



# Relevance of Meiobenthic Research: Indian Perspectives



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## Introduction

Coastal and marine biodiversity play a crucial role in economy by virtue of their resources, productive habitats and rich biodiversity. Within sixty kilometres of the shoreline more than half the world's population lives, and this could rise to three quarters by the year 2020 [1,2]. The population surge along the narrow coastal strip is the ultimate driver for escalating pressures on the world's coastal area, which are dominated by sandy beaches [1]. Thus, much of today's and near future anthropogenic pressure on global ecosystem is directed at coastal wetlands. India has a coastline of about more than 7500km of which the mainland accounts for 5422km, Lakshadweep coast extends up to 132km and Andaman and Nicobar Islands have coastline of 1962km. More than two hundred fifty million people live within a distance of fifty kilometres from the coast. The dissimilarities between the west and east coasts are remarkable. The west coast is generally exposed with heavy surf and rocky shores and headlands whereas the east coast is generally shelving with beaches, lagoons, deltas and marshes [3].

The benthic system comprehends a highly diverse community, composed of bacteria, micro- meio- and macrobenthos, with the classification of benthic organisms generally relying on the organism size. The term "meiofauna" is actually derived from the Greek word meio meaning "smaller". Research on meiobenthic fauna have been known since the 18th century. The study of meiofauna was probably initiated during the eighteenth century and was carried out by Loven [4] who described the worm under new genus. The term "meiobenthos" was introduced and defined by Mare in her account of the benthos of muddy substrates off Plymouth, England [5]. The term 'interstitial fauna' introduced by Nicholls (1935) was used to denote that the animals living in the interstitial spaces between all types of sediment particles. During the year 1940, Remane [6] proposed the equivalent term "Mesopsammon". The other eminent pioneer meiofaunal researchers are Moore & Neil [7] and Moore [8].

The term "meiobenthos" was introduced and defined in 1942 by Mare [5] in her account of the benthos of muddy substrates

off Plymouth, England [5,9] to indicate those benthic metazoans smaller than the 'macrobenthos', but larger than 'microbenthos'. In practice, meiobenthic organisms consist of animals with size ranging from 63 $\mu$  to 500 $\mu$  [10] and are also named as meiofauna. The meiofauna are by no means a homogenous ecological group of meiobenthos. Meiofauna inhabits in an array of diversified habitats and niche of freshwater and marine water bodies. Sediments of all kinds from the softest of muds to the coarsest shell gravels and all those in between harbour meiofauna. Meiofauna plays an important role in maintaining ecological balance by predated within their community.

According to Higgins & Thiel [9], at least twenty two phyla out of thirty three metazoans phyla include meiofauna which remain distributed worldwide [9]. The taxa belonging to meiobenthic faunal groups are Sarcostomatophora, Ciliophora, Cnidaria, Turbellaria, Nematoda, Gastrotricha, Rotifera, Loricifera, Priapulida, Kinorhyncha, Polychaeta, Oligochaeta, Sipuncula, Tardigrada, Cladocera, Ostracoda, Mystacocarida, Copepoda, Sycarida, Thermosbaenacea, Isopoda, Tanaidacea, Amphipoda, Cumacea, Halacarida, Pycnogonida, Palpigradida, Insecta, Bryozoa, Entoprocta, Brachiopoda, Aplousobranchia, Gastropoda and Bivalvia, Holothuroidea and Tunicata. A complicating factor in the taxonomy of meiofauna is not only of their small size, often associated with structural simplification, but also high percentage of morphologically similar or even identical species within related groups [11,12].

Meiofauna, or more generally, the interstitial benthic invertebrates distinguished from macro benthos by their smaller sizes, shares tremendous amount of total benthic biomass in marine habitats. These are exclusively important within any estuarine and marine systems since they facilitate biomineralization, support various higher trophic levels and show a high sensitivity to anthropogenic actions, making them excellent organisms for pollution bio-monitoring. However, their large abundance attracts a considerable number of fin-fishes and shell fishes which used to visit the coastal belts in order to gain energy from the benthic habitats, mostly in the intertidal and sub tidal zones.

The response of ecosystem to environmental impacts are typically complex and diverse. It has been recognized that chemical and physical measurements are unable to properly assess impacts. The use of faunal diversity as indicator of environmental health, is the most effective, advantageous and cost-effective approach. Benthic infaunal monitoring is widely accepted as the fundamental step to most recent interdisciplinary studies of contaminant effects on ecosystems. Responses of the infauna are representative of overall ecosystem status, because the infauna generally depends upon and interact with biological process in the water column. The Phylum, Nematoda was used as an indicator for assessing the ecological quality of marine ecosystems by the European Water Framework Directive (WFD), Directive 2000/60/EC [13,14].

Not only in pollution monitoring, meiofauna also plays important roles in benthic community processes such as bioturbation (organic decomposition, nutrient cycling, redistribution of organic material, oxygenation of the sediment) and an effective link in food web [15]. These organisms are also being used as indicator for global climate change. Meiofauna stimulate bacterial growth by mechanically breaking down the detrital particles, excrete nutrients or by producing slime trails through the secretion of mucus. The significant top-down control of meiofauna in microbial mineralization of polycyclic aromatic hydrocarbon such as naphthalene has already been proved using molecular tools like RFLP etc. High concentration of Sodium Channel Blockers (SCB), a group of neurotoxin such as tetrodotoxin (TTX) and saxitoxin (STX), in free-living marine nematodes were already confirmed using a tissue culture bioassay and their role in accumulation and transfer in marine environment has been proved significant. The analysis of mitochondrial Cytochrome oxidase subunit 1 (COI) gene, nuclear rDNA, rRNA etc. are used generally to reveal the cryptic diversity, intra-genomic variation as well as identification of the meiofaunal groups and new procedures are still waiting to add the accuracy in phylogenetic analysis. Different laboratory cultural procedures were developed for meiofauna, depending on their feeding and behavioural ecology [16-18]. Therefore, smaller marine meiofaunal organisms like free-living nematoda, gastrotricha, ostracoda, foraminifera, oligochaeta, nemaerterea etc. can be effectively utilized in translational and regenerative biological research.

Dhivya & Mohan [19] gave beautiful picture of meiofaunal study of India. In this present article we have tried to provide only some recent and previous works on meiofaunal study from India. According to the published reports, Dr. Nathan Annandale was the pioneer in benthic study of Indian subcontinent and the scientific exploration on benthos of the Indian subcontinent was initiated at the southern part of the Bengal delta [20]. Post Annandale scientific exploration of the benthos was initiated by Panikkar and Aiyar (1937), who studied the brackish water fauna of the Madras coast. Seshappa [21], Ganapati & Rao [22] worked along Malabar Coast and north east coast of India respectively for benthic research.

Kurien [23-25] also undertook some informational works on meiofauna from India. The meiobenthic fauna of south-east coast of

India along the Andhra coast was primarily studied by Ganapati & Rao [26]. Studies on the interstitial fauna of the Southwest coast of India were attempted by Govindan Kutty & Nair [27], Desai & Kutty [28-30], Rajan [31], McIntyre [32], Thiel [33] and Sanders [34] did important quantitative studies of meiofauna from the East and West coasts of India; and Central Indian Ocean was explored mainly by Ingole [35]. Kure in (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. Ansari & Parulekar [36], Ansari [37], Rao & Murthy [38], Vijayakumar [39,40] did some studies on meiofauna from different coastal areas and backwaters of east coast of India.

Damodaran [41,42], Ansari [43,44], Abdul Aziz & Nair [45], Reddy & Hariharan [46,47], Ingole [48], Ansari & Parulekar [49] did some effective works at the western coast of India. Some knowledge on meiofaunal diversity in India was limited to the other works previously done by Krishnaswami [50], Rao & Ganapati [51], Rao & Nagabhushanam [52], Rao [53], Rao [54-58], Sarma & Rao [59], Sarma [60], Murty & Kondalarao [61], Wells & Rao [62], Ansari & Gauns [63], Ansari & Parulekar [64], Ingole & Parulekar [65] etc. Sen et al. [66] worked on benthic foraminifera of Sunderbans. Sivaleela & Venkataraman [67-74] worked on different groups of meiofauna in Tamil Nadu coast. Ansari et al. [75] published some meiobenthic works on lagoonal ecosystem.

Free-living marine nematodes represent the major faunal group in respect of their density and diversity in any meiobenthic faunal assemblage. In a recent report, Ghosh and Mandal (2016) published a huge compilation list of free-living nematodes (288 species) recorded from India but need a through revision. Some interesting works on meiobenthos including nematodes were provided by Sinha & Choudhury [76], Sinha et al. [77]. The occurrence of stylet bearing nematodes from Gangetic delta reported by Sinha & Choudhury [78] from Sagar island, West Bengal were not actually free-living forms. Sinha et al. [77] discovered free-living marine nematode *Anoplostoma macrospiculum* from Indian coast after independence. Some research studies undertaken by Datta et al. [79], Datta et al. [80-82], Jacob et al. [83-85] have been able to describe some free-living marine nematodes in recent time from North-East coast, West coast and around Andaman sea of India respectively.

Most of the meiobenthic researches from several coastal sites of Indian coastal tract have been concentrated basically on ecological work. Free-living nematofaunal taxonomy relative to ecological work was largely neglected for long time. Some new records and checklists of free-living nematode were published in different journals, but clear taxonomic identity was neither given nor clear taxonomic description provided [86]. Therefore the true taxonomic information of marine nematodes at the northern part of east coast of India as well as from whole Indian coast is still very scant.

Ecological articles cannot be proper one if are not based on correct prove the taxonomic identification. A huge number of literatures published on meiofaunal account from India based

only on ecology. But in reality, most of the times, it is difficult to get same organisms from those study sites because of the improper taxonomic validation [87]. When a good portion of the recorded data falls into uncertain and incorrect confirmation then the subsequent checklist and the distributional record becomes irrelevant. Museum collection and subsequent registration of the specimens cannot be achieved for the living organisms. For the higher faunal groups, this process cannot be supported sometimes because of conservational purpose. But, for the very delicate meiobenthic fauna, the morphological study without preservation is difficult.

Therefore, the organisms must be euthanized prior to taxonomic work. From this point of view, the demand of the time is to stop the improper way of biodiversity recording and at the same time, it is imperative to develop and adopt better parallel scientific procedures to record the taxonomic diversity by which the scientific community of the world can be benefitted. For such, the proper way of biodiversity recording by comparative morphology can be achieved by detail morphological description as best as possible, clear and unimaginable illustration with photographic support, ecological data and proper registration for museum collection [87].

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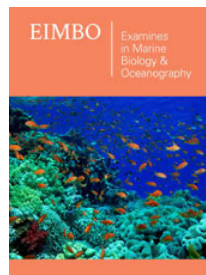
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