

# The influence of land use on water quality and diatom community structures in urban and agriculturally stressed rivers

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## Abstract

Epilithic diatom communities offer a holistic and integrated approach for assessing water quality as they remain in one place for a number of months and reflect an ecological memory of water quality over a period of time. The objective of this study is to use diatom assemblages to distinguish between particular land types and associated water quality impacts that are linked to these land-use patterns. Water quality and diatom community data were collected from sites in the Crocodile and Magalies Rivers (Gauteng and North West Province, South Africa) associated with agricultural, urban and natural (reference) adjacent land use respectively. The data collected were subjected to multivariate statistical techniques to analyse spatial and temporal patterns in water quality (principal component analysis) and diatom community structures (non-metric multidimensional scaling) to elucidate hypothesised differences in community structure per land-use type. Five diatom response indices (Generic Diatom Index, Specific Pollution Sensitivity Index, Biological Diatom Index, Eutrophication/Pollution Index and Percentage Pollution Tolerant Valves) incorporated in the OMNIDIA software were implemented to assess the integrity of diatom communities per land-use type. Principle component ordination of water quality describes 56.6% of the variation in data observed, and indicates the separation of reference sites from test sites for low and high flow conditions combined. It was, however, not possible to distinguish between the agricultural and urban land-use sites using PCA based on water quality data. One-way ANOSIM showed a significant difference ( $p < 0.05$ ) between reference groups, agricultural groups and urban groups, with no significant differences noted ( $p > 0.05$ ) between groups made up of sites exhibiting the same land-use patterns. Diatom indices showed that agricultural sites were in a slightly more modified ecological state than urban sites overall. Based on the species similarity (SIMPER analyses), reference sites showed strong associations with *Achnanthes minutissima*, *Gomphonema venusta* and *Cocconeis placentula* var. *euglypta*, whilst urban sites were associated with *Diatoma vulgaris*, *Navicula tripunctata* and *Amphora pediculus*. Agriculture could be separated into high- and low-intensity practices based on species composition. Sites where high-intensity agriculture took place were dominated by motile species of the genus *Nitzschia*, and low-intensity agriculture was indicated by motile species of the genus *Navicula*. Urban sites contained a combination of species that were tolerant of spikes in water quality.

**Keywords:** diatoms, agriculture, urban, land use, water quality, community structure, aut-ecological indices