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4.3 ROCKY SHORES

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INTRODUCTION

Rocky shores in KZN support a great variety of flora and fauna, each physiologically adapted to a harsh and dynamic physical environment, driven by large environmental gradients at the land-sea interface (Blamey and Branch 2009, Sink 2001, Sink *et al.* 2005). The tidal-driven inundation by waves and the different physical environments this creates is reflected in the zonation of plants and animals in this intertidal strip; well described by Branch and Branch (2018). Vertical zonation patterns can be readily distinguished on most rocky KZN shores, from the upper layers dominated by minute periwinkles to the lowest levels where redbait, echinoderms and seaweeds dominate. These zones are usually most obvious when encountered along a steep shoreline. More detailed descriptions can be found in Steyn and van der Elst (2014) and Branch and Branch (2018).

KZN intertidal rocky shores are a valuable ecosystem that have contributed to the food security of coastal communities for millennia, evidenced by coastal middens of shellfish harvested from KZN rocky shores (van der Elst 2020). Although this widespread subsistence harvesting continues, it is much patchier and more inconsistent (Kyle *et al.* 1997, Sink 2001, Tomalin and Kyle 1998). Extensive research has been conducted on the subsistence fisheries of KZN and the dynamics of important harvested species including mussels (mostly *Perna perna*), redbait (*Pyura stolonifera*) and oysters (De Bruyn *et al.* 2009, Kyle *et al.* 1997, Kyriacou 2017, Mead *et al.* 2013). Rocky shores and their associated micro-habitats and rock pools are also important nursery grounds for nearshore coastal and estuarine fish species (Steyn and van der Elst 2014, Strydom 2008).

The KZN intertidal zone is divided into two distinct biogeographic regions, namely the northern Delagoa ecoregion and the Natal ecoregion in the South (Sink *et al.* 2019a, Sink *et al.* 2005). Recently, these zones were further divided into sub-sections based on wave exposure, which is an important driver of rocky shore ecology and a key determinant of long-shore biodiversity patterns (Sink *et al.* 2019a, Menge and Branch 2001, Blamey and Branch 2009, Branch and Branch 2018). A total of 23 rocky and mixed shore ecosystem types have been mapped for the South African coastline, including five in KZN: the Delagoa Very Exposed Rocky Shore, Natal Boulder Shore, Natal Exposed Rocky Shore, Natal Mixed Shore and the Natal Very Exposed Rocky Shore (Sink *et al.* 2019b).

DRIVERS

URBANISATION

It has been reported that (2019) 62% of South Africans are living in urban areas (Section 2.2). In KZN, most reside in the coastal municipalities around Durban and Richards Bay (EDTEA 2017). Population growth in KZN results in an increased need for food to feed the growing population, putting increased pressure on the natural environment (EDTEA 2017).

POVERTY

High levels of poverty in KZN, exacerbated by poor service delivery often results in untreated waste and effluent (including rubbish and debris) being introduced to rivers and streams; ultimately ending up in coastal environments (EDTEA 2017). High levels of unemployment may put non-sustainable pressure on intertidal resources, threating the resource as well as leading to conflicts with other fishing sectors (Sink *et al.* 2019b).

COASTAL DEVELOPMENT

Poorly planned coastal development, often associated with urbanisation or tourism, can be a significant driver of change in rocky shore ecosystems. While some of these drivers have a direct impact, such as causing direct reef damage, there are also several indirect consequences: waste discharge into the intertidal zone, runoff from large, paved areas, altered sand dynamics smothering reefs, shading of reefs from natural sunlight as well as increased harvesting and foot-pressures from growing coastal populations (Sink *et al.* 2019a).

CLIMATE CHANGE

Predicted climate-induced changes include more frequent storms and high destructive seas, flooding, rainfall variability, increased air and sea surface temperatures and sea-level rise (EDTEA 2017, Kelly *et al.* 2019). Any of these factors can potentially disrupt ecological processes in the rocky zone. While in some cases this may directly destroy mussel and redbait beds, in others this may be more subtle and longer term. For example, temperature-induced changes may alter fecundity, species composition, or facilitate invasions of alien species (Sink *et al.* 2019a, Mvula, 2020).

GOVERNANCE

Living resources fall primarily under the Marine Living Resources Act (1998; MLRA); coastal zone

Left: A blue coral worm, *Pomatoleios kraussi*, showed an increased abundance at the Ballito rocky shore monitoring site during the 2014/2015 period (Ezemvelo) / Right: A macroalgae species, *Codium platylobium*, at the Trafalgar sampling site
Photos: Jennifer Olbers 2015

issues fall under the ICMA while mining is answerable to the Mineral and Petroleum Resources Development Act of 2002. While the MLRA is the main legal instrument for living resources, confusion reigns over legal responsibilities, resulting in fragmented governance and implementation by government departments, threatening the effectiveness of these mechanisms in protecting coastal ecosystems (Goble *et al.* 2014).

PRESSURES

Some of the main pressures affecting rocky shore ecosystems include subsistence harvesting/ overexploitation, recreational harvesting, poaching, pollution, invasive alien species, mining (including sand mining), sand inundation and climate change. Many of these pressures are attributed to an overall higher level of coastal development (EDTEA 2017, Olbers 2017, Sink *et al.* 2019a, Steyn and van der Elst 2014).

Rocky shore biota are excellent indicators of water quality in that they are sessile filter feeders and hence bioaccumulate substances attributable to a specific site (Burrows *et al.* 2014). Furthermore, trends in rocky shore resources, such as key harvested invertebrate species (e.g., *Perna perna*) can serve as good indicators of the impacts of human pressures on rocky shores ecosystems, while changes in size, composition and other community assemblage patterns are important indicators of rocky shore processes and functioning (Kyle *et al.* 1997, Sink 2001, Olbers 2017). Using a combination of these indicators will advance our understanding of the pressures subjected through natural and anthropogenic drivers of change of rocky shore ecosystems.

STATE

Historic perspective

Subsistence harvesting of intertidal rocky shore species dates back 160 000 years (Marean 2007), with most effort targeting mussels (*P. perna* on the east coast of KZN) but significant quantities of limpets were taken too (Mead *et al.* 2013). Historically there is evidence of higher levels of exploitation in Maputaland on the north coast of KZN (Kyle *et al.* 1997, Tomalin and Kyle 1998, Sink 2001). Sink *et al.* (2005) found that *P. perna* was much less abundant on Maputaland shores but that this area demonstrated higher abundances of redbait, *Pyura stolonifera*, another important harvested species, compared with the southern biogeographic region of KZN (Kyle *et al.* 1997). However, these patterns in Maputaland could be inflated by a few monitored sites that have high densities of *P. stolonifera* (Kyle *et al.* 1997). Kyle *et al.* (1997) suggested that generally, subsistence harvesting in Maputaland was sustainable, based on stable catch per unit effort (CPUE) rates between 1988-1994 and no decline in availability and size of mussels. This appears to have changed in recent years though, based on declining stocks throughout KZN (discussed in the following section). In contrast, CPUE of limpets showed a marked decline at Rabbit Rock (a specific monitoring site in the Maputaland area) from 1989, despite a downward trend of harvesting effort (Mead *et al.* 2013). Limpets appeared to be overexploited in Maputaland; however, there are signs of recent recovery at Rabbit Rock (Mead *et al.* 2013). Redbait is a common bait species for anglers, which may account for the low densities observed in the southern parts of KZN.

A commercial rock oyster (*Striostrea margaritacea*) fishery has been operational in KZN since the late 19^{th} century, with initial declines in biomass observed in the early 1900's, which appeared to stabilise once a rotational harvesting approach was implemented in 1955 (De Bruyn *et al.* 2009). All management zones in KZN were depleted to 30-40% of 1984 stock levels; however, exploitation rates have decreased in the last 20 years and oyster populations seem to have stabilised (De Bruyn *et al.* 2009, DEFF 2020).

Current state

Recent studies have shown an overall decline in intertidal species catches (Mead *et al.* 2013, Mvula 2020). However, additional monitoring and data are required to fully understand the drivers of these patterns, whether it's overexploitation, changes in harvesting effort (or methods/technology) or environmental causes. Despite an initial decline in biomass of the Cape rock oyster, *S. margaritacea*, improved management of this species has resulted in sustainable exploitation of this resource (De Bruyn *et al.* 2009, DEFF, 2020). However, a detailed stock assessment is required to fully understand the status of oysters. The latest report of the status of marine fishery resources in South Africa suggests that oysters in KZN are fully and optimally exploited but harvesting rates have still declined in recent years (DEFF 2020), which should be monitored closely. Ezemvelo conducted rocky shore biodiversity monitoring surveys between 2008-2019 at multiple sites along the KZN coast, spanning the Delagoa and Natal ecoregions (Olbers 2017). Overall, results from these studies have shown that rocky shores in the Natal ecoregion appear to be highly resilient and demonstrated good condition with relatively high abundance of key functional groups and diverse communities (Figure 4.5 and Figure 4.6; Olbers 2017, 2015). However, plastic pollution and marine debris appear to be having negative impacts on the rocky shores at Isipingo (Olbers 2017). Surprisingly, rocky shores in Maputaland, which

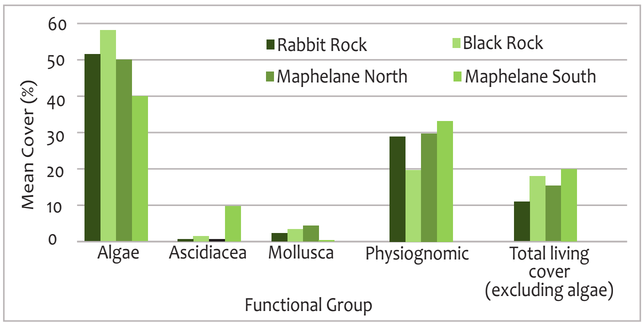


Figure 4.4: Percentage cover of four main functional groups and the total living cover (excluding algae) of biota from rocky shore monitoring sites from the iSimangaliso Wetland Park in northern KwaZulu-Natal. Source: Ezemvelo KZN Wildlife Monitoring programme (Olbers 2017).

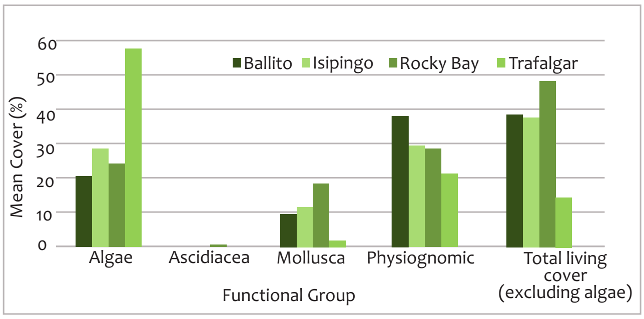


Figure 4.5: Percentage cover of four main functional groups and the total living cover (excluding algae) of biota, from four sites in the Natal ecoregion on the south coast of KZN. Source: Ezemvelo KZN Wildlife long-term rocky shore monitoring programme (Olbers 2017).

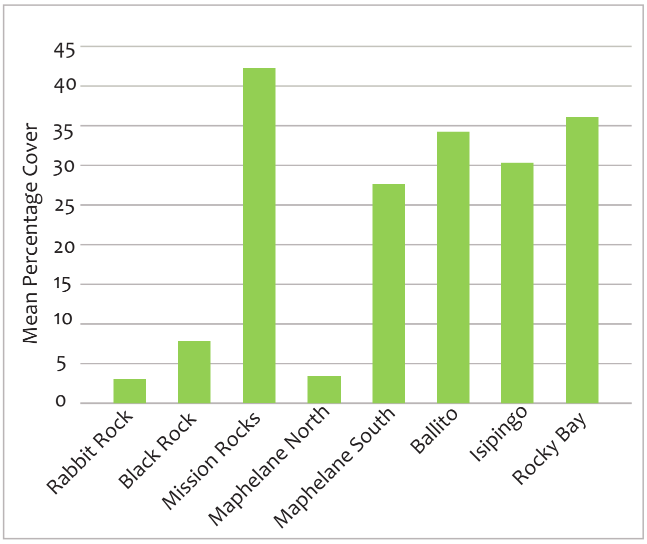


Figure 4.6: Mean percentage cover of the brown mussel, *Perna perna*, from monitoring sites along the KZN coast. Source: Ezemvelo KZN Wildlife long-term rocky shore monitoring programme (Olbers 2017).

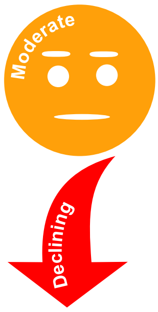
occur in established marine protected areas, are not in as good a condition compared with those in southern KZN (Figure 4.4; Olbers 2015, 2017). There is evidence of large declines in mussels, *P. perna*, and redbait, *P. stolonifera*, at the Black Rock and Rabbit Rock sites (Olbers 2015). Furthermore, there were much higher abundances (percentage cover) of algae compared with important functional groups such as Ascidiacea and Mollusca (Figure 4.4), which suggests that these sites are overexploited and demonstrate signs of ecosystem degradation (Mead *et al.* 2013, Olbers 2015, 2017).

A recent study compared the community composition of rocky shore ecosystems at 14 (re-sampled) sites in KZN, to surveys conducted in the 1990's (Mvula 2020). Significant changes in community composition were observed, showing an increase in species richness and evenness at most of the sites. However, these changes were a result of a decline in harvested mussels, an increase in coralline algae, an invasion of two new species of alien barnacles and a southward range expansion of a subtropical barnacle species (Mvula 2020). These findings include initial evidence of potential climate-induced impacts on rocky shores in KZN; however, additional monitoring and data analyses are required to support this.

IMPACT

If not managed properly, overexploitation of economically important invertebrate species will reduce the sustainability of these species (e.g., mussels, redbait and limpets), resulting in a decline of resources which support subsistence fisheries and livelihoods of vulnerable coastal communities. Changes in community structure, in combination with impacts from climate change, can decrease the resilience of rocky shore ecosystems resulting in a loss of important ecosystem services such as the provision of diverse microhabitats, nursery sites for coastal fish species and water filtration (Sink *et al.* 2005, Strydom 2008, Mead *et al.* 2013).

RESPONSE



Improved management of rocky shore subsistence fisheries is needed, particularly in the Delagoa ecoregion, where some sites, despite being within marine protected areas (e.g., Black Rock), are showing signs of overexploitation and degradation (Sink *et al.* 2005, Olbers 2015, 2017). Management interventions are needed at Isipingo where wastewater effluent and increased plastic pollution is having a detrimental impact on rocky shore communities (Olbers 2017). Continued and additional long-term monitoring at rocky shore sites along the KZN coast is required to identify the status and trends of rocky shore ecosystems. Biomonitoring such as Mussel Watch should be reinstated in KZN to monitor indicator species for water quality and heavy metal pollution.

Data Requirements
Operation LIMPET currently serves as South Africa's national rocky shore monitoring programme, which aims to detect climate impacts on coastal biodiversity. Results from Mvula (2020) were obtained as part of the national monitoring programme. It is considered important that the programmes currently underway (ORI and EKZNW) should collaborate to avoid duplication and maximise benefits.