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Zooplankton community structure during a transition from dry to wet state in a shallow, subtropical estuarine lake

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ABSTRACT

Lake St Lucia is among the most important shallow ecosystems globally and Africa's largest estuarine lake. It has long been regarded as a resilient system, oscillating through periods of hypersalinity and freshwater conditions, depending on the prevailing climate. The alteration of the system's catchment involving the diversion of the Mfolozi River away from Lake St Lucia, however, challenged the resilience of the system, particularly during the most recent drought (2002–2011), sacrificing much of its biodiversity. This study reports on the transition of the St Lucia zooplankton community from a dry hypersaline state to a new wet phase. Sampling was undertaken during routine quarterly surveys at five representative stations along the lake system from February 2011 to November 2013. A total of 54 taxa were recorded during the study period. The zooplankton community was numerically dominated by the calanoid copepods *Acartiella natalensis* and *Pseudodiaptomus stuhlmanni* and the cyclopoid copepod *Oithona brevicornis*. While the mysid *Mesopodopsis africana* was still present in the system during the wet phase, it was not found in the swarming densities that were recorded during the previous dry phase, possibly due to increased predation pressure, competition with other taxa and or the reconnection with the Mfolozi River via a beach spillway. The increase in zooplankton species richness recorded during the present study shows that the system has undergone a transition to wet state, with the zooplankton community structure reflecting that recorded during the past. It is likely, though, that only a full restoration of natural mouth functioning will result in further diversity increases.

1. Introduction

Freshwater supply is an essential component of estuarine ecosystems, yet the increasing demands from our expanding population amplify the pressure on the rivers that supply them. Freshwater ecosystems are under threat from multiple stressors, including pollution, land use changes, water abstraction and invasive species, among many others (Vörösmarty et al., 2010). Superimposing these stressors are the impacts of global climate change, as the frequency and intensity of extreme weather events, including droughts and floods, is forecast to increase (IPCC, 2007). The consequences of these anthropogenic stressors, either singly or combined, are often evidenced worldwide through the declining integrity of aquatic ecosystems.

The St Lucia estuarine lake system is one of Africa's most valuable natural assets, having obtained World Heritage Site status in 1999 (Taylor, 2006). This system is also recognised as a Ramsar Wetland of International Importance. With an average area of 350 km^2 (dependent on freshwater supplies), it represents over 50% of the estuarine area in South Africa. It is well documented that the climate in the area oscillates between wet and dry phases, with each phase lasting up to a decade at a time. The most recent drought (2002–2011) was, however, unprecedentedly severe and a direct result of a range of anthropogenic activities that have taken place in the catchment over the last century. These activities involved mainly the canalisation of the Mfolozi River and the subsequent diversion of its freshwater away from St Lucia, in an attempt to avoid excessive siltation from the Mfolozi catchment. Given that the Mfolozi River was historically St Lucia's main source of freshwater, droughts following this diversion were characterised by extreme hypersaline conditions and low water levels. These harsh conditions, coupled with the predominantly closed mouth connection during the most recent drought, resulted in a significant decline in biodiversity of almost all taxonomic groups (Pillay and Perissinotto, 2008, 2009; Carrasco et al., 2010; Cyrus et al., 2010; Jerling et al., 2010a; Perissinotto et al., 2013). The effects of this freshwater deprivation crisis were not only limited to

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the system, but had significant impacts on offshore fisheries as well (Cyrus et al., 2010; Carrasco et al., 2010; Jerling et al., 2010a), since the prolonged mouth closure inhibited St Lucia's vital role as a nursery ground for fish and macro-crustaceans (Whitfield et al., 2013).

Increased research during this dry phase has revealed a number of distinct biological communities; some specially adapted to thrive under the hypersaline conditions that prevailed for some

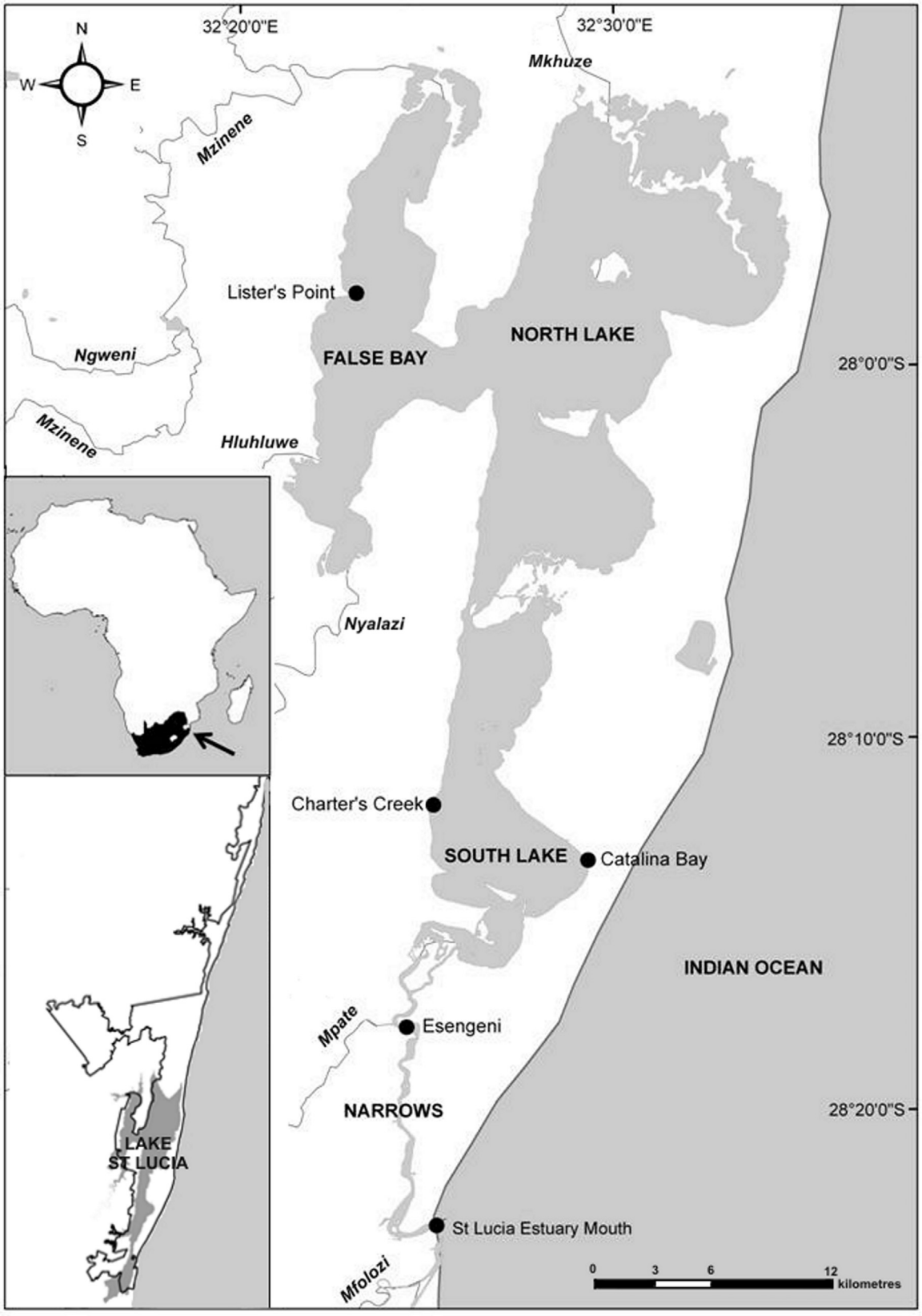

Fig. 1. Map of Lake St Lucia, showing the sampling sites and geographic position within South Africa and the iSimangaliso Wetland Park.

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