

WATER AND WETLANDS

South Africa's swamp forests are very likely critically endangered wetland ecosystems

Latest study showed that South Africa's swamp forests are in danger of disappearing – along with the valuable ecosystem services they offer. Article by H van Deventer; J Adams; JF Durand; R Grobler; P-L Grundling; S Janse van Rensburg; D Jewitt; B Kelbe; CF MacKay; L Naidoo; Jeanne L Nel; L Pretorius; T Riddin; & L Van Niekerk.

There is wide recognition that South African swamp and floodplain forests or forested wetlands, are unique biotypes and that they are threatened (Berliner, 2005; 2009; Jewitt, 2018; Mucina & Rutherford, 2006). The forested wetland extent has been mapped by at least eight different studies using methods such as heads-up digitising or remote sensing classification at various scales.

During the past year, this information was brought together and integrated into a single output, the areal extent, being used to assess the red list status of these wetlands. Following the criteria of the International Union for Conservation of Nature (IUCN) for the Red Listing of Ecosystems (RLE), this protocol was used to evaluate these forested wetlands, and the results recently published by Van Deventer et al. (2021). Here we provide an overview of the study and the implications of the work for South Africa.

Defining forested wetlands of South Africa

The first step of study was to define the type of forested wetlands of South Africa. The most recent typology of Global Ecosystem Types (Keith et al., 2020), published by the IUCN, was used as a basis with literature that distinguished coastal forests from inland forests (Burgess et al., 1998) and different forested wetland types (Martin-Smith, 2004), to characterise these wetlands as the Ecosystem Functional Group (EFG): 'Coastal subtropical-temperate forested wetlands' that includes swamp and floodplain forests.

Geographic extent of the coastal subtropical-temperate forested wetlands

South African forested wetlands extend from the Great Kei Estuary northwards along the coast to the Kosi Estuary on the border with Mozambique. The reference epoch of 2000 was identified as the wettest year with the highest rainfall in Kwazulu-Natal in the last 80 years, following the flooding resulting from Cyclone Eline. It was assumed that the maximum extent of tree canopies that remained after this cyclone should largely still be present to date.

Various aerial, ortho, and satellite images for the epoch of 2000 were used to map the maximum extent as the reference layer. The results showed that the maximum extent of the forested wetlands totalled 120 km² for the epoch of 2000, of which 116 km² is located on the Maputland Coastal Plain (MCP). In many previous studies where the swamp and floodplain forests had been mapped, the canopies of key indicator tree species were used to identify the presence of these wetlands. These 13 indicator tree species were listed in Van Deventer et al. (2021).



Figure 1: A patch of swamp forest near the Maphelane node of the iSimangaliso Wetland Park. Photo by Heidi van Deventer.

Determining the threat status according to the IUCN Red List of Ecosystem (RLE) criteria

The IUCN has published guidelines for RLE (Bland et al., 2017), using five criteria for evaluation. The first two relate to spatial indicators, assessing (a) the losses or transformation that took place in an ecosystem; and (b) the degree to which it is range restricted. The following two relate to functional degradation observed, with (c) changes in abiotic processes and (d) biotic processes. Lastly, the ranks assigned in the previous criteria are integrated in (e), which provides an overall assessment. For all these criteria, qualitative information should be provided, with sub-criteria offering an evaluation period for criteria a, c, and d; and thresholds for b and e. In addition, confidence ranks could also be assigned for each criterion.

The study found that if the rate of decline observed at a landscape scale for the MCP was linearly extrapolated, >80% of the extent of Coastal subtropical-temperate forested wetlands could be lost in 50 years, and therefore be left critically endangered. In itself, the small maximum reference extent of 120 km² is critically endangered, since it is range restricted. Further issues following the full RLE approach were that environmental degradation indices, such as fragmentation metrics, were not fully appropriate as the coastal environment forests are normally very fragmented, and therefore a reference could not be determined.

Also, faunal Taxa of Conservation Concern (ToCC) that are associated with the forested wetlands of the MCP (Figure 2) are all generalists in the landscape, as are many palustrine wetland species. Thus, transformation and loss of MCP forested wetlands may not have a direct impact on these ToCC but could result in the species rather using other parts of the landscape mosaic or migrating further north to less degraded forests and forested wetlands.

Floristic species

(a) *Raphia australis* (Kosi palm)



Raphia palms, May 2013. Photo by Prof. Christoph Moning, University of Applied Sciences Weihenstephan-Triesdorf, Institute for Ecology and Landscape.

(b) *Cassipourea gummiflua* (Large-leaved onionwood)



Large-leaved onionwood tree, April 2014, KwaZulu-Natal, submitted to iNaturalist.org (<https://www.inaturalist.org/observations/37485501>). Attribution-NonCommercial 4.0 International (CC BY-NC 4.0), no edits done.

Vertebrate species

(c) *Aonyx capensis* (African clawless otter)



Cape Clawless Otter, 13 March 2021, Thrift Dam, Great Winterberg (Stormberg) of the Eastern Cape Province. Photo by Dr David J. McDonald Pr. Sci. Nat., Botanical Specialist, Director: Bergwind Botanical Surveys & Tours CC, www.bergwind.co.za.

(d) *Hydriectis maculicollis* (Spotted-necked otter)



Photograph by Simon Tonge taken in December 2019 KwaZulu-Natal, submitted to iNaturalist.org (<https://www.inaturalist.org/observations/37485501>) and in the public domain.

(e) *Cercopithecus albogularis* ssp. *erythrarchus* (Samango monkey)



Coastal forest Samango monkey, 12 August 2018, Catalina Bay Road, iSimangaliso Wetland Park. Photo by Tanja Milotić, uploaded to iNaturalist (<https://www.inaturalist.org/observations/15636843>); no rights reserved.

(f) *Natalobatrachus bonebergi* (Kloof frog)



Kloof frog, Uthungulu, 2020. Photo by Dr Erwin Sieben, University of KwaZulu-Natal (UKZN).

Invertebrate species

(g) *Potamonautes lividus* (Blue River or Swampforest River Crab)



Swampforest River Crab, iSimangaliso Wetland Park, January 2014, submitted by Mr Ryan Tippett to iNaturalist (<https://www.inaturalist.org/observations/35130324>). Attribution-NonCommercial 4.0 International (CC BY-NC 4.0). No edits done.

Not shown, (h) *Varuna litterata* (Peregrine crab)

Figure 2: Threatened species and Taxa of Conservation Concern (TOCC) that show a close association with the subtropical-temperate, coastal swamp and floodplain forests of South Africa.

Concerns of increasing rate of transformation

Increasing temperatures associated with climate change, will very likely result in higher evapotranspiration levels and consequently excessive lowering of water levels across the MCP during dry cycles. During these times, rural communities are able to access previously inaccessible parts of the forested wetlands that were saturated or inundated.

Transformation occurs in activity succession of first land clearing, then planting subsistence crops (Figure 3a) and ultimately commercial crops (Figure 3b) for sale at markets. Crop selection also depends on favourable growing conditions, such as the availability of fertile soils, which include peat in the MCP. Saturated peat soils that are located on a slope can be drained to favour specific crops.

The modification of onsite hydrology through drains and other cultivation practices can result in the loss of soil organic matter through decomposition. A subsequent decrease in soil fertility is therefore also a driver of crop succession. The use of industrial equipment such as chainsaws, rather than the traditional panga, has resulted in an increase extent and rate of forested wetland transformation within the last 5–10 years (Figure 3c).



Figure 3: Examples of land transformation to (a) subsistence crop (*Colocasia esculenta* or Madumbes) and (b) commercial crop (e.g., bananas) production is increasing during dry cycles. (c) The rate and extent of timber felling increases with the use of chainsaws, compared with the historical use of pangas. (d) Channels are dug to drain water and soil moisture from the peatlands. Photographs (a-b) Heidi van Deventer, June 2021; (c-d) August 2017.

Implications for conservation

Wetlands are a rare and critical provisional habitat in South Africa, not only a valuable resource for the provision of water

and food provision for people, but mostly for the resilience they offer under future climate change through carbon sequestration and flood buffers. The predicted increase in temperature and changes in rainfall associated with climate change in this region are expected to exacerbate the effects of the current anthropogenic pressures. Forested wetlands offer flood regulation and refugia during these extreme drought events and should therefore be prioritised as important ecological infrastructure. In this light, their conservation, rehabilitation and protection need to be a priority for stakeholders beyond conservation agencies.

This study showed that forested wetland transformation occurred inside and outside protected areas and that the current top-down approach to protecting these systems requires addressing. In contrast, the bottom-up approach of the IUCN RLE allows for engagement with all stakeholders, taking into consideration a wider landscape focus where there are many challenges in this instance (e.g., slash and burn agriculture, illegal influx of people).

Implications for associations between the freshwater ecosystems and the coastal zone

In the recent National Biodiversity Assessment of 2018 (NBA 2018), freshwater ecosystems were not considered in the coastal zone assessment (Harris et al., 2019), owing to a lack of

information to understand the association of inland wetlands to the coastal zone explicitly. However, the extent of the rivers where aquatic faunal species move between the estuarine and freshwater (river) realms was subsequently mapped as river-estuarine transitional zones (Van Deventer et al., 2020), indicating the association of these rivers with the coastal zone.

This study on forested wetlands now offers as a next step in the realm integration, evidence of the functional association of wetlands to the coastal zone, from an abiotic (influencing habitat characteristics e.g., black-water habitats) and biotic (faunal connectivity between the freshwater inland wetland, estuarine, and offshore marine realms) perspective.

Contribution to the Maputland EFTEON node

Our work contributes to the monitoring of environmental changes at a landscape scale, in particular to the Maputland Expanded Freshwater and Terrestrial Environmental Observation Network (EFTEON) site. This is one of six EFTEON sites in South Africa, where long-term landscape-scale research and monitoring will be undertaken. These sites are managed and coordinated by the South African Environmental Observation Networks (see <https://efteon.saeon.ac.za>).

For more information on the forested wetlands article, please contact Dr Heidi van Deventer at HvDeventer@csir.co.za.

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