

A contribution to the knowledge of South African coastal vleis: The limnology and phytoplankton periodicity of Princess Vlei, Cape Peninsula

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Abstract

This paper summarises the water chemistry regime, phytoplankton assemblage and periodicity in Princess Vlei, between April 1989 and March 1991. Princess Vlei is a small (29 ha), shallow (mean depth 2,4 m) and eutrophic freshwater coastal vlei situated on the Cape Flats adjacent to the Cape Peninsula. Mean annual concentrations of nitrogen and phosphorus are 2,0 and 0,16 mg.l⁻¹, respectively, with chlorophyll *a* concentrations averaging 63 ug.l⁻¹. Hydraulic flushing during the winter plays a significant role in controlling phytoplankton biomass in this system. The phytoplankton assemblage exhibits a low generic diversity composed of Cyanophyta, Chlorophyta and Bacillariophyta. Prior to the development of an *Anabaena circinalis* bloom during the summer of 1991, cyanophyte species had not dominated the phytoplankton assemblage since 1983. Princess Vlei has recreational amenity value for the Cape Town municipal area, and the results of this work are directed towards the management of this urban-impacted system.

Study area

Princess Vlei is a small (29 ha), shallow (*ca.* 2,4 m), permanent, freshwater coastal lake (as defined by Davies and Day, 1986), situated in the Southfield area of Cape Town, South Africa (latitude 34° 03'S; longitude 18° 28'E; (Fig. 1). It was classified in the 1920s as alkaline (Stevens, 1929) and during the 1940s as being alkaline and eutrophic (Harrison, 1962). Princess Vlei lies on sandflats which were originally submerged beneath the sea (Shand et al., cited in Hutchinson et al., 1932). Details of the geology of the area are described in Gardiner (1988). Of the four largest vleis on the Cape Peninsula, viz. Zeekoevlei, Zandvlei, Rondevlei and Princess Vlei, the latter is the smallest and probably the oldest (Hutchinson et al., 1932). With the exception of Rondevlei, which has been developed as a nature reserve, Zeekoevlei and Zandvlei are extensively utilised by the public for a variety of recreational pursuits (City of Cape Town, 1988; 1990a), and together with Princess Vlei, form the only substantial, naturally-occurring areas of inland water suitable for recreation within the Cape Town municipal area, serving a population of 940 000 people (City of Cape Town, 1990b). In a regional context, i.e. inclusive of neighbouring municipalities forming part of the Greater Cape Town area, this figure would exceed 2 million people.

Princess Vlei's inflow emanates from the Southfield Canal (Fig. 1) which drains an urban catchment of approximately 800 ha. An outlet weir, constructed during 1990 (crest height, 6,6 m above mean sea level, AMSL), lies to the south-east and drains into a canal linking Princess Vlei to Rondevlei (Fig. 1). Prior to this, a temporary weir (crest height, 6,45 m AMSL) restricted the outlet. A flood-prevention overflow weir (crest height, 7,4 m AMSL), is positioned to the south-west and drains into the Sand River, terminating ultimately in Zandvlei (Fig. 1).

The vlei is bordered to the north by residential and small-scale industrial areas, to the east and west by public open

space and to the south by a small residential development. In addition to the inflow from the Southfield Canal, several stormwater pipes enter the vlei at various points around its perimeter. Outflow from Princess Vlei usually occurs between April and October during the winter rains. The Cape Town City Council (CCC) has three sewage pumping stations in the Princess Vlei catchment which, during time of malfunction or overloading, are designed to overflow into the Southfield Canal.

Prior to 1985, such overflows were relatively frequent during the winter months but subsequent modifications have greatly reduced the incidence of overflow events, so that only two overflows have been recorded between January 1986 and December 1990 (City of Cape Town, Sewerage Branch records, unpublished).

Vegetation bordering the vlei is sparse, with grass and stands of semi-aquatic reeds (*Typha capensis*) as was previously recorded by Harrison (1962). The inlet bay has dense fringes of *Typha*, and is subject to year-round infestation by water hyacinth (*Eichhornia crassipes* (Mart) Solms). Control of these plants is carried out at intervals using glyphosate herbicides and physical removal.

Princess Vlei is utilised on a regular basis by casual and club anglers, especially during the winter months. Water is abstracted from the vlei by the City Council for irrigation of the surrounding public open space. According to the terms of reference of an ecological management survey of Cape Peninsula waters (Howard-Williams, 1976), Princess Vlei was accorded a low priority with respect to research needs. At that time, attention was directed towards the removal of water hyacinth.

Princess Vlei was dredged between March and July 1983, to remove a shallow sand-bar, running from north-west to south-east across the middle of the vlei. This restrictive sill effectively divided the vlei into two stilling-basins and precluded effective hydraulic flushing, thereby allowing dense phytoplankton populations and blooms with chlorophyll *a* concentrations of up to 600 ug.l⁻¹ to develop (City of Cape Town, Scientific Services Branch records). Sludge accumulation, with fine, black, organically-rich silt overlying white to buff coloured medium-grained sands in these basins, was, on average, between