Epipelic diatoms in the estuaries of South Africa

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Abstract

Epipelic diatom flora was sampled around the South African coast between the Olifants Estuary, on the cool Atlantic Ocean northwest coast, and the St. Lucia Estuary, on the Indian Ocean northeast coast. Altogether, 333 taxa were identified with 14 being ubiquitous, as they were found in the cool temperate, warm temperate, and subtropical areas, as well as in St. Lucia Estuary situated close to Moçambique. There was little difference between the epipelic diatom species present in intertidal and subtidal areas and, because many of the species have a high tolerance to salinity, with some being found in conditions ranging from freshwater to a salinity of more than 150 psu, it was concluded that many of the species sampled do not appear to be reliable indicators for assessing salinity in South African estuaries. Although there was a wide spread of diatoms across all of the estuaries around the coast, the greatest species similarity occurred between the Olifants, Great Berg and Breede estuaries, suggesting that the Breede Estuary, normally considered to fall within the warm temperate region, may be more similar to the cool temperate type estuaries. Data also showed that there was very little similarity between the diatom flora in the rivers flowing into estuaries and the diatom flora in the estuaries.

Keywords: diatoms, distribution, estuary, epipelon, salinity, temperature, tidal

Introduction

There have been many studies on the diatom flora of South Africa. Beginning in the 1960s, much of this was largely taxonomic (Giffen, 1963, 1966, 1970; Cholnoky, 1955, 1963, 1965, 1968 and numerous references therein; Schoeman and Archibald, 1976; Archibald, 1983). More recently, diatom studies have become increasingly focused on ecological interpretations, i.e., in rivers (De la Rey et al., 2004; Taylor et al., 2005; Taylor et al., 2007), in the surf-zone around the coast (Sloff et al., 1984; Campbell and Bate, 1987; Campbell and Bate, 1988a,b; Campbell et al., 1988; Talbot and Bate, 1986; Talbot and Bate, 1987; Talbot and Bate, 1988a,b,c,d; Talbot et al., 1989), a single attempt to examine diatoms in relation to water quality in estuaries (Minne, 2003), and a study of a World Heritage Site (Bate et al., 2008).

Harrison et al. (2000) estimated that there were approximately 370 river outlets to the sea around the South African coastline. Of these, 259 are made up of permanently open (POE) and temporarily open/closed (TOCE) estuaries (Turpie, 2004), estuarine bays, river mouths and estuarine lakes (Whitfield, 1992). However, there have been no studies undertaken in a systematic manner that have reported on the distribution of diatoms present in all of the estuary types around the coast, across salinity gradients and in both intertidal and subtidal domains, i.e., there has been no attempt to identify the distribution of diatom flora in estuaries and to relate this to environmental and geographical variables.

The National Water Act (No. 36 of 1998) makes provision for securing the water resources of the country. This Act, *inter alia*, requires that not only river resources be protected, but also estuarine resources. An interpretation with respect to estuaries is that sufficient freshwater must be discharged into estuaries in order to protect them to a level approved in terms of the Resource Directed Measures (RDM) programme of the Department of Water Affairs (DWA), which includes salinity that should normally fall within reasonable limits, i.e. 0–35 psu, except during periods of drought, when higher values might be expected, or during floods, when lower values might be expected.

The quality of estuary water in South Africa, unlike river water, is not presently analysed on a routine basis by any authority; yet the supply of freshwater, in terms of the Act, must be adequate such that estuary water should conform to prescribed quality minima. In areas where agricultural, industrial and municipal effluents reach estuaries, water quality might necessarily include high concentrations of mineral, heavy metal and biological substances. However, because estuaries, and especially permanently open estuaries, receive water from both the river and the sea on a daily basis, one of the major factors that needs to be kept within prescribed limits is salinity. POEs usually display a salinity gradient, being fresher inland and in the upper reaches, without exhibiting a halocline (Van Niekerk, 2007; Snow and Taljaard, 2007). However, this can break down when water is taken from rivers and utilised inland. TOCEs do not always have a salinity gradient because, being closed for variable periods during the year, they may be mixed by wind or, if the freshwater supply continues at a low flow during mouth closure, there may be a relatively fresh area near the head and a saline area, even hypersaline, near the mouth. Hence, POEs are more predictable with regard to the longitudinal salinity profile than are TOCEs (Snow and Taljaard, 2007).

Diatoms are known to respond to salinity and most references describe them as either freshwater, brackish or marine species (Round et al., 1990; Sims, 1996; Gell, 1997; Potter et al., 2006), hence the possibility of using diatoms to integrate and record salinity fluctuations formed part of the purpose of this research. In past South African studies on estuarine microalgal biomass, diatoms were always found to be present, and often make up a large portion of the microalgal community at the base of the estuarine food-chain (Snow, 2000; Snow et al.,

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