BRIEFING NOTE

ST LUCIA ESTUARINE LAKE IN THE PROCESS OF BECOMING A FRESHWATER ECOSYSTEM

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Objective – A briefing note aims to provide a concise outcome based synopsis of recent research or expert opinion that may inform decision making and activities by authorities, NGOs and NPOs. The briefing note series complements the academic peer reviewed literature published by NRF-SAIAB.

Background

Lake St Lucia was once a thriving estuary, that should act as a very important nursery for marine fish stocks along a large proportion of the South African coastline. Unfortunately, it is rapidly losing its estuarine functionality, and even its status as a World Heritage Site may be under threat. The details outlining this loss have been described in a variety of scientific papers over the past two decades, some of which are mentioned in the reference list of this briefing note.

The St Lucia system (Figure 1) has, until recently, provided approximately 50% of the estuarine surface area for all South African estuaries combined. Loss of the lake as an estuarine system in particular would have a major impact on fish and swimming prawn stocks of the entire subcontinent, and upon which subsistence and small-scale artisanal fisheries depend.

The St Lucia estuarine system is recognised for its beauty, its changeability and its biodiversity. It is a core feature of the iSimangaliso Wetland Park World Heritage Site and is a Ramsar Site of International Importance. It is well named iSimangaliso, meaning "Place of Wonder". It is Africa's biggest estuarine lake that supports large populations of hippos, crocodiles and colonial-breeding birds such as pelicans, cormorants, terns, herons, gulls, pratincoles and other species. It is a magnet for regional and local tourism – being an important economic contributor to the local people, as well as attracting international tourists to South Africa.

Figure 1. Part of the southern portion of St Lucia, a "Place of Wonder".

In this briefing note, which is based on a recently submitted paper (Taylor et al. in review) we identify the key role that St Lucia plays as a **nursery area** for both marine fish and invertebrates that supply the whole of the KwaZulu-Natal coastline with **high quality protein** for artisanal, recreational and commercial fishers. We also describe the physico-chemical processes that are occurring and need to be managed in order to **reverse** some of the **negative impacts** on the ecosystem as a functional estuary. We conclude by providing some **management recommendations** for implementation by the iSimangaliso Wetland Park Authority.

Salinity and the estuarine environment

A key feature of St Lucia is its continually changing salinity in response to natural wet-dry rainfall cycles. The estuarine lake has a surface area of approximately 35 000 ha, depending on water level, yet it has an average depth of less than 1 m (Figure 2). The large surface area to volume ratio means that it is very sensitive to evaporation losses which concentrate the salt in the water; or to the addition of rainfall or river runoff which dilutes the saltiness. The result is that St Lucia is at times in a low-salinity state where it is dominated by both estuarine and freshwater plant and animal species. However, most of the time it is in a range of salinities where it is dominated by estuary-associated marine and estuarine flora and fauna. But, at the other extreme, it may reach salinity concentrations that are well above that of seawater.

Figure 2. The shallow Lake St Lucia (<1 m depth) used to have variable salinity regimes due to the balance between rainfall, saline inflows from the sea, riverine inputs and evaporation.

To be a fully functional estuary, the ideal salinity should be in the 4 to 35 parts per thousand (ppt) range (seawater = 35 ppt), and there should also be a link with the sea through an open estuary mouth. It does not have to be open all the time, but for long enough periods to enable juvenile fish and invertebrates to enter from the sea, or leave the estuary as adults to breed in the marine environment. It is as a functioning estuary that St Lucia is of greatest benefit to the rich fauna and flora, as well as to people. It is to maintain this estuarine condition that all past management interventions have been directed. These actions have mostly focused on countering the effects of human-induced changes, including altered river flow regimes that increased salinity and promoted extended mouth closures, as well as increased quantities of sediment coming from the catchment areas that have promoted shallowing and constrictions developing within the system (Figure 3).

Figure 3. Turbid waters and extensive sedimentation in the St Lucia Estuary (bottom right corner of photo) are visible in this aerial photo taken after reconnection with the uMfolozi River (top right corner of photo). These mainly compacted mud sediments effectively prevent the prevalence of a large tidal prism within the shallow estuary when the mouth is open and this therefore works against the retention and transport of saline water up the system.

Following on from the reconnection of the uMfolozi River to the St Lucia Estuary, in 2011 the iSimangaliso Wetland Park Authority obtained funding from the World Bank's Global Environment Facility to undertake studies to investigate how this reconnection could be optimized. These studies indicated that reconnection, in its original configuration, could result

in having a system that would function naturally and bring uMfolozi River water into St Lucia. The system would have a single estuary mouth that would breach without human interventions, i.e. when water levels overtopped the beach berm or when there was a large river flood. The concept was that the rush of water during such a river flood would increase water levels in the estuary and trigger breaching that would flush accumulated sediment from the system into the sea. GEF funding was then used to reconnect the uMfolozi with St Lucia, an intervention which was achieved in July 2012.

Figure 4. The consequences of uMfolozi River sedimentary deposits is clearly visible in the exposed intertidal area of the single mouth St Lucia Estuary. Shallowing of the estuary and freshwater dominance has promoted the growth and expansion of the common reed across shallow areas of the estuary towards the main channel, thus further restricting tidal saline penetration of the system.

Our findings outlined in the review show that unimpeded uMfolozi water has been entering the St Lucia system since 2012, but the joint estuary mouth has remained predominantly closed for a continuous period between the beginning of 2015 and end of 2020. During this time, large quantities of sediment were deposited in the St Lucia Estuary and Narrows, encouraging littoral vegetation growth as well as reducing channel width and depth (Figure 4). This has severely reduced water flows within the Estuary, Narrows and Potter's Channel. Prolonged closure of the mouth meant that saline water was not entering Lake St Lucia which was becoming increasingly 'fresh' and less 'estuarine' during this process.

Eventually, the lack of estuarine-marine connectivity, together with flooding of farmland on the uMfolozi floodplain, necessitated an 'assisted estuary mouth breach' following river flooding in January 2021. Unfortunately, much of the fine sediment that had accumulated in the Estuary over the many years of mouth closure had compacted and formed an erosion resistant 'sill' within the Estuary and mouth region in particular, and was not flushed out to sea. The reduced tidal exchange of water meant that the suspension and scouring of sediments from the Estuary and Narrows towards the sea did not take place as expected. This reduced tidal prism barely reached the St Lucia Bridge and meant that saline waters did not penetrate up the Narrows, let alone reach the Lake. The result was that Lake St Lucia has become increasingly more like a freshwater coastal lake system than an estuarine lake.

In April 2022 river-flooding caused the Estuary mouth to breach - this time naturally (Figure 5). Again the scouring of accumulated sediments from the Estuary was limited and, once the floodwaters had dissipated, only a relatively small tidal prism was recorded. No seawater was documented reaching the St Lucia Bridge in the first two years that the mouth has remained open. The estuary mouth channel has remained relatively fixed due to compacted mud remaining in place, preventing the natural northward migration of this channel. This 'fixing' of the Estuary mouth may well have prolonged the 2022-2025 open phase since 'wandering' estuary mouths are more prone to closure. However, a major concern of aquatic ecologists is the lack of tidal prism and penetration of marine waters up the St Lucia system during the open mouth phase. This persistent feature during both recent open mouth states signals a transformation of St Lucia from an estuarine coastal lake system into a freshwater coastal lake system.

Figure 5. High sediment load uMfolozi River floodwaters leaving the St Lucia Estuary via the Beach Channel (left) and Estuary Channel (right) after the natural mouth breach in April 2022.

Management implications

So, how should St Lucia be managed going forward? In the near future, iSimangaliso Wetland Park Authority management actions should be to initiate two relatively small interventions that will help retain St Lucia in its estuarine state for as long as possible. This is the state that is of greatest value to both the species richness of St Lucia and to humans. This is currently within our power to implement, but, at some stage there will be little we can do. Then the decision will have to be made to 'let the system go', and allow it to pass through the tipping point to the next phase in its natural geological trajectory.

Figure 6. A river bank breach into the Link Canal brings large amounts of sediment-rich uMfolozi River water into the Honeymoon Bend area of the St Lucia Estuary during river flooding. This breach (shown by the yellow arrow) needs to be blocked as a matter of extreme urgency if Lake St Lucia is to retain its connection with the sea.

Two urgent adaptive management actions are required in the short-term to temporarily steer St Lucia back towards an estuarine trajectory;

- The most important action by far is the closure of the Mfolozi-St Lucia Link Canal (Figure 6) that was decommissioned after the huge 1984 Domoina cyclonic flooding. This canal is a conduit that carries uMfolozi flood sediments into the Honeymoon Bend area of St Lucia and causes a major constriction in the Estuary. To restore estuarine hydrological functioning it may then be necessary, once the canal has been blocked off, to remove the accumulated sediment at the point where this Canal enters the Honeymoon Bend area. This accumulated sediment currently prevents the inflow of marine tidal water into the upper Estuary and Narrows.
- Another important action is to open the Potter's Channel link between the southern part of the Lake and the Narrows. The emergent and submerged vegetation there (Figure 7) prevents free water movement between the Lake and Narrows, and vice versa. Unless this constriction to flow is opened up by recreating Potter's Channel, Lake St Lucia will become a freshwater lake.

Figure 7. Aerial view across the Makakatana Bay southern shore towards Potter's Channel and Brodie's Shallows in the upper central portion of the photo. The restoration of Potter's Channel is a high priority to improve water exchange between the upper Narrows and South Lake.

The way forward

When will it be necessary to allow St Lucia to progress to the state of a freshwater and floodplain wetland? This we do not know as the rate of geological change can be slowed by mega-floods and sea-level change, or speeded up by accelerated sediment yields from the catchment. Monitoring is needed to track the change and to guide the managers when to make the decision that further management actions are futile. From this point onwards there will be novel ecological conditions in St Lucia – that will still have significant conservation value for the system. We do need to embrace change and adapt to new opportunities, as well as guide conservation along these new scenarios.

A comprehensive hydro-ecological monitoring programme needs to be established in the St Lucia system, something that has been largely absent over the past decade. Although monitoring is key to guiding management, little of what will occur in the future can be backed or responded to by hard data at present. This must be done by science-based considered opinions, based on expertise, ecological and geological scientific theory and principles. In this regard, there is a considerable amount of existing scientific knowledge relating to St Lucia (see key papers for consideration at the end of this briefing note). The management authorities must involve experienced scientists who have worked at St Lucia for many decades to provide this advice. Conservation will be going into new territory as St Lucia changes – and this should lead us into new thinking to accompany these changes.

KEY PAPERS FOR CONSIDERATION

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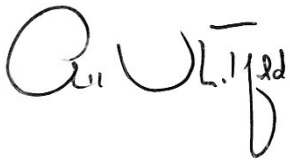

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