

The physical and chemical limnology of Sterkfontein Dam, Eastern Orange Free State, South Africa

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Abstract

The great depth and high altitude of Sterkfontein Dam relative to other large reservoirs in Southern Africa make this an unusual water body. It is also characterised by an almost entirely artificial inflow. As Sterkfontein Dam is the main storage reservoir in the Tugela-Vaal interbasin transfer scheme, the water quality needs to be monitored. This is the first limnological study of this reservoir, where the physical and chemical quality of the water body was examined.

The reservoir was stratified during summer, although not very strong. The stratification was easily destroyed by wind. Mixing was such that aerobic conditions prevailed in the profundal zone. Nutrient concentrations were low, suggesting that this system is oligotrophic. The relatively low mean temperatures, low turbidity and distribution of well-oxygenated water to large depths make this a good potential habitat for fish, especially trout.

Introduction

In South Africa water resources are limited and river systems are naturally turbid (Day, et al., 1986). This can be attributed to highly erodible soils and man-induced soil erosion. Reservoirs, usually part of river systems are directly affected by high silt loads in rivers. In addition to this form of pollution, chemical pollution from mines, industries and urban areas further increases the problem of deteriorating water quality. Managing water systems to improve and maintain a high water quality is therefore important.

Sterkfontein Dam is an important supplier of water to the Vaal Dam, the main water reservoir to the PWV area, during periods of drought. Vaal Dam is eutrophic so the inflow of high quality water from Sterkfontein Dam is valuable. Any changes in the limnological environment of Sterkfontein Dam may therefore have large ecological and economic consequences. A knowledge of the limnology of deep high-altitude reservoirs in the Drakensberg is important in predicting how the proposed reservoirs of the Lesotho Highlands Water Scheme might function.

This is the first study on the limnology of Sterkfontein Dam. The objective of this study was to compile a data base to serve as a reference for future monitoring programmes and for further limnological studies.

Study area

Sterkfontein Dam is situated in the E. Orange Free State (RSA) between 28° 23' and 28° 35'S; and 28° 58' and 29° 04'E, at an altitude of 1 620 m (Fig. 1). The location of Sterkfontein Dam along the edge of the lower Drakensberg escarpment, allows only a small natural catchment area of 193 km². The relevant morphometric characteristics of Sterkfontein Dam (Table 1) show it to be deeper than any other South African reservoir and

to hold more water than all but HF Verwoerd and PK le Roux Dams (Dept. of Water Affairs, 1986).

The Tugela-Vaal project was started in 1969. Regular pumping of water into Sterkfontein Dam began in November 1974 and construction was completed in 1985. The main water source of Sterkfontein Dam is the Tugela River in Natal, rising in the high rainfall area of the Drakensberg. Water is pumped on a weekly basis from the Tugela River into the Driekloof Dam from where it flows over a spillway into Sterkfontein Dam. The present average inflow from Driekloof Dam is 6,8 x 10⁶ m³ per week on a constant basis. Water was released in 1983 for a short period at a flow rate of approximately 45 m³/s, which resulted in a total withdrawal of 294 x 10⁶ m³. This volume represented 34,6% of the initial water volume in Sterkfontein Dam at that time. Water was released again during 1985 at an average flow rate of 40 m³/s. A volume of 539,22 x 10⁶ m³ of water was released during these 4,5 months (Dept. of Water Affairs, 1986). Other than the occasional release of water, there is no outflow of water from Sterkfontein Dam. Water is being pumped continuously into this reservoir until it reaches full capacity. The hydrological regime is therefore very stable.

Geological formations of the area are of the Tarkastad Subgroup of the Beaufort Group and form a part of the Karoo Sequence (Johnson and Keyser, 1980; Truswell, 1977). The surrounding hills and mountains are composed of cave sandstone, with occasional top layers of basaltic lava (Lurie, 1981; Truswell, 1977). The same geological composition accounts for the nearby Tugela catchment.

TABLE 1
RELEVANT MORPHOMETRIC CHARACTERISTICS OF
STERKFONTHEIN DAM

Capacity at full supply level (FSL)	2 656 x 10 ⁶ m ³
Surface area at FSL	6 940 ha
Maximum depth	82 m
Mean depth at FSL	38 m
Maximum width	6,0 km
Maximum length	19,0 km

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