The relevance of diatoms for water quality assessment in South Africa: A position paper#

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Abstract

Water quality assessment protocols based on the use of diatoms are now well developed and their value substantiated at an international level. The use of diatoms is not designed or intended to be a "rapid" technology. The detailed level of information generated from the procedure outweighs perceived disadvantages of the additional time required for sample preparation and analysis to species level. The method is applicable across a wide range of aquatic ecosystem types, namely freshwater, brackish, and estuarine, and is inclusive of both lentic and lotic environments, wetlands and their associated damp, marginal and littoral zones. Details provided by diatom assemblages support palaeoecological investigations, historical reconstruction of water quality and the determination of prevailing water quality conditions. Deliberate determination of responses to management strategies or impacts arising from a variety of anthropogenic activities can be achieved via the simple expedient of retrieving living material from introduced artificial substrates. Previous studies in South Africa and elsewhere have shown that on a site-by-site basis the use of diatoms provides a fine level of diagnostic resolution of the causes underlying changes in water quality and environmental condition.

The South African Diatom Collection ("the Collection"), a repository of diatom specimens and records that spans the length and breadth of this country, contains an as-yet unutilised wealth of ecological and taxonomic information. More importantly, the historical data analysis records provide an insight into water quality conditions prevailing 40 to 50 years ago – in many cases prior to the "development" of many of our rivers, streams and wetlands. The real value of its existence underpins the great potential for renewed attention to the value of diatom-based approaches to water quality assessments. In addition, the Collection provides a ready-made foundation on which a locally relevant tool for water quality assessment may be established to augment the current use of invertebrate indicators.

It is now appropriate that the full potential of the use of diatoms in water quality assessments, and the information contained in the Collection, be developed and utilised for water quality assessment in South Africa.

Keywords: diatoms, water quality, Cholnoky, Archibald, biotic indices

Introduction

Assessing water quality using biotic indices

Few people involved with ecohydrology and water resource management doubt the value of water quality assessments derived from the use of biotic indices, i.e. assessments based on observations of the resident floral and faunal communities (Chutter, 1972; Patrick, 1973; Schoeman, 1976; Descy, 1979; Kelly et al., 1995; Kelly, 1998a; Bate et al., 2002). Assuming requisite levels of ecological experience and taxonomic proficiency on the part of the assessor, such evaluations provide a description of the water quality that is often not achievable from elemental analyses alone. The value of an integrative biological response provided by the analysis of diatom associations offsets the inconsistency of rapid changes in water chemistries that render the use of conventional analytical approaches inadequate. A further potential advantage is that the diatom-based approach could obviate the need for additional and expensive toxicity testing protocols – particularly because of the attendant uncertainty of extrapolation to the real environment of the responses of selected single species testing gauged under laboratory conditions. Ecological risk assessments are more appropriately based on biological endpoints in the field than on measures of chemical constituents (Karr and Chu, 1997). Monitoring procedures based on the biota measure the health of a river and the ability of aquatic systems to support life, as opposed to simply characterising the chemical and physical components of a particular system. This is the central purpose of assessing the biological condition of aquatic communities of a river (Barbour, 1997).

Karr and Chu (1997) have stressed that chemical criteria based on laboratory-derived dose-response curves for single toxicants cannot account for cumulative, synergistic or antagonistic interactions of the suite of chemicals found in a polluted river system. Comprehensive and accurate multimetric indices explicitly embrace several attributes of the sampled assemblage including taxon richness, indicator taxa and the health of individuals. In many cases, biotic indices provide an indication of the existence or absence of life in stream water where routine chemical measurements of "indicator elements", even at the limits of analytical detection are not definitive.

Cairns (1981) highlighted the need for standard methods for the bio-monitoring profession because he recognised that the condition of individual species and of communities of indigenous biota was one of the best measures of the health of an ecosystem. In an effort to

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