ADDO ELEPHANT NATIONAL PARK MARINE PROTECTED AREA STATE OF KNOWLEDGE REPORT

2026

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South African National Parks (SANParks) is collaborating with the Office Français de la Biodiversité (OFB), under the South Africa – France quadripartite cooperation agreement signed on 7 June 2022 by the French Development Agency (AFD), OFB, SANParks and the South African National Biodiversity Institute (SANBI). The agreement aims to facilitate peer-to-peer collaboration and knowledge exchange between the abovementioned French and South African conservation agencies. Through this collaboration, OFB has funded the development of comprehensive State of Knowledge (SOK) reports for the Addo Elephant National Park, Namaqua National Park and Robben Island Marine Protected Areas (MPAs), as well as Situation Assessment Reports (SARs) for the Krom and Wildevoelvlei estuaries, which form part of the Table Mountain National Park MPA. In terms of this initiative, OFB invited experts to submit tender proposals for the development of these SOK and SAR reports. These reports aim to compile, synthesise, and interpret existing information on the ecological, social, and economic aspects of these MPAs and estuaries to support knowledge collation the development of MPA and Estuarine Management Plans.

We would also like to acknowledge the valuable reviews from Dr Cloverley Lawrence, Jessica Hayes, Stefanie Dr Freitag-Ronaldson (SANParks).

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ACRONYMS AND ABBREVIATIONS

ATAP	Acoustic Tracking Array Platform
BIORZ	Bird Island Offshore Restricted Zone
BRUV	Baited Remote Underwater Video
CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CPICZ	Cape Padrone Inshore Controlled Zone
CRICZ	Cannon Rocks Inshore Controlled Zone
CROCZ	Cannon Rocks Offshore Controlled Zone
DAFF	Department of Agriculture, Forestry and Fisheries
DEA	Department of Environmental Affairs
DEAT	Department of Environmental Affairs and Tourism
DFFE	Department of Forestry, Fisheries and the Environment
ENP	Elephant National Park
ENP MPA	Elephant National Park Marine Protected Area
GESAMP	Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection
HAB	Harmful Algal Bloom
IBA	Important Bird and Biodiversity Area
ICES	International Council for the Exploration of the Sea
ICMA	Integrated Coastal Management Act
IDZ	Industrial Development Zone
IMMA	Important Marine Mammal Area
IUCN	International Union for Conservation of Nature
KBA	Key Biodiversity Area
METT	Management Effectiveness Tracking Tool
MLRA	Marine Living Resources Act
MPA	Marine Protected Area
NBA	National Biodiversity Assessment
NEM:PAA	National Environmental Management: Protected Areas Act
NEMA	National Environmental Management Act
NEMBA	National Environmental Management: Biodiversity Act
NGO	Non-Governmental Organisation
NISC	National Inquiry Service Centre
NMU	Nelson Mandela University
R	South African Rand (currency)
SAEON	South African Environmental Observation Network
SAIAB	South African Institute for Aquatic Biodiversity
SANBI	South African National Biodiversity Institute
SANCCOB	Southern African Foundation for the Conservation of Coastal Birds
SANParks	South African National Parks
SECZ	Sundays Estuary Controlled Zone
SERZ	Sundays Estuary Restricted Zone
SICZ	Sundays Inshore Controlled Zone
SIRZ	Sundays Inshore Restricted Zone
SOCZ	Sundays Offshore Controlled Zone
SOK	State Of Knowledge
StCORZ	St Croix Island Offshore Restricted Zone
TAC	Total Allowable Catch
UNESCO	United Nations Educational, Scientific and Cultural Organization

1. INTRODUCTION

The Addo Elephant National Park (Addo ENP) is a renowned wildlife conservation park located within Algoa Bay, in South Africa's Eastern Cape Province, and is one of South Africa's 20 National Parks. The Addo Elephant National Park Marine Protected Area (Addo ENP MPA herein) is an extension of the Addo ENP and shares its commitment to conserving South Africa's unique natural heritage, from iconic elephants and thickets inland to rich estuaries, reefs, rocky and sandy shores and islands offshore. The MPA section of this park lies along South Africa's rugged and biodiverse Eastern Cape coastline, where land and ocean meet in a dynamic system.

Stretching from the north of the Port of Ngqura (Coega) to Cannon Rocks, and extending up to 15 km offshore, the Addo ENP MPA encompasses a mosaic of marine and estuarine habitats, including sandy beaches, rocky reefs and the Sundays Estuary. Two island groups are unique features along the South African east coast and important to several birds including the Critically Endangered African penguin, Cape gannet and several species of migrant terns. Designated in 2019, the MPA is managed by South African National Parks (SANParks) with the aim of conserving marine biodiversity, supporting sustainable livelihoods, and safeguarding the ecological integrity of this important coastal region.

The special marine areas inside the Addo ENP MPA help support a range of marine life, from resident dolphins and Bryde's whales to estuarine-dependent fish and important invertebrate species. It protects critical nursery areas and spawning grounds for commercially important fish species such as dusky kob and white steenbras, while also conserving endangered habitats like subtidal reefs and intertidal zones. This coastal area is also rich in cultural and historical heritage, with archaeological evidence of early human coastal use, shell middens, and long-standing traditional fishing practices. The MPA continues to support the livelihoods and cultural identity of small-scale and traditional fishers, while also offering opportunities for sustainable tourism, environmental education, and community engagement.

Despite its protected status, the Addo ENP MPA faces numerous pressures typical of nearshore systems adjacent to growing human populations such as from pollution, port-related activities including shipping, in addition to wider threats associated with climate change such as sea-level rise and ocean warming. Industrial activities such as commercial trawling and mining are prohibited within the MPA to protect vulnerable habitats and species; however, purse-seine and long-line fishing are permitted in certain zones.

This report focuses on the marine and estuarine ecosystems within the Addo ENP MPA. Its primary objective is to present a comprehensive state of knowledge of the area, including:

- Biotic and Abiotic characteristics
- History and marine Cultural Heritage
- Pressures and Threats
- Management
- Research and Monitoring initiatives
- An inventory of key species

While it is not possible to capture all environmental, societal and cultural aspects of this MPA in a single document, this synthesis is intended to be informative to a wide ranging audience, while providing a foundation for future collaboration, research, and effective marine management in support of both biodiversity conservation and the communities that depend on a healthy Addo ENP MPA.

2. ACCOUNT OF AREA

2.1 LOCATION

Addo ENP MPA is located in Algoa Bay, in the Eastern Cape Province of South Africa, approximately 5–7 km northeast of the coastal city of Gqeberha (formerly Port Elizabeth). The MPA is an extension of the Addo ENP which covers both terrestrial, coastal and marine systems (inshore and offshore out to 20–25 km). The Addo ENP MPA lies adjacent to the terrestrial park's coastal section and spans part of the Eastern Cape's Sunshine Coast (Figure 2.1).

This strategic location places the Addo ENP MPA within a key transitional zone between temperate and subtropical marine bioregions, supporting high biodiversity and endemism while also being influenced by both the warm Agulhas Current and cooler coastal upwellings (Anderson et al. 2009). Its combination of sandy, rocky and mixed shores, two island complexes, harbours and pelagic zones makes the Bay particularly diverse in terms of habitats.

The Addo ENP MPA covers approximately 1,200 square kilometres (120,000 hectares) incorporating both the St Croix and Bird Island groups. This MPA contributes towards the 9% of the South African coast which is considered a 'no take' or 'restricted' area (South African National Parks Board 2008, Field et al. 2025).

2.2 BOUNDARIES

The Addo ENP MPA extends from the high-water mark to the offshore zone. It is bounded by a series of straight lines stretching offshore from just east of the Port of Ngqura harbour, incorporating Bird Island and the Sundays River, up until Cannon Rocks at its eastern most boundary. The area includes the substrata, seabed, subsoil and water column within these boundaries.

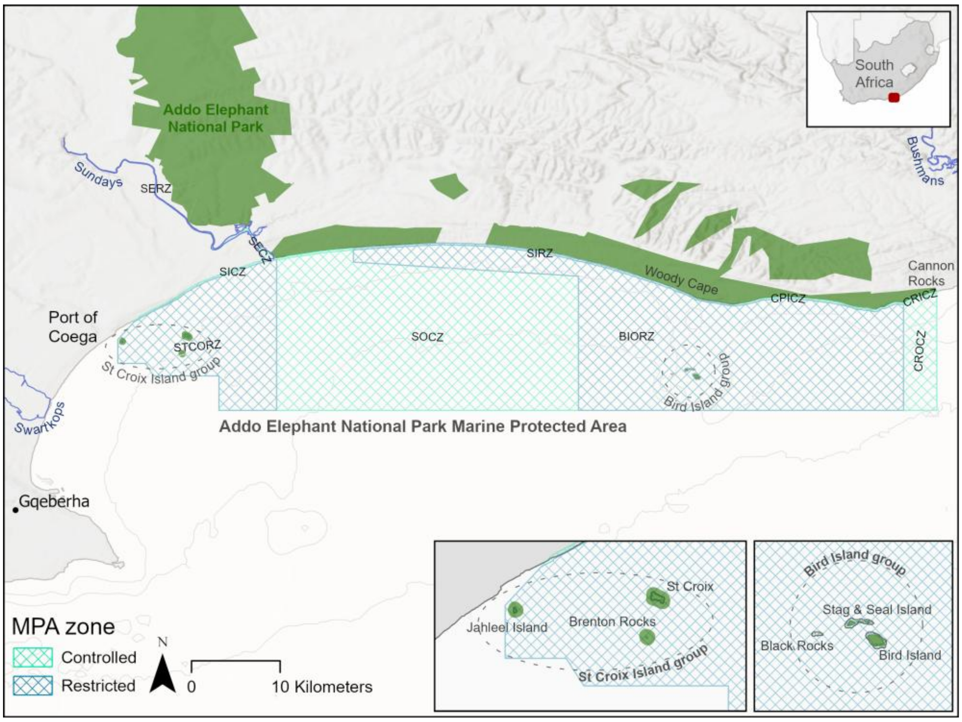


Figure 2.1 Location of the Addo Elephant National Park Marine Protected Area

Boundary points of the Addo ENP MPA

POINT	X	Y
A	26.5298	- 33.754
B	26.5298	-33.875
C	25.8025	-33.875
D	25.8025	-33.84
E	25.7362	-33.84
F	25.728	-33.827333
G	25.7	-33.827333
H	25.7	-33.802983
I	25.721457	-33.779949
J	25.8610	-33.8055
K	25.9387	-33.7103
L	26.3243	-33.7672
M	26.4960	-33.7656
N	26.4960	-33.8750
O	26.1667	-33.8750
P	25.8609	-33.8750
Q	25.9387	-33.7246
R	26.1667	-33.7388
S	25.7712	-33.6837
T	25.7014	-33.6277
U	25.7164	-33.7854
V	25.9387	-33.7122
W	26.4960	-33.7674
Y	26.5298	-33.7561

2.3 ZONES

In line with international trends in marine resource management, South Africa invested in establishing multiple-use MPA networks with different zones offering different levels of protection. These different zones include Controlled and Restricted (no-take) zones. A Controlled Zone is where resources can be extracted while adhering to minimum limits and selective fishing gear. In the Addo ENP MPA specific fishing activities are allowed with a permit. Restricted Zones are where the collection of resources is prohibited, and only non-invasive activities are allowed (NEM:PAA). Bottom trawling is prohibited throughout the MPA. There are also restrictions on boating within the Sundays Estuary and certain controls are in place within the zones (e.g. speed restrictions within Restricted Zones)

The Addo ENP MPA is zoned into four coastal zones: three inshore Controlled and one inshore Restricted Zone; four offshore zones: two offshore Controlled and two offshore Restricted Zones; and two estuarine zones: one estuarine Controlled and one estuarine Restricted Zone (Figure 2.1).

Addo ENP MPA Offshore Zones:

- St. Croix Island Offshore Restricted Zone (StCORZ)
- Sundays Offshore Controlled Zone (SOCZ)
- Bird Island Offshore Restricted Zone (BIORZ)
- Cannon Rocks Offshore Controlled Zone (CROCZ)

Addo ENP MPA Inshore Zones:

- Sundays inshore Controlled Zone (SICZ)
- Sundays inshore Restricted Zone (SIRZ)
- Cape Padrone inshore Controlled Zone (CPICZ)
- Cannon Rocks inshore Controlled Zone (CRICZ)

Addo ENP MPA Estuary Zones:

- Sundays Estuary Controlled Zone (SECZ)
- Sundays Estuary Restricted Zone (SERZ)

2.4 MANAGEMENT AUTHORITY

SANParks is the designated management authority of the Addo ENP MPA. However, the Department of Forestry, Fisheries and the Environment (DFFE) is responsible for issuing fishing permits, allocating fishing quotas and assisting with law enforcement, while SANParks undertakes the management, administrative and law enforcement, surveillance and monitoring as well as educational activities. Research and monitoring is undertaken by SANParks' Scientific

Services as well as several institutions and DFFE, often collaboratively. In addition, the South African Police Service, environmental officers, and fisheries authorities (DFFE) either collaborate with SANParks or independently operate along the coast to ensure law enforcement and compliance (Brill & Raemaekers 2013).

2.5 ACCESS

The Addo ENP MPA primarily lies within the jurisdiction of the Sarah Baartman District Municipality, through the Ndlambe and Sundays Estuary Valley local municipalities. It is also adjacent to the Nelson Mandela Bay Metropolitan Municipality, which plays a key role in regional marine and coastal dynamics.

Due to its location within the ecologically rich and culturally significant Eastern Cape coastline, the Addo ENP MPA supports a wide range of tourism, recreation, research, and educational activities, although at a more modest scale compared to urban-proximate MPAs like Table Mountain National Park MPA.

The Addo ENP MPA includes popular coastal destinations such as Cannon Rocks and the Sundays Estuary which attract local and regional tourists for activities including fishing, birdwatching, beach visits and eco-tourism experiences. The MPA is adjacent to coastal sections of Addo ENP, where visitors enjoy nature-based activities across land and sea, including game viewing, hiking, whale and dolphin watching, and exploring coastal and estuarine biodiversity.

The main estuarine system within the MPA is the Sundays Estuary, which serves as key access points for small vessels and is popular for recreational fishing, canoeing, and guided river cruises. The Sundays Estuary supports tourism operators who offer sandboarding, boat tours, and wildlife experiences near the Colchester entrance to the Addo ENP (Figure 2.1).

There are no formal harbours within the Addo ENP MPA boundaries, but several informal and registered small vessel launching sites exist along the coast. These sites are used primarily by recreational and small-scale fishers, local tourism operators, and for scientific and conservation work. Some sites operate under municipal or community oversight. In terms of the regulations, vessel use in strictly controlled inside the MPA, for example 'No person may use or attempt to use any personal watercraft or hovercraft within the Marine Protected Area.' (Government Gazette No. 42479, Notice No. 777).

3. ABIOTIC CHARACTERISTICS

3.1 CLIMATE

Algoa Bay, within which Addo ENP MPA is located, is a large (~80 km diameter) and shallow (<70 m deep) coastal embayment with temperate coastal climate. It experiences warm summers (average highs around 25–28°C) and mild winters (average highs around 20°C). Rainfall is distributed relatively evenly throughout the year, with slightly wetter conditions in spring and autumn. The Bay is influenced by the warm Agulhas Current, which moderates temperatures and supports high marine biodiversity (Goschen et al. 2012, Jury 2019). Algoa Bay experiences variable wind regimes dominated by strong southwesterlies, with southeasterlies also dominant in summer. These regimes interact with the ocean in different ways, often driving seasonal upwelling and influencing sea temperatures (Schumann et al. 1991). Local upwelling can cause sharp temperature gradients along the coast (see Section 3.7). Fog and occasional berg winds further contribute to the Bay's dynamic coastal climate.

3.2 MARINE GEOLOGY

Algoa Bay lies on a relatively broad, shallow continental shelf, gradually sloping to deeper offshore areas. The shelf is relatively flat but is punctuated by rocky reefs and more rugged topography near the coastal margin and St Croix Island group. The seafloor is dominated by fine to coarse sands, with muddy sediments in deeper or sheltered areas. These sediments are primarily derived from river inputs, notably the nearby Swartkops Estuary and Sundays Estuary, and coastal erosion (Mee & Shone 1989). The 'Algoa Group' is an important geological feature that helps explain the underlying marine and coastal geology of Algoa Bay and its surrounding landscape. The Algoa Group is a geological formation composed primarily of Cenozoic (the most recent geological era, covering about the last 66 million years) sediments. Types include marine sands, estuarine and lagoonal muds and fluvial gravels and silts (Helm et al. 2024). Recent underwater seafloor surveys have refined our understanding of sedimentary processes on the shelf, showing how riverine input, sea-level fluctuations, and tectonic history shape seabed habitats across the Bay (Makhubele & Bordy 2021). The geological structure plays a key role in shaping marine habitats e.g. hard quartzites of the older Cape Supergroup and the softer sediments of the more recent Algoa and Uitenhage groups, results in varied underwater topography. Harder rocks form reefs and ridges, while softer layers erode into sandy plains and depressions.

3.3 BIOGEOGRAPHY

According to the most recent biogeographic divisions, Algoa Bay falls within the warm temperate 'Agulhas Ecoregion'; one of four inshore ecoregions (a region with similar environmental conditions and species) spanning the coast of South Africa (Emanuel et al. 1992, Bustamante & Branch 1996, Turpie et al. 2000, Branch et al. 2010). This ecoregion extends from the Mbashe River in the Eastern Cape west to Cape Point. It represents a dynamic mixing zone where the warm Agulhas Current interacts with the Benguela Current creating ecotonal conditions that enhance productivity and biodiversity. The shelf margin also extends considerably further offshore relative to the east and west of this bioregion (Emery & Uchupi 1975). At a finer scale, the area encompassing Algoa Bay is considered the Agulhas Inner Shelf Ecoregion (Sink et al. 2019a). This region is characterised by transitional oceanographic processes, which together support diverse benthic and pelagic communities. These characteristics of the coast play an important role in providing habitat for many organisms and contribute to supporting important fisheries (Wallace et al. 1984). The wide oceanic shelf provides an array of habitats and the mixing of water masses also plays a large role in accounting for high levels of biodiversity and uniqueness, including the highest number of endemic fish species along the South African coast (Turpie et al. 2000, Sink et al. 2019a).

3.4 COASTAL MORPHOLOGY

The coastline within the Addo ENP MPA covers a range of coastal habitat types, dominated largely by sandy beaches interspersed with rocky outcrops and mixed rock and sand habitats, with some stretches having been transformed through industrial development.

The Alexandria coastal dunefield is one of the largest active dune systems in the southern hemisphere, covering over 130 km² and stretching approximately 50 km along the eastern part of the MPA, between the Sundays Estuary mouth and Woody Cape. The Alexandria coastal dunefield is the largest of its kind in South Africa, ranging from 2 to 3 km in width (Illenberger & Rust 1988, Watson et al. 1996). The dunefield is a unique feature of Algoa Bay with dunes ranging from 10-90 m in height and extending several kilometres inland in places (Illenberger & Rust 1988). Beyond its striking geomorphology, the system has significant ecological value, supporting unique dune thicket vegetation, contributing to regional biodiversity, and acting as a natural buffer against coastal erosion and sea-level rise.

3.5 DRAINAGE

Aquifer

Hydrogeologically, the Addo ENP MPA region is characterised by the presence of aquifers. This is a significant water source in a water scarce region. The Algoa aquifer may contribute to freshwater inputs into coastal marine environments via submarine groundwater discharge. This process can transport nutrients, pollutants, or dissolved minerals into nearshore marine ecosystems, potentially influencing primary productivity or eutrophication (the over-enrichment of water with nutrients) (Dodd 2024).

An aquifer is an underground layer of water-bearing material, consisting of permeable or fractured rock, or of unconsolidated materials, which readily transfers water to wells and springs (Payne & Woessner 2010).

Estuaries

The Addo ENP MPA includes protection of the Sundays Estuary mouth which flows into Algoa Bay at Colchester. The Sundays Estuary is a large permanently open system which is considered

an ecologically important estuarine system in South Africa. The current 'Ecological Status' of this estuary is rated as a category 'C' (moderately modified) but it remains as highly important as a fish nursery area (Van Niekerk et al. 2019). Seasonal freshwater inputs from the Sundays Estuary strongly influences marine water quality and productivity within Algoa Bay and Addo ENP MPA. The estuary, and adjacent MPA habitats (e.g. sandbanks, beaches), are ecologically linked, supporting birds, sharks and fish species alike. The estuary's protection is vital for the recovery of overexploited fisheries resources like abalone *Haliotis midae* and kob *Argyrosomus japonicus*, and supports important feeding grounds for Critically Endangered African penguins and Endangered Cape gannets (Crawford et al. 2015, Van Niekerk et al. 2019). Addo's ENP MPA management objectives include protecting the reproductive capacity of commercially important species, supporting populations to recover, while maintaining ecological linkages with the Sundays Estuary.

3.6 BATHYMETRY

The majority of the Bay is between 20 and 50 m deep, with a maximum depth of 73 m across the Bay's mouth (Bremner 1983). Locally, numerous islands, depressions, ridges and scarps create additional gradients. The topography of the seabed comprises fragmented reef and sand and gradually slopes towards the Bay's mouth giving rise to the Bird Island group joined by a steep seaward-inclined discontinuous ridge called the Bird Island Ridge (Goschen et al. 2012), the most rugged bathymetry in Algoa Bay. Other islands including St. Croix, Brenton Rocks and Jahleel, include small, isolated outcrops of rock generally surrounded by a smooth sea floor (Goschen & Schumann 2011). Recent bathymetric analyses confirm this complex seabed structure and highlight how sediment transport and shelf morphology interact to shape benthic habitats (de Wet & Compton 2021). Stratigraphic studies further suggest that tectonic and sedimentary processes continue to influence basin morphology (Makhubele & Bordy 2021).

In a 2024 survey a fault zone was observed from seismic data, 1.7 km east of Brenton Rocks Island, suggesting a potential link to freshwater aquifers deep beneath the ocean. This discovery indicates that more detailed surveys are needed to understand these geological features better (Linol 2024).

3.7 OCEANOGRAPHY AND HYDROGRAPHY

Oceanographic and meteorological forces are important drivers in Algoa Bay. Nutrient rich water derived from a combination of current and wind-induced upwelling drives primary productivity. Primary production forms the foundation for the ecosystem supporting the marine food web, which in turn supports numerous fisheries and other ecosystem services.(Chalmers 2012).

The Addo ENP MPA is largely influenced by the dominant Agulhas Current. It carries warm, salty waters from the Indian Ocean, influencing the physical conditions near the MPA. The waters off the South Coast are warm temperate in nature, with average sea surface temperatures of 11°C in winter and 22°C in summer (Goschen & Schumann 1988, Schumann et al. 1988, Goschen et al. 2012). The Agulhas Current typically flows southwards along the coast at an average of approximately 1 m/s.

Upwelling events are a further source of temperature variability characteristic of the Eastern Cape coast, with upwelled water moving into Algoa Bay causing sharp changes in temperature by approximately 8°C within a 24 hour period (Schumann et al. 1988, Schumann 1999, Goschen & Schumann 2011). Several hundred kilometres to the northeast of Gqeberha, near East London, the current begins to move away from the shore as the continental shelf begins to widen (Dingle et al. 1987). Friction with the continental shelf occasionally forces cold, nutrient-rich water to the surface, enhancing productivity in the region. This generally results in the inshore waters being cooler by a few degrees compared with the Agulhas Current water further offshore (Schumann et al. 1988, Goschen & Schumann 1995). In Algoa Bay, wind-driven upwelling occurs most frequently in summer when east/north-easterly winds dominate.

The interaction between the warm Agulhas Current and cooler temperate upwelled waters along South Africa's coast contributes significantly to the country's exceptional coastal and marine biodiversity. As the Agulhas Current flows southward along the east coast, it gradually loses heat and occasionally interacts with nutrient-rich, cooler water masses, supporting a shifting mosaic of ecosystems. This dynamic oceanography enables the migration of numerous species, including the spectacular Sardine Run, during which millions of sardines travel from the subtropical East Coast into temperate waters (Roberts et al. 2010).

Algoa Bay, like the rest of South Africa, experiences semi-diurnal (twice daily) tides i.e., two high tides and two low tides each lunar day, with each successive high and low tide separated by 12 hours. Spring tides occur once a fortnight during full and new moons. Tidal activity greatly influences the biological cycles (feeding, breeding and movement) of many marine organisms, and influences when people visit the coastline. The tidal variation in the vicinity of Algoa Bay usually ranges between 0.21 m (relative to the chart datum) at mean low water springs to 1.86 m at mean high water springs with the highest and lowest astronomical tide being 2.14 m and 0 m respectively (SA Navy Tide Tables 2025). Periodic storm surges, however, occasionally result in the water reaching substantially higher levels.

Another factor that greatly influences marine ecology and human activities along the coastline is wave energy. The wave climate in Algoa Bay is predominantly from the south west with swells of less than 2 m most common and occurring approximately 80% of the time (Goschen & Schumann 2011). Most of Algoa Bay is protected from these swells by the rocky headland at Cape Recife. As wind speeds increase, so does wave size. On occasion, large waves enter Algoa Bay, contributing to a dynamic coastline where sand is frequently shifted, reshaped, and redistributed along beaches and nearshore habitats.

3.8 ISLAND GROUPS

Two island groups are located within the Addo ENP MPA and are unique features along the South African east coast, being the only islands between Cape Agulhas and southern Mozambique. The 'Islands of the Cross' – St Croix Islands – are situated within the western sector of Algoa Bay consisting of three separate outcrops, St Croix, Jahleel and Brenton Rocks Islands (Figure 2.1). St Croix is the largest with an area of 0.12 km^2 rising to a height of 58 m above sea level. The St Croix Islands were proclaimed as South Africa's first island marine reserve in 1981 and included a marine component within a 300 m radius around each island, which was extended to 500 m in 1991.

Bird, Stag and Seal islands and a rock outcrop known as Black Rocks form the Bird Island group situated approximately 10 km offshore of the Woody Cape headland in the eastern section of the Addo ENP MPA (Figure 2.1).They have a low relief and are sparsely vegetated with a mixture of shrubs. The islands are important to several birds including the African penguin *Spheniscus demersus*, Cape gannet *Morus capensis* and several species of migrant terns, including the endangered roseate tern *Sterna dougallii*. Black Rocks is home to the eastern-most breeding colony of Cape fur seals *Arctocephalus pusillus* in the region (Huisamen et al. 2012). The Bird Island MPA was proclaimed in June 2004 (DEAT 2004). Both island groups were subsequently incorporated into the Addo ENP MPA.

The group of islands in Algoa Bay are together recognised as an Important Bird and Biodiversity Area (IBA) by BirdLife-SA as well as a global Key Biodiversity Area (KBA) by IUCN. The Addo ENP MPA hosts the largest global populations of Cape gannets, classified as Endangered, on Bird Island (Sherley et al. 2019). Until recently, St. Croix Island was the world's largest breeding colony of African penguins but has since declined dramatically by over 85% since 2016, largely attributed to elevated noise levels in from increased ship traffic (Pichegru et al. 2022). The more rugged seafloor found around the islands also host rocky reef habitats which play a supporting and nursery role for many reef fish species (Beckley & Buxton 1989).

4. BIOTIC CHARACTERISTICS

4.1 INTRODUCTION

The Addo ENP MPA encompasses a unique stretch of South Africa's coastline. Characterised by its diverse ecosystems and its unique environments, the MPA supports a rich mosaic of biodiversity, including numerous endemic and regionally important species (Lombard et al. 2004, Sink et al. 2019a). The Addo ENP MPA plays a vital role in sustaining ecological processes and connectivity along the Eastern Cape coastline (Harris et al. 2019c). The integration of terrestrial and marine conservation efforts in this region enhances the MPA's contribution to biodiversity protection and ecosystem resilience.

Plankton includes both phytoplankton (microscopic plants) and zooplankton (microscopic animals)

4.2 PLANKTON

Plankton communities within the Addo ENP MPA form the foundation of the marine food web. Influenced by seasonal upwelling and estuarine inputs, these communities exhibit high productivity and play a crucial role in nutrient cycling and

Phytoplankton are tiny photosynthetic organisms and are primary producers in marine ecosystems. In temperate seas, phytoplankton exhibit distinct seasonal growth cycles influenced by nutrient availability, oxygen, temperature and sunlight. The intrusion of cold, nutrient-rich water into Algoa Bay can strongly influence productivity and the presence of phytoplankton in the Bay (Goschen et al. 2012, Lemley et al. 2017).

Surf zones are prevalent along the sandy habitat within Addo ENP MPA and have been well studied (McLachlan et al. 1981). Due to the absence of macroalgae within high-energy surf zones, including Sundays Estuary beach, large accumulations of surf diatoms (a type of phytoplankton) (e.g. *Anaulus australis*) are the main source of primary production. These diatoms provide productivity in otherwise producer-poor environment, and form a crucial trophic link by supporting filter organisms and some fish species (McGregor & Strydom 2020), with juvenile fish observed exploiting surf diatom accumulations at Sundays Beach (McLachlan et al. 1981, Talbot & Bate 1988, Odebrecht et al. 2015, McGregor et al. 2021). Surf zones therefore serve as important nursery and transitional habitats (Campbell & Bate 1988a, 1991, Bergamino et al. 2016, McGregor & Strydom 2020). Research has also shown that surf diatom dynamics in Algoa Bay are strongly shaped by nutrient inputs and local hydrodynamics (Campbell & Bate 1988b). Strong rip currents, long beach stretches, and nutrient input from freshwater aquifers help these diatoms proliferate. Nitrogen-rich groundwater and coastal drainage can also fuel these blooms, creating localized hotspots of productivity (Campbell & Bate 1988a, 1991, Talbot & Bate 1988).

Zooplankton, which feed on phytoplankton, include tiny larvae of various marine species such as fish and crustaceans. These zooplankton are, in turn, preyed upon by larger marine animals, establishing a crucial link in the marine food chain. Zooplankton therefore play a key role in the functioning of marine ecosystems and biogeochemical cycles (Hays et al. 2005). Several species comprise the zooplankton communities along the sandy beaches of Algoa Bay, including holo-, mero- and facultative planktonic forms (Romer 1986). Two mysid shrimps (*Gastrosaccus psammodytes* and *Mesopodopsis wooldridgei*) and one penaeid shrimp (*Macropetasma africanus*) form the bulk of the zooplankton biomass and occur in dense concentrations in the inshore waters (Wooldridge 1983). See Appendix H for a full list of planktonic taxa recorded within the Addo ENP MPA.

Zooplankton have developed behavioural mechanisms to ensure that they capitalise on the high food availability behind the surf zone after dusk (Bandara et al. 2021). Resulting dense zooplankton swarms provide a critical food resource for juvenile fish in surf zones, including important estuarine and coastal species like mullets, gobies, and white steenbras (Montoya-Maya & Strydom 2009, McGregor & Strydom 2020).

4.3 ALGAE

Macroalgae are relatively limited in Algoa Bay due to the dominance of sandy substrates and high wave energy, which restrict suitable rocky habitat for attachment. However, patches of macroalgae do occur on subtidal reefs and around rocky outcrops such as St Croix Island, where they support diverse invertebrate and fish communities (Beckley 1986, James et al. 2024).

The limited macroalgal cover means that phytoplankton, including surf diatoms, contribute more significantly to primary production in the Bay. Despite this, macroalgae still play an important ecological role in areas where they occur by providing food, shelter, and nursery habitat for marine organisms e.g. fish species such as strepie *Sarpa salpa* and blacktail *Diplodus capensis*. In the Addo ENP MPA, the presence of scattered reefs and rocky islands offers some refuge for macroalgal growth within an otherwise sediment-dominated system.

Subtidal island reefs are dominated mainly by red foliose species, especially *Plocamium* spp., and the lower growing *Laurencia* spp. (up to 10 cm tall), with intertidal reef flats dominated by low-growing coralline turf *Jania* spp. (James & Whitfield 2023). See Appendix G for a full list of algal species recorded within the Addo ENP MPA. These assemblages help link benthic primary production to higher trophic levels (Beckley 1985).

4.4 MARINE INVERTEBRATES

4.4.1 MACROFAUNAL COMMUNITIES

Relatively few detailed local studies have been conducted on subtidal habitats in Algoa Bay, although some information describing benthic community structure is available. Awad et al. (2002) analysed the distribution of major marine benthic invertebrate taxa (polychaetes, molluscs, crustaceans, echinoderms, etc.) around South Africa, highlighting Algoa Bay as an area of conservation importance (see Appendix E for a comprehensive marine invertebrate species list for the Addo ENP MPA). Visual assessments have documented shallow reef macrofaunal communities to be dominated by seaweeds, with ascidians, octocorals, hydrozoans and sponges becoming more abundant on deeper reefs (Beckley & Buxton 1989). However, due to the lack of taxonomic information for these invertebrate groups, and the limited subtidal surveys conducted both nationally and locally, the diversity and community structure within the Bay is largely unknown (Parker-Nance 2003). Unique stromatolitic and biogenic reef structures in parts of Algoa Bay further add to its benthic diversity (Rishworth et al. 2020). More recently new sponge species have been described from Algoa Bay reefs, such as *Tsitsikamma (Clavicaulis) michaeli*, while studies on *Tethya rubra* at Evans Peak and Riy Banks have shown site-specific variation in microbial symbionts and chemical profiles (Parker-Nance et al. 2019).

Sponge-associated bacteria from *Isodictya compressa* and *Higginsia bidentifera* collected in Algoa Bay have also demonstrated antibacterial activity and the potential for novel natural product discovery (Matobole et al. 2017).

Recent work has helped fill a critical knowledge gap regarding the composition and drivers of epibenthic communities on soft sediment habitats in Algoa Bay (Truter et al. 2022), identifying two distinct communities across the Algoa Bay depth range (30–100 m) using seabed imagery. Overall, polychaetes were most prevalent, with anthozoans, hydrozoans and crinoids also occurring in high abundances. This highlights the ecological heterogeneity of soft-sediment habitats in the Bay and underscores the importance of considering multiple environmental drivers when assessing benthic biodiversity in data-limited regions. These results align with earlier work showing strong links between algal-associated epifauna and benthic biodiversity (Beckley 1985), and are complemented by recent findings that red algae-dominated reefs around Cape Recife, just outside the Addo ENP MPA, provide important a nursery habitat for fish (James et al. 2024). However, sessile macroinvertebrates such as sponges, ascidians, and bryozoans remain poorly documented in the region, indicating the need for further taxonomic and ecological surveys on both soft and hard subtidal substrates. Despite this, the Addo ENP MPA is considered to be home to the largest share of endemic marine invertebrates and seaweeds within South Africa (https://www.marineprotectedareas.org.za/addo-elephant-national-park-mpa).

4.4.2 SQUID OR 'CHOKKA'

The nearshore waters of Algoa Bay, particularly those shallower than 50 m, serve as critical spawning and egg-laying habitats for the commercially important 'chokka' squid *Loligo reynaudi*. Multiple spawning sites and dense aggregations of egg beds have been documented in the Bay (Sauer 1995). These spawning grounds are characterized by soft sandy substrates suitable for egg capsule attachment and are typically re-used over successive breeding seasons, indicating strong site fidelity by spawning females (Jacobs et al. 2022). Experimental studies show that embryonic development and hatching success are strongly influenced by temperature and oxygen variability (Oosthuizen & Roberts 2009), highlighting the sensitivity of spawning to local oceanographic conditions.

Portions of these key spawning habitats fall within the boundaries of the Addo ENP MPA, offering a level of spatial protection to this ecologically and economically valuable species. Peak commercial fishing effort is typically concentrated between Tsitsikamma and the Sundays Estuary, with some fishing effort occurring in the eastern part of Algoa Bay near the Addo ENP MPA. The Controlled Zone of the MPA encompasses several historically documented spawning sites, and although certain fishing activities are still permitted within this zone, the regulation of bottom contact gear

and seasonal closures can help mitigate habitat disturbance during peak spawning periods.

This spatial protection is particularly important given the intense fishing pressure in Algoa Bay, where chokka squid are heavily targeted by both inshore jigging vessels and demersal trawlers operating in close proximity to egg beds (Augustyn et al. 1992, Sauer 1995, Chalmers et al. 2014).

Protecting these habitats within the Addo ENP MPA contributes not only to the conservation of squid spawning grounds but also to the sustainability of the chokka squid fishery, which is one of South Africa's most valuable commercial fisheries. Squid also play a vital ecological role as prey for higher predators, including African penguins (Connan et al. 2016), further underscoring the importance of protecting spawning grounds. Continued monitoring of egg bed distribution and spawning activity within the MPA will be important to assess the effectiveness of current protection measures and inform adaptive management, especially under increasing pressure from climate variability and human activities (Sauer 1995).

4.4.3 ABALONE

The abalone or perlemoen *Haliotis midae* is a high-value species which has been commercially exploited in South Africa since 1949 (Steinberg 2005). Although the perceived low abundances and patchy nature of abalone in the Eastern Cape prevented the development of a large scale commercial fishery, the Eastern Cape became a major source of abalone for the illegal markets in the mid-1990s (Raemaekers & Britz 2009). The growth and economic value of the illegal sector is highlighted by the shift in poaching activity from being largely shore-based and in close proximity to urban centres in the late 1990s, to a highly organised boat-based poaching operation that involves travelling considerable distance at sea (Raemaekers et al. 2011). The shallow reefs and rich macroalgal communities around Bird Island support dense invertebrate communities including abalone (Holness et al. 2022).

The challenges faced by management authorities in controlling increasing illegal poaching activities from 2003 onwards highlighted the vulnerability of abalone populations in the Bird Island MPA. Although the former Bird Island MPA was not originally declared for abalone conservation, the species was explicitly included as an objective in the 2019 proclamation of the larger Addo ENP MPA.

The expanded MPA now provides a vital role in safeguarding remaining abalone populations and supporting broader conservation efforts for this Endangered and heavily exploited species. Recent biophysical modelling suggests that larval connectivity and dispersal processes in the region may further enhance the role of MPAs in sustaining abalone populations (McCarroll et al. 2021).

4.5 MARINE VERTEBRATES

Dominant marine vertebrate fauna of the Bay and the MPA can be grouped into marine mammals (seals, whales, dolphins), birds (penguins, gannets, terns, etc.), fish (migratory and reef species) and highly diverse pelagic fish and shark species. See Appendix *A* for a full list of marine mammals recorded within the MPA

4.5.1 SEABIRDS

The islands of Algoa Bay are home to many Endangered, Vulnerable and Near Threatened birds including breeding colonies of African penguin, Cape gannet, African black oystercatcher *Haematopus moquini*, roseate tern, the endangered Cape cormorant *Phalacrocorax capensis*, as well as Damara tern *Sternula balaenarum* and Antarctic tern *Sterna vittata*, which visit in winter (Tree & Klages 2004). See Appendix B for a full list of birds and shorebirds recorded within the Addo ENP MPA. The islands provide vital breeding, roosting, and feeding habitats for these seabirds. Many raise their chicks in burrows or on open ground and African black oystercatchers nest and forage along the rocky shores, while Roseate and Antarctic terns use the islands for nesting, roosting, or resting during migration and the Damara tern can be found nesting on neighbouring dune systems (Braby et al. 2001). These islands offer safe, predator-free sites essential for the survival of these vulnerable bird species.

However, many of these important seabirds are declining around South Africa. The African penguin is endemic to southern Africa (Whittington et al. 2005) and populations in Algoa Bay, particularly on St Croix and Bird Islands, are facing a critical decline (Sherley et al. 2024). Once home to the world's largest colony, St Croix Island's penguin numbers have

plummeted to approximately 750 breeding pairs as of the 2025 season. The Bird Island colony has remained stable at around 1,800 breeding pairs. Overall, South Africa's African penguin population has dwindled to fewer than 9,000 breeding pairs (as of 2025), with projections indicating potential extinction in the wild by 2035 if current trends persist (Southern African Foundation for the Conservation of Coastal Birds (SANCCOB) 2025) (for more details see Section 8.2).

Both the Cape gannet and Cape cormorant are currently listed as Endangered (BirdLife International 2025), while Algoa Bay also supports nesting populations of the Damara tern, which is decreasing globally (BirdLife International 2021). Long-term monitoring shows that Cape cormorants in particular are highly sensitive to prey fluctuations and human disturbance, reinforcing the value of strict no-take zones around breeding islands (Crawford et al. 2016, Sherley et al. 2020).

This highlights the importance of the islands within the Addo ENP MPA in providing critical habitat and protection for several bird species, particularly those facing population declines. Many of these seabirds forage within 20–40 km of their colonies, making the nearshore waters of the Addo ENP MPA critical for chick provisioning (Campbell et al. 2019). The islands are designated as Important Bird and Biodiversity Areas (IBAs) and lie within a no-take zone of the Addo ENP MPA.

Active conservation measures e.g., predator control (e.g. rodents or gulls), nesting habitat improvement, and monitoring of chick success and foraging ranges, are key strategies used by SANParks and partner NGOs (e.g. BirdLife and SANCCOB). Adaptive management that integrates fisheries closures, predator management, and disease surveillance is increasingly recognised as essential to preventing further declines (Crawford et al. 2018).

4.5.2 MARINE MEGAFAUNA

Whales and dolphins

Algoa Bay supports a vast array of cetaceans, which use the Bay as a calving and nursery area. The Bay's high biodiversity value is reflected in its designation of two Important Marine Mammal Areas (IMMAs) and the focus of multiple spatial conservation efforts. Regular sightings of three whale species and three dolphin species are well documented (Saayman et al. 1972, Karczmarski et al. 2000, Melly et al. 2018). See Appendix A for a full list of marine mammals recorded within Addo ENP MPA. A stretch of coast from the Sundays Estuary to Woody Cape has been identified as a key habitat for southern right whales *Eubalaena australis*, humpback whales *Megaptera novaeangliae*, and bottlenose dolphins *Tursiops aduncus*.

Inshore areas of the Bay provide essential habitat for the Indo-Pacific humpback dolphin *Sousa plumbea*, the most vulnerable coastal cetacean in the Indian Ocean. Fewer than 500 individuals are estimated to remain in South Africa, with Algoa Bay representing critical habitat for the declining 'south coast' population (Saayman et al. 1972, Cerchio et al. 2015, Plön & Relton 2016, Braulik et al. 2023). Remarkably, the largest groups of Indo-Pacific bottlenose dolphins ever recorded globally have been observed in Algoa Bay, with aggregations reaching up to 600 individuals, nearly twice the size of groups observed on the Wild Coast (Bouveroux et al. 2018), earning it the title of 'Bottlenose Dolphin Capital of the World'.

Seasonal patterns further highlight the Bay's importance: southern right whales are commonly seen in winter and spring, while Bryde's whales *Balaenoptera edeni* are more frequent in summer and autumn, underlining the year-round ecological significance of the Addo ENP MPA and Algoa Bay for marine mammal conservation (Best 2001, Findlay et al. 2017).

Seals and sharks

The Black Rocks outcrop is the most easterly Cape fur seal breeding colony in southern Africa, with a population of approximately 2,000 seals (Kirkman et al. 2006). The Cape fur seal is the only pinniped (aquatic, fin-footed mammal) native to southern Africa and is the primary prey species of the great white shark *Carcharodon carcharias* (Kirkman et al. 2013). As a result, the inshore waters surrounding the islands of the Addo ENP MPA are frequented by great white sharks during the winter when white sharks hunt juvenile seals (Dicken et al. 2013, Klein et al. 2022, Kock et al. 2022). Recent tracking studies have highlighted the seasonal residency of great whites in Algoa Bay and their connectivity with other South African aggregation sites (Towner et al. 2019), providing critical information for risk assessments of human-shark interactions and conservation planning.

The ragged-tooth shark *Carcharias taurus* is a wide-ranging coastal species found primarily in warm-temperate and tropical waters. Algoa Bay provides shelter for juveniles of the species in the form of nursery areas (Dicken et al. 2011, Smale et al. 2015). This species is listed as Critically Endangered regionally and globally due to low reproductive output and high vulnerability to fishing pressures (IUCN 2020), underscoring the importance of the Addo ENP MPA as a nursery area for this species.

Other sharks found in the Bay include the bronze whaler *Carcharhinus brachyurus*, dusky shark *Carcharhinus obscurus*, lesser sandshark *Acroteriobatus annulatus* and rays, e.g. blue stingray *Dasyatis chrysonota* and eagle ray *Myliobatis aquila* are encountered in the region along with many other species (Heemstra & Heemstra 2004, ATAP 2022). See Appendix C for a full list of chondrichthyan species recorded within the Addo ENP MPA. The adults of these species usually occur in deeper waters while the juveniles are common in the coastal waters which serve as nursery areas (Smale 1991). They feed on a variety of pelagic and benthic fish and cephalopods. Bronze whalers and dusky sharks are classified as Near Threatened globally (IUCN 2020), with declines linked to overfishing and bycatch, while several ray and skate species are also under increasing pressure. Protecting coastal nursery habitats within the Addo ENP MPA is therefore an important contribution to regional shark and ray conservation.

4.5.3 FISH

Fish communities in Algoa Bay and the Addo ENP MPA are highly diverse, occupying a range of habitats that include subtidal rocky reefs, sandy bottoms, estuaries, surf zones, and nearshore pelagic open water. These habitats support a variety of life stages, from larval and

juvenile fish to adult populations of both resident and migratory species. However, despite the ecological importance of this area, there have been few recent fisheries-independent assessments, and most of the available data come from historical studies or fishery-dependent sources (Kirkman et al. 2021, James et al. 2024)

Surf and reef fish communities are described in detail by Laiak (1981), Buxton (1987), Beckley & Buxton (1989), and Whitfield & Pattrick (2015) where around 50 teleost and four elasmobranch species were identified from various surveys. Sparids such as strepie *Sarpa salpa*, zebra *Diplodus hottentotus*, Cape seabream *Pachymetopon aeneum,* white seabream *Diplodus sargus*, sand steenbras *Lithognathus mormyrus* and white stumpnose *Rhabdosargus globiceps* were frequently caught, in addition to southern mullet/harder *Chelon richardsonii*, olive grunter *Pomadasys olivaceus* and sandsharks *Acroteriobatus* spp. (Refer to Appendix D for a full list of teleost species recorded in the Addo ENP MPA). These fish were classified into three ecological groups: shallow-water residents, deeper reef recruits, and sand-associated species as they utilise this range of habitats in Algoa Bay. Shallow reefs within the MPA, especially around the islands, are thought to serve as key nursery areas for juvenile reef and estuarine-associated species (James et al. 2024). These fish assemblages are, however, highly variable. During early life stages intertidal rock pools and surf zones are known to provide essential shelter and foraging habitat for juvenile fish (Beckley 1985). Nursery areas are also particularly important for estuarine-dependent species such as dusky kob *A. japonicus*, shad *Pomatomus saltatrix* and flathead mullet *Mugil cephalus*, many of which support coastal subsistence and recreational fisheries (Kirkman et al. 2021).

A study of larval fish assemblages recorded over 6,000 larvae, representing 78 species across 32 families (Pattrick & Strydom 2008). The assemblages were dominated by Clupeidae (herrings, sardines, and shads), Gobiidae (gobies), Cynoglossidae (soles), Sparidae (seabreams and allies), and Engraulidae (anchovies), indicating that these groups are key contributors to the early-life fish community in the study area (Pattrick & Strydom 2008). This highlights the ecological role of the shallow nearshore zone in sustaining local fish populations. Follow-up work on larval dispersal in the Eastern Cape has shown strong links between estuarine outflows, wind-driven

transport, and recruitment variability (Pattrick et al. 2013).

The importance of these estuarine and nearshore habitats has been repeatedly highlighted throughout the years and many of the species that inhabit reefs, surf zones, and estuaries have been historically overexploited. Species such as red roman seabream *Chrysoblephus laticeps*, galjoen *Dichistius capensis* and dusky kob have suffered major population declines due to fishing pressure (Attwood & Farquhar 1999, Griffiths 2000). Threats such as illegal fishing, habitat degradation, bycatch, and climate-driven changes to larval dispersal further compound the challenges for fish conservation in this region. Tagging studies in Algoa Bay have also highlighted the restricted movements of many reef-associated fishes, reinforcing the importance of localised protection within MPAs (Cowley et al. 2008). Despite some degree of recovery in other MPAs (Kirkman et al. 2021), limited monitoring within Algoa Bay means the status of these species remains uncertain. However, protection of the Sundays Estuary and the various habitats inside the Addo ENP MPA is likely to provide benefit in the maintenance of many of these overexploited species.

In addition, Algoa Bay plays a prominent role in large-scale pelagic fish dynamics. The region is considered the southernmost staging point of the annual Sardine Run, one of the largest marine wildlife migrations on the planet (Coetzee et al. 2010, van der Lingen et al. 2010, Teske et al. 2021). Each year, vast shoals of sardines migrate from the Agulhas Bank up the South African east coast, driven by oceanographic forces including upwelling and cold-water currents. While peak sardine activity occurs further north along the Wild Coast and KwaZulu-Natal coastline, Algoa Bay marks the beginning of this journey. These aggregations attract a variety of predators such as common dolphins, Cape gannets, sharks, and whales, resulting in dramatic feeding spectacles that underscore the ecological importance of this region for both resident and migratory fish and their predators (Roberts 2010, van der Lingen et al. 2010).

4.6 ECOSYSTEM TYPES

Rocky shores

Rocky intertidal habitats, or rocky shores, are dynamic coastal ecosystems characterized by rock substrate exposed to powerful wave action,

sun, rain and tidal fluctuations, creating a harsh yet remarkably diverse habitat. The rise and fall of tides partition the shore into distinct horizontal zones from the upper 'Littorina zone' (dry most of the time, characterized by organisms that can tolerate these harsh conditions: *Littorina* spp. snails, barnacles, periwinkles, and certain types of algae) to the 'infratidal zone', which remains moist or submerged (often hosting mussel beds and seaweeds). These habitats support high biodiversity including of seaweeds, grazing invertebrates, filter feeders (barnacles, mussels), as well as endemic and resource species such as the Endangered abalone (or perlemoen) *H. midae*. The Addo ENP MPA encompasses a diverse coastline featuring natural rocky outcrops, including Cape Padrone and the Bird and St. Croix Island groups.

Rocky shores are accessible and at the intersection of land and sea, which makes then vulnerable to threats like overharvesting, pollution, oil spills, alien species invasions and climate-driven environmental change (Clark et al. 2002, Griffiths et al. 2010, Mead et al. 2013, Dorrington et al. 2018). Exploited for thousands of years, mainly for food, overharvesting of dominant species often paves the way for ephemeral or nuisance algae to colonise (Martins et al. 2010), while bare substrate becomes vulnerable to invasion by alien species (Airoldi et al. 2005).

A range of ecological studies in Algoa Bay provide valuable baselines on rocky shore community structure and function. Early work highlighted intertidal biogeographic patterns and mussel recruitment variability (Bustamante & Branch 1996, McQuaid & Phillips 2006), while Beckley & McLachlan (1979) documented seaweed and zonation around St. Croix Island. Algoa Bay has been identified as a hotspot for marine invertebrate richness and endemicity, with recent studies emphasizing the nursery function of macroalgae beds (Awad et al. 2002, James et al. 2024). Stromatolitic formations around rocky shores also provide unique ecological insights (Rishworth et al. 2020). More recently, species-specific metabolic and physiological responses to thermal stress in Algoa Bay intertidal organisms were demonstrated (Tagliarolo & McQuaid 2016), underscoring their vulnerability to heatwaves and extreme low-tide exposure. These findings emphasise the need for long-term monitoring, particularly in light of climate change and human impacts.

To support sustainable use and biodiversity conservation, the Addo ENP MPA is zoned into Restricted (no-take) and Controlled-use areas, offering different levels of protection while maintaining equitable access for local communities. Recent long-term monitoring early results show that protected zones host greater species richness and structural complexity than unprotected areas. Furthermore, resource species like alikreukel *Turbo sarmaticus* and blood-spotted abalone *H. spadicea* were larger and more abundant in protected areas, affirming the MPA's role in supporting biodiversity and reducing harvesting pressure (Lawrence et al. unpublished data). These findings underscore the critical role of the Addo ENP MPA and its zoning framework in safeguarding the ecological integrity of rocky shore habitats. By providing varying levels of protection across its zones, the MPA enables both conservation and sustainable use, supporting ecological resilience in the face of ongoing pressures including climate change, pollution, and invasive species.

4.6.1 SANDY BEACHES

Sandy beaches in the Addo ENP MPA and broader Algoa Bay region are shaped by the interaction of sand grain size, wave energy, and tidal range, leading to a range of beach ‘types’ (McLachlan et al. 2018). The sandy beaches are predominantly intermediate, with conditions typically between reflective (steep, course sand and low wave energy) and dissipative (flat, fine sand and high wave energy) states, and consist of well sorted fine to medium sized quartz sands (Mee & Shone 1989, McLachlan et al. 2018, Pfaff et al. 2019, Sink et al. 2019b). The Alexandria dune system dominates the coastal habitat inside the MPA and therefore sandy beaches are prevalent along its entire coastline.

These beaches host an array of specialised macrofauna, including burrowing invertebrates like the scavenging gastropods *Bullia* spp. and the filter-feeding surf clams *Donax serra* and *Scissodesma spengleri* (Brown 1971). These species form critical links in the food web, supporting surf-zone fish, shorebirds, and other predators. The beaches also provide feeding grounds for birds like African oystercatchers and are occasionally associated with surf diatom *Anaulus* spp. blooms and accumulations of kelp wrack, which enhance productivity and biodiversity (Harris et al. 2019a b).

Maintaining the integrity of these beaches is essential to preserve these dynamic systems and the ecosystem services they provide e.g. nutrient cycling, water filtration, shoreline protection. This requires protecting the natural connectivity between dune systems, sandy beaches, and the surf zone. As one of the few South African MPAs adjacent to a terrestrial national park, Addo ENP MPA offers rare opportunities for integrated land-sea conservation of ecotonal coastal systems (Harris et al. 2019c).

4.6.2 SUBTIDAL SOFT SEDIMENT HABITAT

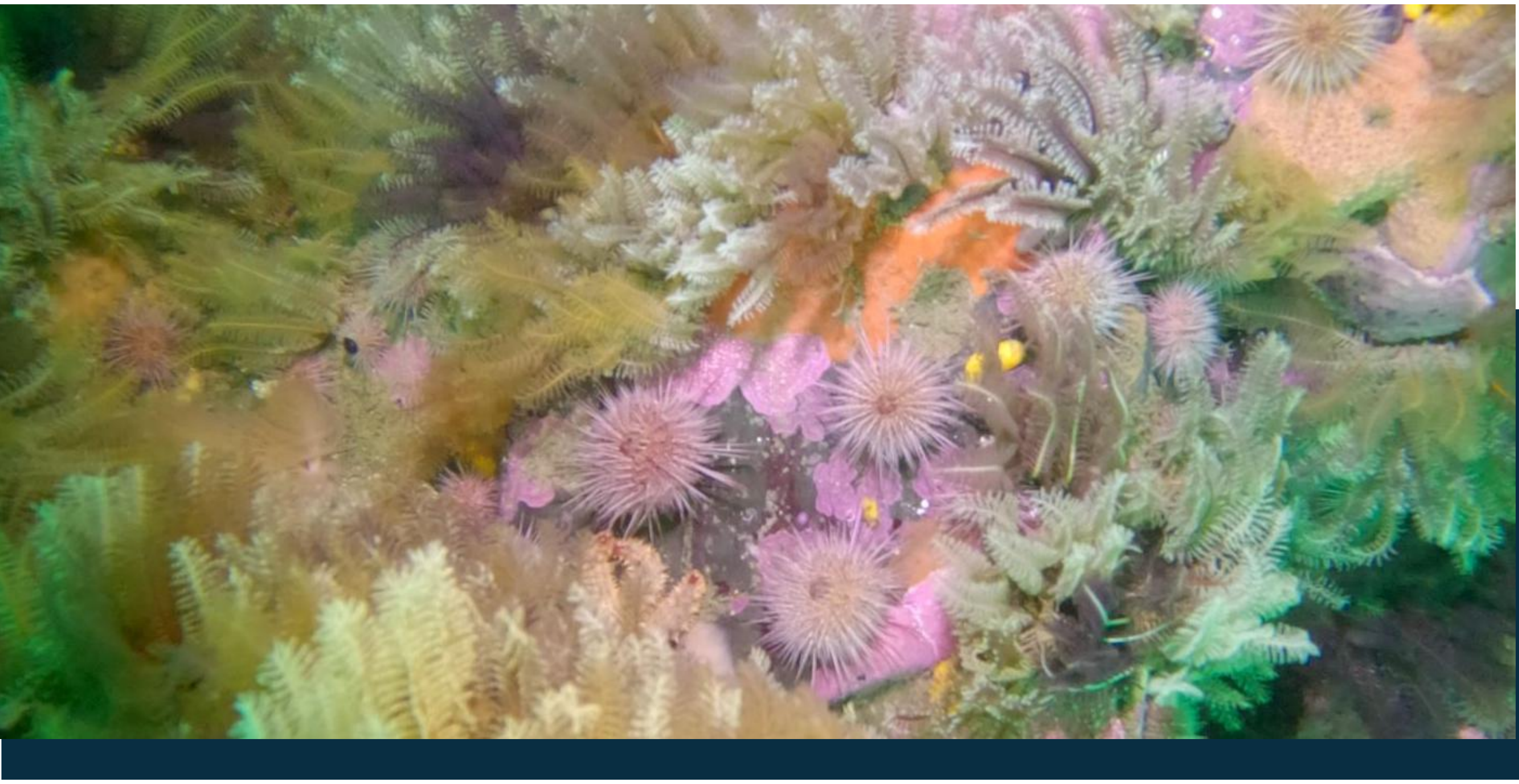
The subtidal soft-bottom habitats of Addo ENP MPA consist primarily of sandy and muddy sediments, particularly within the sheltered areas of the Bay, which support diverse benthic communities including worms, amphipods and burrowing bivalves. Although less structurally complex than rocky reefs, soft-bottom areas provide essential ecosystem functions such as nutrient cycling and habitats for demersal fish species (Chalmers 2012). In the Addo ENP MPA species of rays and flatfish utilise these habitats for foraging and refuge, and species such as hake and kingklip may also use them as nursery grounds. Soft sediments also support ecologically important infaunal assemblages that underpin secondary production and provide prey for higher trophic levels (Roth & Wilson 1998, Snelgrove 1998, 1999, Branch et al. 2010). The productivity of these areas is enhanced by the input of organic matter from nearby estuaries. Soft sediments near the mouth of the Sundays Estuary and within the sheltered zones of the Bay are also important for fish like dusky kob and organisms that inhabit the seabed (Cowley et al. 2008, James et al. 2024). Maintaining these habitats is essential for the ecological functioning of the MPA and the sustainability of surrounding fisheries. A study of nearshore subtidal macrobenthic communities along the western shore of the Bay, reported a high diversity of species (Masikane 2011), and it has been suggested that the invertebrate diversity within the Bay may be extraordinarily high and include several previously undescribed taxa (Dorrington et al. 2018). Additional surveys in Algoa Bay and along the South African coast highlight high levels of regional endemism among benthic invertebrates, as well as sensitivity to trawling and dredging impacts (Atkinson et al. 2011, Fennessy 2016). Climate-driven shifts in sediment temperature, oxygenation, and organic input are expected to further alter these benthic communities, with implications for ecosystem services and fisheries (Kroeker et al. 2013).

4.6.3 SUBTIDAL ROCKY REEF HABITAT

Relative to sandy habitats, reefs are scarce in Algoa Bay. On shallow subtidal reefs (<10 m), algae, grazers and filter feeders are the most prolific fauna. Dominant algae consist mainly of red foliose species, especially *Plocamium* spp. The ascidian red bait *Pyura stolonifera* is also abundant (Beckley & Buxton 1989). Cape rock oysters *Striostrea margaritacea* are prevalent, particularly in areas prone to periodic sand inundation. Abalone are an important species occurring particularly on algae-dominated reefs. The protected areas of the Addo ENP MPA play a critical role in supporting conservation efforts for this Endangered, and heavily illegally fished, species. Evidence from ecological surveys and fishery records shows steep population declines of abalone outside protected areas due to poaching, underscoring the conservation value of refugia within MPAs (Mayfield & Branch 2000, Raemaekers et al. 2011).

Deeper reefs below 10 m are characterised by high levels of diversity and dominated by many species of filter feeders, particularly colonial ascidians, sponges, sea fans, soft corals and bryozoans (Wooldridge & Coetzee 1998). Sponges and ascidians are especially diverse on subtidal reefs in the region and are particularly poorly studied. Sea fans are common in the area as is the purple soft coral *Alcyonium fauri*. Bryozoans become more abundant with depth due to their fragile structure as do feather stars. Macroalgae (seaweeds) are relatively limited in distribution and abundance in Algoa Bay, especially compared to South Africa's more temperate, high-energy west coast and parts of the south coast. Where rocky substrates do occur (e.g. around the islands), some macroalgal species may be found, but they are generally patchy and low in biomass compared to the west coast kelp forests. Much of the Bay is dominated by sandy beaches and soft-bottom subtidal zones, which are unsuitable for macroalgal attachment.

Subtidal reefs within the MPA provide important habitat for a range of reef-associated fish species, including several sparids of ecological



and fisheries significance. These reefs support both adult and juvenile fish, highlighting their role as feeding grounds and nursery areas critical to sustaining local fish populations (Beckley & Buxton 1989). Tagging and fishery-independent surveys confirm that MPAs enhance the abundance and size structure of reef fish such as red roman *C. laticeps* and red steenbras *Petrus rupestris* (Buxton & Smale 1989, Kerwath et al. 2013), reinforcing the ecological role of reef protection in sustaining fisheries.

4.6.4 PELAGIC HABITATS AND THE BAY

The open ocean, or pelagic environment, is a vast expanse of water far from the shore and seabed, playing a vital role in ocean ecosystems. MPAs help safeguard important feeding grounds in these open waters for highly mobile species such as whales, sea turtles, and seabirds (Reynolds 2012). In the Addo ENP MPA, the Bay and adjacent open ocean are crucial for supporting key habitats used by many of these wide-ranging animals (Melly et al. 2018).

Within this environment, food webs are built from the bottom up. Plankton supports small pelagic fish like sardines and anchovies, which in turn are a critical food source for humans and many predators, including African penguins, Cape cormorants, Cape fur seals, and various sharks. The pelagic zone also hosts seasonal gatherings of whales and squid, with Bryde's whales, humpback whales, and common dolphins regularly observed feeding in Algoa Bay on small pelagic fish and squid (Best 2007, Koper et al. 2016) highlighting its importance for biodiversity and ecological functioning.

5. **HISTORY AND MARINE CULTURAL HERITAGE**

5.1 ARCHAEOLOGY AND PALAEONTOLOGY

The Addo ENP and its coastal fringe, particularly the Woody Cape dune fields, preserve a remarkable record of early human history in southern Africa. Long before written records, early inhabitants left behind a legacy of cultural and subsistence practices, preserved in the form of rock art, stone tools, and shell middens. San rock art, found in shelters throughout the region, vividly portrays daily life, hunting scenes, animals, and spiritual rituals (Deacon 1976).

In South Africa, small hunter gatherer groups lived at the coast, where they exploited marine resources such as shellfish (mussels, oysters, perlemoen (abalone), fish, seals and sea birds. Archaeological finds from the Early, Middle, and Late Stone Ages, such as hand axes, spearheads and grave goods, demonstrate the technological and social evolution of human groups over tens of thousands of years. One of the most significant features of the region is its shell middens: large accumulations of discarded marine shells, bone fragments, pottery, and tools that offer a detailed record of coastal life stretching back more than 100,000 years. Over time, especially in the last 2,000 years, the contents of middens shifted, reflecting the arrival of Khoekhoen pastoralists and the transition from foraging to herding economies. These changes provide valuable insights into past climate conditions, settlement patterns, and cultural exchanges between hunter-gatherers and herders (Russell & Lander 2015). Many hundreds of shell middens are found along the coast in the wider Addo ENP. These middens are scattered across the shifting dunes, some buried deep inland, and others exposed near the present-day coast. Because they are exposed to erosion, rising sea levels, and human interference, these archaeological sites are highly vulnerable. Shell middens are protected under heritage law and disturbing them can lead to the loss of critical historical information. Their preservation is essential for reconstructing southern Africa's rich precolonial history and understanding early human adaptation and resilience (Webley 2002). Recent work has also emphasised the need for systematic cultural heritage management in coastal protected areas, given accelerating direct and indirect threats from human pressures (Boswell 2023, Paloma & Cathy 2025).

AENP surveys in 2020 of aeolianite surfaces resulted in the identification of fossilised elephant tracks and a probable hominin trackway in the remote Woody Cape section of the park within the Alexandria dunefield and research is underway to understand more about the human uses of this area. These trace fossils represent direct evidence of Pleistocene elephant activity in the same region where modern elephants now roam. Large track sizes recorded place them among the largest Quaternary elephant footprints globally (Helm et al. 2024).

5.2 GEOLOGICAL HISTORY

The geological evolution of the Addo area reflects a complex sequence of tectonic, sedimentary, and erosional processes that span over 500 million years. This region preserves a geological record that includes some of the oldest and most geologically significant rock formations in southern Africa (Viola et al. 2012).

The oldest rocks in the area belong to the Cape Supergroup, which were deposited in deep marine environments during the early Palaeozoic Era (roughly 500 million years ago), when the region was part of the southern margin of the ancient supercontinent Gondwana. These quartzite-dominated strata form the backbone of the Cape Fold Belt, whose east–west trending mountain chains extend into the Addo region (Blewett & Phillips 2016). Around 250 million years ago, the Karoo Supergroup was created under markedly different conditions. This sequence includes glacial deposits, fluvial sandstones, and volcanic rocks, reflecting a transition from glacial to arid environments. The Karoo succession is closely associated with the initial stages of Gondwana's breakup. As rifting intensified during the Jurassic and Early Cretaceous periods, the Uitenhage Group was deposited in fault-bounded basins. These sediments include sandstones and mudstones, and are notable for containing fossil assemblages of early dinosaurs and flora, indicating terrestrial environments with active sedimentation (Shone & Booth 2005). The Kirkwood Formation within the Uitenhage Group is particularly important, yielding diverse Early Cretaceous dinosaur remains, crocodilians, turtles, and early flowering plants (Holmes & Meadows 2012).

Following the fragmentation of the mega continent Gondwana and the establishment of the African continental margin, the Algoa Group was deposited in coastal and estuarine settings. These younger sediments, which include fossil-rich sands and silts, reflect the development of modern coastal systems and are important for understanding sea-level changes and paleoenvironmental conditions during the Cenozoic (Earth's current geological era, representing the last 66 million years of Earth's history) (Botha & De Wit 1996).

A geological cross-section through the Addo region reveals the structural complexity of the area. This structural framework has influenced both the terrestrial and subtidal geomorphology of the Addo ENP MPA. The geological structure plays a key role in shaping its marine habitats. The composition and resistance of different rock types, e.g. hard quartzites of the Cape Supergroup and the softer sediments of the Algoa and Uitenhage groups, results in varied underwater topography. Harder rocks form reefs and ridges, while softer layers erode into sandy plains and depressions.

This variation in seafloor structure creates a range of habitat types. Rocky areas support kelp forests, reef fish, and encrusting invertebrates, while sandy and muddy zones host burrowing species and soft-bottom communities. These geological–ecological linkages have been demonstrated globally (Harris et al. 2014) and underpin current habitat classification frameworks for South Africa's offshore ecosystems (Sink et al. 2019a).

5.3 MARITIME HISTORY

Algoa Bay has long been a focal point of maritime activity due to its strategic location along historical trade routes between Europe and the East. Despite lacking a natural harbour, its broad, sheltered expanse and prevailing south westerly winds have made it a historically safe anchorage (Goschen & Schumann 2011)

The Bay gained prominence with the arrival of 5,000 British settlers in 1820, who disembarked near the Baakens River to establish the town of Port Elizabeth which catalysed regional development and maritime trade. Wool soon became a major export, and the Bay transformed into a bustling hub linking the Eastern Cape with Cape Town and England. Although sheltered, violent southeasterly gales, especially in spring, have also caused numerous shipwrecks (Ingpen 1979). Over 80 known wrecks, including the 1647 Portuguese galleon Sacramento, now rest on the seabed, offering archaeological insight into centuries of maritime activity. Heritage surveys have identified shipwrecks from multiple historical periods, including Portuguese, Dutch East India Company, and British vessels, highlighting the Bay's longstanding role in global maritime trade networks (Werz 1997, Sharfman et al. 2012). Many of these wrecks are now popular dive sites. Within the Addo ENP MPA, protection of these sites, alongside efforts to conserve the Bay's biodiversity, helps preserve a unique maritime legacy, linking marine conservation with South Africa's deep oceanic and colonial history. Under South African heritage law (National Heritage Resources Act No. 25 of 1999), shipwrecks older than 60 years are automatically protected, reinforcing the integration of cultural and natural heritage within MPA management (Sharfman et al. 2017)

6. PRESSURES AND THREATS

6.1 EXPLOITATION AND OVERFISHING

Thriving fishing industries (commercial and recreational) operate in Algoa Bay. Gqeberha harbour is the primary harbour for these commercial operators. Among the most economically important is the squid *Loligo vulgaris reynaudii* fishery, which supports a large number of jobs and generates significant export revenue (Augustyn et al. 1992). Other key commercial fisheries operating in and around the Bay include small pelagic fisheries (e.g. sardine and anchovy), demersal trawl and linefisheries (targeting hake as well as line fisheries focused on reef-associated species such as kob and geelbek). Long-term analyses highlight declining trends in many linefish species due to historical overexploitation, with several (e.g. dusky kob, red steenbras) listed as collapsed or overfished (Griffiths 2000; Mann et al. 2014).

The Bay also supports a culturally significant recreational fishing sector, which includes shore angling, boat-based fishing, kayak fishing, spearfishing, and rock and surf angling. The Bay's sheltered conditions and high fish diversity make it a popular destination for both local and visiting anglers. Notable areas include the Sundays Estuary and offshore reef areas like Riy Banks or around some of the islands (Baird et al. 1996). These recreational fisheries target the key linefish species including dusky kob, shad, seabreams and steenbras as well as sharks. Recreational fisheries contribute substantial economic and social value, but are also linked to high exploitation pressure on vulnerable linefish stocks (Potts et al. 2019)

Recreational fishing is permitted in certain zones within the Addo ENP MPA. Fishing is prohibited in the Restricted Zones, while certain types of fishing are allowed in Controlled areas under permit conditions. These spatial management measures help protect breeding and nursery grounds, maintain fish stocks, and support the long-term sustainability of fisheries in Algoa Bay. Despite this, resources are still vulnerable to overexploitation which could compromise the protection afforded by the MPA. Overfishing, particularly of large, slow-growing reef-associated species like dusky kob and red roman, poses a threat to population recovery with studies documented across South Africa's coast, observing recovery of these species in areas under effective protection (Kerwath et al. 2013). Illegal or unregulated fishing in Restricted Zones also may undermine conservation efforts, especially around sensitive areas like the St. Croix and Bird Island groups which support reef fish species and Endangered abalone.

6.2 INDUSTRIAL DEVELOPMENT

The proximity to the major Ports of Ngqura and Gqeberha pose a threat to the Addo ENP MPA and its marine life. Port activities such as dredging, coastal construction, and increased vessel traffic can lead to habitat degradation, alter sediment dynamics and introduce multiple sources of pollution (Newell et al. 1998). The deep-water Port of Ngqura, located adjacent to the MPA, was developed as part of a strategic Industrial Development Zone (IDZ) to stimulate regional economic growth, and further expansion has been proposed (Paterson et al. 2013). Gqeberha also serves as a container base, holding larger numbers of containers when terminals in Cape Town and Durban are full. Farming and agriculture exports have played a key role in port activities, which also handles the distribution of manganese ore brought in from the Northern Cape, and petroleum products transported from other ports in South Africa (Wright et al. 2019).

Increased shipping activities can also raise the risk of invasive alien species introductions via ship ballast water or through hull fouling, and can alter habitat structure, displace native biodiversity and disrupt ecological interactions (Legg et al. 2015, Costello et al. 2022, IMO 2025). Estuarine environments and sheltered bays within or adjacent to the MPA are particularly vulnerable due to their environmental variability and proximity to ports (Robinson 2005). Once established, invasive species are often difficult to remove and can cause long-term ecological and economic impacts (Molnar et al. 2008). Currently, there is limited data on the presence, distribution, and impact of invasive species within the Addo ENP MPA, highlighting the need for dedicated monitoring, early detection protocols, and the development of targeted response strategies.

Heavy metal contamination in coastal waters is also of concern. Heavy metals entering the marine environment can originate from many sources including industrial runoff, wastewater discharge, and port-related activities. Mercury, lead, and cadmium can accumulate in sediments and marine organisms, leading to long-term toxicity effects in fish, invertebrates, and top predators (Fatoki & Mathabatha 2001, Cherkasov et al. 2010, Yi et al. 2011). In the Addo ENP MPA, sediment-bound metals may pose risks to benthic habitats and food safety for both wildlife and humans consuming seafood from adjacent areas, especially during high rainfall events when contaminants are flushed into estuaries and coastal areas (Adams et al. 2019).

Mariculture (aquaculture undertaken in the sea), particularly the proposed expansion of finfish and bivalve farming in Algoa Bay Aquaculture Development Zones, poses a potential threat to the ecological functioning of the MPA and surrounding waters. While aquaculture can support food production and local economies, poorly planned or managed operations may lead to nutrient enrichment, disease transmission, genetic introgression from farmed to wild stocks, and displacement of sensitive habitats (Naylor et al. 2021). Recent environmental assessments of proposed aquaculture development in Algoa Bay warn of cumulative impacts on biodiversity and ecosystem services if expansion proceeds without stringent regulation and monitoring (Wright et al. 2019)

6.3 MICROPLASTICS AND PLASTIC POLLUTION

Plastic pollution, particularly microplastics and nurdles (small plastic pellets used in manufacturing), represents a growing threat to marine ecosystems (Wright et al. 2013). Global assessments show that microplastics are now

ubiquitous in coastal and estuarine environments, with concentrations often highest near urbanised shorelines (GESAMP 2013, Jambeck et al. 2015). These materials enter the ocean via stormwater runoff, riverine discharge, and shipping incidents, and are ingested by a wide range of marine organisms, from zooplankton to seabirds (Ryan 1987, Naidoo et al. 2020). Their persistence and bioaccumulation can cause physical harm, disrupt feeding behaviour, and introduce toxic substances into marine food webs. Emerging research also suggests that microplastics can act as vectors for invasive species and pathogens, further compounding ecological risks (Amaral-Zettler et al. 2020).

6.4 SHIPPING AND BUNKERING IMPACTS

Ship-to-ship bunkering involves supplying fuel from one vessel to another outside normal harbour limits. In Algoa Bay, bunkering activities are a significant threat to seabirds and marine biodiversity. Over the past five years, at least four bunkering-related oil spills have been recorded, impacting three of the four Endangered seabird species breeding in the Bay, including African penguins and Cape gannets (Sherley et al. 2021, Sydeman et al. 2021) SANCCOB 2025). The Port of Ngqura is approximately 5 km from the Island of St Croix, and one of the main anchorage sites for bunkering is 7 km from the Island. Prevailing weather could lead to oil spills outside the MPA to spread into the MPA contaminating critical habitats and species. Following repeated spills, ship-to-ship refuelling was temporarily suspended in 2019 and again in 2021, with operations resuming under revised permit conditions sparking ongoing debate between conservation bodies, regulators, and industry (Holness et al. 2022, Pichegru et al. 2022). In addition to bunkering, the broader impacts of shipping in and around the Addo ENP MPA include noise pollution, vessel strikes, and marine debris such as lost shipping containers (Pichegru et al. 2022). The Bay is increasingly busy with international shipping traffic, raising the risk of accidents and cumulative impacts. In response to these risks, the South African Maritime Safety Authority (SAMSA) and DFFE issued new guidelines in 2022 for offshore bunkering in Algoa Bay, including limits on anchorage zones, stricter spill-prevention measures, and mandatory monitoring (SAMSA 2022). However, many argue that these regulations fall short of providing meaningful protection (SANCCOB 2023).

6.5 AGRICULTURAL IMPACTS

The Sundays Estuary is heavily impacted by agricultural activity (Lemley et al. 2017), especially through commercial citrus farming in the upper reaches of the Sundays Estuary surrounding the town of Addo, one of the most productive citrus farming areas in South Africa (Darley-Waddilove et al. 2023). Intensive citrus farming plays a significant role in the contribution of fertilisers and pesticides to the river system through runoff. High nutrient and agrochemical loads have been documented in South African estuaries, including the Sundays Estuary draining into Algoa Bay, with impacts such as altered phytoplankton communities, fish kills, and habitat degradation (Lemley et al. 2015). These chemicals are transported downstream and ultimately into coastal waters. Nutrient loading can lead to eutrophication and harmful algal blooms, while pesticide residues may have toxic effects on estuarine and nearshore species, undermining the ecological health of the MPA. Recent studies show that the Sundays Estuary is contaminated by agricultural chemicals that pose risks to fish and other aquatic life. Organophosphate pesticides were detected at high levels in sediments (up to 48.7 µg/kg), with ecological risk assessments indicating significant acute and chronic toxicity to fish however, human health risk assessments indicated negligible concern (Olisah et al. 2019, 2022, 2023). In addition, organochlorine pesticides and PCBs were found in surface waters, with PCB concentrations reaching 727.6 ng/L, highlighting ongoing pollutant inputs and potential bioaccumulation in the food web (Olisah et al. 2019, 2022, 2023).

6.6 HARMFUL ALGAL BLOOMS

Harmful algal blooms (HABs) are rapid growths of algae or cyanobacteria in aquatic systems that can negatively impact humans, animals, and the environment. These blooms can produce toxins or deplete oxygen levels, leading to various harmful effects such as fish kills, lobster walkouts (mainly on the West Coast), and other ecological disruptions (Pitcher & Calder 2000, Sunda 2006). Algal blooms are linked to nutrient enrichment and upwelling events which are brought on by a high prevalence of easterly winds along the south coast of South Africa. Algoa Bay is a recognised hotspot for HABs with recent reports documenting harmful taxa including the non-indigenous dinoflagellate *Lingulodinium polyedra* and the domoic-acid producer *Pseudo-nitzschia* (Pitcher et al. 2014, Bizani et al. 2023). In addition, HABs are formed by the raphidophyte *Heterosigma akashiwo* in adjacent estuaries discharging into the Bay (Pitcher et al. 2014, Bizani et al. 2023, Giesler et al. 2023).

The South African Environmental Observation Network (SAEON), in collaboration with DFFE: Oceans & Coasts, maintains long-term phytoplankton and toxin monitoring in Algoa Bay, providing an early warning system for aquaculture operations and public health (Bernard et al. 2021). These monitoring programs have documented increasing HAB frequency and diversity, highlighting the need for continued surveillance under climate change scenarios that may intensify bloom dynamics.

6.7 CLIMATE CHANGE

Climate change represents a pervasive and long-term threat to the ecological integrity of the MPA. Rising sea surface temperatures can alter species distributions, affect breeding and feeding patterns of marine megafauna, and lead to shifts in plankton communities. Long-term analyses show that the Agulhas Current system and adjacent shelf waters have warmed significantly since the 1980s, with implications for thermal habitat ranges of fish, seabirds, and marine mammals (Rouault et al. 2009, Jury 2020). Ocean acidification, caused by increased CO_2 absorption, can disrupt calcifying organisms such as coralline algae, molluscs, and planktonic foraminifera, with cascading effects , throughout the ecosystem (Gattuso et al. 2014). Experimental work on southern African estuarine and coastal invertebrates indicates reduced growth and survival under lowered pH (high CO_2), raising concern for key resource species such as abalone and mussels (*Mytilus galloprovincialis*) (Zardi et al. 2016, Pratiwi et al. 2024).

Changes in wind and current patterns linked to climate variability may influence upwelling intensity in Algoa Bay, affecting productivity and the occurrence of harmful algal blooms as well as impact species distributions (Goschen & Schumann 2011). Increased storm frequency and sea level rise could also impact coastal and estuarine habitats, such as the Alexandria dunefield and the Sundays Estuary, which serve as important interfaces between land and sea. National assessments identify these systems as climate-sensitive hotspots, with increasing extreme events projected (DEA 2013). Regional records also show rising trends in severe coastal storms over southeast Africa, heightening risks to sandy shores and estuaries (Fitchett & Grab 2014). Monitoring and modelling these changes will be critical to understanding the resilience of the Addo ENP MPA and planning for climate-adaptive management. Integrating climate change projections into MPA zoning, fisheries management, and biodiversity monitoring has been highlighted as an urgent priority in South Africa's national climate and biodiversity strategies (DEA 2013, Niang et al. 2014)

7. SOCIAL ECOLOGY

7.1 RECREATION, TOURISM AND MARKETING

The Addo ENP MPA has emerging potential for recreation, tourism, and nature-based marketing, though current usage is relatively limited compared to more established coastal destinations.

Tourism and recreation in and around the MPA are closely linked to the greater Addo ENP, which is one of South Africa’s most visited terrestrial parks, attracting over 350,000 visitors annually (SANParks 2022). While most visitors are drawn to the terrestrial "Big 5" experience, the park’s coastal and marine components offer added value, particularly in terms of scenic beaches, birdwatching, whale and dolphin sightings, and island-based seabird colonies. The islands host critical breeding populations of African penguins and Cape gannets and may offer potential tourism experiences such as seabird safaris, boat-based wildlife watching, and marine photography, if carefully managed to avoid disturbance (a tourism industry has developed around the increased presence of great white sharks).

The Sundays Estuary, adjacent to the MPA, is already a hub for recreational boating, fishing, canoeing, and sandboarding on the Alexandria dunes. This area acts as a key access point to the marine and coastal zone and could serve as a gateway for marketing marine eco-experiences. However, infrastructure to support sustainable marine tourism is currently limited and again these activities need to be carefully managed.

Marketing of the Addo ENP MPA remains underdeveloped, partly due to its relatively recent proclamation and the broader lack of public awareness around South Africa’s MPAs. National assessments have noted that public awareness of South Africa’s MPAs remains very low, limiting stakeholder support and compliance (Sowman et al. 2011, Sowman & Sunde 2018).

Going forward, partnerships with SANParks, local tourism operators, NGOs, and community organisations could help develop low-impact marine tourism offerings that align with conservation goals helping to position the Addo ENP MPA as a destination where tourism supports both biodiversity protection and community benefit.

7.2 EDUCATION AND AWARENESS

Environmental education is crucial in raising awareness and educating people of all ages about the importance of conserving the environment and cultural heritage to promote a sustainable environment and responsible resource use for future generations. Increasing public understanding of the ecological importance of marine ecosystems, the role of MPAs, and the specific features of the Addo ENP MPA helps to build stewardship, reduce user conflicts, and promote compliance with regulations.

At present, general awareness of the Addo ENP MPA among the public, local communities, and even some stakeholders remains limited. However, this presents an opportunity to develop targeted education and outreach programmes that can improve knowledge, foster connection with the marine environment, and support behaviour change.

Existing SANParks education programmes within the broader Addo ENP provide a strong foundation for expansion into marine topics. Public events such as Marine Week, beach clean-ups, and exhibitions can serve as platforms to promote the MPA and its benefits for biodiversity and sustainable development. Case studies from other MPAs show that participatory education initiatives not only enhance compliance but also increase local support for conservation (Leisher et al. 2012, Bennett & Dearden 2014). Leveraging these approaches could help position the Addo ENP MPA as a model for integrating conservation education across both land and sea

7.3 ECOSYSTEM SERVICES AND SOCIO-ECONOMIC CONSIDERATIONS

Many MPAs, both in South Africa and globally, have been established with a strong focus on protecting habitats and species, but with limited integration of the social, cultural, and economic realities of the people who depend on these areas. This gap has also been noted for Algoa Bay, where marine spatial planning processes highlighted the importance of aligning ecological goals with socio-economic needs (Dorrington et al. 2018). These areas also provide a range of ecosystem services which are often undervalued or ignored altogether. This oversight can lead to management strategies that face resistance from stakeholders, undermine compliance, and fail to deliver the intended conservation outcomes.

Factors such as supporting livelihoods, cultural heritage, recreational use, food security, and economic dependency on marine resources are integral components of successful MPAs. The Addo ENP MPA encompasses key coastal and offshore habitats which provide a wide range of ecosystem services that underpin both biodiversity conservation and human wellbeing. Its rich mosaic of sandy beaches, rocky shores, estuarine outlets, kelp beds, and temperate reefs supports high ecological productivity and plays a critical role in maintaining the health of marine ecosystems in the region. Its proximity of urban centres, the presence of small-scale fishing communities, and the significance of the bay for recreation and tourism highlight the need for socio-economic integration in management. Gqeberha has a strong socio-economic reliance on the Bay's marine resources (Dorrington et al. 2018).

Provisioning services of the Addo ENP MPA include small-scale and recreational fisheries. Although the MPA is zoned to regulate extractive activities, these resources remain culturally and economically important to local communities and recreational users.

Supporting and regulating services are delivered through the MPA's protection of habitats that buffer coastal erosion, provide resilience for threatened and overexploited species and their populations, and sustain fish spawning and nursery areas, particularly in estuarine zones such as the Sundays Estuary. The Bay's sheltered waters also serve as a vital refuge during harsh oceanic conditions for migratory fish and seabirds. Algoa Bay is globally recognised for hosting two of the largest remaining breeding colonies of the Critically Endangered African penguin on St Croix and Bird Islands, and the MPA plays a crucial role in the species' foraging success and population viability. In terms of tourism, in 2022/23, total revenue from media-related permits was around R184, 000 of which around half of the revenue came from drone and documentary filming in the Bird Island section of Addo ENP (Brühl & Turpie 2025).

The Bay is a hotspot for charismatic megafauna, including humpback and southern right whales, dolphins, and large seabird aggregations, making it a popular destination for whale watching, scuba diving, kayaking, and nature-based tourism; enhancing its value for eco-tourism and environmental education.

However, the full magnitude of these benefits remain poorly understood. Compared to the biodiversity, there is a lack of equivalent effort in documenting and valuing the MPA's socio-economic contributions. Ecosystem service valuations in South African MPAs are scarce, but studies suggest significant unrealised potential in demonstrating benefits to policymakers and communities (Mann-Lang et al. 2021). Key knowledge gaps include the economic value, and potential, of recreational activities and tourism.

Additionally, little is known about the distribution of benefits and costs among different stakeholder groups, or how these influence perceptions of and compliance with MPA regulations. Integrating ecological, economic, and social data would provide a stronger evidence base for demonstrating the MPA's role in coastal resilience, food security, and economic development. Such studies are also essential for ensuring that conservation objectives are balanced with the needs and rights of local communities, thereby strengthening support for long-term protection measures.

8. MANAGEMENT

8.1 PROTECTED AREA DESIGN AND EFFECTIVENESS

MPAs have become globally recognised as essential tools for marine biodiversity conservation and sustainable fisheries management (Ballantine 2014). While the primary objective of MPAs remains the conservation of marine ecosystems and cultural heritage, this aim is not necessarily incompatible with resource use activities such as fishing, provided these are ecologically sustainable and appropriately regulated (Day et al. 2019). Global syntheses have demonstrated that well-managed MPAs can increase biomass, biodiversity, and fisheries spillover benefits, especially when no-take zones are adequately enforced (Edgar et al. 2014). The success of an MPA therefore depends not only on its ecological setting but also on its governance structure and implementation capacity.

The Addo ENP MPA represents a significant step forward in protecting the unique biodiversity and ecological processes of the Agulhas ecoregion. Given the high biodiversity, ecological function as well as the important habitats for threatened species the proclamation of the MPA was considered critical to protecting important biodiversity in light of the current and proposed development for this region.

Chadwick et al. (2014) highlight that strategic management plans and a conservation development framework are essential for the effective management of MPAs. In 2026, a Management Plan for the Addo ENP MPA is to be developed and must explicitly address zoning effectiveness, compliance needs, estuarine and catchment pressures, and opportunities for local economic benefit through sustainable use and ecotourism. In most MPAs, management effectiveness is monitored annually through either the use of Key Performance Areas, a Monitoring Effectiveness Tracking Tool (METT) or other forms of audit system (Chadwick et al. 2014). The METT allows MPA managers to identify needs, constraints and priority actions to improve the effectiveness of MPA management. South Africa has applied the METT framework across its MPA estate since 2010, with results highlighting strengths in legal designation but persistent weaknesses in enforcement, capacity, and funding (Sink et al. 2012; DEA, 2013).

Initial assessments by SANParks and the DFFE have emphasised that the Addo ENP MPA’s success hinges on strong enforcement capacity, stakeholder collaboration, and the development of an adaptive management framework. Challenges remain in terms of compliance, with illegal fishing and inadequate patrolling noted as persistent issues, particularly in remote offshore zones and the estuarine areas near the park boundary. Limited capacity for ecological monitoring, especially for cryptic or migratory species, hinders a complete understanding of the MPA’s effectiveness to date. These challenges mirror findings from other South African MPAs, where enforcement capacity and integration with coastal communities are critical determinants of success (Sowman et al. 2011, Sink et al. 2012) Ongoing collaboration between SANParks, DFFE, academic institutions, and civil society will be critical to realising the full ecological and social benefits of this large, ecologically diverse MPA.

8.2 SPECIES OF CONSERVATION CONCERN

African penguin

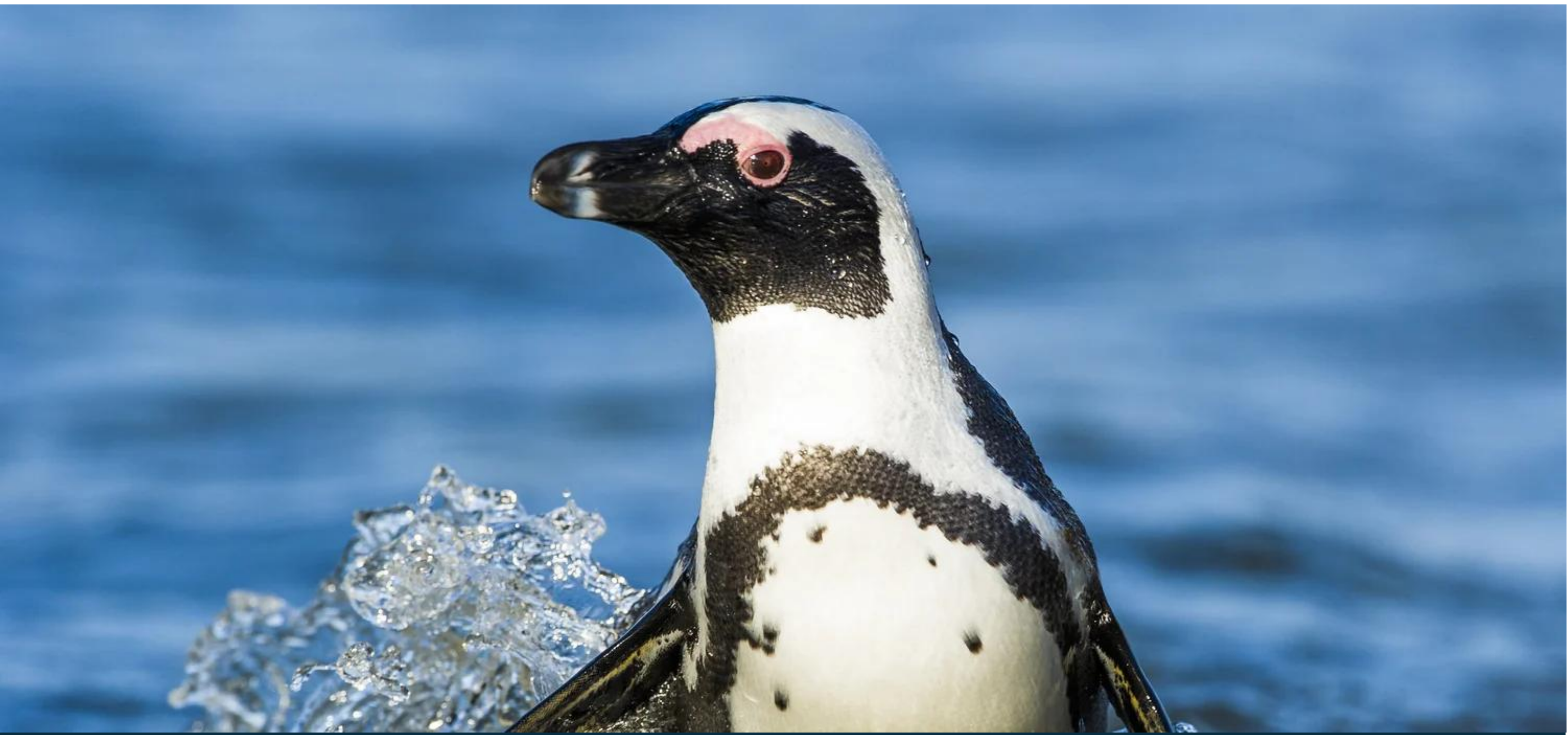
The African penguin population is facing a critical decline country wide. Once home to the world's largest colony, St Croix Island's penguin numbers have plummeted to approximately 750 breeding pairs as of the 2025 season. Bird Island hosts around 1,650 pairs. Overall, South Africa's African penguin population has dwindled to fewer than 9,000 breeding pairs (as of 2025), with projections indicating potential extinction in the wild by 2035 if current trends persist (SANCCOB 2025). The IUCN uplisted the species to Critically Endangered in 2024, reflecting these ongoing declines (BirdLife International 2024; Sherley et al. 2024).

It is theorised that these declines are as a result of numerous factors including pollution (from oil spills), changes in the abundance and distribution of small pelagic fish populations, competition with commercial fisheries and seals for food and predation pressure from kelp gulls and Cape fur seals, as well as potential exposure to conservation-significant pathogens (David et al. 2003, Crawford 2009, Pichegru et al. 2009, Crawford et al. 2011, 2014, Weller et al. 2014, 2016, de Moor & Butterworth 2015, Grémillet et al. 2016, Parsons et al. 2016, Sherley et al. 2020, BirdLife International 2023). Recent modelling has also highlighted reduced adult survival linked to declining prey biomass as the single largest demographic driver of population trajectories (Sherley et al. 2018; Robinson et al. 2021).

Ship-to-ship fuel transfers, known as 'bunkering', have been identified as a significant threat due to associated oil spills and underwater noise pollution. Following a pause in bunkering activities in 2023, a slight recovery in penguin numbers was observed at St Croix Island. However, counts show this recovery was marginal and short-lived, with breeding pairs continuing to decline into 2024 (Pichegru et al. 2022). In response, the DFFE is advancing stricter regulations to permanently restrict such activities in ecologically sensitive areas, aiming to mitigate further harm to the penguin population.

Collaborative efforts between SANParks, SANCCOB, Birdlife and other institutions have intensified monitoring and rehabilitation initiatives (as part of the African penguin Biodiversity Management Plan). Rangers and seabird monitors conducted patrols on Bird Island, rescuing and rehabilitating injured, weak or oiled adult penguins and chicks. Additionally, artificial nest structures have been installed to protect breeding adults and chicks from predators and extreme weather conditions. To gather real-time data on penguin foraging success and health, Automated Penguin Monitoring Systems (APMSs) have been deployed at Bird Island. These systems include weighbridges and electronic tag readers, providing valuable insights to inform conservation strategies and policy decisions (BirdLife South Africa 2025).

These actions demonstrated some success. For example, rehabilitation efforts may have increased the 2023 penguin breeding population by around 7% (Pichegru et al. 2025). Nevertheless, numbers continued decreasing and the species is now Critically Endangered (BirdLife International 2024, Sherley et al. 2024). This has led to several



revisions of the updated Biodiversity Management Plan (Government Gazette No. 42775 18 October 2019, Government Gazette No. 47061 22 July 2022). These revisions still consider a decline of food availability as a major driver of African penguin population decline and recommends fishery closures around colonies. On the 16 September 2022, the DFFE announced closures for small pelagic fishing around the major penguin breeding colonies, including St Croix Island and Bird Island (www.gov.za/speeches/forestry-fisheries-and-environment). These measures aim to protect foraging areas for penguins, ensuring access to essential prey like sardines and anchovies over the next decade (McInnes et al. 2024). An expert panel reviewed the results of the Island Closure Experiment and noted that "excluding fishing around island breeding colonies is likely to reduce the rate of decline in the population to a small extent, mediated through improvements in reproductive success" (Punt et al. 2023). Other benefits for penguins, such as increased adult survival was also thought to be a benefit of excluding purse seine fishing around breeding colonies although the Island Closure Experiment did not test for such effects (Punt et al. 2023). In March 2025, a landmark settlement was reached between conservation organizations (BirdLife South Africa and SANCCOB), the fishing industry, and the DFFE. Specifically, a 20 km fishing exclusion zone was established around Bird Island, while a reconfigured closure was implemented around St Croix Island. DFFE announced a decision to extend the purse seine fishing limitations in the waters around important penguin colonies for a minimum of 10 years.

While there have been tremendous efforts towards African penguin conservation, the drastic and rapid decline of the species (Sherley et al. 2024) and its recent further uplisting to Critically Endangered calls for urgent unlocking of political will, increased capacity and funding to prevent its extinction in the wild. Without substantial interventions to restore prey availability and address cumulative threats, extinction in the wild within the next decade remains a realistic possibility (Robinson et al. 2021; BirdLife International 2024).

Cape gannet

Cape gannets *Morus capensis* are restricted to the coast of Africa, from the Western Sahara, around Cape Agulhas to the Kenyan coast. In southern Africa they breed on six offshore islands, including Bird Island which hosts the largest global populations of Cape gannets. The Cape gannet is listed as Endangered on the IUCN's global Red List, due to its restricted range and population declines (BirdLife International 2018a). Cape gannets breed on islands which afford them protection from terrestrial predators. They feed out at sea and will often forage more than a hundred kilometres away from their nesting sites (Adams & Navarro 2005). The quality of water and fish stocks can therefore have significant effects on the Cape gannet population.

Their extensive foraging range and diverse diets have proved adaptable to the changes in pelagic fish distribution and nationally, until recently, numbers were thought to have not declined (Crawford et al. 2014). The most recent IUCN Red List Assessment, however, upgraded Cape gannets from Vulnerable (2017) to Endangered (2018) due to a large population reduction (51.5% between 1956 and 2015) over the past three generations with projected further declines over the next three generations (BirdLife International 2018a). A revised assessment estimated the population decline at 44.7% over the preceding three generations with the balance of evidence suggesting that a global classification of Vulnerable would be the most appropriate status (Sherley et al. 2019). The IUCN Red List status, however, remains Endangered (BirdLife International 2018a). As with African penguins, a food shortage due to the collapse of the sardine stocks and an eastwards displacement of small pelagic fish is considered the major driver of population declines. Competition with purse-seine fisheries in South Africa is associated with negative impacts on foraging success, adult body condition and chick growth rates (Okes et al. 2009, Cohen et al. 2014, Grémillet et al. 2016) but there is little evidence for impacts on the local population size or a decrease in adult survival rate (Crawford et al. 2014). The impacts of global warming including sea level rise and increased frequency and magnitude of storms constitutes a further risk to Cape gannet colonies due to coastal flooding.

Oiling (petroleum and other) from fish waste and shipping spills have also been observed to contaminate these species on Bird Island. SANCCOB responded to three oil spills in recent years (2016, 2019 and 2021) caused by bunkering-related activities. Direct predation by Cape fur seals and kelp gulls constitute further threats to Cape gannet populations (Makhado et al. 2006, Pichegru et al. 2007, Sherley et al. 2019).

Cape cormorant

Cape cormorants *Phalacrocorax capensis* are endemic to southern Africa. They were historically abundant on the West Coast but less common on the East Coast, occurring as far east as Algoa Bay, where they also breed. With a locally significant breeding population of Cape cormorants, St Croix Island is one of the few breeding localities for this species in the warmer Agulhas Current. They generally feed within 10–15 km of the shore, preying on pelagic goby *Sufflogobius bibarbatus*, Cape anchovy, pilchard and Cape horse mackerel *Trachurus trachurus* (Crawford et al. 2016, Masiko et al. 2021).

Key colonies of the Cape cormorant in South Africa and Namibia have undergone rapid population declines over the past three generations and the Cape cormorant has therefore been up-listed to Endangered (BirdLife International 2018b). Declines were most notable from Dassen Island on the West Coast while Algoa Bay island populations remained stable but nationally the species has declined by ~50–57% since the late 1970s and breeding has shifted south-east; (Crawford et al. 2007, 2016). At St Croix Island, breeding output has been variable with a complete breeding failure recorded in 2011. Declines are primarily believed to have been driven by collapsing pelagic fish stocks (Pichegru et al. 2025). However, pelagic fish stocks increased greatly in the late 1990s and early 2000s, and although sardine biomass subsequently crashed, anchovy biomass remained relatively high until 2020. This suggests that other factors are also involved in declining Cape cormorant numbers. Overall the numbers of Cape cormorant breeding in South Africa decreased by nearly 57% from ~107, 000 pairs in 1977–1981 to 57, 000 pairs in 2010–2014 (Crawford et al. 2016).

Avian cholera (in the 1990s), predation by Cape fur seals, shifts in prey and oiling are all known to impact Cape cormorants. Discarded fishing gear and marine debris also entangles and kills many birds. Kelp gulls prey on Cape cormorant eggs and chicks and this is exacerbated by human disturbance, especially during the early stages of breeding, as well as the increase in gull numbers (Crawford et al. 2016). Avian influenza outbreaks have more recently emerged as an additional threat, causing large-scale mortality events in coastal seabird colonies since 2018 (Hirschinger et al. 2025).

Abalone

The South African abalone, commonly referred to by its Afrikaans name perlemoen, is a species of marine gastropod endemic to South Africa (Rhode et al. 2017). They have a disjunct distribution between St Helena Bay on the West Coast to just north of Port St Johns on the East Coast of South Africa, divided into a western and eastern population (DFFE 2020). They favour rocky reefs and kelp beds in water less than 5 m deep but occur down to 20 m (DFFE 2020). As broadcast spawners, they aggregate in large groups and have a maximum dispersal distance of several kilometres (Morgan & Shepherd 2006). This species is the largest of its South African counterparts, growing up to 230 mm shell diameter (van der Merwe 2009). Living up to 30 years (DFFE 2020), they reach sexual maturity after seven years and minimum legal size for harvest only after eight to nine years (DFFE 2020).

Abalone meat is an expensive delicacy, and an abalone conservation crisis has ensued (Raemaekers et al. 2011, Zeeman et al. 2014). Of the five species of abalone found in South Africa, *H. midae* supported a robust commercial fishery for six decades; and this abalone is currently the most exported species in South African aquaculture, contributing considerably to the country's international trade (DFFE 2020). Unrestricted commercial harvesting began in 1949, but due to concerns about the declining stock, seasonal restrictions were implemented in 1968 (Raemaekers et al. 2011). The total annual catch remained stable until the mid-1990s, after which abalone poaching and the illegal trade boomed in South Africa, causing continuous declines in commercial catches and TAC (Steinberg 2005, Raemaekers et al. 2011, DFFE 2020). The illegal trade is driven by demand from East-Asian markets, with Hong Kong receiving 90% of exports (DFFE 2020, Okes et al. 2018). Within a decade, the species was threatened with commercial extinction. Additionally, in 2004, abalone was listed on the CITES Appendix 3 and the National Environmental Management: Biodiversity Act 10 (NEMBA). Each year the commercial total allowable catch was decreased until 2008 when a complete and controversial fishery closure was implemented (Raemaekers et al. 2011; DFFE 2020). However, due to pressure from the fishing industry and the listing having little effect on the illegal trade, they were removed from CITES in 2010, and the commercial fishery was reopened. The recreational sector also caught abalone for many years, but due to illegal fishing and the decline in the resource recreational harvesting is now prohibited (Raemaekers et al. 2011, DAFF 2017, DFFE 2020).

Along the East Coast, the resource was considered to be discontinuous and sparsely distributed and as a result no commercial fishery for abalone was implemented there. However, experimental and subsistence permits were allocated along the East Coast at various times in the past. Although the perceived low abundances and patchy nature of abalone in the Eastern Cape prevented the development of a large scale commercial fishery, the Eastern Cape became a major source of abalone for the illegal markets in the mid-1990s (Raemaekers & Britz 2009). The growth and economic value of the illegal sector is highlighted by the shift in poaching activity from being largely shore-based and in close proximity to urban centres in the late 1990s to a highly organised boat-based poaching that involves travelling considerable distance at sea (Raemaekers et al. 2011). Today illegal harvesting continues to extents far greater than historical legal quotas (Raemaekers et al. 2011, Okes et al. 2018). An average of 2,174 tonnes of abalone were poached annually, between 2000 and 2016, estimated to be worth R628 million each year (Okes et al. 2018). Poaching is increasing, demonstrated by the 47% increase in illegal catch from 2017-2018 (DFFE 2020). The combined effect of poaching and ecological changes has resulted in severe declines in the abalone resource.

The shallow reefs and rich macroalgal communities around Bird Island support high densities of abalone (Holness et al. 2022). The inability of management authorities to control increasing illegal poaching activities from 2003 onwards led to the proclamation of the Bird Island MPA in an attempt to halt illegal activities. Now incorporated into the larger Addo ENP MPA, this protected area likely plays a vital role in safeguarding remaining abalone populations and supporting broader conservation efforts for this Endangered and heavily exploited species.

9. RESEARCH AND MONITORING

9.1 RESEARCH PERMITS

A permit is required to conduct research inside an MPA. In addition, registering research in national parks is a legal requirement under the National Environmental Management: Protected Areas Act (NEM:PAA, Act No. 57 of 2003), read together with the National Environmental Management Act (NEMA, Act No. 107 of 1998). These laws establish that research activities in protected areas must be authorised, compatible with the objectives of the park, and subject to conditions set by the management authority. Both internal and external researchers are required to submit research proposals outlining research aims and requirements obtain a permit to be reviewed by SANParks scientific and management staff. Each research 'node' oversees the research and monitoring conducted in its complement of parks, working closely with the park managers to guide management strategies and actions: for the Addo ENP MPA this node is the Garden Route & Frontier Research Unit.

Each research proposal will be evaluated by an internal research committee. SANParks scientists provide feedback on each proposal. Projects may be rejected if they are incompatible with the environment, visitor experiences, or with ethical treatment of animals, if they are deemed unfeasible, or if SANParks does not have the capacity to meet the requirements of the project. If the proposal is accepted, researchers provide SANParks with reports on the outcomes of the project and copies of data and publications. Results and subsequent recommendations are communicated directly to MPA scientists and managers. Researchers are required to share their results and their data via the SANParks Data Repository.

9.2 LONG-TERM ECOLOGICAL MONITORING

Effective conservation relies on integrating sound management actions and robust scientific research and monitoring critical for the implementation and good governance of MPAs. SANParks monitoring and research is guided by an overarching strategy (SANParks Research Strategy 2020 (Freitag et al. 2020), national policies and priorities, gazetted objectives of protected areas and management plans. Long-term ecological monitoring is essential to inform our understanding of the factors driving changes in biodiversity and the impacts of pressures on ecosystem function.

Algoa Bay has been a sentinel site for long-term ecological research since 2007 and is considered the best-monitored coastal area in Africa and the southern hemisphere (Goschen et al. 2012, Dorrington et al. 2018). It was formally designated as the Algoa Bay Sentinel Site under SAEON, which coordinates multi-decadal ecological monitoring and climate research (Roberts et al. 2010; Goschen et al. 2015). Several long-term marine monitoring programmes are active in the Bay, and its surrounds, many of which contribute directly to understanding and managing the Addo ENP MPA. These programmes, some of which have been running for decades, are coordinated by a range of institutions including Nelson Mandela University (NMU), SAEON, South African Institute for Aquatic Biodiversity (SAIAB), now DFFE and BirdLife South Africa. Together, they form an integrated monitoring network that supports science-based conservation, policy, and spatial planning.

For example, the Sandy Beach Monitoring Programme led by both NMU and SAEON involves monthly surveys of physical parameters of the surf zone (such as surf energy, wave height, and topography), water chemistry (including nutrients like ammonium and phosphate), and biological indicators (such as phytoplankton biomass and species composition). It also includes groundwater flow assessments in the Alexandria dunefield. Samples are collected from Sundays estuary to Woody Cape, within the MPA. Similarly, rocky shore monitoring has been ongoing since 2000 in various guises, focussing on intertidal community composition around the Algoa Bay islands. To coincide with MPA designation

SANParks, DFFE, and SAEON initiated a rocky shore monitoring (biannual) programme to assess the MPA's ecological effectiveness for conserving intertidal habitats. This program uses photo transects and species counts, from the same fixed locations.

SAIAB has led a reef monitoring programme for many years surveying macro-benthic communities and habitat profiles across various MPAs. These surveys provide long-term datasets on reef health both within and outside protected areas. More recent additions include BRUV (baited remote underwater video) surveys for reef fish biodiversity monitoring.

Seabird monitoring is one of the longest-standing efforts, with several programmes running since the late 1970s. DFFE, NMU, SANParks and SANCCOB monitor population trends of vulnerable seabirds annually, primarily around Algoa Bay. Additional research by BirdLife South Africa and NMU has focused on penguin diet, foraging, movement, and breeding ecology, particularly on Bird Island. These data are critical for understanding seabird responses to changing marine conditions and human impacts.

The pelagic ecosystem is monitored by SAEON, SAIAB, and NMU. Surveys assess water column nutrients, phytoplankton, and zooplankton abundance and diversity in Algoa Bay. Long-term oceanographic moorings and high-frequency monitoring have revealed shifts in circulation, stratification, and plankton communities, closely tied to climate variability and upwelling intensity (Goschen et al. 2015, Lamont et al. 2018). These physical and biological datasets are crucial for understanding long-term variability, ecosystem productivity, and climate-driven change, and are collected both within and outside MPA boundaries.

Together, these long-term programmes provide some understanding of the temporal changes within marine ecosystems in Algoa Bay. They support MPA performance evaluation, help identify ecological baselines, and inform adaptive management. Many are now integrated under broader initiatives such as the Algoa Bay Sentinel Site and South African Coastal Observing Network, highlighting the region's national importance for marine monitoring and ecosystem-based management.

9.3 RESEARCH PRIORITIES

There are several key research gaps that have been identified for the Addo ENP MPA, which need to be addressed to support effective management, policy development, and adaptive conservation strategies. One important gap is the need for better understanding of invasive alien species within the MPA. Marine invasive species can outcompete native fauna and flora, alter habitat structure, and disrupt food webs. Currently, there is limited information on the presence, extent, and ecological impact of non-native species in the Addo ENP MPA, making it difficult to assess the urgency and appropriate management responses.

Related to this is the need for improved species management and control strategies. While the MPA is home to several iconic and threatened species the effectiveness of current protection measures for these species has not been fully assessed. Research is needed to support the development of targeted conservation interventions, especially for species vulnerable to fishing pressure, habitat degradation, or changing ocean conditions.

The socio-economic dimensions of the MPA also remain poorly understood. While some work has been done, a comprehensive socio-economic assessment of the Addo ENP MPA is still needed. This should include valuation of ecosystem services (e.g. coastal protection, carbon storage, recreation), documentation of cultural heritage connections, and distributional analyses of benefits and costs across stakeholder groups. Understanding the impacts of the MPA on fisheries, both positive and negative, is another critical focal area. While MPAs can enhance fish stocks through spillover and habitat protection, they can also restrict access for local fishers. There is a lack of quantitative evidence on how the Addo ENP MPA has affected fish populations and fishing livelihoods since its establishment.

Finally, there is a clear need to establish a baseline for commercial activities and assess carrying capacity within the MPA. This includes activities such as tourism, shipping, bunkering, and fishing. Without baseline data, it is difficult to evaluate cumulative impacts or determine what levels of use are ecologically sustainable. Research in this area would directly support marine spatial planning and the long-term zoning and permitting framework for the MPA.

10. CONCLUSIONS AND LOOKING AHEAD

The Addo ENP MPA protects one of South Africa's most ecologically significant marine ecosystems, supporting internationally important seabird colonies, productive estuaries, diverse benthic habitats, rocky reefs and pelagic ecosystems.

Algoa Bay has one of the strongest marine ecological evidence bases in Africa.

Although a strong baseline exists, the effectiveness of the MPA in achieving its conservation objectives has yet to be comprehensively evaluated.

Several species of conservation concern, including African penguins, continue to decline despite spatial protection, reflecting pressures that extend beyond MPA boundaries.

Illegal harvesting, declining prey availability, pollution, maritime activities, coastal development and catchment-derived impacts remain key threats to biodiversity.

Knowledge gaps remain regarding management effectiveness, fisheries impacts, ecosystem service provision, socio-economic benefits, invasive species status, cumulative impacts and climate change resilience.

EMERGING PRIORITIES

- Evaluate management effectiveness through measurable ecological, socio-economic and governance indicators.
- Strengthen long-term monitoring to detect ecological change, assess recovery, and inform adaptive management.
- Improve compliance and enforcement, particularly in relation to illegal fishing and abalone poaching.
- Balance sustainable use and economic development with the conservation of biodiversity, ensuring that emerging pressures do not compromise the ecological values for which the MPA was proclaimed.
- Address land-sea connectivity by integrating catchment management, estuarine conservation and marine spatial planning.
- Strengthen stakeholder partnerships.
- Priorities research to address knowledge gaps relating to zoning effectiveness, fisheries spillover, ecosystem services, invasive species management, climate change resilience etc.
- Ensure monitoring and research findings are regularly incorporated into management decisions and future revisions of the Management Plan.

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APPENDICES

SPECIES LISTS

Compiled species list for the Addo ENP MPA. Species lists were compiled from multiple sources, including published literature, regional field guides, biodiversity databases and expert knowledge. In some cases, species were included based on their documented regional distribution, and their presence within the study area has not yet been verified through targeted field surveys. These lists should therefore be considered preliminary and subject to refinement as additional information becomes available.

Appendix A Marine Mammals

Family	Scientific Name	Common Name	Source
Balaenidae	*Eubalaena australis*	Southern right whale	CMORE, iNat
Balaenopteridae	*Balaenoptera edeni*	Bryde's whale	iNat
Balaenopteridae	*Megaptera novaeangliae australis*	Southern humpback whale	iNat
Delphinidae	*Delphinus delphis*	Short-beaked common dolphin	FBIP_Sea, Robinson 1976
Delphinidae	*Tursiops aduncus*	Indo-Pacific bottlenose dolphin	Robinson 1976, iNat
Delphinidae	*Sousa plumbea*	Indo-Pacific humpback dolphin	Saayman et al. 1972, Cerchio et al. 2015, Plön & Relton 2016, Braulik et al. 2023
Otariidae	*Arctocephalus pusillus pusillus*	Cape fur seal	iNat

Appendix B Birds and Shorebirds

Family	Scientific Name	Common Name	Source
Accipitridae	*Haliaeetus vocifer*	African fish eagle	CMORE, Birda, AENPBirdCmore, SABAP2, iNat
Alcedinidae	*Alcedo semitorquata*	Half-collared kingfisher	EOD
Alcedinidae	*Ceryle rudis*	Pied kingfisher	CMORE, AENPBirdCmore
Alcedinidae	*Corythornis cristatus*	Malachite kingfisher	iNat
Alcedinidae	*Megaceryle maxima*	Giant kingfisher	iNat
Anatidae	*Alopochen aegyptiaca*	Egyptian goose	EOD, AENPBirdCmore, Obs.org, CMORE, Birda, SABAP2, iNat
Anatidae	*Anas capensis*	Cape teal	SABAP2
Anatidae	*Anas erythrorhyncha*	Red-billed teal	SABAP2, Obs.org
Anatidae	*Anas undulata*	Yellow-billed duck	EOD, AENPBirdCmore, Obs.org, Birda, SABAP2, iNat
Anatidae	*Dendrocygna viduata*	White-faced whistling duck	SABAP2
Anatidae	*Plectropterus gambensis*	Spur-winged goose	SABAP2
Anatidae	*Tadorna cana*	South African shelduck	SABAP2, iNat
Anhingidae	*Anhinga rufa*	African darter	iNat, Obs.org, EOD, Natgucker
Ardeidae	*Ardea alba*	Great egret	CMORE, AENPBirdCmore

Family	Scientific Name	Common Name	Source
Ardeidae	*Ardea cinerea*	Grey heron	SABAP2, CMORE, AENPBirdCmore
Ardeidae	*Ardea goliath*	Goliath heron	Natgucker, Obs.org, CMORE, AENPBirdCmore, iNat
Ardeidae	*Ardea melanocephala*	Black-headed heron	SABAP2, EOD, iNat
Ardeidae	*Bubulcus ibis*	Cattle egret	SABAP2, EOD, iNat
Ardeidae	*Egretta garzetta*	Little egret	iNat
Ardeidae	*Nycticorax nycticorax*	Black-crowned night heron	iNat
Burhinidae	*Burhinus capensis*	Spotted thick-knee	SABAP2
Burhinidae	*Burhinus vermiculatus*	Water thick-knee	EOD, Natgucker, Obs.org, SABAP2, iNat
Charadriidae	*Charadrius hiaticula*	Common ringed plover	SABAP2, iNat, Birda
Charadriidae	*Charadrius marginatus*	White-fronted plover	SABAP2, AENPBirdCmore, CMORE, Birda
Charadriidae	*Charadrius pecuarius*	Kittlitz's plover	SAFRING
Charadriidae	*Charadrius tricollaris*	Three-banded plover	SABAP2, EOD, Natgucker
Charadriidae	*Pluvialis squatarola*	Grey plover	SABAP2, iNat
Charadriidae	*Vanellus armatus*	Blacksmith lapwing	Obs.org, Birda, CMORE, AENPBirdCmore, SABAP2, iNat
Charadriidae	*Vanellus coronatus*	Crowned lapwing	SABAP2, EOD
Charadriidae	*Vanellus melanopterus*	Black-winged lapwing	SABAP2
Chionidae	*Chionis albus*	Snowy sheathbill	SABAP2, iNat
Haematopodidae	*Haematopus moquini*	African oystercatcher	EOD, Obs.org, SAFRING, CMORE, AENPBirdCmore, SABAP2, iNat
Laridae	*Chroicocephalus cirrocephalus*	Grey-headed gull	CMORE, EOD, iNat, AENPBirdCmore
Laridae	*Chroicocephalus hartlaubii*	Hartlaub's gull	Obs.org, iNat
Laridae	*Hydroprogne caspia*	Caspian tern	CMORE
Laridae	*Larus dominicanus*	Kelp gull	EOD, Birda, AENPBirdCmore, SABAP2, iNat
Laridae	*Sterna dougallii*	Roseate tern	SABAP2
Laridae	*Sterna hirundo*	Common tern	EOD, Obs.org, CMORE, AENPBirdCmore, SABAP2, iNat
Laridae	*Sternula balaenarum*	Damara tern	SABAP2, iNat, SAFRING, EOD
Laridae	*Thalasseus bergii*	Greater crested tern	Obs.org, EOD, iNat, AENPBirdCmore
Phalacrocoracidae	*Microcarbo africanus*	Reed cormorant	SABAP2, Obs.org, iNat
Phalacrocoracidae	*Phalacrocorax capensis*	Cape cormorant	EOD, Natgucker, Obs.org, SAFRING, CMORE, AENPBirdCmore, SABAP2, iNat
Phalacrocoracidae	*Phalacrocorax carbo*	Great cormorant	SAFRING, EOD
Phalacrocoracidae	*Phalacrocorax lucidus*	White-breasted cormorant	SABAP2, Obs.org, AENPBirdCmore, Birda
Phoenicopteridae	*Phoeniconaias minor*	Lesser flamingo	AENPBirdCmore

Family	Scientific Name	Common Name	Source
Phoenicopteridae	*Phoenicopterus ruber*	American flamingo	Obs.org, iNat
Procellariidae	*Procellaria aequinoctialis*	White-chinned petrel	AntTrack_SCAR
Procellariidae	*Thalassoica antarctica*	Antarctic petrel	EOD
Recurvirostridae	*Himantopus himantopus*	Black-winged stilt	Obs.org, EOD, iNat, Birda
Scolopacidae	*Actitis hypoleucos*	Common sandpiper	EOD, iNat
Scolopacidae	*Arenaria interpres*	Ruddy turnstone	SABAP2, SAFRING, EOD
Scolopacidae	*Calidris alba*	Sanderling	SABAP2, iNat, AENPBirdCmore
Scolopacidae	*Calidris ferruginea*	Curlew sandpiper	Obs.org
Scolopacidae	*Calidris pugnax*	Ruff	SABAP2
Scolopacidae	*Limosa limosa*	Black-tailed godwit	Obs.org, iNat
Scolopacidae	*Numenius arquata*	Curlew	iNat
Scolopacidae	*Numenius phaeopus*	Eurasian whimbrel	EOD, Natgucker, Obs.org, CMORE, AENPBirdCmore, SABAP2, iNat
Scolopacidae	*Tringa glareola*	Wood sandpiper	AENPBirdCmore
Scolopacidae	*Tringa nebularia*	Common greenshank	Obs.org, iNat
Spheniscidae	*Spheniscus demersus*	African penguin	AENPBirdCmore
Stercorariidae	*Stercorarius antarcticus*	Brown skua	SABAP2
Stercorariidae	*Stercorarius parasiticus*	Arctic skua	SABAP2
Stercorariidae	*Stercorarius pomarinus*	Pomarine jaeger	EOD
Sulidae	*Morus capensis*	Cape gannet	SABAP2, Obs.org, EOD, iNat
Threskiornithidae	*Platalea alba*	African spoonbill	SABAP2, iNat
Threskiornithidae	*Threskiornis aethiopicus*	African sacred ibis	SABAP2, Obs.org, EOD, iNat

Appendix C Chondrichthyans

Family	Scientific Name	Common Name	Source
Callorhinchidae	*Callorhinchus capensis*	St Joseph shark	Branch et al. 2010
Carcharhinidae	*Carcharhinus brachyurus*	Bronze whaler shark	Heemstra & Heemstra 2004, ATAP 2022
Carcharhinidae	*Carcharhinus obscurus*	Dusky shark	Heemstra & Heemstra 2004, ATAP 2022
Dasyatidae	*Dasyatis chrysonota*	Blue stingray	Branch et al. 2010
Gymnuridae	*Gymnura natalensis*	Butterfly ray	Dando 2020, FBIP_Fish, SAIAB
Hexanchidae	*Notorynchus cepedianus*	Broadnose sevengill shark	Dando 2020
Lamnidae	*Carcharodon carcharias*	Great white shark	Dicken et al. 2013, Klein et al. 2022, Kock et al. 2022
Myliobatidae	*Myliobatis aquila*	Eagle ray	Dando 2020
Odontaspididae	*Carcharias taurus*	Ragged-tooth shark	Dicken et al. 2011
Rajidae	*Raja straeleni*	Biscuit skate	Branch et al. 2010
Rajidae	*Raja miraletus*	Brown ray	iBOL, ENA_INSDC

Family	Scientific Name	Common Name	Source
Rajidae	*Rostroraja alba*	Bottlenose skate	Branch et al. 2010
Rhinobatidae	*Acroteriobatus annulatus*	Lesser sandshark	Branch et al. 2010
Rhinobatidae	*Acroteriobatus ocellatus*	Speckled sandshark	SAIAB
Scyliorhinidae	*Halaelurus natalensis*	Tiger cat shark	Dando 2020, SAIAB
Scyliorhinidae	*Haploblepharus edwardsii*	Puffadder shyshark	Dando 2020
Scyliorhinidae	*Haploblepharus fuscus*	Brown shyshark	Dando 2020
Scyliorhinidae	*Haploblepharus pictus*	Dark shyshark	Branch et al. 2010
Scyliorhinidae	*Poroderma africanum*	Pyjama shark	Dando 2020, iNat
Scyliorhinidae	*Poroderma pantherinum*	Leopard catshark	Dando 2020
Scyliorhinidae	*Scyliorhinus capensis*	Yellow-spotted catshark	Dando 2020
Squalidae	*Squalus megalops*	Shortnose spurdog	iNat, FLMNH
Triakidae	*Galeorhinus galeus*	Soupfin shark	Branch et al. 2010
Triakidae	*Mustelus mustelus*	Common smooth-hound shark	Dando 2020
Triakidae	*Triakis megalopterus*	Blackspotted smooth-hound shark	Dando 2020

Appendix D Teleosts

Family	Scientific Name	Common Name	Source
Anguillidae	*Anguilla mossambica*	African longfin eel	SAIAB
Ariidae	*Galeichthys ater*	Black seacatfish	Dando 2020
Ariidae	*Galeichthys feliceps*	White seacatfish	Dando 2020, SAIAB
Batrachoididae	*Batrichthys apiatus*	Snakehead toadfish	SAIAB
Bramidae	*Brama brama*	Atlantic pomfret	SAIAB
Carangidae	*Lichia amia*	Leervis/garrick	Dando 2020
Carangidae	*Seriola lalandi*	Yellowtail	Dando 2020
Carangidae	*Trachinotus africanus*	Southern pompano	FBIP_Fish, SAIAB
Carangidae	*Trachurus trachurus*	Atlantic horse mackerel	Dando 2020, SAIAB
Chaetodontidae	*Chaetodon marleyi*	Doubledash butterflyfish	Dando 2020
Cheilodactylidae	*Cheilodactylus fasciatus*	Redfingers	Dando 2020
Cheilodactylidae	*Cheilodactylus pixi*	Barred fingerfin	Dando 2020, SAIAB
Cheilodactylidae	*Chirodactylus brachydactylus*	Two-tone fingerfin	Dando 2020
Cheilodactylidae	*Chirodactylus grandis*	Bank steenbras	Dando 2020
Cichlidae	*Oreochromis mossambicus*	Mozambique tilapia	FBIP_Fish, SAIAB
Clinidae	*Cirrhibarbis capensis*	Barbelled klipvis	SAIAB
Clinidae	*Climacoporus navalis*	Fleet klipvis	SAIAB
Clinidae	*Clinus cottoides*	Bluntnose klipvis	iNat, SAIAB
Clinidae	*Clinus superciliosus*	Super klipvis	iNat, SAIAB
Clinidae	*Clinus taurus*	Bull klipvis	SAIAB
Clinidae	*Clinus venustris*	Speckled klipvis	SAIAB

Family	Scientific Name	Common Name	Source
Clinidae	*Fucomimus mus*	Mousey klipvis	SAIAB
Congridae	*Conger cinereus*	Ash-colored conger eel	SAIAB
Dussumieriidae	*Etrumeus whiteheadi*	Red-eye round herring	Dando 2020, SAIAB
Gobiesocidae	*Chorisochismus dentex*	Giant clingfish	FBIP_Fish, iNat, SAIAB
Gobiidae	*Awaous aeneofuscus*	Freshwater goby	iNat
Gobiidae	*Caffrogobius natalensis*	Baldy	SAIAB
Haemulidae	*Pomadasys olivaceus*	Olive grunter	Dando 2020
Lotidae	*Gaidropsarus capensis*	Cape rockling	SAIAB
Ophichthidae	*Ophisurus serpens*	Serpent eel	FBIP_Fish
Oplegnathidae	*Oplegnathus conwayi*	Beaked galjoen	Dando 2020, SAIAB
Parascorpididae	*Parascorpis typus*	Jutjaw	Dando 2020
Platycephalidae	*Platycephalus indicus*	Bar-tailed flathead	FBIP_Fish, iNat
Pomatomidae	*Pomatomus saltatrix*	Shad	Dando 2020
Priacanthidae	*Heteropriacanthus cruentatus*	Glasseye snapper	SAIAB
Pseudochromidae	*Halidesmus scapularis*	Snakelet	Ichthyology Collection - Royal Ontario Museum, SAIAB
Sciaenidae	*Argyrosomus japonicus*	Dusky kob	Dando 2020, SAIAB
Sciaenidae	*Atractoscion aequidens*	Geelbek	Dando 2020, FBIP_SAEON
Sciaenidae	*Umbrina ronchus*	Slender baardman	Dando 2020
Scombridae	*Sarda orientalis*	Striped bonito	SAIAB
Serranidae	*Acanthistius sebastoides*	Scorpion grouper	Dando 2020
Serranidae	*Epinephelus albomarginatus*	White-edged grouper	SAIAB
Serranidae	*Epinephelus marginatus*	Dusky grouper	Dando 2020, SAIAB
Serranidae	*Hyporthodus chabaudi*	Moustache grouper	SAIAB
Serranidae	*Serranus cabrilla*	Comber	Dando 2020
Sparidae	*Acanthopagrus vagus*	Wandering seabream	iNat
Sparidae	*Argyrozona argyrozona*	Carpenter seabream	Dando 2020, FBIP_SAEON, SAIAB
Sparidae	*Boopsoidea inornata*	Fransmadam	Dando 2020
Sparidae	*Cheimerius nufar*	Santer seabream	Dando 2020
Sparidae	*Chrysoblephus cristiceps*	Daggerhead seabream	Dando 2020
Sparidae	*Chrysoblephus gibbiceps*	Miss Lucy/red stumpnose	Dando 2020
Sparidae	*Chrysoblephus laticeps*	Red Roman	Dando 2020
Sparidae	*Cymatoceps nasutus*	Black musselcracker	Dando 2020, SAIAB
Sparidae	*Diplodus capensis*	Blacktail	Dando 2020, SAIAB
Sparidae	*Diplodus hottentotus*	Zebra	Dando 2020
Sparidae	*Gymnocrotaphus curvidens*	Janbruin	Dando 2020, FBIP_SAEON
Sparidae	*Lithognathus lithognathus*	White steenbras	iNat, SAIAB

Family	Scientific Name	Common Name	Source
Sparidae	*Lithognathus mormyrus*	Sand steenbras	Dando 2020, SAIAB
Sparidae	*Pachymetopon aeneum*	Blue seabream	Dando 2020
Sparidae	*Pachymetopon blochii*	Cape bream	Dando 2020
Sparidae	*Pachymetopon grande*	Bronze seabream	Dando 2020
Sparidae	*Pagellus natalensis*	Natal Pandora	Dando 2020
Sparidae	*Petrus rupestris*	Red steenbras	Dando 2020
Sparidae	*Polyamblyodon* sp.	Seabreams	SAIAB
Sparidae	*Polysteganus undulosus*	Seventy-four seabream	Dando 2020
Sparidae	*Porcostoma dentatum*	Dane seabream	Dando 2020
Sparidae	*Pterogymnus laniarius*	Panga seabream	Dando 2020
Sparidae	*Rhabdosargus globiceps*	White stumpnose	Dando 2020
Sparidae	*Rhabdosargus holubi*	Cape stumpnose	Dando 2020
Sparidae	*Sarpa salpa*	Strepie	Dando 2020, SAIAB
Sparidae	*Sparodon durbanensis*	White musselcracker	Dando 2020, SAIAB
Sparidae	*Spondyliosoma emarginatum*	Steentje	Dando 2020
Tetraodontidae	*Amblyrhynchote honckenii*	Evileye blaasop	Dando 2020
Tetraodontidae	*Arothron inconditus*	Bellystriped blaasop	iNat
Tetraodontidae	*Lagocephalus* sp.	Pufferfishes	SAIAB
Triglidae	*Chelidonichthys kumu*	Bluefin gurnard	Dando 2020, SAIAB
Triglidae	*Chelidonichthys lastoviza*	African gurnard	SAIAB
Triglidae	*Chelidonichthys queketti*	Lesser gurnard	FBIP_Sea, SAIAB
Tripterygiidae	*Cremnochorites capensis*	Cape triplefin	SAIAB

Appendix E Marine Invertebrates

Phylum	Scientific Name	Common Name	Source
Arthropoda	*Acanthonyx* spp.	Decorator crabs	iNat
Arthropoda	*Diogenes brevirostris*	Common sand hermit crab	iBOL
Arthropoda	*Guinusia chabrus*	Red rock crab	iNat
Arthropoda	*Jasus* spp.	Spiny lobsters	iNat
Arthropoda	*Pagurus liochele*	Blue-striped hermit crab	ENA_INSDC
Arthropoda	*Palaemon peringueyi*	Reel life sand shrimp	iBOL
Cnidaria	*Anthothoe* spp.	Sea anemones	iNat
Cnidaria	*Chrysaora* spp.	Sea nettles	iNat
Cnidaria	*Crambionella* spp.	Blubber jellyfish	iNat
Cnidaria	*Macrorhynchia* spp.	Hydroids	SMNHInvertCol
Cnidaria	*Physalia physalis*	Bluebottle	iNat
Cnidaria	*Porpita* spp.	Blue button jellyfishes	iNat
Cnidaria	*Sertularella arbuscula*	Planar hydroid	SMNHInvertCol
Cnidaria	*Velella* spp.	By-the-wind sailors	iNat

Phylum	Scientific Name	Common Name	Source
Echinodermata	*Callopatiria granifera*	Red starfish	iNat
Echinodermata	*Marthasterias* spp.	Spiny starfishes	iNat
Echinodermata	*Parvulastra exigua*	Dwarf cushion star	iNat
Mollusca	*Afrivoluta* spp.	Volutes	UF Invertebrate Zoology
Mollusca	*Argobuccinum* spp.	Triton shells	AMus_OZCAM, UF Invertebrate Zoology, IZIKO_Survey
Mollusca	*Austromitra* spp.	Mitre shells	ANS_MalaCol
Mollusca	*Barbatia* spp.	Ark clams	PaleoData, INHS_MollCol
Mollusca	*Barnea* spp.	Boring clams	MalCGY_Cltn
Mollusca	*Berthellina* spp.	Side-gilled slugs	iNat
Mollusca	*Bulla ampulla*	Bubble snail	PaleoData
Mollusca	*Bullia annulata*	Ringed plough snail	Natal Museum Dredging Programme marine mollusc data, ANS_MalaCol, SBMNH_Invert, PaleoData, NHMUtahInvert
Mollusca	*Bullia digitalis*	Finger plough snail	ANS_MalaCol, PaleoData, INHS_MollCol
Mollusca	*Bullia pura*	Plough snail	ANS_MalaCol
Mollusca	*Burnupena cincta*	Ribbon whelk	MCZ_Harv, INHS_MollCol
Mollusca	*Burnupena pubescens*	Pubescent Burnupena	SBMNH_Invert, INHS_MollCol
Mollusca	*Cabestana africana*	South African triton	iNat
Mollusca	*Cabestana cutacea*	Mediterranean bark triton	MCZ_Harv, INHS_MollCol
Mollusca	*Cerithidea decollata*	Truncated horn shell	ANS_MalaCol, INHS_MollCol
Mollusca	*Charonia lampas*	Triton’s trumpet	iNat
Mollusca	*Choromytilus* spp.	Mussels	UF Invertebrate Zoology
Mollusca	*Clanculus* spp.	Top shells	SBMNH_Invert
Mollusca	*Clavatula tripartita*	Turrid snail	FBIP_Invert, IZIKO_Survey, INHS_MollCol
Mollusca	*Clionella kraussii*	Krauss's turrid	INHS_MollCol
Mollusca	*Colina* sp.	Turban shells	ANS_MalaCol, INHS_MollCol
Mollusca	*Conus capitaneus*	Captain cone	MCZ_Harv, CMNH_Mollu
Mollusca	*Conus infrenatus*	Infernal cone	MCZ_Harv, INHS_MollCol
Mollusca	*Coralliophila* spp.	Coral snails	ANS_MalaCol
Mollusca	*Cymbula miniata*	Pink-rayed limpet	INHS_MollCol
Mollusca	*Demoulia abbreviata*	Brown whelk	ANS_MalaCol, PRICollection

Phylum	Scientific Name	Common Name	Source
Mollusca	*Demoulia ventricosa*	Fat whelk	ANS_MalaCol, PaleoData, INHS_MollCol
Mollusca	*Dendrodoris* spp.	Nudibranchs	iNat
Mollusca	*Dinoplax* spp.	Chitons	iNat
Mollusca	*Donax serra*	White mussel	iNat
Mollusca	*Dosinia afra*	African Venus clam	PaleoData
Mollusca	*Dosinia hepatica*	Venus clam	MalCGY_Cltn
Mollusca	*Dosinia lupinus*	Smooth Artemis clam	MalCGY_Cltn
Mollusca	*Fusitriton* spp.	Giant tritons	MalCGY_Cltn
Mollusca	*Gastrana matadoa*	Ridged tellin	PaleoData
Mollusca	*Gibbula zonata*	Top shell	ANS_MalaCol, INHS_MollCol
Mollusca	*Gyroscala* sp.	Wentletraps	MalCGY_Cltn
Mollusca	*Haliotis* spp.	Abalones	ANS_MalaCol, iNat
Mollusca	*Isara* spp.	Mitre shells	ANS_MalaCol
Mollusca	*Janthina janthina*	Violet snail	iNat
Mollusca	*Kilburnia* spp.	Whelks	MalCGY_Cltn, SBMNH_Invert, IZIKO_Survey
Mollusca	*Lamarcka avellana*	Hazelnut ark clam	PaleoData
Mollusca	*Latona* spp.	Venus clams	ANS_MalaCol
Mollusca	*Luria isabella*	Isabella cowry	ANS_MalaCol
Mollusca	*Marginella* spp.	Margin shells	SBMNH_Invert
Mollusca	*Modiolus auriculatus*	Eared horse mussel	PaleoData
Mollusca	*Modiolus philippinarum*	Philippine horse mussel	PaleoData
Mollusca	*Monoplex* spp.	Triton shells	MalCGY_Cltn, IZIKO_Survey
Mollusca	*Nassarius capensis*	Cape dogwhelk	INHS_MollCol
Mollusca	*Natica forata*	Moon snail	ANS_MalaCol
Mollusca	*Nerita albicilla*	Blotched nerite	MalCGY_Cltn
Mollusca	*Nerita plicata*	Plicate nerite	MalCGY_Cltn
Mollusca	*Nerita polita*	Polished nerite	MalCGY_Cltn
Mollusca	*Nucella dubia*	Common dogwhelk	PaleoData
Mollusca	*Nucella squamosa*	Scaly dogwhelk	UF Invertebrate Zoology, INHS_MollCol
Mollusca	*Octopus* spp.	Octopuses	iNat
Mollusca	*Oxymeris dimidiata*	Orange auger	INHS_MollCol
Mollusca	*Pallidea palliderosea*	Margin shell	ANS_MalaCol, Natal Museum Dredging Programme marine mollusc data
Mollusca	*Pecten sulcicostatus*	South African scallop	NL_Mollusca
Mollusca	*Perna perna*	Brown mussel	iNat
Mollusca	*Pholas* spp.	Piddocks	PaleoData

Phylum	Scientific Name	Common Name	Source
Mollusca	*Pinna* spp.	Pen shells	MalCGY_Cltn, FBIP_SAEON
Mollusca	*Polinices mammilla*	White moon snail	INHS_MollCol
Mollusca	*Pseudoliva* spp.	False olive shells	MalCGY_Cltn
Mollusca	*Psichion inclara*	Margin shell	University of Michigan Museum of Zoology, Division of Mollusks
Mollusca	*Pupillaea aperta*	Mantled keyhole limpet	SBMNH_Invert, PaleoData
Mollusca	*Scaltpia* spp.	Margin shells	ANS_MalaCol, MCZ_Harv
Mollusca	*Scutellastra tabularis*	Giant limpet	University of Michigan Museum of Zoology, Division of Mollusks
Mollusca	*Semicassis labiata*	Helmet bonnet shell	ANS_MalaCol
Mollusca	*Semicassis zeylanica*	Helmet shell	ANS_MalaCol, SBMNH_Invert, FBIP_Invert, IZIKO_Survey
Mollusca	*Semiricinula* spp.	Rock snails	PaleoData
Mollusca	*Standella* spp.	Venus clams	PaleoData
Mollusca	*Talochlamys*	Scallops	MalCGY_Cltn, NL_Mollusca
Mollusca	*Tectonatica* spp.	Moon snails	ANS_MalaCol, INHS_MollCol
Mollusca	*Thecalia concamerata*	Dead man's hands	ANS_MalaCol
Mollusca	*Tritonoharpa* spp.	Harp tritons	INHS_MollCol
Mollusca	*Triviella ovulata*	False cowrie	INHS_MollCol
Mollusca	*Trochita helicoidea*	Slipper limpet	ANS_MalaCol
Mollusca	*Trochus nigropunctatus*	Black-spotted top shell	ANS_MalaCol
Mollusca	*Turbo cidaris natalensis*	Natal turban shell	ANS_MalaCol, University of Michigan Museum of Zoology, Division of Mollusks, iNat
Mollusca	*Turricula* spp.	Turrids	INHS_MollCol
Mollusca	*Vaughtia fenestrata*	Fenestrate oyster-drill	INHS_MollCol
Mollusca	*Vexillum patulum*	Wide-mouth mitre shell	ANS_MalaCol
Mollusca	*Zemiropsis* spp.	Volutes	ANS_MalaCol
Porifera	*Higginsia bidentifera*	Bidentate sponge	Matobole et al. 2017
Porifera	*Isodictya compressa*	Compressa sponge	Matobole et al. 2017
Porifera	*Tethya samaaii*	Tsitsikamma sponge	Matobole et al. 2017
Porifera	*Tsitsikamma (Clavicaulis) michaeli*	Red sponge	Matobole et al. 2017

Appendix F Hagfish

Family	Scientific Name	Common Name	Source
Myxinidae	*Eptatretus hexatrema*	Sixgill hagfish	Dando 2020

Appendix G Algae

Family	Scientific Name	Common Name	Source
Corallinaceae	*Jania* spp.	Coralline algae (red algae)	Branch et al. 2010
Halimedaceae	*Halimeda cuneata*	Wedgeweed (green algae)	iNat

Appendix H Plankton

Family	Scientific Name	Common Name	Source
Anaulaceae	*Anaulus australis*	Surf diatom	McGregor & Strydom 2020
Anaulaceae	*Anaulus* spp.	Surf diatom genus	McGregor & Strydom 2020
Bacillariaceae	*Pseudo-nitzschia multiseries*	Toxin-producing diatom	Pitcher et al. 2014, Bizani et al. 2023
Lingulodiniaceae	*Lingulaulax polyedra*	Bioluminescent dinoflagellate	Pitcher et al. 2014, Bizani et al. 2023
Mysidae	*Gastrosaccus psammodytes*	Surf-zone mysid shrimp	Wooldridge 1983
Mysidae	*Mesopodopsis wooldridgei*	Mysid Shrimp	Wooldridge 1983
Penaeidae	*Macropetasma africanus*	African Penaeid Shrimp	Wooldridge 1983

South African
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