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Sandy Shores

4.1 SANDY SHORES

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INTRODUCTION

Dunes, beaches and the surf zone function as a single unit called the littoral active zone, within which there are constant exchanges of sand, nutrients and animals between land and sea (McLachlan 1990). Waves and tides sculpt grains of sand into a continuum of beach types, from wide, fine-grained dissipative beaches with gentle slopes and wide surf zones, through a series of intermediate types, to narrow, coarse-grained reflective beaches with steep slopes and narrow surf zones. KZN has three beach ecosystem types:

1. Natal-Delagoa Dissipative-Intermediate;
2. Natal-Delagoa Intermediate; and
3. Natal-Delagoa Reflective Sandy Shores (Figure 4.1).

Beach biodiversity is surprisingly higher than expected, and many of the species are unique to South Africa (Harris *et al.* 2014). Under a single beach towel on the KZN beach, there are approximately 30-50 animals buried in the sand

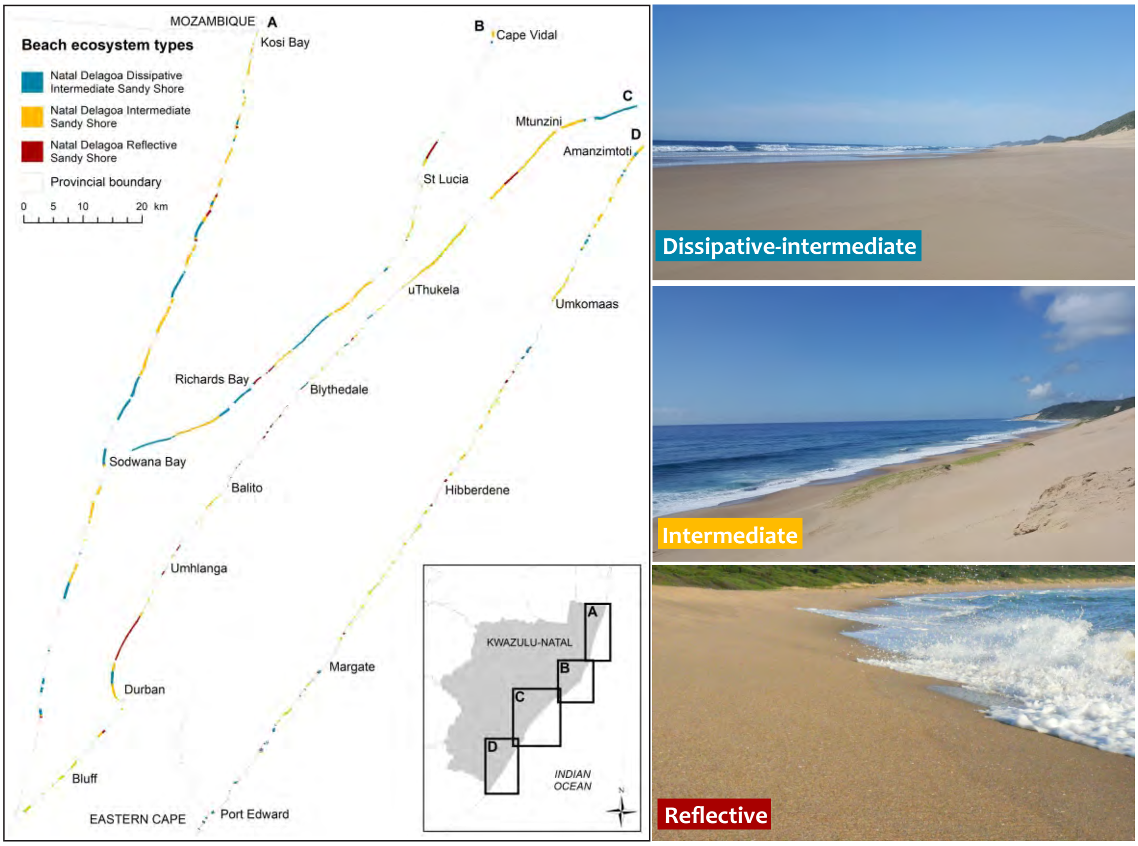


Figure 4.1. There are three beach ecosystem types in KZN. 1) Natal-Delagoa Dissipative-Intermediate Sandy Shores; 2) Natal-Delagoa Intermediate Sandy Shores; 3) Natal-Delagoa Reflective Sandy Shores (Harris *et al.* 2019a; *photos: Linda Harris*).

from a total of about 70 different species (Harris *et al.* 2014).

When sandy shores are in good ecological condition, they provide many benefits, including food and other resources, playgrounds for sports and recreation, scenic vistas, sites of cultural and spiritual significance, and protection against large wave events (Harris *et al.* 2019b). They also perform key services such as nutrient cycling and water purification (McLachlan 1979, McLachlan 1982).

This section focuses on sandy shores, defined as the area spanning the dune base to the back of the surf zone (Harris *et al.* 2019a). However, because sandy shores are part of the littoral active zone, their condition depends strongly on the state of the adjacent foredunes. Thus, four indicators are considered.

COASTAL DEVELOPMENT

Landcover change (Skowno 2020, Skowno *et al.* 2019b), especially coastal development, is an important indicator of the state of sandy shores because it is a direct driver of habitat loss. Further, development prevents the natural inland migration of beaches as sea levels rise, and they are gradually inundated and lost through a process called coastal squeeze.

ECOLOGICAL CONDITION

Ecological condition is estimated from an assessment of cumulative pressures to beaches (Sink *et al.* 2019a, Harris *et al.* 2015). The premise is that the higher the intensity of a greater number of pressures, the poorer the ecological condition. Ecological condition also informs the ecosystem threat status and ecosystem protection level (Skowno *et al.* 2019a).

ECOSYSTEM THREAT STATUS

Ecosystem threat status is assessed based on the criteria of the IUCN Red List of Ecosystems (Bland *et al.* 2017, Keith *et al.* 2013), providing an indication of the risk of ecosystem collapse. Ecosystem types are classified as either Data Deficient, Least Concern, Near Threatened, Vulnerable, Endangered, Critically Endangered or Collapsed (Bland *et al.* 2017, Keith *et al.* 2013).

ECOSYSTEM PROTECTION LEVEL

Ecosystem protection level is a measure of how well each ecosystem type is represented in South Africa's protected area network, which together with ecosystem threat status, helps to prioritise ecosystem types in greatest need of protection. Ecosystem types are classified as Well Protected, Moderately Protected, Poorly Protected or Not Protected, with habitat in only good ecological condition counting towards the Well Protected category (Sink *et al.* 2019b).

DRIVERS

The strongest direct driver of beach ecological condition is the state of the adjacent foredunes. Keeping the dune-beach connection intact, unconstrained and maintaining natural sand storage and transport are critical for resilience in sandy shores. Hence, coastal development, coastal squeeze and mining cause the greatest impact to beaches. However, freshwater-flow reduction and impacts from less destructive pressures like fishing and other resource harvesting are widespread and contribute to cumulative declines in ecological condition.

The root driver of change to sandy shores is population and economic growth. The ongoing development in prime seaside locations results in increased pressure through increased demand, such as sand for construction (increased sand mining), and more abstraction of water from catchments to support the growing population. These effects contribute to disrupting natural flows of sand between land and sea and result in sand-starved shores. Further, as coastal population densities increase, so too do recreational activities and the number of beach visitors, heightening impacts from disturbance and resource extraction, with dune trampling contributing to increased erosion. Superimposed on this are stressors from climate change, particularly sea-level rise and storms, which synergistically contribute to habitat loss in sand-starved systems by accelerating erosion and contributing to coastal squeeze.

PRESSURES

Sandy shores face two types of anthropogenic pressures: high-impact pressures that contribute to habitat loss (e.g., coastal development and mining); and low-impact pressures that collectively contribute to declines in ecological condition through cumulative effects (e.g., pollution, trampling and harvesting). The latter can easily go unnoticed because beach biota is generally very small, live buried in the sand or in the surf zone, so the impacts are not visually obvious. Further, the dynamic nature of sandy shores makes it difficult to distinguish long-term declines in sand supply to beaches from natural periods of heightened erosion without monitoring data.

STATE

Historic perspective

Refinement of the national classification and mapping of beach ecosystem types (Harris *et al*. 2019a), together with a change in the methodology by which ecological condition, ecosystem threat status and ecosystem protection level were assessed in the NBA 2004, 2011 and 2018, precludes a trend analysis of these indicators for beaches. However, habitat loss, especially from coastal development, can be tracked over time. Coastal development is significantly correlated with the sum of all other pressures on beaches (Harris *et al.* 2015), suggesting that it is also a good surrogate for a trend analysis of ecological condition.

The National Landcover datasets aid in tracking habitat loss over time, showing clear trends, in spite of the coarseness of the data (Skowno 2020, Skowno *et al.* 2019b). From 1990–2014, natural habitat was converted mostly to plantations, buildings and croplands (Figure 4.2). However, from 2014–2018, there has been a

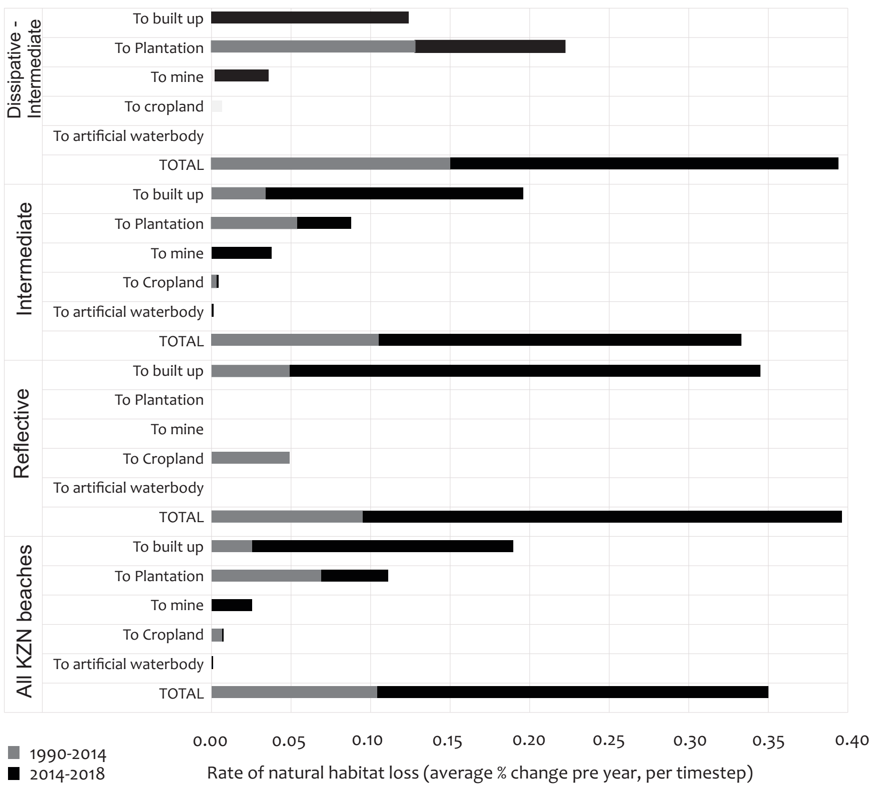


Figure 4.2. Rate of natural habitat loss (average percent of whole area: annually converted from Natural to another landcover class: 1990-2014 (grey) and 2014-2018 (black)) within area spanning the shore to 200 m inland of the dune base for the three beach ecosystem types in KZN, and for all KZN beaches.

marked increase in coastal development and mining (Figure 4.2). Differences in habitat loss among beach types relates to their geographic distribution along the KZN coast (Figure 4.1), but overall, coastal development is the greatest driver of natural habitat loss (Figure 4.2).

Current state

Ecological condition is estimated by assessing cumulative pressure from human activities on beaches at a site level and determining the proportion of an ecosystem type in each of four condition classes, from Natural to Very Severely Modified (e.g., heavily developed beaches with numerous pressures). This cumulative pressure assessment was undertaken by Sink *et al.* (2019a) and Harris *et al.* (2015) following the same methodology but including different pressures. Neither of these assessments have been ground-truthed, which will need to be addressed in future.

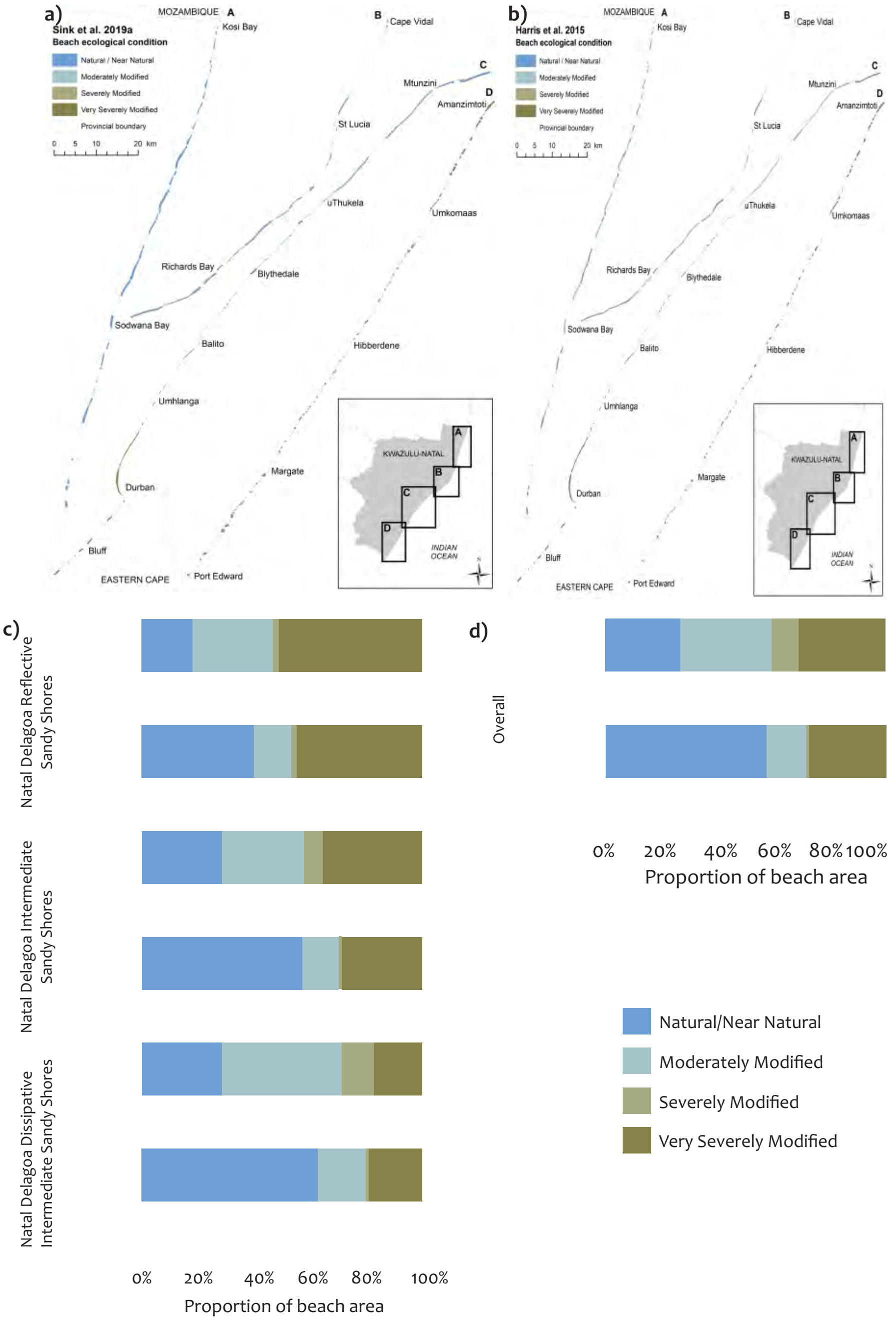


Figure 4.3. Ecological condition based on a cumulative pressure assessment from (a) the NBA 2018 (Sink et al. 2019a) and (b) data from Harris et al. (2015) for the KZN beaches (c) by beach morphodynamic type, and (d) for all beaches collectively. Data are given as a proportion of the area in each ecological condition class.

Therefore, both assessments are presented because the results are slightly different and the true proportion of sandy shore habitat in each ecological condition class is likely somewhere between the two estimates (see Sink *et al.* 2019a and Harris *et al.* 2015 for details).

Notwithstanding, the broad trend in both assessments shows that beaches north of uThukela Estuary are in much better ecological condition than the beaches further south (Figure 4.3). This matches the footprint of coastal development (more intensive south of the uThukela Estuary) and coastal protection (most coastal protection is north of the uThukela Estuary) in KZN. All ecosystem types have some

Sandy shore dunes and sensitive dune vegetation
Photo: Kierran Allen

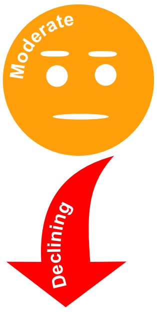
habitat in each of the four classes of ecological condition, but about a third (30-41%) of the beaches overall are Severely to Very Severely Modified (Figure 4.3). It is also salient to note that the Natal-Delagoa Sandy Shores are under significantly more cumulative pressure than sandy shores in the rest of South Africa (Harris *et al.* 2015).

The amount of ecosystem modification, as estimated by the ecological condition, informs the ecosystem threat status (Sink *et al.* 2019a). The Natal-Delagoa Reflective Sandy Shores are the only threatened beach ecosystem type in KZN, with a status of *Vulnerable* (Sink *et al.* 2019a). Given the excellent coastal protection in KZN, all three beach types have an ecosystem protection level of *Well Protected* with at least 20% of each type in good (Natural) ecological condition located in protected areas (Sink *et al.* 2019b). iSimangaliso and uThukela MPAs contribute most to protecting sandy shores in KZN. Importantly, both MPAs offer land-sea protection because of contiguous terrestrial protected areas that safeguard the adjacent dunes, particularly in iSimangaliso. Protecting the adjacent dunes is imperative for providing effective protection to sandy shores.

IMPACT

As coastal development increases, particularly when constructed within the littoral active zone, it decreases the beaches' adaptive capacity to respond to stressors from climate change, including sea-level rise and extreme storms. Sand erodes from beaches until they are gradually narrowed and lost through coastal squeeze. Urban beaches backed by seawalls also become inaccessible to tourists during high tides because the sea fully inundates the shore. The impacts are therefore both ecological: where high-shore species are extirpated due to habitat loss, and social: where beach-visiting is not possible at certain times, and development immediately behind the shore is at increasing risk of wave damage. Further, reduced supplies of terrigenous sand to the coast through estuaries from sand mining, dams and weirs can result in erosion and inland realignment of the shore, also placing development at risk.

RESPONSE



Ten priority actions for managing and conserving coastal biodiversity are identified in the NBA 2018 (Harris *et al.* 2019c). For KZN beaches, the most salient are:

1. Restore and maintain coastal ecological infrastructure to strengthen climate resilience and sustain ecosystem services and benefits. This includes implementing conservative coastal management lines and carefully planning future development to ensure the littoral active zone remains intact; rehabilitating dunes; and addressing pollution.
2. Re-establish natural sand supplies to the coast, where possible, to replenish sand-starved beaches and dunes and thereby maintain benefits of coastal protection, sustain South Africa's most important biodiversity asset for tourism, and safeguard our unique beach biodiversity. This critically includes ensuring sufficient freshwater and sediment flows through estuaries to the coast.
3. Reduce the impacts of mining by stopping illegal mining, avoiding biodiversity priority areas, and improving rehabilitation and developing a sand mining policy.

Particularly important is the revising and ground-truthing of the methodology for measuring beach ecological condition. This may require identifying ecological or biological indicators that could be monitored for temporal analyses of the state of sandy shores in addition to the physical metric of coastal development and other landcover change.

Data Requirements
Harris, *et al.* (2019a) provides on overview of beach extent in KZN. Indicator data comes from the NBA 2018 (ecosystem threat status: Sink, *et al.* (2019a); ecosystem protection level: Sink *et al.* (2019b)). Ecological condition is important and information from NBA 2018 (Sink, *et al.* 2019a) and Harris, *et al.* (2015) has been used in this assessment. Data on habitat loss is included based on the National Landcover 1990, 2014 and 2018 (Skowno, 2020; Skowno, *et al.* 2019b).