Science of the Total Environment, vol. 612: 214-222

Development of a diatom-based multimetric index for acid mine drainage impacted depressional wetlands

Riato L
Leira M
Della Bella V
Oberholster PJ

ABSTRACT:

Acid mine drainage (AMD) from coal mining in the Mpumalanga Highveld region of South Africa has caused severe chemical and biological degradation of aquatic habitats, specifically depressional wetlands, as mines use these wetlands for storage of AMD. Diatom-based multimetric indices (MMIs) to assess wetland condition have mostly been developed to assess agricultural and urban land use impacts. No diatom MMI of wetland condition has been developed to assess AMD impacts related to mining activities. Previous approaches to diatom-based MMI development in wetlands have not accounted for natural variability. Natural variability among depressional wetlands may influence the accuracy of MMIs. Epiphytic diatom MMIs sensitive to AMD were developed for a range of depressional wetland types to account for natural variation in biological metrics. For this, we classified wetland types based on diatom typologies. A range of 4–15 final metrics were selected from a pool of ~ 140 candidate metrics to develop the MMIs based on their: (1) broad range, (2) high separation power and (3) low correlation among metrics. Final metrics were selected from three categories: similarity to reference sites, functional groups, and taxonomic composition, which represent different aspects of diatom assemblage structure and function. MMI performances were evaluated according to their precision in distinguishing reference sites, responsiveness to discriminate reference and disturbed sites, sensitivity to human disturbances and relevancy to AMD-related stressors. Each MMI showed excellent discriminatory power, whether or not it accounted for natural variation. However, accounting for variation by grouping sites based on diatom typologies improved overall performance of MMIs. Our study highlights the usefulness of diatom-based metrics and

provides a model for the biological assessment of depressional wetland condition in South Africa and elsewhere.