APPLICATION OF THE CLIMATE VULNERABILITY INDEX FOR iSIMANGALISO WETLAND PARK

CVI

Climate Vulnerability Index Assessment for iSimangaliso Wetland Park

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Images

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Front and back cover**:** The iSimangaliso Wetland Park supports a diverse array of waterbirds and other species in coastal areas, with a high level of biodiversity in adjacent marine and terrestrial habitats.

Inside cover: A loggerhead sea turtle (*Caretta caretta*) returns to the ocean in the north of iSimangaliso.

CVI

VALUES-BASED | SCIENCE-DRIVEN | COMMUNITY-FOCUSED

Climate Vulnerability Index Assessment for iSimangaliso Wetland Park

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EXECUTIVE SUMMARY

Amanzimnyama Lake, one of the four interconnected Kosi Bay lakes
Welly Qwabe

Climate change is the fastest growing global threat to heritage places around the world, with many places already experiencing significant negative impacts and degradation. Recent observed trends for a range of climate stressors are expected to continue and accelerate as climate change intensifies.

As part of the *Building socio-ecological resilience to climate change impacts by Ecosystem-based Adaptation (EbA) approaches at iSimangaliso Marine Protected Area (MPA)* project supported by the Blue Action Fund, the Climate Vulnerability Index (CVI) was applied for the iSimangaliso area. This encompasses terrestrial and coastal marine areas of the inscribed iSimangaliso Wetland Park World Heritage (WH) property, including the communities residing within, together with the broader iSimangaliso MPA.

iSimangaliso comprises pristine marine, coastal, wetland, estuarine and terrestrial environments of diverse natural beauty and recognised biodiversity. These habitats have resulted from and continue to evolve due to the interaction of riverine, wind-driven and oceanic processes. Each of these are vulnerable to climatic influences.

The CVI assessment was undertaken in November 2023 during a workshop in St Lucia that involved representatives from the management agencies for the property, non-government conservation organisations, other experts and community representatives; and was facilitated by the co-developers of the CVI. Of note, this was considered the first meeting at which both community leaders and upper-level managers of the iSimangaliso Wetland Park Authority were present.

Six key values were identified for the property, drawn from the approved Statement of Outstanding Universal Value (OUV). This report describes the outcomes of that expert appraisal of the effects of climate change on the values of iSimangaliso using the best-available climate science.

Assessments of the current condition of the key values revealed nearly half of the attributes were categorised as in *Good* condition, all of which had a stable trend since the time of inscription. The remainder of the attributes were evaluated in the *Good with some concerns* category – among these, descriptors of coastal biodiversity and habitat had a stable trend since inscription and those related to communities had improved through that period; however, a deterioration in condition was noted for ecological processes (including towards the threshold for the *Significant concern* category).

A standardised list of climate stressors is considered in the CVI process to determine which are most likely to impact the WH values. The three key climate stressors identified for the iSimangaliso area were:

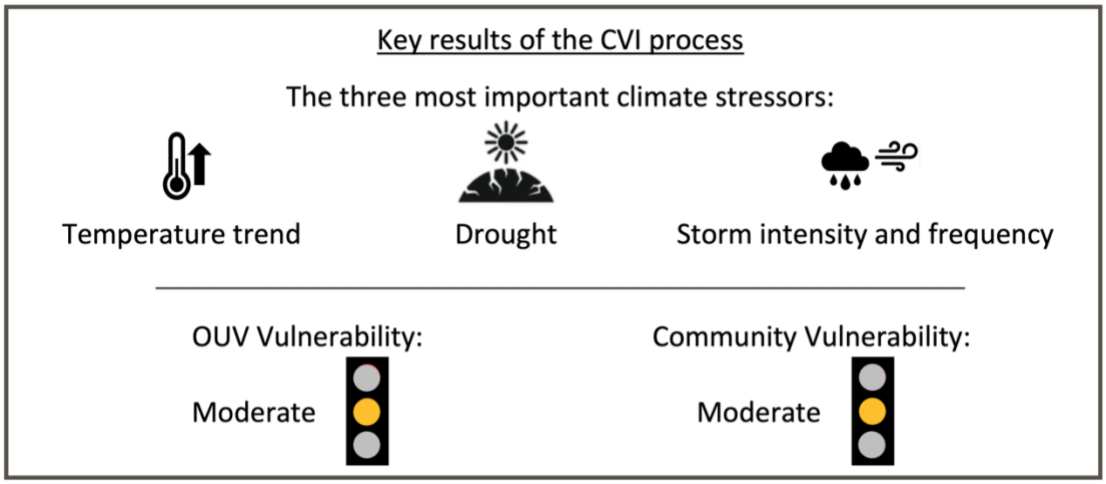
- **Temperature trend** (air and/or water);
- **Drought**; and
- **Storm intensity and frequency**.

Workshop participants selected ca. 2050 as the future time scale on which to assess vulnerability and chose to consider a high-emissions scenario (RCP8.5). These three key stressors are likely to interact with each other, as well as with other stressors, to increase the vulnerability of the property over this time scale.

The CVI process determined that the **OUV Vulnerability** for the property to be **Moderate** (on a three-point scale, Low/Moderate/High), indicating the potential for some decline or alteration of many of the values and attributes that comprise the OUV.

Seven key areas of economic activity connected with iSimangaliso were also identified, with varying degrees of reliance upon the values and attributes. Three of these activities (Tourism, Small-scale/subsistence activities and Community connections) have strong linkages to social and cultural aspects of the community. The workshop assessed the **Community Vulnerability** to also be in the middle category (**Moderate**).

These two vulnerability assessments considered the adaptive capacity of WH values (and their management) and of the community, respectively. Various adaptive strategies were discussed to mitigate potential impacts from the key climate stressors. These were prioritised based on feasibility and likely



future resourcing for their implementation. Importantly, without timely implementation of those strategies, the OUV Vulnerability would revert to the highest category.

The workshop participants identified a broad range of existing and potential management actions, including:

- Engaging in climate smart agricultural practices;
- Developing a multi-stakeholder Emergency Response Plan with adaptive management approach;
- Implementing monitoring, including via more citizen science (locals in the communities);
- Undertaking protection and restoration of coral reef, swamp-forest, reed bed, mangrove and salt marsh systems;
- Improving management of key hydrological systems (including erosion and developing restoration approaches); and
- Creating more watering tanks and boreholes – for community members and livestock – inside the Park.

Knowledge acquired at iSimangaliso may be transferrable to support the management of other wetland environments in Africa. This includes the Maputo National Park in Mozambique, which in July 2025 was inscribed on the WH List as an extension to iSimangaliso Wetland Park.

Immediate global action to substantially reduce greenhouse gas emissions is critical, especially to reduce climate change impacts in the near-term. The combination of actions to address climate change (mitigation) and support climate adaptation will be essential to maintain the OUV of iSimangaliso.

INTRODUCTION

Hippopotamuses are frequently seen near St Lucia
Caroline Fox

1.1 Background to this report

This report outlines the results of applying the Climate Vulnerability Index (CVI) to assess the iSimangaliso Wetland Park, one of 12 UNESCO World Heritage (WH) properties[1] in South Africa. iSimangaliso's significant values were internationally recognised in 1999 when the area was inscribed on the WH List meeting three of the four natural criteria. The area's geographic location, spanning subtropical and tropical Africa, has resulted in exceptional species diversity including a large number of threatened and/or endemic species. Within the area, four Ramsar sites have also been recognised as wetlands of international significance. The mosaic of landforms and habitat types provide superb scenic vistas and wild natural landscapes. The Park also provides critical habitats for a range of species across Africa's marine, coastal, wetland and savannah environments.

Climate change is the fastest growing global threat to a wide range of WH properties (Osipova et al. 2017, 2020); many are already being impacted. The severity of current climate impacts on individual habitats varies, as do the range of climate hazards causing those impacts and the rate at which they are occurring. In most cases, climate change impacts result in a degradation of the attributes that collectively convey the Outstanding Universal Value (OUV), the central concept for WH properties and the basis for inscription on the WH List.

The comprehensive and adaptive management approach that has been applied in iSimangaliso over many years provides valuable lessons for other natural properties combatting the effects of climate change and related management issues. These issues include high visitation and complex relationships with adjoining communities. Multiple projects in iSimangaliso continue to play important roles to increase understanding and respond to the effects of climate change, providing exemplars for similar areas elsewhere in Africa's natural environment.

Today a wide range of pressures, including climate change and unsustainable land use practices, threaten the values for which the iSimangaliso area has been internationally recognised. This vulnerable natural landscape, modified by natural processes and human activities, continues to evolve. Among the main drivers of change are the variety of climatic conditions that have and will continue to change, as outlined in this report.

1.2 Overview of the Climate Vulnerability Index (CVI)

The Climate Vulnerability Index (CVI) is a systematic and rapid assessment tool that is values-based, science-driven and community-focused. It was initially developed to assess the vulnerability of climate change upon all types of WH properties – natural, cultural and mixed – but it is now being more widely applied, including through different delivery formats.

The CVI is comprised of two phases, assessing:

- **OUV Vulnerability** through use of a modified version of the IPCC vulnerability framework to evaluate the exposure, sensitivity and adaptive capacity of the key values of the property (i.e., the WH attributes that convey the OUV). Application of this process determines to what degree the key values may be impacted by the three key climate stressors chosen to be the most relevant for that property; and
- **Community Vulnerability** through consideration of economic, social and cultural connections of the community associated with the WH property. The dependency of the community upon the property and the capacity of the community to cope with any climate change-related decline in the key values are each evaluated.

Both assessments of vulnerability are highly relevant for key stakeholders including site managers, management agencies and the community that lives

[1] The term World Heritage 'property' is the formal name in the international convention referring to a site or an area that is inscribed on the WH List; however, terms such as WH Site are colloquially used in other documents.

in and around the property. More information about the CVI is provided in Chapter 5. Through its application, the CVI enables managers and stakeholders to consider what may be appropriate strategic response actions for the management of their natural, cultural and community assets.

1.3 Why was iSimangaliso chosen for a CVI application?

Whilst CVI assessments had been undertaken previously for WH properties in other parts of the African continent, iSimangaliso was the first CVI assessment conducted in South Africa. The application of the CVI at this site was prompted by the need for a rapid and systematic assessment of climate risks to support ongoing and future adaptation planning within the iSimangaliso Wetland Park.

This need became evident during the early implementation of the project titled *Building socio-ecological resilience to climate change impacts by Ecosystem-based Adaptation (EbA) approaches at iSimangaliso Marine Protected Area (MPA)*, led by WILDTRUST in partnership with the iSimangaliso Wetland Park Authority, Ezemvelo KZN Wildlife and Traditional Leadership, and funded by the Blue Action Fund. An additional key driver was the development of the Climate Change Response Plan for the iSimangaliso MPA in 2023. During this process, it became clear that a robust and structured climate vulnerability assessment would be essential to ensure the plan was grounded in site-specific risks and realities.

To address this, WILDTRUST approached the CVI developers at James Cook University (JCU) to explore collaboration. The CVI process was identified as a suitable method to assess the vulnerability of iSimangaliso's natural and cultural values to climate change, and to understand how changes in these values could affect the well-being of local communities.

The CVI methodology offered several benefits, including:

- A documented compilation of site values for use in future assessments and management planning;
- An evaluation of the current condition and recent trends of these values, providing a systematic baseline for monitoring;
- A prioritised list of climate-related stressors;
- Identification of response actions and adaptation strategies targeting key vulnerabilities;
- A summary of knowledge gaps, research needs, and policy considerations; and
- Opportunities to strengthen community awareness and engagement around climate-related issues.

Although the Climate Change Response Plan had been drafted, its finalisation was intentionally delayed to allow the CVI findings to meaningfully inform the plan and the broader set of EbA interventions — particularly in the areas of ecosystem rehabilitation, protection and climate-resilient livelihoods.

A multi-stakeholder Steering Committee was established to guide the CVI process, comprising representatives and experts in cultural heritage, climate change and site management (see Appendix 4). This committee was responsible for compiling relevant information and coordinating the CVI workshop.

The assessment was conducted through an in-person CVI workshop held from 20–24 November 2023. Facilitated by Professor Scott Heron and Dr Jon Day from JCU, the workshop brought together site managers, scientists, community leaders and other key stakeholders to evaluate climate risks to the OUV of the site and the influence of potential decline in values on the people and practices that depend on them. The workshop enabled collaborative identification of adaptation strategies, policy needs and knowledge gaps, and provided a critical foundation for strengthening climate resilience in iSimangaliso.

iSIMANGALISO WETLAND PARK

Palisade fish kraals (fish traps) in Kosi Bay, an example of traditional knowledge and a cultural symbol for the Tonga people in iSimangaliso Wetland Park
Riaan Cedras

2.1 Location of iSimangaliso Wetland Park

On the east coast of South Africa, iSimangaliso Wetland Park extends approximately 200 km along the coast of KwaZulu-Natal (KZN) province from the border with Mozambique, north of Kosi Bay estuary, to the south of the Maphelane Nature Reserve (Figure 2.1), spanning approximately one third of KwaZulu-Natal's coastline. The terrestrial component covers 241,574 hectares, complemented by an extended marine component of 1,072,965 hectares. The total area of 1,314,539 hectares encompasses 15 interlinked ecosystems and a variety of notable landscapes.

2.2 The World Heritage property

iSimangaliso Wetland Park plays a vital role in South Africa's biodiversity, especially along the eastern coastline with the Indian Ocean (which has greater species diversity than along South Africa's Atlantic coast). The mosaic of 15 interconnected ecosystems range from a migratory route for whales, deep canyons, coral reefs and mangrove swamps to coastal dunes and estuarine systems. These diverse habitats support a high concentration of endemic species, with some species (such as coral reefs) reaching their southern distribution in Africa within the iSimangaliso Marine Protected Area.

Historically known as the Greater St. Lucia Wetland Park, iSimangaliso holds not only ecological but also cultural and social significance, particularly due to its complex history during the Apartheid era (1948–1994). During that time, the government forcibly removed local Black communities, primarily Zulu-speaking, from their ancestral lands in the Greater St. Lucia area to expand conservation zones and white-owned enterprises. This policy of displacement

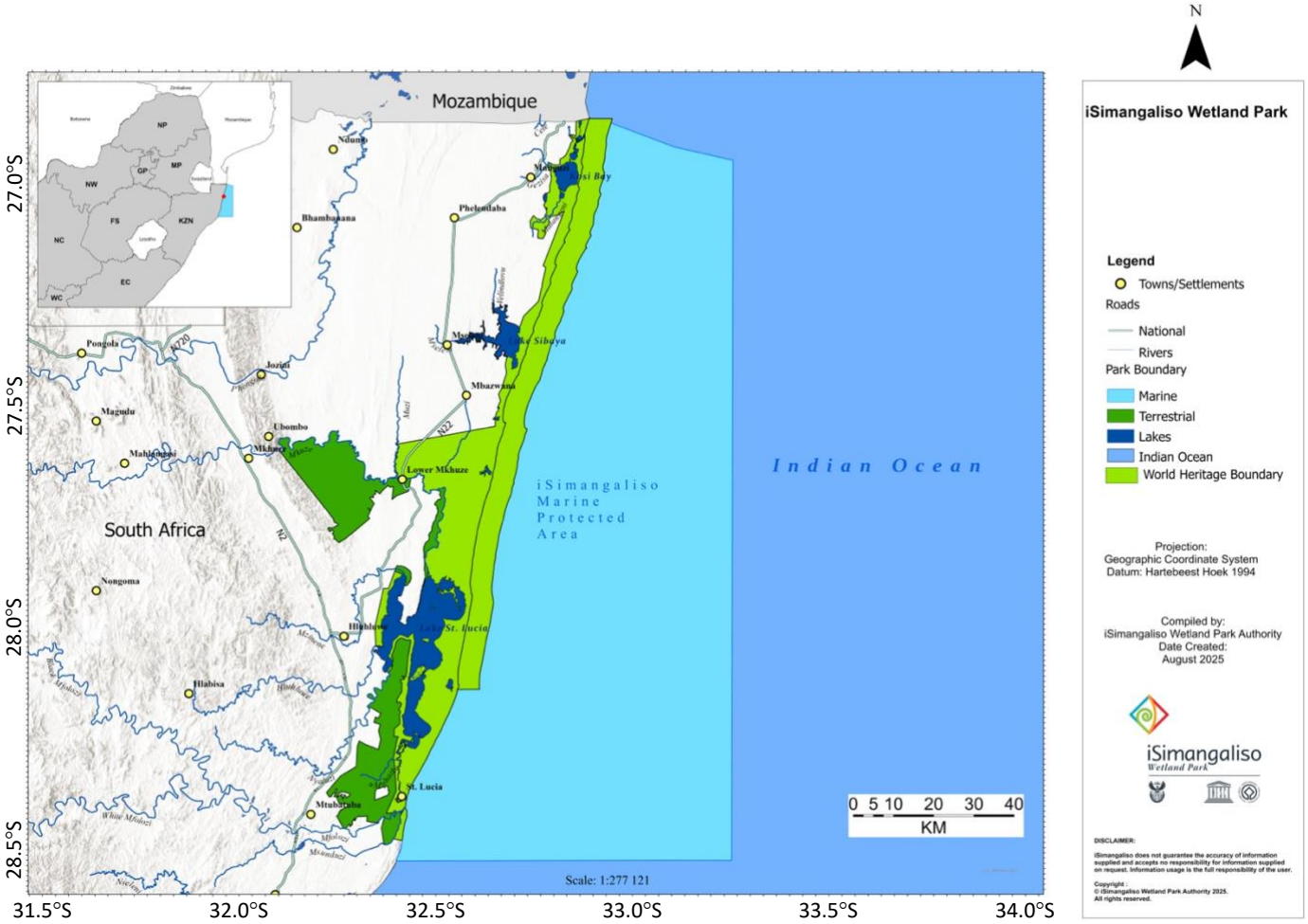


Figure 2.1 Map of iSimangaliso Wetland Park; inset shows location within eastern South Africa.

sidelined community members rights and severed the traditional connection of local people to their land, disrupting lives and livelihoods for generations.

The area surrounding Greater St. Lucia Wetland Park (iSimangaliso) faced environmental challenges during the 1980s and 1990s with proposed mining of coastal dunes for titanium. After an environmental impact assessment, the Government rejected the mining proposal in 1996. The Government chose an ecotourism land-use option for the Park that balances economic and ecological needs while respecting the incorporation of local communities' rights through the integrated conservation and management models.

In 1999, the Park was designated as South Africa's first UNESCO World Heritage property, acknowledging its extraordinary ecological value. Renamed in 2008, iSimangaliso – a Zulu word meaning "miracle" or "wonder" – reflected the Park's new identity and a commitment to honour the cultural heritage of the local communities and promote inclusivity in conservation efforts. The inscribed iSimangaliso Wetland Park World Heritage property consolidated 13 parcels of previously fragmented land into a contiguous conservation unit. However, a proclamation in November 2000 incorporated a further three protected areas with the WH property (Mkhuze Game Reserve, Dukuduku State Forest and uMfolozi Swamps) to consolidate a total of 16 parcels of previously fragmented land into a larger, single protected area.

Following its designation, efforts to address historical injustices took shape as local communities filed land claims under the *Restitution of Land Rights Act of 1994*, seeking redress for forced removals. Collaborations between the government, Park authorities and local communities created a model of conservation that respected community rights while preserving the Park's ecological significance. This reconciliation took multiple forms such as benefit sharing of resources and community development programmes (e.g., some communities received a proportion of the Park's annual income to address historical losses).

2.3 Physical geography/seascape and landscape geography

The Agulhas Current is among the world's strongest western boundary currents (Lutjeharms 2007), flowing southward along the iSimangaliso coastline and shaping the dynamic marine environment. The Agulhas Current is particularly strong along the narrow continental shelf near Cape Vidal and St Lucia, where recorded speeds have reached up to 2 m/s. Localised upwelling off Sodwana Bay occasionally creates nutrient influxes from coastal currents that support diverse marine life.

The coastline and continental shelf landforms are primarily influenced by prevailing winds, longshore currents and minimal direct impact from major rivers. Sea-level changes have been the primary drivers of geomorphic features within the Park, leading to the formation of coastal barrier dunes and offshore beach rock formations (including aeolianite rocks in the intertidal zone) that constitute present-day patch reefs. The continental shelf features deep, steep-sided submarine canyons, which provide important habitats for benthos-associated species, such as the coelacanth. These bathymetric features, especially near Leadsman Shoal and Kosi Reef, support the southernmost subtropical coral reef system along the African coast.

Wave data indicate that the coast is primarily impacted by swells from the SSE to ESE (approximately 82% of the year), driven by cold fronts, low-pressure systems and occasional tropical cyclones. Nearshore, wave refraction turns these swells, influencing patterns of coastal erosion and sediment deposition. Around 10% of swells originate from the northeast, typically generated by high-pressure systems, which further contribute to the dynamic coastal processes.

The Park's geology encompasses Jurassic lava and sedimentary layers from the Cretaceous to Quaternary periods, which shape the Makhatini Flats on the Zululand Coastal Plain. Aeolianite and beach rock headlands create gentle bays that influence sedimentation patterns, providing varied habitats from sandy, turtle-nesting beaches to rocky reefs and coastal dunes.

These combined geological and oceanographic factors foster a diverse coastal and marine landscape crucial for the Park's biodiversity. iSimangaliso's hydrology is defined by interconnected systems of rivers, lakes, estuaries and wetlands that support a rich variety of species.

The iSimangaliso Wetland Park is one of Africa's important natural sites, with diverse and pristine ecosystems. Recognised for its scenic beauty, unique geological processes and rich biodiversity, iSimangaliso includes key Ramsar sites that play an essential role in conserving South Africa's natural heritage.

The *Turtle Beaches/Coral Reefs of Tongaland* Ramsar site spans 39,500 hectares in KwaZulu-Natal and is known for its unique reef communities on non-limestone substrates. It supports 16 coral species, 1,200 fish species, five marine turtle species, 41 marine mammal species and 49 bird species, with predominant algal flora marking the southern range for many species.

The *St. Lucia System* Ramsar site covers 155,500 hectares and is a critical coastal wetland associated with Lake St. Lucia. It supports South Africa's largest estuarine prawn nursery and is a migratory bird staging area. The area provides nursery grounds for 82 fish species and includes crocodile breeding sites. Lake St Lucia estuarine system also hosts hippopotamuses and white rhinos and offers extensive recreational activities.

The *Kosi Bay* Ramsar site spans 10,982 hectares, comprised of four tidal lakes and numerous estuarine channels and swamps. Habitats include mangrove forest and coastal grassland that support diverse fauna, including eight endangered fish species, endemic butterflies, birds and mammals. A distinctive cultural feature is the traditional fish traps (fish kraals) used by local communities, reflecting a heritage dating back centuries.

The *Lake Sibaya* Ramsar site includes the largest freshwater lake in South Africa (7,750 hectares) and is unique within the country as it is completely enclosed with no outlet to the sea. This isolation has led to high levels of endemism among its aquatic species. The lake supports a diverse array of aquatic life and bird species and is valued for its pristine, unspoiled natural environment, making it a critical site for conservation and ecological research.

Other significant systems include Shazibe Lake and Mgobozeleni, the smallest estuarine system that is linked by a narrow channel through swamp forests to the sea. Seasonal freshwater pans and perched wetlands are distributed across the Park, offering critical habitats during dry periods and adding to the hydrological diversity of the region. The Maputaland coastal plain's groundwater system supports perched wetlands and other aquatic habitats and is crucial for sustaining surface water features.

2.4 Biodiversity (plants & animals)

iSimangaliso's 15 interlinked ecosystems are categorised into three main biomes—marine, terrestrial, and aquatic—each supporting diverse species and ecological functions.

The *marine/coastal biome* includes dune, rocky shore, rocky reef, coral reef and pelagic ecosystems. It represents the southernmost coral reefs on Africa's coast and contains submarine canyons that host the coelacanth. Sandy beaches provide nesting grounds for loggerhead and leatherback turtles. Marine regions are divided into two biogeographic areas:

- Maputaland sub-province north of Cape Vidal, rich in tropical species unique to South Africa; and
- Natal sub-province south of Cape Vidal, home to numerous endemic marine species.

The *terrestrial biome* includes savanna, sand forest, coastal forest and grassland ecosystems. Sub-tropical forests and grasslands are prevalent on the eastern shores, while ancient shoreline terraces and dry savanna woodlands dominate the western shores. Sand forests, particularly at False Bay, are among the last examples of this globally unique ecosystem.

The *aquatic biome* includes wetland, riverine and freshwater lake systems. Lake St Lucia features diverse inputs from five rivers, while the Mkuze River supports swamp forests and the uMfolozi floodplain

hosts reed and papyrus wetlands. Transitional ecosystems, such as estuaries and swamp forests, illustrate the dynamic interactions between terrestrial, freshwater and marine processes, supporting diverse plant and animal communities. Mgobozeleni exemplifies this transition, with a small estuarine system connected to swamps and coastal habitats.

Vegetation

Located within the Maputaland Centre of Plant Endemism, iSimangaliso supports a remarkable variety of plant species across savanna, forest and coastal ecosystems (over 2,185 species, including 46 endemics). Key vegetation and habitat types include: (i) distinct savanna units, such as Southern Lebombo Bushveld and Makatini Clay Thicket; (ii) Indian Ocean Coastal Belt Maputaland Wooded Grassland and Northern Coastal Forest; and (iii) Sand Forests at False Bay, representing globally rare examples of this vegetation. The diversity of marine vegetation is also notable with over 325 seaweed species, accounting for nearly 80% of KwaZulu-Natal's coastal seaweed diversity. Conservation efforts focus on wetland rehabilitation and controlling invasive species and restoring native vegetation.

Faunal Diversity

The Park supports a broad range of fauna across six primary groups:

- Invertebrates – Over 800 species of marine molluscs, butterflies, beetles and dragonflies are prevalent;
- Fish – A high diversity of freshwater and marine fish species, with over 992 marine species, including several endangered shark species (Cliff and Olbers 2022) and the rare coelacanth;
- Amphibians – 50 species, including two species on the Red List of South African Species[2];
- Reptiles – 162 species, including Gaboon Adders and nesting Loggerhead and Leatherback turtles;
- Birds – 525 species, making iSimangaliso a major breeding ground, particularly around Lake St Lucia; and
- Mammals – Significant terrestrial populations of key megafauna, including lion, leopard, rhinoceros, elephant and buffalo, as well as notable marine populations of dolphin and whale species.

2.5 Human habitation

Early Stone Age tools, including Oldowan and Acheulean implements, have been discovered at sites within iSimangaliso, dating back 500,000 to one million years (Avery 1980). The Middle Stone Age, marked by advanced tools and the emergence of *Homo sapiens sapiens*, transitioned to the Late Stone Age around 14,000 years ago, when rising sea levels reshaped subsistence patterns and led to the introduction of bow-and-arrow hunting techniques.

The Iron Age brought transformative cultural shifts. The Early Iron Age, beginning 1,700 years ago, saw the rise of agricultural and metallurgical communities. By the Late Iron Age (c. AD 1500), Xitsonga-speaking peoples inhabited the region, leaving behind distinctive pottery with shell-impressed designs found in the south of iSimangaliso to Kosi Bay area. Portuguese sailors trading along iSimangaliso shorelines identified these groups as Tembe-Tsonga in the south and Nyaka-Tsonga in the north (Webster 1986).

Maize, introduced by the Portuguese in the mid-1500s, led to innovations like 'bird bath' grinding stones to process the hard kernels. Tembe-Tsonga pottery, dated 1500–1750, reflects traditions that continued in Mozambique into the 1960s. During this time, sailors noted the Kosi Bay fish traps (fish kraals), showing how the Tsonga people were traders. These fish traps are still used today, connecting their past traditions to the present. This cultural wealth positions iSimangaliso as a prime destination for archaeotourism, with ongoing efforts to document and preserve its heritage resources.

[2] https://speciesstatus.sanbi.org/

During 1500–1850, the Tsonga State was a dominant regional power. By the late 18th century, Zulu-speaking groups moved into the region, with King Shaka Zulu ruling southern iSimangaliso during the Mfecane (1820–1830). The territory was later divided between Portuguese and British rule under an 1875 treaty (Webster 1986). Subsequent conflicts, such as the 1884 battle of eTshaneni, where King Dinizulu defeated Chief Zibhebhu, further shaped the region's history.

As noted, the iSimangaliso Wetland Park was created from 16 different parcels of land. The area included a patchwork of state-owned land, commercial forests and former military sites. Some of the areas within iSimangaliso have a rich legacy of local communities' activities in conservation and cultural traditions. The recognised Traditional Leadership expressions in and surrounding the Park are geographically distinct and provide rich cultural diversity to the landscape of the region in northern KwaZulu Natal (Figure 2.2).

At the proclamation of the Park as a WH property, iSimangaliso had 14 land claims – three were settled between 1998 and 2002, another six were settled in 2005, while the rest of the claims remained unsettled.

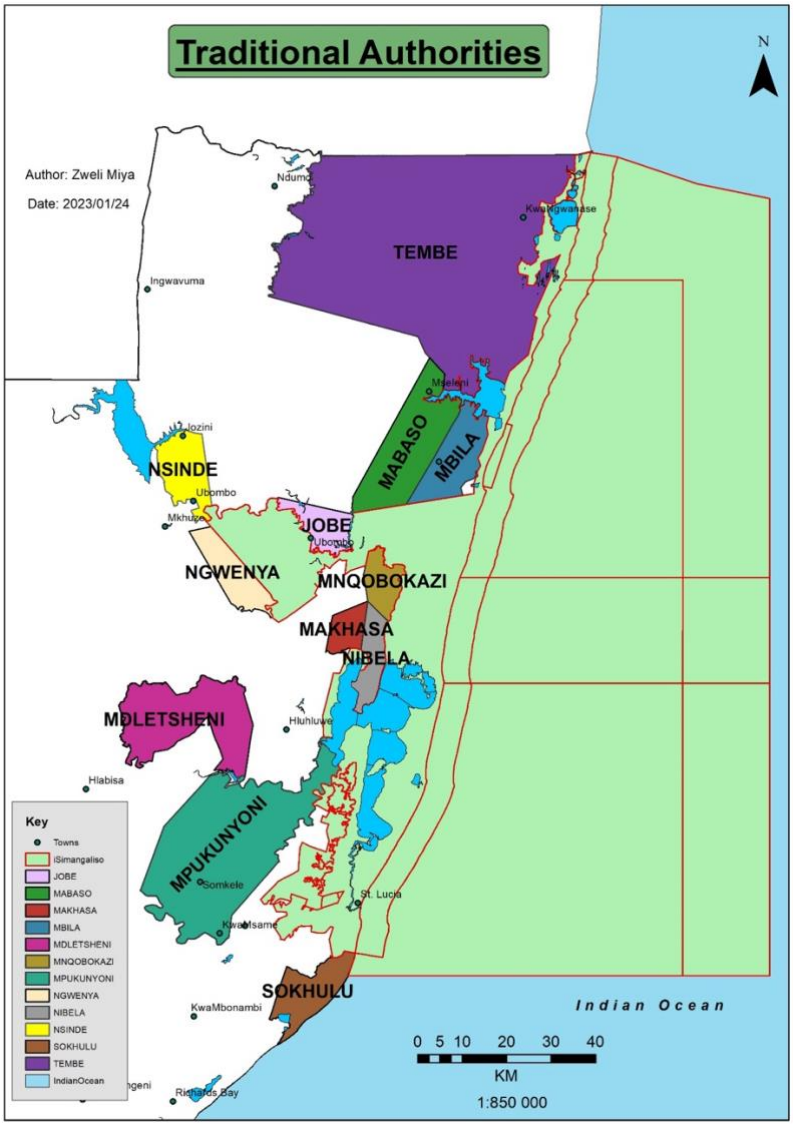


Figure 2.2 Traditional Authorities (Leadership) of iSimangaliso Wetland Park.

In 2004, a decision was taken that stated that the land claimants and local communities were accepted as partners in the development of the Park.

These settled claims have enabled co-management agreements with claimant communities, fostering collaboration and equitable benefit-sharing arrangements that help ensure the continued protection and promotion of this heritage. The benefits of co-management include: access to the area; sustainable use of natural (biological and land) resources; representation on the Board; and revenue sharing from gate fees, concession fees and game sales. Communities also gain equity ownership and partnerships in major tourism developments, such as Thonga Beach Lodge and Mabibi Camp, along with opportunities for local economic development; tourism-related skills training; procurement and tourism contracts; land care and infrastructure projects; and bursaries to support education and training.

2.6 Identifying the values of the World Heritage property

When formally listing an area as a WH property, UNESCO's WH Committee approves the significant components in a Statement of Outstanding Universal Value (SOUV), a fixed description of the values of the property referenced to the date of inscription. The SOUV for iSimangaliso Wetland Park (Appendix 1) forms part of the property's UNESCO webpage[3].

Prior to the CVI workshop, excerpts from the SOUV for iSimangaliso were identified and grouped together to form six 'key values' (listed here and expanded upon in Table 2.1). This was initially compiled by the CVI developers from the SOUV (Appendix 1) and the identified key values subsequently cross-referenced with other resources describing the WH property and associated marine and terrestrial protected areas. These key values were reviewed and endorsed by the Steering Committee before being presented to the workshop participants. The key values are underpinned by associated 'attributes', which are the elements of a heritage place that convey its heritage/conservation values and enable an understanding of those values. Attributes can be physical qualities, material fabric and other tangible features but can also be intangible aspects such as processes, social arrangements, cultural practices, associations and relationships that are reflected in physical elements of the property. Management is typically of the tangible attributes. While the values were unchanged when considering the sources beyond the SOUV, additional attributes associated with some of the values were incorporated based on contents of the other sources.

The six key values identified for iSimangaliso are:

1. Terrestrial biodiversity and habitats
2. Coastal biodiversity and habitats
3. Marine biodiversity and habitats
4. Significant ecological and evolutionary processes
5. Superb natural & scenic beauty
6. Importance for local people/communities

Workshop participants made specific mention of the dated nature of the wording in some parts of the SOUV, particularly in regard to the descriptions of the Traditional Leadership living within the property. Despite being adopted in 2011, the directive for retrospective Statements of OUV is that they be written in the style of and with content reflecting the time of inscription (in this case 1999). However, even with this understanding, the use of some of the chosen language does not appropriately reflect the situation. Examples include "*small townships*" better described as 'local communities'; *"tribal groups*" as 'Traditional Leadership'; and the use of "*impoverished communities*" when 'communities' would be sufficient without the disparaging adjective. Some wording represents the specifics of the time of inscription; e.g., the specific mention of "*WWF*" would now be more relevant to represent the larger number of non-government organisations (NGOs) currently active in iSimangaliso; and the "*free access*" to the protected area is no longer the case for some areas. Importantly,

[3] *https://whc.unesco.org/en/list/914* (n.b., updated in 2025 with property extension to include Maputo National Park, Mozambique)

none of these would alter the identified key values that became a foundation for the initial assessments in the CVI process.

Other Significant Property Values

As well as values that have been internationally recognised as being of OUV, WH properties invariably include other significant values, whether they are heritage values (tangible or intangible) or other values (e.g., social, cultural, economic, spiritual, environmental, scientific). These values may be important locally, regionally or internationally and may even be considered 'significant' under local or regional by-laws or even national legislation. For the CVI, these are referred to as *other Significant Property Values* (SPVs), recognising that these other values will also be subject to impacts from stressors like climate change (see Appendix 2 for the list of other SPVs developed for iSimangaliso).

2.7 Evaluation of current condition and recent trend of the key World Heritage values

Using the key values of the property and the corresponding excerpts from the SOUV, assessments of the current condition (four-point categorical scale from Good to Critical) and recent trend (since inscription; improved, stable, deteriorated or unknown) were made during a plenary session. Where the assessments were consistent across all excerpts within a key value, they were reported at the key value level; where there was variation, excerpts were grouped accordingly (Table 2.1).

Regarding 'Terrestrial biodiversity and habitats' (key value #1), concerns were raised around some areas of bush encroachment and increased carbon dioxide levels impacting woody species. Despite impacts on certain forests, there is an overall maintenance of habitat (*Good* condition). Government interventions to control invasive species by use of hot fires have been successful, noting that the fire regime has been fairly static with no instances of big wildfires. Some poaching continues (e.g., rhino), while rewilding activity after 1999 indicates improvement. The aggregated assessment for the trend was *Stable*.

Coastal regions (key value #2) have similarly shown some areas of improvement, such as those related to the opening of the mouth of Lake St Lucia, but also some areas of decline (the mouth of Lake St Lucia not flushing naturally, together with reeds and other vegetation overgrowth and sedimentation; while Lake Sibaya has deteriorated). The aggregated assessment was *Good with some concern* with a *Stable* trend. The marine environment (key value #3) was assessed as in *Good* condition and *Stable*, noting concerns about fishing pressure to the north (in Mozambique) and plastic pollution (including micro-plastics), together with an absence of whale sharks.

The fourth key value, regarding ecological and evolutionary processes, was assessed as *Good with some concerns* and having *Deteriorated*. Specific discussion topics included that salinity levels in Lake St Lucia are close to raising significant concern (orange) and had deteriorated. In contrast, there are no indications that changes have occurred in submarine canyons, which are in good condition; however, it was also noted that there is no direct measurement to support this. With respect to the superb beauty (key value #5), there were noted areas of deterioration (e.g., forest and swamp destruction) and improvement (e.g., plantation removal, rehabilitation to grassland/forest) with an aggregated assessment of *Good* condition and *Stable* trend. Development and increased light pollution from outside the protected area have had a detrimental effect on the broad-scale aesthetics.

Connections with community (key value #6) improved regarding relations between the iSimangaliso Park Authority and communities, noting the required balance between WH integrity and services provision; however, not all communities have access to key infrastructure (roads, water, electricity, clinics). Community land claims have been settled in nine instances with five claims still open, while structures to support communities have improved. Community partnerships in the development of iSimangaliso have provided direct benefits to local people including through employment, micro-enterprises, training and revenue sharing of gate fees. Conservation efforts in partnership with NGOs have also continued and grown through new opportunities; however, these are

currently not commensurate with the expensive livelihood support and social infrastructure needs that still exist, nor can they be without increased economic investment in the area from the national government.

Whilst the aggregated assessment for the trend was positive (*Improved*), the current condition indicated opportunity for further improvement (*Good with some concerns*).

Table 2.1 Key values derived from the Statement of Outstanding Universal Value (OUV), together with the current condition and recent trend since inscription in 1999 assessed within the CVI process (legend below table).

Key values	Excerpts taken directly from the Statement of OUV	Attributes (site-specific characteristics that inherently contribute to a value)	Assessment of current condition and recent trend (since 1999 inscription)
1. Terrestrial biodiversity and habitats	a wide range of pristine … terrestrial environments, including lake systems	*Tangible attributes* • *savannah woodlands* • *lake systems* *Intangible attributes* • *transitional geographic location* • *viable population sizes* • *outstanding diversity of habitats* • *ecological limits* • *endemic species* • *threatened species*	
	continuing speciation and exceptional species diversity		
	critical habitat for a wide range of species from Africa's … savannahs		
	transitional geographic location between sub-tropical and tropical Africa … has resulted in exceptional species diversity		
	species lists for iSimangaliso are the lengthiest in the region and population sizes for most of them are viable		
	over 6,500 plant and animal (including 521 bird) species recorded from the Park		
	populations of species of conservation importance include 11 species endemic to the park, 108 species endemic to South Africa, while 467 species are listed as threatened in South Africa.		
	outstanding diversity of habitats supports a wide variety of animal species, some at the northern and many at the southern limit of their range		

(table continues on the following pages)

LEGEND

Current condition

(i.e., colour of box around arrows)

Rating	Criteria
Good	The site's values are in good condition and are likely to be maintained for the foreseeable future, provided that current conservation measures are maintained.
Good with some concerns	While some concerns exist, with minor additional conservation measures the site's values are likely to be essentially maintained over the long-term.
Significant Concern	The site's values are threatened and/or may be showing signs of deterioration. Significant additional conservation measures are needed to maintain and/or restore values over the medium to long-term.
Critical	The site's values are severely threatened and/or deteriorating. Immediate large-scale additional conservation measures are needed to maintain and/or restore the site's values over the short to medium-term or the values may be lost.

Recent trend  **STABLE**  **IMPROVED**  **DETERIORATED** **? UNKNOWN**

Key values	Excerpts taken directly from the Statement of OUV	Attributes (site-specific characteristics that inherently contribute to a value)	Assessment of current condition and recent trend (since 1999 inscription)
2. Coastal biodiversity and habitats	outstanding natural wetland and coastal sites a wide range of pristine coastal, wetland, estuarine …environments continuing speciation and exceptional species diversity long sandy beaches, coastal dunes, swamps, and extensive reed and papyrus wetlands nesting turtles and large aggregations of flamingos and other waterfowl critical habitat for a wide range of species from Africa's …wetlands transitional geographic location … as well as the coastal setting have resulted in exceptional species diversity outstanding diversity of wetland and coastal habitats supports a wide variety of animal species, some at the northern and many at the southern limit of their range	*Tangible attributes* • *nesting turtles/ ray aggregation* • *sandy beaches/coastal dunes* • *wetlands/ estuaries/ swamps/ mangroves* • *waterfowl aggregations* *Intangible attributes* • *transitional geographic location* • *outstanding diversity of habitats* • *ecological limits* • *endemic/threatened species*	
3. Marine biodiversity and habitats	a wide range of pristine marine environments, including coral reefs continuing speciation and exceptional species diversity, including endemic species critical habitat for a wide range of species from Africa's seas transitional geographic location between sub-tropical and tropical Africa have resulted in exceptional species diversity outstanding diversity of aquatic habitats supports a wide variety of animal species, some at the northern and many at the southern limit of their range the abundance of dolphins and migration of whales and whale sharks off-shore submarine canyons	*Tangible attributes* • *coral reefs* • *canyons/deep-water habitats* • *kelp forests* • *dolphins, whales & whale sharks* *Intangible attributes* • *transitional geographic location* • *outstanding diversity of habitats* • *ecological limits* • *endemic/threatened species*	

Key values	Excerpts taken directly from the Statement of OUV	Attributes (site-specific characteristics that inherently contribute to a value)	Assessment of current condition and recent trend (since 1999 inscription)
4. Significant ecological and evolutionary processes	major floods and coastal storms	*Tangible attributes* • *ecological processes* • *climatic cycles* • *sediment transport* • *flooding/coastal storms* • *shifting salinity states (low to hypersaline)* *Intangible attributes* • *evolutionary processes* • *long-term functioning of ecosystem*	
	the shifting salinity states within Lake St. Lucia which are linked to wet and dry climatic cycles, with the lake responding accordingly with shifts from low to hyper-saline states		
	combination of fluvial, marine and aeolian processes		
	Past speciation events in the Maputaland Centre of Endemism are also ongoing		
	environmental heterogeneity is further complicated by major floods and coastal storms, events which are regularly experienced in iSimangaliso		
	site is also of sufficient size and retains most of the key elements that are essential for long-term functioning of the ecosystems		
	diversity and interplay of evolutionary processes at work in iSimangaliso. In the marine component of the site, the sediments being transported by the Agulhas current are trapped by submarine canyons on the continental shelf		 *canyons:* 
5. Superb natural & scenic beauty	scenically beautiful and basically unmodified	*Tangible attributes* • *clear waters* • *wide undeveloped sandy beaches* • *forested dune cordon* • *mosaic of wetlands* *Intangible attributes* • *superlative scenic vistas* • *outstanding natural phenomena* • *exceptional aesthetic qualities*	
	vivid natural spectacles		
	superlative scenic vistas along its 220 km coast		
	the clear waters of the Indian Ocean, wide undeveloped sandy beaches, a forested dune cordon and a mosaic of wetlands, grasslands, forests, lakes and savannah, the park contains exceptional aesthetic qualities		
	… natural phenomena are judged outstanding		
	the spectacle of large numbers of nesting turtles on the beaches		
	the huge numbers of waterfowl and large breeding colonies of pelicans, storks, herons and terns are impressive and add life to the wild natural landscape of the area		

Key values	Excerpts taken directly from the Statement of OUV	Attributes (site-specific characteristics that inherently contribute to a value)	Assessment of current condition and recent trend (since 1999 inscription)
6. Importance for local people/ communities	park is not inhabited by people apart from six small townships in the Kosi Bay Coastal Forest Reserve also two villages (Makakatana and St Lucia Estuary) which are enclaves within the Park but not part of it. About 100,000 people from 48 tribal groups live in villages surrounding the Park community conservation programmes are key to minimising conflicts and maximising benefits. progressive neighbour-relations policy fosters good relations with communities who live near the Park wetlands … as resources of economic, cultural, scientific and recreational value Some funds to assist in community conservation have come from WWF several land claims by impoverished communities have been lodged before the Land Claims Court Mbuyazi whose rights near Cape Vidal have been recognised, not to settle, but to develop ancestral lands for tourism …by 2004 it was stated that the land claimants and local communities were accepted as partners in the development of the Park direct benefits from the protected area such as free access, business and employment	*Tangible attributes* • *six small townships in coastal reserve of iSimangaliso* • *48 tribal groups live in villages around the Park* • *community conservation programmes* • *local communities accepted as partners in Park development* • *land claims* • *Historical features* *Intangible attributes* • *progressive neighbour-relations policy* • *recognition of rights* • *human linkages* • *benefits from protected area* • *spiritual value* • *historical activities*	 [4]

[4] Key value 6 was assessed as "*Good with some concerns*" (light green) and *Improved* (upward arrow) noting that this assessment doesn't capture the depth and seriousness of some issues that are of significant concern and even critical.

MANAGEMENT AND USE OF iSIMANGALISO

Branching Staghorn coral (*Acropora* spp.), Sodwana Bay
Welly Qwabe

3.1 Management of the property

The iSimangaliso Wetland Park World Heritage property is a public entity managed by the iSimangaliso Wetland Park Authority. The Authority, led by the Chief Executive Officer (CEO), reports directly to the Department of Environment, Forestry and Fisheries (DFFE). The property is managed through a Board appointed by the Minister of Environmental Affairs. By virtue of the *World Heritage Convention Act 49 of 1999* that outlines the operating requirements for a World Heritage property, the Board formulates policy and provide formal direction to the Executive. Additionally, the Act provides for the Authority to establish regulations of the WH property under its jurisdiction with the approval from the Minister. Therefore, iSimangaliso Wetland Park Authority is responsible for implementing policy and delivering operations of the WH property, as well as maintaining important relationships with other stakeholders (Figure 3.1). The primary functions of the Authority include to:

- Develop measures for the environmental and cultural protection of the iSimangaliso Wetland Park and ensure that the values of the WH Convention are given effect. This includes oversight of conservation management in the Park;
- Promote, manage and facilitate tourism and related development in connection with the iSimangaliso Wetland Park;
- Facilitate programmes that encourage job creation; and
- Establish and implement the Integrated Management Plan (IMP).

The iSimangaliso Authority undertakes its functions for the WH property mainly through Co-operative Governance Agreements (CGA). Day-to-day conservation management activities in the Park are undertaken by Ezemvelo KZN Wildlife, a provincial conservation agency, through a management agreement. According to the IMP (iSWPA 2016; 2020), Ezemvelo is responsible for:

- Day-to-day operational conservation management of the iSimangaliso Wetland Park, including implementation of iSimangaliso policy; policing and law enforcement activities; and assisting the iSimangaliso Authority in compliance monitoring of concessionaires with contractual and statutory obligations; and
- Implementation of a Conservation Operational Plan and regulatory enforcement related to conservation within the iSimangaliso Wetland Park.

In accordance with the management agreement, the KZN Tourism department supports the iSimangaliso Authority with the necessary tourism marketing activities. Furthermore, the Authority is mandated to fulfil its core-functions by entering into co-operative governance agreements with other institutions, including local government. In terms of local communities, not including Park employees there are approximately 2,000 local residents that live within the Park, while those that live within the municipalities abutting the Park are estimated to be more than 740,000. With this directly impacting the management of the WH property, co-management arrangements are entered into, where appropriate, with the local communities. For example, the Authority undertakes implementation of co-management agreements with land claimants within the WH property. However, such claims are settled by the Department of Rural Development and Land Affairs under the Commission on Restitution of Land Rights for claims within protected areas, the WH property and State forests.

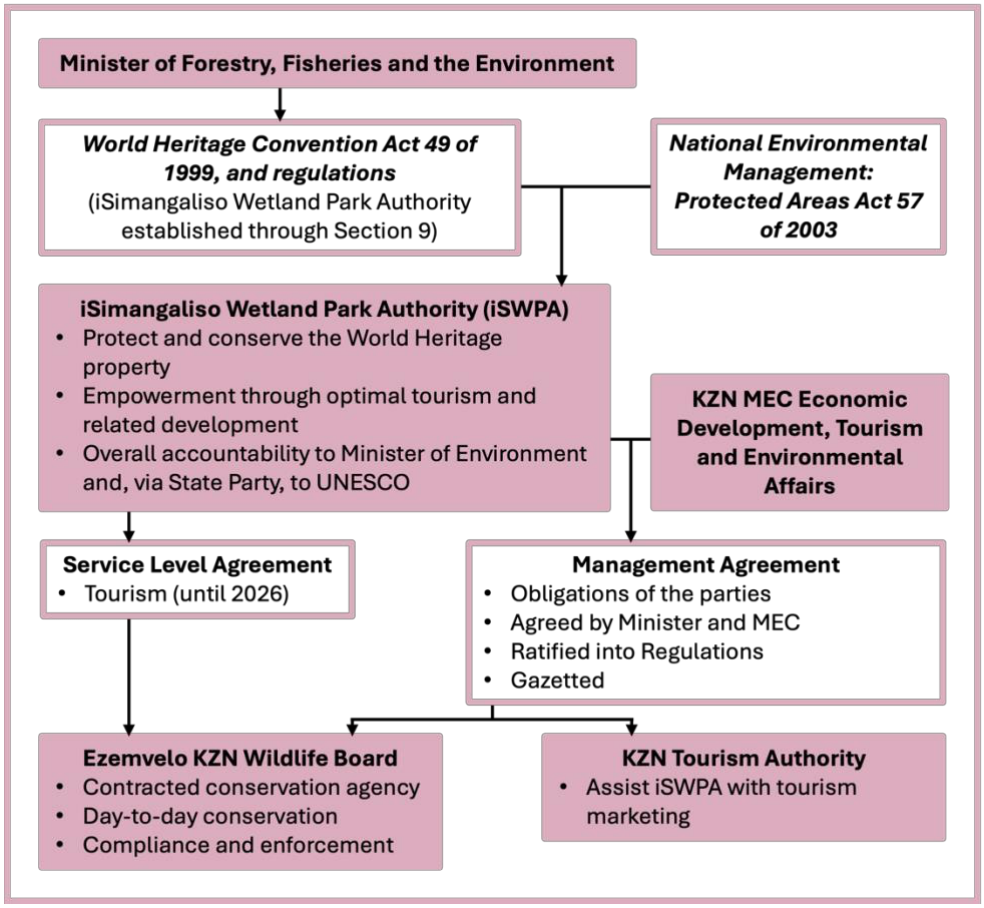


Figure 3.1 iSimangaliso Wetland Park management structure (after Figure 2 from iSimangaliso Wetland Park Integrated Management Plan 2022-2031; iSWPA 2020). KZN = KwaZulu-Natal; MEC = Member of the Executive Council; NEM = National Environmental Management.

3.2 Management plans and other documents

In accordance with the regulations designating the iSimangaliso Wetland Park as a WH property, the Authority was established with the responsibility of ensuring adherence to the values of the WH Convention. The legislation proclaiming iSimangaliso as a WH property requires the Authority to develop an Integrated Management Plan (IMP) that guides site operations. The IMP provides critical measures used for protecting and managing the property in a way that aligns with the objectives and principles of the governing Acts. In addition to *World Heritage Convention Act 49 of 1999*, the IMP aligns with several other legislations, including the *Marine Living Resources Act 18 of 1998*; *National Environmental Management: Biodiversity Act 10 of 2004*; *National Environmental Management: Protected Areas Act 57 of 2003*; and *Public Finance Management Act 1 of 1999*. The current IMP of iSimangaliso Wetland Park runs for 10 years (2022–2031; iSWPA 2020) and builds significantly on the previous five-year IMP (2017–2021; iSWPA 2016). It emphasises conservation, tourism development and local economic development for empowering historically disadvantaged communities associated with the Park.

Similarly, the marine component of iSimangaliso Wetland Park – the iSimangaliso Marine Protected Area – and associated estuarine coastal lake systems (viz., St Lucia, Mgobozeleni and Kosi Bay) should, according to the above governing Acts, have management plans. These management plans are subsidiary plans within the iSimangaliso Wetland Park IMP. This CVI report was prepared at the time that the Estuarine Management Plans was awaiting ministerial approval prior to implementation. In addition, the first management plan for the marine component of

iSimangaliso Wetland Park, which was established in May 2019 under the *National Environmental Management: Protected Areas Act*, is still being developed. Collectively, these management plans provide measures for the Authority to protect and manage the WH property in a manner that is consistent with the objectives and principles of the governing Acts.

3.3 Economic context

The *World Heritage Convention Act* emphasises the development of local economy in addition to commitment to the protection, conservation and preservation of WH values. In the context of iSimangaliso Wetland Park, striking this balance is critical given the high rates of poverty in the Park's associated communities. Most of iSimangaliso Wetland Park is located within uMkhanyakude District Municipality, which is ranked as the second poorest and most deprived municipality in the country. With an estimated 42% of the population formally employed, over 80% of households live below the poverty line (iSWPA 2020). As a result, people living in and around the property perceive it as a provision for employment opportunities or use of natural resources for subsistence and income generation.

While most households are generally dependent on a combination of government welfare grants and income from family members employed elsewhere, the Park continues to optimise developments that uplift communities and provide sustainable employment opportunities. Business-related trainings, mentorship and capacity building comprise the cornerstones of iSimangaliso's empowerment and transformation programs for local communities. These initiatives are envisioned to boost local economic activity by increasing availability of jobs and fostering a more valuable market for entrepreneurs. Building on its predecessor, the current IMP demonstrates the Authority's commitment to transformation programs. The economy of uMkhanyakude District Municipality is mostly driven by agriculture and tourism sectors.

Agricultural sector

Commercial and subsistence farming are crucial to food security in the uMkhanyakude District Municipality. In the northern parts of uMkhanyakude, cattle farming; homestead-based food production; and small sugarcane and cotton productions are the most common agricultural activities. For some households, livestock has proven to be a valuable asset during economic difficulties but the resource is also used for non-economic purposes, such as communicating with ancestors and bride wealth (ilobolo). The southern part of uMkhanyakude is mostly characterized by commercial agriculture activities such as sugarcane, pineapple and timber production. However, communities bordering the Park in this area also practice domestic agricultural activities similar to those undertaken in the north, including vegetable and chicken farming. With uMkhanyakude and Zululand District Municipalities both classified as high-risk climate areas, potential future decline in the agricultural output is likely to happen (Mthembu and Hlophe 2020; Fatokun 2025), which presents a serious threat to food security, particularly for vulnerable households. Previously identified factors to limit agricultural opportunities in the region include:

- Nutrient poor soils;
- Land tenure insecurity;
- Climate factors, mainly drought and unfavourable rainfall;
- Lack of finance for previously disadvantaged farmers; and
- Distances from markets.

Tourism sector

Tourism transformation strategies implemented by the Park Authority include assisting beneficiary communities to actively engage in the commercial development. While tourism transformation strategies and empowerment create jobs and tourism-related skills, ownership or equity interests in certain commercial enterprises of the Park are possible for some beneficiary communities.

Examples of tourism-related transformation programs include:

- Tourism skills development programme, including training in hospitality and guiding;
- Craft development programme focusing on product development with crafters and facilitation of links to high value markets; and
- Infrastructure and land care small- and medium-sized enterprise (SME) development programme, which targets community-based contractors that undertake alien clearing, land rehabilitation, infrastructure construction and infrastructure maintenance work.

Tourism transformation also advances the procurement of goods and services for tourism enterprises from local communities and subject matter experts. By optimising economic potential, natural and cultural integrity of the WH property are envisaged not to be compromised; hence, this is a priority for the iSimangaliso Authority.

The IMP further identifies the following potential community benefits to aid local economy:

- Economic benefit packages for land claimants;
- Land care contractors and temporary employment;
- Mandatory partners in tourism accommodation facilities;
- Sub-contractors and temporary employment in infrastructure development;
- Sustainable natural resource use;
- Mandatory partners in tourism accommodation;
- Regulated community-based B&Bs and home stays;
- Percentage of revenue;
- Security industry employment opportunities; and
- Community guides for trails.

3.4 Social and cultural context

The iSimangaliso Wetland Park is known for its rich cultural heritage resources. These include archaeological and palaeontological sites and artefacts, historical buildings and jetties, graves, fish traps, shipwrecks and scenic landscapes. Additionally, intangible resources such as spiritual places, oral traditions and rituals are associated with the Park. The rich cultural heritage of the Park demonstrates substantial flow of social dynamics and human values over a long period of time. The Park is acknowledged for having a "sense of place," which is experienced and upheld by people from different backgrounds, cultural norms and beliefs. This "sense of place" is felt in relation to individual's needs and expectations and it varies from one person to another.

Social and cultural aspects of iSimangaliso date back to the arrival of Nguni-speaking people in parts of southern Africa. The Nguni people gave rise to several cultures including Zulu and Tsonga/Xitsonga-speaking people who still occupy the Park today. As a result, the Park provides some evidence of the settlement of Xitsonga-speaking people around the 1500s, which bears critical insights into how African people adapted socially and culturally in south-east Africa. Before the existence of the South Africa-Mozambique border, early Portuguese sailors documented Xitsonga-speaking people as Tembe-Tsonga, living in the south, and Nyaka-Tsonga, occupying the north of the Ubombo Mountains (Webster 1986). The Tembe-Tsonga were notably associated with the Kosi Bay fish traps and pottery dated AD 1500–1750, with remnants discovered between Richards Bay in the south of the Park and Kosi Bay in the north of the Park. Today, fish traps are regarded as one of the most important age-old fishing traditions associated with the site and protecting this activity as living history adds to the Park's "sense of place".

The discovery of Zulu pottery in the southern part of iSimangaliso Wetland Park suggests that the Zulu people migrated from Mkhuzi into this area in the late 1800s, with their pottery replacing that of Xitsonga-speaking people. The present-day communities in the Park are the result of this historical migration of people over the landscape due to shifts in political allegiances. The Tsonga culture predominates in communities in the north of the Park, whilst Zulu culture is prevalent in communities in the south of the Park. Similarities exits between these two cultures – notably subsistence agricultural activities, such as cattle that are important feature of various rituals

including communication with ancestors, bride wealth (ilobolo), and for ploughing, transport, savings and social status.

Early historical records of human settlement in iSimangaliso indicate that people were intrinsically and spiritually connected to their land with social organisation based on a system of traditional leadership known as *Amakhosi*. People lived in synchronisation with their natural environment. For example, the ocean was key to people as the provider of essential subsistence marine resources rich in protein. Grassy plains were used for herding cattle, which were an important form of family asset. The fertile land on the banks of the lake was critical for subsistence farming and the vegetation provided material for building their dwellings structures (Skelcher 2003). The displacement of people from their land through colonisation and apartheid affected their social and cultural practices as they were forced to move from their lands and settle elsewhere in less productive lands. Increases in poverty, unemployment, health issues, overpopulation and inadequate social and physical infrastructure became unavoidable over time. Added to this was the denial of hunting and fishing licences to these communities, which further reduced their livelihood opportunities. However, much has happened in the post-apartheid era including the proclamation of iSimangaliso Wetland Park, managed by the Park Authority. Better policies have been developed to redress social, political and economic exclusions injected by the apartheid government; e.g., the settlement of nine of the 14 Park-associated land claims filed by communities that were evicted from their land. Nevertheless, the lack of progress in resolving the remaining land claims and the extension of the deadline for restitution claim submissions has caused ambiguity and, in many instances, deteriorated the Park Authority relationship with land claimants.

Apart from the land restitution, the Park has witnessed a number of initiatives attempting to alleviate poverty and historical societal issues. Some of these initiatives involved technical training for the youth, education and awareness-raising. This is critical given that the apartheid regime uprooted communities, resulting in younger and older generations having distinct identities with respect to the Park. The older generation sense of identity emanates from the loss of land and has a “sense of place” that differs significantly from that of the younger generation, which has only perceived the Park post-apartheid and cannot fully appreciate its value in their upbringing. Today, communities in the north of the Park have been provided community resource hubs, which serve as multipurpose space for holding social activities, including community meetings and workshops (Figure 3.2). These newly established hubs can be viewed as a strategy for advancing social cohesion in the Park. They provide support for a number of key activities, such as building ocean awareness; demonstrate projects linked to nature-based approaches and climate-smart agriculture; enable micro-enterprise development and employment opportunities for youth; and facilitate access to amenities, such as a library, a play area for children, cell-phone charging stations, printers, computers and internet access. Moreover, they can unlock socioeconomic opportunities by promoting tourism and local craft production sales.

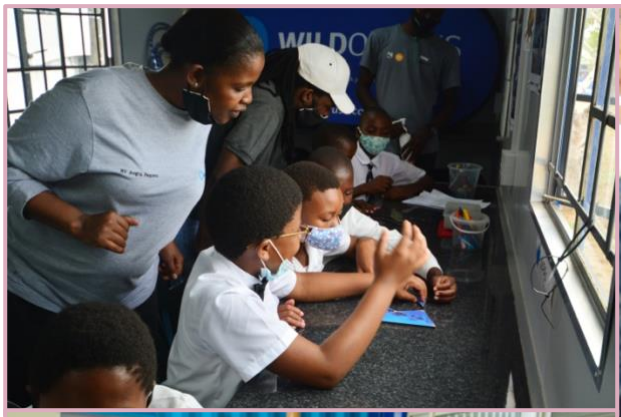


Figure 3.2 Community hubs in iSimangaliso have provided rich opportunities for community connection, activities, education and celebration.

CLIMATE AND ITS INFLUENCE ON iSIMANGALISO

The St Lucia Estuary was completely dry in 2014
but has since reconnected to the sea
Riaan Cedras

4.1 Current climate

iSimangaliso has seasonal variations in temperature and rainfall that are typical of subtropical locations. The austral summer (January–March) is both the warmest and wettest period of the year, contrasting with the dry winter (June–August). Summertime has recently been characterised by typical daily maximum temperature around 31°C and minima of 21–22°C (exemplified for the Vasi Science Centre in Figure 4.1). While the daily maximum temperature is ~5°C lower in winter than in summer, the wintertime daily minimum is even cooler (~8°C less than in summer). This pattern correlates directly with range of monthly-average solar radiation from summer (~1300 W/m^2) to winter (~750 W/m^2). Average monthly rainfall totals are greater than 120 mm in summer, contrasting with ~40 mm or less in winter (Figure 4.1).

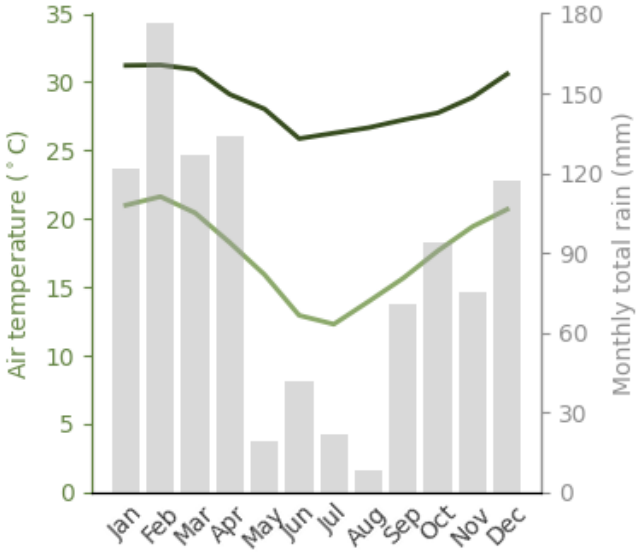


Figure 4.1 Seasonal variation in average daily maximum (dark green) and minimum (light green) temperature and monthly-averaged rainfall from the Vasi Science Centre automated weather station, averaged for the period 2019–2024. *Source: SAEON*[5].

4.2 Observed and projected climate change

Observed historical changes in climate were examined using a variety of data sources and, where appropriate, informed by hindcast modelling. Future projections were informed by the climate modelling undertaken to support the 6th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC 2021). This modelling in the Coupled Model Intercomparison Project Phase 6 (CMIP6; Riahi et al. 2017) defined several scenarios (shared socio-economic pathways; SSP) based on modelled radiative forcing levels and socioeconomic development. Two scenarios were employed here: a very high emissions scenario, SSP5-8.5, that reflects continued expansion of fossil fuels, with CO_2 emissions reaching roughly triple present levels by 2075; and an intermediate emissions scenario (SSP2-4.5), in which annual emissions peak around 2050 scenario and then decrease to 2100 to approximately half the peak level. For each presented variable, the median value of the model ensemble is cited, with variability shown in the corresponding figure.

Air temperature

Analysis of historical data products for the KwaZulu-Natal (KZN) province indicates that annual-average air temperature at the surface has increased by over 0.5°C since the 1950s (Figure 4.2-upper). The rate of warming in the last two decades analysed (0.24°C/decade, 1995-2014) was more than double the rate over the entire record (0.11°C/decade, 1950-2014), indicating the acceleration in warming. Projected air temperature indicates further warming by approximately 1°C from current levels under SSP2-4.5 and 1.4°C under SSP5-8.5 by the middle of this century. End-of-century projections indicate additional warming above current levels of 1.4°C and over 4°C, under the respective scenarios.

A consequence of warming is that the number of hot days (>35°C) has doubled, on average, from the beginning (0.6 days/year) to the end (1.2 days/year) of the historical period. Projections indicate that the number of hot days will increase further, with a range of 5 days/year (under SSP2-4.5) to 7.5 days/year (SSP5-8.5) around 2050. By the end-of-century,

[5] https://doi.org/10.15493/OBS.MONITOR.41183728?referrer=observationmonitor.saeon.ac.za

further increases in hot days are projected that the frequency will average 10 days/year under SSP2-4.5 and 40 days/year under SSP5-8.5.

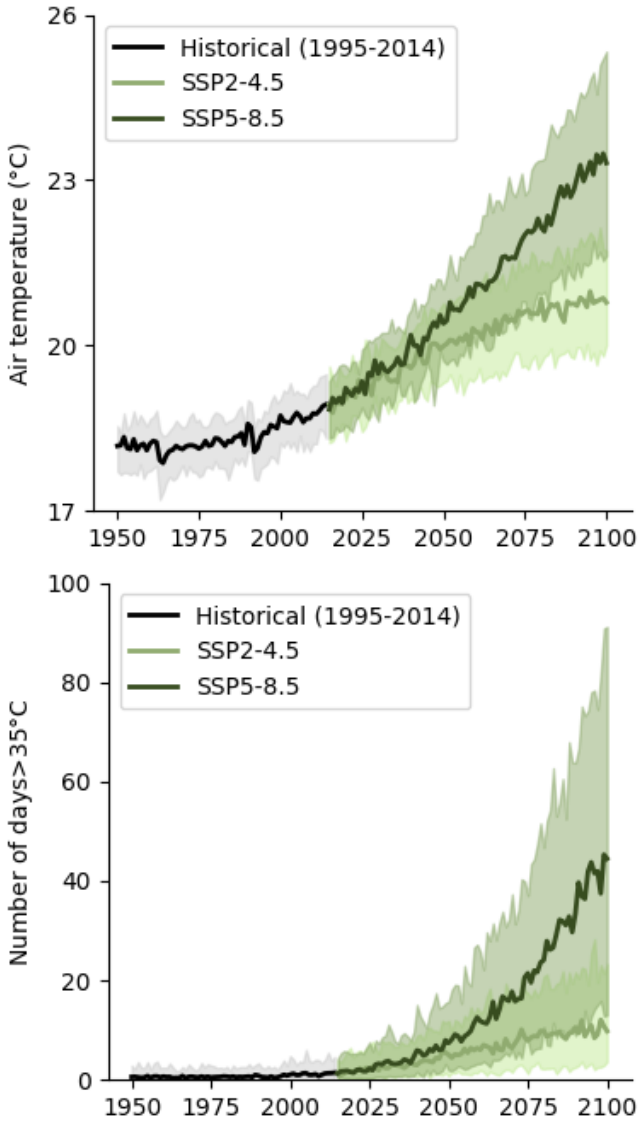


Figure 4.2 Time series of annual-average air temperature (upper panel) and number of hot days (lower panel) for the KwaZulu-Natal province for 1950–2014 (historical) and 2015–2100 (projected for two Shared Socioeconomic Pathways, SSP). Ensemble-median with 10th–90th percentile range. *Source: Climate Change Knowledge Portal* [6].

Precipitation

Long-term rainfall data stations provide insight to the spatial and temporal variability across iSimangaliso. Two stations near Kosi Lake, in the north of iSimangaliso, providing overlapping (but not co-located) rainfall spanning 1967–2013 (Figure 4.3-upper panel). These reveal an annual total rainfall of approximately 1000 mm with substantial interannual variability. There is no apparent trend in the early part of the record but there appears to be a decreasing (but non-significant) trend in the latter part of the record. Similarly, around 110 km away, near the southern extent of the property, two stations in the vicinity of St Lucia span 1951–2023 (Figure 4.3-lower panel). These stations recorded lower annual total rainfall (730–960 mm, average) than the more-northern location, with similar interannual variability and no apparent trend within the records.

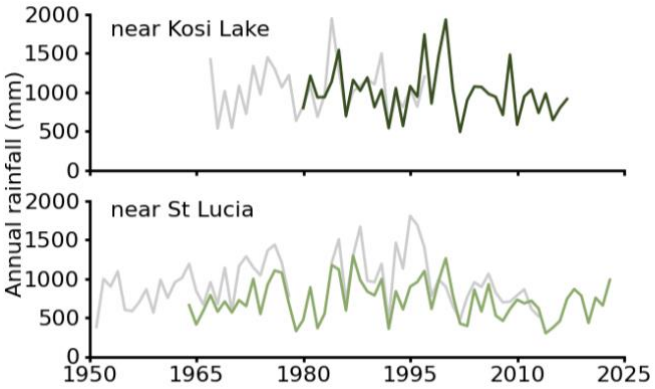


Figure 4.3 Historical annual rainfall at meteorological stations (upper panel) near Kosi Lake [stations W7E001, 1967–1997; and W7E004, 1980–2017]; and (lower panel) near St Lucia [stations W3E001, 1952–2013; and W3E003, 1964–2023]. *Source: Department of Water and Sanitation*[7].

At the scale of KZN, the historical provincial rainfall (Figure 4.4-upper panel) is consistent in magnitude and trend with the presented station data (Figure 4.3). Projected rainfall has variability similar to historical conditions and with no significant trend.

Rainfall during the heaviest events (measured by the maximum 5-day total each year) showed a slight increase through the historical period (Figure 4.4-lower panel). The rate of increase in this metric was projected to be maintained under SSP2-4.5; however, that rate is projected to increase three-fold under SSP5-8.5. Whilst relatively small in absolute magnitude, extreme rainfall events have already led

[6] https://climateknowledgeportal.worldbank.org/country/south-africa
[7] https://www.dws.gov.za/Hydrology/Verified/hymain.aspx

to impactful flooding events; the projected increase in the 5-day total rainfall will almost certainly increase impacts of flooding. A further implication of increased heavy rainfall with an unchanged annual total is a decrease in rain outside of heavy rainfall events, which may have an associated increased duration of interstitial periods with low or no rain.

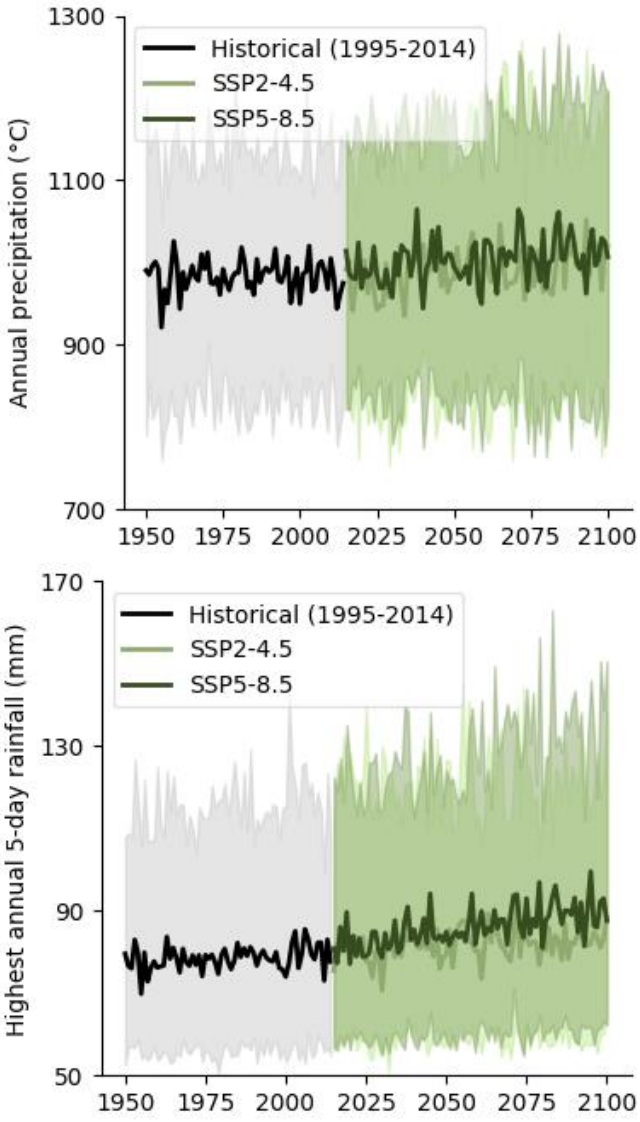


Figure 4.4 Rainfall time series for the KwaZulu-Natal province for 1950–2014 (historical) and 2015–2100 (projected for two Shared Socioeconomic Pathways, SSP): [upper panel] of annual total rainfall; and [lower panel] highest annual 5-day rainfall total. Ensemble-median with 10th–90th percentile range. *Source: Climate Change Knowledge Portal* [6].

Sea-surface temperature

Surface temperature in the Sodwana Bay region has increased in the past century by ~0.7°C (Figure 4.5). Future projections are for continued ocean warming, with a further temperature increase of 0.6°C (under SSP2-4.5) to 0.9°C (SSP5-8.5) by around 2050. By 2100, ocean temperature increase from present-day levels is projected as 1.2°C under SSP2-4.5; and 2.5°C under SSP5-8.5. The implications of this for marine ecosystems are potentially dire, noting observed impacts of extreme temperature on coral reefs and seagrasses in various global locations (Hughes et al. 2018; Losciale et al. 2023).

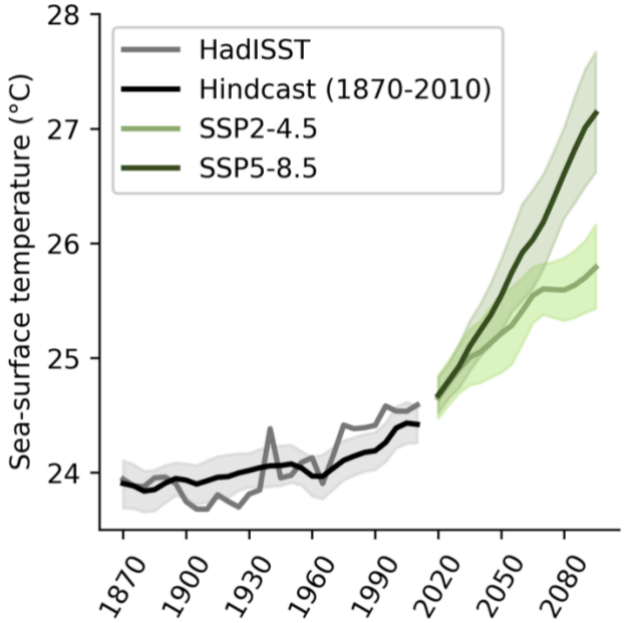


Figure 4.5 Pentad-average (5-year period) time series of sea surface temperature for Sodwana Bay shown at the first year of each pentad 1870–2010 (historical) and 2020–2099 (projected for two Shared Socioeconomic Pathways, SSP). *Source: HadISST*[8] and *Coupled Model Intercomparison Project 6 (CMIP6)*[9].

Sea level

During the satellite altimetry era (1993–2023), sea level at Sodwana Bay increased by 3.1 mm/year, equivalent to ~6 cm across two decades (Figure 4.6). This rate is consistent in magnitude with but

[8] https://www.metoffice.gov.uk/hadobs/hadisst/data/HadISST_sst.nc.gz; Rayner et al. (2003)
[9] https://esgf-node.llnl.gov/search/cmip6/

accelerated from a previously reported trend in tide gauge measurements along the east coast of South Africa for the period 1967-2006 of 2.74 mm/year (Mather et al. 2009). Future sea level is projected to increase a further 17–20 cm by 2050 under the two scenarios; however, by 2100 the projections diverge, with projected sea level rise from current levels by 56 cm under SSP-2.45 and 78 cm under SSP-5.85. Sea level rise has direct implications for the wetland hydrology and coastal areas, through flooding and erosion. Furthermore, sea level rise has been related to increased storm surge (by ~3%; Muis et al. 2023).

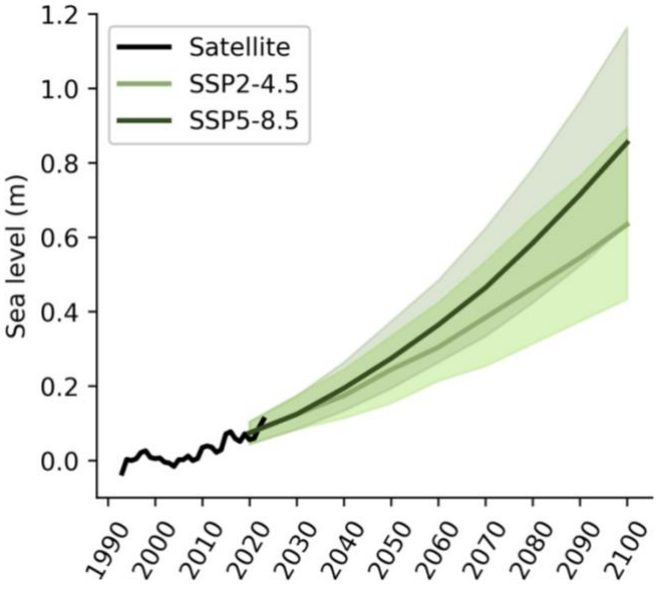


Figure 4.6 Sea level for the South Africa Exclusive Economic Zone for 1993–2023 (historical) and 2020–2100 (projected for two Shared Socioeconomic Pathways, SSP). *Source: Climate Change Knowledge Portal* [6].

In summary, KwaZulu-Natal has experienced an increase in air temperature, which is projected to continue. This will lead to further increases in the number of very hot days (>35°C) and the frequency of heatwaves. Change in rainfall has been variable across the region, with the most notable effect being an increase in the frequency of extreme rainfall events during the summer months. This has led to increased flooding in urban, coastal and estuarine areas. Coastal ocean temperature and sea level have also increased and are projected to accelerate.

APPLYING THE CLIMATE VULNERABILITY INDEX TO iSIMANGALISO

Community hubs have provided an important base for activities and education

5.1 Background

The Climate Vulnerability Index (CVI) is a systematic and rapid assessment tool that is values-based, science-driven and community-focused. The CVI was initially developed to assess the vulnerability to climate change of all types of WH properties, considering the Outstanding Universal Value (OUV) and the associated 'community' (local, domestic, and international).

The CVI framework builds upon the vulnerability framework approach described in the 4th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC 2007). In the first phase of the framework, the vulnerability of OUV is determined by assessing the exposure, sensitivity and adaptive capacity with respect to determined climate stressors (Figure 5.1). The OUV Vulnerability then becomes the exposure term for the second phase of the framework, in which the vulnerability of the community associated with the property to a decline in the WH values is evaluated. This combines assessments of economic-social-cultural dependency (sensitivity) and adaptive capacity (Figure 5.1). A customised spreadsheet-based worksheet is used to determine outcomes based on user inputs. A more detailed outline of the CVI methodology is provided by Day et al. (2020).

The foundation for the CVI process is the Statement of OUV for a property (Appendix 1), from which key WH values are summarised (Table 2.1). The key climate stressors most likely to impact the key values (and attributes) are identified for a defined and agreed time scale (e.g., by 2050) from a list of possible stressors (Table 5.1). With this foundation established, the CVI process is initiated.

At the time of this report, applications of the CVI had occurred in natural and cultural WH properties in Africa, Australia, Europe and the Indian Ocean (see https://cvi-heritage.org).

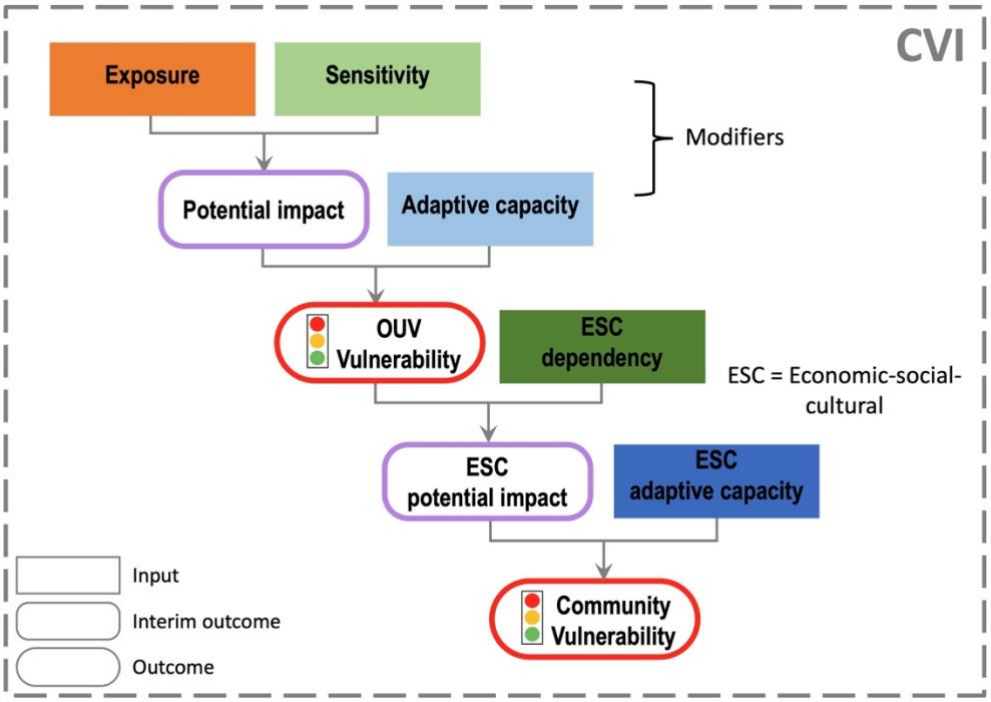


Figure 5.1 The CVI framework used to undertake rapid assessment of climate change vulnerability of World Heritage properties and the associated community

5.2 The CVI process for iSimangaliso

Prior to application of the CVI framework in iSimangaliso, various preparatory steps were undertaken:

1. The Statement of OUV for iSimangaliso (Appendix 1) was analysed and 'broken-down' into key values and their accompanying attributes (see Table 2.1); using additional sources describing the area, these six key values were confirmed as representative of the area's values, while providing additional attributes;
2. Background information was prepared outlining key aspects of climate change;
3. A list of other Significant Property Values (SPVs) was initiated (see Appendix 2); and
4. An overview of information related to economic, social and cultural connections was compiled.

The CVI application for iSimangaliso was undertaken through a workshop held 20th–24th November 2023. It was convened in St Lucia, South Africa, near the southern extent of the property. The workshop employed a series of plenary and breakout sessions, in which information was presented and assessments were undertaken and discussed. Though fairly stable, there was a small amount of variation in the make up of the breakout groups due to participant availability each day. All assessed outputs from the groups were reported back to subsequent plenary sessions for synthesis. Outcomes for each component were recorded in the customised spreadsheet to determine final results.

5.3 Key climatic stressors

A list of 15 climate stressors typically considered in the CVI process was provided to participants (Table 5.1). Prior to the workshop as part of the registration process, participants were asked to "Select the climate stressor/s … [they thought were] … likely to influence each key value in the future". The purpose of this was to have participants begin thinking about the key values (Table 2.1) and how climate change may have an effect in the future; however, these selections were neither displayed nor discussed in the workshop.

During the workshop, the first step in determining which climate stressors were most likely to impact the key values was to determine the future timescale and climate scenario to be used. Regarding the timescale of the vulnerability assessments, participants were invited to consider options ranging from ca. 2030 to the end of this century (i.e., ca. 2100). Discussions included selecting a timescale that would incorporate projected changes of sufficient magnitude to inform appropriate response planning but also allowing enough time to implement and evaluate adaptation strategies. As a result, the workshop determined the timescale in which to consider impacts as ca. 2050. Within these discussions, participants had elected to consider future effects under a high-emissions climate scenario (RCP8.5, SSP5-8.5) as this was deemed most likely to reflect future conditions from the available options and to best inform management and community preparedness.

Breakout groups were then asked to identify which three of the climate stressors were most likely to affect each key value for that timescale and emissions scenario. After collating the selections, stressors appearing in the top three identified for each value (including equal-third) were used to rank the stressors (Table 5.1; Figure 5.2). Temperature trend was identified as among the top-three stressors most likely to impact five of the six key values and was identified by all four groups as among the top-three stressors to *Significant ecological and evolutionary processes* (and by three groups with respect to *Terrestrial biodiversity and habitats*). Drought was identified to affect four of the key values; and selected by all breakout groups for the key values *Terrestrial biodiversity and habitats* and *Importance for local people/communities* (and by three groups for *Significant ecological and evolutionary processes* and *Superb natural & scenic beauty*). Storm intensity and frequency was identified as the third key climate stressor and was among the top-three stressors for three key values. Of particular note is the broad range of climate stressors identified as among the top-three for one or two of the key values that illustrates the diversity of values and

attributes for iSimangaliso, as well as how climate change may affect these. This included expansion of the supplied list (of 15 stressors) to include consideration of Ocean acidification and Wildfire.

Table 5.1 Climate stressors identified as likely to have the greatest impact for each of six identified key values. Marked cells indicate that the climate stressor was in the top three responses (including equal-third) for each key value. Stressor impacts were assessed for ca. 2050 and a high-emissions climate scenario.

Key values of OUV	Temperature trend (air and/or water)	Extreme temperature events	Precipitation trend	Intense precipitation events	Flooding (fluvial, pluvial)	Drought (severity, duration, frequency)	Mean wind trend	Storm intensity and frequency	Sea/lake ice change	Snow cover change	Sea level rise (trend)	Coastal flood	Storm surge	Coastal erosion	Changing currents	Ocean acidification	Wildfire
	Climate stressors																
Terrestrial biodiversity and habitats	x	x	x	x		x		x									x
Coastal biodiversity and habitats					x			x					x	x			
Marine biodiversity and habitats	x	x													x	x	
Significant ecological and evolutionary processes	x					x									x		
Superb natural & scenic beauty	x					x							x	x			
Importance for local people/communities	x		x	x	x	x		x			x	x					
Total	5	2	2	2	2	4	0	3	0	0	1	1	2	2	2	1	1

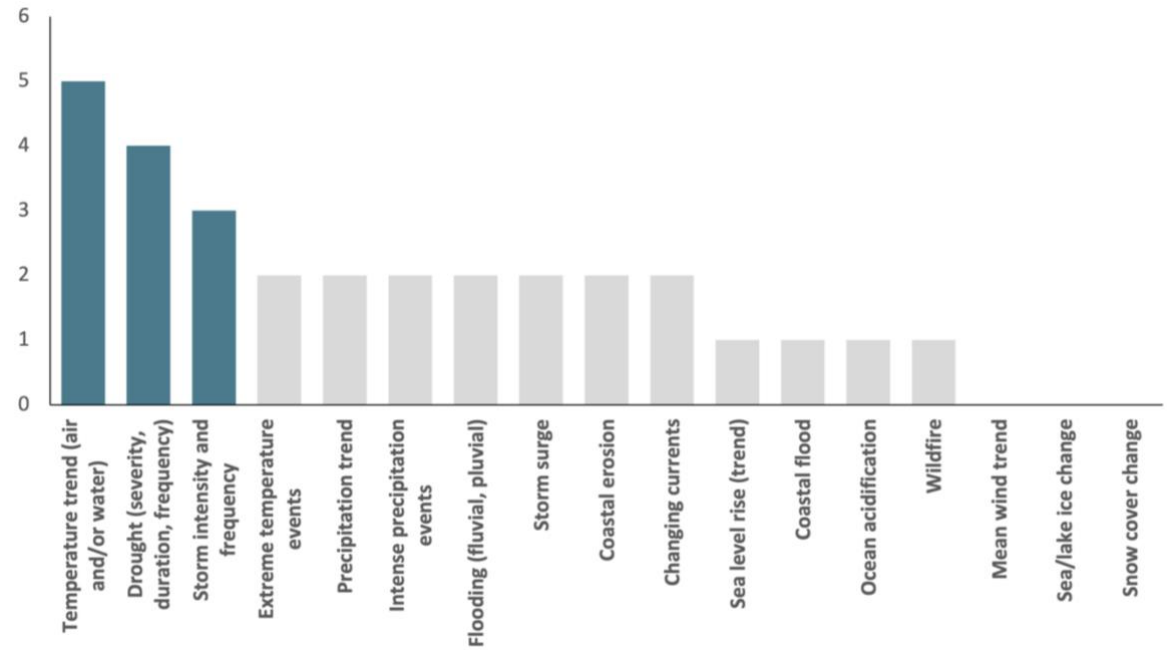


Figure 5.2 Histogram of the number of key values of OUV for iSimangaliso for which each 17 climate stressors were among the top three likely to cause impacts (ca. 2050, high-emissions scenario).

In summary, the three climate stressors identified for the CVI analysis were:

- Temperature trend (air and/or water) – TT;
- Drought (severity, duration, frequency) – D; and
- Storm intensity and frequency – SIF.

Notably, the impacts resulting from these three key climate stressors are likely to interact. Links between drought characteristics and increases in temperature are anticipated, while sequences of drought and storm may exacerbate impacts related to terrestrial erosion and run-off, which in turn can affect coastal and marine environments.

5.4 OUV Vulnerability

Assessments of **exposure** and **sensitivity** of the OUV system to each of the identified three key climate stressors were undertaken using a five-point categorical scale, adapted from categories used by IPCC and IUCN analyses (see Day et al. 2020 for details). Modifiers were applied to the initial assessments to include effects of temporal scale and trend (for exposure), and spatial scale and compounding factors (for sensitivity).

Results from exposure and sensitivity assessments undertaken in breakout groups, with the spectrum of responses synthesised in plenary. After including modifiers, the Exposure to conditions that would impact values in the future was assessed as very likely (>90%, highest category; Table 5.2) with respect to Drought and Storm intensity and frequency; and spanned the Likely and Very likely classifications for Temperature trend. Sensitivity of the values to Temperature trend was determined as high (second highest category), indicating potential for significant loss or alteration of many key values; sensitivity to Drought was assessed to span the High and Very high categories (indicating potential for greater decline in values), whilst for Storm intensity and frequency the assessed sensitivity was at the Moderate to High level (indicating some loss for some key values). Notably, the application of modifiers elevated the assessed

Table 5.2 Rapid assessment of OUV Vulnerability to the identified top-three key climate stressors. Assessed values of exposure, sensitivity and adaptive capacity contribute to derived outcomes for potential impact and OUV Vulnerability (traffic-light scale). Colours refer to the elements of the CVI framework (Figure 5.1).

Key Climate Stressors:	Temperature trend (air and/or water)	Drought (severity, duration, frequency)	Storm intensity and frequency
Exposure	Likely	Very likely	Very likely
Temporal scale	Frequent/On-going	Periodic	Frequent
Trend	Moderate increase	Slow increase	Moderate increase
Exposure	**Likely/V. likely** ○○○◑◐	**Very likely** ○○○○●	**Very likely** ○○○○●
Sensitivity	Moderate	High	Moderate
Spatial scale	Extensive	Localised	Localised
Compounding factors	High probability	High probability	Moderate probability
Sensitivity	**High** ○○○●○	**High/V. high** ○○○◑◐	**Moderate/High** ○○◑◐○
Potential impact	**Extreme** ○○○●	**Extreme** ○○○●	**Extreme** ○○○●
Local management response	Moderate	Moderate	Low/Moderate
Scientific/technical support	High	Moderate/High	Moderate
Effectiveness	Low/Moderate	Low/Moderate	Moderate
Adaptive capacity	**Moderate** ○○●○	**Moderate** ○○●○	**Moderate** ○○●○
OUV Vulnerability	**Moderate** ○●○	**Moderate** ○●○	**Moderate** ○●○
Combined OUV Vulnerability	**Moderate** ○●○		

Sensitivity with respect to each of the top-three climate stressors (Table 5.2).

A contributing factor to the sensitivity was the recognition by participants that the climate stressors would interact with each other, as well as with other stressors, to increase risk of impacts and lead to unforeseen consequences. Examples of these compounding factors raised by participants included (and subsequently supported by communications received from other stakeholders; e.g., R. Taylor *pers. comm.)*:

- an increase in disease related to warming, affecting birds, fish, plants and human populations;
- temperature-related changes in terrestrial vegetation and lake biodiversity, with associated effects on fauna (particularly megafauna);
- impacts on agricultural activity from warming and the water cycle (which incorporates both drought and rainfall regime shifts), with implications for groundwater extraction; and
- increasingly extreme and variable drought and storm events, with associated effects from either or both stressors on built infrastructure and tourism visitation.

A high probability of compounding factors (highest category, 4-point scale) was assessed for Temperature trend and Drought, while for Storm intensity and frequency this was at the second highest level (moderate). One important acknowledgement is that these stressors are likely to operate both inside and outside the property boundary. If the resources of neighbouring communities are impacted, this may lead to increased pressures on the Park's resources.

The **potential impact**, derived from exposure and sensitivity, was determined as extreme (highest on a four-point scale, low to extreme) for each of the top-three climate stressors (Table 5.2).

The **adaptive capacity** of a system to respond to stress can reduce the potential impacts and can result from a combination of inherent characteristics (i.e., intrinsic) and management interventions (i.e., extrinsic). Workshop participants first brainstormed adaptive capacity options linked to one or more key values and identified to which of the top-three climate stressors each strategy would respond (Table 5.3). Related strategies were loosely grouped, with a subset selected as the focus for the assessment of adaptive capacity (shown in bold). These represented strategies considered of highest feasibility or likelihood to occur; those adaptation strategies deemed amongst the least feasible or likely are listed towards the bottom (Table 5.3). Assessments of extrinsic adaptive capacity focused on the strategies shown in bold.

Adaptive capacity of the key values was assessed with respect to each key climate stressor, with the extrinsic component incorporated through levels of local management response and scientific/technical support (four-point scale), as well as the effectiveness of these to address impacts from each stressor (four-point scale).

Adaptive capacity was assessed to be moderate (second highest on a four-point scale, very low to high) for all three key climate stressors. The generally moderate levels of local management resourcing and budget capacity and moderate-to-high knowledge base assessments (see Table 5.2) were contrasted by a low-to-moderate assessment of effectiveness of adaptive capacity to respond to the threats. Workshop participants queried and discussed whether the assessed Moderate overall level of adaptive capacity may be overly optimistic given the breadth of threats across the diverse values and attributes, while noting that the Potential impact was assessed in the highest category for each key climate stressor.

Based on the workshop assessments, the OUV Vulnerability (three-point scale, low to high) was determined to be **Moderate** with respect to each of the three key climate stressors (Temperature trend, Drought, Storm intensity and frequency) and, therefore, for the combined **OUV Vulnerability** for iSimangaliso (Table 5.2). However, participants noted that this result heavily depended upon the mitigation of the extreme assessments of Potential impact through the assessed level of Adaptive capacity, which

Table 5.3 Strategies for adaptive capacity brainstormed during the workshop, grouped by commonality, noting for each the relevant key climate stressors (TT: Temperature trend; D: Drought; SIF: Storm intensity and frequency; X indicates direct association, ~ indicates indirect association) and key values (numbered in Table 2.1).

Adaptation strategy	Key climate stressors			Relevant key value/s					
	TT	D	SIF	1	2	3	4	5	6
Climate smart agricultural practices	X	X	~	■	■	■	■	■	■
More indigenous trees that produce fruit (incl. restoration, introduction of mangroves)									■
Better crop management	X	X	X						■
Sustainable food harvesting approaches and preservation methods	X	X	X	■	■	■			■
Increase Community Gardens to localise farming practices in one area, less dependence on wetlands	X	X		■	■	■			■
Education and Awareness †	X			■	■	■			■
Good communication networks for people across different disciplines - quickly!	X	X	X	■	■	■	■	■	■
Multi-stakeholder Emergency response plan with adaptive management approach		X	X	■	■				■
Monitoring, including via more citizen science (locals in the communities)			X	■	■	■	■	■	■
Early weather detection systems	X	X	X	■	■	■			■
Multi-party, co-designed decision-making management structure	X	X	X	■	■	■	■	■	■
Coral reef, swamp-forest, reed bed, mangrove and salt marsh protection and restoration	X	X	X	■	■	■	■	■	■
Management of key hydrological systems (including erosion and developing restoration approaches)	X	X	X	■	■	■	■	■	■
Riparian vegetation restoration			X	■	■		■		■
Reduce groundwater impact	X	X		■	■		■	■	■
Creating more watering tanks and boreholes – for community members and livestock – inside the Park	X	X							■
Small-scale fisheries sustainable management and additional livelihoods target	X	X							■
Local public transport system	X		X	■					■
Pedestrian suspension bridge Kosi Bay			X						■
Install bins to encourage local people to dispose of their litter/rubbish in a better manner	~			■	■	■	■		■
Using renewable energy sources like solar	X			■	■	■			■
Rehabilitate the uMfolozi Swamps			~		■		■	■	■
Clear reeds out of the banks			~		■		■	■	■
Stop sedimentation upstream		X		■	■		■	■	■
Assist turtle population (translocation of turtle nests)	X		X			■		■	■
Turtle nest protection / shading / temp monitoring	X					■			
Climate adapted tourism	~		~	■	■	■			

† *e.g., teaching people: how to respond to the change in temperature (working in the cooler parts of the day); about control harvesting; and providing capacity to engage with management about climate change, including how to reduce shocks (e.g., from heat), resource utilisation and work optimisation.*

if insufficient could lead to OUV Vulnerability in the highest category. This emphasised the importance of a sustained implementation of adaptive strategies and of monitoring to understand beneficial effects.

5.5 Community Vulnerability

The assessment of Community Vulnerability considers the economic, social and cultural (ESC) aspects of the community associated with the property using two evaluations. **Dependency** reflects the extent to which a decline in key values will affect ESC indicators in the future. These effects can be positive or negative. Separate assessments for economic, social and cultural dependency are combined to give an overall ESC dependency. **Adaptive capacity** reflects the current level of capacity within each component to adapt in the face of a decline in key values due to key climate stressors and only has a positive directionality. As for dependency, separate assessments for economic, social and cultural adaptive capacity are combined to give an overall ESC adaptive capacity. Evaluations were undertaken in small breakout groups, which again resulted in a spectrum of responses for each that was resolved in plenary.

A specific scenario was provided to participants to guide assessment of likely effects upon the economic, social and cultural aspects of a potential decline in WH values from climate change impacts. The selected scenario elements, based on climate projections for ca. 2050 (Section 4.2), were:

i. an air temperature increase by 1.3°C above 2023 conditions (based on projections for KwaZulu Natal from the Climate Change Knowledge Portal[10]);
ii. drought anticipated to "become more frequent … more intense and prolonged" (Beraki 2019); and
iii. "Intense thunderstorms are plausible to occur more frequently over South Africa" (Engelbrecht 2019).

The economic component considers the effects on economic activities/business types that are directly associated with the WH property. In preparation for the workshop, the steering committee developed a list of seven broad areas of economic activity ("business types"):

- Tourism activities (e.g., operators, accommodation, arts & crafts);
- Goods & services (e.g., shops, utilities);
- Community connections (e.g., hubs, clinics);
- Conservation industry (including Park management and NGO activities);
- Research;
- Large-scale industry (e.g., agriculture, forestry); and
- Small-scale/subsistence activities (e.g., fishers, farmers).

Prior to the relevant workshop session, these business types were shared with participants who were asked to rank them in order from least to greatest reliance upon the discussed key values; the primary purpose of this activity was to engage participants in thinking about these associations between the values and business types (Figure 5.3).

During the workshop, the economic dependency across the seven business types was assessed as low-negative (i.e., a negative impact at a low level), whilst the adaptive capacity was evaluated as moderate (Table 5.4). At the request of participants, the economic analyses were repeated to include a weighting of the business types based on the average participant ranking for each (Figure 5.3). Applying this did not change the categories (low-negative and moderate, respectively) but moved the dependency score to a more-negative value and resulted in a lower adaptive capacity score within the respective categories.

Social indicators used to inform the assessments were introduced prior to the relevant workshop session via an online poll in which participants were asked one

[10] *https://climateknowledgeportal.worldbank.org*

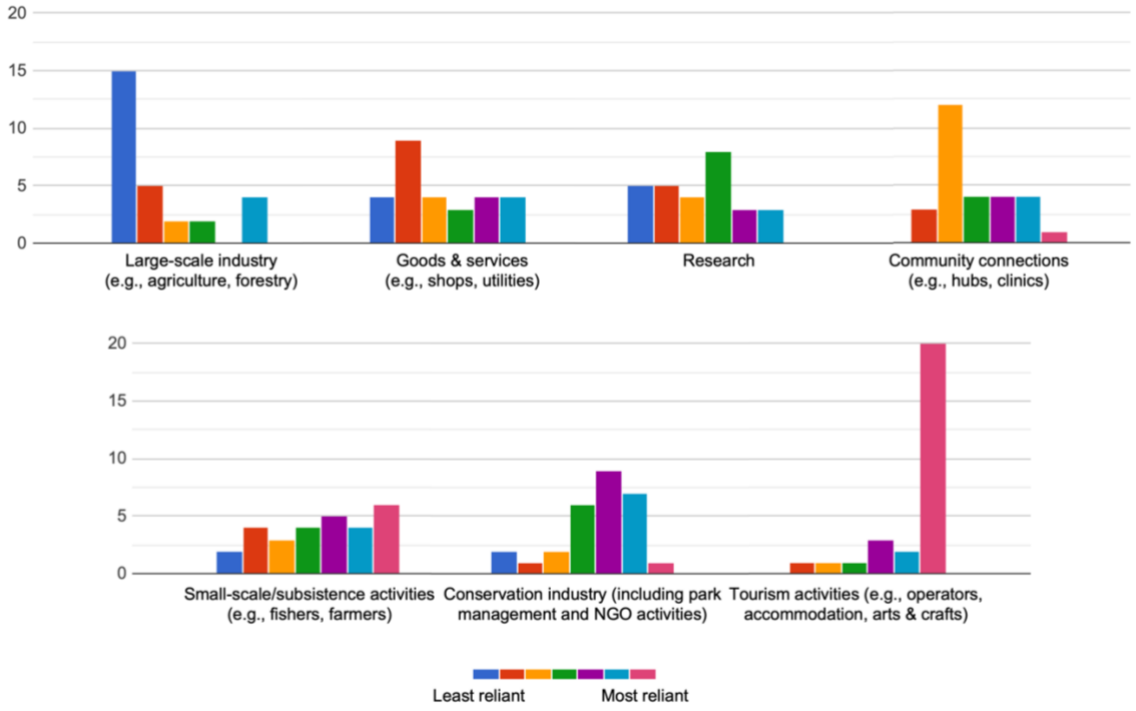


Figure 5.3 Histograms of participant rankings of the relative reliance of seven business types upon the key values of iSimangaliso, ordered from least to most reliant.

Table 5.4 Rapid assessment of Community Vulnerability to values decline due to identified three key climate stressors. Assessed values of economic, social and cultural (ESC) dependency (sensitivity, ranging from negative to positive) and adaptive capacity contribute to derived outcomes for ESC potential impact and Community Vulnerability.

Economic	*Low-negative*
Social	*Moderate-negative*
Cultural	*Moderate-negative*
ESC dependency	[-] ○ ● ○ ○ *Moderate-negative* ○ ○ ○ ○ [+]
ESC potential impact	**Moderate** ○ ● ○
Economic	*Moderate*
Social	*Moderate*
Cultural	*Moderate*
ESC adaptive capacity	**Moderate** ○ ● ○
Community Vulnerability	**Moderate** ○ ● ○

question from each of four categories relating to Human capital, Social capital, Natural capital and Built capital (after Costanza et al. 2007). Workshop participants considered three people groups for the assessment: locals – those living within the iSimangaliso Wetland Park, other South Africans, and internationals; it was determined that social connections should be considered across all groups. Social connections with the iSimangaliso values require a physical interaction, whether by residents (i.e., locals) or visitors (i.e., other South Africans and internationals). Social dependency varied across the three people groups and was assessed overall as moderate-negative; similarly, the existing capacity to adapt to future changes was variable with an overall evaluation of a moderate adaptive capacity (Table 5.4).

In contrast to the Social assessment, Cultural connections can have but do not require a physical interaction with the location and are more linked to identity (e.g., a person whose family history involves iSimangaliso may have a cultural connection without ever having visited). As for the Social indicators, the Cultural assessment was introduced through an online poll that contained one question from each of four categories of connection pertaining to Self, People, Environment and Pleasure (after Marshall et al. 2019). Assessments for the same three people groups described previously were undertaken and revealed the Cultural dependency was assessed as moderate-negative (i.e., a decline in the key values due to climate change would lead to a negative effect on cultural connections at a moderate level), whilst the Cultural adaptive capacity was determined to be moderate (Table 5.4).

Combining the three components, the overall ESC dependency was determined as moderate-negative that, when combined with the OUV Vulnerability (as the community exposure term), resulted in the ESC potential impact being assessed as Moderate (three-point scale, low to high; Table 5.4). The combined ESC adaptive capacity was assessed as Moderate (three-point scale, low to high). These outcomes determined the **Community Vulnerability** as **Moderate** (three-point scale, low to high; Table 5.4).

5.6 Summary

Temperature trend (air and/or water), Drought (severity, duration, frequency) and Storm intensity and frequency were identified as the three climate stressors likely to most impact the key values of iSimangaliso. Potential impact from each of these key stressors was scored as extreme, with adaptive capacity to mitigate impacts assessed as moderate for each key climate stressor. As a result, the **OUV Vulnerability** was determined to be in the middle category (**Moderate**). Impacts from the key climate stressors were judged as likely to lead to a negative future impact at a moderate level on the economic, social and cultural aspects of the community associated with iSimangaliso. As the adaptive capacity of the community to the climate stressors was determined to be at a moderate level, the overall **Community Vulnerability** was assessed to be in the middle category (**Moderate**).

The workshop results indicate the changes that might be expected over the next ~30 years (ca. 2050 scenario) have the potential for significant impacts on the key values of iSimangaliso unless mitigated through effective adaptation strategies. In the absence of those, the level of vulnerability of the property and the community, as described here, would be exacerbated.

During the CVI Workshop, presentation and discussions conducted in plenary were complemented by breakout group sessions and descriptions from expert participants during the field visit.

CONCLUSION

Squirrel fish (*Sargocentron* spp.) hide out in Lettuce Reef, Sodwana Bay
Bryan Hart

6.1 Outcomes from the CVI process

Impacts of climate change are already affecting the iSimangaliso region, including those related to each of the three key climate stressors identified in the workshop (i.e., long-term change in temperature, drought and storms). Other stressors, such as heatwaves and heavy rainfall are also having impacts upon natural heritage.

Furthermore, as well as singularly, climate stressors may act synergistically to exacerbate impacts on iSimangaliso. Beyond the apparent relationship between temperature trend and drought, sequences of drought and storms are likely to increase erosion, affecting not only terrestrial habitats but also causing downstream effects in the coastal and marine environments. Other key concerns are around changes in ocean currents affecting marine biodiversity, evaporation impacts to lakes and the effects of heatwaves in both terrestrial and aquatic habitats. Climate projections for iSimangaliso suggest that future impacts may become apparent at different times.

The CVI process indicated that the potential impact from each of the three key climate stressors is extreme, though with the realisation of effective adaptation strategies the OUV Vulnerability was assessed to be at the Moderate level. In addition to the various adaptation strategies proposed for development, trial and potential implementation (Table 5.3), various opportunities for further investigation, whether scientific research or policy framing, were identified through the workshop (Section 6.2). The Community Vulnerability to a climate change-driven decline in World Heritage values was also assessed to be Moderate, balancing the anticipated low-to-moderate negative effects on the broader community with their moderate capacity to adapt to the changes.

6.2 Gaps Identified

The results from the CVI workshop are important for adaptive management, especially as climate change is recognised as one of the biggest threats to the natural values of iSimangaliso. In addition to the recommended adaptive strategies in Table 5.3, the CVI workshop also identified the following gaps for possible further investigation:

Knowledge gaps

- Decline in vegetation outside Park (data are unclear as to whether there is a decline within the Park);
- A broad need for improved monitoring efforts:
  - Weather stations, including information sharing of weather data, especially from community weather stations to give insight at the local scale;
  - Groundwater boreholes (including those outside the protected area that affect groundwater levels inside);
  - A more comprehensive long-term marine monitoring programme across the entire MPA, including for submarine canyons;
- Limited understanding of submarine canyons and processes;
- Clarify key “issues” for communities; and
- Finer-scale climate projections required – from KwaZulu-Natal provincial scale to a scale directly relevant to the areas within the iSimangaliso region.

Research opportunities

- Water dynamics in Lake Sibaya and Lake St Lucia and associated ecological links;
- Attribution analysis of disturbance events and other environmental impacts to factors such as climate change and land use change, and the interactions between these; and
- Impacts of plastics in the marine environment (especially microplastics).

Policy needs

- Policy support for more comprehensive long-term marine monitoring programme across the entire MPA; and
- ‘Co’-management governance policy to be addressed through further information exchange.

Management requirements

- Better integration of real-time meteorological data;
- Climate literacy workshops for:
  - community leaders and other members, including potential climate risks grounded in their lived experience, adaptation measures communities can take themselves and possible response actions and their benefits for communities;
  - all conservation scientists and managers; and
- Communication of the outcomes of this report to communities.

Research priorities must be closely linked to the priority management requirements and community needs. Understanding the key areas of climate vulnerability provides the starting point for conservation decisions that respond to the threats of climate change. The research opportunities identified through the CVI process are a starting point and will require appropriate resourcing, such as through the on-going Blue Action Fund project; this is also true of the need for management activities that are informed by research outcomes.

6.3 Management implications – national and local

In 2017, the growing evidence of climate change impacts across World Heritage properties was observed by the World Heritage Committee (WHC/17/41.COM/7). Subsequently, it was established that, in order to reduce global warming and adapt to the effects of climate change, immediate and decisive action was essential.

In the context of Kwazulu-Natal province, extreme rainfall-related urban floods and drought are expected to worsen, posing a threat to the functioning of iSimangaliso Wetland Park. Drought is particularly expected to affect the northern part of the province. These climate perturbations could significantly impact the OUV of iSimangaliso World Heritage property, including its integrity, and impact upon economic and social development.

For communities associated with the Park, climate change could lead to reduced quality-of-life due to degradation of local economic activities, reduction in the availability of subsistence natural resources and degradation of costal infrastructure.

To reduce risks, enhance resilience and ensure the long-term sustainability and well-being of coastal communities, multiple physical, ecological, economic, social, educational and governance aspects need to be considered when developing coastal adaptation strategies for climate change, whilst still addressing the immediate and short-term livelihood needs of local communities. With coastal adaptation strategies and management options that are robust and adaptable to different scenarios, iSimangaliso Wetland Park could aid in the preservation of the rich biodiversity in its ecosystems and maintain its economic integrity. Protecting important habitats (such as grasslands, forests, saltmarshes, mangroves and others with similarly high capacity to reduce carbon dioxide release into the atmosphere) should be prioritised to reduce the effects of climate change.

Already, the Park is attempting the implementation of several measures including restoration of natural systems to improve resilience against climate change impacts – e.g., restoration of the Lake St Lucia estuarine system; and the interconnection of wetlands and dune rehabilitation at Sodwana and St Lucia. Through the current Integrated Management Plan (IMP) and subsidiary management plans for estuaries and the marine protected area, the Park Authority has committed itself to the implementation of measures to manage the effects of climate change in relation to the country's climate change response and adaptation strategies.

The iSimangaliso CVI was undertaken at the time when the first Climate Change Adaptation Response Plan (CARP) for South Africa's Coastal Sector[11] was initiated, setting the scene for climate change goals in the country's coastal zone. A number of adaptation

[11] *https://www.dffe.gov.za/sites/default/files/docs/strategy.framework/oceans/climatechangeresponseplan_oceanssector.pdf*

measures suggested in the CARP underpin and provide options for the implementation of iSimangaliso CVI outcomes (DFFE 2025).

6.4 Lessons for other properties

The findings of the CVI assessment for iSimangaliso may be pertinent for other WH properties with similar key values. This may include those properties with limnological, riverine and/or wetland features previously identified in a thematic analysis of natural WH properties in the UNESCO Africa region (Venkatachalam et al. 2022), particularly any that are likely to be exposed to comparable climate stressors. Whilst addressing the specific requirements for each property would be ideal, property management could be informed by the actions undertaken in iSimangaliso, including through the establishment of systematic monitoring programmes. Of particular relevance at this time is the recent extension of the World Heritage property to include the Maputo National Park in Mozambique; the findings from this analysis may be directly applicable across the updated transboundary property.

The CVI workshop for iSimangaliso provided the first opportunity for an exchange of knowledge and experience between community leaders, property managers and other stakeholders. To have these participants together in a single room was recognised as a significant milestone for the effective management of the property in conjunction with the communities. It is hoped that the workshop outcomes will be implemented through a more collaborative approach across all stakeholder groups. These learnings from the iSimangaliso workshop should be applied in other locations.

6.5 Revisiting the CVI process for iSimangaliso

Through the CVI process, iSimangaliso now has a baseline and a systematic basis for reporting to UNESCO on the status of climate vulnerability (e.g., via periodic reporting). It is recommended that the CVI process be repeated on a periodic basis to systematically assess system changes to iSimangaliso as well as the effectiveness of management responses. This would also provide bespoke information for the Mozambican component of the extended property. Furthermore, new research and knowledge will inform managers and aid future workshop participants in their discussions. This can also contribute to the role that WH properties can play in understanding climate mitigation and adaptation efforts and contribute to the mobilisation of global efforts on climate action.

Future applications could involve one of the shorter delivery modes of the CVI (i.e., Snapshot or Consult) rather than repeating the full Workshop mode, and with local facilitation. To ensure that trends and results are comparable, it is proposed that future CVI workshops apply the same methodology, beginning with a systematic review of the 2023 workshop inputs. Additional involvement of local community members (e.g., through consultative surveys prior to the workshop) may enable more local perspectives and knowledge to be better considered in the workshop or provide different perspectives on relevant issues.

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Giant palm forest (*Raphia australis*), Kosi Bay
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APPENDICES

Bluebanded snapper (*Lutjanus kasmira*), Sodwana Bay
Welly Qwabe

Appendix 1: Statement of Outstanding Universal Value for iSimangaliso Wetland Park World Heritage Property
Inscribed by the UNESCO World Heritage Committee in 1999: *https://whc.unesco.org/en/list/914* (noting that this is the original statement, prior to the property extension in 2025 to include Maputo National Park, Mozambique)

Brief synthesis
The iSimangaliso Wetland Park is one of the outstanding natural wetland and coastal sites of Africa. Covering an area of 239,566 ha, it includes a wide range of pristine marine, coastal, wetland, estuarine, and terrestrial environments which are scenically beautiful and basically unmodified by people. These include coral reefs, long sandy beaches, coastal dunes, lake systems, swamps, and extensive reed and papyrus wetlands, providing critical habitat for a wide range of species from Africa's seas, wetlands and savannahs. The interaction of these environments with major floods and coastal storms in the Park's transitional location has resulted in continuing speciation and exceptional species diversity. Its vivid natural spectacles include nesting turtles and large aggregations of flamingos and other waterfowl.

Criterion (vii): iSimangaliso is geographically diverse with superlative scenic vistas along its 220 km coast. From the clear waters of the Indian Ocean, wide undeveloped sandy beaches, a forested dune cordon and a mosaic of wetlands, grasslands, forests, lakes and savannah, the park contains exceptional aesthetic qualities. Three natural phenomena are judged outstanding. One is the shifting salinity states within Lake St. Lucia which are linked to wet and dry climatic cycles, with the lake responding accordingly with shifts from low to hyper-saline states. A second is the spectacle of large numbers of nesting turtles on the beaches and the abundance of dolphins and migration of whales and whale sharks off-shore. Finally, the huge numbers of waterfowl and large breeding colonies of pelicans, storks, herons and terns are impressive and add life to the wild natural landscape of the area.

Criterion (ix): The combination of fluvial, marine and aeolian processes initiated in the early Pleistocene in iSimangaliso has resulted in a variety of landforms and continues to the present day. The Park's transitional geographic location between sub-tropical and tropical Africa as well as the coastal setting have resulted in exceptional species diversity. Past speciation events in the Maputaland Centre of Endemism are also ongoing and contribute another element to the diversity and interplay of evolutionary processes at work in iSimangaliso. In the marine component of the site, the sediments being transported by the Agulhas current are trapped by submarine canyons on the continental shelf allowing for remarkably clear waters for the development of coral reefs. The interplay of this environmental heterogeneity is further complicated by major floods and coastal storms, events which are regularly experienced in iSimangaliso. The site is also of sufficient size and retains most of the key elements that are essential for long-term functioning of the ecosystems.

Criterion (x): The five interlinked ecosystems found in iSimangaliso provide habitat for a significant diversity of African biota, including a large number of threatened and/or endemic species. The species lists for iSimangaliso are the lengthiest in the region and population sizes for most of them are viable. Of the over 6,500 plant and animal (including 521 bird) species recorded from the Park[1], populations of species of conservation importance include 11 species endemic to the park, 108 species endemic to South Africa, while 467 species are listed as threatened in South Africa. The outstanding diversity of habitats (terrestrial, wetland, coastal and aquatic) supports a wide variety of animal species, some at the northern and many at the southern limit of their range.

Integrity
The property consists of 13 separate but contiguous conservation units totalling 239,566 hectares including some 85,000 hectares of marine reserves. Its history of conservation management dates back to 1895 when the first reserves were created by the Zululand Government, and later proposals for titanium sand mining were rejected. Ongoing integrity issues include the protection of catchment area and regional development (upstream water abstraction, agricultural practices and road construction); land claims (which may result in further boundary issues); resource harvesting and local community issues; and restoration of degraded habitats. A unified management system for all 13 components was also requested.

The park is not inhabited by people apart from six small townships in the Kosi Bay Coastal Forest

Reserve. There are also two villages (Makakatana and St Lucia Estuary) which are enclaves within the Park but not part of it. About 100,000 people from 48 tribal groups live in villages surrounding the Park and community conservation programmes are key to minimising conflicts and maximising benefits. A progressive neighbour-relations policy fosters good relations with communities who live near the Park to ensure that they derive direct benefits from the protected area such as free access, business and employment.

Protection and management requirements

Management of the Park at the provincial level is by the KwaZulu-Natal Nature Conservation Service working with the provincial administration in accordance with national and provincial legislation. South Africa has solid legislation that affords iSimangaliso the necessary legal protection, such as the World Heritage Convention Act, 1999. iSimangaliso contains four Ramsar sites [St. Lucia Lake System (Ramsar Site # 345) (ii) Turtle Beaches/Coral Reefs of Tongaland (Ramsar Site # 344) (iii) Kosi Bay Lake System (Ramsar Site #527), and (iv) Lake Sibaya (Ramsar Site # 528)] that recognise the ecological functions of wetlands as well as their importance as resources of economic, cultural, scientific and recreational value. All human uses of iSimangaliso are subject to intensive management, research and monitoring. They are also confined to about a third of the total area while the remainder is free from extractive uses. Some funds to assist in community conservation have come from WWF, but the main funding to ensure that iSimangaliso management is adequately supported comes from the Province.

A major threat to the Park is damage to the hydrology and salinity of the wetland system including reduction in the water supply by the transformation of the upper uMfolozi Swamps by agriculture. Serious droughts have raised salinity and killed off shoreline vegetation, causing bank erosion and silting of the lake. The uMfolozi River has also threatened to break into the lake, again raising the likelihood of sedimentation and invasion by sand and sea-water following breaching of the sand bar. Catastrophic events such as the grounding of an oil tanker near the park in 2002 also threaten the site. Other threats include damage by over-use (tourism and over-exploitation of resources such as unsustainable fishing).

The park has high visitation rates and has been zoned into three ecotourism use-zones: a zone of low intensity use in the wilderness core of the Park where access is by foot except for staff; a moderate use zone where visitors can view wildlife from vehicles and from scattered camps and hides; and high intensity use zones where, at seven development nodes, there are roads, interpretative and educational displays, guided walks, accommodation and other facilities.

Infestation by alien invasive plants is a problem, although limited in area at present. The worst invaders are Chromolaena odorata, Psidium guajava, Pereckia acuelata and Melia azedarach. Programmes by the Plant Protection Research Institute have used biological control, especially to remove plant infestations from important water-producing catchment areas. In addition pine and eucalyptus plantations around the lake have been removed to improve water seepage.

In the past several land claims by impoverished communities have been lodged before the Land Claims Court. These areas include the Eastern Shores State Forest, Cape Vidal State Forest and Sodwana State Forest. One solution has been reached with the Mbuyazi whose rights near Cape Vidal have been recognised, not to settle, but to develop ancestral lands for tourism. More recently, there has been conflict over other large hotel developments launched in environmentally sensitive areas without contact with local stakeholders, environmental impact assessments or adequate infrastructure. However by 2004 it was stated that the land claimants and local communities were accepted as partners in the development of the Park.

Appendix 2: List of other Significant Property Values (SPVs) for iSimangaliso

Whilst the CVI process typically focuses on the values embodied within the Statement of Outstanding Universal Value, it is also recognised that there are other Significant Property Values (SPVs) beyond that included as World Heritage (WH). These *other SPVs* may be locally, regionally, nationally or internationally significant and they may be recognised under legislation (e.g., National or State Heritage Lists/Registers, local or regional by-laws). Other SPVs may include economic, social, spiritual, environmental, scientific and other heritage values. They may be tangible, intangible or described as having both of these aspects. Furthermore, they may be as important as the WH values for management and may require specific management actions to ensure their protection and/or conservation (where appropriate), including with respect to impacts from climate change and other stressors. The below list represents an initial draft of other SPVs for iSimangaliso, which is intentionally distinct from the WH values and can be periodically updated with contributions where appropriate.

Broad grouping	Other SPVs	Additional justification
Biological diversity	*Lower uMfolozi floodplain/swamps. Part of the St Lucia Ramsar Site*	*This is one of the largest freshwater wetlands in the country and its wellbeing is critical for the functioning of the St Lucia-uMfolozi Mouth. It is likely to become more flood-prone with sea-level rise and increased severity of river floods. As such the risk to life and livelihoods of human activities in the area increases. It is important to have a strategic retreat as sea-level rises. This area has very important intrinsic biodiversity value as a freshwater wetland.*
	Mkhuze floodplain/swamp	*Important wetland that traps sediment. Likely to be progressively flooded in response to sea-level rise*
	*False Bay Park and Mkhuze GR endorheic ephemeral pans. These form a unique wetland habitat for the Park – in which there are at least three species of animals that are found nowhere else in the iSWP, at least 2 crustaceans (*Triops *and* Artemia*) and a fish (*Notobranchius*) that can withstand periods of total desiccation.*	*Threatened by altered hydrology caused by woody-plant thickening of the sites they occur in.*
	Mzinene Delta – bird hotspot	*Consistently has the greatest numbers and variety of birds of any locality in the iSWP*
	Mkhuze Mouth – IUCN declared Crocodile Sanctuary	*Declared in about 1972*
	Freshwater swamp-forests (Sihadla, Mgobezeleni, Ozabeni, Eastern Shores) Possibly has more conservation significance than the coral reefs of the MPA	*These areas contain a very high proportion of this rarest forest type in South Africa. I would guess >80% of this habitat in South Africa occurs in the Park. In places it is affected by people from outside the Park clearing for agriculture.*
	Groundwater seepage lines at the toe of the Bomveni mound (Eastern Shores) that has tropical Sphagnum and is rich in carnivorous plants	*I am unaware of any similar feature in South Africa.*
	Bhangazi-Mfabeni link – which can flow in either direction – exhibiting a 'flipping' of groundwater flow directions	*The scene of opportunistic catfish (Clarias) spawning migrations*

Broad grouping	Other SPVs	Additional justification
Biological diversity (cont.)	*Bats Caves*	*Used by Rousettus bats – which have been shown to migrate from near Tzaneen to Tsitsikamma – and at times are in large numbers in these caves. Also used by insectivorous bats that breed here*
	Endemic freshwater sponge from Bhangazi-north.	*This species has its type-locality in Bhangazi-north and it has not been found anywhere else. It poses some interesting zoo-geographic questions as the Bhangazi-north system is not linked to other wetland systems*
	A rare Vanilla orchid occurs in the forest adjacent to Lake Sibaya.	*This is possibly the only occurrence of this species in South Africa*
	The Raphia australis forest at Kosi	*The only such natural instance in South Africa*
	'Champion trees. Newtonia trees in the False Bay sand forest, and Ficus trichopoda in the Mgobezeleni floodplain	*The orchid festooned Newtonia trees are extremely old (They are photographed and measured every few years to record growth and mortality)* *The F. trichopoda have canopy diameters exceeding 100 m (almost double that of the Wonderboom in Pretoria.*
	Protea caffra patches on the Eastern Shores – 3 patches (St Lucia Game Park, Mamba point and Embomveni)	*The coastal protea habitat closes to the tropics*
	Red dunes at Embomveni with fulgurite (natural tubes formed when lightning hits the ground - fossilized lightning)	*The presence of fulgurites in this area can be used to estimate the frequency of lightning over a period of time, which can help to understand the formation of the area*
	Grass dunes at Mount Tabor & Ochre Hill (Eastern Shores)	*Iron smelting works occurred here – the present-day grassy dunes were cleared of their forests by iron workers and maintained now by fire*
	Regional conservation value	*It is becoming increasingly apparent that the Park is one of the last remaining bastions for conservation for many marine/ coastal species in the Western Indian Ocean – WIO (also likely for certain terrestrial species). This is because of the increasing human pressures on marine/coastal habitats in the WIO, and the limited and ineffectual MPAs off mainland East Africa. Many species which have a WIO distribution extending to the east coast of South Africa are being extirpated further north – so iSimangaliso represents for many the last stronghold. Unfortunately, even iSimangaliso is not immune from poaching, the incidences of which are increasing, even in sanctuary areas*
	MPA connectivity	*Other KZN MPAs (e.g. uThukela, Aliwal) benefit from recruits (eggs and larvae) and juvenile/adult migrants of marine and coastal species emanating from iSimangaliso. Known examples are various species of prawns, fishes, and corals. Some of these species do not spawn in MPAs to the south, or their southern spawning potential has been comprised, therefore iSimangaliso represents a vital source of recruits to sustain other MPAs, as well as a stepping stone for species which undertake long-distance migrations*

Broad grouping	Other SPVs	Additional justification
Economic values	*The estuaries, as fish nurseries, have economic value that exceeds the value of all the tourism to the Park*	
	Fisheries recruitment	*The Maputaland reefs are an extremely important source of recruits (eggs and larvae) to fisheries species important to areas outside of the Park; some species are the mainstay of the KZN commercial and recreational hook and line fishery to the south of the Park and in the rest of the province; the commercial fishery directly supports considerable numbers of jobs, the recreational fishery indirectly supports numerous economic opportunities for associated enterprises*
Historic/ cultural values	*Bread oven – Mission Rocks*	*Used by the Missionaries*
	Mount Tabor station – Mission Rocks	*Use as a radar station during World War II*
	Mission Rocks path – to Mission Rocks beach	*Created by the RAF (Royal Airforce) to transport rocks blasted on the Mission Rock ledges to build the Catalina jetty – taken over by SANDF (South African National Defence Force). Rocks also used for road building, jetties, and buildings*
Historic/ cultural values (cont.)	*Old Jetty (Catalina Jetty) -remnants' still can be viewed*	*Used by the RAF during the World War II by Catalina squadron – taken over by SANDF*
	Catalina wreckage (from WW II)	*Some remnants can be viewed at Brodies Shallows when the lake levels drop during drought*
	Cattle dips – Lake Bhangazi South & below Mission Rocks	*Used by the original farmers in the area*
	Memorial Church at Mission Rocks	*Wooden Church – foundation used for current abattoir*
	Bread oven – Mission Rocks	*Used by the Missionaries*
Spiritual/ philosophical fulfilment	*Outdoor Church at Hell's Gate (Western Shores)*	*Used by staff of the SANDF up till mid1990's – remnants can still be viewed*
Other/ special places	*Transboundary opportunity*	*The Ponta do Ouro Partial Marine Reserve (POPMR) in southern Mozambique is adjacent to iSimangaliso. Its offshore extent is only 3 nautical miles. Having iSimangaliso as a World Heritage Site neighbour offers an opportunity to expand the POPMR, increasing the value of the wider transboundary conservation area, as well as offering scope for improved management of the marine/coastal biodiversity. There are terrestrial benefits too, also considering the wider Lubombo Transfrontier Conservation and Resource Area*

Broad grouping	Other SPVs	Additional justification
Sites indicative of important physical processes (often important ecological drivers)	*Maphelane Dune (>180 m)*	*Indicative of dune-building processes. Has a rich dune-forest habitat and associated species*
	Cretaceous fossils along W. Shores and False Bay	*~90 m year old fossils including very spectacular ammonites. Main importance is that the strata are at an incline and so it has been possible to record the sequence of deposition and the relationship of different species to each other and to the assemblages they are part of an important geological feature with global relevance in determination of Cretaceous chronology*
	Bird-breeding Islands in Lake St Lucia	*Important for attracting birds to the system.* *Will be lost as sea-level rises*
	Fossil coral reefs of False Bay (Listers Point, Rocky Point and Picnic Point)	*In-situ corals fossilised at an elevation above that of present-day sea-level. Indicative of clear-water conditions where there would have been direct contact with the sea, and at a time of higher sea-levels*
	Mzinene Delta – fossil Cretaceous wood and of terrestrial dinosaur remnants	*Record of ancient wood deposited during flood conditions*
	Selley's Lakes – Primary production by benthic algae	*These large flats of shallow, warm, clear water have very high primary production – driven by the 'wind-pumping' action that circulates water and nutrients. Conceptually very important for the overall productivity of St Lucia Has similarities to the stromatolites found in high-evaporation environments*
	Sengwana palaeo shoreline/ dune feature – used for palaeo-climate studies	*Part of the past-climate archive of the Park*
	Mfabeni Swamp – provides a >40 000-year climate record (pollen deposits in peat)	*Part of the Park's palaeo-climate archive*
	Bomveni dune-fields and fulgurites. Also, pottery	
	Deep peat deposits associated with groundwater seepage (Kosi, Sibaya, Mgobezeleni and E Shores	*>4 m deep. Tells part of the story of the geological evolution of this region*
	The Lake Mgobezeleni-Lake Shazibe system and associated floodplain has groundwater-based hydrology which has promoted the formation of deep peat deposits in a sand basin.	*It has an array of different habitats in close proximity to each other. It is the habitat for Pels fishing owls*
	Nsumu Pan, and the pans linked with the Mkhuze floodplain are hot spots for waterbirds and waterplants. A feature is the riparian Ficus sycamores forest	*These pans are associated with the flooding of the Mkhuze River.*

Appendix 3: CVI workshop schedule, 20th–24th November 2023

Day 1 – Monday 20 November 2023 *(start 12:45)*

1 Welcome to the workshop; Introduction to the broader Blue Action Fund project and context setting.
2 Overview of workshop aims; use of plenary and breakout-group sessions; basic logistics; parking lot; Steering Group introduction.
3 Introductions of participants.

AIM 1: Understand the Climate Vulnerability Index (CVI) framework and its application to iSimangaliso.

4 Brief overview of the CVI process.

AIM 2: Understand the significant values that comprise the OUV for ISimangaliso; and assess condition and trend. Discuss other Significant Property Values (SPVs).

5 Ensure all participants are aware of the Statement of OUV for ISimangaliso Wetland Park and how the table of key values and attributes were derived from the Statement of OUV.
6 Undertake high-level assessment of current condition of key values and the recent trend in those values (i.e., since the date of inscription, 1999).
7 Discuss other values that are significant at a local/regional scale (i.e., other SPVs) but are not part of OUV.

Wrap up discussion, review Day 1; preview Day 2

Day 2 - Tuesday 21 November 2023

AIM 3: Background info on iSimangaliso and climate. Understand future climate change scenarios.

8 Introduction to climate change globally, regionally and locally.
9 Provide overview of climate change projections for iSimangaliso. Agree upon the climate scenario and time scale for the assessment (e.g., *High emissions scenario for 2050*).

AIM 4: Assess the climate stressors impacting the values of iSimangaliso and select key climate stressors.

10 Show list of climate stressors – check for (i) understanding; and (ii) timescales. Demonstrate selection of top three climate stressors impacting each key value.
11 Using the list of climate stressors provided, small groups brainstorm what are the top three climate stressors impacting the key values of OUV.
12 Bring outputs from #11 back to plenary and ensure all participants agree on which climate stressors are impacting the attributes of OUV.

Field trip (11:30–16:00).

Day 3 - Wednesday 22 November 2023

AIM 5: Evaluate vulnerability of OUV to key climate stressors, considering exposure, sensitivity and adaptive capacity for a selected climate scenario.

13 Introduce process for exposure, including detail of categories, and review modifiers.
14 Participants in breakout groups assess the exposure term and modifiers for each of the three key climate stressors.
15 Bring outputs from #14 back to plenary and discuss any variation in assessments of exposure.
16 Introduce process for sensitivity, including categories and modifiers, and review potential impact matrix that combines sensitivity with exposure. Remind all of climate scenario for analysis.
17 Participants in breakout groups assess the sensitivity and modifiers for the key climate stressors.
18 Bring outputs from #17 back to plenary and discuss any variation in assessments of sensitivity. Review the potential impact matrix that combines sensitivity with exposure.
19 Introduction to adaptive capacity (intrinsic and extrinsic) and brainstorming task to identify existing strategies used to mitigate climate-related impacts and potential adaptive capacities.
20 Participants in breakout groups brainstorm existing adaptation strategies used to mitigate climate-related impacts and potential adaptive capacities, identifying which key climate stressors and key values these respond to.
21 Bring outputs from #20 back to introduce adaptive capacity assessment. Prioritise

extrinsic adaptation strategies in terms of feasibility. Introduce adaptive capacity assessment.

22 Participants in breakout groups assess the adaptive capacity for the key climate change stressors.

23 Bring outputs from #22 back to plenary and discuss any variation in assessments of adaptive capacity (thus determining the OUV Vulnerability).

Wrap up discussion, review Day 3; preview Day 4

Day 4 - Thursday 29 August 2024

24 Plenary discussion of assessments of exposure, sensitivity and adaptive capacity and resulting OUV Vulnerability.

AIM 6: Consider economic, social and cultural dependencies (sensitivity) and adaptive capacity, to determine Community Vulnerability.

25 Revisit process for analysing economic, social and cultural (ESC) dependency. Review the ESC potential impact matrix that combines these. Revisit process for analysing economic, social and cultural adaptative capacity.

26 ESC overview for iSimangaliso.

27 Discussion of business types for analysis and introduction to economic breakout groups.

28 Participants in breakout groups assess the economic dependency and adaptive capacity for iSimangaliso.

29 Bring outputs from #28 back to plenary and discuss any variation in assessments of economic dependent and adaptive capacity.

30 Introduction to social dependency breakout groups.

31 Participants in breakout groups assess the social dependency and adaptive capacity for iSimangaliso.

32 Bring outputs from #31 back to plenary and discuss any variations of social dependencies and corresponding adaptive capacities.

33 Introduction to cultural dependency breakout groups.

34 Participants in breakout groups assess the cultural dependency and adaptive capacity for iSimangaliso.

Wrap up discussion, review Day 4; preview Day 5

Day 5 - Friday 30 August 2024 *(end 12:15)*

35 Bring outputs from #34 back to plenary and discuss any variation in assessments of cultural dependencies and corresponding adaptive capacities (thus determining Community Vulnerability).

AIM 7: Summary, feedback and next steps.

36 Summarise outcomes from workshop and present final analysis.

37 Discussion of items ‘parked’ during the workshop.

38 Discussion of next steps.

39 Receive feedback from participants on CVI framework and workshop process.

40 Complete workshop evaluation forms; receive other feedback from participants.

41 Thanks and close.

Appendix 4: List of workshop participants

*Workshop Steering Committee members indicated by *.*

Name	Role	Organisation
Anesu Machite	PhD student	Nelson Mandela University
Asanda Mthethwa	Environmental and Social Management System (ESMS) Project Coordinator	WILDTRUST
Asisipo Mhlonyane	Project Site Community Manager	WILDTRUST
Bheki Mabika	Tourism Contract Manager	iSimangaliso Wetland Park Authority
Brian Mantlana	Holistic Climate Change	Council for Scientific and Industrial Research (CSIR)
Buhle Mkona	Project Logistics and Administrative Assistant	WILDTRUST
Caiphus Khumalo	Executive Manager, Socio-Economic Development	iSimangaliso Wetland Park Authority
Caroline Fox	Ecologist	Ezemvelo KZN Wildlife
Chanelle Govender	GIS and Data Manager Technician	WILDTRUST
Craig Mulqueeny	Manager Ecological Advice	Ezemvelo KZN Wildlife
Erna Kruger	Managing Director	Mahlathini Development Foundation
Grant Smith	Managing Director	Sharklife
Heidi van Deventer	Principal Researcher	Council for Scientific and Industrial Research (CSIR)
Ilse Aucamp	Director	Equispectives Research and Consulting Services
Jabulani Ngubane	Executive Manager, Tourism and Business Development	iSimangaliso Wetland Park Authority
James Wood	Marine Conservation Manager	Ezemvelo KZN Wildlife
Jean Harris*	WILDOCEANS Executive Director	WILDTRUST
Jon Day*	CVI co-developer; Adjunct Senior Research Fellow	James Cook University, Australia
Laylaa Teixeira	MPA Sustainable Finance Intern	WILDTRUST
Lungelo Zulu	Area Manager	iSimangaliso Wetland Park Authority
Mark Gerrard	Africa Director	Conservation Strategy Fund

Name	Role	Organisation
Mnqobi Zuma	Communications Content Creator	WILDTRUST
Nandipha Sibiya	Project Coordinator	Indalo Inclusive
Nikeziwe Mthlyane	Community representative	Sokhulu
Niki Glen	CEO	Africa Ignite
Nkosingizwile Ndlovu	MSc student	University of Pretoria
Nonhle Mngadi	Senior Project Manager	WILDTRUST
Nontokozo Manzini	Intertidal harvester	eMalangeni
Nosipho Mdamba	Communications Manager	WILDTRUST
Nozi Mbongwa*	Senior Project Manager	WILDTRUST
PL Ngubane	Traditional Leader	KwaDapha
Riaan Cedras*	Ecologist	iSimangaliso Wetland Park Authority
Roelie Kloppers	CEO	WILDTRUST
Rose Masuku	Traditional Leader	Mabibi
Sandile Ntuli	Project Manager	WILDTRUST
Santosh Bachoo	Regional Ecologist Marine – Coastal & Estuaries	Ezemvelo KZN Wildlife
Scott Heron*	CVI co-developer; Professor of Physics and UNESCO Chair	James Cook University, Australia
Sean Fennessy	Assistant Executive Director	Oceanographic Research Institute (ORI)
Senzo Msane	Community representative	Sokhulu Small-scale Fishery Co-ops
Sethabile Mkhize	Research Assistant	WILDTRUST
Siboniso Mbense	Manager, Environmental Compliance	iSimangaliso Wetland Park Authority
Sibusiso Zondi	Senior Project Manager	iSimangaliso Wetland Park Authority
Sifiso Vumase	Environmental Educator	iSimangaliso Wetland Park Authority
Simone Dale*	Director, Organisational Resilience	WILDTRUST
Sipho Mbuyisa	Community Conservation Officer	Ezemvelo KZN Wildlife

Name	Role	Organisation
Siyabonga Simelane	Extension Officer, Community member	WILDTRUST, KwaDapha
Sizo Sibiya	Executive Manager – Biodiversity and Conservation	iSimangaliso Wetland Park Authority
Sphamandla Gumede	Dukuduku farmer	Dukuduku
Thandeka Mbambo	Policy Advisor	Department of Forestry, Fisheries and the Environment (DFFE)
Theuns Theunissen	Regional Manager for Pongola and uMfolozi	SA Canegrowers
Tony Roberts	Fire Protection Officer/CEO	Zululand Fire Protection Association
Vusi Mntambo	Community member	Mabibi
Vusi Mthembu	Traditional Leader	eNkovukeni
Welly Qwabe*	Regional Ecologist, Marine-Offshore	Ezemvelo KZN Wildlife
Yamkelani Nkalane	Assistant Project Site Manager	WILDTRUST
Zibane Ncube	Community member	Dukuduku

Appendix 5: Glossary and Acronyms

Adaptive capacity	The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.
Amakhosi	A system of traditional leadership in iSimangaliso.
Anthropogenic	Resulting from or produced by human activities.
Benthos	The community of organisms that live on, in, or near the bottom of a sea, river or lake (in the benthic zone).
Biodiversity	The variety of animals, plants, fungi, and microorganisms (e.g. bacteria) that make up the natural world in a particular habitat or in a specific area. Each of these species and organisms work together to maintain balance and support life. However, biodiversity changes over time as extinction occurs and new species evolve.
Citizen science	The collection of (typically) environmental data by members of the general public, usually in collaboration with professional scientists.
Climate	The composite or generally prevailing expected weather conditions of a region (e.g., temperature, air pressure, humidity, precipitation, sunshine, cloudiness, winds) throughout the year, averaged over a series of years.
Climate change	A change in the pattern of weather, and related changes in oceans and land surfaces, occurring over time scales of decades or longer.
Climate literacy	The understanding of how the climate system works, the impacts of climate change, the influence of climate on individuals and societies, and the ways they can respond to it.
Climate projection	A projection of the response of the climate system to emission or concentration scenarios of greenhouse gases and aerosols, or radiative forcing scenarios, often based upon simulations by climate models. Projections from the Coupled Model Intercomparison Project Phase 6 (CMIP6), which include societal decisions and effects are referred to in this report.
Coelacanth	A large bony marine fish with a three-lobed tail fin and fleshy pectoral fins, known only from fossils until one was found alive in 1938.
Community	The human population/s associated with an area of significance.
Compounding factors	Interacting stressors (both climate and non-climate) whose combined effect (synergy) is greater than the sum of individual effects.
Cretaceous	The geological period that lasted from about 143 to 66 million years ago.
Culture	A way of life of a group of people – the behaviours, beliefs, values, and symbols that they accept, generally without thinking about them, and that are passed along by communication and imitation from one generation to the next.
Current condition and recent trend	Assessment of the present status of values and their attributes; and how that has changed since the time of recognition (e.g., since World Heritage inscription)
Endemic	A plant or animal that is native and restricted to a certain place
Exposure	A measure of the contact between a system (whether physical or social) and a stressor.
Extreme weather event	A weather event that is rare at a particular place and time of year. Definitions of 'rare' vary, but an extreme weather event would normally be as rare as or rarer than the 10^{th} or 90^{th} percentile of the observed probability.
Geomorphic	Of or relating to the form of the landscape and other natural features of the earth's surface.
Hindcast	Simulation of past conditions by a model, useful for revealing past events and evaluating model performance (through comparison with historical data), which can aid in refining a model for future predictions.

Hydrology	The study of water, specifically its movement, distribution, and properties on Earth. It encompasses the science of water, including the hydrologic cycle, and its interactions with the environment.
Intangible attributes	Non-physical aspects that represent heritage values, including folklore, customs, beliefs, traditions, knowledge, language and senses.
Intergovernmental Panel on Climate Change (IPCC)	The United Nations body, established in 1988, for assessing the science related to climate change; it was created to provide policymakers with regular scientific assessments on climate change, its implications, and potential future risks, as well as to put forward adaptation and mitigation options. The IPCC is the most authoritative international body on climate science and is an essential component of the world's response to climate change.
Integrated Management Plan	A comprehensive document that aims to achieve a common goal by integrating different management systems, strategies, and actions through a coordinated approach to managing a specific area or resource; such a plan often involving multiple stakeholders and considers various aspects of development, conservation, or other relevant factors.
Mitigation (of climate change)	A human intervention to reduce emissions or enhance the sinks of greenhouse gases (GHGs). Mitigation measures in climate policy are technologies, processes or practices that contribute to mitigation, for example renewable energy technologies, waste minimisation processes, public transport commuting practices, etc.
Palaeontology	The scientific study of prehistoric life, primarily through the analysis of fossilized plants and animals to understand their evolution, relationships to modern species, geographic distribution, and the environments they inhabited.
Quaternary	Relating to or denoting the most recent geological period in the Cenozoic era, which began only 2.58 million years ago.
Ramsar	The international convention for the conservation and sustainable use of wetlands (named after Ramsar, Iran where it was signed in 1971).
Refraction	A change in the direction of propagation of a wave (whether it is light, water, etc.) due to different points along the wave front travelling at different speeds.
Restoration (in a cultural heritage context)	Involves human interventions to authentically maintain the values of cultural heritage that has been degraded, damaged or destroyed.
Restoration (in an environmental context)	Involves human interventions to assist the recovery of an ecosystem that has been previously degraded, damaged, or destroyed.
Riverine	Living on, or situated along the edges of a river, stream or creek
Sensitivity	The degree to which a system is affected, either adversely or beneficially, by climate variability or change.
Social-ecological resilience	The ability of linked social and environmental systems to absorb disturbances, adapt to change, and maintain their essential functions and structures; it emphasizes the interconnectedness of human societies and the ecosystems upon which they rely.
Tangible attributes	Physical aspects that represent heritage values.
Upwelling	The upward movement of deep, colder water that occurs when surface waters are pushed offshore by wind and water from below replaces the water that has been pushed away. This deeper water rising to the surface during upwelling is rich in nutrients.
Weather	The state of the atmosphere – its temperature, humidity, wind, rainfall and so on – over hours to weeks.

Acronyms

CARP	Climate Change Adaptation Response Plan
CCKP	Climate Change Knowledge Portal
CCRT	Current condition and recent trend
CGA	Co-operative Governance Agreement
CMIP	Coupled Model Intercomparison Project
CO_2	Carbon dioxide
CSIR	Council for Scientific and Industrial Research
CVI	Climate Vulnerability Index
D	Drought
DFFE	Department of Environment, Forestry and Fisheries
ESC	Economic-social-cultural (components of Community Vulnerability)
ICOMOS	International Council on Monuments and Sites
IMP	Integrated Management Plan
IPCC	Intergovernmental Panel on Climate Change
iSWPA	iSimangaliso Wetland Park Authority
IUCN	International Union for Conservation of Nature
JCU	James Cook University
KV	Key Value
KZN	KwaZulu-Natal
MEC	Member of the Executive Council
MPA	Marine Protected Area
NEM	National Environmental Management
NGO	Non-government organisation
OUV	Outstanding Universal Value
RCP	Representative Concentration Pathway
SAEON	South African Environmental Observation Network
SIF	Storm intensity and frequency
SOUV	Statement of Outstanding Universal Value
SLR	Sea level rise
SME	Small- and medium-sized enterprise
SPVs	(Other) Significant Property Values
SSP	Shared Socioeconomic Pathway
TT	Temperature trend
UNESCO	United Nations Educational, Scientific and Cultural Organization
WH	World Heritage

The iSimangaliso Wetland Park supports a diverse array of waterbirds and other species in coastal areas, with a high level of biodiversity in adjacent marine and terrestrial habitats.