

The effects of a single freshwater release into the Kromme Estuary.

5. Overview and interpretation for the future

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Abstract

The Mpofu Dam completely blocks the Kromme River a few kilometers above the estuary and prevents a normal flow of freshwater. Because of this, the biological characteristics of the estuary have changed and the system is now more like an arm of the sea than a productive estuary. An annual allocation of $2 \times 10^6 \text{ m}^3$ water (less than 2% of the natural mean annual run-off) is released to prevent the salinity in the estuary from rising above that of the sea (i.e. 35‰). An experiment was undertaken in which the annual allocation of freshwater was released as a single pulse in an attempt to create a salinity gradient and stimulate a biological response particularly in the estuary water column. The release was expected to create freshwater conditions throughout the upper half of the estuary. Instead the low density freshwater flowed over the more dense seawater and there was little mixing. A week after the release both the vertical and longitudinal salinity gradients began to disappear. The measurable concentration of mineral nutrients in the estuary after the release remained low, with the result that there was a negligible increase in microalgal biomass either in the water column or on the subtidal sediment. These effects were noticeable in the zooplankton and larval fish communities, both of which remained almost unchanged during and after the release. The results of this experimental release, and other data, indicate that a baseflow of water is necessary to create a longitudinal salinity gradient and a productive river-estuary interface zone. This information should be used to guide assessments of the freshwater requirements of South African estuaries.

Introduction

Water is becoming an increasingly precious commodity in South Africa that will have to be managed efficiently if all the requirements of this developing country are to be met. Large pristine permanently open estuaries in Southern Africa had a regular flow of river water, interspersed at intervals by droughts and floods. They had an unblocked link to the river inland, a continuous or discontinuous connection with the sea and occasional floods. An estuary that is deprived of this freshwater input loses the physical characteristics of an estuary and begins to function as a marine embayment or as an arm of the sea.

In the case of the Kromme Estuary, a regular flow is absent because of the size of the Mpofu and Churchill Dams. The storage capacity of the dams ($133 \times 10^6 \text{ m}^3$) exceeds the mean annual runoff (MAR) of $106 \times 10^6 \text{ m}^3$ from the catchment. The dams completely block the river and also prevent faunal migrations between the sea and the river. There is a continuous connection between the estuary and the sea because of a large tidal volume. However, with depositions of marine sand into the estuary this situation could change in the future. There are occasional floods of freshwater to the sea, but because of the large sizes of the impoundments, these are very irregular.

South Africa has been described as a "water-short country". While to describe a semi-arid environment the public may use this, it leaves the wrong impression and it is incorrect in ecological terms. From an ecological perspective the supply of water is determined by the climate and a "shortage" of water relates either to there being too many people for the available water supplies or to the inefficient management of the water that is available. Inefficient management may be either water wastage by consumers, e.g. not closing taps, inefficient methods of irrigation, excessive industrialisation or inefficient storage by building shallow

dams. The use of the term "water-short" implies that the climate is at "fault", whereas in reality the environment is the condition in which we find it either with a high rainfall or only a little.

The National Water Act (No. 36 of 1998) recognises rivers, groundwater, wetlands and estuaries as resources and requires that they be protected so that they will be sustained into the foreseeable future. In order to achieve this there is an ongoing interaction between water engineers and biologists. This interaction is taking place in an effort to solve the difficult questions that arise from the social need to abstract water from waterways and the ecological need to allow water to flow as naturally as possible. Cooper et al. (1999) described estuaries as the meeting place of terrestrial drainage systems with the coast. Because of this, they are highly variable environments in both time and space. Their characteristics depend on climate, hinterland topography, coastal dynamics, sediment supply and coastal lithology. Schumann et al. (1999) stated that estuaries lie at the interface between the ocean and the land, forming the meeting place of the saltwater regime of the sea and the freshwater flow of parent rivers. These latter authors further stated that the regular forcing of the tides drives the oceanic input, while the freshwater input is dependent on variable rainfall in the catchment areas of the rivers. It is the continual interaction between saltwater and freshwater that forms the basis of estuarine hydrodynamics, compounded by other influences such as channel structure and sediment movement and the effects of wind, waves, insulation, human influences and biotic processes.

The foregoing descriptions of the estuarine environment indicate that there are many complexities that need to be understood. At the same time, and in line with most countries in the world, there is a severe shortage of finance to undertake the research needed to answer all the questions. It was this milieu of necessity and lack of understanding that prompted the study that is reported here. The study brought together researchers from the University of Port Elizabeth, JLB Smith Institute of Ichthyology, CSIR (Environmentek), the Department of Water Affairs and Forestry, the Engineering Department of the City of Port Elizabeth and interested and affected parties, particularly the members of the Kromme Trust.

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