

A baseline limnological study of Wagendrift Dam (Thukela basin, KwaZulu-Natal)

Rob C Hart

School of Botany and Zoology, University of Natal, P/Bag X01, Scottsville, 3209, Pietermaritzburg, South Africa

Abstract

Basic features of the physical and biological limnology of Wagendrift Dam, a moderately large impoundment on the Boesmans River, were studied between July 1989 and May 1990. This man-made lake showed a typical monomictic pattern of summer stratification (November through April) and holomictic winter circulation (May to October). Water quality was chemically good (Department of Water Affairs and Forestry records), with little evidence of nutrient enrichment. Water clarity during the study was moderately low (mean SD and K_{dPAR} values of 0.45 m and 2.55 m⁻¹), with little evidence of persistent mineral turbidity, suggesting reasonably satisfactory catchment conditions. In keeping with the low nutrient status, surface chlorophyll content remained below 5 µg · l⁻¹ throughout the study. In terms of ecological groupings, the phytoplankton was numerically dominated mostly by 'Competitive' green algae for most of the year. 'Stress-tolerant' cyanophytes were continuously sparse, but were marginally more abundant during summer stratification. Diatoms and other disturbance-tolerant 'ruderal' algae persisted throughout the year. No spring peak in ruderal algae was evident, but it may have been masked by high zooplankton grazing pressure. An autumnal peak in ruderal algae coincided broadly with flood-related inflows and annual de-stratification.

Zooplankton was dominated (numerically and/or gravimetrically) by typical clear-water taxa. The copepod *Tropodiatomus spectabilis* and cladoceran *Daphnia pulex* along with various unidentified cyclopoids and rotifers were seasonally persistent, while other cladoceran taxa (*D. laevis* and *Diaphanosoma excisum*) showed considerable seasonal periodicity. Zooplankton standing stock was collectively substantial, annually averaging around 0.65 g·m⁻² DM, and approaching 1 g·m⁻² DM in spring/early summer, implying potentially significant natural grazer-control of phytoplankton, aided perhaps by large numbers of benthic bivalve molluscs (*Unio caffer*), observed stranded in littoral margins following reservoir draw-down.

Nomenclature

CSIR	Council for Scientific and Industrial Research
DM	Dry mass
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
K_d	Down welling extinction coefficient
MAR	Mean annual runoff
PAR	Photosynthetically active radiation (400 to 700 nm)
SD	Secchi depth transparency

Introduction

The level of limnological knowledge and understanding of South African man-made lakes belies both their dominance of the country's limnetic landscape (Allanson et al., 1990), and their strategic importance in this generally water-scarce region (Noble and Hemens, 1978). Studies undertaken within the Inland Water Ecosystems thrust of the CSIR's former National Programmes for Environmental Sciences (Allanson and Jackson, 1983; Breen, 1983; National Institute for Water Research, 1985) provided holistic (i.e. physical, chemical and biological) understanding of limnological structure and functioning of three of the country's major reservoirs with strikingly different features (high mineral turbidity, clear oligotrophic waters, and hypertrophic waters, respectively), with a sister study of a smaller turbid system (Pieterse and Keulder, 1982). The general limnology of most of the remainder of more than 500 major state dams (Department of Water Affairs,

1986; Uys, 1996) is largely undescribed, apart from Walmsley and Butty's (1980) baseline survey of 21 impoundments and various other narrower studies addressing general physico-chemical limnology (e.g. Tow, 1981; Dörgeloh et al., 1993), particular biotic components (e.g. Van Ginkel, 1987) and problems (e.g. Selkirk and Hart, 1984), or specific catchment issues wider than the impoundments themselves (e.g. O'Keeffe et al., 1996; Keinzle et al., 1997; Graham et al., 1998). Baseline limnological information resulting from often time-constrained studies obviously cannot encompass the hydrological variability of the region (Schulze, 1997), and provides no information on progressive and longer-term changes (like eutrophication, salinisation, and sedimentation) that generally accompany or are associated with catchment developments.

The present study was undertaken to provide some baseline knowledge of the general limnology of Wagendrift Dam, one such previously unstudied impoundment on the Boesmans River at Estcourt, in the midlands of KwaZulu-Natal. Findings of a parallel sister study of Spioenkop Dam, a highly turbid reservoir on the upper Thukela River, are published elsewhere (Hart, 1999).

The primary objective of the present study was to determine the seasonal characteristics of phytoplankton and zooplankton abundance and composition in Wagendrift Dam in relation to the general thermal and hydrological characteristics of this superficially clear-water reservoir. Given corresponding information on Spioenkop Dam, a reasonably proximate but highly turbid system (Hart, 1999) lying in a somewhat drier watershed, but with otherwise similar catchment geology, soil type, erodibility index, and vegetation (Midgley et al., 1994; Schulze, 1997), some comparative evaluation of drainage basin conditions on limnological characteristics was expected (Hynes, 1975).

☎(033) 260-5104; fax: (033) 260-5105; e-mail: Hartr@nu.ac.za

Received 19 December 2000; accepted in revised form 11 July 2001.