African Journal of Aquatic Science 2015, 40(2): 175–185
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AFRICAN JOURNAL OF AQUATIC SCIENCE
ISSN 1608-5914 EISSN 1727-9364
http://dx.doi.org/10.2989/16085914.2015.1032208

Impact of marine inundation after a period of drought on the lakeshore vegetation of Lake St Lucia, South Africa: resilience of estuarine vegetation

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The shore of Lake St Lucia in the vicinity of Catalina Bay, in the southern part of the lake, receives freshwater input as surface and groundwater seepage from the adjacent elevated coastal plain. Vegetation, water quality and landform were recorded on the lakeshore and on the dry lakebed near one of these seepage zones. This was done along a gradient perpendicular to the lakeshore and along the lakeshore away from the fluvial source of freshwater input. A number of plant communities were found along a gradient of water salinity from the shoreline (fresh water) towards the centre of the lake, and also away from the fluvial input of water (increasingly saline). Species richness decreased with increasing salinity. The first study was conducted in 2006 after a prolonged drought associated with low lake levels and closure of the mouth, and repeated again in 2010 three years after breaching of the estuarine mouth by a tropical cyclone at sea, which caused inundation of the partly dry lakebed with sea water. The vegetation of the lakeshore after these major disturbances was remarkably similar in the two time periods, suggesting rapid recovery near freshwater seepage zones, following an influx of sea water.

Keywords: disturbance, environmental gradients, estuarine lake, hydrogeochemistry, vegetation dynamics

Introduction

Estuaries occur where fluvial and marine ecosystems grade into each other. Estuarine ecosystems show dynamics displayed by riverine ecosystems in four dimensions: longitudinal (inland towards sea), lateral (bank towards the stream), vertical (from surface towards hyporheos) and seasonal variation temporally (Davies and Day 1998). In addition, estuaries display a salinity gradient from freshwater to saline conditions that is related to interactions between fluvial and marine inputs. This gradient is both spatial – with increasing salinity longitudinally along the stream towards the ocean – and temporal – one component of which is determined by variation in fluvial input that typically varies seasonally, and another component that is determined by marine input related to daily tidal fluctuations (Day et al. 1989; McLusky 1989; Davies and Day 1998; Little 2000). Variation in salinity associated with variation in fluvial input of fresh water typically cycles annually due to seasonal rainfall patterns, but it may exhibit cycles over longer time-scales depending on climate variability. For example, Lake St Lucia exhibits a quasi-decadal scale salinity cycle (Whitfield et al. 2006) due to drought cycles that, in southern Africa, are linked to eleven-year cycles in sunspot activity (Tyson and Preston-Whyte 2000). Such cycles are associated with hypersaline conditions, since fluvial inputs decline and evaporation dominates the water balance. Estuarine ecosystems are able to adapt to most of these dynamics, since the disturbances are more or less predictable (Poff 1992), but the occurrence of tropical cyclones that occasionally move unusually far south into the northern coastal areas of South Africa adds to the dynamics in a less predictable way. Cyclones that drift southwards but do not move onto land increase the energy of tidal surges that may breach closed estuary mouths and inundate estuaries and estuary margins. Should tropical cyclones move onto land, they are associated with extremely heavy rainfall events that lead to widespread and extreme flooding. For estuarine ecosystems, such events constitute severe and unusual disturbances.

Few species are adapted to the dynamism of estuarine ecosystems caused by the high fluctuations in water level and salinity. Therefore, most estuarine ecosystems do not have a particularly high species diversity (Remane and Schlieper 1972; Attrill 2002). Since estuarine ecosystems are usually very productive, species that are able to adapt to the dynamic environment usually dominate the ecosystem, leaving little space for less competitive species (Schlesinger and Bernhardt 2013). However, although the typical pattern in estuaries is of high biomass but low diversity, small-scale habitats can exist that are much richer in species because such habitats display strong turnover along environmental gradients (Flindt et al. 1999; Bergamasco et al. 2003; Elliott and Quintino 2007; Franco et al. 2007). Such environmental gradients are best developed when the freshwater input into an estuary is

Published online 03 Jun 2015