

# On the limnology of Spioenkop, a turbid reservoir on the upper Thukela River, with particular reference to the structure and dynamics of its plankton community

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## Abstract

Basic features of the physical and biological limnology of Spioenkop, a large turbid impoundment on the Thukela River, were studied between July 1989 and May 1990, following surveys in spring 1987 and 1988. The lake showed a typical monomictic pattern of summer stratification (November through April) and holomictic winter circulation (May to October). Water quality was chemically good, with little evidence of nutrient enrichment (South African DWA records). Biological production was confined by high turbidity (SD around 25 cm, NTU values of ca 90) imposed by suspended sediments, limiting annual maximum surface chlorophyll content to below  $5 \mu\text{g}\cdot\text{L}^{-1}$ , and spring primary production to  $< 500 \text{ mg C}\cdot\text{m}^{-2}\cdot\text{d}^{-1}$ .

Zooplankton was dominated (numerically and/or gravimetrically) by typical turbid-water fauna; the copepods *Metadiaptomus colonialis* and *Lovenula falcifera*, and cladocerans *Daphnia barbata* and *Moina micrura*. These species and other taxa present showed considerable seasonal periodicity, but maximal total abundance of the entire community ( $680 \text{ mg}\cdot\text{m}^{-2}$  DW) was attained in mid-summer. Limited information regarding littoral zoobenthos and fish is provided.

Considerations of Spioenkop as a mirror of its catchment, and in relation to the major Thukela-Vaal inter-basin transfer scheme invite critical appraisal of the level of scientific knowledge and understanding. The plea and challenge is made for more holistic and integrated approaches to ensure sustainable environmental management.

## Nomenclature

CPUE	catch per unit effort
DW	dry weight
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
$K_d$	downwelling extinction coefficient
MAR	mean annual runoff
NTU	nephelometric turbidity unit
PAR	photosynthetically active radiation (400 - 700 nm)
P/B	production to biomass ratio
$P_{\text{max}}$	maximum volumetric primary production
SD	Secchi depth transparency

## Introduction

Man-made lakes dominate the limnetic landscape of South Africa (Allanson et al., 1990), with some 520 major state dams capturing 50% of the nation's MAR (Uys, 1996). As dams are logically sited to maximise capture of river flow, the resulting impoundments are rendered especially vulnerable to all land uses and developments in their respective catchments; water quality is almost inevitably impaired (Marzolf, 1984). In South Africa, as elsewhere globally, eutrophication and chemical pollution represent major water-quality threats to river impoundments. But in contrast to relatively mesic conditions experienced in many nations, the aridity or semi-aridity of South Africa renders its impoundments especially susceptible to two additional water quality problems. Firstly, elevated mineral turbidity - a consequence of erosion of land surfaces with limited vegetal cover, high intensity rainfall, etc. Secondly,

salinisation arising through evaporative concentration (DWA, 1986a).

Despite the large number of storage reservoirs (DWA, 1986a), baseline limnological information is available for relatively few. What does exist is often meagre, and based on once-off or short-term studies. Seasonally comprehensive data are seldom available for a complete year, let alone spanning sufficient time to encompass the inherent hydrological variability of the region (Schulze, 1997). Ironically, such deficiencies exist even in respect of significant major impoundments in this water-limited nation. The present study was undertaken as a preliminary attempt to improve this deficiency in respect of selected reservoirs in the midlands of KwaZulu-Natal. This paper considers Spioenkop, a system highly impacted by mineral turbidity. A parallel comparative study on Wagendrift, a neighbouring and relatively clear-water impoundment on the Bushmans River, will be reported separately.

The primary objective of this study was to provide a baseline limnological study of Spioenkop, with particular reference to the seasonal abundance and community composition of its plankton in relation to annual changes in thermal stratification and turbidity. As such, it merely provides introductory documentation of the limnology of this reservoir, augmenting similarly descriptive studies undertaken elsewhere e.g. Sterkfontein (Dörgeloh et al., 1993).

## Study site

Spioenkop is a large reservoir sited on the Thukela (formerly Tugela) River near Bergville (KwaZulu-Natal), some 65 km downstream from this river's headwater sources in the Drakensberg mountains (Fig. 1). It was impounded in 1972 by Spioenkop Dam ( $28^{\circ}38'S$ ,  $29^{\circ}28'E$ ), to regulate river flow for downstream users following development of the Thukela-Vaal inter-basin transfer and pumped storage scheme, but is operationally divorced from the

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