

Persistent organic pollutants

Threats posed by the organic pollutants to a tourist destination

The Water Research Commission (WRC) has completed a study on prevalence and significance of organic contaminants and metals in aquatic ecosystems in the eThekwin area of kwaZulu-Natal.

Background and rationale

Organic chemicals, including polycyclic aromatic hydrocarbons, pesticides, and polychlorinated biphenyls are routinely analysed in water, sediment and biological tissue for ecological and human health risk assessment purposes in many regions of the world.

This is because these chemicals pose significant risks to ecological and human health when present at elevated concentrations. Many of these chemicals have a high bioaccumulation (absorbed into the body) potential and also a high biomagnification potential (absorbed up the food chain/web).

An important pathway of exposure to these chemicals for humans is dietary, with the consumption of fish and shellfish being one of the most significant pathways. Besides being absorbed into bodies, many of these organic chemicals are also persistent in the environment, meaning that they retain or change their chemical forms over a long time.

Because of their toxicity the production and use of some organic chemicals has been banned or restricted under conditions of the Stockholm Convention on Persistent Organic Pollutants, to which South Africa is a signatory. Despite their banning, because of their persistence many of these chemicals continue to pose ecological and human health risks. For example, the production and use of DDT was banned (or restricted) in the late 1970s, yet in many parts of the world these chemicals remain a major ecological and human health concern.

In recent years, there has been a significant increase in research on the prevalence and potential ecological and human health risks posed by organic chemicals in South African aquatic ecosystems. The level of attention is nevertheless far lower than in many parts of the world.

For example, there are no local or national aquatic monitoring programmes that consistently monitor for chemicals such as polychlorinated biphenyls. There appear to be a number of reasons for this low level of attention in South Africa, including significant technical and human capacity constraints for organic chemical analysis and the high cost of analyses that is often considered prohibitive by public funding organisations.

Also, many government agencies appear not to appreciate the significant risks that these chemicals pose to ecological and human receptors and consequently rarely stipulate the need for their monitoring. The majority of attention on organic chemicals in South Africa was historically and still is focused on freshwater ecosystems.

South African coastal ecosystems have received comparatively little attention. It should come as no surprise that our understanding on whether organic chemicals are widespread and significant contaminants of water, sediment and biological tissue in coastal ecosystems and whether they are cause for ecological and human health concern is virtually non-existent.

This lack of understanding has important implications since coastal ecosystems, especially sheltered estuaries and embayments, are ecologically highly productive and provide

numerous ecological services to people. Sheltered estuaries and embayments are, however, well-known depositional zones susceptible to contaminant accumulation.

The overarching aim of this study was to improve scientists' understanding on whether organic chemicals are widespread and significant contaminants of aquatic ecosystems in the eThekweni area of KwaZulu-Natal and, if so, to determine whether they are a cause for concern from an ecological and human health risk perspective.

Investigation

Sediment was collected in rivers, estuaries and canals in the eThekweni area (Fig.1). The systems spanned the range from highly urbanised and industrialised catchments to lightly urbanised and rural catchments. Fish and mussels were caught and collected mainly in Durban Bay, uMngeni and Isipingo River estuaries.

Sediment, fish and mussels were analysed for a wide suite of chemical parameters. The chemical concentrations were used for the purposes of screening and assessment potential risk to human health. Analysis were undertaken at accredited labs and shared with others in the country to improve confidence in the results.

Key findings and discussion

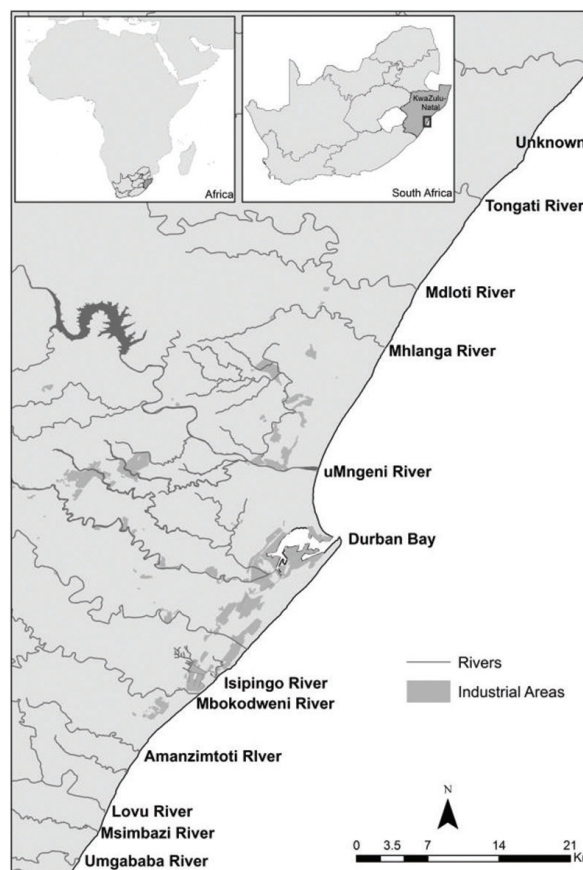
The concentrations of POPs selected for the study mainly exceeded the limits. For example, seventeen organochlorine pesticides and/or metabolites were detected in sediment at concentrations exceeding the method detection limit.

Toxaphene was the most frequently detected pesticide at 13 of the 54 stations sampled. Pesticide and/or their metabolite concentrations at numerous stations exceeded sediment quality guidelines.

Based on a comparison to sediment quality guidelines derived to be protective of sediment-dwelling organisms in North America, there is the likelihood that polycyclic aromatic hydrocarbon concentrations in sediment in some rivers and estuaries posed a toxic risk to sediment-dwelling organisms.

The greatest toxicological risk was for sediment in the Amanzimnyama River, though all estuaries showed higher

Fig 1. The study area



than acceptable concentrations of POPs in sediment. The suite of organic chemicals detected in the tissue of fish and mussels generally reflected the suite of chemicals detected in sediment within each system studied.

The notable exception was for chlordane, which was fairly frequently detected in sediment but was never detected in the tissue of fish and mussels. The fish and mussel species sampled thus appear to provide a reliable indicator of contaminants that are introduced into the catchments of Durban Bay and Mngeni and Isipingo River estuaries, while high concentration pose a serious threat to fisherman, especially subsistence ones.

This needs further research, however, the eThekweni Municipality will be alerted to this risk, including impacts on blue beach status and tourism.

Policy implications and recommendations

This study has provided evidence for significant sources of organic and metal contaminants to aquatic ecosystems in the Durban Bay catchment. Inflows from the Amanzimnyama River, Island View Canal, Bayhead Canal, and numerous stormwater outfalls are important conduits for the introduction of contaminants to Durban Bay.

There is also evidence that certain port activities are significant sources of contaminants to the Bay.

All sources of contaminants need to be identified and managed if there is to be any improvement in water and sediment quality in Durban Bay. This will reduce the uptake of contaminants by fish, shellfish and other biota, and thereby reduce potential health risks posed by contaminants to human.

The concentrations of several chemicals in the tissue of fish caught and mussels collected, especially in Durban Bay, uMngeni and Isipingo River estuaries were high enough to pose a potential risk to the health of human consumers. The most notable were polychlorinated biphenyls and mercury.

Since this study could not perform a comprehensive human health risk assessment, it is recommended that this be done,

urgently. Meanwhile, people at risk of contaminants through fish/mussel consumption or indirectly as bathers must be alerted by the eThekweni Municipality.

There is an urgent need to develop sediment quality guidelines for freshwater and coastal ecosystems in South Africa, instead of relying on international benchmarks.

Coincidentally, an Estuarine Management Plan for Durban Bay is being formulated. The plan recognises the need for a catchment scale approach to the sustainable management of the Bay.

The findings of this study can be incorporated into this plan and used to identify and prioritise areas of the catchment where contaminant source identification, reduction and control procedures should be implemented. Within this plan a monitoring and evaluation system is critical to ensure proper management of Durban estuarine systems. It must be aligned with the Department of Water and Sanitation's national and regional monitoring efforts.

Further reading:

To order the report, *Prevalence and significance of organic contaminants and metals in aquatic ecosystems in the eThekweni area of KwaZulu-Natal* (Report No. 1977/1/15) contact Publications at Tel: (012) 330-0340, Email: orders@wrc.org.za or Visit: www.wrc.org.za to download a free copy.