A study of the water quality of the Mhlathuze River, KwaZulu-Natal (RSA): Microbial and physico-chemical factors

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Abstract

The microbial quality (total and faecal coliform counts) and some physico-chemical parameters of the Mhlathuze River water source were monitored during March 2001 to November 2002 and compared to the previous study conducted during 1998-1999. The results showed that most of the physical and chemical values obtained were within the recommended limits specified in the South African Water Quality Guidelines. High concentrations of metal were detected in water samples from Felixton and the Richards Bay estuary. Water samples from the Mhlathuze Pumping Station and Felixton, which contained higher concentrations of total nitrogen and phosphate, possessed higher faecal coliform contamination than other sites. The total coliform counts of the Mhlathuze River in this study period were noted to be significantly higher than those in the 1998 to 1999 period. As observed in the previous study, Felixton continues to be the site with major faecal contamination. The resuscitation results indicated that the level of faecal contamination in the Mhlathuze catchment was higher than that measured using conventional methods. Therefore the real impact of this "viable but non-culturable" state of micro-organisms in this water system requires urgent attention. Larger fluctuations in the trend of total and faecal coliform counts were observed in 2001. This phenomenon coincided with the major construction of the Mhlathuze pumping station. High water surface temperatures and rainfall figures might have also contributed to this observation. Evidence from our results strongly suggests that the use of faecal coliform bacteria as indicators should be expanded and more research is indicated to identify the impact of the "viable but non-culturable" (VBNC) state of pathogens in this environment.

Keywords: water quality, total and faecal coliforms, physico-chemical, Mhlathuze

Introduction

The Mhlathuze catchment supports a rapidly growing agricultural and industrial community in northern KwaZulu-Natal, South Africa (Steyl et al., 2000). 78.5% of the population dwelling in the catchment area are classified as rural. 63% of these people use dams, rivers and streams as their primary water sources. Sanitation services are unavailable for 34.8% of the population (Census, 1996).

With increasing demands on water resources and contamination from industrial waste and human activities, the potential outbreaks of water-borne diseases in this area continue to grow. In 1996, it was found that the bacteriological quality of the Mhlathuze River posed an increased risk of infectious disease transmission to the communities that were dependent on the river for household, recreation and other purposes (Department Of Water Affairs And Forestry (DWAF), 1996). According to the Institute of Water Quality Studies of DWAF (IWQS Report, 2000) this catchment area (W12 C-J) is high on the National Microbial Water Quality Monitoring Programme's priority list (14th in a total of 120).

DWAF has adopted Strategic Environmental Assessment (SEA) as a tool in managing and planning the Mhlathuze catchment area by considering all aspects of the social, economic and biophysical aspects of the environment (Steyl et al., 2000). The quality of water is typically determined by monitoring microbial presence, especially faecal coliform bacteria, and physico-chemical properties (Gray, 1994; DWAF, 1996; USA-EPA, 1999). However, the microbiological aspects of the water quality, namely the prevalence of human pathogens and indicator micro-organisms in the Mhlathuze catchment and surroundings have not been adequately addressed.

A previous study (1998 to 1999) showed high levels of faecal contamination in this area (Bezuidenhout et al., 2002). This problem is further compounded by the possible survival strategies of the viable but non-culturable state of bacterial flora in water systems (Colwell et al., 1985, Singh et al., 1986, Garcia-Lara et al., 1991). It is therefore imperative that microbial and physico-chemical data of the river are documented to provide comprehensive baseline information for future microbial monitoring purposes.

The primary aim of the study was to determine the microbial quality (total and faecal coliform counts) and some physico-chemical parameters of the Mhlathuze River water source. Secondly the impact of environmental factors was compared with the previous results in the same area.

Materials and methods

Sampling

Five sites along the Mhlathuze River were selected for this study (Fig. 1). Site 1 (KwaDlangezwa) is situated near a sewage treatment plant at the University of Zululand. The area surrounding Site 2

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