CHAPTER 3:ASSESSMENT OF NATURAL AND ANTHROPOGENIC IMPACTS IN MALINDI-UNGWANA BAY

THE BENTHIC COMMUNITY OF THE MALINDI-UNGWANA BAY

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INTRODUCTION

Marine bottom-dwelling organisms provide a number of extremely important ecosystem services. The benthic food web is an important element in nutrient regeneration in the benthic system. It differs essentially from its pelagic counterpart since it represents the slower part of the nutrient cycle, due to longer transport paths. With its strong chemical and biological gradients, the benthic system has a vertical structure that enables its different layers to interact hence giving many types of microenvironments. The deposit feeding macrobenthos is a major link between the benthic food web and higher trophic levels in the system. The benthic organisms also form food for fish. Thus the benthic community forms an important part of the benthic ecosystem. Biogeochemical flows are altered when trawling and dredging equipment churns up bottom sediment and resuspends it in the water column. During the trawling activities, the sock-like net is pulled along the seabed, and this net is kept on the bottom by means of a weighted foot line. The weights and pulling of the net is said to affect the benthic community.

Infauna play a significant role in the sedimentary processes. Through the production of mucus or through specific structures on the sea floor, they help prevent sediment disturbances. Mucus can act as glue causing sediment particles to stick together so that higher velocity currents are needed to erode the sediments. Macrofaunal animals also modify sediments in the benthic boundary layer with profound implications for both physical and chemical processes through Bioturbation (biologically mediated sediment-water interactions).

RESEARCH METHODS

Samples of organisms were collected within the Malindi- Ungwana Bay and presented in 5 major locations: Malindi, Kalifi, Tana, Sadani and Kipini. Samples of discarded material from Trawlers were collected in the months of December (2001), April (2002) for strategic (cruise) samples and monitoring samples were collected in the months of October, November (2001), January and March (2002). The different benthic organisms were sorted out and identified. These organisms represented the epibenthic organisms i.e. the organisms found on the surface of the sediment.

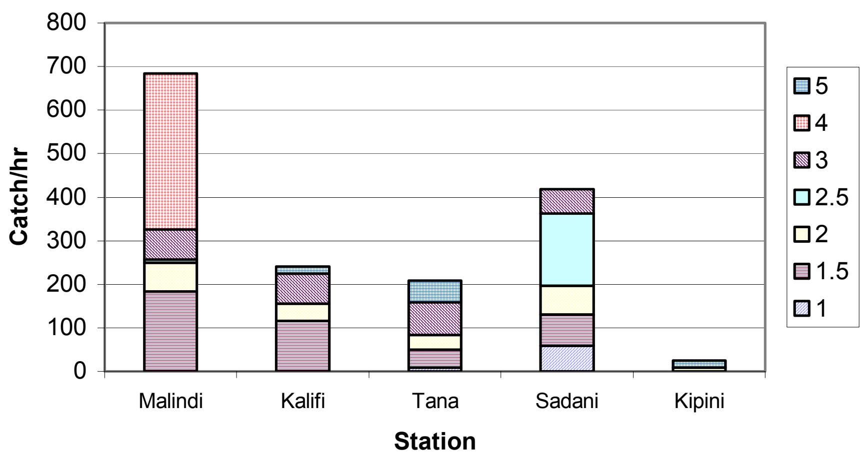
Sediment for infauna analyses was collected using a grab. Strategic sampling was done in December (2001), April and May (2002) and monitoring sampling was done in October and November (2001) and in January and March (2002). The sediment collected was placed in a 1 mm meshed size sieve and sieved using seawater. The sediment remaining in the sieve was placed in jars and preserved and then transferred to the lab for analysis.

RESULTS AND OBSERVATIONS

Epibenthic Organisms

A total of 72 epibenthic species were recorded, which include 26 flora and 46 fauna. Red algae dominated for flora while Crustacea dominated for fauna. The epibenthic organisms encountered included crabs, tiny shrimps, mantis shrimps, sponges, molluscs, seaweeds/seagrasses, starfish, jellyfish/comb jellies sand dollars, flatworms, sea pens and other types of crustaceans. Fig.1 shows the mean biomass/hour for each station for the different distances off-shore. The highest biomass was recorded in December at Malindi 1.5 nm. This was attributed to mantis shrimps. The lowest biomass was recorded in April at Kipini 2nm. Generally for all areas, the highest biomasses were recorded during the cruise periods compared to the monitoring periods (apart from Kalifi in October). This could be due to the larger area covered during this sampling to cover upto 5nm, where the trawlers would otherwise not trawl. Mantis shrimps (47%), crabs (29%), molluscs (4%) and seaweeds (11%) contributed higher percentage compositions by weight in most areas.

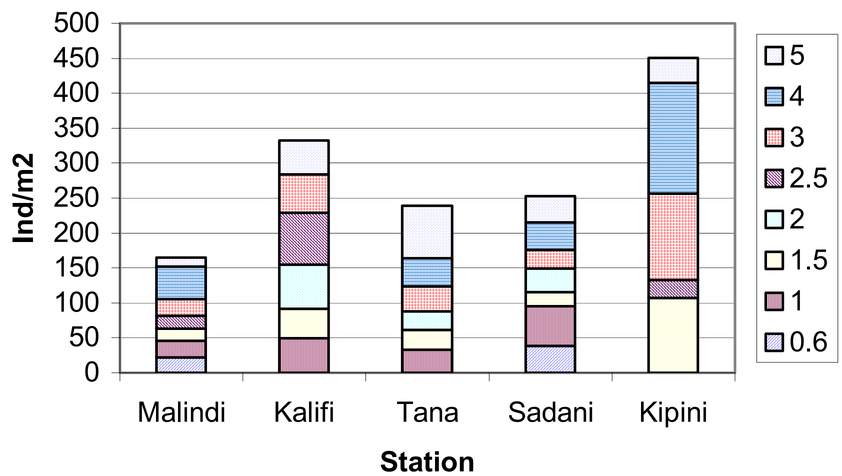
Fig.2: Mean biomass/hr in the different stations

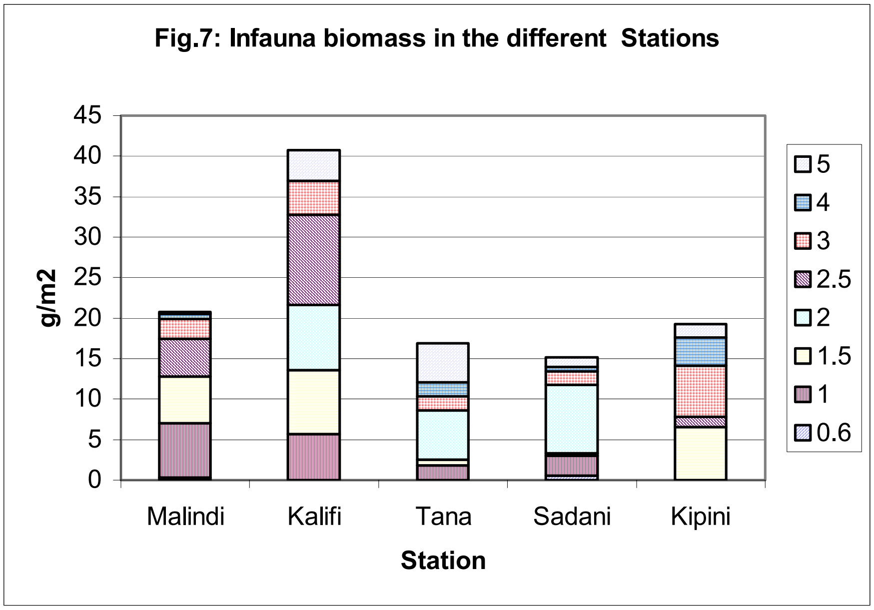


Infauna

The highest densities of infauna were recorded in Malindi from October to January and from April to May the highest densities were recorded in Kipini, indicating seasonality in the infauna distribution. In May was the highest density. Kipini 4nm and the lowest was in December at Tana 3nm. The biomass was highest in December. The highest biomass was recorded in January at Malindi 0.6nm and was attributed to Bivalves. Overall, the highest density was recorded in Kipini (4nm) as shown in Fig.6 and the highest biomass was recorded in Kalifi (2.5) as shown in Fig.7. A total of 53 infauna taxa were recorded with polychaetes dominating with 30 taxa. The species diversity (H') varied from 0.88 in Kipini to 1.24 in Sadani. Sadani had the highest diversity index.

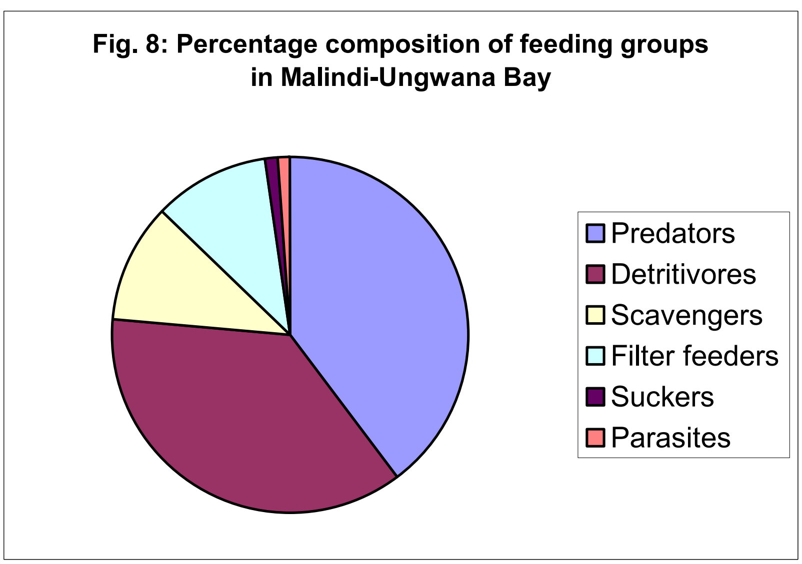
Fig.6: Infauna densities in the different stations





THE BENTHIC COMMUNITY

The benthic community of the Bay was composed of various feeding groups which include predators (carnivorous), detritivores, scavengers, filter feeders, suckers and parasites. Figure 8 shows the percentage compositions of the these groups. Predators (39%) and detritivores (34%) had the highest percentages.



DISCUSSION

The Ungwana bay benthic community has been disturbed and this is indicated by the dominance of predators, detritus feeders and scavengers. This is supported by studies on the long-term changes in the Northern Adriatic Sea benthos in a trawled area by Kollomann & Stachowitsch (2001), showed how the benthic community of suspension and filter feeders shifted to one dominated by detritus feeders. Therefore one of the effects of trawling is change in the benthic community structure. In addition, an EU (European Union) funded research has shown that commercial beam trawling has detrimental effects on the structure and composition of benthic communities in the North Sea (Keegan *et al*., 1998). It appeared that short –lived species were favoured while longer-lived species are more adversely affected with the result that the disturbed communities may favour scavengers, and predators other than fishery target species.

THE EFFECTS OF TRAWLING ON THE BENTHIC COMMUNITY

Different fishing methodologies vary in the degree to which they affect the seabed and the benthic community. Benthic communities experience continual natural disturbances at various scales in time and space. In general, shallow continental-shelf sea environments experience more frequent disturbances than deeper sea environments that are not exposed to wave action and strong currents. Studies have revealed intertidal dredging as having the most negative impact, beam trawling having less negative impacts and otter trawling having the least negative impacts (Kaiser,et al., 2002). Many marine organisms dig into muddy bottoms to create burrows and tubes to hide from predators and capture food. On these bottoms, trawl gear collapses the burrows and breaks the tubes, exposing inhabitants to predators. Some of these small species -- essential links in the marine food chain – are unable to rebuild their homes. This disturbance and displacement by trawling can however create “new” habitats which can be easily colonized by opportunistic organisms.

Consequences

Trawling eventually reduces species diversity and abundance. This is the present situation in the Ungwana bay, exhibited by the low species diversity and low abundance. Trawling reshuffles bottom-dwelling communities at many levels. For instance, increased murkiness of the water column may cause a shift from species that hunt by sight to those that locate prey by sound or touch, or from filter-feeders to deposit-feeders. In Ungwana bay, predators and deposit feeders dominate with lack of suspension or filter feeders. This situation is found in disturbed areas and the community structure of this area has changed with a reduced structural complexity. In terms of biomass, bivalves and brittle stars dominate in Ungwana bay. These are organisms that are flat structured and covered by hard shell, which indicates a dominance by organisms much adapted to disturbance.

Often in trawled areas, short-lived, rapidly-reproducing creatures (such as nematode worms) move in, tending to replace larger, longer-lived organisms (such as sponges or shellfish) that take longer to propagate and re-establish themselves. This is the situation found in Ungwana bay where short-lived organisms such as polychaetes and nematodes dominate. Typically, reducing structural complexity results in an increased abundance of opportunistic, more adaptable species that benefit from disturbance, at the expense of a richer variety of species and more fragile organisms. Although information on the benthic community in Ungwana bay before Trawling commenced is lacking, the present community recorded is similar the ones common in disturbed areas.

REFERENCES

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