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Effect of nutrient enrichment on seagrass associated meiofauna in Tanzania

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ABSTRACT

Abundance, diversity and community structure of meiofauna, with special emphasis on epiphytic harpacticoid copepods, occurring in Tanzanian seagrass beds under various nutrient inputs was determined. All measured parameters for epiphytic meiofauna and diatoms (fucoxanthin) were negatively affected by nutrient input and this was detected even at the higher taxonomic levels of meiofauna, supporting the validity of higher taxon surrogacy in environmental impact studies. However, benthic meiofauna and other biofilm characteristics (chlorophyll *a*) did not show any difference between sites suggesting that nutrient enrichment had less impact on these variables. This indicates a differential impact of pollution on epiphytic vs. benthic communities. Consequently, different trophic levels will be impacted in various ways and hence the effects of pollution on the overall ecosystem functioning of seagrass beds are complex and not straightforward. Although the seagrass plants themselves don't show any major changes under different nutrient input, associated organisms that guarantee energy flow at basal levels of the food web in this ecosystem can be largely impacted.

1. Introduction

Anthropogenic disturbance of nearshore ecosystems appears to be the most widespread phenomena threatening coastal ecosystems (Short and Wyllie-Echeverria, 1996). In coastal marine environments, sewage discharge is a common practice which can affect several ecosystems in multiple ways by changing structural and functional attributes of biodiversity (Pearson and Rosenberg, 1978; Short and Wyllie-Echeverria, 1996).

In East-African coastal cities domestic sewage infrastructures are in general poorly developed and can be considered as a major source of pollution to nearshore coastal waters. Impacted areas are mainly those that border major towns and cities from which they receive untreated municipal and industrial wastes due to high population densities and industrial aggregation. A good example along the East-African coast is the city of Dar es Salaam where the main sources of water pollution include sewage, heavy metal pollution, hydrocarbon pollution, solid wastes, agrochemical pollution and sedimentation, with domestic waste being the most serious source of pollution (Machiwa, 1992). As a result, the coastal waters, especially in the vicinity of the city, are heavily polluted. The Msimbazi River and Msimbazi Creek meander through the city centre and are the most polluted water bodies ultimately discharging their waters into the sea (Mohammed, 2000). The river and the creek receive large quantities of untreated domestic waste water from the city in addition to industrial wastes from various industries and drains into the ocean near Ocean Road. These waste waters influence not only the water quality but also the coastal ecosystems including seagrass beds, mangrove forests and the reef fringing the coast.

Along tropical coasts, seagrass beds typically support a large diversity of associated fauna and flora (Hemminga and Duarte, 2000). They provide food, shelter and nurseries for a variety of animals, including many commercially important fish and shellfish species (Bell and Pollard, 1989). In addition, seagrass beds form an important link between mangrove and coral reef ecosystems. Seagrass communities are however subjected to frequent disturbance by anthropogenic (e.g. shoreline construction, eutrophication, mechanical damage) or natural (sand wave motion, storms and hurricanes/typhoons, overgrazing) sources which can lead to alterations in vegetation complexity (De Troch et al., 2001a; Gray, 1997; Snelgrove et al., 1997). The main impact is of course visible on the plants and the size of the seagrass beds. However, the impact can also be evaluated as being less severe when plants remain intact but yet the associated fauna can be influenced, although often neglected in impact studies.

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The present study aimed to analyse seagrass associated meiofaunal organisms (Metazoa that pass through a 1 mm sieve but are retained on a 38 μm sieve). There are numerous advantages to use meiofauna in pollution studies including their widespread occurrence, high diversity and densities, permanent and intimate contact with contaminated sediment, high sensitivity and fast response, and their short generation time allows for tests of sensitive reproductive stages (Heip, 1980; Vincx and Heip, 1991; Warwick and Clarke, 1993; Giere, 2009). The present study focussed on harpacticoid copepods (Crustacea, Copepoda) since they are abundant in seagrass beds (Bell et al., 1988; Bell and Hicks, 1991; De Troch et al., 2001a,b; Hicks, 1977a,b,c, 1980) but also play a pivotal role in the energy flow from primary producers to higher trophic levels such as fish (Sogard, 1984; Fujiwara and Highsmith, 1997).

The impact of habitat modifications of seagrass beds for the associated meiofauna is far from being well documented. In order to unravel the impact of nutrient enrichment on ecosystem functioning of seagrass beds and their associated fauna and flora, the present study analysed the abundance, diversity and community structure of meiofauna, with special emphasis on epiphytic harpacticoid copepods, occurring in Tanzanian seagrass beds under contrasting nutrient levels.

2. Materials and methods

2.1. Study area

The study was conducted at Ocean road and Mbweni area off Dar es Salaam City, Tanzania (Fig. 1). Ocean Road is located close to the city centre just outside the entrance of the Dar es Salaam harbour (about 6°48′21.2″S; 39°17′41.9″E). This beach extends northwards to the mouth of Msimbazi creek. To the south, the beach is protected from the open sea by the Kigamboni headland as a result of change of the coastal alignment across the harbour, and

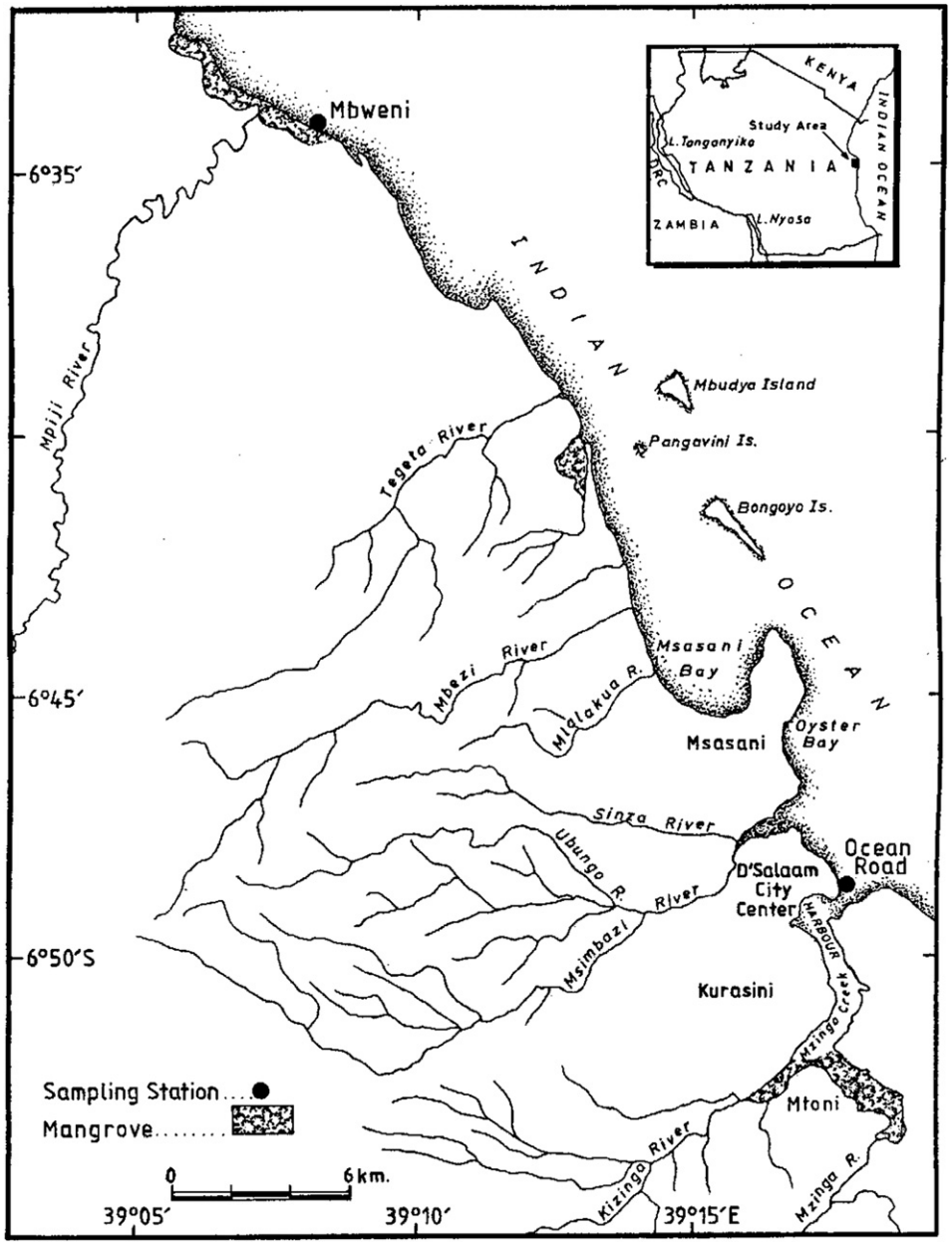

Fig. 1. Map of the study area with indication of the sampling sites.