



## Trace metal pollution and its influence on the community structure of soft bottom molluscs in intertidal areas of the Dar es Salaam coast, Tanzania

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### ABSTRACT

The influence of trace metal pollution on the community structure of soft bottom molluscs was investigated in intertidal areas of the Dar es Salaam coast. Significant enrichment of As, Mn, Mo, Sb, and Zn in sediments was recorded. Redundancy analysis indicated that trace metal pollution contributed 68% of the variation in community structure. Monte Carlo permutation test showed that As and Sb contributed significantly to variation in species composition. *T*-value biplots and van Dobben circles showed that the gastropods *Acteon fortis*, *Assiminea ovata*, and *Littoraria aberrans*, were negatively affected by As and Sb, while the bivalve *Semele radiata* and the gastropod *Conus litteratus* were only negatively affected by As. Bioaccumulation of As, Cd, Cu, Mo and Zn occurred in the bivalve *Macra ovalina* and the gastropod *Polinices mammilla*. This calls for regular monitoring and management measures.

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### 1. Introduction

Molluscs and other benthic macroinvertebrates have been used extensively in biomonitoring studies to assess the extent of anthropogenic pollution. Invertebrates are preferred, because they are diverse, highly adapted to a wide range of natural conditions and most are benthic with a limited mobility (Braccia and Voshell, 2006).

The community structure of benthic macroinvertebrates can be influenced by several physicochemical and biological factors. Due to complexity of the environment, it is difficult to identify the parameter that is affecting the invertebrates. Complexity of the environment is caused by interdependence among several environmental variables (Feld and Hering, 2007). For instance, waves and currents determine sediments particle size and organic matter content, which in turn determine the occurrence of invertebrate functional feeding groups (Lomovasky et al., 2010). Sediment particle size (Van Hoey, 2004; Jones et al., 2011), salinity (Pinder et al., 2005), availability of food and nutrients (Frost et al., 2009), anthropogenic pollution, and pH, are among the factors influencing the community structure of benthic macroinvertebrates. Pollution affects the community structure of benthic macroinvertebrates, because they exhibit species-specific responses to certain anthropo-

genic stressors (Goto and Wallace, 2010). Introduction of contaminants into the environment results in loss of sensitive species (Dauvin, 2008), while tolerant species may grow faster since their competitors have been eliminated by the toxicant (Connell et al., 1999). This results in a decrease of species diversity, species number, species abundance, and a shift in species composition.

Trace metals pollution is a serious problem in many developing countries, such as Tanzania. This is mainly due to poor infrastructure, use of inappropriate and insufficient technology, and failure of local authorities to act responsibly by enforcing existing laws and regulations (Linden and Lundin, 1995). Rapid expansion of coastal cities like Dar es Salaam also puts pressure on coastal ecosystems due to increase in land based activities, such as urbanisation and industrialisation, resulting in increased amount of domestic and industrial wastes. This combined with stress resulting from discharge of municipal sewage and recreational activities, puts benthic fauna like molluscs at a great risk.

Efforts have been taken to assess the concentration of trace metals in water, sediments, and fauna of the Dar es Salaam coast (De Wolf et al., 2001; Mtanga and Machiwa, 2007; Muzuka, 2007; Kruitwagen et al., 2008; De Wolf and Rashid, 2008). However, very little efforts have been made to assess the influence of these pollutants on the community structure of marine fauna, and hence very little is known about the impact of these pollutants on the community structure of sediment dwelling biota. Thus, the objective of the present study was to assess the extent of trace metal pollution and its influence on the community structure of soft bottom molluscs in intertidal areas of the Dar es Salaam coast, Tanzania.

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## 2. Materials and methods

### 2.1. Study site

This study was carried out in intertidal areas of the Dar es Salaam coast (Fig. 1). Samples were collected from Mbweni, Kunduchi, Msa-sani, Msimbazi, Mjimwema and Geza Ulole. Mbweni (site 1) and Kunduchi (site 2) are located 40 and 25 km north of the Dar es Salaam city centre respectively. With the exception of a few hotels built at Kunduchi (De Wolf et al., 2001) these areas are not heavily populated. The only industry located in the area is a cement factory.

Msasani (site 3) and Msimbazi (site 4) are located about 10 and 2 km north of Dar es Salaam city centre respectively. These areas have been reported to be heavily polluted, mainly by streams and rivers that drain from the city (De Wolf et al., 2001). Msimbazi river, which drains from the Dar es Salaam city centre is the main source of domestic and industrial contaminants for the Msimbazi mangroves and other areas in its vicinity. This area is also close to the Dar es Salaam harbour, which is located in the Mtoni estuary. High concentration of trace metals are reported for the Mtoni estuary which is attributed to a textile mill located on the banks of Kizinga stream (Kruitwagen et al., 2008).

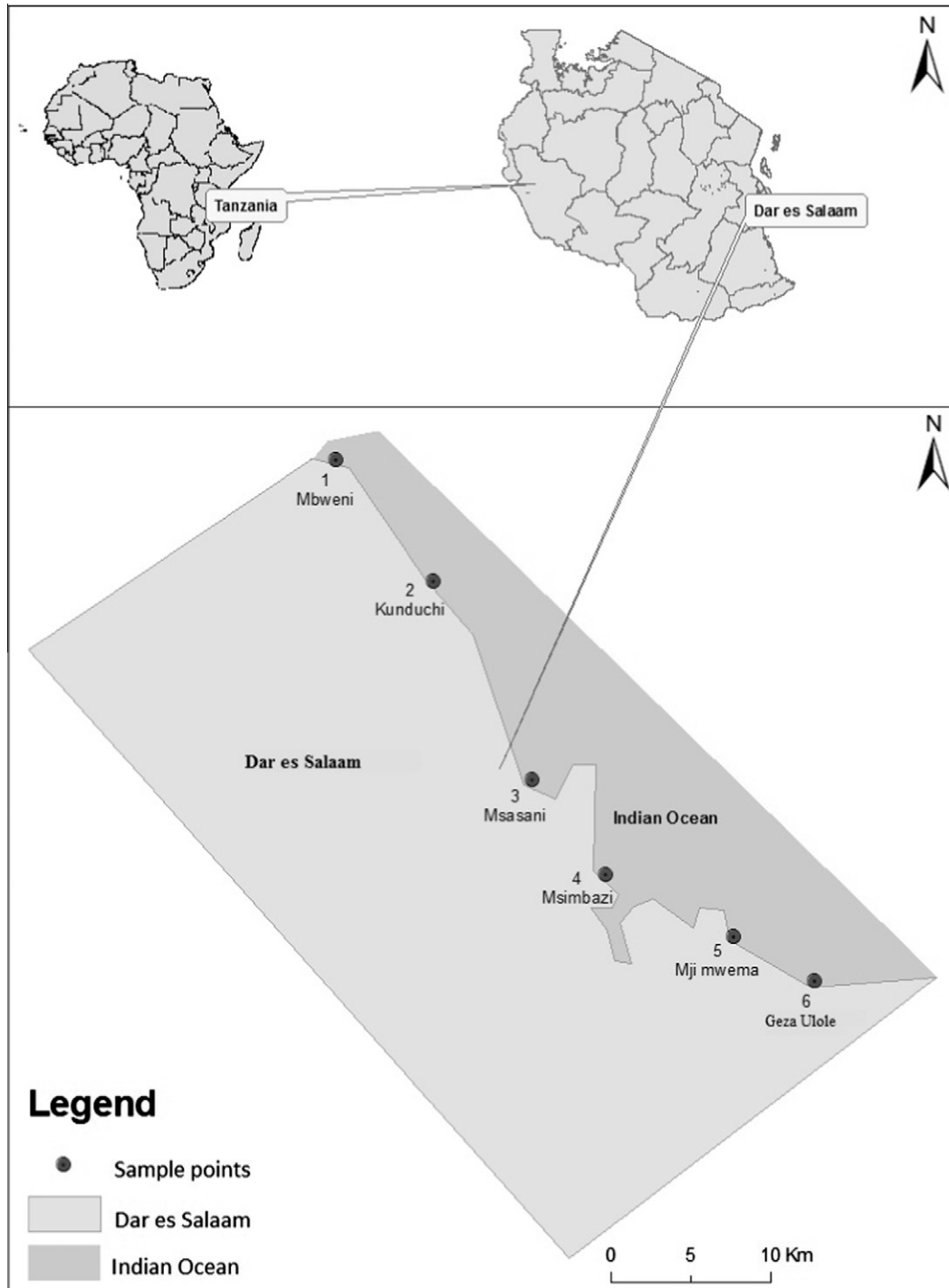


Fig. 1. Map of the Dar es Salaam coast indicating sampling sites.

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