions of present specimens are closely allied to the original material. The aforesaid details cause it to be placed as *Trypyloides marinus* Butschli, 1874.

Family: Phanodermatidae Filipjev, 1927

Characterized by the presence of rudimentary stoma, conoid oesophagus, weak musculature, amphid not elongate, 10 cephalic setae and absence of mandibles.

Genus*: *Crenopharynx Filipjev, 1934

The genus is characterized by the combination of a weak cephalic capsule, buccal cavity with sclerotised structures, long spicules and no precloacal supplement. Species are differentiated mainly on the structure of the spicules and gubernaculums and shape of the tail.

17.*Crenopharynx marioni* Southern, 1914. (Plate 3.Fig. 17a & 17b)

Body length is 4.187mm (Male: a=51; b=4.12; c=19.4). Body attenuated anteriorly. Cuticle is smooth. Somatic setae are absent throughout the body except in the tail. Cephalic setae 10µm long (10nos.) Buccal cavity is small. Cephalic capsule is weakly developed. Oesophagus widens posteriorly and posterior to nerve ring it becomes glandular giving a characteristic crenellated outline. Tail is conico-cylindrical with a bulbous tip. Spicules are elongated and measures 200µm, narrow distal portion. Gubernaculum is well developed.

Geographical distribution: West Ireland (Shell), Isles of Scilly (shell gravel).

Remarks: The material is closely related to *Crenopharynx marioni* Southern, 1914 in the nature of the cephalic setae, oesophagus, spicular apparatus and tail. The only distinguished difference is the length of the spicules (in Wieser's specimens it is 260µm). Despite this dissimilarity, all other features are closely allied to the original species. Therefore they are referred to as *Crenopharynx marioni* Southern, 1914.

Family: Trefusiidae

Genus: Trefusia De Man, 1893.

Trefusia species have jointed cephalic setae, no buccal cavity and two opposed ovaries. Species are distinguished on the relative lengths and position of the head setae, the length of the spicules, the form of the amphids and the length of the tail.

18. *Trefusia longicaudata*. De Man, 1893 (Plate 3.Fig. 18a & 18b)

Body length is 2.3mm (Female: a=79; b=10.2;c=6.2). Cuticle is faintly striated. Six cephalic setae are 8µm long, each with a filiform tip. Buccal cavity is small and conical shaped. Amphids are pocket like, 4µm wide. Oesophagus is cylindrical. Tail is long filiform and more than 30 a.b.d long. Vulva placed at 34% of body length.

Geographical distribution: British Isles (Muddy sands)

Remarks: The material is closely allied to *Trefusia longicaudata* De Man 1893 in the nature of the buccal cavity, placement of head setae and length of the tail. Therefore they are considered as *Trefusia longicaudata* De Man 1893.

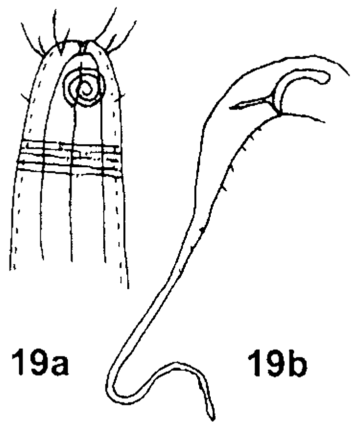
Order: Chromadorida

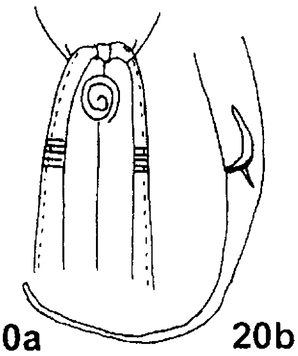
Oesophagus three parts, bulb commonly present, sometimes clavate, very rarely cylindroid, amphids spiral, sheperd's crook, circular, vesiculate, and transversely elliptical or very rarely pore like. Ovaries out stretched or reflexed.

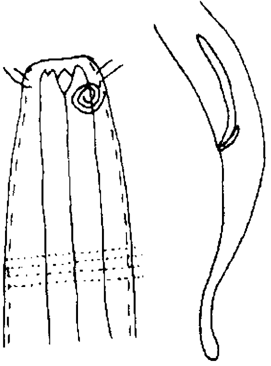
Family: Comesomatidae Filipjev, 1918

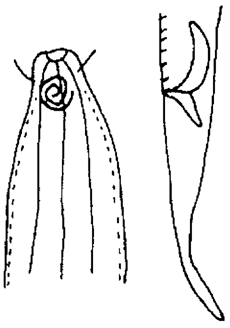
Comesomatids typically have the following characters; annulated cuticle with transverse rows of punctuations; multispiral amphids; buccal cavity not 12 folded anteriorly; oesophagus broadens gradually towards posterior end but has a fine posterior bulb; gubernaculum with paired dorsal apophyses; precloacal suppliments in male; testes paired; ovaries paired; opposed and outstretched; vulva at about mid-point of body length; tail conico-cylindrical with more or less swollen tip (clavate tail).

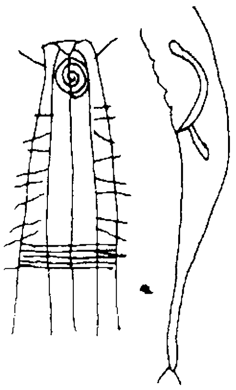
Plate 4

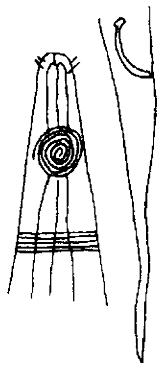

19a 19b


20a 20b


21a 21b


22a 22b


23a 23b


24a 24b

19a&b. Laimella longicaudata (Male head and tail)
20a&b. Laimella filipjevi (Male head and tail)
21a&b. Paracomesoma longispiculum (Male head and tail)
22a&b. Sabatieria paracupida (Male head and tail)
23a&b. Setosabatieria hilarula (Male head and tail)
24a&b. Cervonema macramphis (Male head and tail)

Genus: Laimella Cobb, 1920a

Cuticle with transverse rows of very fine dots or striated; cephalic capsule with two circles of cephalic setae close together; buccal cavity is poorly developed, sometimes with three weakly developed teeth; tail with posterior section long and filiform; spicules are short.

19. ***Laimella longicaudata*** Cobb, 1920 (Plate 4. Fig. 19a & 19b)

Body length is 1.125mm (Male: a=36.3 b=11.02; c=3.4). Cuticle is provided with fine punctuations in regular transverse rows. Dots are so close that the appearance may be of transverse striations. Six shorter cephalic setae are 7µm, four longer setae 19µm long. Four circles of setae are present in the oesophageal region and numerous somatic setae in the region of anus and tail. Amphids spiral with 3.25 turns, 10µm wide, 12µm c.b.d. Buccal cavity is narrow, cylindrical and weakly cuticularised. Oesophageal bulb is present. Tail is filiform. Spicules are 34µm, arcuate. Papillate precloacal supplements 5 numbers.

Geographical distribution: Liver pool Bay, N.W. England (Sublittoral, muddy sand, muddy sand with gravel)

Remarks: The present specimens are related to *Laimella longicaudata Cobb, 1920* in many aspects of morphology. The notifying similarity was observed in buccal cavity, cephalic sense organs, tail, structure of the spicules and gubernaculum. Therefore they are considered as *Laimella longicaudata* Cobb, 1920.

20. ***Laimella filipjevi*** Jensen, 1979 (Plate 4.Fig. 20a & 20b)

Syn: *Sabatieria longicaudata* Filipjev, 1922

Body length is 1.075mm (Male: a=29.8; b=7.1;c=5.65). Body cylindrical and slightly attenuate anteriorly. Base of tail is conical with cylindrical posterior portion flagelliform. Head slightly rounded with thin flattened lips. Cephalic sense organs in two crowns with six internal labial papillae and about 3µm further back; a crown of 9 setae of different lengths (Six labial setae, 4µm long, 4 cephalic 10µm long) Cuticle with transverse striations dorsally and ventrally from level of cephalic setae to the tail tip. Amphids spiral, with 3 turns, 9 µm in diameter and placed 4µm behind front end. Buccal cavity is with two compartments. Oesophagus is cylindrical without a bulb. Copulatery apparatus is with two equal spicules, 30µm long. Spicules are tapering towards both ends. Gubernaculum are 7.2 µm long, surrounding the spicules and with 11µm long apophysis directed caudally and a prominent triangular median piece, as long as the gubernaculum. Seven pre-anal supplements are papillae like dilations. Tail 11 a.b.d long, tip enlarged with 3 terminal setae.

Geographical distribution: Danish waters.

Remarks: The present material is closely related to *Laimella filipjevi* Jensen, 1978 in the nature of the sclerotizated buccal cavity, length of the cephalic and cervical setae. The species is related to *Laimella longicaudata* in many aspects but the distinction is clear as described by Jensen, 1979. Thus with certainty they are placed as *Laimella filipjevi*, Jensen, 1978.

Genus: Paracomesoma Hope and Murphy, 1972

21. *Paracomesoma longispiculum* Timm, 1961; Hopper, 1967. (Plate 4.Fig. 21a & 21b)

Syn: *Vasostoma longispiculum* Timm, 1961; Hopper, 1967a; Jensen, 1979

Body length is 1.475mm (Male: a=30.5; b=8.3; c=11.2). Cuticle with transverse rows of striations regularly arranged in almost all body length except caudally. Lateral differentiation absent. Somatic setae are 6µm in length, arranged in six longitudinal rows. Lips cushion like. Cephalic sensilla are arranged in 3 crowns. Amphids spiral, 2.5 turns, closely behind the cephalic setae. Buccal cavity with anterior dilated portion, 3 horns like projections visible on protrusion of cavity. Oesophagus gradually enlarges posteriorly with a small cardia. Tail conico-cylindrical, anterior two third conical and posteriorly cylindrical with enlarged tip. Two terminal setae are present. Spicules are with a slight dorsal curve, 109µm in length. Gubernaculum is with a pair of minute lateral guiding pieces running parallel to spicules. One of the spicule is slightly smaller than other. Anteriorly placed 6 preanal supplements are present.

Geographical distribution: Chile, England, Bay of Bengal.

Remarks*:* The above-cited material is closely resembled to *Paracomesoma longispiculum* Timm, 1961 in the size of cephalic setae, nature of the buccal cavity, size and disposition of the amphids, and in the structure of the spicular apparatus. The size of the spicules differed from the descriptions of the species reported by Sulthan Ali *et al*, 1998. However a good number of the features of the original specimens by Hope and Murphy, 1967 are in close similarity to present specimens and therefore they are located among *Parcomesoma longispiculum*, Timm, 1961.

Genus: Sabatieria Rouville, 1903a

Syn: *Sabatieria* De Rouville, 1905a

Syn: *Sabatiera* Wieser, 1954a

Features include punctuated cuticle without longitudinal lateral files of dots; cephalic setae in two separate circles, posterior ones longer than anterior; amphids immediately posterior to the posterior cephalic setae; buccal cavity cup-shaped without teeth; spicules short.

22. *Sabatieria paracupida* Filipjev, 1927; Wieser and Hopper, 1967 (Plate 4.Fig 22a & 22b).

Total length is 1.070mm (Male: a=18.7; b=6.1;c=8.9). Head diameter is 13.7µm. Amphid 2.25 turns, 11µm wide, 65% of c.b.d. Cephalic setae are 10µm long. Buccal cavity small and cup shaped, without teeth. Cuticle dotted with lateral differentiation. Spicules are 55µm, 1.7a.b.d long, curved, tapering proximally with a list. Gubernaculum is with lateral guiding pieces and caudally directed apophyses (24µm long). Tail is long, about 4 a.b.d long. 19 preanal supplements present and are minute.

Geographical distribution: Canada-Vero Beach.

Remarks: The specimens are closely related to *Sabatieria paracupida* Filipjev, 1927 in the nature of amphids, and the details of the spicular apparatus. The details of preanal suppliments are also similar to the original descriptions of the species. The above mentioned details are caused it to place them as *Sabatieria paracupida* Filipjev 1927.

Genus: Setosabatieria. Platt, 1985

Species in this genus are similar to *Sabatieria* species, but without cuticle punctuations and with characteristic sublateral files of numerous long cervical setae.

23. *Setosabatieria hilarula* De Man, 1922. (Plate 4. Fig. 23a & 23b)

Body length is 1.12mm (Male: a=24.4; b=7.2; c=8.75) Cuticle with faintly transverse striations, which are more widely placed posterior to the oesophagus region and are also discontinuous with lateral fields. Four cephalic setae are present, 14µm long. Four longitudinal files of closely spaced long cervical setae are present. Other somatic setae are shorter and scattered at least upto middle of the body. Amphids in males 3.5 turns, 10µm wide. Tail is conico-cylindrical with 3 terminal setae. Long spicules, measuring 68µm. Gubernaculum is with straight dorso-caudal apophyses. Minute precloacal supplements are present. Leaf like extension of the cuticle lateral to cloaca is present.

Geographical distribution: Northumberland coast, NE. England, Tamar Estuary, S.W England, W. coast of Scotland, Loch striven, West Scotland, Celtic Sea.

Remarks: The material is closely related to *Setosabatieria hilarula* De Man 1922 in the nature of cephalic and body setae, spicular apparatus and tail. The size and width of amphids are well agreement with the descriptions of the species by De Man, 1922 and also by Platt and Warwick in their British species. Therefore they are placed in the species *Setosabatieria hilarula* De Man, 1922.

Genus: Cervonema Wieser, 1954

=Linhomoella Stekhoeven 1950

Cephalic papillae are setose, almost as long as cephalic setae. Cervical region is elongated. Amphids are placed at considerable distance from anterior end. Buccal cavity small, unarmed. Cuticular ornamentation is indistinct. Male genital apparatus is weakly developed, spicula almost straight and short. Gubernaculum is with a dorsal apophysis. Tail is elongated.

24.***Cervonema macramphis*** Wieser 1954 (Plate 4. Fig 24a & 24b)

=**Linhomoella** Stekhoven 1950; Cobb1920.

Body length is 1.010mm (Male: a=28.8; b=6.3; c=7.7). Cylindrical body, tapering towards extremities and cervical region is elongated. Anterior most 50% of tail is conical, posterior cylindrical portion slender. Tail tip enlarged with 3 terminal setae (2µm). Prominent spinneret is present in specimens. Cuticle is finely striated. Somatic setae are 2.3µm long. Amphids spiral with 6 turns, 12µm diameter covering more than 90% of c.b.d; placed 13µm behind front end. Six external labial setae 3µm long and 2µm further back, four cephalic setae 2.7µm long. Buccal cavity is tubular and narrow, 5µm deep. Oesophagus surrounds posterior most 3µm of buccal cavity and posteriorly enlarged as an elongated bulb. Excretory pore placed just in front of the enlarged portion of the oesophagus. Spicule is 30µm long. Vulva positioned at 52% of body length. Vagina is short.

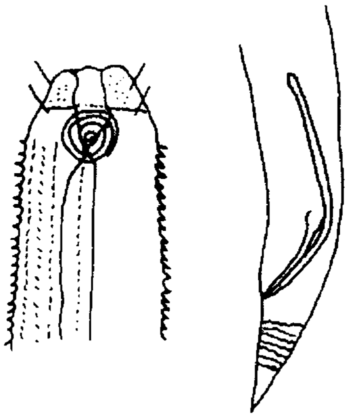
Geographical distribution: Danish waters, Chile.

Remarks: The material is closely related to *Cervonema macramphis* Wieser 1954 in the nature of the buccal cavity, size and disposition of the amphids and in the nature of the oesophagus. The refereed features enabled it to be placed as *Cervonema macramphis* Wieser 1954.

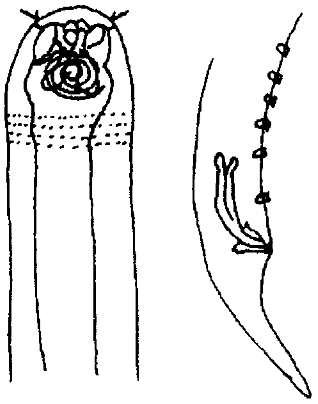
Family: Selachinematidae Cobb, 1915

Annulated cuticle with transverse rows of punctations; multispiral amphids; buccal cavity armament when present in the form of mandibles and never the

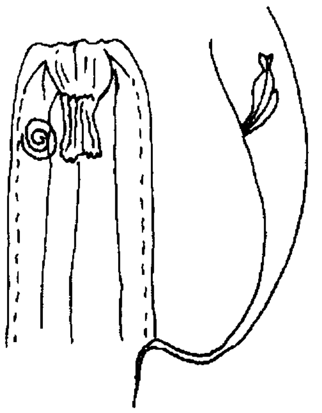
Plate 5



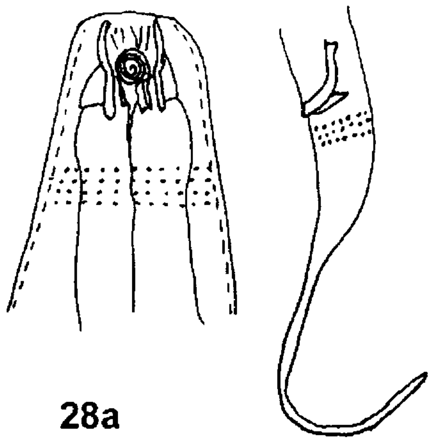
25a 25b



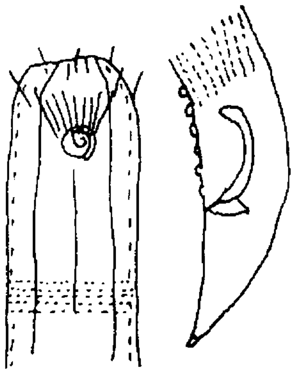
26a 26b



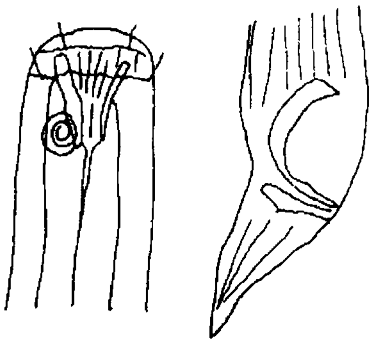
27a 27b



28a 28b



29a 29b



30a 30b

25a&b. Richtersia inaequalis (Male head and tail)
26a&b. Choniolaimus papillatus (Male head and tail)
27a&b. Halichoanolaimus consimilis (Male head and tail)
28a&b. Halichoanolaimus dolichurus (Male head and tail)
29a&b. Latronema orcina (Male head and tail)
30a&b. Latronema piratica (Male head and tail)

dorsal and subventral teeth found in other chromadorid families; precloacal supplements, when present, cup shaped or setose but never tubular; testes usually paired; ovaries always paired, opposed, reflexed; vulva usually situated slightly posterior to the mid- point of the body.

Genus*: *Richtersia Steiner, 1916.

Syn: *Richtersiella* Kreis, 1929a

Short fusiform body; cuticle with numerous longitudinal files of small spines, six cephalic and six sub cephalic setae; buccal cavity a cuticularised cylinder devoid of any armament; oesophagus without posterior bulb; without supplements.

25. *Richtersia inaequalis* Riemann, 1966 (Plate 5. Fig. 25a & 25b).

Body length is 0.65mm (Male: a=7.5; b= 3.6; c=4.6). Cuticle transversely striated with about 40 files of spines in anterior region and 26 in posterior. Six 8µm stout cephalic setae behind which there is a prominent collar with a circle of six 7µm sub cephalic setae. Cervical setae are in eight files of 6µm long. Cervical setae are more numerous anteriorly. Somatic setae are shorter and sparser. Amphids are in male 4.5 turns (15µm), single loop in female (8µm). Buccal cavity is rectangular in outline. Tail is conical with an unstriated terminal portion. Spicules are unequal; shorter left spicule 39µm long curved and cephalate proximally, with a pair of faint ventral alae. Longer right spicule is 110µm long, narrow, curved and cephalate proximally. Gubernaculum paired, well cuticularised proximally but less so distally.

Geographical distribution: British waters, NE Ireland, W. Scotland and East Scotland.

Remarks: The specimens recorded in present collection are easily recognized as *Richtersia Inaequalis* Riemann 1966 by the nature of cephalic setae, collar like structure, amphid position and structure of spicules. These features are in close similarity to the details of the British Species by Platt and Warwick. So they are placed as *Richtersia Inaequalis* Riemann 1966.

Genus: Choniolaimus Ditlevsen, 1918

Cuticle is laterally differentiated with larger more widely spaced punctations; precloacal supplements are papillae like pierced by fine pores. Buccal cavity is divided in to an anterior cup- shaped section supported by strongly developed buccal rugae and a narrower posterior tubular section supported by longitudinal cuticular rods. 'Teeth 'of various kinds are present between these two sections of the buccal cavity.

26. ***Choniolaimus papillatus*** Ditlevsen 1918 (Plate 5. Fig. 26a & 26b).

Body length is 0.987mm (Male: a=28.2; b=5.4; c=32.9). Four longer 10μm and six shorter papilliform cephalic setae are present. Amphids are with 2.5 turns, 0.5 c.d. wide. Tail 1.9 a.b.d. long with anterior half conical and posterior half cylindrical. Spicules are 89μm long, swollen at the proximal end, but terminating distally in a narrow section with a distinct right-angle bend. Gubernaculum are 15μm long and rod shaped. 11 cup shaped precloacal supplements are present.

Geographical distribution: Whitstable, South East England (harbour mud)

Remarks: The material is closely related to *Choniolaimus papillatus* Ditlevsen 1918 in the nature of the cephalic setae, buccal cavity, in the nature of the oesophagus and in the structure of the spicular apparatus. Most of the features are well in agreement with the descriptions of British specimens by Platt and

Warwick 1994. Therefore they are placed as *Choniolaimus papillatus* Ditlevsen 1918.

Genus: Halichoanolaimus De Man 1886a

Precloacal supplements are setose; 'Teeth's between the two sections of the buccal cavity appear as rows of squarish blocks; tail always elongated with a distal cylindrical section.

27. *Halichoanolaimus consimilis* Allgen 1933b (Plate 5. Fig. 27a & 27b)

Body length is 1.300mm (Male: a=30.2; b=6.5; c=5.4). Labial setae are very small. Cephalic setae are 5µm long. Amphids 2.5-4.5 turns, 40% of c.b.d. Anterior portion of buccal cavity is 19µm long and posterior portion 16µm deep. Anterior width is 20µm. Cuticular ornamentation in the form of fine dots to level of cephalic setae; lateral differentiation present, horizontal; in mid body 10 dots of each transverse row coarser. Oesophagus is with plasmatic interruptions. Spicula are 55µm long with accessory piece. Preanal supplements are setose. Tail two third filiform.

Geographical distribution: Artic Sea, Chile.

Remarks: The material is closely related to *Halichoanolaimus consimilis* Allgen 1933b in the nature of cephalic setae, cuticular ornamentation, size and disposition of the amphids, in the nature of the oesophagus and in the structure of the spicular apparatus. Therefore they are referred as *Halichoanolaimus. consimilis* Allgen 1933b.

28. *Halichoanolaimus dolichurus* Ssaweljev 1912 (Plate 5. Fig. 28a & 28b).

Body length is 1.490mm (Male: a=24; b=13.5; c=3.3). Head bears 10 small cephalic sensilla which are papilliform and conical. Amphids are transversely oval loop, 3.75 turns and 12µm wide. Tail long and filiform, posterior portion finely striated, not punctuated. Cuticular dots appear coarser and widely spaced at the junction of conical and cylindrical section of tail. Spicules are 90µm long and proximally rounded. A ventral swelling is present near the distal tip. Gubernaculum are as a pair of doubly curved rods, 38µm long. Pre cloacal papillae are present.

Geographical distribution: Russian waters, British waters, Celtic Sea and Bay of Bengal.

Remarks: The present specimens are closely allied to *Halichoanolaimus dolichurus* Ssaweljev 1912 in most of the morphological features. The main establishing characters are the size and position of amphids, tail and spicular apparatus. The precloacal papillae are also found matching with the descriptions of Platt and Warwick's British specimens. Despite these similarities, there exist certain differences as well. The body length is varying with that of the descriptions of British material, where it was given as 3.2mm. However relying on to the similarities of the morphological features they are located as *Halichoanolaimus dolichurus* Ssaweljev 1912.

Genus: Latronema Wieser 1954a

=Synonchiella Gerlach

Anterior end with 12 flap- like appendages; 6 long labial setae; 10 cephalic setae in one circle, about equidistant from each other; buccal cavity with two portions, weakly developed posterior portion; anterior portion consisting of 12 broad apophyses which are arranged in three groups to 4 each; cuticle punctate with longitudinal differentiations; spicula simple, accessory piece small; preanal supplements numerous.

29. *Latronema orcina* Gerlach 1952 (Plate 5. Fig. 29a & 29b).

Body length is 0.987mm (Male: a=17.9; b=11.3; c=19.1). Anterior end with 12 flap like appendages. 6 long labial setae and 10 cephalic setae are arranged in one circle. Cephalic setae are simple. Amphids spiral. Buccal cavity consisting of two portions, the posterior portion weakly developed, anterior portion consisting of 12 broad apophyses which are arranged in 3 groups to 4 each; the posterior end of each apophysis is differentiated in to 2 acute teeth. Cuticle punctuates with longitudinal differentiations; spicula simple; accessory piece small; no pre and post anal setae in male, spicule strongly curved with ventral cusp. Cuticular annulations are resolvable in to dots. 13 supplements observed.

Geographical distribution: Chile

Remarks: The material is closely related to *Latronema orcina* Gerlach 1952 in the nature of the cephalic setae, buccal cavity, size and disposition of the amphids and in the structure of the spicular apparatus. Based on these features they are referred as *Latronema orcina* Gerlach 1952.

30. *Latronema piratica* Wieser 1954a (Plate 5. Fig. 30a & 30b).

Body length is 1.11mm (Male: a=15.8; b=4.6 c=15.8). Head is 65µm wide, bearing labial setae 12µm long and cephalic setae 18µm long. Amphids single turn and about 11µm wide. Cervical setae are long (22µm). Buccal cavity is 19µm wide, anterior and posterior portion 15µm deep. Cuticle with fine punctuations to level of cephalic setae, longitudinal rows beginning in the anterior cervical region each accompanied by two rows of additional dots (situated in the interspaces between the transverse rows of dots). Longitudinal rows of dots are present in all circumference of the body. Spicula are 51µm long, plate like accessory piece 17µm long. Cup shaped supplements 20. Tail 1.1 a.b.d long with terminal setae.

Geographical distribution: Chile (sub littoral coarse bottom)

Remarks: The material is closely related to *Latronema piratica* Wieser 1954a in the nature of the buccal cavity, cuticular ornamentations and spicular apparatus. The numbers of suppliments are varying from that of Wieser's descriptions of Chilean material. Despite this variation all other features are well agreement with the type species. Hence they are referred as *Latronema piratica* Wieser 1954a.

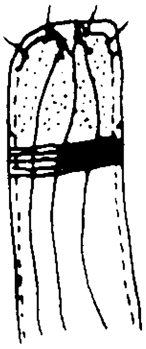
Genus: Leptonemella Cobb1920

Cuticle with fine striations; unstriated head region set-off, usually punctuated; six anterior cephalic sensilla, often not visible; four posterior cephalic setae at anterior boarder of amphids; two or three circles of sub cephalic setae on the cephalic capsule; amphids loop-shaped; buccal cavity and muscular buccal bulb absent.

31. Leptonemella aphanothecae Gerlach 1950 (Plate 6. Fig. 31a & 31b).

Body length is 3.375mm (Male: a=96.4; b=16.8; c=43.9). Cephalic capsule rounded, and heavily cuticularised with small irregularly arranged punctuations. Six-minute and four long 21µm cephalic setae are placed at the anterior extremity of the head. Eight 15µm sub cephalic setae located just posterior to amphids. Another set of 8µm sub cephalic setae positioned about half way down cephalic capsule. Amphids are 8µm wide, a single loop at the anterior end

Plate 6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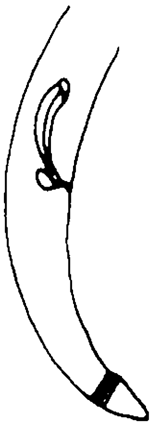
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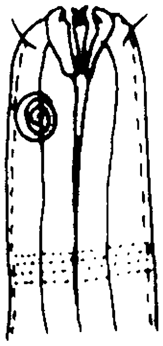
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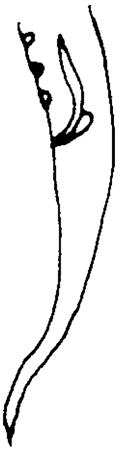
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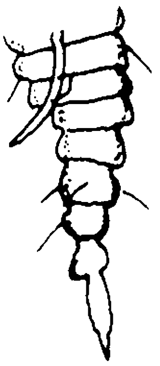
33a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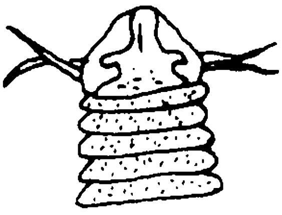
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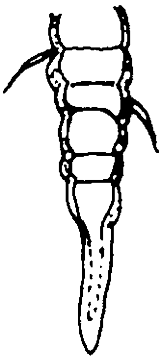
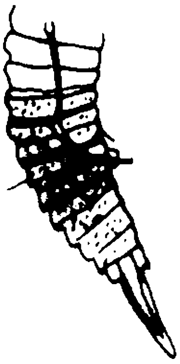

34b


35a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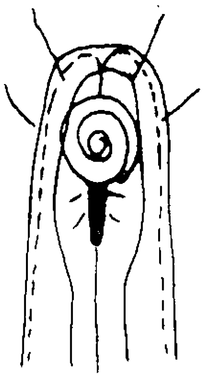
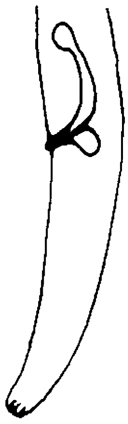

36a


36b

31a&b. Leptonemella aphanothecae (Male head and tail)
32a&b. Synonchiella riemanni (Male head and tail)
33a&b. Tricoma filipjevi (Male head and tail)
34a&b. Tricoma brevirostris (Female head and tail)
35a&b. Quadricoma scanica (Male head and tail)
36a&b. Catanema macintyrei (Male head and tail)

of the cephalic capsule. Oesophagus narrows at its anterior end with an elongated posterior bulb. Tail is conical, with an unstriated tip. Spicules are 45µm, arcuate, squarely cephalate proximally with slender ventral ala. Gubernaculum 12µm long, with rounded proximal projection.

Geographical distribution: British waters, North East Ireland and Isles of Scilly.

Remarks: The material is closely allied to *Leptonemella aphanothecae* Gerlach 1950 in the nature of cephalic setae arrangement and its size; size and disposition of the amphids; cephalic cuticular features and also with the spicular apparatus. The body length is slightly less as compared to the original material (3.9mm). Except this dimensional variation in body size all the morphological details are matching with the original species. Therefore they are referred to as *Leptonemella aphanothecae* Gerlach 1950.

Genus*: *Synonchiella Cobb 1933a

Cuticle with transverse rows of dots without lateral differentiation; buccal cavity with 3 large solid cuticularised mandibles which are blobbed anteriorly; oesophagus without posterior bulb; cup shaped pre cloacal supplements.

32. *Synonchiella riemanni*_Warwick 1970. (Plate 6. Fig. 32a & 32b).

Body length is 1.123mm (Male: a=37.4; b=5.3; c=8.6). Cuticle is with two lateral files of short setae down body length, more numerous in the anterior and tail regions. Six small conical labial papillae are present. Head is 21µm wide. Four short 3µm and six longer 8µm cephalic setae, the latter jointed with a pointed tip. 3 mandibles in buccal cavity with two long incurving teeth anteriorly, at the bases of which there are four rounded projections. Tail is with the anterior two thirds conical and the remainder cylindrical. Spicules 40µm measured as curve, arcuate, terminating proximally in dorsally directed openings, and prominent hook like structure on the dorsal edge about one third of the way from the distal end. Gubernaculum is large and rounded at its distal end. More or less equally placed cup–shaped pre cloacal supplements are present.

Geographical distribution: British waters (sublittoral mud and muddy sand).

Remarks: The present specimens are closely related to *Synonchiella riemanni* Warwick 1970 in the features of buccal cavity, cephalic setae, position of amphid and details of spicular apparatus. The only difference is the size of the spicule, which is (66µm in type species) slightly smaller than that of the British specimens. Despite these differences, the present specimens are closely allied to *Synonchiella riemanni* in many respects and hence they are referred as *Synonchiella riemanni* Warwick 1970.

Family: Desmoscolecidae Shipley 1896

Cuticle annulated, often in adults with thick tyre-like rings of secretions and foreign bodies (desmen); somatic setae in adults may be arranged in a characteristic pattern of alternating pairs of subdorsal and sub ventral spines; four cephalic setae on peduncles; amphids round or oval, never spiral, with a vesicular corpus gelatum; single anterior testis; ovaries paired, outstretched.

Genus*: *Tricoma Cobb 1894a

Syn: *Quadricoma* Filipjev 1922a

Syn: *Neoquadricoma* Kreis 1963a

Symmetrical oval desman closely spaced with, virtually no gaps between them. Somatic setae are in a characteristic pattern of alternating pairs of subdorsal and subventral spines. Amphids round.

33. *Tricoma filipjevi* Chitwood 1951 (Plate 6. Fig. 33a & 33b).

Male is 0.360mm long (Male: a=6.4; b=3.3; c=3.5). Body marked with 37 opaque concretion annules. Spicules are 39µm long and slightly cephalated. Gubernaculum is with a proximal arch. Tube setae consist of subdorsal pairs on annules 3, 7, 11, 16, 20, 25, 30 and 34. Tail consists of six annules, anus on annule 31.

Geographical distribution: Mud Island, Aransas Bay, Texas.

Remarks: The material is closely related to *Tricoma filipjevi* Chitwood 1951 in the nature of the body annules, dorsal setae positions and the tail features. There exist 3 other species of *Tricoma* with 37 annules but present specimens agree well with that of the original specimens by Chitwood. There fore they are placed as *Tricoma filipjevi* Chitwood 1951.

34. *Tricoma brevirostris*_Southern 1914 (Plate 6. Fig. 34a & 34b)

Body length is 0.58mm (Female: a=17; b=4.7; c=7.2). Maximum body diameter is 34µm. Body composed of 78 closely spaced desmens. Cephalic setae are 0.8 h.d long. Head is triangular with thickened cuticular walls.

Geographical distribution: Clew Bay and West Ireland.

Remarks: The material is closely related to *Tricoma brevirostris* Southern *1914* in the nature of total number of body desmens and body size. There is no much disparity was discernible from the descriptions of the British specimens. Therefore they are referred to as *Tricoma brevirostris* Southern 1914.

Genus**: **Quadricoma Filipjev 1922a

Syn: *Tricoma*, Cobb 1894a

Syn: *Neoquadricoma* Kreis 1963a

In addition the family characters *Quadricoma* has: 33-66 asymmetrical desmen, wider at their anterior part of the body and reversing at some point, closely spaced with virtually no gaps between them.

35 *Quadricoma scanica* Allgen 1935 (Plate 6. Fig. 35a & 35b).

Body length is 0.437mm (Male: a= 5.8; b=3.4; c=6.2). 39 asymmetrical desmens; male the 13th desmen has a ventral protuberance. Four 11µm cephalic setae and irregular somatic setae are present. 13 sub dorsal and more than 20 subventral setae are 9µm long, longer in posterior part. Amphids are almost covering the whole head. Spicules are 68µm long and slender, distally arcuate with proximal cephalisation. Gubernaculum is with paired dorsal apophysis. Cloaca positioned on an extended tube.

Geographical distribution: British waters.

Remarks: The material is closely related to *Quadricoma scanica* Allgen 1935 in the nature of the body desmens, cephalic setae and spicular apparatus. However in the present specimens, the amphids are not discernible but rest of the morphology resembles that of the Allgen's details. Therefore they are referred to as *Quadricoma scanica* Allgen 1935.

Family Desmodoridae Filipjev 1922

Cuticle with transverse striations but never punctuated; head region unstriated; cephalic setae in two separate circles, the posterior four always the longer;

amphid spiral described as loop shaped; buccal cavity anteriorly 12-folded, but folds are never strongly cuticularised in to rugae; oesophagus with a muscular posterior bulb; tail conical; gubernaculum is without a dorsal apophysis ; testis single, anterior; paired ovaries, opposed, reflexed, vulva usually situated posterior to the mid point of the body.

Genus*: *Catanema Cobb 1920

Syn: *Chromaspirina* Filipjev 1918a

Syn: *Mesodorus* Cobb 1920a

Syn: *Metonyx* Chitwood 1936b

Fine cuticular striation is present except on head; four sub cephalic setae, and additional sub cephalic setae sometimes present; buccal cavity minute but with a muscular buccal bulb; gubernaculum with a solid dorsal apophysis; tail conical.

36.*Catanema macintyrei*_ Platt and Zhang 1982. (Plate 6. Fig. 36a & 36b).

Typical desmodorid characters are present. Body length is 2.2mm (Male: a=85.3; b=33.3; c=47.8). Six small and four 18µm cephalic setae present at anterior extremity of head. The rest of the setae are not visible. Six files of stout setae along the length of the body are observed. Amphids are 9µm wide, loop shaped and spiral (2.5 turns, 0.4 c.d). Oesophagus is with a rounded posterior bulb, without cuticularised lining. Tail is conical. Spicules 43µm, measured as curve, arcuate, proximally squarely cephalate. Gubernaculum is with a well cuticularised dorso-caudally directed apophysis.

Geographical distribution: English and Scotland (Sub littoral sand) waters.

Remarks: The present specimens are closely related to *Catanema macintyrei* Platt and Zhang 1982 in the aspects of cephalic setae, the buccal cavity and oesophageal bulb. The position of amphid and its size and shape are in well agreement with the features of the original specimens by Platt and Zhang, 1982. The notable difference is the body size, which is given as range 3.5 to 4.5mm in their specimens where as in present specimens the length is 2.2mm. Apart from this difference all other distinguishing features are well agreement with the British material. Therefore the material is considered as *Catanema macintyrei* Platt and Zhang 1982.

Genus*: *Spirinia Filipjev 1918; Gerlach 1963

Syn: *Spira* Bastian 1865a

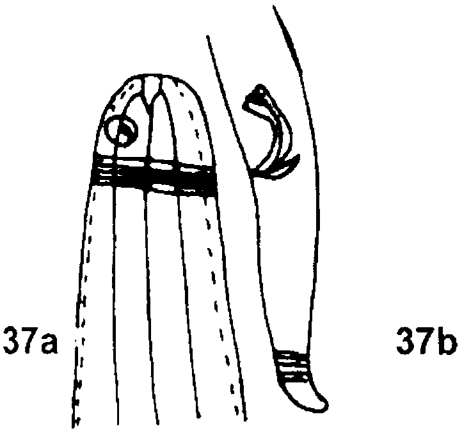
Head is not set off as a distinct cephalic capsule, the cuticle is only finely striated and the amphid is surrounded by the cuticular striations; Length and distribution of somatic setae; tail shape; relative size and position of amphids; cephalic setae and shape of spicules are important distinguishing characters of this genus.

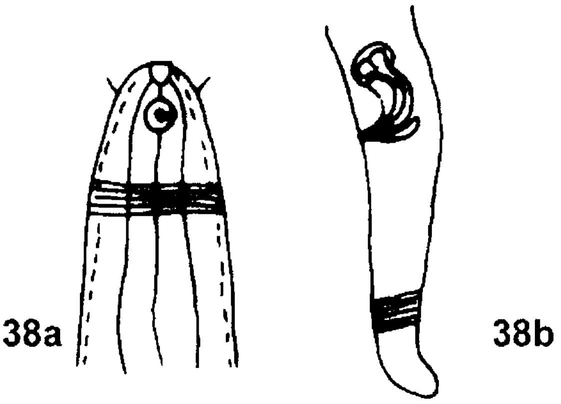
37. Spirinia similis Cobb 1898 (Plate 7. Fig. 37a & 37b).

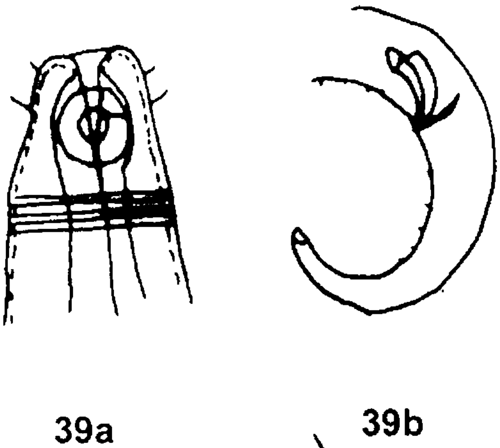
Body length is 3.10mm (Male: a=58.3; b=24.8; c=28.1). Head is not set off as a distinct cephalic capsule, cuticle is only finely striated and the amphid is surrounded by the cuticular striations. Head diameter is 16µm. Amphid diameter 3µm. Dorsal tooth is minute. Spicula 2 a.b.d. long, oesophageal bulb more than 75% of the c.b.d. in width. Tail is conical.

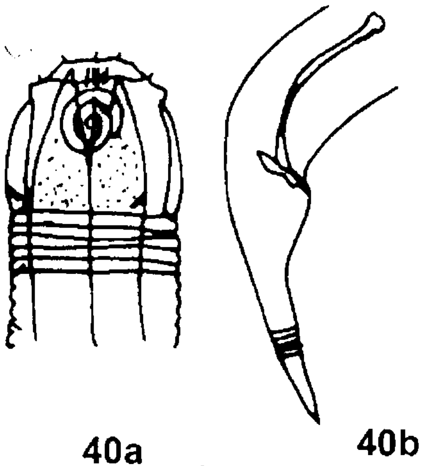
Geographical distribution: Australia

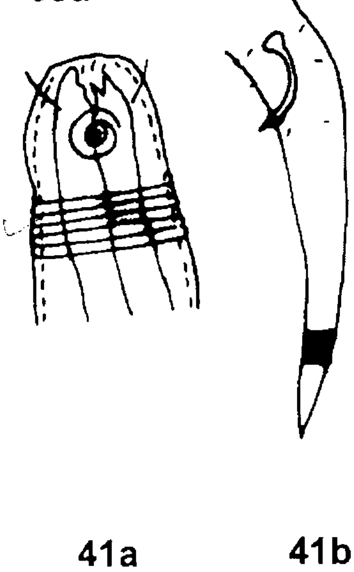
Plate 7

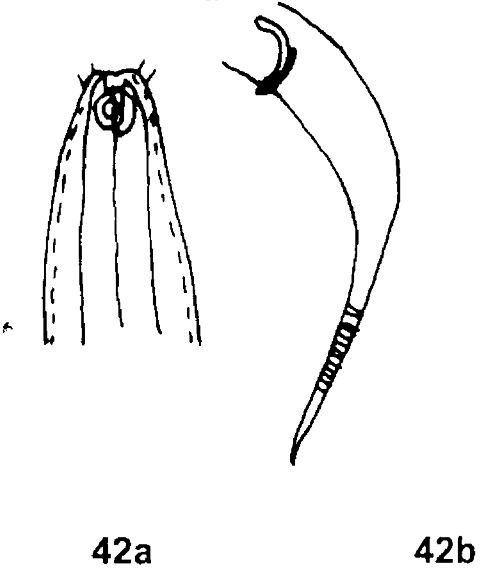












37a&b. Spirinia similis (Male head and tail)
38a&b. Spirinia parasitifera (Male head and tail)
39a&b. Chromaspirina inaurita (Male head and tail)
40a&b. Desmodora tenuispiculum (Male head and tail)
41a&b. Desmodora scaldensis (Male head and tail)
42a&b. Desmodora brachypharynx (Male head and tail)

Remarks: The material is closely related to *Spirinia similis* Cobb 1898 in the nature of cephalic capsule, the buccal cavity, size and disposition of the amphids and in the structure of the spicular apparatus. The present specimens are closely allied to the species in all morphological accounts enabling them to place it under *Spirinia similis* Cobb 1898.

38. ***Spirinia parasitifera*** Bastain 1865; Gerlach 1963b (Plate 7. Fig. 38a & 38b).

Syn: Spira parasitifera Bastian 1865

Body length is 1.624mm (Male: a=30.2; b=11.2; c; 17.9). Six papilliform anterior cephalic sensilla are followed by four 5µm cephalic setae. Several somatic setae are present and are short. Amphids is a single loop, 6µm wide. Buccal cavity is narrow, small dorsal tooth and posteriorly placed two minute subventral teeth. Oesophagus is short and round with well-developed posterior bulb, 36µm long and 30µm wide with plasmatic interruptions in the middle. Tail is conical with an unstriated tip. Spicules are 53µm long, conspicuously round and cephalated proximally with a terminal internal cuticularised knob. Gubernaculum is 30µm long and arcuate. Vulva positioned at 49% body length.

Geographical distribution: Baltic, North Sea, North Atlantic, Black Sea, Mediterranean, Barrents Sea, Indian Ocean, Bay of Bengal.

Remarks: The present material is closely related to *Spirinia parasitifera* Bastian 1865 in most of the morphological details. The descriptions of cephalic setae and amphids are agreeing with the earlier descriptions of the species. The details of the spicules and oesophageal bulb were also related in account of their shape and similar length. Therefore they are referred to as *Spirinia parasitifera* Bastian 1865.

Genus: ***Chromaspirina*** Filipjev 1918.

Similar to *Spirinia* except: six anterior cephalic sensilla setiform; buccal cavity with a large well-developed dorsal tooth; oesophagus with posterior bulb only slightly swollen; tubular precloacal supplements may be present.

39.*Chromaspirina inaurita* Wieser and Hopper 1967(Plate 7. Fig. 39a & 39b).

Body length is 1.27mm (Male: a=39.6; b=12.8; c=14.7). Head diameter is 13.3µm. Six minute cephalic setae 4µm long and two sub cephalic setae are present. Cervical setae are scattered and short. Amphids loop- shaped, 12µm, inner circle more heavily cuticularised. Distinct cuticular annulations are present. Buccal cavity equipped with 3 small teeth. Oesophageal bulb is pyriform. Spicula 30µm long with a faint velum; hooked proximal end. Gubernaculum is 13µm long and sickle-shaped. The preanal ventral cuticle is crenate over a long distance. Stout spine is present in front of anus.

Geographical distribution: Biscayne Bay, Florida.

Remarks: The details of the present material are in close similarity with that of the descriptions of the species originally by Wieser and Hopper 1967. The difference was noticed in the absence of subventral supplements. Despite this, all other details are similar. Hence it was considered as *Chromaspirina inaurita* Wieser and Hopper 1967.

Genus:* *Desmodora (Desmodorella) Filipjev 1922.

Syn: *Aculeonchus* Kreis 1928b

Syn: *Amphispira Cobb 1920a*

Syn: *Bla* Inglis 1963a

Syn: *Bolbonema* Cobb 1920a

Syn: *Brachydesmodora*, Allgen 1932

Syn: *Bradylaimoides* Timm 1961a

Syn: *Croconema* Cobb 1920a

Syn: *Eudesmodora* Allgen 1932a

Syn: *Desmodorella* Cobb 1933a

Syn: *Heterodesmodora* Micoletzky 1924b

Syn: *Mastodex* Steiner 1921a

Syn: *Micromicron* Cobb 1920a

Syn: *Pseudochomadora* Daday 1899a

Unstriated head region of thickened cuticle set off as a conspicuous cephalic capsule; amphids lie on capsule; tubular precloacal supplements. A large heterogeneous genus with 7 subs genera.

40. ***Desmodora tenuispiculum*** Allgen 1928 (Plate 7. Fig. 40a & 40b).

Body length is 1.212mm (Male: a=25.2; b=7.0; c=12.7). Cuticle is with coarse transverse striations and longitudinal files of ridges; about 15 in mid body. Posterior part of cephalic capsule is with rounded punctuations. Six slender labial setae present in specimens, which are 2µm long. Cephalic setae arranged in 6x4 patterns, 4µm long. Amphids spiral, of 2.5 turns. Oesophagus is with a distinct posterior bulb, 29µm long and 24µm wide. Tail is conical, with unstriated tip. Spicules long (70µm), slender and indistinct. Gubernaculum 18µm long and with proximal end free from spicules. No supplements. Vulva positioned at 68% of body length.

Geographical distribution: British waters.

Remarks: The present specimens are identical to the descriptions of the Allgen's details. The details of cephalic capsule and amphids are similar in both present specimens and the original material. The only difference is the relative body size where, present specimens are larger than the original (given as 0.7-0.8mm). But since the body size variations are usual in nematodes from various geographical areas they are placed as *Desmodora tenuispiculum* Allgen 1928.

41. ***Desmodora scaldensis*** De Man 1889 (Plate 7. Fig. 41a & 41b).

Body length is 1.150mm (Male: a=28.7; b=7.1; c=10.7). Cuticle coarsely striated without additional ornamentations. 6 minute labial papillae are present in the anterior end of head. Four 5µm cephalic setae are placed anterior to amphids. Cephalic setae are short and scattered. Amphids are spiral, 6µm wide. Buccal cavity is with hollow anteriorly pointing dorsal tooth. Oesophageal bulb is 30µm long and 25µm wide. Tail ends in an unstriated tip. Spicules are 55µm long, arcuate with a ventral swelling at the proximal end. Gubernaculum closely applied to spicules. No supplements.

Geographical distribution: North Sea, Artic, Hawaii, California, British waters, (Intertidal seaweeds); Isles of Scilly (Intertidal coarse sand; kelp holdfasts and sea weeds)

Remarks: The present specimens are identical in almost all features of the original descriptions of De Man 1889. The most of the descriptions of head and tooth are well in agreement with the descriptions of Wieser 1955. The size of the amphids, in the nature of the oesophageal bulb and in the structure of the spicular apparatus is also, showed resemblance. The aforesaid details are adopted in placing the materials as *Desmodora scaldensis* De Man 1889.

42. *Desmodora brachypharynx* Allgen 1947d (Plate 7. Fig. 42a & 42b).

Length in male is 1.42mm and in female it is 1.52mm (Male: a=22.1; b=8.2 c=11.2). Head diameter 22µm. Cuticle thickened posteriorly with labial papillae. Cephalic setae are 3µm and 6µm long and arranged in two circles. Amphids 13.5µm, covering 50% of c.b.d. Buccal cavity is with a medium dorsal and small ventral tooth. Body setae are arranged in longitudinal rows, beginning on level with end of oesophagus, 6µm long. Spicula are 48µm long and plate shaped. Supplements are absent. Tail is long.

Geographical distribution: W. America, Bay of Panama; Chile (sublittoral).

Remarks: The material is closely related to *Desmodora brachypharynx* Allgen 1947d in the nature of the cephalic setae, buccal cavity, teeth, and in the structure of the spicular apparatus. The slight difference in the length of the spicules was noted. Despite this there is no much variation from the original descriptions of Allgen's material. Therefore they are considered as *Desmodora brachypharynx* Allgen 1947d.

Genus*: *Metachromadora Filipjev 1918

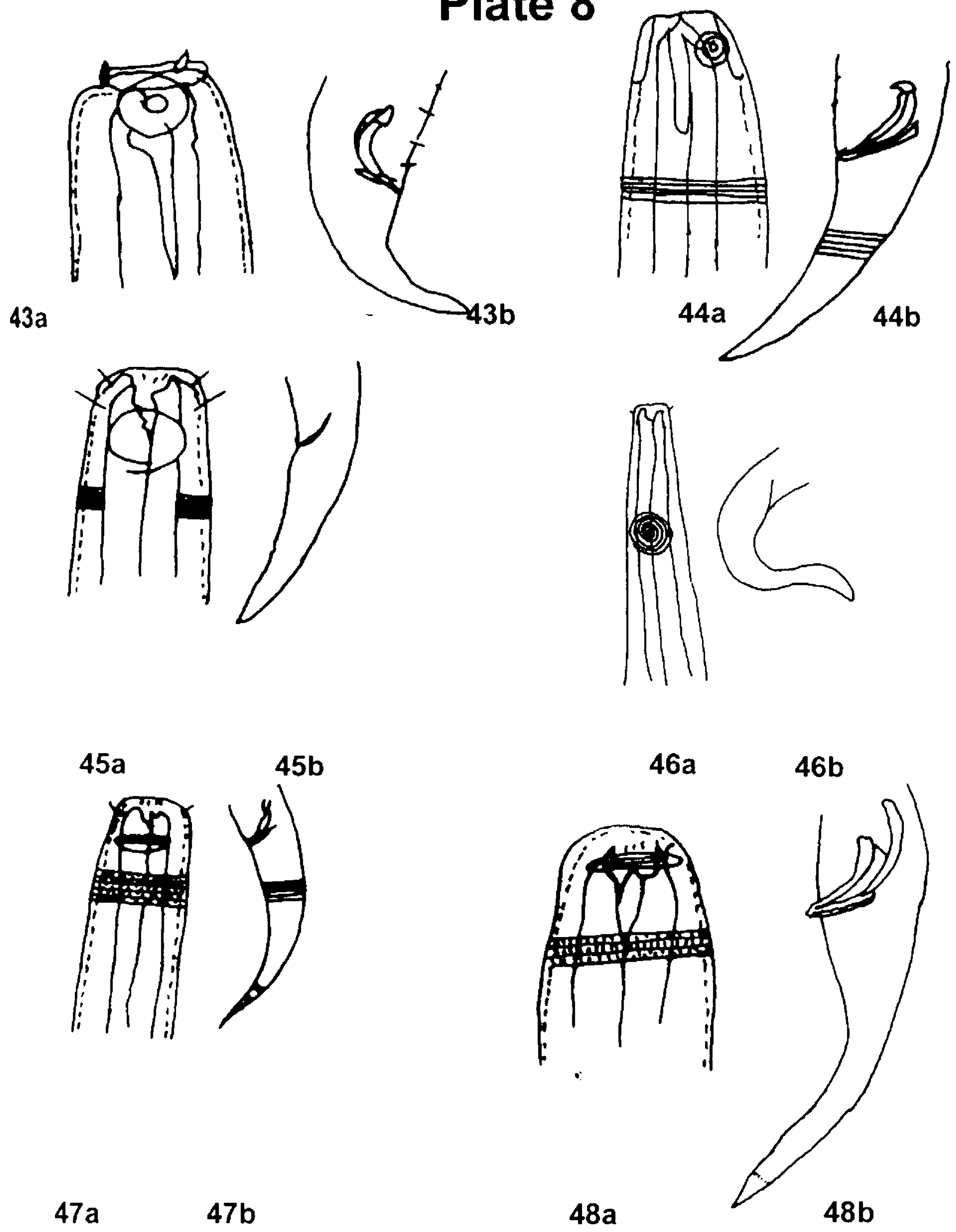
Syn: *Bradylaimus* Stekhoven 1931a

Syn: *Chromadoropsis* Filipjev 1918a

Syn: *Metachromadoroides* Timm 1961a

Cuticle finely striated; unstriated cephalic capsule absent; amphid surrounded by cuticle striations; anterior circle of six cephalic sensilla usually setiform; large dorsal tooth in buccal cavity; posterior oesophageal bulb well developed

Plate 8



43a&b. Metachromadora pulvinata (Male head and tail)
44a&b. Acanthopharyngoides chitwoodi (Male head and tail)
45a&b. Bolbolaimus teutonicus (Female head and tail)
46a&b. Calomicrolaimus spirifer (Female head and tail)
47a&b. Actinonema pachydermatum (Male head and tail)
48a&b. Parapinnanema harveyi (Male head and tail)

with a thick cuticular lining often partitioned in two or three sections; precloacal supplements of various forms. This heterogeneous genus has been divided in to 6 subgenera.

43. ***Metachromadora pulvinata*** Wieser and Hopper 1967(Plate 8. Fig. 43a & 43b)

Body length is 1.03mm (Male: a=22.8; b=6.4; c=12.8). Head diameter on level of amphids is 26μm. Lips are cushion like, demarcated from head by a distinct groove. Cephalic setae are stout and 7μm long. Amphids in the form of a ring placed on cuticularised plates. Cuticular striations are distinct, reaching to the base of lips. No pronounced lateral differentiation can be visible. Buccal cavity is strongly cuticularised with a large dorsal tooth. Two small subventral teeth are present and an additional tooth at the bottom of the buccal cavity. Oesophageal bulb is tripartite, with cuticular lining. Spicules are with accessory piece. Tail is with ventral preanal warts.

Geographical distribution: Canada (Vero Beach)

Remarks: The material is closely related to *Metachromadora pulvinata* Wieser and Hopper 1967 in the nature of the cephalic setae, buccal cavity, position of the amphids, and tail details. Despite these similarities there exist the difference in body length (1.72mm in original) and the body diameter. Above and beyond this the relevant features of this species are in well agreement with the original descriptions of the type species. Therefore they are considered as *Metachromadora pulvinata* Wieser and Hopper 1967.

Genus*: *Acanthopharyngoides Chitwood, 1936b

This genus includes 3 species separated by length and position of amphids, cephalic setae and structure of spicula.

44. ***Acanthopharyngoides chitwoodi*** Wieser 1954 (Plate 8. Fig. 44a & 44b).

Body length is 2.39mm (Male: a=48; b=6.9; c=33.4). Head diameter is 30µm. Labial setae are 2µm long. Cephalic setae are 4µm long. Amphids 8µm. Buccal cavity is 30µm deep, with cuticular duplication at base; armature consisting of large dorsal tooth, two sub ventral teeth and a dentate ring with 18 denticles. Cuticle is striated. Spicules are 63µm long. Accessory piece is 46µm long, not hooked proximally but provided with a small cusp. 7 supplements are present. Tail is short.

Geographical distribution: Chile

Remarks: The material is closely related to *Acanthopharyngoides chitwoodi* Wieser 1954 in the size of cephalic setae and amphids, nature of buccal cavity, oesophagus and spicular apparatus. Despite this resemblance the cuticle was striated in present specimens whereas it is only finely striated in wieser's details. All other features are well in agreement with that of *Acanthopharyngoides chitwoodi* Wieser 1954; therefore they are referred as *Acanthopharyngoides chitwoodi* Wieser 1954.

Family: Microlaimidae Micoletzky 1922

Cuticle with transverse striations without lateral differentiation; head set off as an unstriated region but without an obvious cephalic capsule; labial sensilla minute; 6+4 cephalic sensilla, always in two separate circles, posterior four always longer; amphids circular; oesophagus with a muscular posterior bulb; Tail is conical.

Genus**:* ***Bolbolaimus Cobb, 1920a

Characterized by presence of a muscular peribuccal bulb and strongly cuticularised buccal cavity. Degree of development of the buccal cavity; relative lengths of the cephalic setae; structure, position and size of the amphids; form of copulatery structures are important in distinguishing features of separation.

45. ***Bolbolaimus teutonicus*** Riemann 1966 (Plate 8. Fig. 45a & 45b).

Body length is 1.158mm (Female: a=60.5; b=19.1; c=25.5). Cuticle in the cervical region is with faint longitudinal markings. Six 4µm anterior and four 5µm posterior cephalic setae are present in cephalic capsule. A circle of short 5µm setae is placed 15µm posterior to amphids. Other somatic setae are not visible or absent, except in tail tip. Amphids are 11µm wide, somewhat transversely oval in shape. Buccal cavity is equipped with a solid dorsal and a smaller subventral tooth. Additional cavity is also present containing another tooth posterior to buccal bulb. Tail is short.

Geographical distribution: British waters and W. Scotland (Intertidal sand).

Remarks: The features of the present specimens agree well with *Bolbolaimus teutonicus* Riemann 1966 in the nature of the buccal cavity, relative lengths of the cephalic setae, size and disposition of the amphids. The present specimens are closely allied to *Bolbolaimus teutonicus* Riemann 1966 in many aspects and hence they are referred as *Bolbolaimus teutonicus* Riemann 1966.

Genus**:* ***Calomicrolaimus Lorenzen, 1976

Similar to *Bolbolaimus sp. loc cit.*

46.*Calomicrolaimus spirifer* Warwick 1970 (Plate 8. Fig. 46a & 46b).

Body length is 0.97mm (Female: a=33; b=8.8; c=11.2) Six short 3µm and four longer 5.2µm cephalic setae are present. Amphids are 8µm long, situated 2.5h.d from posterior end; multispiral of more than 5 turns. Buccal cavity is fairly well cuticularised, teeth about equal in size. Posterior oesophageal bulb, 30 X 18µm.

Geographical distribution: British waters (Intertidal sand).

Remarks: The material is closely related to *Calomicrolaimus spirifer* Warwick 1970 in the nature of the buccal cavity, size and disposition of the amphids. Since most of the morphological details are in resemblance to the type species they are referred as *Calomicrolaimus spirifer* Warwick 1970.

Family: Chromadoridae Filipjev 1917

Annulated cuticle with punctations and various other forms of ornamentations, frequently quite complex; amphids slit- like, loop– shaped or oval but never multispiral; buccal cavity anteriorly 12-folded, the folds usually cuticularised and called rugae; at least one dorsal tooth in buccal cavity, testis single, anterior, ovaries paired, equal, opposed, reflexed; vulva at about mid point of the body.

Genus: Actinonema Cobb 1920a.

=*Pareuchromadora* Stekhoven and Adam 1931a

Ten cephalic setae (6+4) Distinguished by the presence of a conspicuous transversely oval amphid with a double contour, L- shaped telamons and simple curved spicules.

47. ***Actinonema pachydermatum*** Cobb 1920a (Plate 8. Fig. 47a & 47b).

Body length is 0.88mm (Male: a=23.6;b=5.3;c=5.5). Body in oesophagial region abruptly narrows in anterior third. Cuticular ornamentation is heterogeneous and complex; irregular dots around amphid, transverse rows of dots in anterior part of oesophagus, with lateral differentiation beginning about middle of oesophagus. Somatic setae are minute and inconspicuous. Buccal cavity is conical with a distinct sharply pointed dorsal tooth. Amphid are transversely oval with double contour, 0.7 c.d. wide. Oesophagus is with a well-developed posterior bulb. Tail is conical with a pointed tip. Spicules are 32µm long, thin inconspicuous tube with L- shaped telamons and gubernaculum.

Geographical distribution: British waters (sublittoral fine sand and silt), Florida and Chile.

Remarks: The present material is closely related to *Actinonema pachydermatum* Cobb 1920 in the nature of the buccal cavity, dorsal tooth, and lateral differentiation in the body, in the nature of the oesophagus and in the structure of the spicular apparatus. In the structure of spicular apparatus present specimens differs from that of Wieser's specimens in that telamons are not mentioned in his Chilean material. Despite these differences, the present specimens are closely related to *Actinonema pachydermatum* Cobb 1920 in many aspects and hence they are referred as *Actinonema pachydermatum* Cobb 1920

Genus: Parapinnanema Inglis, 1969

Prominent precloacal cuticular modification; the body cuticle is thickened to a greater or lesser degree in the oesophageal region.

48. *Parapinnanema harveyi*_ Warwick and Coles 1975 (Plate 8. Fig. 48a & 48b).

Body length is 2.85mm (Male: a=35.6; b=10.8 c=12.6). Cuticle with hexagonal blocks commences at level of dorsal tooth. More elongated blocks in posterior part of the body. Six small conical labial papillae are present which is not discernible in most of present specimens. Ten shorter cephalic setae 4-4.5µm, positioned a little anterior to the four longer setae, which are 6.1 µm. Amphids crescentric 16µm wide, level with posterior cephalic setae. Dorsal tooth is long and solid. Ventral tooth is small and pointed. Oesophagus is without a bulb. Tail is conical, long and ventrally bent. Spicules are 50µm long, equal and arcuate with no ala. Telamons are 37µm long, L-shaped, the sharp flexure forming an almost exact right angle, without teeth or other modifications. Gubernaculum is 40µm, swollen at its distal end. Raised area anterior to cloaca is seen.

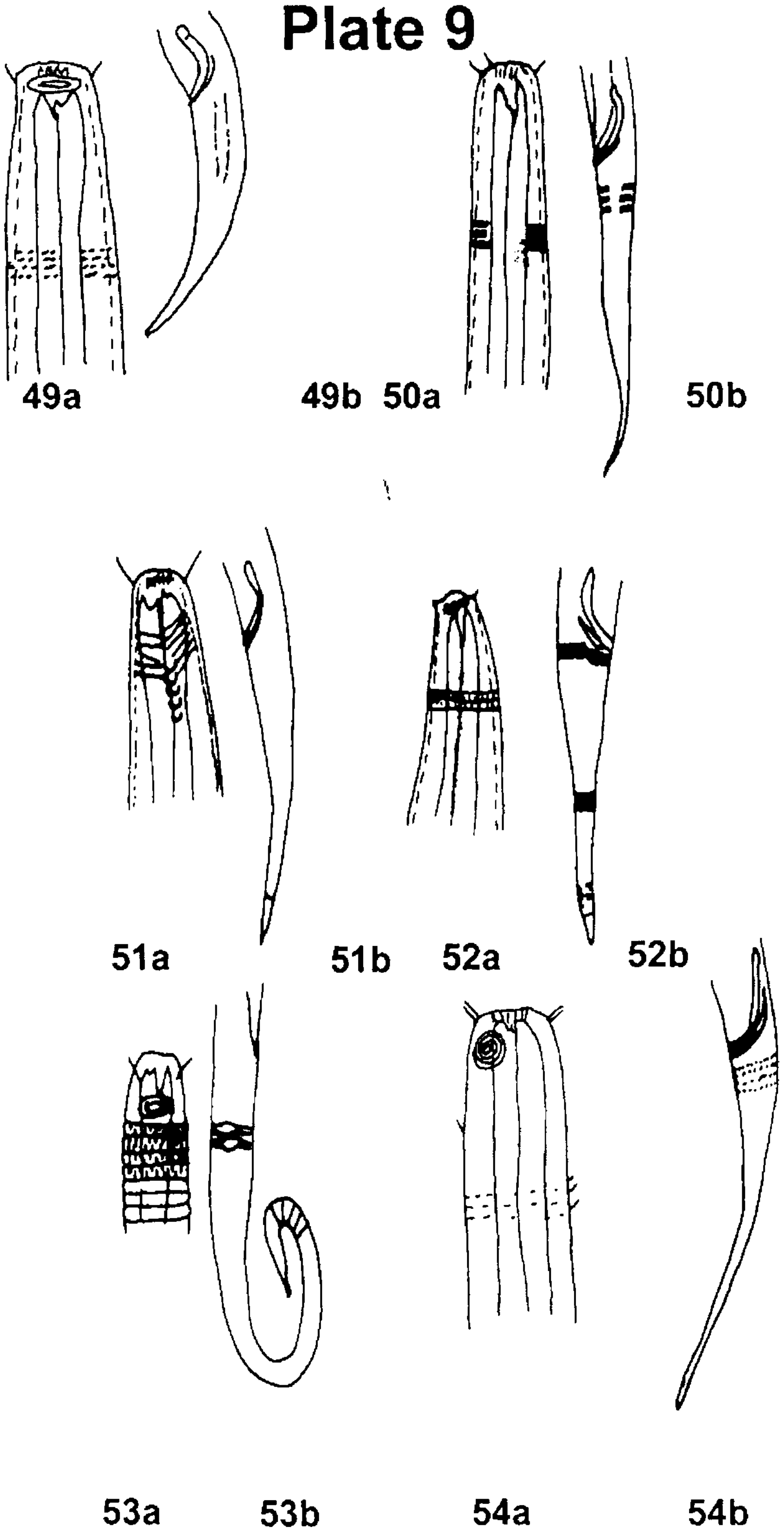
Geographical distribution: Isles of Scilly (Intertidal sand at low water)

Remarks: The material is closely related to *Parapinnanema harveyi* Warwick and Coles 1975 in the nature oesophagus, size and disposition of the amphids and in the structure of the spicular apparatus. The aforesaid morphological details are caused to be considering the present specimens as *Parapinnanema harveyi* Warwick and Coles 1975.

Genus*: *Spilophorella Filipjev 1918a.

Complex heterogeneous cuticle with lateral differentiation; deep buccal cavity containing a long hollow dorsal tooth; elongated double posterior oesophageal bulb; a long pointed unstriated spinneret well set-off from the rest of the tail.

Plate 9



49a&b. Spilophorella euxina (Male head and tail)
50a&b. Spilophorella candida (Male head and tail)
51a&b. Spilophorella tollenifera (Male head and tail)
52a&b. Dichromadora geophila (Male head and tail)
53a&b. Paraeuchromadora longicaudata (Female head and tail)
54a&b. Longicyatholaimus quadriseta (Male head and tail)

49.*Spilophorella euxina* Filipjev 1918; Stekhoven 1950 (Plate 9. Fig. 49a & 49b).

=? S. *campbelli* Allgen 1927c

Body length is 0.89mm (Male: a=22.8; b=5.3; c=8.4). Head diameter is 11.5µm. Complex heterogeneous cuticles with lateral differentiation, deep buccal cavity containing a long hollow dorsal tooth; elongated double posterior oesophageal bulb. A long pointed unstriated shorter spinneret, well set-off from the rest of the tail. The two portions of oesophageal bulb are equal in size. Spicula are strongly arcuate, 27µm long. Dots are enlarged in anterior region of the body.

Geographical distribution: Sebastopol, Chile, Mediterranean and Campbell islands.

Remarks: The material is closely related to *Spiliphorella euxina* Filipjev 1918 in the nature of cuticular ornamentation, in the nature of the oesophagus and in the structure of the spicular apparatus. The most striking feature is that of equal sized oesophageal bulbs. Based on these comparable features they are located as *Spiliphorella euxina* Filipjev 1918.

50. *Spilophorella candida*_ Gerlach 1951. (Plate 9. Fig. 50a & 50b)

Body length is 1.08mm (Male: a=20; b=7.1; c=8.3). The lateral rows of large dots do not extend throughout the length of the body but are replaced by rows of smaller elongated markings. Cephalic setae 11µm long; the spinneret is shorter; the anterior section of oesophageal bulb only slightly shorter than posterior section (25µm and 30µm). Spicules are 30µm long with gubernaculums 20µm long.

Geographical distribution: Danish coast, British waters and W. Scotland (Intertidal sand).

Remarks: The material is closely related to *Spilophorella candida* Gerlach 1954 in the features of cuticular ornamentation, cephalic setae, buccal cavity, and oesophagus and in the structure of the spicular apparatus. Since the demarcating features are agreeing with type species, they are located with Spilophorella *candida* Gerlach 1954.

51. ***Spilophorella tollenifera*** Wieser 1955 (Plate 9. Fig. 51a & 51b).

Body length is 0.870mm (Male: a=22.5; b=6.3;c=8.1). Head is 14µm wide. Cephalic setae are 7µm long in male and 5.5µm in female. Buccal cavity is deep and large. Dorsal tooth is large, with two sub lateral, backward pointing apophyses. The longitudinal rows of dots are separated from each other by 5µm in the anterior region. The transverse bands are smooth in the anterior and more rod like markings posteriorly. The pharyngeal bulb is double. The spicules are 32µm long. The tail is long, 5 anal body diameters. Spinneret is 8µm long.

Geographical distribution: Japan.

Remarks: The material is closely allied to *Spilophorella tollenifera* Wieser 1955 in the nature of the head, in the nature of the oesophagus and in the structure of the spicular apparatus. This species is differentiated from other species of *Spilophorella* by the posterior apophyses of the dorsal tooth, and simple spicular structure. However the body size of present specimens is slightly higher than that of Wieser's specimens where it is given as 0.733mm. Despite this difference, the present specimens are closely allied to *Spilophorella* *tollenifera* in many respects and hence they are referred as *Spilophorella tollenifera* Wieser 1955.

Genus: Dichromadora Kreis 1929a

Presence of hollow teeth, mostly one dorsal and two sub-ventral. Amphid oval or ovally loop- shaped. Pronounced lateral differentiation is present in the cuticle in the form of two longitudinal files of enlarged dots.

52. *Dichromodora geophila* De Man 1876 (Plate 9. Fig. 52a & 52b).

Body length is 0.79mm (Male: a=13.1; b=6.6; c=8.9) Cuticle with lateral files of enlarged dots flanked by transverse rows of finer markings. Lateral dots 4µm apart in middle; united by transverse bars. Six short and four longer 4µm cephalic setae are present in head. Amphids are not clear. S-shaped hollow dorsal tooth, and a pair of very small subventral projections present. Oesophagus is with a rounded posterior bulb with plasmatic interruptions. Tail is short, tapering with a spinneret. Spicules 35µm, arcuate, rounded proximally with a fine ventral ala. Supplements are absent.

Geographical distribution: North America, Swedish coast, Exe estuary, S.W England (Intertidal mud); Tamar estuary, Skippers Island, Essex.

Remarks: The material is closely related to *Dichromadora geophila* De Man 1876 in the nature of cuticular markings, cephalic setae, dorsal tooth and the features of oesophageal bulb. The tail tip with a distinct spinneret is also aids in locating the present specimens as *Dichromadora geophila* De Man 1876.

Genus: Paraeuchromadora Stekhoven and Adam 1931

Stoma with a single hollow dorsal tooth

53. *Paraeuchromadora longicaudata* Chitwood 1951 (Plate 9. Fig. 53a & 53b).

Syn: *Actinonema* Cobb 1920a

Length is 1.075mm (Female: a=28; b=6.3 c=3.5). Four cephalic setae are 2.5µm long. Amphids are transverse heavy walled. Cuticle is coarsely striated rod like in anterior part of body, disappear posteriorly. Cuticle in mid and posterior regions is with lateral internal flecks. Oesophagus is without a bulb; stoma weak with one hollow dorsal tooth. Tail is very characteristically long and hooked.

Geographical Distribution: Mud Island, Aransas Bay and Texas.

Remarks: The present material is closely related to *Paraeuchromadora longicaudata* Chitwood 1951 in the nature of the cuticular ornamentation, buccal cavity, features of amphids and in the nature of tail. The only difference was the difference in size of cephalic setae and average body length. However the more pertinent features of distinguishing the species are in well agreement. Hence they are referred to as *Paraeuchromadora longicaudata* Chitwood 1951.

Family: Cyatholaimidae Filipjev 1918

Annulated cuticle with transverse rows of punctuations; multispiral amphids; 6+4 cephalic setae in a single circle, the six always longer than the four; buccal cavity is anteriorly 12- folded, appeared as rugae, more posteriorly with a distinct dorsal tooth and sometimes small subventral teeth; oesophagus with out a bulb. Vulva is placed at mid-point of the body.

Genus*: *Longicyatholaimus Micoletzky 1924b

Lateral differentiation irregular, no transverse bars; No oesophageal bulb; teeth small to medium size; tail elongate to filiform.

54. *Longicyatholaimus quadriseta* Wieser 1954 (Plate 9. Fig. 54a & 54b).

Body length is 1.27mm in male (Male: a=23; b=6.1; c=5.9) and 1.37mm in female (a=29, b=6.2; c=6.3). Head diameter is 18µm. Labial setae are conspicuous. Cephalic setae are in 6µm in male. Cervical setae irregularly distributed. Amphids are 11µm, covering more than 50% of c.b.d in width. Lateral differentiation in cervical region is both vertical and horizontal. Longitudinal rows are absent in the anal region. Spicula are 37µm in length. Accessory piece 32µm long, distally dilated and provided with small cusps. Six supplements are small and single. Tail is long.

Geographical distribution: Chile.

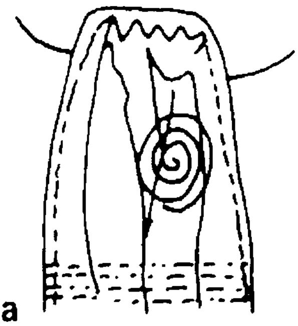
Remarks: The material is closely related to *Longicyatholaimus quadriseta* Wieser, 1954 in the details of cephalic setae, amphid size, lateral differentiation and spicular structure. The small variations of size of the cephalic setae and spicules are noticed. Despite these differences, the cited morphological features are accounted for placing the present material as *Longicyatholaimus quadriseta* Wieser 1954.

Genus*: *Pomponema Cobb 1917

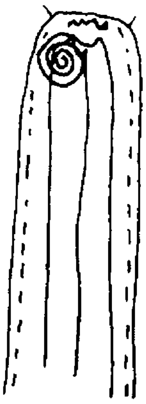
Syn: *Cobbiacanthonchus* Allgen 1953a

Cuticle with fine punctations and lateral differentiation of four longitudinal files of enlarged dots commencing some distance behind the head, cuticle in head region particularly thick with the punctuations appearing in lateral view as elongated rods with Y-shaped ends; buccal cavity strongly armed with a large

Plate 10


55a


55b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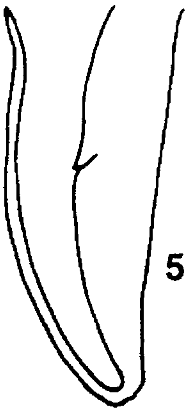
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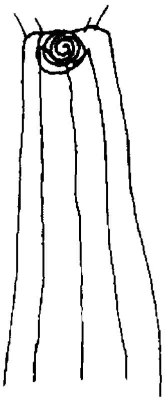
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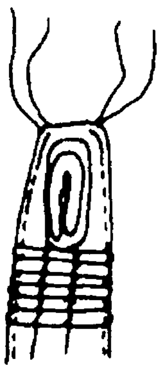
57b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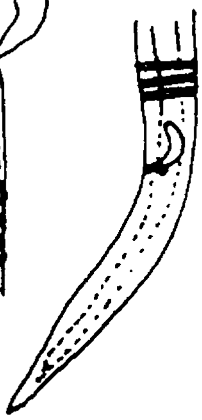
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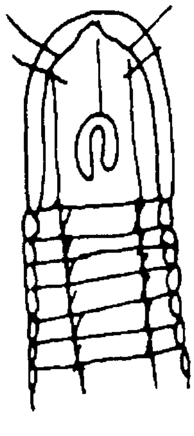
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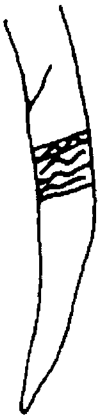
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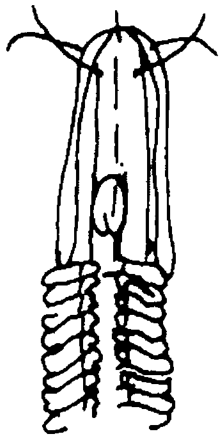
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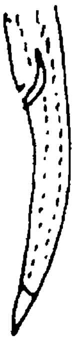

60b

55a&b. Pomponema segregata (Female head and tail)
56a&b. Paralongicyatholaimus minutus (Female head and tail)
57a&b. Metacyatholaimus spatiosus (Female head and tail)
58a&b. Pselionema longiseta (Male head and tail)
59a&b. Ceramonema carinatum (Female head and tail)
60a&b. Dasynemoides albaensis (Male head and tail)

pointed dorsal tooth, medium sized subventral teeth and additional denticles; gubernaculum with lateral wigs in the middle which enfold the spicules, spicules with a central lamella, precloacal supplements characteristic with several elements. Tail is with swollen tip.

55. ***Pomponema segregata*** Wieser 1959 (Plate 10. Fig. 55a & 55b).

Body length is 0.990mm (Female: a=24.7; b=6; c=9.3). Cuticle is with horizontal and vertical differentiation all along the body. Cuticular dots are very large in the anterior cervical region. Lateral differentiations beginning irregularly on a level with the amphids; from the mid cervical region onwards, 2 longitudinal rows are clearly established. Head diameter is 24µm. There are 6 setose labial papillae, 5µm long. First circle of 4 setae are 7µm, second circle of 6 setae are 12µm long. Amphids are 11.3µm wide, 50% c.b.d, and 4 turns. Buccal cavity is spacious. The anterior most papillae are situated 150µm in front of the anus. Tail is 4.4 anal body diameters long with a row of setae on its ventral surface.

Geographical distribution: Bain Bridge Island, Chile

Remarks: The material is closely allied to *Pomponema segregata* Wieser 1959 in the nature of the cephalic setae and the shape of tail. The relative length of the specimens was also comparable. Therefore they are located among *Pomponema segregata* Wieser 1959.

Genus: Paralongicyatholaimus Stekhoven 1950a.

Buccal cavity without teeth; Cuticle without lateral differentiation; oesophagus with a posterior bulb; spicule simple; gubernaculum without teeth; precloacal supplements absent; tail filiform.

56.***Paralongicyatholaimus minutus*** Warwick 1971 (Plate 10. Fig. 56a & 56b).

Body length is 2.100mm (Female: 52.5; b=10.5;c=8.0). Cuticle is with transverse rows of small dots. Cephalic setae are in 4+6 pattern (four shorter 2.2 µm and six longer 3.6µm). Buccal cavity is cup shaped without teeth. Oesophagus is long, terminating in a rounded bulb 13µm long and 11µm wide. Tail is filiform.

Geographical distribution: British waters (sublittoral fine sand)

Remarks: The material is closely allied to *Paralongicyatholaimus minutus* Warwick 1971 in the nature of the buccal cavity, size and nature of the amphids and in the nature of the oesophageal bulb. However the body size shows a variation. Specimens are larger than those of the British specimens described by Warwick, 1971. The morphological features like rows of small dots and all other demarcating features of the species are apparent. Therefore it was placed as *Paralongicyatholaimus minutus* Warwick 1971.

Genus: Metacyatholaimus Stekhoven 1942a

Syn: *Metachoniolaimus* Stekhoven 1950a

Lateral differentiation is regular in longitudinal rows; tooth absent or small; oesophageal bulb present; accessory piece plate-like; preanal papillae absent; tail filiform.

57. ***Metacyatholaimus spatiosus*** Wieser 1954 (Plate 10. Fig. 57a & 57b).

Body length is 0.750mm (Female: a=21.4; b=7; c=21.4). Head diameter is 20µm and covering 53% of c.b.d. Cephalic seta is 5.6µm long. Amphids are wide, 10.7µm with 4 turns. Teeth are small. Oesophageal bulb well developed, about 1/5th of oesophagus in length. Lateral differentiation of cuticle is present. 5

longitudinal rows, the outermost 13µm apart; the lateral rows are more pronounced than the sub lateral ones.

Geographical distribution: Chile

Remarks: The present material is closely allied to *Metacyatholaimus spatiosus* Wieser, 1954 in the nature of the head, cephalic setae and size of oesophageal bulb. Most of the details are in close similarity to the descriptions of Wieser's specimens. The size of present specimens was differed from that of Wieser's specimens where the size is given as an average of 1.09mm. Despite this difference cited above, the present specimens showed close resemblance to *Metacyatholaimus spatiosus* Wieser 1954, in many aspects therefore they are referred to as *Metacyatholaimus spatiosus* Wieser 1954

Family: Ceramonematidae Cobb 1933

Cuticle thick, coarsely annulated in the form of overlapping plates with longitudinal ridges; cephalic capsule unstriated on which amphids are situated; labial sensilla not discernible; usually 6+4 cephalic sensilla; amphids usually Ω-shaped; buccal cavity minute; tail conical with an unstriated tip.

Genus: Pselionema Cobb, 1933a

In addition to the family characters *Pselionema* has: 70-350 cuticle annules; only four cephalic setae; buccal cavity absent; cuticle ridges are not markedly enlarged.

58. *Pselionema longiseta* Ward 1974 (Plate 10. Fig. 58a & 58b).

Body length is 1375mm (Male: a=55; b=?; c=9.4). Cuticle is coarsely annulated, each annule being composed of a number of cuticular plates, the ends of which are prolonged in to ridges. Ten ridges form a series of 8 longitudinal ridges on the body. Total number of annules is 240. Somatic and caudal setae are absent. Amphids are large loop, 14µm long and 4.5µm in width. Head diameter is 16µm. Cephalic helmet is well developed. Four long cephalic setae are 28µm long. Buccal cavity is reduced. Oesophagus is cylindrical without a bulb. Spicule is 21µm long. Tail is elongated and conical.

Geographical distribution: British waters (sublittoral coarse sand with shell gravel)

Remarks: The material is closely related to *Pselionema longiseta* Ward 1974 in the nature of the cephalic setae, amphid, cuticular annulations and in the nature of spicules. The relative body size is also similar to the original species. Hence they are referred to as *Pselionema longiseta* Ward 1974 with certainty.

Genus: Ceramonema Cobb 1929

Syn: *Steineria* Filipjev 1922a

Species are with about 70-280 numbers of transversely undulating cuticle annules; eight longitudianal cuticle ridges or crests; 6+4 cephalic setae.

59. ***Ceramonema carinatum*** Wieser 1959 (Plate 10. Fig. 59a & 59b).

Body length is 2.3mm (Female: a=93; b=? c=18.4). Cuticle is tiled. Crests that are arranged in 8 long rows along the body interrupt tiles. The longitudinal rows extend up to the head as rows of dots. Annules are 8µm wide in the cervical region. Head is 33µm long. Lips are indistinct. Cephalic setae are in two circles of 6 and 4 (each seta 11µm long). Amphids are placed in posterior half of head, 14.9µm long and 8.2µm wide. Tail, distal cone 12.7µm long, anal diameter is 16.3µm.

Geographical distribution: Alki point (subterranean water) and Chile.

Remarks: The material is closely allied to *Ceramonema carinatum* Wieser 1959 in the nature of cephalic setae and size and disposition of the amphids. However the relative size of the specimens recorded varied from that of the Wieser's specimens. The other body dimensions are well in agreement with the features described by Wieser. The cited details enabled it to be placed as *Ceramonema carinatum* Wieser 1959.

Genus: Dasynemoides Chitwood 1936b

In addition to the family characters *Dasynemoides* has: over 500 cuticle annules; particularly elongated cephalic capsule; 6+4 cephalic setae.

60.***Dasynemoides albaensis*** Warwick and Platt 1973 (Plate 10. Fig. 60a & 60b).

Body length is 1.45mm (Male: a=61; b=12.8; c=24.3). Cuticle is with 8 longitudinal ridges in the anterior and posterior region, 10 in the middle region and six near the tail tip. Cephalic capsule 28µm long and 16 µm wide, with 8 cuticular ribs extending forwards from its base. Cephalic seta is in 6+4 pattern, 8 µm and 12µm long. Somatic setae are absent. Amphids is a closed loop, 4.6 µm wide. Buccal cavity is absent. Spicules are 21µm long and arcuate. Tail is with 30µm end cone.

Geographical distribution: British waters and Scotland (intertidal sand)

Remarks: The present specimens are in close resemblance to *Dasynemoides albaensis* Warwick and Platt 1973. The similarities were in the nature of the cephalic capsule, cephalic setae, size and disposition of the amphids and in the structure of the spicular apparatus. The cuticular nature and tail tip are also key identifying characters of this species. Therefore they are referred to as *Dasynemoides albaensis* Warwick and Platt 1973.

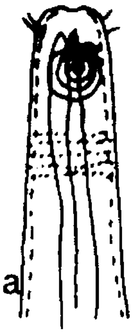
Family Ethmolaimidae Filipjev and Stekhoven 1941

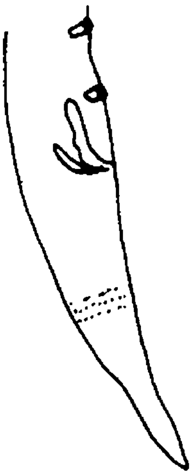
Annulated cuticle with transverse rows of punctations, sometimes with lateral differentiations of fewer rows; amphids spiral; buccal cavity with vestibule divided in to twelve parts; dorsal tooth in buccal cavity; oesophagus with muscular posterior bulb; cup-shaped precloacal supplements; tail conical with a rounded tip.

Genus: Filitonchus Platt, 1982

Slender body; papilliform labial sensilla; relatively long anterior and posterior cephalic setae; poorly developed buccal cavity; spicules straight and gubernaculum simple plate like.

Plate 11


61a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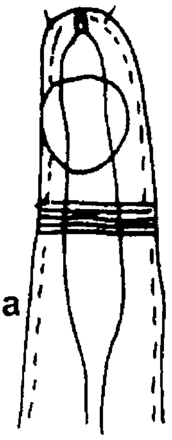
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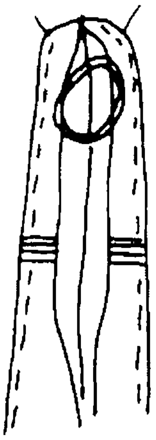
62b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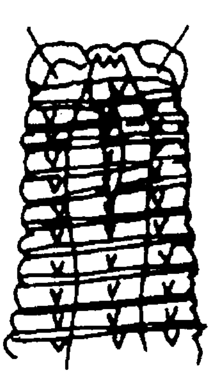
63b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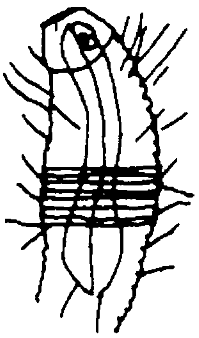
64b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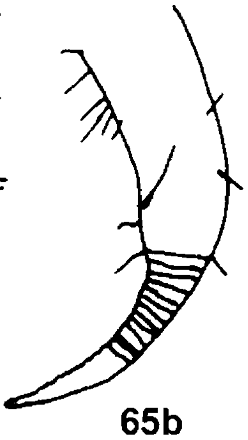
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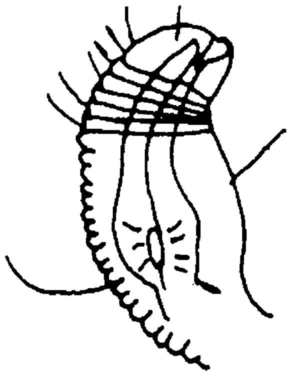
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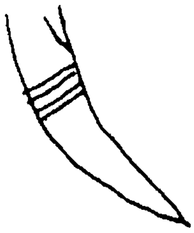

66b

61a&b. Filitonchus filiformis (Male head and tail)
62a&b. Cyartonema germanicum (Female head and tail)
63a&b. Southernia zosterae (Male head and tail)
64a&b. Nudora crepidata (Female head and tail)
65a&b. Dracognomus simplex (Female head and tail)
66a&b. Notochaetosoma killieri (Female head and tail)

61.*Filitonchus filiformis* Warwick 1971 (Plate 11. Fig. 61a & 61b).

Body length is 0.769mm (Male: a=38.4; b=8; c=10.2). Cuticle is with transverse rows of small dots; without lateral differentiation. Inconspicuous pores in cuticle are difficult to discern. Cephalic setae arranged in 6+4 pattern, six 5µm and four 8µm long. Dorso-sublateral sub cephalic seta placed level with posterior part of each amphid. Amphids are of 4.5 turns, 5.9µm wide. Buccal cavity is slender with a small pointed dorsal tooth. Tail is short and round. Spicules are 16µm long. Eight supplements are present.

Geographical distribution: British waters (Sub littoral silt).

Remarks: The above said specimens are closely related to *Filitonchus filiformis* Platt 1972 in the nature of the poorly developed buccal cavity, details of the amphids, and in the structure of the spicular apparatus. The number of precloacal supplements and tail tip are also closely allied to type species. Therefore they are located among the species *Filitonchus filiformis* Platt 1972.

Family Aegialoalamidae Lorenzen 1981

Cuticle striated; only posterior four cephalic sensilla are visible; buccal cavity minute, unarmoured; oesophagus with a narrow non-muscular central section and a posterior bulb; tail conical; testes paired; ovaries paired and reflexed.

Genus: Cyartonema Cobb 1920a

In addition to the family characters *Cyartonema* has: amphids circular; ovaries outstretched.

62.*Cyartonema germanicum* Juario 1972 (Plate 11. Fig. 62a & 62b).

Body length is 0.860mm (Female: a=43; b=13.2; c=14.3). Cuticle is faintly striated. Four cephalic setae are 6µm long; two pairs of cervical setae absent. Oesophageal bulb is short and broad; 12µm long and 16µm wide. Tail is conical.

Geographical distribution: British waters and W. Scotland (Intertidal sand)

Remarks: The material is closely related to *Cyartonema germanicum* Juario 1972 in the nature of amphid size and disposition, and details of oesophageal bulb. The other pertinent features include cephalic setae and tail tip. Therefore the present specimens are referred as *Cyartonema germanicum* Juario 1972.

Genus: Southernia Allgen 1929

Syn: *Siphonolaimus* De Man 1893a

Syn: *Anthraconema* Zur strassen 1904a

Syn: *Chromagaster* Cobb 1894a

Syn: *Solenolaimus* Cobb 1894a.

Similar to *Cyartonema* except that the ovaries are reflexed.

63.***Southernia zosterae*** Allgen 1929 (Plate 11. Fig. 63a & 63b).

Body length is 1.00mm (Male: a=33; b=18.1; c=22.1). Cuticle is faintly striated. Four 7µm cephalic setae are present. Male tail is with two subventral files of setae, female tail with only a few small setae near the tip. Somatic setae are otherwise absent. Amphids are 12µm wide, rounded but some what squared posteriorly, walls strongly cuticularised, with rounded central fleck. Oesophagus is elongated posteriorly as a bulb. Tail is cylindrical with a rounded end. Spicules are 32µm, arcuate, proximally cephalate and distally open-ended. Gubernaculum is with a pair of dorso-caudally directed apophyses.

Geographical distribution: British waters, NE Ireland and Scotland.

Remarks: The material is closely related to *Southernia zosterae* Allgen 1929 in the details of the structures like amphid, oesophageal bulb and the spicules. The specimens are much related to *Cyartonema* sp. but differentiated from it by reflexed ovaries and comparitively elongated bulb. Hence they are treated as *Southernia zosterae* Allgen 1929.

Family: Monoposthiidae Filipjev 1934

Strongly striated cuticle with longitudinal ornamentation usually in the form of several files of V- shaped markings; labial sensilla short; 6+4 cephalic sensilla in two separate circles, the posterior four always longer; amphids circular without a trace of a spiral; buccal cavity with strongly developed dorsal tooth; tail conical; testes paired and opposed; single anterior reflexed ovary.

Genus: Nudora Cobb 1920a

Spicules in addition to the unpaired gubernaculum is the characteristic of *Nudora*

64.*Nudora crepidata* Wieser 1954 (Plate 11. Fig. 64a & 64b).

Body length is 0.925mm (Female: a=19.6; b=5.1;c=13.6). Labial papillae are setiform; big lips are prominent. Cephalic setae of first circle are minute and second circle is long. Amphids are 3.4 µm, 20% of the c.b.d in width, positioned between first and second cuticular annule. Oesophagus is with a conspicuous pharyngeal bulb; posterior bulb oval. Cuticle annules are apart from each other in the middle of the body than on anterior and posterior ends. Tail is 3.4 anal body diameters long.

Geographical distribution: Chile. (Littoral exposed sand; sublittoral secondary substrate and coarse bottom).

Remarks: The material is closely related to *Nudora crepidata* Wieser 1954 in the details of cephalic and labial setae, disposition of the amphids and in the nature of the oesophagus. The size of present specimens was slightly less than that of Wieser's specimens (1.4mm). Besides the body size variation all other details are similar, hence they are referred to as *Nudora crepidata* Wieser 1954.

Family: **Draconematidae** Filipjev 1918

Body S-, Z- or rarely ε -shaped with the ovaries situated anterior to the dorsal curvature of the body; subventral ambulatory stilt setae through which adhesive glands open, situated posterior to the dorsal curvature; cuticle with coarse striations except on head.

Genus: Dracognomus Allen and Noffsinger 1978

Oesophageal region is not bulbous; buccal cavity with small dorsal tooth; amphids inconspicuous and situated at the base of the rostrum; anterior and posterior ambulatory setae not in the form of adhesive bristles.

65.*Dracognomus simplex* Gerlach 1954 (Plate 11. Fig. 65a & 65b).

Body length is 0.612mm (Female: a=10.5; b=13.5; c=10.2). Posterior to oesophageal region, cuticle annulations are with small warts. Six 5µm cephalic setae are present. Several sub cephalic setae are present in rostrum merging with somatic setae. Dispositions of general somatic setae are not easily discernible, other than their concentration on the anterior dorsal part of the oesophageal region and ventral posterior region. Amphids 1.4µm wide, situated at the base of the rostrum. Buccal cavity is poorly developed. Oesophagus is with a posterior bulb. Tail is 3.3 a.b.d long, conical with an unstriated tip. One pair of setae is on unstriated tail region. Anal tube is present.

Geographical distribution: Isle of Scilly (Intertidal coarse sand)

Remarks: The specimens are closely allied to *Dracognomus simplex* Gerlach 1954 in the details of the overall body morphology including long body setae, unstriated head and tail tip. The relative body length is also similar to the original descriptions of the Gerlach's material, enabling them to be placed as *Dracognomus simplex* Gerlach 1954.

Genus: Notochaetosoma Irwin- Smith 1918a

Oesophageal region is not so conspicuously bulbous; and lacks an isthmus; cuticle of rostrum is very thick.

66.***Notochaetosoma killieri*** Warwick 1977 (Plate 11. Fig. 66a & 66b).

Body length is 0.610mm (Female: a=15.2; b=5.5; c=13.2). Rostrum is a truncated cone 26µm wide punctuated in the region posterior to the amphids. Six 6.5µm cephalic setae are with an additional pair of similar setae alongside each amphid. Many sub cephalic setae are with asymmetrical length. Amphids 11µm long and 6µm wide, horse shoe shaped. Oesophagus is with weakly developed posterior bulb. Tail is 3.3 a.b.d long, conical with a long unstriated but uniformly punctuated tip. Posterior ambulatory setae are in 2 subventral files.

Geographical distribution: Isles of Scilly (Kelp holdfasts)

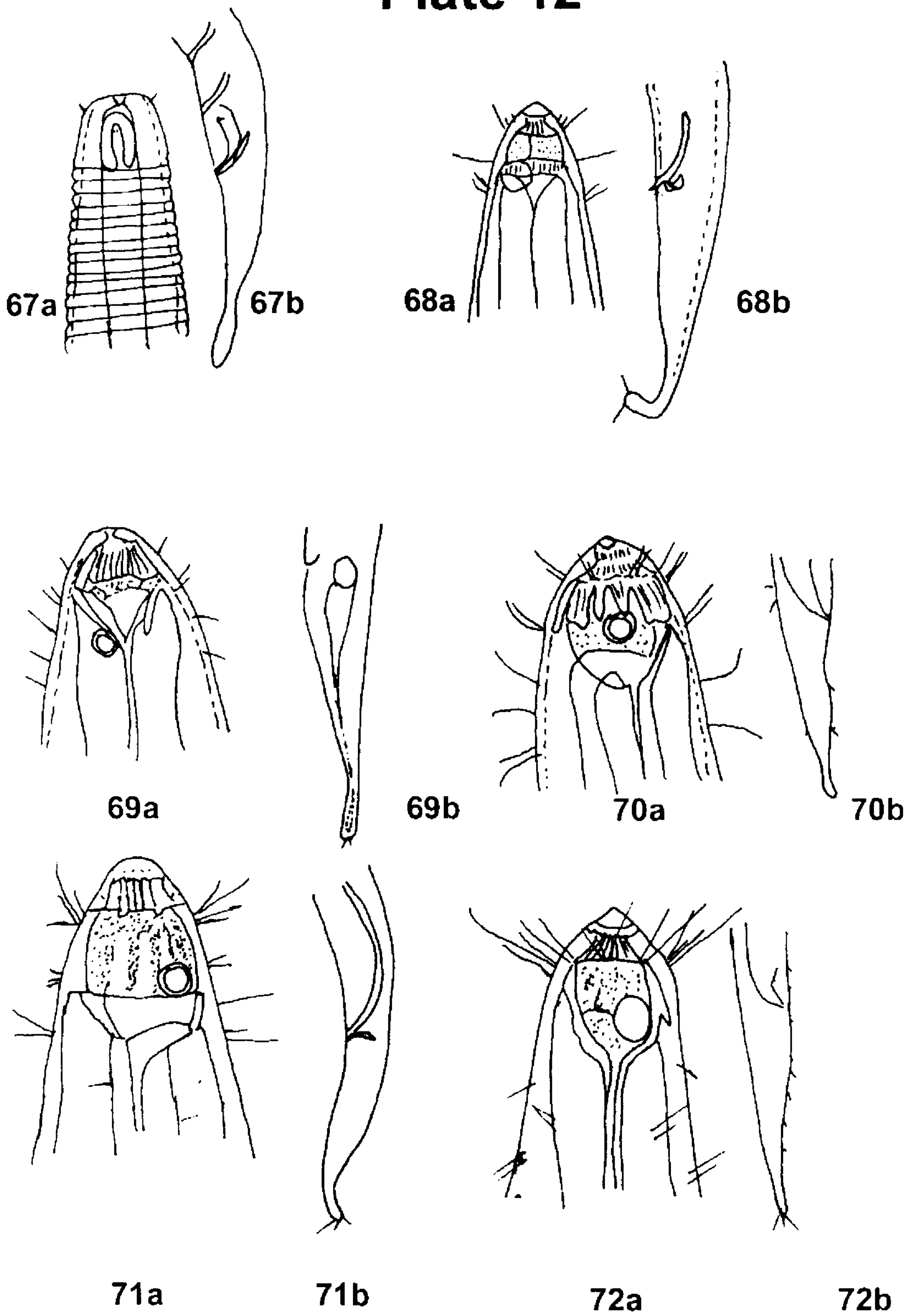
Remarks: The cited material above is closely related to *Notochaetosoma killieri* Warwick 1977 in the structural details of the amphids, characteristic body setae, cephalic capsule and tail tip. The above-mentioned features are allied to the original specimens by Warwick 1977. Therefore it was placed as *Notochaetosoma killieri* Warwick 1977.

Family: Leptolaimidae Orley 1880

Cuticle striated, never punctated, the striations usually not coarse but widely spaced; six anterior cephalic sensilla usually minute; four posterior cephalic sensilla setiform; amphids never multispiral; buccal cavity often tubular, rarely with teeth; oesophagus usually with posterior bulb; males almost always with conspicuous well-cuticularised tubular precloacal supplements; testes usually paired and opposed; ovaries usually paired and always reflexed.

Genus: Antomicron Cobb 1920

Plate 12



67a&b. Antomicron elegans (Male head and tail)
68a&b. Sphaerolaimus pacifica (Male head and tail)
69a&b. Sphaerolaimus islandicus (Female head and tail)
70a&b. Sphaerolaimus hirsutus (Female head and tail)
71a&b. Sphaerolaimus macrocirculus (Male head and tail)
72a&b. Sphaerolaimus penicillus var. pugetensis (Female head and tail)

In addition to the family characters *Antomicron* has: amphids in the form of an elongated loop and a minute buccal cavity.

Syn: *Eutelolaimus* DeMan 1922a

67. *Antomicron elegans* De Man 1922 (Plate12. Fig. 67a & 67b).

Body length is 1.17mm (Male: a=39 b=19.1c=27.2). Cuticle with widely spaced transverse striations, with a well-defined narrow unstriated lateral band. Four 4µm cephalic setae are present. Amphids are longitudinally oval with a granulated central area (11x4.2µm). Buccal cavity is tubular, merging imperceptibly with oesophageal lining. Oesophagus with two weakly developed bulbs in the mid region, and a large pyriform posterior bulb with a thickened cuticular lining. Tail 4.6 a.b.d long and distal third is cylindrical. Spicules are 36µm, slender, curved and proximally cephalate. Gubernaculum is 23µm long and curved anteriorly. Four 29µm tubular cuticularised precloacal supplements are present swollen proximally with anteriorly directed openings.

Geographical distribution: British waters.

Remarks: The present material is very much related to *Antomicron elegans* De Man 1922 in the details of amphids, oesophagus and in the structure of the spicular apparatus. The tubular cuticularised supplements are also key identifying character. For that reason it was placed as *Antomicron elegans* De Man 1922.

Order: Monhysterida

The order monhysterida is a heterogeneous taxon without any single character or group of characters, which can be used to define it uniquely. They have typically an annulated cuticle without dots or other markings, a simple buccal cavity without teeth or mandibles, circular or loop–shaped amphids, outstretched ovaries, and in some families there is a single anterior ovary (hence the etymological origin of the name -monhysterida). Males seldom have prominent precloacal supplements.

Family: Sphaerolaimidae Filipjev 1918

Sphaerolaimids typically have the following characters: cuticle transversely striated; four cephalic setae always longer than the other six; eight groups of sub cephalic setae; buccal cavity not completely surrounded with oesophageal tissue, usually barrel-shaped, bordered anteriorly by a ring of pointed leaf-elements or chielorhabdions; amphids circular, often more posteriorly positioned in juveniles than adults; tail conico- cylindrical with two or three terminal setae.

Genus: Sphaerolaimus Bastian 1865a

Syn: *Parasphaerolaimus* Ditlevsen 1919a

In addition to the family characters Sphaerolaimus species have: buccal cavity surrounded by a solid, heavily sclerotised buccal capsule; inner lining of oesophagus strongly cuticularised; groups of sub cephalic setae absent in first two juvenile instars; with 4-6 groups in the third stage, and eight in the fourth stage juvenile and adult; two testes.

68. *Sphaerolaimus pacifica* Allgen 1947d (Plate12. Fig. 68a & 68b).

Body length is 0.760mm (Male: a=14.9; b=3.5;c=8.4). 6 small labial papillae are present. 10 cephalic setae arranged in 6+4 pattern, 7µm and 2µm long. First circle of sub cephalic setae are in 8 groups, 18µm long. Second circle of sub cephalic groups are in 6 groups, the sub median setae up to 18µm, the lateral setae are up to 25µm long. Cervical setae are 16µm long. Cuticle is finely striated. Amphids are 8µm, 18% of c.b.d. Buccal capsule is typical, sclerotised portion broad, with fenestrae. Oesophageal lumen is strongly cuticularised. Excretory pore positioned 187µm from the anterior end. Spicules are 79µm long. Tail 3.9 a.b.d long, posterior third to fourth cylindrical. Terminal setae are 17µm long.

Geographical distribution: West America, Chile (Sub littoral soft bottom) and Bay of Bengal.

Remarks: The material is closely related to *Sphaerolaimus pacifica* Allgen 1947d in the morphological details of cephalic setae, amphids, spicular apparatus and tail features. The body size is also comparable to Wieser's Chilean material. So they are placed as *Sphaerolaimus pacifica* Allgen 1947d.

69.*Sphaerolaimus islandicus* Ditlevsen1926 (Plate12. Fig. 69a & 69b).

Body length is 0.850mm (Female; a=17; b=13.7;c=11.7). Cuticle is with faint transverse striations. Cephalic setae are 4µm long. Sub cephalic setae in eight groups of 3, measures 10µm; amphids 10.5µm. Cephalic capsule is a narrow sclerotised ring. Tail 3.9 a.b.d. long and with a longer posterior cylindrical part. Vulva is positioned at 70% of body length.

Geographical distribution: Danish and British waters.

Remarks: The present specimens are closely related to *Sphaerolaimus islandicus* Ditlevsen 1926 in the details of cephalic capsule, body setae, amphid position, and relative dimensions of body. However the specimens are smaller than that of Ditlevsen's original material. Despite this disparity all other characters and morphology are well agreement with the type specimens and therefore they are placed as *Sphaerolaimus islandicus* Ditlevsen 1926.

70. *Sphaerolaimus hirsutus* Bastian 1865 (Plate12. Fig. 70a & 70b).

Body length is 2.5mm (Female: a=17.4; b=36.7; c=46.2). Cephalic sensilla reduced to a small papilla. Amphids are 8μm long, situated anterior to base of the oesophagus. Groups of 2 somatic setae are present in eight longitudinal files throughout the body. Buccal cavity is with alternating heavily and weakly punctuated areas. Oesophagus widens posteriorly with out a true bulb. Vulva positioned at 78% of body length.

Geographical distribution: France and British Isles (Intertidal & shallow subtidal mud).

Remarks: The present specimens are closely related to *Sphaerolaimus hirsutus* Bastian 1865 in the nature of the buccal cavity, size and disposition of the amphids and in the nature of the oesophagus. Since the descriptions are based on female specimens the details of males are lacking from the study area. As the descriptions of females by Bastian are true with respect to the present specimens they are considered as *Sphaerolaimus hirsutus* Bastian 1865.

71. *Sphaerolaimus macrocirculus* Filipjev 1918 (Plate12. Fig. 71a & 71b)

Body length is 1.232mm (Male: a=25.6; b=5.6;c=38.5). Cephalic setae are 5.2μm long. Amphids are17μm long situated level with the base of the cephalic capsule. Spicules are 145μm long and slender. Gubernaculum is with a strongly curved apophysis. Pre cloacal supplements consisting of raised pores. Tail 4.3 a.b.d long, anterior two thirds conical, remainder is cylindrical. Longer terminal setae are present.

Geographical distribution: British waters.

Remarks: The material is closely related to *Sphaerolaimus macrocirculus* Filipjev 1918 in the nature of the buccal cavity, size and disposition of the amphids, in the nature of the oesophagus and in the structure of the spicular apparatus. The relatively larger amphid and spicular apparatus is the key identifying features of this species from rest of the species in this genus. Except the comparatively smaller body size, all other body proportions are in well agreement with original descriptions. Therefore they are referred as *Sphaerolaimus macrocirculus* Filipjev 1918.

72. *Sphaerolaimus penicillus var. pugetensis* Wieser 1959 (Plate12. Fig. 72a & 72b).

Body length is 1.010mm (Female: a=25.2; b=4.8; c=10.1). Head diameter is 26μm. Lip region conical, labial papillae not seen. Cephalic setae are 8μm long. Sub cephalic setae in eight groups of 4 setae, the longest setae measuring 37μm. In front of the amphids, there are 2 characteristic setae present. Amphids are 11μm long. Buccal cavity is spacious, wall consisting of thick cuticular columns. Vestibulum 8μm long with a sculptured portion of 17μm. Posterior end is 13μm deep. Excretory pore is positioned 185μm behind anterior end. Tail long and setose, posterior seventh cylindrical.

Geographical distribution: Bainbridge Island, Vashon Island; Brazil and Puget Sound.

Remarks: The cited material is closely related to *Sphaerolaimus penicillus var. pugetensis* Wieser 1959 in the nature of the cephalic setae, amphids, buccal cavity and position of excretory pore. The body size is varied by relatively smaller size specimens in present collection. Despite these differences, the present specimens are closely allied to the type species in many respects and hence they are referred as *Sphaerolaimus penicillus var. pugetensis* Wieser 1959.

Family: Xyalidae Chitwood 1951.

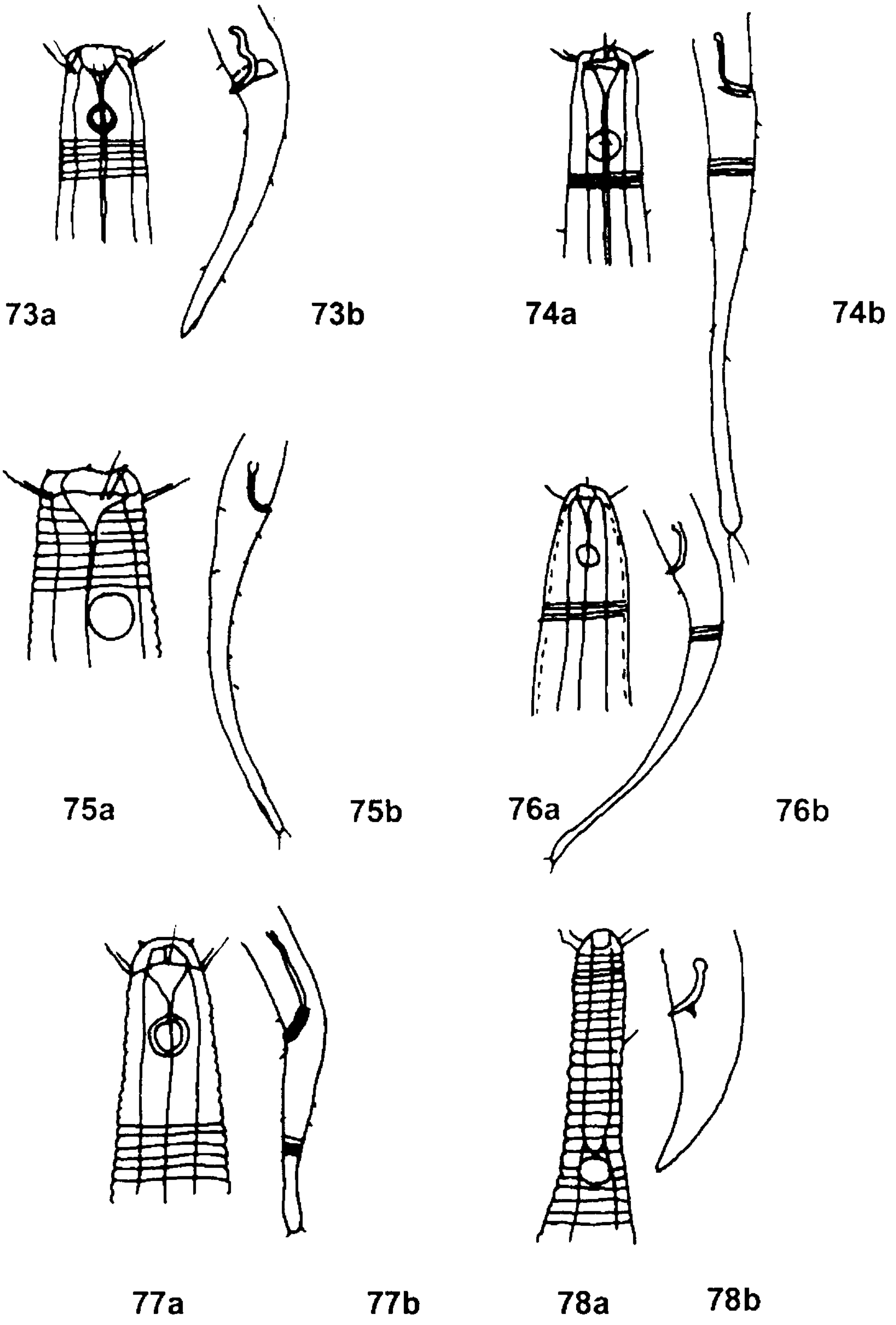
Xyalids typically have the following characters: transversely striated cuticle; ten cephalic setae in a single circle, six always equal to or longer than the other four, often with an additional cephalic setae; anterior ovary or testis to the left of the intestine, posterior testis to the right; buccal cavity, usually without teeth.

Genus: Theristus Bastian 1865

Syn: *Daptonema* Cobb 1920a

Syn: *Penzancia* De Man 1889a

Plate 13



73a&b. Theristus acer (Male head and tail)
74a&b. Theristus alternus (Male head and tail)
75a&b. Theristus fistulatus (Male head and tail)
76a&b. Theristus exutus (Male head and tail)
77a&b. Paramonohystera buetschlii (Male head and tail)
78a&b. Rhynchonema cinctum (Male head and tail)

Syn: *Spirotheristus* Timm 1961a

In addition to the family characters *Theristus* has the following characters. 10-14 cephalic setae in six groups; unarmed simply conical buccal cavity; conical tail without terminal setae; somatic setae not much longer than 1.c.d.; spicules short, less than 2 a.b.d.

73.***Theristus acer*** Bastian 1865 (Plate 13. Fig. 73a & 73b).

Body length is 2.1mm (Male: a=42.2; b=13.1;c=17.5). Head diameter is 20µm, cephalic setae 10µm long. Diameter at the end of oesophagus is 42µm. Weak cuticular annulations and scattered cervical and somatic setae are present. Amphids 60µm long placed about 17µm from the anterior end. Spicula are 21µm long, gubernaculum plate shaped and 19µm long. Tail is conical and setose.

Geographical distribution: North Atlantic, Barents Sea, Mediterranean and Puget Sound.

Remarks: The above-mentioned material is closely related to *Theristus acer* Bastian 1865 in the nature of the cephalic features, amphid size, spicular apparatus and tail. Most of the body dimensions are also similar to that of original descriptions. Account of this similarity they are treated as *Theristus acer* Bastian 1865.

74. ***Theristus alternus*** (***Cylindrotheristus***) Wieser 1956 (Plate 13. Fig. 74a & 74b).

Body length is 1.68mm (Male: a=56; b=10.2; c=11.8). Head diameter is 15µm. Labial setae are short, cephalic setae are sub equal, 14µm long. Cervical setae are 7 µm long and arranged in 4 sub median rows. Amphids are 8.8µm and placed 2 head diameters distance from anterior end. Buccal cavity is conical unarmored. Buccal ring is distinct. Spicula are 21µm long, with a rectangular bent. Gubernaculum is shoe–shaped, without apophysis. Tail is about 8 a.b.d. long with posterior half cylindrical; terminal setae 18µm long.

Geographical distribution: Chile (Littoral sand).

Remarks: The material is closely related to *Theristus alternus* Wieser 1954 in the nature of the cephalic setae, size and disposition of the amphids, in the nature of the oesophagus and in the structure of the spicular apparatus. Thus details of amphid and cephalic setae are used to differentiate the present species from other related forms. Hence they are considered as *Theristus alternus* Wieser 1954.

75. *Theristus fistulatus* *(Cylindrotheristus)* Wieser & Hopper 1967(Plate 13. Fig. 75a & 75b).

Body length is 0.937mm (Male: a=29.28; b=6.0; c=6.5). Oesophagus is 153µm in length. Head diameter is 14µm. Lips are round, bears short setose papilla. Cephalic setae are 10, 12+11µm long. Scattered cervical and somatic setae present in the body. Amphids are 5.3µm, placed 18µm behind anterior end. Spicula are 24µm long, cephalate proximally, outwardly curved in its distal sixth.

Gubernaculum sleeve- like,, without apophysis. Distally with curved tubular piece. Tail is long 21µm a.b.d.

Geographical distribution: Biscayne Bay and North America.

Remarks: The present material is closely related to *Theristus fistulatus* Wieser and Hopper 1967 in the nature of cephalic features, amphids, spicula and tail. Tubular element present in the distal portion of the gubernaculums are also identifying feature for this species. Relying on to the morphological details of the current specimens they are placed as *Theristus fistulatus* Wieser and Hopper 1967.

76. ***Theristus exutus*** (*Pseudotheristus*) Wieser 1954 (Plate 13. Fig. 76a & 76b).

Body length is 1.426mm (Male: a=44.5; b=9.7; c=3.4). Head diameter is 16µm. Labial setae are very short, cephalic setae 15 + 12µm long. No cervical setae or somatic setae. Amphids are 11µm long and about 50% of c.b.d., placed 29µm behind anterior end. Buccal cavity is conical and unarmored, buccal ring distinct. Cuticular annulations are very coarse. Spicules are 22µm long. Tail is about 10 a.b.d long; terminal setae 17µm long.

Geographical distribution: Chile (sub littoral coarse and soft bottom).

Remarks: The present specimens are closely related to *Theristus exutus* Wieser 1954 in the nature of cephalic and labial setae, amphids, cuticular annulations, and spicula. The body length is slightly higher than that of Wieser's

Chilean species. Despite the above cited difference the present specimens are allied to *T. exutus,* therefore considering them as *Theristus exutus* Wieser 1954.

Genus: Paramonohystera Steiner 1916a

=*Leptogastrella* Cobb 1920a

In addition to the family characters *Paramono*hystera has similarities to *Daptonema* in the following characters. 10- 14 cephalic setae in six groups; unarmed simply conical buccal cavity; conical tail without terminal setae; somatic setae not much longer than 1.c.d.; spicules short, less than 2 a.b.d. Exceptions are in the structure of spicules which are elongate, slender; body setae may be longer than 1 c.d.

77. *Paramonohystera buetschlii* Bresslau and Stekhoven in Stekhoven 1935 (Plate 13. Fig. 77a & 77b).

Body length is 1.195mm (Male: a=24.2; b=6.4; c=8.2). Cephalic setae are in 6+4 pattern, 0.6 and 0.45 h.d long. Somatic setae are short and scattered. Amphids are placed 0.7h.d. from the anterior end. Tail is 4.2 a.b.d long, distal third cylindrical, terminal setae short. Spicules are very slender (160µm long), bifurcated at distal end; distinctly rounded and offset proximal cephalisation. Gubernaculum is tubular, slight dorsal swelling but no distinct apophysis, each half with a distal pair of forwardly directed hooks.

Geographical distribution: Isles of Scilly. (Fine sand among Zostera roots, Intertidal algae)

Remarks: The present specimens are closely similar to *Paramonohystera buetschlii* Bresslau and Stekhoven in Stekhoven 1935 in the nature of the cephalic setae, size and disposition of the amphids and in the structure of the spicular apparatus. The details of the spicules are considered to differentiate this species from other species of *Daptonema*. Most of the features are well agreement with the descriptions of authors; therefore it was placed as *Paramonohystera buetschlii* Bresslau and Stekhoven in Stekhoven, 1935.

Genus: Rhynchonema Cobb 1920; Murphy 1964a.

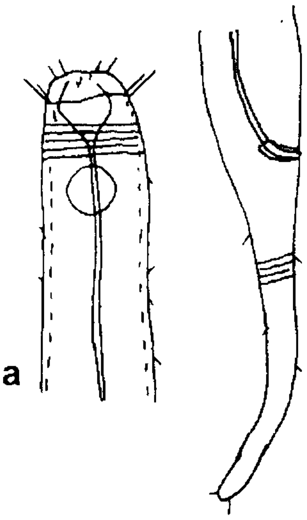
78. *Rhynchonema cinctum* Cobb 1920 (Plate 13. Fig. 78a & 78b).

Body length is 0.610mm (Male: a=24.2; b=4.3; c=8.25). Head diameter is 4µm. Labial sense organs are not seen. Ten cephalic setae are 3.8µm long. Cervical setae present anterior to amphids are only two, posterior to amphids numerous, with long somatic setae in rows of 8. Amphids are 5µm long placed 40µm behind anterior end. Cuticle annulations are very coarse, each annule about 2µm broad, between anterior end and amphids there are 25 annules. Oesophagus with out a bulb, excretory pore placed 70µm from anterior. Spicules with caudally directed apophysis. Tail is long and conical.

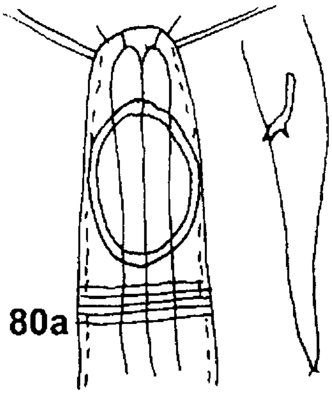
Geographical distribution: Peru and Salaverry, Chile. (Littoral, exposed algae)

Remarks: The material is closely related to *Rhynchonema cinctum* Cobb 1920 in the nature of the cephalic features, size and disposition of the amphids and cuticular annulations. The body length is also similar and therefore referring present specimens as *Rhynchonema cinctum* Cobb 1920.

Plate 14

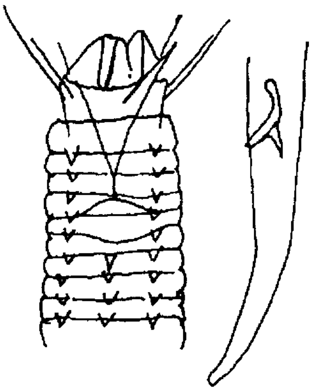


79a 79b

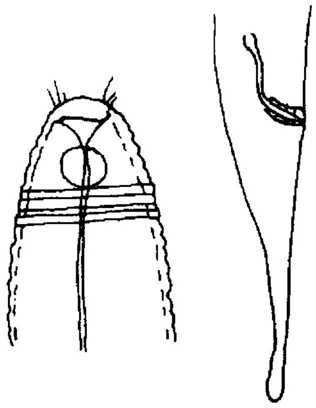


80a 80b

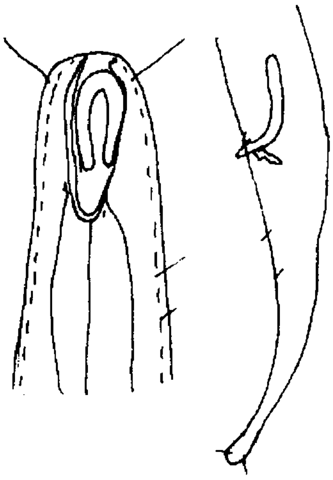
81a 81b



82a 82b



83a 83b



84a 84b

79a&b. Promonhystera faber (Male head and tail)
80a&b. Amphimonhystera anechma (Male head and tail)
81a&b. Metadesmolaimus aduncus (Male head and tail)
82a&b. Xenolaimus striatus (Male head and tail)
83a&b. Daptonema oxycerca (Male head and tail)
84a&b. Axonolaimus spinosus (Male head and tail)

Genus: **Promonhystera** Wieser 1956a

Labial papillae are setose, very long. 10 cephalic setae; cervical and somatic setae present. Amphids are of paramonhystera-type. Cuticle is striated. Spicula are elongated. Gubernaculum is a small plate at the distal end of the spicula. Tail is conical or cylindro-conical. Ovary is asymmetrical.

79.***Promonhystera faber*** Wieser 1954 (Plate 14. Fig. 79a & 79b).

Body length is 0.950mm (Male: a=19; b=3.8; c=7.9). Head diameter is 20µm. Labial setae are 8µm long. Ten cephalic setae are present, 20µm and 15µm long. No sub cephalic setae in male. Cervical and somatic setae present are up to 12µm long and scattered. Amphids are 11µm and occupy 52% of c.b.d. placed 21µm from anterior end. Buccal cavity is large, cheilorhabdions are well developed, buccal ring is feeble. Cuticle is coarsely annulated. Spicula are 60µm long, not cephalate proximally. Gubernaculum are small strongly cuticularised plate, with a distal hole. Tail is long, with terminal setae.

Geographical distribution: Chile (Littoral sheltered sand)

Remarks: The present specimens are closely related to *Promonhystera faber* Wieser 1954 in the nature of cephalic features like labial and cephalic setae, the buccal cavity, size and disposition of the amphids, in the nature of the oesophagus and in the structure of the spicular apparatus. The tail with a terminal setae and cuticular annulations are also demarcating features. Therefore referring present materials as *Promonhystera faber* Wieser 1954.

Genus: ***Amphimonhystera*** Allgen 1929c

In addition to the family characters *Amphimonhystera* has a large thick walled amphid with an internal cuticularised opening; buccal cavity with a posterior chamber and swollen anterior part of oesophagus containing pharyngeal tubes; tail without true terminal setae.

80. *Amphimonhystera anechma* Southern 1914 (Plate 14. Fig. 80a & 80b).

Body length is 1.8mm (Male: a=33.9; b=? c=24.3) Maximum diameter 53µm. Distinct hyaline lips with six thin labial setae are present. Cephalic setae are 26µm long. Scattered somatic setae are very thin up to 18µm. Amphids 40µm long, almost 1 c.d. wide with a central tooth like cuticularisation. Buccal cavity is small. Tail is conico-cylindrical. Spicules are 47µm long. Gubernaculum is a complex structure surrounding the distal end of the spicule and consisting of several elements.

Geographical distribution: Clew Bay and West Ireland. (Sub littoral sand).

Remarks: The present specimens are related to *Amphimonhystera anechma* Southern 1914 in having long cephalic setae, size and disposition of the amphids and in the structure of the spicular apparatus. The specimens are closely similar to the details given by Riemann, 1967 and Lorenzen 1977. Hence they are treated as *Amphimonhystera anechma* Southern 1914.

Genus: Metadesmolaimus Stekhoven 1935; Adam and De Coninck 1935a

Metadesmolaimus is similar to *Daptonema* except; the buccal cavity is not simply conical, but has an extended cylindrical anterior section; between the labial and cephalic setae is a ventro-lateral soft setiform structure; cuticle a brownish colour.

81. ***Metadesmolaimus aduncus*** Lorenzen 1972 (Plate 14. Fig. 81a & 81b).

Body length is 0.81mm (Male: a=25.3; b=3.8; c=5.7). Cephalic setae are in 6+4 pattern, six longer 13µm and four shorter 11µm. Amphids 8µm in diameter. Tail is 4 a.b.d long, distal three-fifths cylindrical, terminal setae long in male and short in female. Spicules are 25µm; curved, with a distal hook. Gubernaculum is small unpaired, between distal ends of spicules, no apophysis.

Geographical distribution: British waters and W. Scotland (Intertidal sand)

Remarks: The present specimens are related to *Metadesmolaimus aduncus* Lorenzen 1972 and were earlier described by Gerlach 1956 as *Theristus hamatus*. However the specimens are having all the features of the original description by Lorenzen 1972. The body dimensions showed close similarity; owing to the similarity they are placed as *Metadesmolaimus aduncus* Lorenzen 1972.

Genus: Xenolaimus Cobb 1920a

In addition to the family characters Xenolaimus has: cuticle with fish-bone longitudinal markings.

82. ***Xenolaimus striatus*** Cobb 1920 (Plate 14. Fig. 82a & 82b).

Body length is 2.02mm (Male: a=67.3; b=12.6; c=139.1). Head diameter is 26µm. Lips 7µm high flap like. Labial setae are 6µm long. Ten cephalic setae, the longer ones measuring more than 17µm. Buccal cavity is wide and deep with two weakly cuticularised teeth. Amphids placed in enlarged portion of the fifth cuticular annule. First cuticular annule is wider than the following ones.

Cuticular annulations are coarse, with in an unspecified number of longitudinal rows of v-shaped structures. Spicula are asymmetrical, 29µm long. Apophyses of gubernaculums are also asymmetrical, 19µm long. Tail is conical and long.

Geographical distribution: Biscayne Bay, Florida.

Remarks: The specimens are closely allied to *Xenolaimus striatus* Cobb 1920 in the nature of the head, buccal cavity, size and disposition of the amphids and in the nature of the first cuticular annule. All the body dimensions are also similar to the descriptions by Wieser and Hopper, 1967. Therefore they are considered as to be *Xenolaimus striatus* Cobb 1920.

Genus: Daptonema Cobb 1920

Syn: *Theristus* Bastian 1865.

Syn: *Penzancia* De Man 1889a

Syn: *Spirotheristus* Timm 1961a

In addition to the family characters *Daptonema* has the following characters. 10-14 cephalic setae in six groups; unarmed simply conical buccal cavity; conico-cylidrical tail with terminal setae; somatic setae not much longer than 1 c.d.; spicules short, less than 2 a.b.d.

83. ***Daptonema oxycerca*_** DeMan 1888 (Plate 14. Fig. 83a & 83b).

Body length is 1.07mm (Male: a=18.5; b=5.8; c=28.8). Cephalic setae are in 6+6 pattern, six, 10µm long and six 7.2 µm long. Somatic setae are scarce and short. Amphids are 8.9µm in diameter. Tail is 3.7 a.b.d long; posterior third is cylindrical with terminal setae short. Spicules are 60µm long, proximally cephalate, distally with fine small teeth. Gubernaculum surrounds distal ends of spicules, apophyses absent. Vulva placed at 76% of body.

Geographical distribution: British waters and Bay of Bengal.

Remarks: The present specimens are closely related to *Daptonema oxycerca* De Man 1888 in the nature of the cephalic setae, size and nature of the amphids and in the structure of the spicular apparatus. Present specimens are relatively smaller than that of the original specimens. Despite the above cited variation it is with certainty that present species are considered to be *Daptonema oxycerca* De Man 1888.

Family Axonolaimidae Filipjev 1918

Buccal cavity has a double conical shape, often with six tooth-like structures in the anterior part; cuticle faintly striated; 6+4 cephalic setae in separate circles, but the anterior six normally reduced to papillae; amphids loop or crook-shaped, often longitudinally elongated; usually two testes and two ovaries.

Genus: Axonolaimus DeMan 1889a

With reference to the family characters *Axonolaimus* species have elongated amphids and lack odontia in the buccal cavity.

84. ***Axonolaimus spinosus*** Butschli 1874 (Plate 14. Fig. 84a & 84b).

Body length is 1.010mm (Male: a=30.4; b=5.5; c=9.75). Cuticle finely striated, beginning just posterior to the cephalic setae. Six conical cephalic papillae are present. Four cephalic setae are 8µm in male and 6µm in female. A few relatively long cervical setae are present. Somatic setae are otherwise scarce and short except for the ventral region of the male tail. Amphids are 4.2 µm wide, 13µm long, with two arms lying parallel and contiguous. Buccal cavity is 16µm long. Oesophagus broadens towards the base, but without a bulb. Tail, three quarters conical with the remainder more or less cylindrical. Spicules 35µm long bent almost at right angles in the middle. Gubernaculum is with 11µm apophyses. Precloacal papillae in males are 14µm. Vulva positioned at 52% of body length.

Geographical distribution: British waters and Isles of Scilly.

Remarks: The present specimens are closely related to *Axonolaimus spinosus* Butschli 1874 in details of the cephalic setae, buccal cavity, amphids, and nature of the oesophagus and in the structure of the spicular apparatus. Relying on to the morphological features they are located as *Axonolaimus spinosus* Butschli 1874.

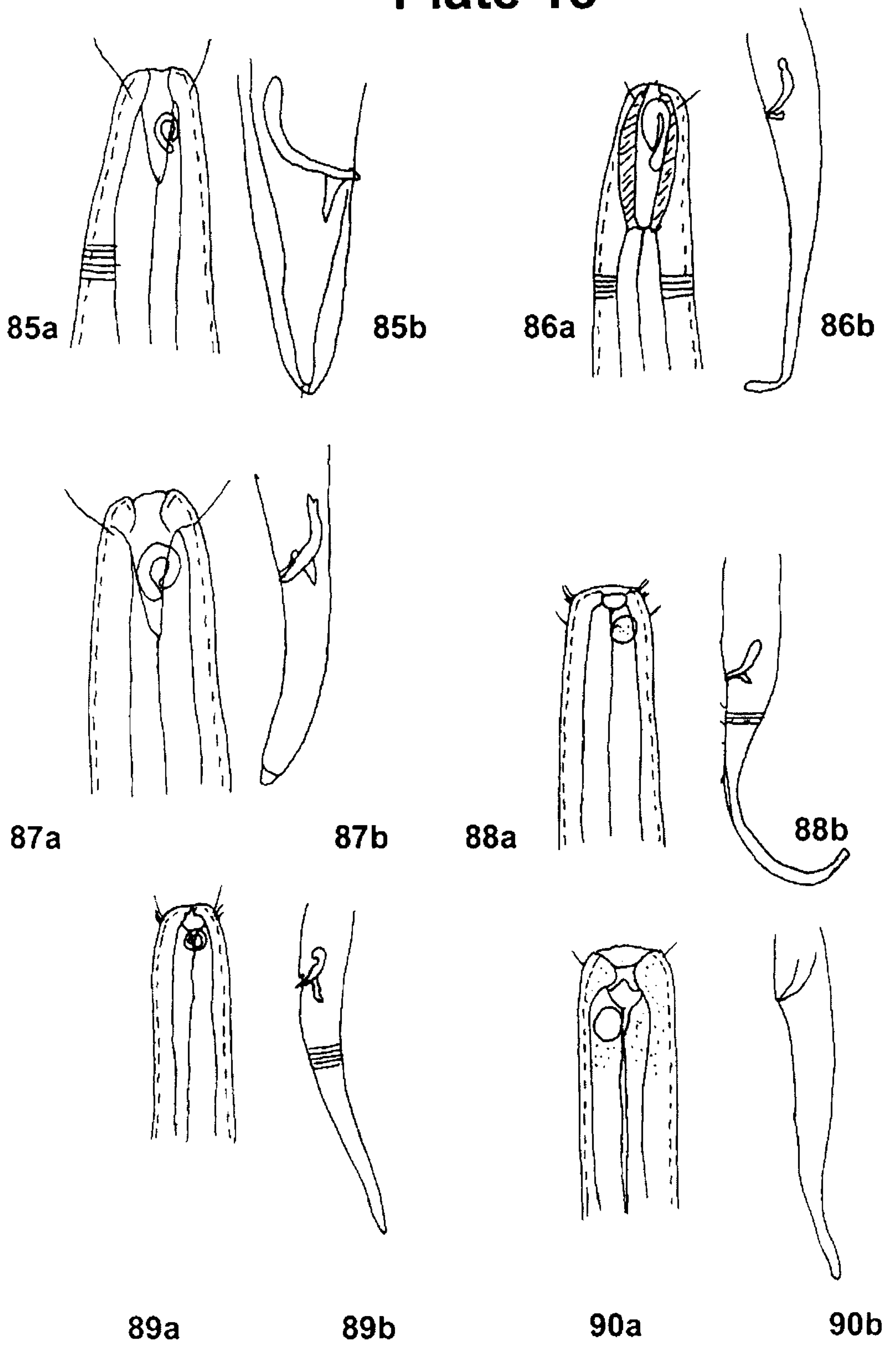
Genus: Ascolaimus Ditlevsen, 1919.

This genus supposedly differs from Axonolaimus in having rounded rather than elongate amphids, and a swollen posterior section of the tail.

85. ***Ascolaimus elongatus*** Butschli 1874 (Plate 15. Fig. 85a & 85b).

Body length is 2.25mm (Male: a=38.7; b=5; c=28.8). Cuticle is finely striated; six small cephalic papillae are present. Four 20µm cephalic setae are present. Four files of 6µm cervical setae extend as far as the base of the oesophagus;

Plate 15



85a&b. Ascolaimus elongatus (Male head and tail)
86a&b. Parodontophora brevamphida (Male head and tail)
87a&b. Parodontophora breviseta (Male head and tail)
88a&b. Paralinhomoeus pachyamphis (Male head and tail)
89a&b. Paralinhomoeus tenuicaudatus (Male head and tail)
90a&b. Paralinhomoeus lepturus (Female head and tail)

somatic setae otherwise scarce apart from the ventral region of the male tail. Amphids 7.2µm wide, forming a rounded loop. Buccal cavity is 18µm long. Oesophagus broadens towards the base, but with no bulb. Tail is more or less cylindrical at the anterior half, with the ducts of the caudal glands typically swollen towards the tip. Spicules are 47µm long with a curved tooth projecting anteriorly from the distal tips. Gubernaculums are with 16µm apophyses.

Geographical distribution: British waters, W. Scotland and E. Scotland (Intertidal sand).

Remarks: The present material before me is closely related to *Ascolaimus elongatus* Butschli 1874 in the structural and morphological details of the buccal cavity, amphids, oesophagus, spicula. The swollen tail also is typical in differentiating the species. Hence they are positioned as *Ascolaimus elongatus* Butschli 1874.

Genus: Parodontophora Timm 1963a

Syn: ***Pseudolella pacifica***

Species with an odontia present in the anterior part of the buccal cavity. Oesophagus without a true bulb. Tail is conical; amphids crook-shaped.

86. ***Parodontophora brevamphida*** Timm 1952 (Plate 15. Fig. 86a & 86b).

Syn: *Pseudolella pacifica* sensu Timm 1961

=*Odontophora pacifica* sensu Gerlach 1962

=*Parodontophora pacifica* Wieser and Hopper 1967

Body length is 1.2mm (Male: a=28.4.1; b=7.38; c=7.2). Four rows of somatic setae are present, two on either side of each lateral chord. Anteriorly the somatic setae are 3.7µm long in the region of the nerve ring. Cuticle is striated except in the anterior most part. Amphid is short and shepherd's crook like, with the ventral arm longer than the dorsal. Dorsal arm is 9.6µm long and ventral arm 14µm long. Amphid is located on a level with and distinctly shorter than the 17µm long posterior cylindrical portion of the stoma. Head rounded with six lips, six labial papillae, and four 7µm long, cephalic setae. Oesophagus diameter is increasing posteriorly, without a buccal bulb. Spicules are arcuate, 52µm long. Gubernaculum 18.9µm long, arcuate. Tail is elongate-conoid. Male is with a short preanal seta and two subventral rows of 7 setae. Spinneret is present. Vulva positioned at 48% of body length.

Geographical distribution: Florida, Chesapeake Bay, Maryland, Bay of Bengal, Arabian Sea and Maldives.

Remarks: The material is closely allied to *Parodontophora brevamphida* Timm 1952 in the nature of the buccal cavity, size and disposition of the amphids, and most of the cephalic features. Therefore it was referred as *Parodontophora brevamphida* Timm *1952.*

87.***Parodontophora breviseta*** Stekhoven 1950; Timm 1963 (Plate 15. Fig. 87a & 87b).

Syn: *Odontophora breviseta* Stekhoven 1950

Body length is 0.690mm .(Male: a=24.6; b=5.9; c=13.6). Cuticle is with fine striations; head constricted distinctly. Head is bears small labial papillae and four cephalic setae, no sub cephalic seta. Somatic setae are scattered. Stoma is cylindrical, parallelly arranged walls, anteriorly possessing six strong odontia. Amphids thick walled, shepherd's crook-like in structure. Arms are more or less equal. Oesophagus is cylindrical, distal and slightly enlarged. Tail is conico cylindrical. Spinneret is with bands, proximally cephalate. Gubernaculums are with dorsally directed apophyses, 7.1µm in length. Nine preanal supplements are present.

Geographical distribution: Mediterranean Sea and Bay of Bengal.

Remarks: The material is closely related to *Paralinhomoeus breviseta* Stekhoven 1950 in the nature of the buccal cavity, size and disposition of the amphids, in the nature of the oesophagus and in the structure of the spicular apparatus. Despite these similarities, the present specimens are varying in the body size with that of the original material. However, relying on to the morphological similarity they are referred to as *Paralinhomoeus breviseta* Stekhoven 1950.

Family: Linhomoeidae Filipjev 1922

Linhomoeids have the following typical characters: cuticle striated; labial sensilla minute, often not detectable; cephalic setae usually arranged in two separate circles although these may be close together; amphids round, but oval or loop-shaped in some cases; buccal cavity with markedly narrow entrance, and may have one dorsal and two subventral tooth-like arches at its base;

cardia long, set off from the intestine; usually two outstretched ovaries and two testes.

Genus: *Paralinhomoeus* De Man 1907b

Syn: ***Paradesmolaimus*** Schulz 1932a

Syn: ***Crystallonema*** Cobb 1920a

In addition to the family characters this genera have 6+4 cephalic setae close together with the anterior six usually longer than the posterior four. *Paralinhomoeus* has a thin walled unarmed buccal cavity.

88.***Paralinhomoeus pachyamphis*** Wieser 1954 (Plate 15. Fig. 88a & 88b).

Body length is 2.61mm and 3.1mm in female (Male: a=87; b=14.1; c=10.0). Labial papillae are indistinct. Cephalic setae are 5.6µm long and sub equal. Sub cephalic setae are 6; cervical setae are 4 on level with amphids. Amphids 13.2µm long, thick walled with central spots. Buccal cavity is thin walled, 12.8µm large and 9µm deep, unarmored. Oesophagus dilated posteriorly; excretory pore 101µm behind anterior end. Spicules are 43µm long. Gubernaculums are plump. Tail 7 a.b.d long, flagellum is occupying about four fifths of total length.

Geographical distribution: Chile (Sublittoral soft bottom)

Remarks: Since the aforesaid specimens showed strong resemblance to *Paralinhomoeus pachyamphis* Wieser 1954 in the nature of the buccal cavity, size and disposition of amphids, nature of the oesophagus and also in the structure of the spicular apparatus they are placed under this species.

89.***Paralinhomoeus tenuicaudatus*** Butschli 1874 (Plate 15. Fig. 89a & 89b).

Body length is 2.89mm (Male: a=55; b=14.6; c-12.1). Cuticle is faintly striated. Six small labial papillae are present. Cephalic setae in 6+4 pattern, six 4.1µm and four 11.2µm long. In male a circle of six short additional cephalic setae are present at the same level as the other ten. Four sub cephalic setae are present between cephalic setae and amphids. Several cervical setae are present posterior to amphids. Other somatic setae are scarce except for a few short caudal setae. Amphids are 8.3µm in diameter, with a central fleck. Buccal cavity is cup shaped; cuticularised posteriorly but with no tooth–like structures. Oesophagus increases in width posteriorly. Tail is 5a.b.d long, anterior two third conical and then filiform. Spicules are 58µm. Gubernaculum with two 31µm apophyses. Vulva positioned at 50% of body length.

Geographical distribution: Sweden, France, British waters and NE Ireland

Remarks: The specimens are closely related to *Paralinhomoeus tenuicaudatus* Butschli 1874 in the nature of cup shaped buccal cavity, size and disposition of the amphids, elongated oesophagus and the structure of the spicular apparatus. The relative body size is having small variation. Despite this difference, the present specimens are closely allied to *Paralinhomoeus* *tenuicaudatus* Butschli 1874 in many respects and hence they are referred as *Paralinhomoeus tenuicaudatus* Butschli 1874.

90. ***Paralinhomoeus lepturus*** DeMan 1907 (Plate 15. Fig. 90a & 90b).

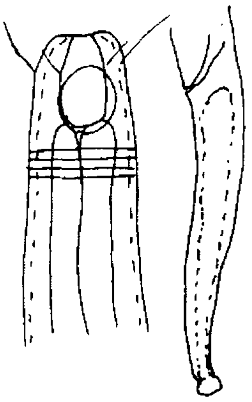
Body length is 3.96mm (Female: a=71; b=24.7; c=46.5) Cuticle is faintly striated. Labial papillae are not clear. 10 Cephalic setae are arranged in six groups; four longer sub median 14µm; lateral setae slightly shorter than the shorter sub median ones. Amphids are 9µm, in width, with central dots. Buccal cavity is cup shaped; with dorsal tooth –like structure through which the dorsal oesophageal gland empties. Oesophagus widens in the posterior third. Tail is conico-cylindrical.

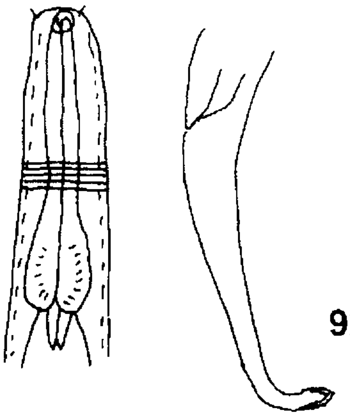
Geographical distribution: Kiel Bay, Sweden, Mediterranean and British waters.

Remarks: The aforesaid material is closely related to *Paralinhomoeus lepturus* DeMan 1907 in the nature of the cephalic capsule, size and disposition of the amphids and nature of the oesophagus. However the dorsal tooth like structure described in original material is not clear in present specimens. Despite this difference, the present specimens are closely allied to the original species in many respects and hence they are referred as *Paralinhomoeus lepturus* DeMan 1907.

Genus*:* ***Eumorpholaimus*** Schulz 1932a

Plate 16


91a 91b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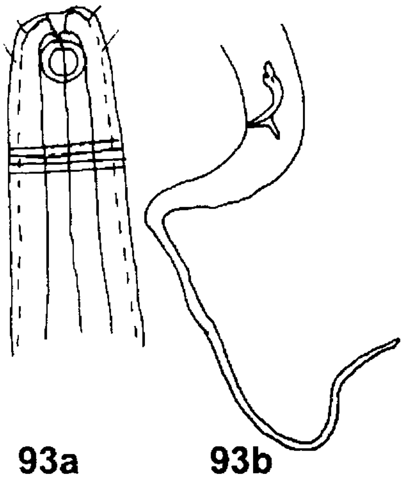
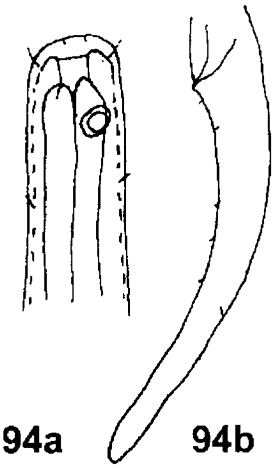

93a 93b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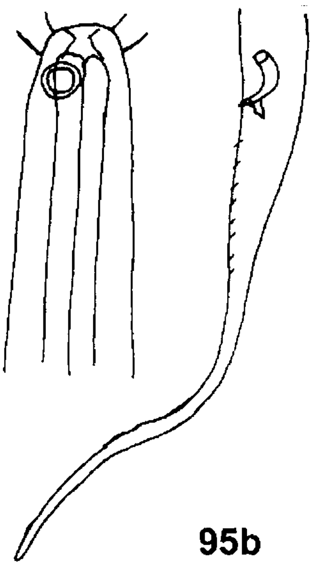
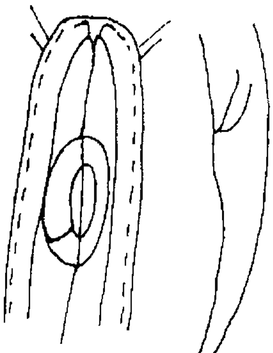

95a 95b


96a 96b

91a&b. Eumorpholaimus subulicolus (Female head and tail)
92a&b. Terschellingia communis (Female head and tail)
93a&b. Terschellingia longicaudatus (Male head and tail)
94a&b. Eleutherolaimus stenosoma (Female head and tail)
95a&b. Metalinhomoeus longiseta (Male head and tail)
96a&b. Disconema alaima (Female head and tail)

In addition to the family characters *Eumorpholaimus* have: buccal cavity cylindrical and relatively deep; a circle of four anterior and six posterior cephalic setae, the latter situated medially and sub laterally.

91. ***Eumorpholaimus subulicolus*** Schulz 1932 (Plate 16. Fig. 91a & 91b).

Body length is 1.150mm (Female: a=46; b=11.2; c= 4.8). Six small conical labial papillae are present. Cephalic setae are in 4+6 pattern; four 4µm and six 12µm long. Cervical setae are up to 12µm long. Mid body region is devoid of setae. Amphids are 8.7µm in male; located level with the anterior part of the buccal cavity. Buccal cavity is deep and cylindrical with heavily cuticularised walls. Oesophagus is without posterior bulb. Tail is short, 5.2 a.b.d. Tail is tapering throughout its length with a truncated tip.

Geographical distribution: France and British waters.

Remarks: The material is closely related to *Eumorpholaimus sabulicolus* Schulz 1932 in the nature of cephalic setae, buccal cavity and size and disposition of the amphids. The tail tip is also showed similarity. Despite these similarities the relative body size is less in present specimens. The cited resemblances of morphology in the present specimens are considered for placing them as *Eumorpholaimus sabulicolus* Schulz 1932.

Genus: Terschellingia De Man 1888a

In addition to the family characters *Terschellingia* species typically have: buccal cavity minute or absent; only four setose cephalic sensilla; four sub cephalic setae; amphid usually positioned relatively far forward on the head; tail conico-cylindrical.

92. *Terschellingia communis* De Man 1888 (Plate 16. Fig. 92a & 92b).

Body length is 1.37mm (Female: a=26.8; b=8.7; c=4.2). Cuticle is transversely striated, six conical cephalic papillae. Four 3µm cephalic setae are placed level with the amphids. Four 2.5µm are sub cephalic setae are present posterior to the amphids. Somatic setae are absent apart from the tail. Amphids are 6.7µm in diameter. Buccal cavity is absent. Oesophagus is with a prominent rounded posterior bulb and long cardia projecting in to the lumen of the oesophagus. Anterior half of tail is conical and posterior half filiform. Vulva positioned at 96% of body length.

Geographical distribution: North Sea and British waters.

Remarks: The present specimens are closely related to *Terschellingia communis* De Man 1888 in the size and disposition of the amphids and in the nature of the oesophagus. Since almost all features of the type species is in close agreement with the present specimens they are referred as to *Terschellingia communis* De Man 1888.

93. ***Terschellingia longicaudata*** DeMan 1907 (Plate 16. Fig. 93a & 93b).

=*T. baltica* Schulz

=*T. pontica* Filipjev 1918

Body length is 1.47mm (Male: a=21.9; b=9.4; c=5.6). Cuticle is striated. Four 3µm long cephalic setae are present, no other cephalic sensilla discernable. Four 4µm sub cephalic setae are situated either side of the amphid. A pair of cervical setae are placed behind each amphid; somatic setae otherwise absent, except in the tail. Amphids are 6.6µm diameter. Buccal cavity is absent. Oesophagus is with a prominent round posterior bulb. Long cardia is projecting in to the intestine. Tail is 12 a.b.d. with a long filiform tip consisting 75% of total tail length. Spicules are 36µm with a short central lamella in the broad proximal portion. Gubernaculum is with a pair of 21µm, dorsal apophyses. Vulva positioned at 40% of body length.

Geographical distribution: France, Sebastopol, Kiel bay, British waters and Bay of Bengal.

Remarks: The present material is closely related to *Terschellingia longicaudata* De Man 1907 in the nature of labial papillae, amphids, cardia and spicular apparatus. Most of the details are in well agreement with that of descriptions of Wieser and that of the British specimens described by Platt and Warwick. Thus they are referred to as *Terschellingia longicaudata De Man 1907.*

Genus:***Eleutherolaimus*** Filipjev 1922a

In addition to the family characters, *Eleutherolaimus* species have: buccal cavity with cylindrical walls; 4+4 cephalic setae.

94. Eleutherolaimus stenosoma De Man 1907 (Plate 16. Fig. 94a & 94b).

Body length is 1.25mm (Female:a=65; b=13.1 c=17.3) Cuticle is faintly striated. Six small labial papillae are present. Two circles of four fine cephalic setae, anterior 2 µm, and posterior 4µm. A lateral seta is placed a short distance behind each amphid. Somatic setae are up to 4.5µm and scattered. Amphids are 4.6µm in diameter. Buccal cavity is a short cylinder. Oesophagus is with a posterior bulb. Cardia is present. Tail gradually tapering.

Geographical distribution: Skippers Island, British waters, Isles of Scilly, Strangford Lough, N.E.Ireland, San Diego Bay, Coasts of Holland, Norway, Sweden and Belgium.

Remarks: The present material is closely related to *Eleutherolaimus stenosoma* DeMan 1907 in the nature of the buccal cavity, size and disposition of the amphids and nature of the oesophagus. Hence they are refferd to as *Eleutherolaimus stenosoma* DeMan1907.

Genus: Metalinhomoeus DeMan 1907

In addition to the family characters *Metalinhomoeus* species typically have: only four setose cephalic sensilla; four sub cephalic setae; relatively small buccal cavity; posterior oesophageal bulb.

95.*Metalinhomoeus longiseta* Kreis 1929 (Plate 16. Fig. 95a & 95b).

Body length is 1.4mm (Male: a=63.6; b=12.5; c=2.7). Cuticle is faintly striated. Four 15.5µm long cephalic setae are present. Sub cephalic setae 11µm; two situated medially between cephalic setae and amphids. Amphids are 12.6µm in diameter, situated 0.5h.d from anterior. Buccal cavity is with a cuticularised base. Oesophagus with a prominent posterior bulb is present. Tail is filiform. Spicules are 37µm long, curved and cephalate proximally, with ventral alae. Gubernaculum is 17µm, with paired dorsal apophyses. Pre- cloacal papillae are present.

Geographical distribution: British waters and Bay of Bengal.

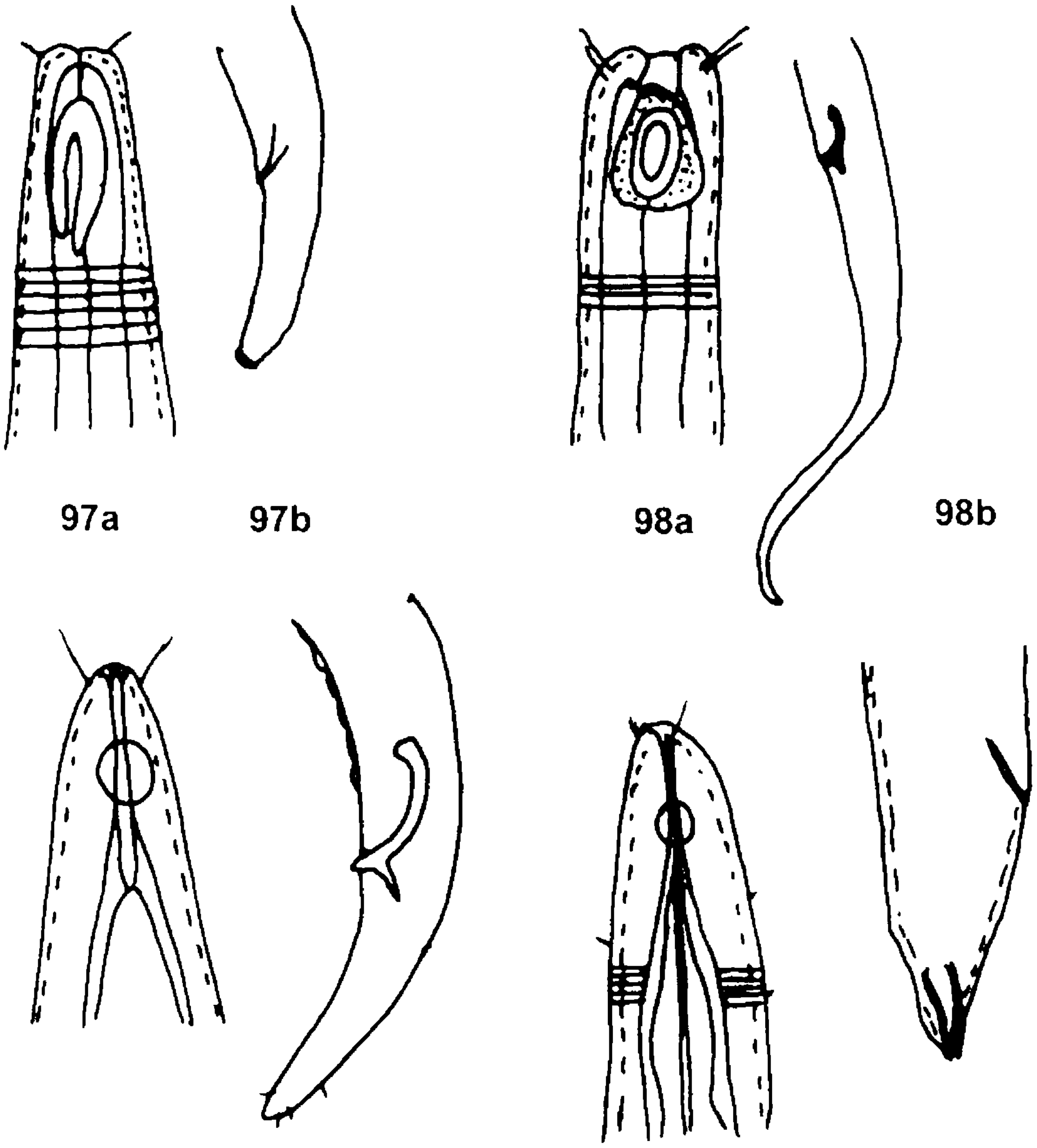
Remarks: The present material is closely resembled to *Metalinhomoeus longiseta* Kreis, 1929 in the nature of the buccal cavity, size and disposition of the amphids, nature of the oesophagus and in the structure of the spicular apparatus. Presence of pre-cloacal papillae is also aids in fixing this species. Therefore they are referred to as *Metalinhomoeus longiseta* Kreis 1929.

Genus: Disconema

96. *Disconema alaima*_Filipjev 1927 (Plate 16. Fig. 96a & 96b).

Body length is 2.1mm (Female: a=38.18; b=13.1; c=7.2). Head diameter is 50µm. Maximum diameter 55µm. Cuticle is striated; labial sensilla minute, often not detectable; cephalic setae are arranged in two separate circles. The anterior one is longer than the posterior one. Buccal cavity is absent or reduced. Amphids longitudinally oval and donut-like, covering almost 50% of the c.b.d. Tail is conical.

Plate 17



97a&b. Didelta scutata (Female head and tail)
98a&b. Diplopeltula asetosa (Male head and tail)
99a&b. Siphonolaimus auratus (Male head and tail)
100a&b. Siphonolaimus pachyderma (Female head and tail)

Geographical distribution: Sebastopool

Remarks: The present material is closely related to *Disconema alaima* Filipjev 1927 in the nature of cephalic setae, size and disposition of the amphids and nature of the oesophagus. Therefore they are placed under the species *Disconema alaima* Filipjev 1927.

Family: Diplopeltidae Filipjev 1918.

Diplopeltids typically have the following characters: cuticle smooth or striated; four cephalic setae always prominent, with the six labial and sixc cephalic sensilla either very small or not visible; amphids consist of a spiral with one loop; buccal cavity narrow and tubular or very small, never with tooth-like structures; oesophagus without posterior bulb; two testes and ovaries; precloacal supplements absent.

Genus: Didelta Cobb, 1920.

Cephalic setae are one-third of head diameter long.

97.***Didelta scutata*** Wieser1954 (Plate 17. Fig. 97a & 97b).

Body length is 1.67mm (Female: a=32.5; b=7.5; c=4.8). Head diameter is 21µm. Labial papillae are indistinct. Ten cephalic setae are present. The longer setae 7.2µm long, the shorter ones 3.6µm long. Cervical setae 4, placed on level with anterior, 4 on level with posterior portion of amphids 4.6, 5.1µm long. Cuticle is striated. Amphids are oval, 24.9µm long and 15µm wide. Plaque is triangular.

Oesophagus dilated posteriorly without bulb. Tail is long and posterior three-fourths filiform.

Geographical distribution: Chile (Sublittoral soft bottom)

Remarks: The present specimens are differentiated from the species described Cobb, *Didelta maculata* by the difference in cephalic setae. Present material is having the cephalic setae lengthed one-third of the cephalic diameter and so it is referred to as *Didelta scutata*. The other details are in close similarity to the descriptions of Wieser. Therefore they are referred to as *Didelta scutata* Wieser 1954.

Genus:***Diplopeltula*** Gerlach1950a

In addition to the family characters *Diplopeltula* species have: amphids on a cuticular plaque; buccal cavity small or absent, mouth terminal or subterminal; ocellus absent.

98. *Diplopeltula asetosa* Juario 1974 (Plate 17. Fig. 98a & 98b).

Body length is 0.75mm (Male: a=41.6; b=18; c=14.4). Cuticle is coarsely annulated. Four 6µm cephalic setae are present. Somatic setae are absent except for a few on the male tail. Amphids are 7.3µm wide, 16.2µm long and loop shaped with non-contiguous limbs. Buccal cavity is absent. Oesophagus is with a slight posterior bulb. Tail is conical. Spicules are 16µm. Gubernaculum is with small dorsal apophyses. Vulva positioned at 49% of body length.

Geographical distribution: W. Ireland, British waters and E. Scotland.

Remarks: The present material is closely related to *Diplopeltula asetosa* Juario, 1974 in the nature of cephalic setae, size and disposition of the amphids, nature of the oesophagus and in the structure of the spicular apparatus. The aforesaid details are considered to place the present materials as *Diplopeltula asetosa* Juario, 1974.

Family: Siphonolaimidae Filipjev 1918

Siphonolaimids typically have the following characters: buccal cavity containing an axial cuticularised spear-like structure; cuticle striated; 6+4 cephalic setae situated more or less at the same level, the six always shorter than the four; amphids round; one anterior outstretched ovary; single anterior testis; gonad always lies left of the intestine.

Genus: Siphonolaimus De Man 1893

Only one genus is recorded in this family. Many species have a black appearance due to the opaque granules in the intestine and/or throughout the body.

99. *Siphonolaimus auratus* Wieser1954 (Plate 17. Fig. 99a & 99b).

Body length is 3.36mm (Male: a=54; b=17; c=6.9). Head diameter is 11.3µm. cephalic setae 10 arranged in two circles, 11.2 and 3µm long. Cervical setae are 6 placed in front of amphids, 8.9µm long. Amphids are placed 15.9µm from anterior end, 11µm long. Cuticle is striated, thin. Spear is 39µm long. Spicula are 60µm long, large with medial list. Apophyses of gubernaculum are 21µm long, more than 25 supplements. Tail is about 2.3 a.b.d long with terminal setae

Geographical distribution: Chile.

Remarks: The material is closely related to *Siphonolaimus auratus* Wieser, 1954 in the character of spear, size and nature of the amphids, nature of the oesophagus and in the structure of the spicular apparatus. Other details like tail and number of supplements are also key identifying features. Body dimensions are also matching with Wieser's descriptions. Hence they are referred to as *Siphonolaimus auratus* Wieser 1954.

100. *Siphonolaimus pachyderma*_Wieser 1954 (Plate 17. Fig. 100a & 100b).

Body length is 1.82mm (Female: a=54; b=17; c=6.9). Head diameter is18µm, cephalic setae are 7.6µm long. No papillae are seen. Cervical setae are arranged in one circle of 6 setae in front of amphids, 5µm long. Amphids are placed 23µm from anterior end, 9.2µm. Spear is 40µm long. Excretory pore is placed 138µm from anterior end. Tail is about 1.3 a.b.d long, plump and conical. A terminal setae is present.

Geographical distribution: Chile.

Remarks: The present specimen is differentiated from other species of *Siphonolaimus* by the details of tail and the size of amphids. The details of Wieser's specimens are taken into account and the close similarity was showed in many of the other reliable features of this species. Hence the present materials are placed under the species *Siphonolaimus pachyderma* Wieser 1954.

Table 7.3a Diversity indices for free- living nematodes
Depth range 30-50m

Stations	Sp. No	Abundance	Margalef's	Pielou's	Shannon	Simpson's
	S	N	d'	J'	H'(log2)	Lambda'
cape1	12	25	3.42	0.97	3.46	0.06
tvm	24	73	5.36	0.94	4.31	0.05
klm1	17	75	3.71	0.84	3.41	0.14
klm2	21	58	4.93	0.97	4.25	0.04
kch	27	86	5.84	0.95	4.54	0.04
vad	22	72	4.91	0.97	4.32	0.04
kzh1	3	5	1.24	0.96	1.52	0.20
kzh2	4	9	1.37	0.88	1.75	0.25
knr	22	78	4.82	0.99	4.41	0.04
mngr1	10	32	2.60	0.99	3.28	0.08
cnpr	8	61	1.70	0.94	2.83	0.14
btkl	12	71	2.58	0.98	3.52	0.08
goa	7	51	1.53	0.99	2.78	0.13
rtngr	12	80	2.51	0.96	3.44	0.09
dbhl	11	56	2.48	0.99	3.44	0.08
ofmb	16	78	3.44	0.64	2.57	0.34
almb	10	70	2.12	0.84	2.79	0.18
prbn	7	51	1.53	0.97	2.72	0.15
SD			1.50	0.09	0.88	0.08
Mean			3.12	0.93	3.30	0.12
Cl.upper			3.86	0.97	3.73	0.16
Cl.lower			2.37	0.89	2.86	0.08

Table 7.3b Diversity indices for free- living nematodes
Depth range 51-75m

Stations	Sp. no.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
	S	N	d	J'	H'(log2)	Lambda'
Cape2	6	7	2.57	0.98	2.52	0.05
tvm	12	16	3.97	0.96	3.45	0.04
klm	14	68	3.08	0.96	3.64	0.08
kch	24	83	5.20	0.98	4.52	0.03
vad	10	68	2.13	0.99	3.30	0.09
knr1	25	84	5.42	0.97	4.53	0.04
knr2	30	95	6.37	0.97	4.76	0.03
mngr2	5	9	1.82	0.95	2.20	0.14
cnpr	14	38	3.57	0.96	3.66	0.06
btkl1	15	23	4.47	0.95	3.71	0.05
btkl2	14	35	3.66	0.96	3.64	0.06
goa1	5	38	1.10	0.96	2.23	0.20
goa2	20	98	4.14	0.99	4.29	0.04
rtngr	21	90	4.44	0.99	4.35	0.04
dbhl	13	67	2.85	0.99	3.68	0.07
ofmb	22	89	4.68	0.98	4.36	0.04
almb	9	46	2.09	0.97	3.09	0.10
dwrk	7	24	1.89	0.96	2.69	0.13
SD			1.44	0.02	0.80	0.05
Mean			3.53	0.97	3.59	0.07
Cl.upper			4.24	0.98	3.99	0.10
Cl.lower			2.81	0.96	3.19	0.05

Table 7.3C Diversity indices for free- living nematodes
Depth range 76-100m

Stations	Sp. no.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
	S	N	d	J'	H'(log2)	Lambda'
rtngr	14	45	3.42	0.98	3.74	0.06
dbhl1	6	30	1.47	0.93	2.40	0.19
dbhl2	5	19	1.36	0.98	2.27	0.17
ofmb1	12	26	3.38	0.95	3.41	0.07
ofmb2	6	18	1.73	0.98	2.53	0.13
almb1	2	5	0.62	0.97	0.97	0.40
almb2	3	8	0.96	0.99	1.56	0.25
almb3	10	23	2.87	0.96	3.19	0.08
almb4	5	14	1.52	0.98	2.27	0.15
dwrk	6	9	2.28	0.97	2.50	0.08
SD			0.98	0.02	0.83	0.10
Mean			1.96	0.97	2.48	0.16
CI.upper			2.66	0.98	3.08	0.23
CI.lower			1.26	0.96	1.89	0.08

Table 7.3C Diversity indices for free- living nematodes
Depth range 101-150m

Stations	Sp. no.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
	S	N	d	J'	H'(log2)	Lambda'
Cape	3	4	1.44	0.95	1.50	0.17
tvm	6	11	2.09	0.93	2.41	0.13
klm	10	19	3.06	0.98	3.26	0.06
kch	7	7	3.08	1.00	2.81	0.00
vad	15	50	3.58	0.97	3.78	0.06
kzh	5	16	1.44	0.98	2.28	0.16
knr	6	20	1.67	0.99	2.55	0.13
cnpr	9	32	2.31	0.97	3.08	0.10
btkl	2	7	0.51	0.86	0.86	0.52
goa	14	48	3.36	0.95	3.62	0.07
rtngr	8	18	2.42	0.99	2.97	0.08
SD			0.95	0.04	0.87	0.14
Mean			2.27	0.96	2.65	0.13
95%CI.Upper			2.91	0.99	3.24	0.23
95%CI.lower			1.63	0.94	2.06	0.04

Table 7.3C Diversity indices for free- living nematodes
Depth range >150m

Stations	Sp. no.	Abundance	Margalef's	Pielou's	Shannon	Simpson's
	S	N	d	J'	H'(log2)	Lambda'
Cape	1	2	0.00	0.00	0.00	1.00
klm	3	9	0.91	1.00	1.58	0.25
kch	10	18	3.11	0.94	3.13	0.08
vad	10	52	2.28	0.97	3.22	0.10
kzh	1	4	0.00	0.00	0.00	1.00
knr	3	8	0.96	0.99	1.56	0.25
mangr	3	5	1.24	0.96	1.52	0.20
cnpr	12	68	2.61	0.93	3.33	0.11
btkl	5	34	1.13	0.96	2.23	0.20
goa	6	26	1.53	0.93	2.41	0.18
rtngr	7	14	2.27	0.93	2.61	0.12
prbr	3	5	1.24	0.86	1.37	0.30
SD			0.97	0.04	1.13	0.33
Mean			1.44	0.79	1.91	0.31
95%CI.Upper			2.06	0.97	2.63	0.52
95%CI.lower			0.82	0.92	1.20	0.11

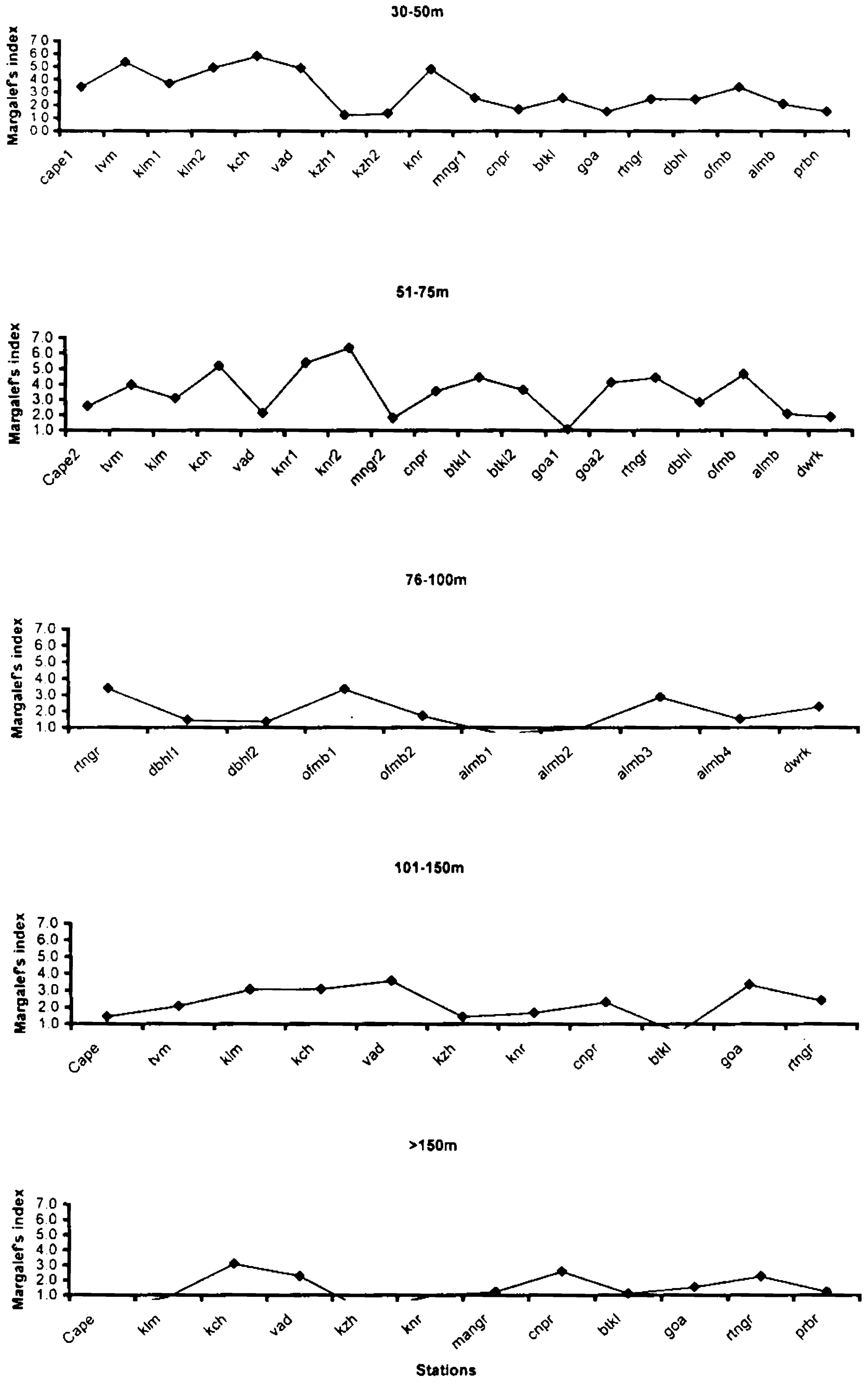


Fig. 7.3a. Diversity indices for free living marine nematodes, west coast of India

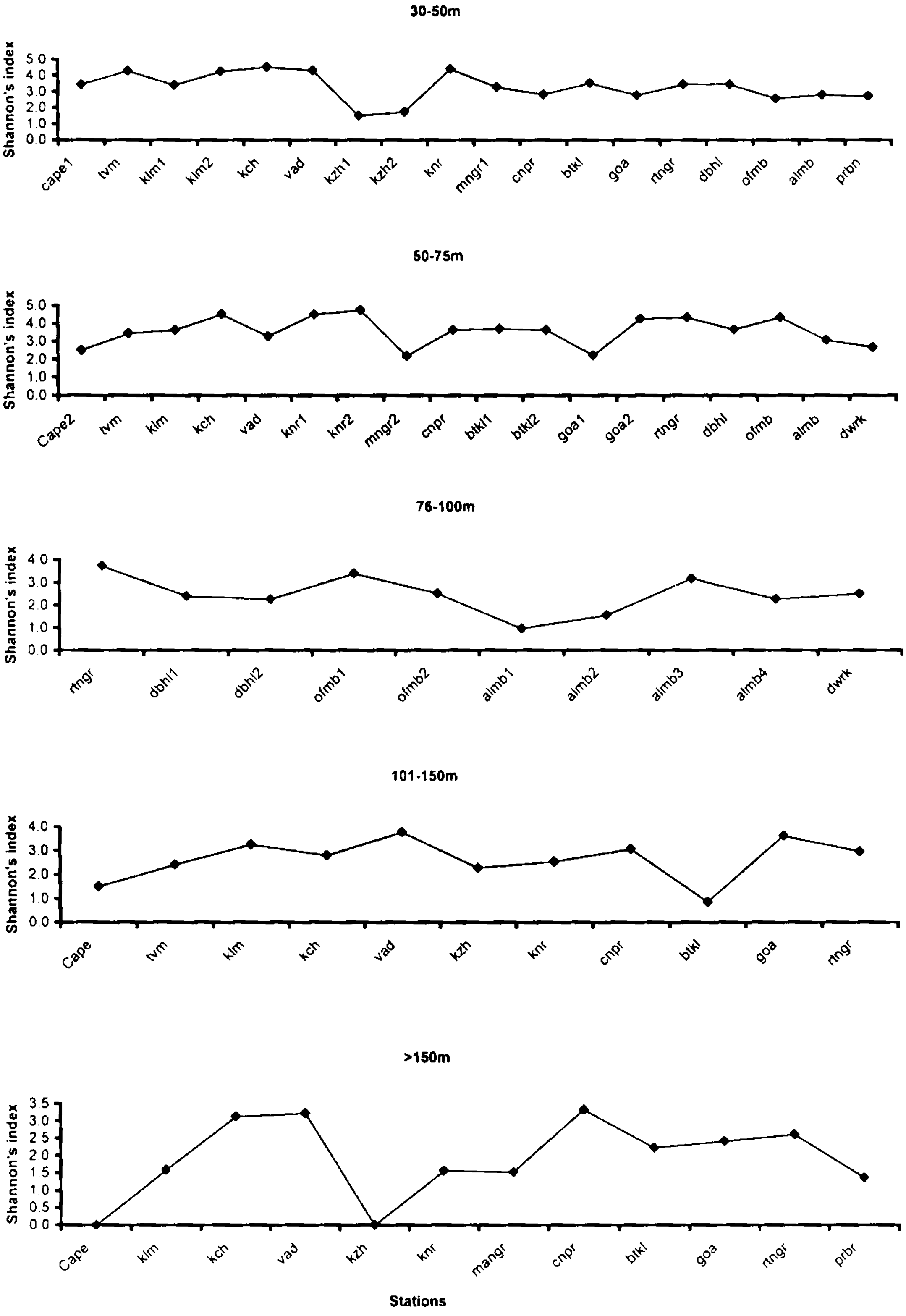


Fig. 7.3b. Diversity indices for free living marine nematodes, west coast of India

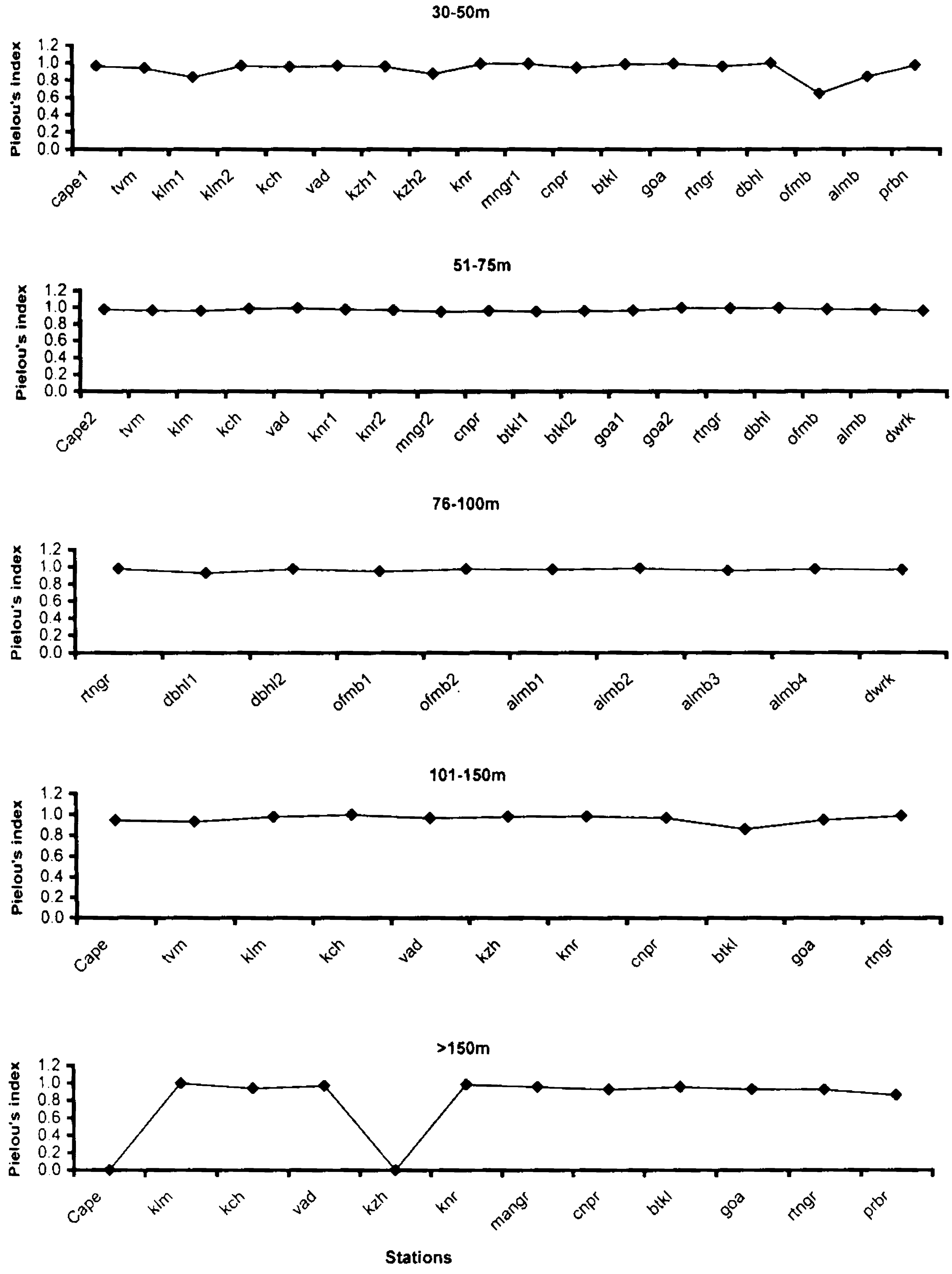


Fig. 7.3c. Diversity indices for free living marine nematodes, west coast of India

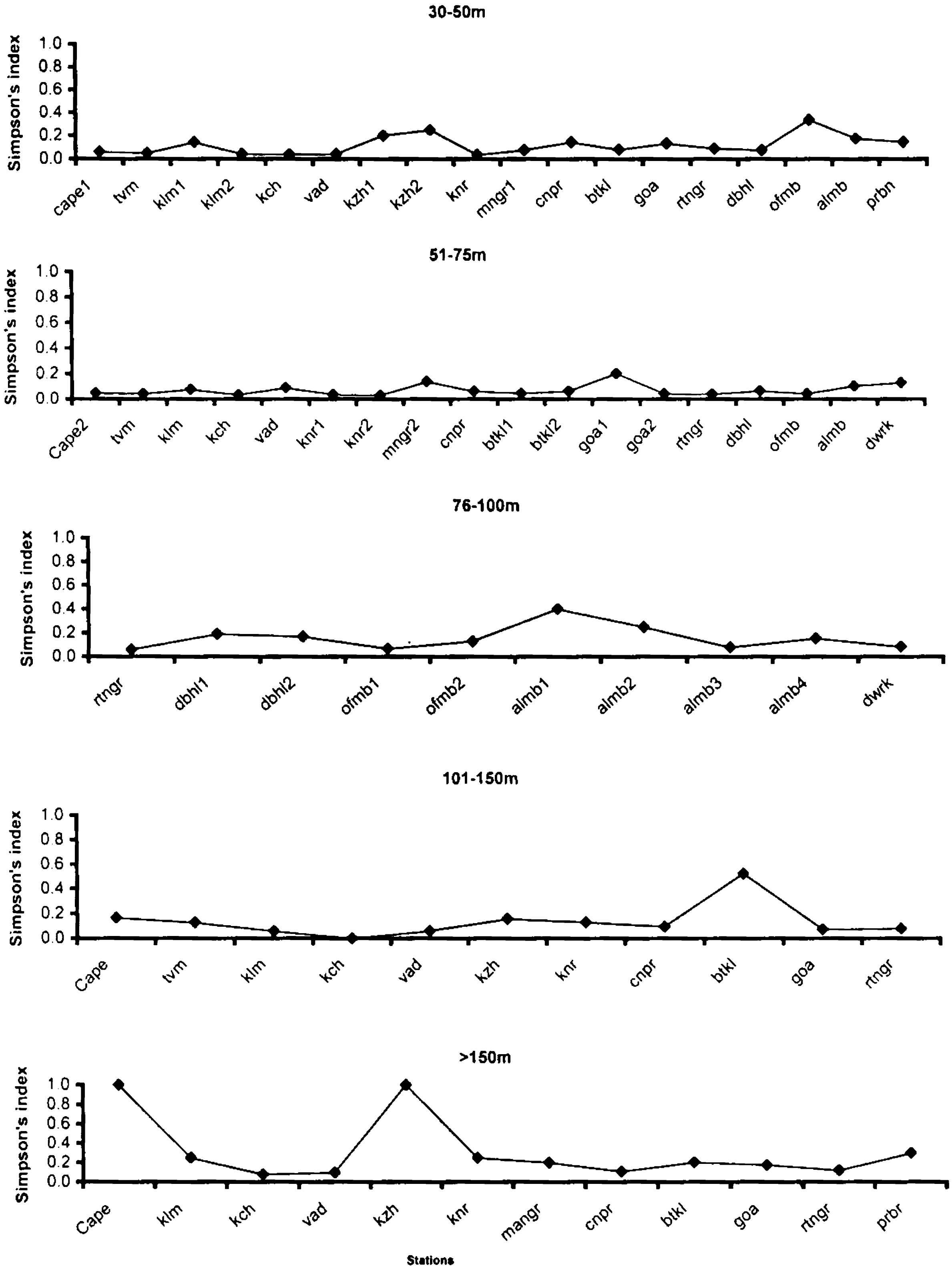


Fig. 7.3d. Diversity indices for free living marine nematodes, west coast of India

7.3: Community structure of free-living nematodes.

Community structure of free-living nematodes along the shelf waters of west coast of India was studied using Primer statistical software. Since nematodes were the most abundant groups among meiofaunal organisms, this group was selected for detailed study. The diversity indices such as species richness (Margalef's index, d), species evenness (Pielou's index, J'), species diversity (Shannon index, H') and species dominance (Simpson's index, λ) were worked out for nematodes.

7.3.1: Species richness (Margalef's index, d) (Table 7.3. & Fig.7.3a). The species richness is used to estimate the total number of species in a given area. Within 30-50m depth range, 'd' varied from 1.242 (off Kozhikode1) to 5.83 (off Kochi) with a mean of 3.11. Species richness showed high values in southern transects, up to Kannur with an exception off Kozhikode. The decreasing trend occurred from off Mangalore to the northern transects of the west coast. In 51-75m, 'd' ranged between 1.69 (off Goa1) and 6.36 (off Kannur2, 67m) with an average of 3.52. Similarly in 76-100m depth range, variation of 'd' was 0.621 (Along Mumbai, 95m) to 3.41 (off Ratnagiri) with an average of 1.95. Within 101-150m depth range, 'd' varied from 0.51 (off Bhatkal) to 3.57 (off Vadanapilly) with an average of 2.26. Beyond 150m, it varied from nil (off Kozhikode and off Cape) to 3.11 (off Kochi) with an average of 1.44. Maximum variation in 'd' with respect to latitudes was noticed in 51-75m (44.41%) and minimum at 30-50m (13.16%). Average species richness showed an increase with depth up to 76m, beyond which it decreased rapidly (Fig.7.6)

7.3.2: Evenness index: (Pielou's index, J') (Table 7.3. and Fig.7.3b). This index expresses how evenly the individuals are distributed among the different species. Within 30-50m depth range J' ranged between 0.642 (off Mumbai) and 0.99 (off Dhabol) with an average of 0.93. In 51-75 m, the range was 0.94 (off Mangalore2) to 0.99 (off Dhabol) with an average of 0.97. Within 76-100m, the variation of J' was from 0.92 (off Dhabol1) to 0.98 (off Along Mumbai2) with an average of 0.96. Whereas in 101-150m depth range, J' varied from 0.86 (off Bhatkal) to one (off Kochi) with an average of 0.96. Beyond 150m depths, J' ranged from nil (Off Cape; off Kozhikode) to one (off Kollam) with an average of 0.78. There was minimum spatial variation of J' recorded in 51-76m (0.30%) and maximum at 100m depth (17.89%). Average values showed more or less same evenness index in 51-75, 76-101m and 100-150m depth. Highest index was noticed at 50-76m (0.97) and beyond that it decreased uniformly and minimum (0.78) was noticed at 150m (Fig. 7.6).

7.3.3: Species diversity: (Shannon index, H') (Table 7.3. and Fig.7.3c). The term species diversity is used for the number of species per number of individuals. Within 30-50m depth range, H' ranged from 1.52 (off Kozhikode1) to 4.54 (off Kochi) with an average of 3.29. Higher species diversity was observed off Cape to off Mangalore with exception in off Kozhikode. From off Kozhikode the diversity values were progressively decreasing towards the northern regions of northwest coast. In 51-75 m depth range, H' ranged between 2.19 (off Mangalore2) and 4.75 (off Kannur2) with an average of 3.58. Similarly in 76-100m depth range, the variation of H' was from 0.97 (Along Mumbai) to 3.73 (off Ratnagiri) with an average of 2.48. Within 101-150m depth

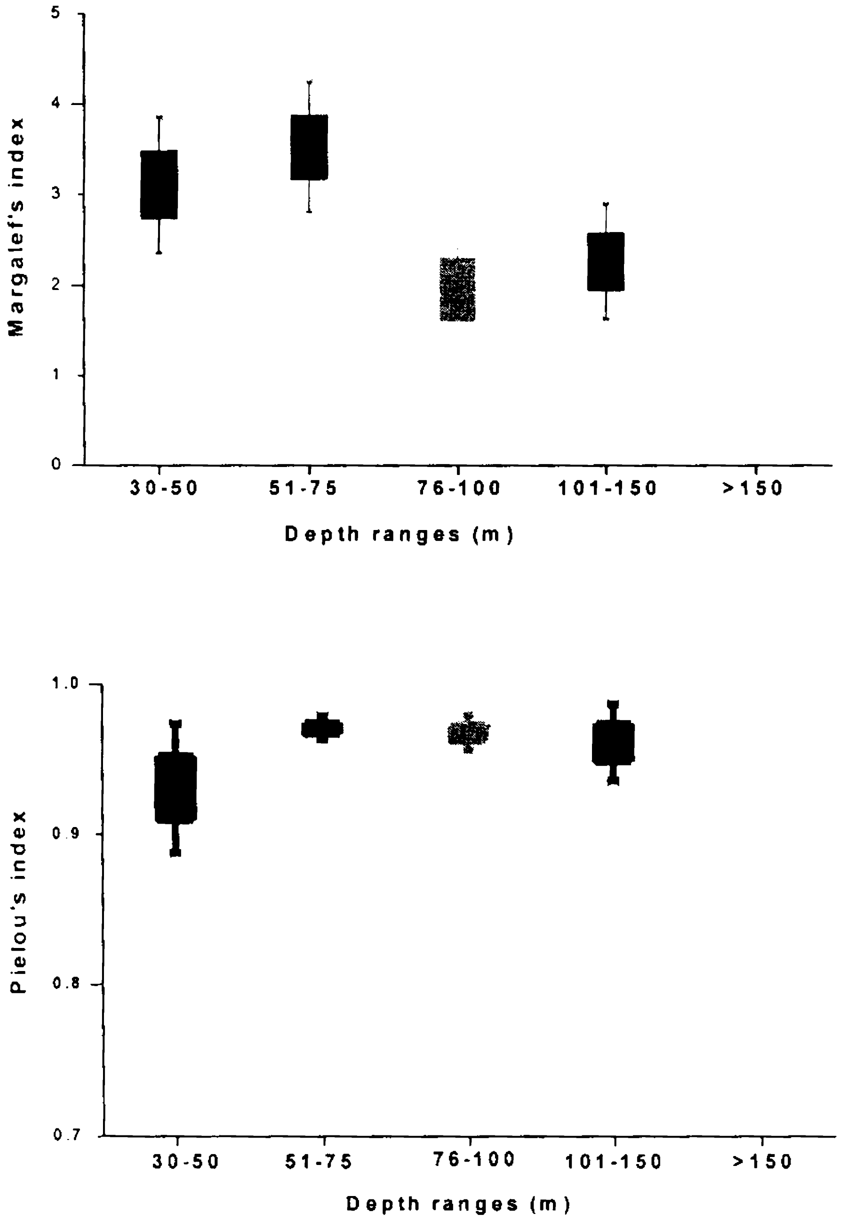


Fig. 7.6. Mean and 95% confidence intervals of diversity indices for free living marine nematodes.

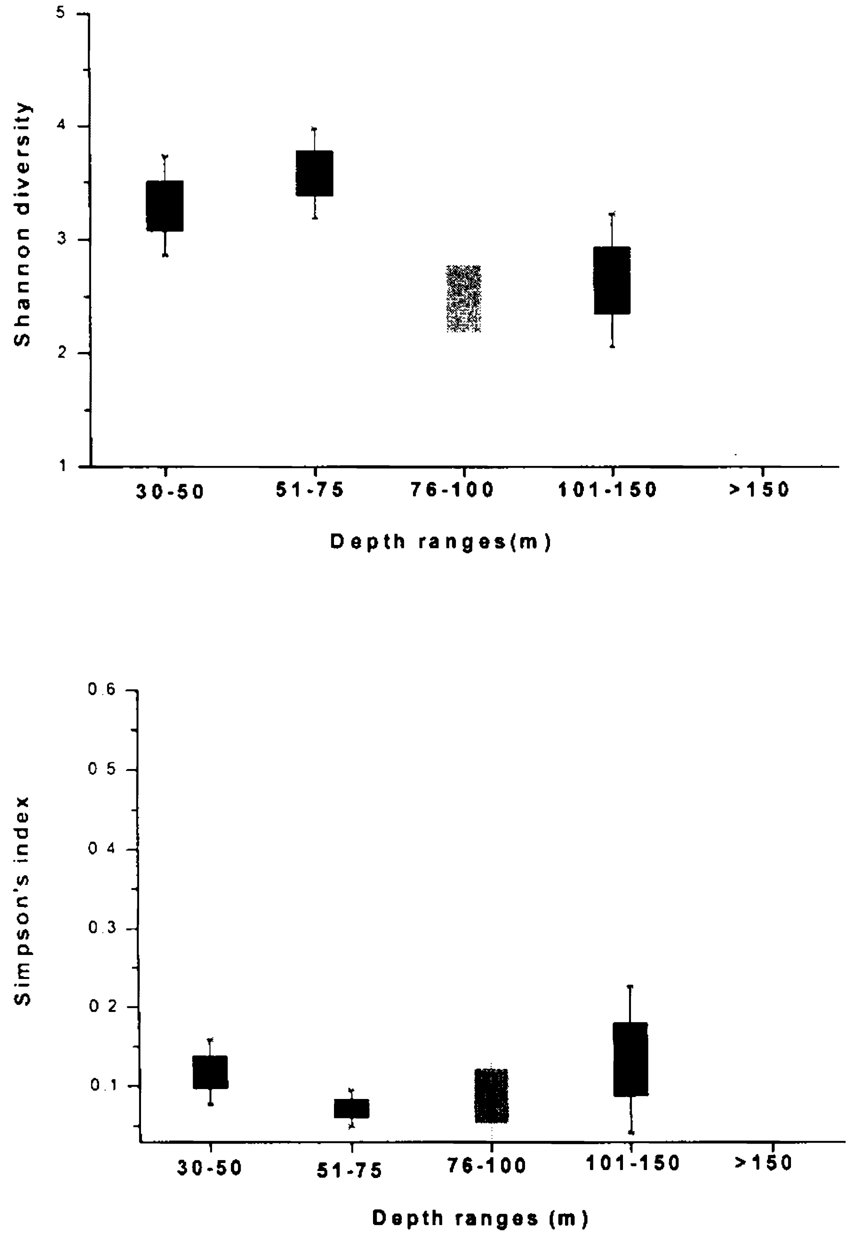


Fig. 7.6. Mean and 95% confidence intervals of diversity indices for free living marine nematodes.

range, H' varied between 0.86 (off Bhatkal) and 3.78 (off Vadanapilly) with an average of 2.64. Beyond 150m, H' ranged nil (off Cape and off Kozhikode) to 3.32 (off Coondapore) with an average of 1.91. Latitudinal variation was minimum at 76-100m (6.61) and maximum at 50-75 m depth ranges (30.78). From the average values, it was noticed that species diversity showed a progressive increase with increase in depth up to 75 m, beyond which it decreased rapidly (Fig. 7.6).

7.3.4: Species dominance (Simpson's index, λ) (Table 7.3. and Fig.7.3d)

Species dominance is the relative occurrence of species with other species. Within 30-50m depth range, λ' ranged from 0.036 (off Kannur) to 0.338 (off Mumbai) with an average of 0.117. In 51-75 m depth range, λ' ranged 0.03 (off Kannur2) and 0.203 (Off Goa1) with an average of 0.071. Within 76-100m, λ' varied from 0.05 (off Ratnagiri) to 0.4 (off almb1) with an average of 0.158. Similarly in 101-150m, λ' varied between nil (off Kochi) and 0.52 (off Bhatkal) with an average of 0.134. Beyond150m, λ' ranged from 0.07 (off Kochi) to one (off Cape; off Kozhikode) with an average of 0.314. Species dominance showed a progressive increase from 30-50m to the edge of the shelf (Fig.7.6). Variation within latitude was maximum at >150 (134.8%) and minimum at 76-100 (15.3). Mean and 95% confidence intervals were calculated for diversity indices showed the pattern of diversity in selected depths (Fig.7.6)

7.4. Cluster analysis (Bray- Curtis similarity)

The results of the comparison of nematode community at the species level, using cluster analysis based upon the Bray-Curtis index of similarity and group dendrogram is given in Table 7.4. & Fig. 7.4.

cape1																	
tvm	18.67																
klm1	17.20	50.94															
klm2	16.56	38.59	38.17														
kch	22.35	40.26	22.80	39.61													
vad	15.63	13.12	10.84	22.18	31.39												
kzh1	0.00	6.98	25.71	22.53	12.37	7.34											
kzh2	0.00	13.63	17.47	8.40	7.11	0.00	29.3										
knr	16.16	29.40	28.28	35.31	40.31	27.51	13.1	0.0									
mngr1	0.00	5.98	14.38	24.96	21.27	24.60	14.3	0.0	19.6								
cnpr	8.75	0.00	0.00	12.01	5.47	25.84	0.0	0.0	19.7	10.8							
btkl	0.00	11.09	15.66	22.62	25.36	17.77	20.0	0.0	30.1	43.8	9.5						
goa	9.28	7.98	25.82	24.99	13.31	22.00	29.5	12.4	28.1	11.4	13.7	22.7					
rtngr	7.18	13.33	26.93	37.12	31.13	38.94	21.3	12.0	23.7	41.3	20.4	16.7	41.2				
dbhl	6.52	5.04	21.58	28.19	19.82	23.24	22.1	0.0	19.0	19.0	31.4	26.4	22.4	33.3			
ofmb	6.86	24.72	32.63	30.03	22.76	15.43	28.3	11.2	15.1	14.8	7.9	12.8	23.9	32.7	25.4		
almb	17.07	26.63	30.51	23.98	18.61	6.40	23.6	14.2	24.0	0.0	10.0	15.9	21.6	19.7	15.8	33.6	
prbn	0.00	20.57	28.93	26.89	24.14	14.74	45.8	17.6	21.3	22.9	0.0	31.3	41.1	32.2	21.5	27.6	23.26

Table 7.4. Similarity index between stations with respect to free living nematodes
51-75 m depth range.

	Cape2	tvm	klm	kch	vad	knr1	knr2	mngr2	cnpr	btkl1	btkl2	goa1	goa2	rtngr	dbhl	ofmb	almb	dwrk
Cape2																		
tvm	10.59																	
klm	24.03	12.10																
kch	5.18	9.70	15.22															
vad	17.95	6.95	24.11	21.45														
knr1	10.11	18.19	26.58	24.57	11.76													
knr2	8.81	16.14	33.57	18.53	21.04	42.15												
mngr2	0.00	0.00	0.00	12.47	12.08	6.09	11.16											
cnpr	16.81	6.60	32.70	7.99	37.59	24.46	31.19	18.79										
btkl1	17.79	13.80	31.61	9.90	8.73	31.37	28.75	9.09	31.73									
btkl2	18.71	6.69	35.00	5.69	9.40	33.30	21.20	0.00	26.96	61.45								
goa1	0.00	11.38	21.68	6.96	0.00	14.42	23.13	0.00	21.34	19.41	19.71							
goa2	12.23	18.91	34.56	17.46	19.93	31.40	39.91	6.73	22.93	34.34	36.90	24.09						
rtngr	12.08	24.27	33.20	17.95	18.31	26.55	37.58	14.01	33.11	24.02	26.76	30.84	47.40					
dbhl	7.78	13.59	21.68	16.76	25.58	26.69	42.20	19.87	36.48	18.86	13.64	43.56	36.67	52.86				
ofmb	5.41	14.67	22.29	25.67	12.06	50.81	47.91	13.04	24.56	28.85	25.98	16.65	32.82	33.19	34.29			
almb	0.00	0.00	15.44	18.32	0.00	23.46	19.73	12.47	7.68	8.02	8.60	13.11	13.86	26.08	26.71	31.37		
dwrk	0.00	19.84	17.51	18.13	0.00	17.28	26.32	15.78	19.30	27.79	27.78	45.71	32.80	34.34	36.03	18.88	20.91	

Table 7.4. Similarity index between stations with respect to free living nematodes
76-100 m depth range.

	rtngr	dbhl1	dbhl2	ofmb1	ofmb2	almb1	almb2	almb3	almb4	dwrk
rtngr										
dbhl1	46.99									
dbhl2	19.65	33.16								
ofmb1	36.66	35.19	22.84							
ofmb2	19.72	32.86	17.83	43.72						
almb1	0.00	0.00	0.00	14.22	22.99					
almb2	22.38	18.88	0.00	13.19	20.40	0.00				
almb3	41.08	36.62	0.00	28.36	26.41	0.00	31.49			
almb4	10.53	17.31	17.81	0.00	0.00	0.00	0.00	0.00		
dwrk	25.37	28.53	0.00	40.31	30.39	0.00	19.25	23.47	0.00	

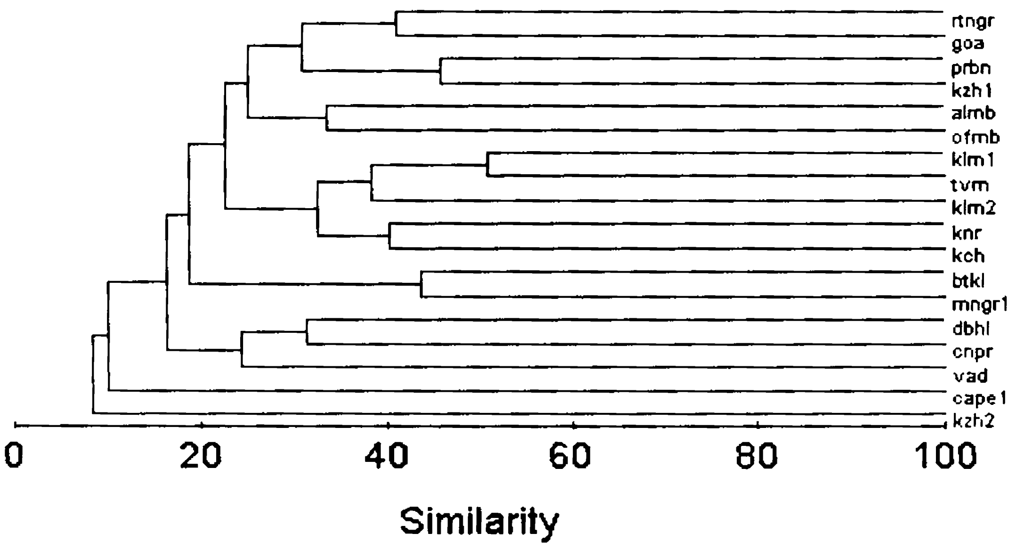
Table 7.4. Similarity index between stations with respect to free living nematodes
101-150 m depth range.

	Cape	tvm	klm	kch	vad	kzh	knr	cnpr	btkl	goa	rtngr
Cape											
tvm	23.76										
klm	0.00	10.83									
kch	0.00	0.00	10.73								
vad	8.65	0.00	13.86	0.00							
kzh	20.33	0.00	0.00	14.65	0.00						
knr	0.00	0.00	0.00	0.00	18.59	0.00					
cnpr	0.00	0.00	9.97	0.00	37.00	13.96	13.96				
btkl	34.05	0.00	0.00	0.00	0.00	25.48	24.49	0.00			
goa	10.90	26.56	14.47	7.81	18.50	18.82	19.51	16.89	0.00		
rtngr	15.44	0.00	0.00	23.86	8.01	45.01	0.00	11.98	19.10	25.13	

Table 7.4. Similarity index between stations with respect to free living nematodes
150 m depth range.

	Cape	klm	kch	vad	kzh	knr	mangr	cnpr	btkl	goa	rtngr	prbr
Cape												
klm	0.0											
kch	16.0	0.0										
vad	0.0	0.0	45.7									
kzh	0.0	0.0	15.7	17.3								
knr	0.0	0.0	0.0	0.0	0.0							
mangr	52.1	0.0	29.8	13.0	0.0	0.0						
cnpr	0.0	0.0	16.5	36.1	14.6	0.0	0.0					
btkl	26.0	22.1	25.1	13.7	0.0	0.0	21.0	10.9				
goa	0.0	0.0	13.3	0.0	0.0	0.0	16.9	9.0	0.0			
rtngr	25.6	0.0	20.6	19.0	0.0	16.8	38.1	26.0	17.6	0.0		
prbr	0.0	0.0	31.7	11.0	0.0	0.0	0.0	18.8	17.7	22.4	0.0	

30-50 m depth range.



51-75 m depth range.

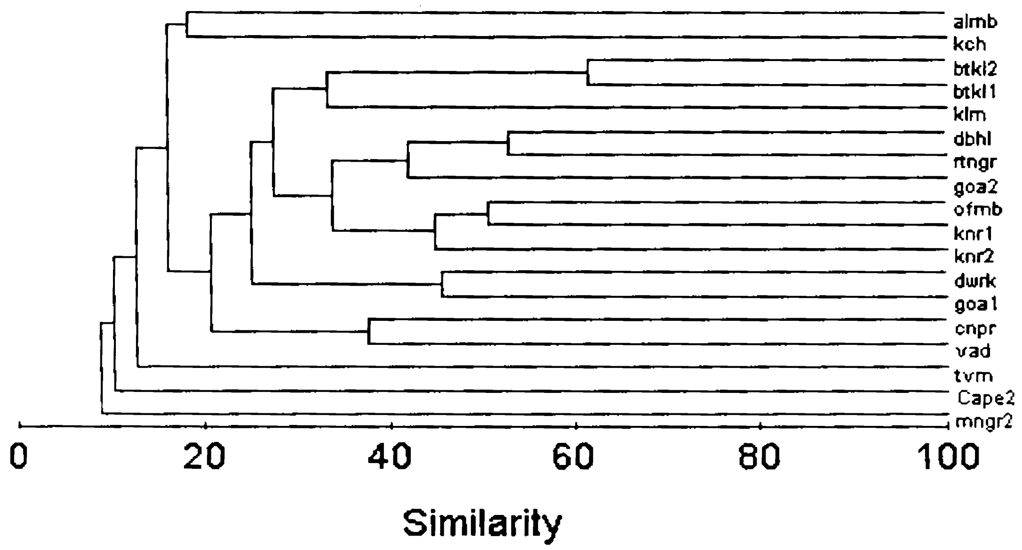
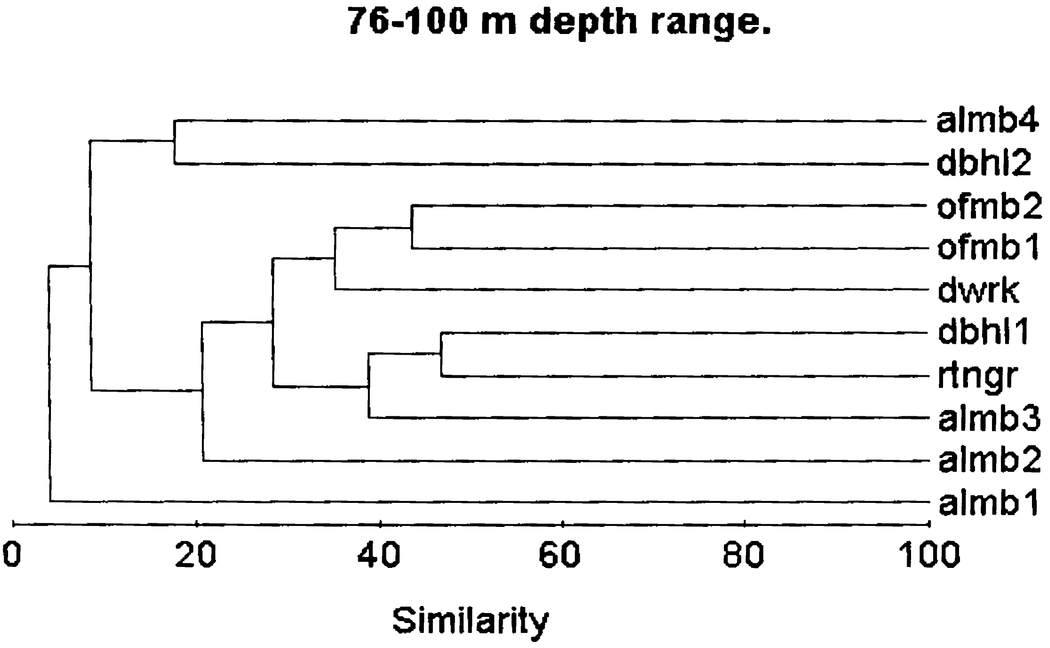


Fig. 7.4. Dendrogram (hierarchical clustering) of free-living marine nematodes.



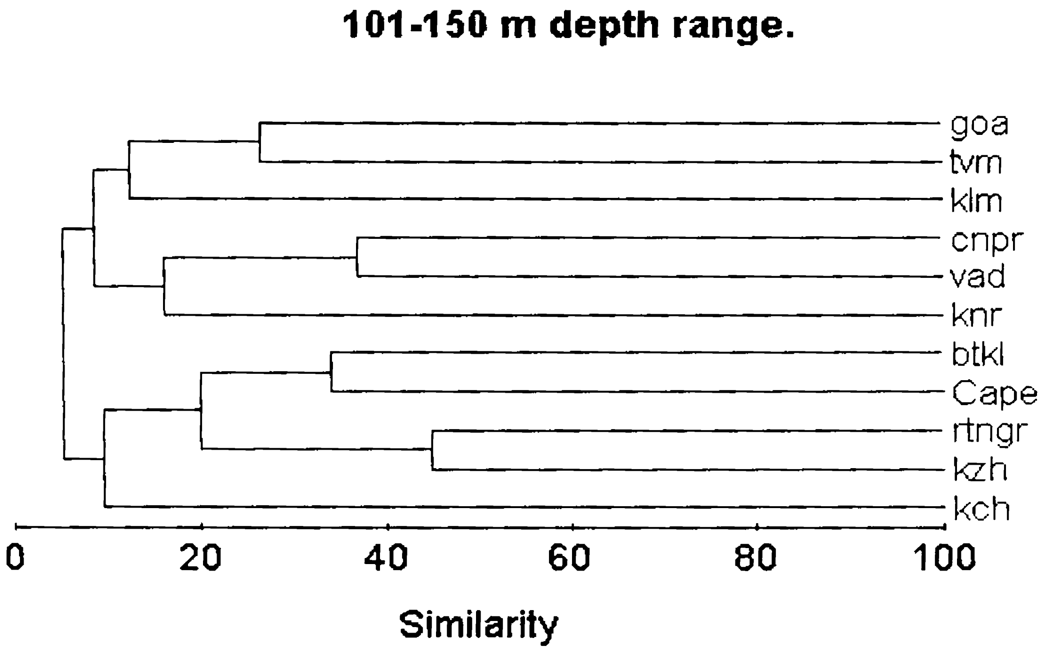


Fig. 7.4. Dendrogram (hierarchical clustering) of free-living marine nematodes.

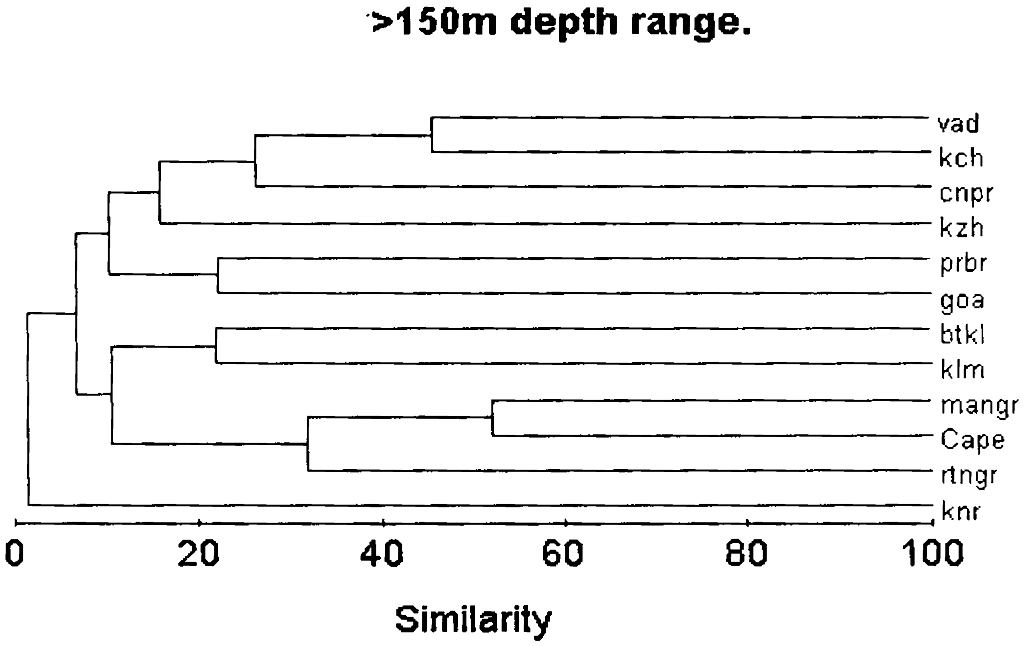


Fig. 7.4. Dendrogram (hierarchical clustering) of free-living marine nematodes.

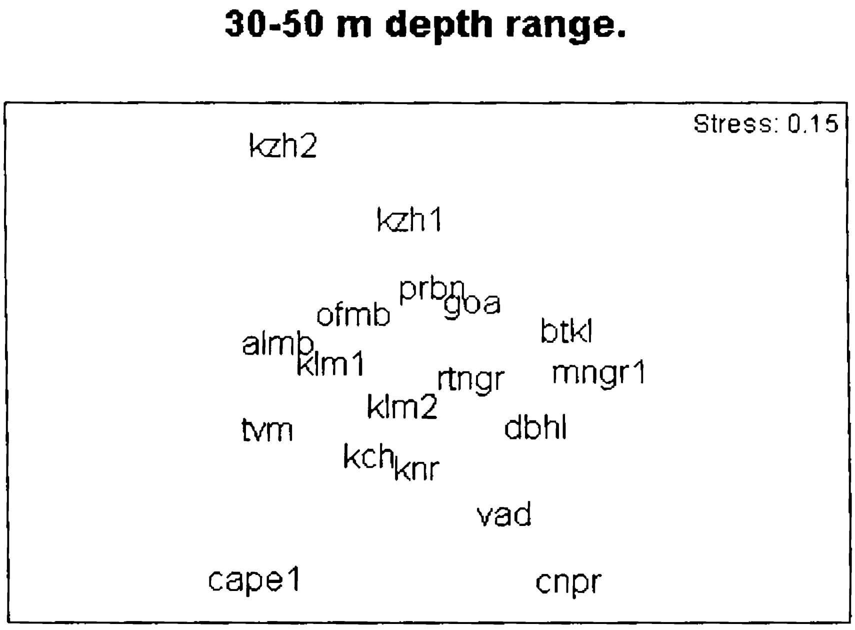
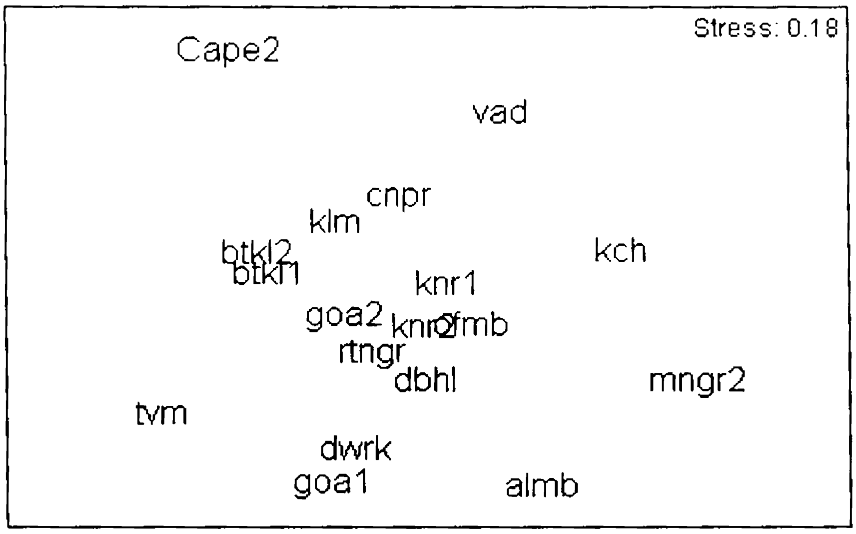


Fig.7.5. MDS ordination for the free-living marine nematodes.

51-75 m depth range.



76-100m depth range.

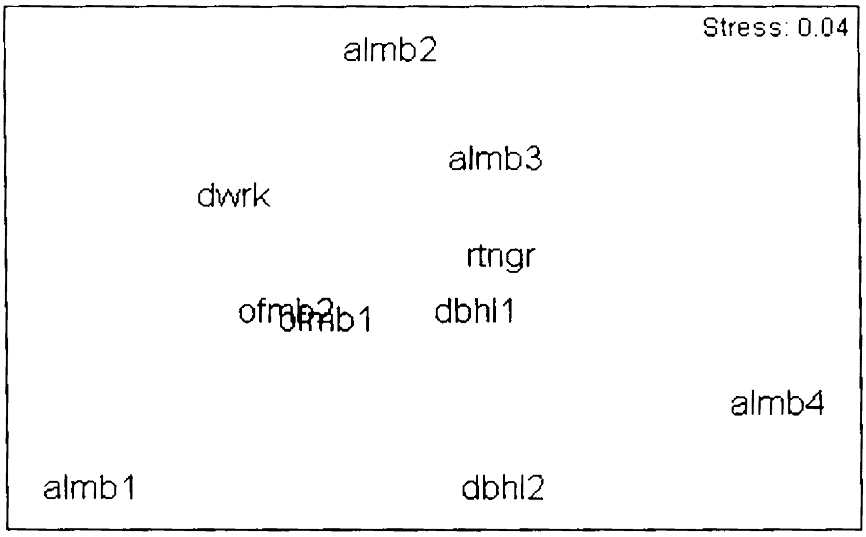
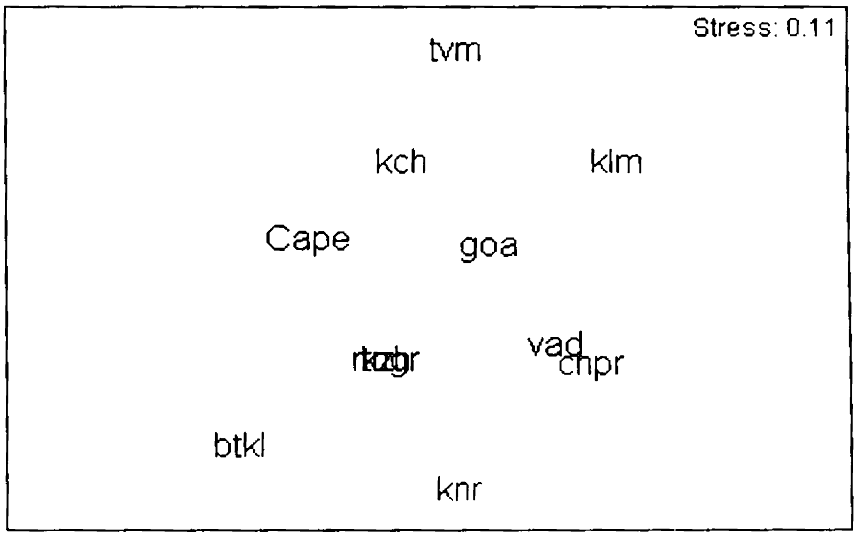


Fig.7.5. MDS ordination for the free-living marine nematodes.

101-150m depth range.



>150m depth range.

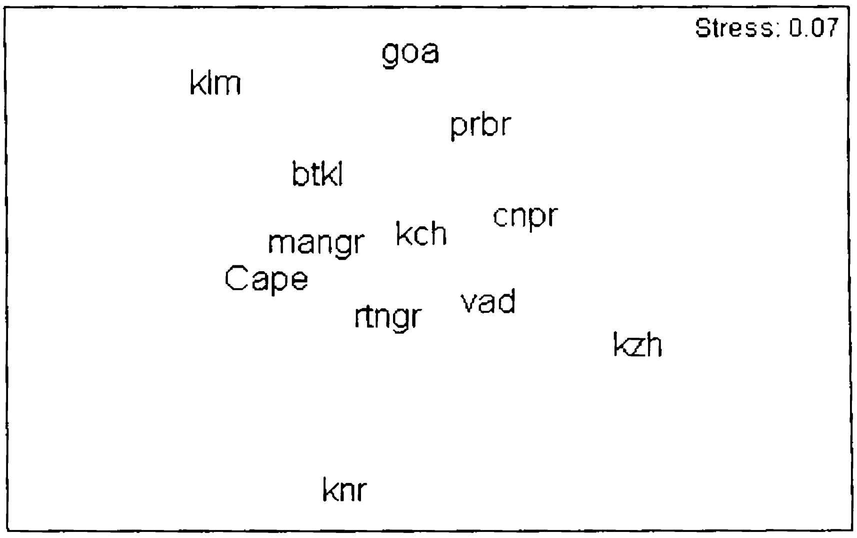


Fig.7.5. MDS ordination for the free-living marine nematodes.

The clusters formed between stations in various depths depict the patterns in the similarity matrix. In 30-50m, Thiruvananthapuram and Kollam transects showed the highest similarity and are combined, at similarity level 51.0%. Within 51-75 m, the highest linkage was between off Bhatkal$_1$ and off Bhatkal$_2$ at 61.45%. Within 76-100m, maximum similarity was observed off Dhabhol1 and Ratnagiri and is clustered at 47% similarity level. Within 101-150m, maximum similarity was observed off Kozhikode and off Ratnagiri (45%). Beyond 150m, maximum was noticed between Mangalore and Cape (52%). It was observed that the environmental variables like temperature, dissolved oxygen and salinity were more or less similar in the clustered stations of 30-50m and 51-75m. However in other depth it was the substratum similarity, which was accounting for the maximum observed similarity. Organic matter values showed no such similarity between more similar stations. Since cluster analysis is best used in conjunction with ordination, the clusters were superimposed to an ordination plot. The similarities of stations were preserved in the nonmetric multidimensional scaling (NMDS) figure 7.5.

7. 5. SIMPER procedure:

Species contributions to the similarities or dissimilarities were examined with the SIMPER procedure. It indicates which species are principally responsible either for an observed clustering pattern or for difference between sets of samples. In the present study similarity or dissimilarity between nematode species in selected depth ranges was selected for SIMPER analysis, and the responsible species for observed pattern was elucidated. For this analysis the similarity and dissimilarity between species from all the depths such 30m, 51m 76m, 101m and 151m was checked.

The average similarities or dissimilarities between the selected groups were vouched by the responsible species present therein. The average similarity of group 30m was 19.47%, and about 55% of it was contributed by species like *Dorylaimopsis*, *Desmodora*, *Halalaimus* and *Tricoma*. Similarly in the group 51m the average similarity was 20.58, about 56% of which is contributed by species like *Halalaimus, Theristus, Dorylaimopsis, Sabatieria* and *Tricoma*. However in the group 76m, the average similarity was 17.72% and 55% of which was shared between *Tricoma* and *Spirinia* spp. While in group 101m the average similarity was only 10.22% and 56% of this similarity was shared between *Tricoma* spp, *Spiliphora tollenifera*, *Paramonhystera* spp and *Sabatieria* spp. In the group beyond 150m the average similarity was 10.77% and more than 57% of it was contributed by *Desmodora* spp, *Theristus* spp and *Dorylaimopsis* spp.

The dissimilarities between the selected groups were also studied to reveal any dominance or discriminating species accounting for the present observation. This analysis showed the fact that there was no consistent or discriminative species that can be accountable for the community pattern and the dissimilarity was reciprocated between numbers of species together. The average dissimilarities between different groups are given in the table with the number of species contributing to 50% of it. (Table 7.5)

Sl. no	Groups selected (m)	Average dissimilarity (%)	50% contribution
1	30 and 51	81.75	27 Species
2	30 and 76	87.71	20 Species
3	51 and 76	85.86	20 Species
4	30 and 101	90.07	23 Species
5	51 and 101	88.1	23 Species
6	76 and 101	87.8	16 Species
7	30 and151	87.54	19 Species
8	51 and 151	88.4	19 Species
9	76 and 151	90.07	12 Species
10	101 and 151	92.58	16 Species

Table. 7.5 The average dissimilarities between selected depth ranges and number of species contributing the 50% dissimilarity level.

7.6: ANOSIM-analysis of similarity

In the present investigation one-way Anosim test was employed to study the distribution of nematodes in different depths. The statistical test of null hypothesis was tested prior specified depth ranges as factors. The simulated R- values in selected depths along the west coast of India showed evidence of variation in nematode species. The R- values varied between –0.10 and 0.12. The distributions of R- values were found to fall above the simulated range except in groups 76-100m. The table and histogram for the R-statistic values of simulated permutations are given below (Table 7.6 & Fig. 7.6).

Groups (Depths)	R Statistic	Significance Level %	Possible Permutations	Actual Permutations	Observed Number >=
30,51	0.078	2.5	Too many	999	24
30,76	0.336	0.1	13123110	999	0
30,101	0.372	0.1	34597290	999	0
30,151	0.227	0.2	86493225	999	1
51,76	0.260	0.3	13123110	999	2
51,101	0.278	0.3	34597290	999	2
51,151	0.262	0.1	86493225	999	0
76,101	0.034	28.9	352716	999	288
76,151	0.139	2.3	646646	999	22
101,151	0.121	3.4	1352078	999	33

Table.7.6. Pair wise comparison of nematode species from selected depths using one-way Anosim, West coast of India.

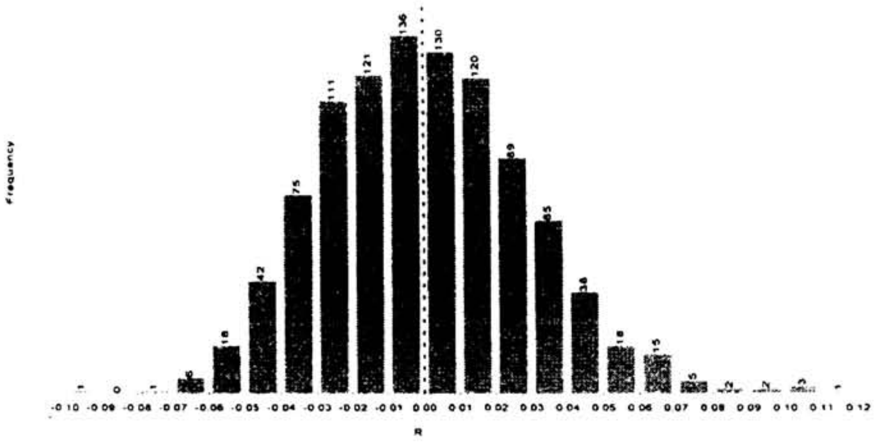


Fig: 7.6. Simulated distribution of the test statistic "R".

Table 7.2.Free-living marine nematode families recorded from selected depth west coast of India

Family	30-50m	51-75m	76-100m	101-150m	>150m
Oncholaimidae	√	√	√	√	√
Oxystominidae	√	√	√	√	√
Enchellidae	√	√	a	a	a
Trypyloidae	√	√	√	a	a
Anoplostomatidae	√	√	a	√	a
Leptosomatidae	√	a	a	a	a
Rhabdonematidae	√	√	a	√	a
Phanodermatidae	√	√	√	a	a
Trefusidae	a	a	√	a	a
Enoplidae	a	a	a	√	a
Comesomatidae	√	√	√	√	√
Selachinematidae	√	√	√	√	√
Desmodoridae	√	√	√	√	√
Desmoscolecidae	√	√	√	√	√
Microlaimidae	√	√	a	√	a
Monoposthidae	√	√	a	√	a
Aegialaimidae	√	a	a	√	a
Chromadoridae	√	√	√	√	√
Cyatholaimidae	√	√	√	√	√
Ceramonematidae	√	√	√	√	a
Ethmolaimidae	a	√	a	a	a
Leptolaimidae	a	√	a	a	√
Draconematidae	√	√	√	√	√
Sphaerolaimidae	√	√	a	a	√
Xyalidae	√	√	√	√	√
Axonolaimidae	√	√	a	a	a
Linhomoeidae	√	√	√	√	√
Diplopeltidae	√	√	√	√	a
Siphonolaimidae	√	√	√	√	a

7.7. Discussion:

Free-living marine nematodes were represented in 3 orders of 29 families. Chromadorida was the most important order represented in both species and abundance of individuals followed by Monhystrida and Enoplida. This is the first base line information for free living nematodes of the west coast as a whole. The general pattern of decreasing nematode diversity was apparent from 50m depth. 10 families were represented throughout the depth profiles selected. Two families, Trefusidae and Enoplidae were represented only in 75 and 100m respectively. Deeper waters recorded a decline in the number of families represented (Table.7.2). The families like Diplopeltidae, Siphonolaimidae and Ceramonematidae are absent in >150m depths. These families occurred in all other selected depths.

The most common free-living nematodes recorded from the selected depth ranges are given below.

Selected depths (m)	Dominant species
30-50	*Desmodora sp; Dorylaimopsis sp; Tricoma sp. and Terschellingia longicaudatus.*
51-75	*Halalaimus sp; Theristus sp; Dorylaimopsis sp; Tricoma sp* and *Sabatieria sp*
76-100	*Tricoma sp.; Sabatieria sp. and Spirinia sp.*
101-150	Sabatieria sp.
>150	Promonhystera *sp.* and *Theristus sp.*

7.7.1. Community structure

There exists two paradigms in marine diversity, i.e there is a latitudinal cline of increasing species richness from poles to tropics and that species richness increases with depth to a maximum around 2000 m and thereafter decreases. The present study showed that species richness progressively decreased from shallower stations to the deeper stations of the shelf.

This classical interpretation was that of Sanders (1968) which remain unquestioned for long time. Modern ecologists like Gage and Tyler (1992), Huston (1994), Levinton (1995), Begon *et al*, (1990) supported the first paradigm. However, several workers questioned the second paradigm. Their studies in shallow water areas showed high diversity than deeper waters (Gray, 1994, Coleman *et al.*, 1997 and Gray *et al.* 1997).

Sanders (*loc cit.*) established a fundamental relation between species diversity and nature of the environment. Since then ecologists started assessing species diversity as a powerful tool in community studies. Boucher and Lambshead (1995) analysed data on nematodes from temperate estuaries and sublittoral, bathyal, abyssal and trench and found that tropical species richness was lower than temperate and there was an inverse relationship between productivity and species richness. Nematode diversity was considered to be more powerful than meiofaunal abundance in detecting spatial variation in monitoring studies (Li *et al.*, 1995).

The quantification of the biodiversity is fundamental to the identification of changes that may be taking place and to our understanding of their possible consequences. Biodiversity can be measured by many levels and number of different ways (Harper and Hawksworth, 1994). Different diversity indices emphasize the species richness or equitability components of diversity to varying degrees. The key mechanisms suggested, explaining these patterns of species richness are: biological interactions, energy-productivity, species ranges (Rapoport's Rule, Stevens, 1989), the random boundary hypothesis, and historical (evolutionary factors).

The most commonly used diversity measure is the Shannon diversity index. In the present study high species diversity and species richness values were recorded at 50-75m depth range and low values in 150m-depth range. In accordance the Simpsons dominance index values were recorded maximum beyond 150m depth range. The evenness index values was more in 51-76 m depth range and lowest recorded in >150m depths. However beyond this depths the diversity values showed a significant decline. Similar observations were already been reported elsewhere (Gray, 1994). The correlation between various environmental parameters and diversity are discussed in Chapter 8.

Studies of Warwick and Buchanan, 1970 showed a strong correlation between sedimentary parameters such as grain size and silt content and diversity. However there is no such correlation was noted in the present study.

The higher diversity observed in the shallower stations of the shelf was attributed to the primary productivity. The correlations of diversity and environmental parameters showed that the temperature and dissolved oxygen are significant in the observed pattern of diversity. In the case of substratum the clayey silt and silty sand showed maximum diversity. Ansari (1978) reported the preference of nematodes to silty substratum. Whether diversity is controlled by local or by regional processes is a major theme of ecological research (Lawton, 1999). Although different levels of community control clearly exists (Latham and Ricklefs, 1993; Silvertown *et al.*, 1999), evidence from diverse systems is now firmly in favour of regional control (Cornell and Lawton, 1992; Caley and Schluter, 1997, Cornell, 1999). North Sea studies of nematode diversity showed that substratum characteristics are important in observed diversity patterns (Heip and Decraemer, 1974). The studies of deep-sea nematode diversity in Atlantic Ocean showed that the pattern is related to productivity gradients (Lambshead *et al.*, 2000, 2001) and they concluded that nematode diversity may be affected by physical disturbances but deep-sea nematodes are more robust to impacts than other invertebrates. The major parameters behind the observed patterns might involve abiotic parameters and biotic interactions operating over different scales (Roy *et al.*, 1996, 1998; Vanhove *et al.* 1999).

7.7.2 Cluster analysis

The similarities between stations from different transect were apparent from dendrogram plots. The topography of the dendrogram was uneven indicating species variability between stations. In the present study the shallow water (30m) nematode communities are comparatively more similar than the deeper water forms. The occurrence of a number of closely related species in the same local area has been noted earlier as a characteristic of marine nematode fauna in shallow water studies (Castillo-Fernandez and Lambshead, 1990). At the family level, a high degree of similarity among selected depth ranges in entire west coast was noticed. In the present study highest similarities among stations were explained to be due to similar substratum types and similar environmental variables. However the organic matter value showed no such similarity among high similarity stations.

Cluster analysis attempts to group samples into discrete clusters, without displaying their interrelationships if any; the latter is the province of an ordination plot. The ranks of similarities obtained from the Bray-Curtis similarity matrix was also preserved in the 2 dimensional MDS ordination plot. In the present study the ordinations depicted from similarity matrix revealed the same patterns as in the cluster analysis (Fig.7.4). The similar stations were closely placed and with the stress values below 0.2 it was clear that MDS was applicable for the present study. The outliers are also evident here as depicted in the cluster analysis. The stress values in the present study was <0.2 which corresponds to a good ordination with no real prospect of a misleading interpretation. Similar stress values were obtained in the studies of Warwick (1971). The applicability of ordination and clustering are highlighted in the studies of Gray *et al.* (1988) and Clarke and Green (1988) who suggested the demand of two methods for a better interpretation of the community structure.

7.7.3 SIMPER procedure:

The simper procedure envisages the contribution of species to the similarity or distinction between the selected groups. In the present study all selected groups showed much significant distinction, which was explained by the ANOSIM analysis. The conclusion that can be drawn from the analysis is that even though the similarities among groups were shared by few dominant species the dissimilarity pattern was contributed by a number of species together. This is supporting the fact that marine nematodes are rather heterogeneous in their diversity and distribution pertaining to different sediment and ecological conditions.

7.7.4 ANOSIM (Analysis of Similarities)

The test of non parametric permutation procedure, applied to the similarity matrix underlying the ordination or classification of samples, is the standard of ANOSIM procedure. The R values never technically lie outside -1, 1; Zero values of R holds the fact that the null hypothesis is true, so that similarities between and within sites will be the same on average.

In the present study, the significant level of the pair wise analysis by Anosim procedure establishes that there are statistically significant differences between species of different depths. However the difference was not discernible between species 76-100m depth range. Since there are no related studies are available using the similar procedure a comparison was not possible. This study might be useful for future workers to make comparison.

Chapter 8

Ecology and distribution of free-living nematodes

8.1. Introduction:

Nematodes are probably the most abundant metazoans in the biosphere and are of great importance to man. The importance of parasitic nematodes has been recognised for many decades, but it is not the case for the free- living species, especially those of aquatic environments. Free-living nematodes remained relatively unstudied, despite the fact that they are extremely abundant, often numbering millions per square meter in sediments. They occur in a range of habitats, which is unsurpassed by any other metazoan group and being absent only from oceanic plankton.

Nematodes usually dominate all meiofaunal samples both in abundance and biomass and represent the most frequent metazoans. In meiofauna, this group usually makes up 90-95% of sampled individuals and 50-90% of sample biomass. All the free-living nematodes are fall within meiobenthic size range. Despite their similar basic morphology nematodes occupy very different roles and trophic positions in sediments. Many species feed on bacteria, on algae or both. They eat detritus and possibly dissolved organic matter, and a considerable number are predators, feeding on other nematodes, oligochaetes, polychaetes, etc. This diversity in feeding is reflected in species diversity. Ecology of nematodes are discussed by various workers like Wieser (1959b), Alongi and Tietjen (1980), Platt and Warwick (1980), Heip *et al.* (1982,1985), Jensen (1987), Ott and Novak (1989), Warwick (1989). The present chapter deals with the ecology and distribution of free-living nematodes of the west coast of India.

8.2 Ecological relationships:

8.2.1. Feeding types of nematodes.

Studies on the feeding types of aquatic free-living nematodes were approached in the past by various methods, all concerned with feeding structure. Much of the literature on feeding and indeed general ecology of marine nematodes is based on a paper by Wieser (1953b) who classified nematodes into feeding types according to the morphology of their buccal cavity. Inspite of uniformity in the organization of nematodes, there exists a considerable variation in the buccal armature, which bears on ecological relationships and the niche of the species.

From the lateral views of the buccal cavity of fixed specimens Wieser made a division in marine nematodes into four trophic groups: (1A): selective deposit feeders; which contain those species in which there is no real buccal cavity, although some species wherein it was small are included (These species supposedly pick up small food particles, such as bacteria selectively). (1B): non selective deposit feeders, which contains those species in which the unarmored buccal cavity is wide and they supposedly feed non-selectively on deposits (both groups encompassing species without teeth, and with small and large buccal cavities, respectively); (2A) epistrate feeders, which contains species which are presumably herbivorous; (2B) Omnivore–predators, in which species have wide buccal cavities and glands opening on teeth, and they are supposedly carnivores or omnivores. This classification has been repeatedly

Table 8.1 Feeding type of nematodes with preffered substratum

S= Sand; SiS= Silty Sand; CSi= Clayey Silt;SSiC= Sand Silt Clay;SiC= Silty Clay; SSi= Sandy Silt

No.	Species	Feeding type	Substratum
1	*Oncholaimus dujardini*	2B	S
2	*Oncholaimium vesicarium*	2B	S
3	*Oncholaimellus carlbergi*	2B	S
4	*Metoncholaimus spp*	2B	CSi,S,SiS
5	*Filoncholaimus filicaudatus*	2B	SiS
6	*Oncholaimus spp*	2B	S,SiS,SiC,
7	*Viscosia macramphida*	2B	S
8	*Viscosia carynleyensis*	2B	S
9	*Viscosia viscosa*	2B	SiC
10	*Viscosia elagans*	2B	S
11	*Enoplus spp*	2B	S
12	*Viscosia spp.*	2B	CSi,S,SiS,SSiC,SiC,
13	*Halalaimus isaitshikovi*	1A	CSi,SiS
14	*Halalaimus meyersi*	1A	CSi,S,SiS
15	*Halailaimus gracilis*	1A	CSi,SiS
16	*Halalaimus longicoudatus*	1A	CSi,S,SiS
17	*Halalaimus spp*	1A	CSi,S,SiS,SSiC,SiC,
18	*Oxystomina clavicoudata*	1A	SiS
19	*Oxystomina elongata*	1A	CSi,S,SiS,SSiC,SiC,
20	*Weiseria spp*	1A	CSi,SiC,
21	*Eurystomina spp.*	2B	S
22	*Tripyloides marinus*	1B	CSi
23	*Ledovitia phanertrata*	2B	S
24	*Bathylaimus spp*	1B	CSi,S,
25	*Anoplostoma spp*	1B	CSi,S,SiS
26	*Trefusia longicoudata*	1A	CSi,S,SiC
27	*Pseudocella spp*	1B	CSi,SiC
28	*Rhabdonemania spp.*	1A	CSi,S,SiC
29	*Crenopharynx marioni*	1A	S,SiC
30	*Laimella filipjevi*	1B	S
31	*Laimella longicaudata*	1B	CSi,S
32	*Laimella spp*	1B	CSi,S,SiS
33	*Dorylaimopsis spp*	1B	CSi,S,SiS,SSi,SiC,
34	*Comesoma spp*	1B	CSi,S,SiC,
35	*Sabatieria paracupida*	1B	S
36	*Sabatieria spp*	1B	CSi,S,SiS,SSi,SiC,
37	*Setosebatieria hilarula*	1B	S,SiS
38	*Hopperia spp*	1B	CSi,S,SiC
39	*Actarjania spp*	1B	CSi,S,SiS,SiC
40	*Paracomesoma longispiculum*	1B	S,SiS
41	*Cervonema macramphis*	1B	S
42	*Parapinnanema harveyi*	1B	SiS
43	*Richtersia inaequalis*	1B	S
44	*Richtersia spp*	1B	CSi,S
45	*Gamanema spp*	1B	Csi
46	*Choniolaimus papillatus*	1B	S
47	*Halichoanolaimus dolichurus*	2B	S,SiS,SiC,
48	*Halichoanolaimus consimilis*	2B	S
49	*Synonchiella riemanni*	2B	CSi,S,SiC
50	*Latronema piratica*	2B	SiS
51	*Latronema orcina*	2B	S
52	*Latronema sp*	2B	CSi,S,SiS,SiC
53	*Cherionchus spp*	2B	CSi,S,SiS,SiC
54	*Tricoma brevirostris*	1A	S

No.	Species	Feeding type	Substratum
55	*Tricoma filipjevi*	1A	CSi
56	*Tricoma spp*	1A	CSi,S,SiS,SiC
57	*Greeffiella spp.*	1A	CSi,S,SiS,SiC
58	*Quadricoma scanica*	1A	CSi
59	*Quadricoma spp.*	1A	CSi,S,SiS,SSi,SiC,
60	*Spirinia similis*	2A	CSi,S
61	*Spirinia parasitifera*	2A	S,SiS
62	*Spirinia spp*	2A	CSi,S,SiS
63	*Desmodora tenuispiculum*	2A	CSi,S,SiS,SSi,SiC,
64	*Desmodora spp*	2A	CSi,S,SiS,SSi,SiC,
65	*Desmodora brachypharynx*	2A	CSi,S,SiC
66	*Desmodora scaldensis*	2A	CSi,S,SiC
67	*Catanema macintyrei*	1A	CSi,S,SiS,SiC
68	*Chromaspirina spp*	2B	S,SiS
69	*Chromaspirina inaurita*	2B	S,SiS
70	*Metachromadora pulvinata*	2A	SiC
71	*Metachromadora spp*	2A	CSi,S
72	*Acanthopharyngoides chitwoodi*	2B	S,SiS
73	*Perspira spp.*	2A	CSi,S,SiC
74	*Acanthopharynx spp*	2B	CSi,S,SiS,SiC
75	*Bolbolaimus teutonicus*	2A	S,SiS
76	*Actinonema pachydermatum*	2A	S,SiS,SiC
77	*Spilophorella euxina*	2A	CSi,S
78	*Spilophorella candida*	2A	S
79	*Spilophorella tollenifera*	2A	S
80	*Spilophorella spp*	2A	CSi,S
81	*Dichromodora geophila*	2A	CSi,S,SiS
82	*Neochromadora spp*	2A	S,SiS,Ssi
83	*Trochamus spp*	2A	S,SiS
84	*Longicyatholaimus quadriseta*	2A	S
85	*Longicyatholaimus spp*	2A	CSi,S,SiC
86	*Paralongicyatholaimus minutus*	2A	S
87	*Metacyatholaimus spatiosus*	2A	S,SiC
88	*Metacyatholaimus spp.*	2A	CSi,S,SiS,SiC
89	*Pomponema segregata*	2B	S,SiC
90	*Pselionema longiseta*	1A	S
91	*Pselionema spp*	1A	CSi,S,SiS
92	*Ceramonema carinatum*	1A	CSi,S,SiS
93	*Cyartonema spp*	1A	S
94	*Cyartonema germanicum*	1A	S
95	*Dasynemoides albaensis*	1A	SiS
96	*Dasynemella spp*	1A	S
97	*Filitonchus filiformis*	1B	S
98	*Rhinema spp*	2B	SiS
99	*Calomicrolaimus spirifer*	2A	S,SiS
100	*Nudora crepidata*	2A	S,SiS
101	*Paraeuchromadora longicaudata*	2A	S
102	*Nudora spp.*	2A	SiC
103	*Notochaetosoma killieri*	1A	S
104	*Dracognomus simplex*	1A	S
105	*Leptonemella aphanothecae*	1A	S
106	*Southernia zosterae*	1A	CSi,S,SiS,SSi,SiC,
107	*Antomicron elegans.*	1A	SSi,S
108	*Monhystera spp*	1B	S,SiC
109	*Sphaerolaimus pacifica*	2B	S,SiS,SiC
110	*Sphaerolaimus hirsutus*	2B	Csi
111	*Sphaerolaimus islandicus*	2B	S
112	*Sphaerolaimus penicillus var. Pugetens*	2B	S

No.	Species	Feeding type	Substratum
113	*Sphaerolaimus macrocirculus*	2B	CSi,SiC
114	*Sphaerolaimus spp*	2B	CSi,S,SiS,SSi,SiC,
115	*Theristus acer*	1B	S,SSiC
116	*Theristus fistulatus*	1B	S
117	*Theristus exutus*	1B	S
118	*Theristus alternus*	1B	S
119	*Theristus spp*	1B	CSi,S,SSiC,SiS,SiC,
120	*Paramonohystera spp*	1B	S,SiS,SiC
121	*Paramonohystera buetschlii*	1B	CSi,S,SiS,Ssi
122	*Promonhystera spp.*	1B	S,SiS
123	*Metadesmolaimus aduncus*	1B	SiS
124	*Metadesmolaimus spp*	1B	SiC
125	*Linhystera spp*	1B	S,SiS,SiC
126	*Elzalia spp*	1B	S,SiS
127	*Rhynchonema cinctum*	1B	S,SiC
128	Promonhystera faber	IB	S, SiS
129	*Cobbia spp*	1B	S,SiC
130	*Daptonema spp*	1B	CSi,S
131	*Daptonema oxycerca*	1B	S
132	*Linhomoeus spp*	1B	S,SiS
133	*Xenolaimus striatus*	1B	S
134	*Axonolaimus spp*	1B	SiC
135	*Axonolaimus spinosus*	1B	CSi,S,SiC
136	*Ascolaimus elongatus*	1B	S
137	*Parodontophora brevamphida*	1B	S
138	*Parodontophora breviseta*	1B	CSi,S,SiC
139	*Paralinhomoeus tenuicaudatus*	1B	S,SiS
140	*Paralinhomoeus pachyamphis*	1B	S,SiC
141	*Paralinhomoeus lepturus*	1B	S,SiS
142	*Paralinhomoeus spp*	1B	CSi,S,SiC
143	*Terschellingia communis*	1A	CSi,S,SiC
144	*Terschellingia longicoudatus*	1A	CSi,S,SiS,SiC
145	*Metalinhomoeus longiseta*	1B	CSi,S,SiS,SiC
146	*Eumorpholaimus subulicolus*	1B	S
147	*Metalinhomoeus spp*	1B	CSi,SiS,SiC
148	*Eleutherolaimus stenosoma*	1B	SiS
149	*Amphimonhysterella anechma*	1B	S
150	*Disconema alaima*	1A	S,SiS
151	*Didelta scutata*	1B	S,SiS,SiC
152	*Diplopeltula asetosa*	1B	SiS,SiC
153	*Siphonolaimus pachyderma*	2B	S
154	*Siphonolaimus auratus*	2B	S
155	*Siphonolaimus spp*	2B	S,SiS,SiC

found applicable also to studies from other areas (e.g. Ott, 1972), but it has also been refined to meet the requirements of local nematode populations (Boucher, 1973, Platt, 1977, Jensen, 1983, Romeyn and Bouwman, 1983). Table 8.1 shows the feeding types of free-living nematodes of the west coast of India with their corresponding substratum type.

The feeding types of 155 species of nematodes from the west coast shelf was studied based on the general observations of buccal cavity. All the four feeding types were noticed among the free-living nematodes of the study area. In 30-50 m depth range, of the total 99 species, non-selective deposit feeders (1B) were dominant (35%). The epistrate feeders (2A) were represented by 26%, whereas the omnivore-predators (2B) were 23% and selective deposit feeders (1A) 16%. Altogether deposit feeders (IA and IB) were more abundant in this depth range. In 51-76m range, of the total 99 species, non-selective deposit feeders (1B) and omnivore predators (2B) were almost equally represented, 32%, and 28% respectively. Epistrate feeders (2A) and selective deposit feeders (1A) were 22% and 16% respectively. Altogether deposit feeders (IA and IB) were more in this depth range. In 76-100 m depth range, of the total 37 species, deposit feeders (1B and 1A) together contributed 64%. The epistrate feeders (2A) and omnivore predators (2B) were almost equally represented, 16% and 19% respectively. In 101-150 m depth range, of the total 52 species, deposit feeders (1A and 1B) together contributed 63%. The epistrate feeders (2A) were represented by 23% and the omnivore/predators (2B) by 11% only. In >150 m of the total 35 species, non-selective deposit feeders (1B) were dominant (47%). The selective deposit feeders(1A) and epistrate feeders (2A) were equally distributed, 19% each, whereas predators(2B) are poorly represented (14%). The overall percentage of deposit feeders, omnivore/carnivores and epistrate feeders in the west coast was 56.8%, 23% and 20% respectively.

The correlation between sediment composition and trophic structure of the community has been studied by Wieser (1953b, 1959b), Hopper and Meyers (1967), Tietjen (1969), Warwick and Buchanan (1970), Coull (1970), and Juario (1975). In general, they state that non-selective deposit feeders dominate muddy sediments and sandy sediments are dominated by epistratum-feeders. In the Weddel Sea shelf and slope the studies of nematode feeding type when related with the microbial food and organic matter lead to the conclusion that applied classification does not adequately explain the trophic status of deep water communities' (Vanhove *et al.*, 1999). Observations on actual feeding and histochemical analysis of digestive enzymes in marine nematodes and better knowledge of grazing efficiency on specific microbes shall improve present idea of nematode nutrition and their role in trophic dynamics.

8.2.2. Free-living nematodes and hydrography.

Hydrographical parameters exert a combined effect on the survival, growth and development of most of the nematodes. Among them temperature has a profound effect on minimum generation time in all nematodes (Gerlach and Scrage, 1971, Warwick, 1981). For many species development is more temperature dependant as they prefer lower temperature ranges than near the optimum. Development rate reaches maximum at optimum temperature beyond which generation time is prolonged. This is the typical response for most meiofauna (Vernberg and Coull, 1981). Only a few studies (Tietjen and Lee, 1972, Warwick, 1981) report on the combined effect of temperature and salinity on generation time. The reproductive potential of many nematodes is profoundly influenced by temperature, salinity and food (Tietjen and Lee, 1977; Alongi and Tietjen, 1980). The dissolved oxygen content and availability of the living space are considered to be affected by the decrease in water content of substrate (Tietjen, 1969). Bradfield (1964) has shown that the oxygen content of the interstitial water decreases significantly with depth in the sediments.

It is clear that in the shelf waters of west coast there is a sharp decline in the bottom temperature and dissolved oxygen concentration with increase in depth (refer Chapter 4, hydrography), The increase in depth is often associated with the decrease in temperature and dissolved oxygen. In the case of nematodes the abundance and biomass values showed prominent decline in the depth ranges selected while in the depth beyond 150 m, an increase in the numerical abundance was observed. Soltwedel (2000) reported similar observations in his review on meiobenthos of the continental margins. The salinity showed a variation with depth but the magnitude was meager. So salinity cannot be considered to be a limiting factor.

The nematode biomass and abundance showed a negative correlation with depth (r=-0.37 and r=-0.36 respectively). Nematode biomass and abundance showed a poor correlation with temperature (r=0.19 and 0.17). The dissolved oxygen showed a positive correlation (1%) with nematode biomass (r=0.34) and nematode abundance (r=0.32). Species richness and species

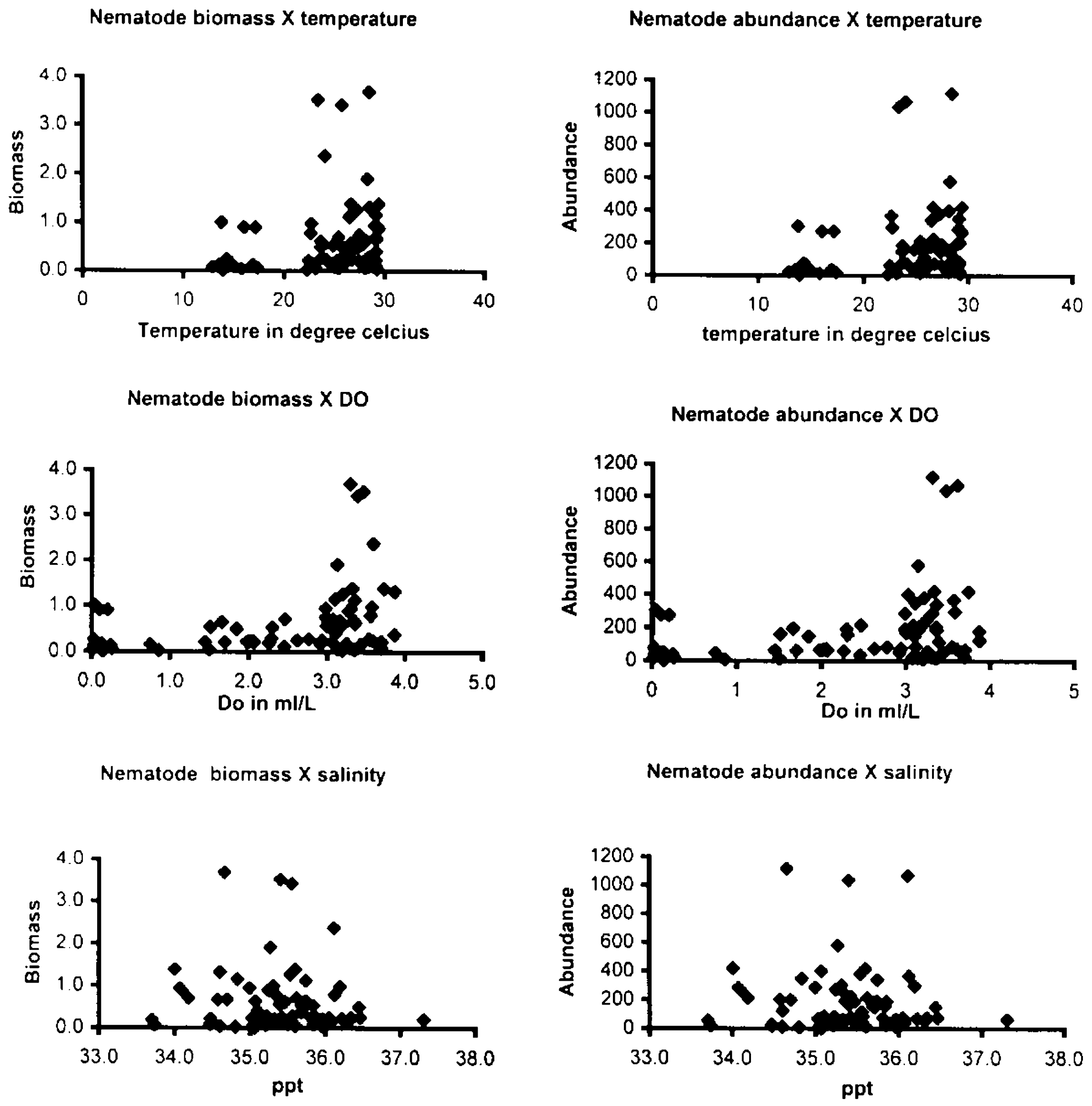


Fig. 8.1 Relation between nematodes and physical parameters

diversity of nematodes also showed a positive correlation with dissolved oxygen (r=0.27 and r=0.28 respectively). Salinity showed no significant relation with nematode abundance and biomass. The correlation between diversity and environmental parameters was carried out. A significant correlation was observed between Shannon diversity and temperature (1% significance) and with dissolved oxygen (5% significance). The richness index "d" showed a positive correlation (1%) with temperature and a negative correlation with salinity (0.5%). Scatter diagram reveals the details of relation between nematodes and hydrographical parameters (Fig.8.1).

Metazoan meiofauna tend to be more tolerant than macrofauna to anoxia (Giere, 1993), and nematodes are more tolerant than other meiofaunal taxa (Moodley *et al.*, 1997; Levin *et al.*, 1991). Jensen (1987) investigated low oxygen conditions in sandy sediments at shallow depths and found that nematode abundance was unaffected by oxygen concentration. Similar result was obtained from the studies of nematodes of Louisiana shelf in the Gulf of Mexico (Murrel and Fleeger, 1989). The studies of nematode abundance in various deeper waters of Arabian Sea support the hypothesis that low oxygen (0.13ml/L) does not affect the abundance of nematodes. (Cook *et al.*, 2000). The studies of nematodes of the bathyl transects of Peru suggested that there is an indirect effect of low oxygen level on the nematode density in the deeper layers (Neira *et al.*, 2001). They suggested that reduction of predators and competitors and preservation of organic matter leading to high food availability may be playing a crucial role in nematode abundance in deeper sediment layers.

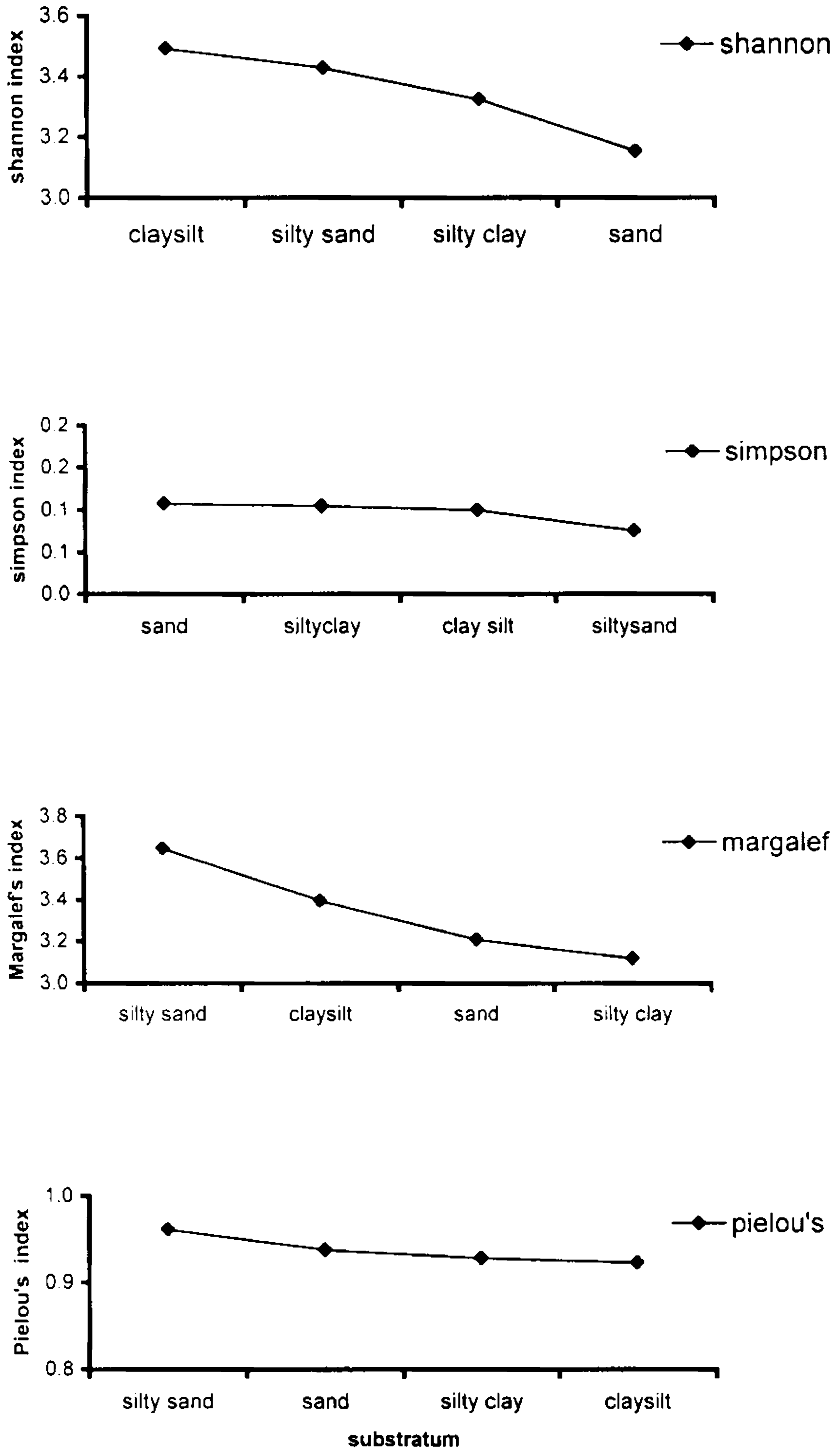


Fig.8.3 Relation between nematode diversity indices and sediment texture

It was found that the number of families occurred among various depth levels also showed marked decline. In the shallower region about 25 families were represented while in the deepest part of the shelf only 13 families were present. This suggests the robustness of such families to environmental conditions of deeper waters (>150m).

8.2.3. Free-living nematodes and substratum.

When describing meiofauna habitats, grain size is a key factor, which directly determines spatial and structural conditions, and indirectly determines the physical and chemical milieu of the sediment. Besides the pore volume, the size of the internal surfaces of the sediment particles is an important determinant for meiobenthic life. There is a well-established relationship between the relative proportions of nematodes and harpacticoids and the grain size. The sediment differences affect the two major groups of meiobenthos, nematodes and harpacticoids, finer sediments are preferred by nematodes and coarser often by harpacticoids (Coull, 1985; Gray, 1971; McLachlan *et al.*, 1981).

High average species richness of free-living nematodes was observed in silty sand immediately followed by clayey silt (Fig 8.3). Ansari (1978) reported the preference of meiofauna to silty substratum in general and nematodes in particular. Average evenness index of nematodes was high in silty sand followed by sand. Average species diversity of nematodes was high in clay silt and silty sand followed by silty clay. Average species dominance of nematodes was high in sand followed by silty clay.

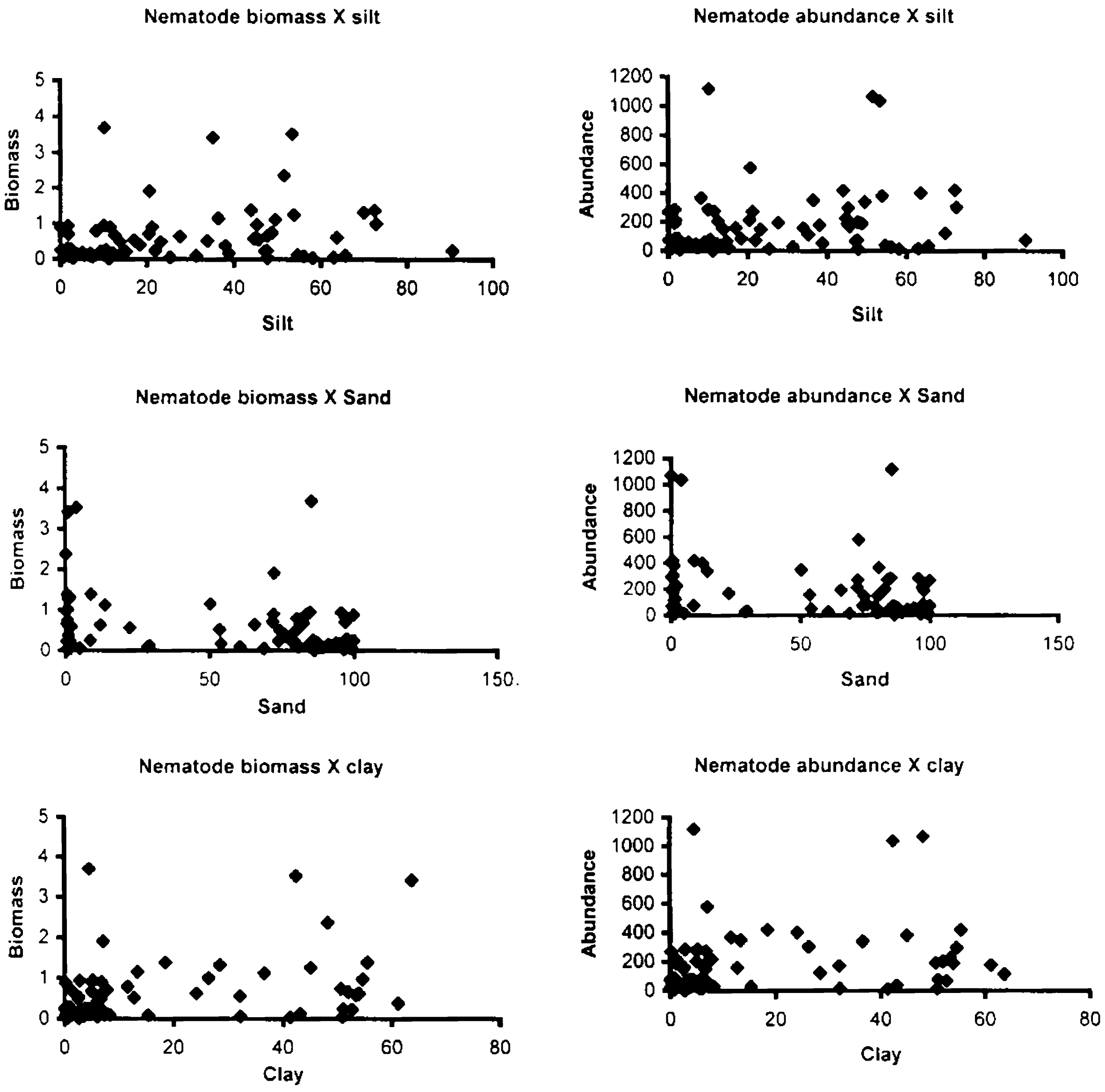


Fig.8.2 Scatter diagram showing the relation between nematodes and substrata.

The present study revealed that nematode abundance was high in clayey silt (Fig.8.2). The silty sand was in second position, which was followed by silty clay and sand. The nematode biomass was high in clayey silt followed by silty clay. The next importance was silty sand and sand.

The free-living nematodes of the sub-littoral waters are studied by describing different communities in different habitats, mostly characterized by sediment composition. Wieser (1960) was the first to deal with the community concept in marine nematodes. The existence of numerous microhabitats within a more general environment can be inferred from the distribution of closely related species. More species, and a more even distribution of feeding types will be present in a habitat with a larger number of niches. Silt-clay content, sorting efficiency, and medium grain size determine the heterogeneity of the sediment.

During the present study coastal inshore (30m) muddy stations are characterized by the presence of families like Comesomatidae, Desmodoridae, Xyalidae and Linhomoedae. The major genera or species include, *Halalaimus* sp; *Dorylaimopsis* sp; *Desmodora* sp, *Theristus* sp; *Terschellingia longicaudatus, Metalinhomoeus longiseta and Spirinia* sp. Beyond this depth the dominance of *Laimella* sp, *Sabatieria* sp, *Monhystera* sp, *Oxystomina elongata, Promonhystera* sp. and *Linhomoeus* sp, was apparent.

Similar nematode assemblages were observed in muddy substratum, worldwide. In such sediments, the existence of families like Comesomatidae, Linhomoeidae, Xyalidae, Spiriniidae, and Sphaerolaimidae are reported. The different studies of muddy substratums shows that *Dorylaimopsis* sp, *Sabatieria* sp, *Terschellingia* sp *Tripyloides gracilis* and *Spirinia parasitifera,* were the most dominant species among the free-living nematodes (Stekhoven, 1950; Warwick and Buchanan, 1970, 1971; Boucher, 1972; Ward, 1973; Vitiello, 1974; Lorenzen, 1974; Juario, 1975; Tietjen, 1977).

Similarly the sandy stations of the present study are characterized by the presence of predatory forms. The major families include Desmoscolicidae, Desmodoridae, Selachinematidae Comesomatidae and Chromadoridae. The abundant genera or species include in the sandy stations of 30-50m Tricoma sp, *Desmodora* sp, *Latronema* sp, *Dracognomus simplex, Parodontophora breviseta, Eurystomina* sp, *Laimella* sp *and Spirinia* sp. In stations of 51-75 the dominant species were *Tricoma* sp, *Viscosia* sp, *Choniolaimus papillatus, Halichoanolaimus* sp, *Desmodora* sp, *Trochamus* sp. In 76-100m depth range *Tricoma* sp, *Latronema* sp, *Trefusia* sp, *Tripyloides marinus, Spirinia* sp, *Desmodora brachypharynx* were the dominant members. Beyond this depth level the abundance of *Tricoma* sp, *Richtersia inaequalis, Desmodora tenuispiculum, Sabatieria* sp, *Latronema* sp, *Paralinhomoeus tenuicaudatus, Notochaetosoma killieri, Promonhystera* sp, *Theristus* sp, *Metacyatholaimus spatiosus, Cherionchus* spp were noticed.

Similar observations were reported from the studies of sandy stations of various geographical areas. The species like *Neochromadora* sp, *Desmodora* sp, *Theristus* sp, *Paralinhomoeus* sp, *Tricoma* sp, *Latronema* sp, *Choniolaimus* sp, *Richtersia* sp *and Nudora* sp (Jensen, 1974, Tietjen, 1977, Nichols, 1980, Willems, *et al.*, 1982, Wieser, 1959a) are dominant forms reported.

The dominant species of free living nematodes like *Desmodora* sp, *Dorylaimopsis* sp *and Halalaimus* sp which were present in most of the stations

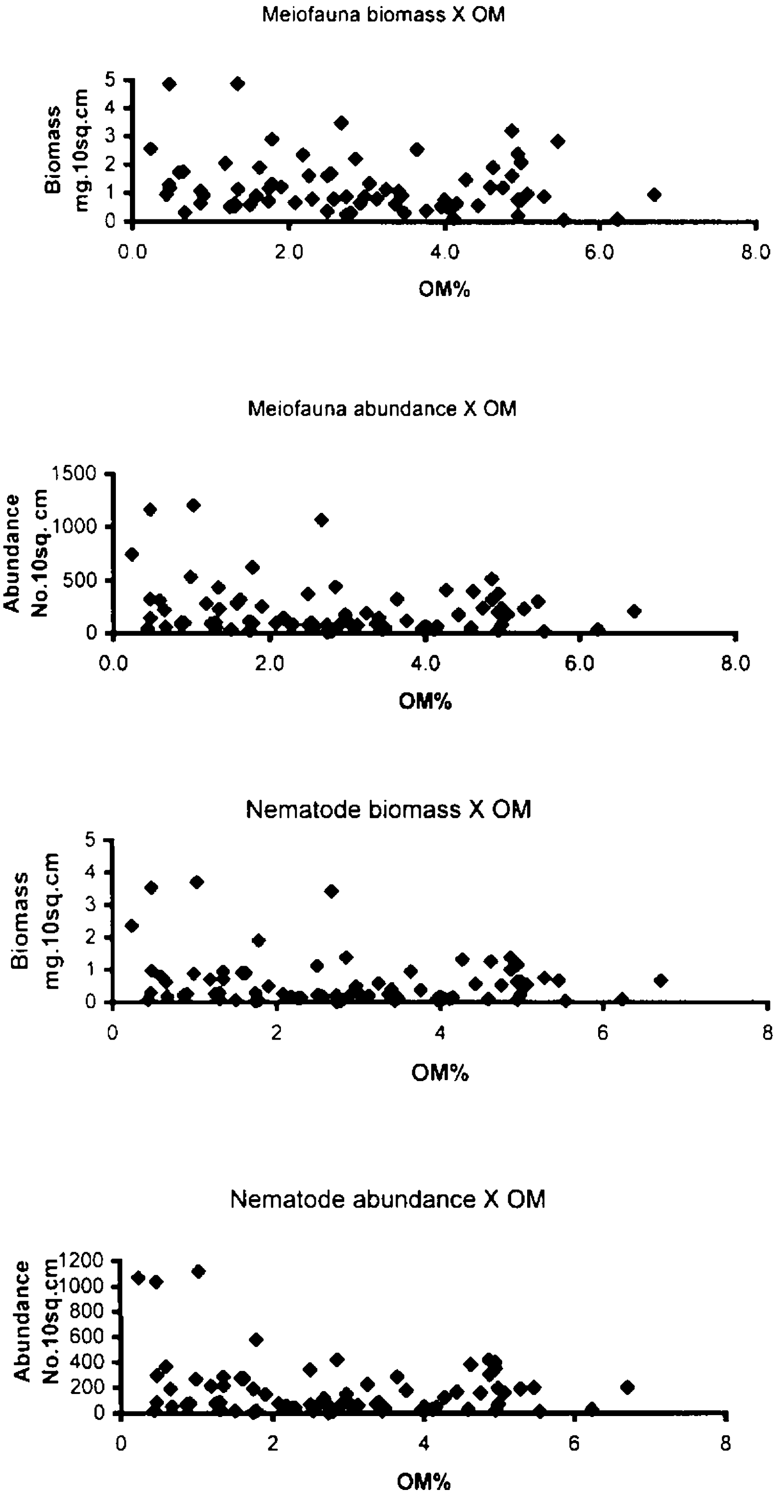


Fig.8.4 Relation between organic matter and fauna

and their distribution indicates that they were occur between stations of different substratum nature. 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. So the present study shows that even if many species are characteristically associated with a given sedimentary habitat, their distributions are rarely confined to that environment. Some species show little affinity with any one particular sediment type, and the fauna within different sediment environments invariably show some degree of overlap.

The substratum and its organic content are connected with the distributions of organisms. The organic matter and the content of organic debris and bacterial biomass are closely linked (Jorgenson *et al*, 1981). Detritus, especially through its rich coating of bacteria, can entail high concentrations of meiofauna. With the aging of plant debris, the bacterial colonisation grows and the protein content of a sample increases. This, in turn, makes it more attractive to meiofauna, especially for nematodes (Warwick, 1989). In addition rottening animal tissues can attract meiofauna (nematodes) in the sediment (Gerlach, 1977; Olafsson, 1992).

The correlation between organic matter and the nematode abundance or biomass and diversity (Fig. 8.4) does not show any significant relation. Detailed understanding of the qualitative nature of organic matter is availed to explain the relation between nematodes and organic matter.

8.2.4. BIO-ENV procedure:

Further in order to reveal the relation between the environmental parameters and nematodes the BIOENV procedure was also carried out. In the present study, the available set of environmental variables was as follows. (1.) Temperature, (2) Salinity, (3) Dissolved Oxygen, (4) Depth, (5) Organic matter, (6) Sand, (7) Silt and (8) Clay. The combination of variables, which manifested in explaining the nematode species distribution were temperature, dissolved oxygen, depth, and silt. The best 5 combinations are given in the table. 7.

Table.8. 2. Combinations of environmental variables controlling nematode abundance.

Number of Variables	Best selection	Correlation
4	1,3,4,7	0.185
3	1,4,7	0.183
3	1,3,4	0.180
5	1,2,3,4,7	0.178
2	1,4	0.177

In the present study, the BIO-ENV- procedure provides the combinations of five environmental variables- temperature, dissolved oxygen, depth, and silt as the most important factors defining the existing nematode abundance. However the coefficient of environmental parameters to nematode species similarity matrix was 0.185. There is not much studies which are available to make a comparison with the present study. However the studies of Clarke and Ainsworth (1993) observed the combinations of organic carbon, sediment particle size and cadmium, which form the best explanation for nematode distribution.

8.3.Distribution

8.3.1.Spatial distribution

The spatial distribution of nematodes of various depth ranges along the west coast of India is given in the table (8.3). Significant differences in number of nematodes do exist between the stations and transects all along the western continental shelf waters. The population density of nematode fauna varied from 2 ind. 10cm^{-2} to 1118 ind.cm^{-2}. In 30-50 m depth range, 99 species of free-living nematodes belonging to 25 families and 3 orders were identified. The order Chromadorida was the most abundant (50%) in this depth range representing 51 species from 11 families. Chromodorida was followed by Monhystrida and Enoplida. Monhystrida was represented by 30 species of 6 families and Enoplida by 18 species of 8 families. The major families representing the order Chromadorida were Desmodoridae, Comesomatidae, Chromadoridae, Desmoscolicidae and Selachinematidae. Among Monhystrida the important families were Xyalidae, Linhomoeidae, Sphaerolaimidae and Axonolaimidae. The major families in the order Enoplida were Oxystominidae and Oncholaimidae. The most abundant species in this depth range were *Halalaimus* spp, *Tricoma* spp, *Dorylaimopsis* spp, *Desmodora* spp, and *Theristus* spp.

In 50-75 m depth range, 99 species of free-living nematodes belonging to 24 families and 3 orders were identified. The chromadorids and monhystrids together represented 80% of the total species. Chromadora was represented by 50 species belonging to 11 families. Monhystrida was represented by 30 species of 6 families. Enoplida was represented by 19 species of 7 families. The

Table 8.3a. Distribution of free- living nematodes of west coast of India in 30-50 m depth range.

Species	cape1	tvm	klm1	klm2	kch	vad	kzh1	kzh2	knr	mngr1	cnpr	btkl	goa	rtngr	dbhl	ofmb	almb	prbn
Oncholaimus spp	0	3	0	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0
Viscosia viscosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Viscosia elagans	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
Viscosia spp	2	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
Halalaimus isaitshikovi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
Halalaimus meyersi	0	0	0	0	0	4	0	0	0	0	4	0	0	0	0	0	0	0
Halalaimus longicoudatus	0	2	5	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
Halalaimus spp	0	0	6	2	0	0	1	0	4	0	0	7	7	0	7	2	2	5
Oxystomina elongata	2	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0
Weiseria spp	0	0	0	0	0	0	0	0	3	0	4	0	0	0	0	0	4	0
Eurystomina spp	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0
Ledovitia phanertrata	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Bathylaimus spp	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	5
Anoplostoma spp	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0
Trefusia longicoudata	0	0	0	0	2	0	0	0	3	0	0	0	0	0	0	0	0	0
Pseudocella spp	0	0	0	0	0	0	0	0	0	4	0	4	0	0	0	0	0	0
Rhabdonemania spp.	0	0	2	2	0	0	0	0	0	2	0	0	0	4	0	0	0	0
Crenopharynx marioni	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Laimella longicaudata	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0
Laimella spp	0	0	0	0	2	0	0	0	0	0	0	6	0	0	0	0	0	0
Dorylaimopsis spp	0	0	8	2	4	7	2	0	5	4	0	11	10	7	5	3	0	6
Comesoma spp	0	4	0	3	3	0	0	0	4	0	0	5	0	0	0	0	5	0
Sabateria spp	0	0	0	2	0	0	0	0	0	0	7	0	0	0	6	0	0	0
Setosabatieria halirula	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
Hopperia spp	0	0	2	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
Actarjania spp	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Richtersia inaequalis	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
Richtersia spp	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Halichoanolaimus dolichurus	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0
Synonchiella riemanni	0	0	0	0	0	0	0	0	0	3	0	0	0	5	0	0	0	0
Latronema sp	1	2	2	3	2	0	0	0	0	0	0	0	0	0	5	0	0	0
Cherionchus spp	0	0	0	0	0	0	0	0	0	0	0	0	7	8	0	0	0	9

Table 8.3a contd.	cape1	tvm	klm1	klm2	kch	vad	kzh1	kzh2	knr	mngr1	cnpr	btkl	goa	rtngr	dbhl	ofmb	almb	prbn
Tricoma filipjevi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Tricoma spp	2	8	2	2	9	4	0	0	5	0	0	0	8	12	0	0	9	0
Greeffiella spp	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Quadricoma scanica	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0
Quadricoma spp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	2	3	0
Spirinia similis	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spirinia parasitifera	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spirinia spp	0	4	0	8	4	0	0	0	3	0	0	0	0	0	0	0	0	0
Desmodora tenuispiculum	3	0	0	0	5	0	0	0	0	0	0	0	0	0	0	2	0	0
Desmodora spp	0	11	26	3	7	0	2	4	0	0	0	0	0	7	0	45	20	13
Desmodora brachypharynx	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	19	0
Desmodora scaldensis	0	2	3	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
Catanema macintyrei	0	0	0	2	0	0	0	0	0	0	0	0	0	5	4	1	0	0
Leptonemella aphanothecae	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chromaspirini inaurita	0	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Metachromadora pulvinata	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0
Metachromadora spp	0	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acanthopharyngoides chitwoodi	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Perspira spp	2	1	1	4	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Acanthopharynx spp	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
Actinonema pachydermatum	0	0	0	0	2	0	0	0	4	0	0	0	0	0	0	0	0	0
Spilophorella euxina	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
Spilophorella tollenifera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spilophorella spp	0	2	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Dichromodora geophila	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neochromadora spp	1	2	0	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Trochamus spp	4	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0
Longicyatholaimus spp	0	0	0	0	0	4	0	0	0	0	6	0	0	0	5	0	0	0
Paralongicyatholaimus minutus	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
Metacyatholaimus spatiosus	0	0	0	0	3	5	0	0	0	0	0	0	0	4	0	0	0	0
Metacyatholaimus spp.	0	0	0	0	2	0	0	0	0	0	0	0	0	0	4	0	0	0
Ceramonema carinatum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cyartonema germanicum	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Calomicrolaimus spinfer	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0

Table 8.3a. Contd.	cape1	tvm	klm1	klm2	kch	vad	kzh1	kzh2	knr	mngr1	cnpr	btkl	goa	rtngr	dbhl	ofmb	almb	prbn
Nudora spp	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0
Dracognomus simplex	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leptonemella aphanothecae	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Monhystera spp	0	0	0	0	0	0	0	1	0	0	0	0	6	0	0	0	0	0
Sphaerolaimus pacifica	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	2	0	0
Sphaerolaimus hirsutus	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0
Sphaerolaimus macrocirculus	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0
Sphaerolaimus spp	0	0	0	2	1	2	0	0	0	3	0	0	0	6	0	2	0	0
Theristus exutus	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Theristus alternus	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Theristus spp	0	3	0	4	6	4	0	0	5	4	0	8	0	0	0	0	0	7
Paramonhystera buetschlii	0	0	0	0	0	0	0	0	0	3	0	4	0	0	0	0	0	0
Linhystera spp	0	0	0	0	0	2	0	0	3	0	0	0	0	0	0	0	0	0
Elzalia spp	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhynchonema cinctum	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0
Cobbia spp	0	2	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
Linhomoeus spp	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Metadesmolaimus spp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Xenolaimus striatus	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Axonolaimus spinosus	0	4	3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Ascolaimus elongatus	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Parodontophora brevamphida	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Parodontophora brevisita	0	2	3	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0
Paralinhomoeus pachyamphis	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
Paralinhomoeus lepturus	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Paralinhomoeus spp	0	0	0	0	0	2	0	0	0	0	0	0	0	5	4	0	0	0
Terschellingia longicoudata	0	0	0	0	3	2	0	0	5	4	15	5	0	14	6	0	0	0
Metalinhomoeus longiseta	0	0	0	2	0	4	0	0	4	0	13	0	8	3	0	3	0	0
Metalinhomoeus spp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0
Didelta scutata	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
Diplopeltula asetosa	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0
Siphonolaimus spp	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Southernia zosterae	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified spp	4	9	6	9	11	7	0	4	9	3	11	11	12	6	4	6	5	8

Table 8.3b Distribution of free- living nematodes of west coast of India in 50-75 m depth range.

Species	Cape2	tvm	klm	kch	vad	knr1	knr2	mngr2	cnpr	btkl1	btkl2	goa1	goa2	rtngr	dbhl	ofmb	atmb	dwrk
Oncholaimus spp	0	0	0	4	0	0	0	0	0	0	0	0	5	0	0	0	0	2
Oncholaimus dujardini	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Viscosia spp	0	2	0	4	0	0	4	0	0	0	0	6	0	4	6	0	0	4
Viscosia macramphida	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Viscosia carnleyensis	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oncholaimium vesicarium	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oncholaimellus carlbergi	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Metoncholaimus spp	0	2	0	0	0	3	0	0	0	0	0	0	0	0	0	5	0	0
Halalaimus spp	0	0	8	0	0	9	2	0	2	2	3	8	6	5	5	9	4	2
Halalaimus isaitshikovi	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	4	0	0
Halalaimus longicoudatus	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	5	0	0
Halalaimus gracilis	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	3	0	0
Oxystomina elongata	0	0	0	0	0	0	0	0	0	0	0	8	5	5	4	0	0	0
Weisena spp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0
Eurystomina spp	0	0	2	0	0	0	2	0	3	0	0	0	0	0	0	0	0	0
Tripyloides marinus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
Anoplostoma spp	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhabdonemania spp	0	1	0	0	0	0	1	0	0	0	0	0	0	4	0	4	0	0
Crenopharynx marioni	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
Laimella longicaudata	0	0	0	3	0	0	0	0	0	0	0	0	0	4	0	0	0	0
Laimella filipjevi	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Laimella spp	0	0	0	0	0	3	7	0	0	0	0	0	6	3	0	5	0	0
Dorylaimopsis spp	0	0	0	8	0	6	5	2	0	0	0	0	7	6	7	6	6	2
Comesoma spp	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	4	0	0
Paracomesoma longispiculum	0	0	0	0	0	4	0	0	0	0	2	0	0	0	0	0	0	0
Parapinnanema harveyi	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0
Sabatieria spp	1	1	4	0	7	5	5	0	4	0	0	0	6	4	6	0	0	0
Setosabatieria hilarula	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Actarjania spp	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0
Choniolaimus papillatus	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Halichoanolaimus consimilis	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Halichoanolaimus dolichurus	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0
Synonchiella nemanni	0	0	4	0	0	0	2	0	0	0	0	0	0	5	0	0	2	0
Latronema sp	0	0	0	0	0	0	0	0	2	1	0	0	0	5	0	0	0	0
Latronema piratica	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0
Latronema orcina	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cherionchus spp	0	0	0	3	0	3	0	0	0	0	0	0	0	5	0	3	6	0
Tricoma spp	1	0	12	4	6	4	4	0	1	4	6	0	0	0	0	4	0	0
Tricoma brevirostris	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Greeffiella spp.	0	0	0	0	0	0	2	0	0	3	3	0	4	0	0	0	0	0
Quadricoma spp	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	4	0	0
Spirinia parasitifera	0	0	0	0	0	4	2	0	0	0	0	0	0	0	0	0	0	0
Spirinia spp	0	1	7	2	0	3	1	0	0	1	0	0	4	0	0	2	0	0
Desmodora tenuispiculum	0	1	0	0	0	0	0	0	0	2	3	0	4	6	0	0	0	6
Desmodora spp	0	0	0	0	0	3	5	0	0	1	1	0	7	0	0	4	0	0
Catanema macintyrei	0	0	0	0	0	0	3	0	0	0	0	0	4	0	4	2	0	0
Chromospirina inaurita	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chromaspirina spp	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Acanthopharyngoides chitwoodi	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0
Acanthopharynx spp	0	0	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0
Bolbolaimus teutonicus	0	0	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0	0
Spilophorella tollenifera	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spilophorella euxina	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dichromodora geophila	0	1	0	0	0	0	0	0	0	0	0	0	3	4	0	0	0	0
Neochromadora sp	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 8.3b contd.

Trochamus spp	0	0	0	0	0	3	0	0	3	1	3	0	0	0	0	0	0	0
Longicyatholaimus quadriseta	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Longicyatholaimus sp	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Pomponema segregata	0	0	0	0	0	0	0	0	0	1	0	0	0	0	4	0	0	0
Metacyatholaimus spp	0	0	0	0	6	0	0	0	4	0	0	0	0	5	5	0	0	0
Metacyatholaimus spatiosus	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Pselionema spp	0	0	4	0	0	0	0	0	0	0	2	0	6	3	0	0	0	0
Ceramonema carinatum	2	0	4	0	0	0	0	0	0	1	3	0	4	3	0	0	0	0
Dasynemella spp	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Filitonchus filiformis	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
Rhinema spp	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
Nudora crepidata	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Antomicron elegans	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Paraeuchromadora longicaudata	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
Sphaerolaimus pacifica	0	0	0	2	7	0	0	0	0	0	0	0	0	0	0	0	0	0
Sphairolaimus islandicus	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sphaerolaimus spp	0	0	0	3	0	2	3	0	0	0	0	0	0	0	5	3	4	0
Sphaerolaimus macrocirculus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	6	0
Sphaerolaimus penicillus	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Theristus acer	0	0	0	0	0	0	3	0	0	0	0	4	0	0	0	0	0	0
Theristus spp	0	0	4	0	0	3	6	0	6	2	2	12	5	5	6	6	0	4
Theristus fistulatus	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
Paramonhystera spp	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4
Linhystera spp	0	0	0	0	0	2	0	0	0	1	1	0	0	0	0	0	0	0
Elzalia spp	0	0	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0
Promonhystera faber	0	0	0	2	6	0	0	0	0	0	0	0	5	0	0	0	0	0
Linhomoeus spp	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Daptonema spp	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	2	0	0
Daptonema oxycerca	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Axonolaimus spp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0
Paralinhomeous pachyamphis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0
Paralinhomoeus spp	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0
Paralinhomoeus tenuicaudatus	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Amphimonhystere anechma	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Terschellingia communis	0	0	0	0	0	0	2	0	0	0	0	0	0	5	6	5	0	0
Terschellingia longicoudata	0	0	0	0	10	0	4	3	2	0	0	0	0	3	5	0	0	0
Eleutherolaimus stenosoma	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Disconema alaima	0	0	5	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Metalinhomoeus longiseta	0	0	0	0	8	0	5	0	3	0	0	0	5	0	0	0	0	0
Metalinhomoeus spp	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	3	0	0
Didelta scutata	0	0	4	4	5	0	0	0	0	0	0	0	0	0	0	0	0	0
Siphonolaimus spp	0	0	0	3	0	0	0	2	1	0	0	0	0	0	0	3	0	0
Siphonolaimus pachyderma	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Siphonolaimus auratus	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified spp	4	1	6	8	9	7	2	1	5	3	8	4	1	2	3	2	8	1

Table 8.3c.Distribution of free- living nematodes of west coast of India in 76-100m depth range.

Species	rtngr	dbhl1	dbhl2	ofmb1	ofmb2	almb1	almb2	almb3	almb4	dwrk
Viscosia spp.	0	0	0	0	0	0	0	0	0	2
Halalaimus spp	3	3	2	0	0	0	0	0	3	0
Halalaimus longicoudatus	0	0	0	0	0	0	0	0	2	0
Tripyloides marinus	0	0	0	0	0	0	0	0	3	0
Trefusia longicoudata	0	0	0	0	0	0	0	0	4	0
Crenopharynx marioni	0	0	0	0	0	0	0	0	0	2
Laimella spp	0	0	5	1	3	0	0	0	0	0
Dorylaimopsis	4	0	0	0	0	0	3	4	0	0
Sabatieria spp	3	11	4	4	0	0	0	0	0	0
Actarjania spp	3	0	0	2	0	0	0	0	0	0
Richtersia spp	0	0	0	0	2	0	0	0	0	0
Halichoanolaimus dolichurus	0	0	0	2	0	0	0	0	0	0
Synonchiella riemanni	0	0	0	0	2	0	0	0	0	0
Latronema sp	0	0	0	2	4	2	0	0	0	0
Tricoma spp	4	5	0	3	4	0	2	3	0	1
Greeffiella spp.	0	0	0	0	0	0	0	1	0	0
Quadricoma spp	0	4	0	0	0	0	0	2	0	0
Spirinia spp	2	3	0	4	3	0	0	4	0	2
Desmodora tenuispiculum	3	0	0	0	0	0	0	2	0	0
Desmodora brachypharynx	0	0	0	0	0	0	3	0	0	0
Catanema macintyrei	5	0	0	0	0	0	0	0	0	0
Desmodora spp	0	0	0	3	0	0	0	0	0	1
Chromaspirini inaurita	4	0	0	0	0	0	0	0	0	0
Acanthopharyngoides chitwoodi	3	0	0	0	0	0	0	0	0	0
Neochromadora spp	0	0	0	0	0	0	0	2	0	0
Metacyatholaimus spp	2	4	0	0	0	0	0	0	0	0
Pselionema spp	0	0	0	0	0	3	0	0	0	0
Ceramonema carinatum.	0	0	0	0	0	0	0	0	2	0
Theristus spp	5	0	0	0	0	0	0	2	0	0
Linhystera spp	0	0	0	1	0	0	0	0	0	0
Elzalia spp	2	0	0	1	0	0	0	0	0	1
Promonhystera spp.	0	0	4	0	0	0	0	0	0	0
Cobbia spp	0	0	4	0	0	0	0	0	0	0
Eumorpholaimus subulicolus	0	0	0	2	0	0	0	1	0	0
Metalinhomoeus longiseta	0	0	0	1	0	0	0	0	0	0
Didelta scutata	0	0	0	0	0	0	0	2	0	0
Siphonolaimus spp	2	0	0	0	0	0	0	0	0	0
Unidentified spp	5	3	2	2	4	2	2	4	2	1

Table 8.3d.Distribution of free- living nematodes of west coast of India in 101-150m depth range.

Species	Cape	tvm	klm	kch	vad	kzh	knr	cnpr	btkl	goa	rtngr
Filoncholaimus filicaudatus	0	0	0	1	0	0	0	0	0	0	0
Halalaimus spp	0	0	2	0	4	0	0	2	0	0	0
Halalaimus longicoudatum	0	0	1	1	0	0	0	0	0	0	0
Oxystomina clavicoudata	0	0	0	0	0	0	4	0	0	0	0
Anoplostoma spp	0	0	0	1	0	0	0	0	0	0	0
Rhabdonemania spp	0	0	0	0	0	0	0	0	0	0	2
Enoplus spp	0	1	2	0	0	0	0	0	0	0	0
Paraeuchromadora longicaudatum	0	0	0	0	0	4	0	0	0	0	0
Laimella spp	0	0	2	0	0	0	0	0	0	0	0
Dorylaimopsis	0	0	0	0	4	0	4	0	0	2	0
Comesoma spp	0	0	0	0	0	0	0	4	0	0	0
Sabatieria spp	0	0	0	0	2	0	4	6	0	4	0
Sabatieria paracupida	0	0	2	0	0	0	0	0	0	0	0
Setosebatieria hilarula	0	0	0	0	4	0	0	2	0	0	0
Synonchiella riemanni	0	0	0	0	0	0	0	0	0	2	2
Cervonema macramphis	0	0	2	0	0	0	0	0	0	0	0
Richtersia inaequalis	0	0	3	0	0	0	0	0	0	0	0
Richtersia spp	0	3	0	0	0	0	0	0	0	2	0
Latronema sp	0	0	1	0	2	0	0	0	0	4	0
Cherionchus spp	0	0	0	0	0	0	0	0	0	0	2
Tricoma spp	1	0	0	0	0	4	0	0	2	0	2
Tricoma brevirostris	0	3	0	0	0	0	0	0	0	0	0
Quadricoma spp	0	0	0	0	0	0	3	0	5	0	0
Spirinia parasitifera	0	1	0	0	0	0	0	0	0	2	0
Spirinia spp	0	0	2	0	0	0	0	0	0	2	0
Desmodora tenuispiculum	2	2	0	0	0	0	0	0	0	9	0
Desmodora scaldensis	0	0	0	0	0	3	0	0	0	0	0
Actinonema pachydermatum	0	0	0	1	0	0	0	0	0	0	0
Spilophorella candida	0	0	2	0	0	0	0	0	0	0	0
Neochromadora spp	0	0	0	0	2	0	0	0	0	0	2
Trochamus spp	1	0	0	0	2	0	0	0	0	0	0
Metacyatholaimus spp	0	0	0	0	6	0	0	2	0	0	0
Pselionema longiseta	0	0	0	0	0	3	0	4	0	2	3
Ceramonema carinatum	0	0	0	0	0	0	3	0	0	0	0
Cyartonema spp	0	0	0	0	0	0	0	4	0	0	0
Calomicrolaimus spirifer	0	0	0	0	6	0	0	0	0	0	0
Nudora crepidata	0	0	0	0	0	0	2	0	0	0	0
Dasynemoides albaensis	0	0	0	0	4	0	0	0	0	0	0
Notochaetosoma killieri	0	1	0	0	0	0	0	0	0	0	0
Theristus spp	0	0	0	0	0	0	0	0	0	5	0
Promonhystera spp	0	0	0	1	0	0	0	0	0	0	3
Paramonhystera spp	0	0	0	1	0	2	0	0	0	4	2
Elzalia spp	0	0	0	1	0	0	0	0	0	0	0
Paralinhomoeus tenuicaudatus	0	0	0	0	0	0	0	0	0	4	0
Paralinhomoeus lepturus	0	0	0	0	4	0	0	0	0	0	0
Eumorpholaimus subulicolus	0	0	0	0	0	0	0	4	0	0	0
Metalinhomoeus longiseta	0	0	0	0	0	0	0	0	0	4	0
Terschellingia longicoudatus	0	0	0	0	2	0	0	4	0	0	0
Diplopeltula asetosa	0	0	0	0	2	0	0	0	0	0	0
Disconema alaima	0	0	0	0	2	0	0	0	0	0	0
Southernia zosterae	0	0	0	0	4	0	0	0	0	0	0
Siphonolaimus auratus	0	0	0	0	0	0	0	0	0	2	0
Unidentified spp.	0	2	5	2	8	4	4	2	3	7	6

Table 8.3e. Distribution of free- living nematodes of west coast of India in >150m depth range.

Species	Cape	klm	kch	vad	kzh	knr	mangr	cnpr	btkl	goa	rtngr	prbr
Viscosia spp	0	0	0	6	0	0	0	6	0	0	2	0
Halalaimus spp	0	0	0	6	0	0	0	0	0	0	0	0
Laimella spp.	0	0	0	0	0	0	0	0	0	4	0	0
Oxystomina clavicoudata	0	0	0	6	0	0	0	0	0	0	0	0
Dorylaimopsis spp	0	0	2	4	0	0	2	0	0	0	1	0
Sabatieria spp	0	0	0	0	0	0	0	16	0	0	1	0
Hopperia spp	0	0	1	0	0	0	0	0	0	0	0	0
Richtersia spp	0	3	0	0	0	0	0	0	8	0	0	0
Gamanema spp	0	0	0	0	0	0	0	0	4	0	0	0
Cherionchus spp	0	0	0	0	0	0	0	7	0	0	0	1
Tricoma spp	0	0	0	0	0	0	1	0	0	6	0	0
Quadricoma spp	0	0	0	6	0	0	0	3	0	0	0	0
Spirinia spp	0	0	2	2	0	0	0	0	0	0	0	0
Desmodora tenuispiculum	0	0	3	0	0	0	0	0	0	8	0	3
Desmodora spp	2	0	1	0	0	0	2	0	10	0	4	0
Perspira spp	0	3	0	0	0	0	0	0	0	0	0	0
Metachromadora spp	0	0	1	0	0	0	0	0	0	0	0	0
Acanthopharynx spp	0	0	0	0	0	0	0	0	4	0	0	0
Neochromadora spp	0	0	0	0	0	2	0	0	0	0	1	0
Metacyatholaimus spatiosus	0	0	0	0	0	0	0	6	0	2	0	0
Antomicron elagans	0	0	0	0	0	0	0	0	0	0	3	0
Catenema macintyrei	0	0	0	0	0	0	0	3	0	0	0	0
Monhystera spp	0	0	0	0	0	0	0	0	0	4	0	0
Sphaerolaimus spp	0	0	0	0	0	3	0	2	0	0	2	0
Theristus alternus	0	0	1	0	0	0	0	0	0	0	0	0
Theristus spp	0	0	4	6	0	0	0	4	8	0	0	1
Paramonhystera butchschli	0	0	2	3	0	0	0	0	0	0	0	0
Linhystera spp	0	0	0	0	0	0	0	2	0	0	0	0
Elzalia spp	0	0	0	0	0	0	0	0	0	2	0	0
Rhynchonema cinctum	0	3	0	0	0	0	0	0	0	0	0	0
Promonhystera spp	0	0	1	9	4	0	0	7	0	0	0	0
Linhomoeus spp	0	0	0	4	0	0	0	0	0	0	0	0
Metadesmolaimus aduncus	0	0	0	0	0	3	0	0	0	0	0	0
Terschellingia longicoudatus	0	0	0	0	0	0	0	8	0	0	0	0
Metalinhomoeus longiseta	0	0	0	0	0	0	0	4	0	0	0	0
Unidentified spp	0	1	2	8	1	2	0	3	4	3	4	1

major families among the order Chromadorida were Comesomatidae, Desmodoridae, Selachinematidae, Chromadoridae, and Desmoscolicidae. The important families of order Monhystrida were Xyalidae, Linhomoeidae and Sphaerolaimidae. Oncholaimidae and Oxystominidae were the most abundant families among the order Enoplida. The most abundant species in this depth range were *Halalaimus* spp, *Sabatieria* spp, *Tricoma* spp, *Dorylaimopsis* spp, *Desmodora* spp and *Theristus* spp.

In 76-100 m depth range, 37 species of free-living nematodes belonging to 16 families and 3 orders were identified. The Chromadorida was the most abundant (57%) nematode order, representing 22 species of 7 families. Chromodorida was followed by Monhystrida, which were represented by 9 species of 4 families. Enoplids was represented by 6 species of 5 families. The major families among Chromadorida were Desmodoridae, Comesomatidae, Selachinematidae, and Desmoscolicidae. The important families among Monhystrids were Xyalidae and Linhomoeidae. The most dominant family among the order Enoplida was Oxystominidae. The most abundant species in this depth range were *Tricoma* spp *and Spirinia* spp.

In 101-150 m depth range, 52 species of free-living nematodes belonging to 20 families and 3 orders were identified. The Chromadorida was the most abundant (63%) nematode order, representing 33 species of 11 families. Monhystrida was represented by 12 species of 4 families. Enoplida was represented by 7 species of 5 families. The major families among the order Chromadorida were Comesomatidae, Chromadoridae, Selachinematidae, Desmodoridae, Desmoscolicidae and Ceramonematidae. The important monhystrid families were Linhomoeidae and Xyalidae. The major family in the order Enoplida was Oxystominidae. The most abundant species in this depth range were *Sabatieria* spp and *Pselionema longiseta.*

In depth >150m range, 35 species of nematodes belonging to 12 families and 3 orders were identified. The Chromadorida was the most abundant (52%) nematode order, representing 19 species of 7 families. Chromodorida were followed by Monhystrida and Enoplida. Monhystrida was represented by 13 species of 3 families. Enoplids were represented by 3 species belonging to 2 families. The major families among Chromadorids were Desmodoridae, Comesomatidae and Selachinematidae. The important families of the order Monhystrida were Xyalidae and Linhomoeidae. The major family among Enoplida was Oncholaimidae. The most abundant species in this depth range were *Theristus* spp and *Promonhystra* spp.

The nematode species abundance showed the general trend of decreasing species as the depth increases. In the shallow stations of 30-50m, 99 species were represented. Whereas beyond this depths a progressive decrease in species numbers were observed. Beyond 150m only 35 species were present. Similarly the diversity also showed the decreasing pattern with increase in depth.

Latitudinal differences among the distribution of free-living nematodes were apparent in the selected depth ranges in West Coast shelf waters. In general, the number of species and individuals varied from southern transects to northern part of the continental shelf in all selected depth ranges. In 30-50 m depth range, maximum number of species (28) was recorded was off Kochi, the lowest (1) was recorded off Mangalore. In 51-76 m depth range maximum number of species (30) recorded was off Kannur2, the lowest (6) was recorded off Goa1. In 76-100 m, maximum number of species (15) was recorded off Ratnagiri and minimum (4) species off along Mumbai4. In this depth range all the stations were from north west coast. In 101-150 m depth, maximum number of species (16) was recorded off Vadanapilly and minimum at (2) off Bhatkal. In >150m, maximum species (15) was recorded off Coondapore and minimum (2) off Kozhikode.

All the transects exhibited a general trend of decreasing faunal abundances and biomass with increasing water depth, probably reflecting an overall decrease in food availability for meiobenthos.

8.3.2Vertical distribution of Nematodes.

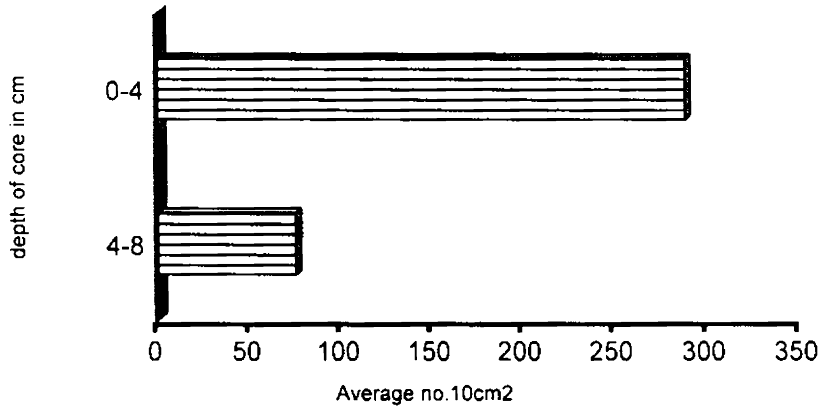
The study of the vertical distribution of marine animals aims at linking a certain mode of distribution with a vertical gradient prevailing in the sea water or on the sediment, e.g. a gradient of temperature, salinity, or content of oxygen, etc. The most important of these factors is the shape of the substrate, especially for meiofauna, plays utmost to their composition (Giere, 1993)

The vertical distribution of meiofauna in general and nematodes in particular in sediments has attracted much attention since the development of the sulphide system concept (Fenchel and Riedl, 1970). As originally defined, this sulfide system is the anaerobic environment typically established under a cover of oxidised aerobic sediments; it occurs worldwide except along surf-stressed beaches and has been postulated to be the environment where early

Table 8.4. Vertical distribution of free living nematodes in selected transects

	Coondapore				Dhabol				Vadanapilly			
Station	29A	29B	29C	29D	44A	44B	44C	44D	16A	16B	16C	16D
Depth	193	104.3	53.6	33.9	35.3	57.1	95.7	94.3	197.3	103.4	53	36.2
Upper 4 cm												
Viscosia elagans	0	0	0	3	0	0	0	0	0	0	0	3
Viscosia spp.	6	0	0	0	6	6	0	0	6	0	0	0
Halalaimus isaitshikovi	0	0	7	0	0	0	0	0	0	0	0	0
Halalaimus meyersi	0	0	0	4	0	0	0	0	0	0	0	4
Halalaimus spp	6	4	0	0	4	4	3	2	6	3	0	0
Oxystomina clavicaudata	6	0	0	0	0	0	0	0	6	0	0	0
Oxystomina elongata	0	0	0	0	1	0	0	0	0	0	0	0
Eurystomina spp	0	0	0	7	0	0	0	0	0	0	0	7
Dorylaimopsis spp	3	4	0	5	5	5	0	0	4	4	0	7
Sabatieria spp	0	2	5	0	4	5	6	3	0	2	7	0
Setosebatieria hilarula	0	4	0	3	0	0	0	0	0	4	0	3
Halichoanolaimus dolichurus	0	0	6	0	0	0	0	0	0	0	6	0
Tricoma spp	0	0	6	4	0	0	5	0	0	0	6	4
Quadricoma spp	6	0	0	0	0	0	4	0	6	0	0	0
Catanema macintyrei	0	0	0	0	4	4	0	0	0	0	0	0
Neochromadora spp	0	2	0	3	0	0	0	0	0	2	0	3
cobbia sp	0	0	0	0	0	0	0	4	0	0	0	0
Trochamus spp	0	2	0	2	0	0	0	0	0	2	0	2
Longicyatholaimus spp	0	0	0	4	0	0	0	0	0	0	0	4
Paralongicyatholaimus minutus	0	0	0	3	0	0	0	0	0	0	0	3
Pomponema segregata	0	0	0	0	4	4	0	0	0	0	0	0
Metacyatholaimus spatiosus	0	0	0	5	0	0	0	0	0	0	0	5
Metacyatholaimus spp	0	6	6	0	4	5	4	0	0	6	6	0
Dasynemoides albaensis	0	4	0	0	0	0	0	0	0	4	0	0
Calomicrolaimus spirifer	0	6	0	3	0	0	0	0	0	6	0	3
Sphaerolaimus pacifica	0	0	7	0	0	0	0	0	0	0	7	0
Sphaerolaimus spp	0	0	0	2	5	5	0	0	0	0	0	2
Theristus spp	5	0	0	3	0	4	0	0	6	0	0	4
Paramonhystera buetschlii	3	0	0	0	0	0	0	0	3	0	0	0
Linhystera spp	0	0	0	2	0	0	0	0	0	0	0	2
Promonhystera spp	7	0	0	0	0	0	0	0	5	0	0	0
Promonhystera faber	0	0	6	0	0	0	0	0	0	0	6	0
Linhomoeus spp	4	0	0	1	0	0	0	0	4	0	0	1
Paralinhomeous pachyamphis	0	0	0	3	4	4	0	0	0	0	0	3
Paralinhomoeus lepturus	0	4	0	2	0	0	0	0	0	4	0	2
Terschellingia communis	0	0	0	0	5	6	0	0	0	0	0	0
Terschellingia longicoudatus	0	2	8	0	5	4	0	0	0	2	10	2
Metalinhomoeus longiseta	0	0	6	0	0	0	0	0	0	0	8	4
Disconema alaima	0	2	0	0	0	0	0	0	0	2	0	0
Didelta scutata	0	0	5	0	0	0	0	0	0	0	5	0
Diplopeltula asetosa	0	2	0	0	0	0	0	0	0	2	0	0
Southernia zosterae	0	4	0	2	0	0	0	0	0	4	0	2
Unidentified spp	6	6	7	5	2	3	2	1	5	5	0	7
Lower 4 cm												
Halalaimus isaitskovi	0	0	0	0	0	0	0	0	0	0	7	0
Halalaimus spp	0	0	0	0	0	1	0	0	0	1	0	0
Oxystomina elongata	0	0	0	0	3	4	0	0	0	0	0	0
Latronema spp	0	2	0	0	0	0	0	0	0	2	0	0
Dorylaimopsis spp	1	0	0	2	1	2	0	0	0	0	0	0
Laimella spp	0	0	0	0	0	0	0	5	0	0	0	0
Sabatieria spp	0	0	2	0	1	1	5	1	0	0	0	0
Spirinia spp	2	0	0	0	0	0	3	0	2	0	0	0
Theristus spp	1	0	0	1	0	2	0	0	0	0	0	0
Promonhystera spp	2	0	0	0	0	0	0	4	4	0	0	0
Paralinhomoeus spp	0	0	0	2	0	0	0	0	0	0	0	2
Terschellingia longicoudata	0	0	2	0	1	1	0	0	0	0	0	0
Metalinhomoeus longiseta	0	0	2	4	0	0	0	0	0	0	0	0
Un identified spp.	2	2	2	2	1	0	1	1	3	3	9	0

Vertical distribution of nematodes in selected transects. West coast of India



Vertical distribution of meiofauna

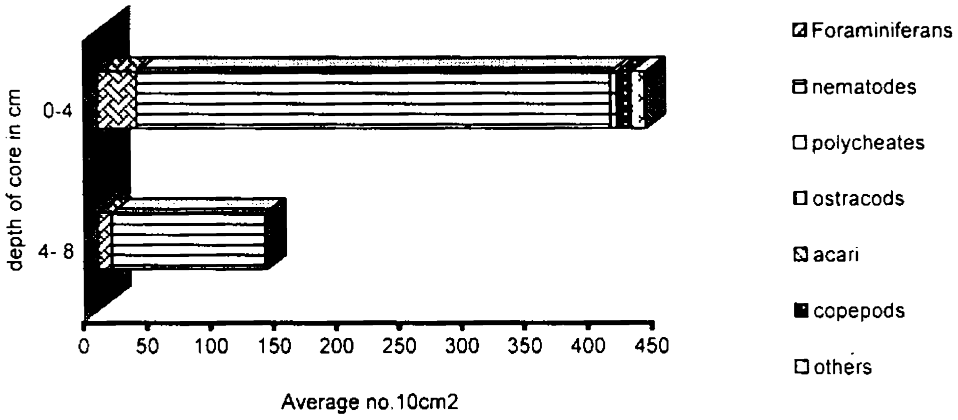


Fig. 8.5. Vertical distribution of meiofauna and nematodes in selected stations

metazoan evolution took place. This sulfide biome or thiobios, as it was subsequently renamed by Boaden and Platt (1971) is bounded at its top by the redox discontinuity layer where oxidized processes became replaced by reducing processes.

The vertical distribution of meiofauna in sediments has been studied by several workers (Moore, 1931; Rees, 1940; Mare, 1942; Smidt, 1951; Wieser and Kanwisher, 1961; Muus, 1964; Teal and Wieser, 1966; Damodaran, 1972; Ansari, 1978). All of them have called attention to the decline in numbers of organisms with increasing depth in the sediment. Several workers also studied vertical distribution of nematodes from different biomes. The major works include that of Reise and Ax (1979) on intertidal sand flats; Sikora and Sikora (1982) on salt marshes; Tietjen (1969) on shallow subtidal sands; Skoolmun and Gerlach (1971) on intertidal fine sands. The occurrence of nematodes in deeper layers of sediments was observed by Mclachlan (1977). Shirayama (1984) studied the vertical distribution of nematodes in bathyal to hadal stations in the western Pacific. He noticed that meiofauna was most abundant in the top few centimeters and declined exponentially with depth in the sediment. A surface maximum for meiofauna was also found by Soetaert (1983) in deeper waters (350-1600m) of Mediterranean and by Rutgerss van der Loeft and Lavaleye (1984) in the Iberian deep sea.

During the present study three selected transects, off Vadanapally, off Coondapore and off Dhabol. Identifications of nematodes were carried out and the results were presented in the table 8.4 & Fig.8.5. In 30-50 m depth range nematode families Oxystomatidae, Desmoscolecidae, Comesomatidae, Xyalidae, Cyatholaimidae, Linhomoeidae and Desmodoridae represented the upper 4 cm of the sediment. In the lower 4 cm line, Linhomoedae, Oxystominidae, Cyatholaimidae, Selachinematidae and Comesomatidae were the forms present. In 51-75 m depth range, the major families represented in the upper core were Xyalidae, Comesomatidae, Oxystominidae, Cyatholaimidae, Desmodoridae and Oncholaimidae. Likewise in the lower core, Oxystomatidae, Linhomoeidae, Siphonolaimidae, Eurystominidae and selachinematodae were the dominant forms present. In 76-100 m depth range the upper core nematodes were from the families of Comesomatidae, Xyalidae, Oxystominidae, Cyatholaimidae, and Desmoscolecidae where as in the lower core it is the Comesomatidae, Xyalidae and Microlaimidae were found to penetrate to deeper sediment portions. In 100-150 m depth range the majority of nematodes in the upper core, were from Comesomatidae, Cyatholaimidae, Oxystominidae, Aegioloalamidae, Desmodoridae, Xyalidae, Chromadoridae and Ceramonematidae. In the lower part of the core Oxystominidae, Linhomoidae and Selachinematidae were present. In >150 m depth, the upper core was represented by Xyalidae, Comesomatidae, Oxystomatidae, Desmoscolecidae, Cyatholaimidae, Desmodoridae, Oncholaimidae and Selachinematidae and in the lower 4cm the representing families were Sphaerolimidae, Xyalidae and Desmodoridae.

The vertical distribution of nematodes in sublittoral and some littoral marine substrates seems to be restricted to the upper 8 cm, with the majority of all specimens occurring in the upper 4 cm (Wieser and Kanwisher, 1961). In the present observation the vertical distribution of nematodes showed that 80% of the individuals inhabited the uppermost 4 centimeters of the sediment (Fig.8.5). In deeper waters, penetration of nematodes into the sediment diminishes. In mud stations off the Belgian coast, 93% of the nematodes were found in the upper 4 cm, but in a sandy station penetration was much deeper and maximum density was found between 6 and 10 cm (Heip *et al.*, 1979). In temperate regions the vertical distribution of nematodes are in accordance with the seasons. Boucher (1980) found most nematodes in the surface layers of a subtidal (19 m) fine sand in Brittany during spring, 59% in the upper 2 cm and summer (51%). But in autumn and winter, nematodes migrated down, only 42% were present in the upper 2 cm in autumn and only 13% in winter.

In deeper waters, at depths around 100 m in North Sea, nematodes remain important at least 10-cm depth in the sediment (Heip *et al.*, 1979). The same is true in deep sea sediments where Coull *et al.* (1977) found nematodes evenly distributed through the first 6 cm of 400 m depth, with a surface maximum of 800 m depth and a subsurface maximum between 2-3 cm at 4000 m depth. Vivier (1978) found Araeolaimidae, Desmodorida and Desmoscolecida living in the surface layers together with Enoplida (Oxystominidae), Chromadoridae, Cyatholaimidae and Choanolaimidae. The Comesomatidae were present in all layers of the fluid red muds studied (108-580 m).

Most sublittoral meiofauna has been reported to be concentrated in the upper few centimeters of deposit, and in some cases most of the animals were even restricted to the top 2 cm (Thiel, 1966; Tietjen, 1971; Damodaran, 1972). Numbers below 5 cm were usually very low, these being almost exclusively nematodes (Moore, 1931; Mare, 1942; Bougis, 1946) The faunal concentration in the upper sediment layers is thought to result from the availability of oxygen, as well as the concentration of food material at the deposit surface (McIntyre, 1969; Damodaran, 1972; Elmgren, 1975). The deeper penetration of nematodes is due to their ability to exist anaerobically for long periods (Moore, 1931; Fenchel and Riedl, 1970; Damodaran, 1972). The penetration of meiofauna in sublittoral sands has been studied by Wieser (1960) who reported the presence of most of the fauna in the top 10 cm. Coull (1970) found 91% of meiofauna in the top 5 cm. Tietjen (1971) recorded 95% in the top 1 to 2 cm and McIntyre and Murison (1973) found 80% in the upper 12 cm in subtidal sand. Wieser (1959b) also set the grain size barrier and suggested that median particle size of 120µ might be the finest in which interstitial life including nematodes can occur. Nematodes are very slender and better adapted to fine interstices Wieser (1959b) and Ward (1975) recorded them in sediments of 102µm median particle diameter. Tietjen (1969) attributed 4 possible causes for the vertical decline in the fauna which are vertical pH changes, vertical decrease in oxygen, decrease in interstitial water content and vertical differences in organic content.

The tendency of nematodes to penetrate deep into the sediment layers is not understood. One possible explanation is the larger mobility of longer nematodes enabling them to penetrate into the more compact deeper layers (Jensen, 1983). The importance of species size distribution of meiofauna was also correlated to vertical profile (Schwinghamer, 1981, Warwick, 1984, Gerlach *et al.*, 1985). The work of Tita *et al* (1999) showed that species size distributions are influenced by sediment characteristics. Results from the recent studies

(Vanhove *et al.*, 1998; Steyaert *et al.*, 1999) show that nematode species tend to distribute vertically according more to the vertical distribution of trophic sources rather than to the redox chemistry of the sediment. Recent studies on the vertical distribution of nematodes in relation to depth in sediments showed that nematodes have adapted to changing conditions in the sediment. The relation between body size and width was well correlated with the food sources in the sediment (Soetaert *et al.*, 2002). The occurrence of nematode species below the RPD (Redox Potential Discontinuity) layer indicated their ability to tolerate sulfides and to utilize the high density of microbial organisms in this layer (Shabdin and Ross, 1999). It might be concluded that fine scale vertical distribution of nematodes is the result of combination of physical factors and biological interaction in the sediments.

Summary and Conclusion

The marine benthos is considered as the largest ecosystem on earth, and ecosystem processes occurring within it have important effects both locally and globally. The scarcity of information on meiobenthos of the west coast of India prompted the present study. Even though much attention was paid to the larger macrobenthos the studies on meiobenthos was totally lacking and scarce as far as the country is concerned. The studies on meiobenthos were only on the quantitative aspect of different groups and no attention was paid to the qualitative aspect of meiobenthic groups. The present study is the first attempt to understand the standing crop of the meiobenthos of the shelf waters of the entire west coast. The study focused on the quantitative and qualitative aspects of meiobenthos as a whole and relates it with environmental parameters. In this stuffy a detailed qualitative study of the major group, nematoda was also attempted. The two dedicated cruises of FORV Sagar Sampada (Cruise 162 and 192A) was utilized for collecting samples for the present study.

Introduction of the thesis covers the objectives, scope and significance of the study.

The second chapter present with a detailed review of literature on the status of meiobenthic studies around the world and India.

The third chapter reveals the study area and the methods of measuring the hydrographical, sediment characters and procedures in meiofaunal identification. It also provides the statistical testing of the data for the precise interpretation of the meiofauna and it's interactions in the shelf waters. Sampling was conducted in 30, 50, 100 and 200m depths with additional stations at 75 m depth where shelf width was more. The covering area of the present study was from off Cape Comorin to off Dwarka and include 74 stations falling under 17 transects.

The fourth chapter is discussing about the hydrography of the shelf waters. The three major parameters like temperature, salinity and dissolved oxygen were measured. Except salinity, temperature and dissolved oxygen followed a trend of decreasing with respect to increase in depth. However, a marginal increase in salinity was observed with increase in depth. Latitudinal variation was also prevalent in the study area. Accordingly temperature values were decreased from south to north upto a depth of 100m and thereafter it progressively decreased from northwest to southwest. The salinity also showed an increase towards northern part of the shelf. Dissolved oxygen values were showing it's minimum values (near zero) in shelf edge (200m) and particularly in the northern part of the shelf.

The fifth chapter reveals the sediment characteristics along the shelf water sediments. During the present study 7 different types of sediment patterns were recorded. They are sand, silty sand, sandy silt, silt, sand silt clay, clayey silt and silty clay. In view of the different depths, the pattern of sediment distribution varied. The muddy nature was dominated at 30-50m depths whereas beyond this depth range sand was dominating. The organic content of the sediments varied from 0.24 to 6.71%, with a general increase in organic content as the depth increases. The finer sediments retained more organic carbon.

The sixth chapter is dedicated to meiobenthos of the shelf waters. The detailed account of the faunal composition, numerical abundance and biomass, and its relation to ecological parameters were discussed.

The composition of meiobenthos includes nematodes, copepods, foraminiferans, ostracods, kinorhynchs, oligochaetes, acarids and polychaetes. However numerically, nematodes contributed about 84% of the numerical abundance and they were the most abundant groups in all studied depths. The contribution of copepods, foraminiferans, and others to the total meiofaunal abundance was 7.88%, 2.83 and 3.7% respectively. The contribution of the biomass was shared between .nematodes, and 'Others' which include polychaetes, oligochaetes, acarids, kinorhynchs and ostracods.

Identification of the non-nematode taxa were attempted upto group level only. However during the present study, 17 species of foraminiferans, 8 species of copepods, 7 species of polychaetes and 2 species of Phylum Kinorhyncha were identified. Nematodes were studied in detail with identification upto the lowest taxonomic level. From the present study 155 species of free-living marine nematodes were identified, of which 100 species was identified with certainty and another 55 species was tentatively identified.

In the present study, the average meiobenthic biomass of the western continental shelf of India is 1.398 mg.10cm^{-2} The biomass of meiobenthos was 1.498 mg .10cm^{-2} from southwest and 1.268 mg.10 cm^{-2} from northwest region.

Assuming that the average meiobenthic generation time is 3 months per annum, the meiobenthic production will be about 5592 kg/km^2 Average population density of west coast of India was 219 $ind.10cm^{-2}$ and that of southwest coast were 186 $ind.10cm^{-2}$ and northwest was 225 $ind.10cm^{-2}$ From the present study the meiobenthic production showed that meiobenthos are contributing significantly to the total benthic production. Earlier studies on the benthic production from the Arabian Sea showed the significance of meiobenthos.

The BIO-ENV analysis showed no significant relation with substratum. However, the observed relation between numerical abundance and environmental parameters was the percentage of sand whereas the nematode abundance was correlated with silt percentage. In the west coast as a whole the numerical abundance was more in northern regions of the shelf and biomass showed more or less similar patterns between both regions. In the present study biomass was more in sandy stations owing to the contribution of 'other ' organisms in the south west coast. Whereas in northern regions of the shelf, biomass and abundance was more in stations of finer sediments, vouched by the fact that nematodes was the main group contributing to this biomass. The total richness of the fauna along the southwest coast was due to different groups, and northwest coast a decrease in other groups and dominance of nematodes can be noticed.

However the organic carbon was not significantly correlated with either biomass or numerical abundance. The correlation values between organic matter and the abundance or biomass does not show any significant relation. Perhaps this relation can be understood only after the detailed qualitative composition of the organic matter.

Numerical abundance showed a decrease with increase in the depth in case of groups. In general, all the meiofaunal groups showed a decrease in biomass with increase in depth. Dissolved oxygen showed near anoxic values in the depth >150m, especially in northern shelf edge. In this zone, a decline in meiofaunal biomass was visible in most of the stations. This can be due to the anaerobic condition prevailing, where only few organisms can tolerate. In the case of nematodes also a decreasing trend was noticed. But beyond 150m depths, there occur a slight increase, which was attributed to their tolerance to hypoxic conditions.

High benthic biomass and abundance in nearshore areas were attributed to the higher nearshore primary productivity as the supply of food to subtidal benthic environment depends on proximity to shore and water depth. The other important parameters, which are playing a crucial role in the meiofaunal standing stocks, were temperature and dissolved oxygen. Though there was slight variation in temperature and salinity with latitudes, it did not reflect much with the fauna. The various ecological parameters explaining the observed pattern of distribution and the structuring of meiobenthos was evolved from the analysis of BIO-ENV. The best combinations explaining the meiobenthic abundance were depth, sand, temperature, dissolved oxygen.

Seventh chapter deals with the systematics and taxonomy of free-living nematodes. 155 species of nematodes representing 29 families and 3 orders were identified. Descriptions of 100 species were given with certainty and other 55 species was tentatively identified. Most of these nematodes were reported for the first time from Indian waters. The Chromadorida was the most dominant order represented and followed by Monhysterida. The most common species represented in entire shelf waters was *Dorylaimopsis* spp. *Desmodora* spp and *Halalaimus* spp. Most significant observation is the absence of 16 families beyond 150m, which was represented in other depths studied.

The community structure of the nematodes showed that diversity is decreasing with increase in depth. Depth wise it was observed that 99 species were observed in 30-50m, whereas beyond 150m only 35 species were recorded. The depth wise variation among species was noticed from all selected depths. The analysis of ANOSIM showed that species from 75m and 100m are similar and all other depths ranges species showed dissimilarity. The similarities and dissimilarities were evident in the clustering and ordination (MDS) plots. The similarities between stations were due to same substratum and hydrographical conditions. The SIMPER procedure showed that similarities were contributed by a few species whereas the dissimilarity was reciprocated by many species. This suggested that there was no discriminative species that was vouched for the observed dissimilarity.

The ecology and distribution of free-living nematodes are discussed in chapter 8. The feeding types of nematodes were studies and it was found that deposit feeders were dominating the shelf. The overall percentage of deposit feeders, omnivore/carnivores and epistrate feeders in the west coast was 56.8%, 23% and 20% respectively. BIO-ENV procedure was carried out to understand the interaction between nematodes and environmental parameters. The most important environmental parameter vouched for nematode species distribution was temperature, depth, dissolved oxygen and silt content. The spatial distribution of nematodes showed variation in species between stations and substratum types. The vertical distribution of the nematodes was also analysed. It clearly showed that 80% of the individual are present in the upper 4cm of the sediment core. The availability of oxygen and food could be the factors controlling the vertical distribution of nematodes.

Lists of references that are discussed during the study have been presented at the end of the thesis.

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