NATIONAL DATA AND INFORMATION REPORT

FOR MARINE SPATIAL PLANNING

KNOWLEDGE BASELINE FOR MARINE SPATIAL PLANNING IN SOUTH AFRICA

REPUBLIC OF SOUTH AFRICA

OPERATION PHAKISA
planning | Implementation | growth

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PETROLEUM AGENCY SA

NRF National Research Foundation
SAEON South African Environmental Observation Network

SAHRA
SOUTH AFRICAN HERITAGE RESOURCES AGENCY

SAMSA
SOUTH AFRICAN MARITIME SAFETY AUTHORITY

SANBI
Biodiversity for Life
South African National Biodiversity Institute

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DISCLAIMER

The information contained in this report is a snapshot, and a static presentation of what is essentially a dynamic environment. Ocean uses change, priorities change, the socio-economic context changes, and the ocean environment also changes, sometimes quickly and unpredictably so. What is presented here is the best available data and information at the time of compiling the report (July 2020). This particularly applies to the maps contained in this report which are based on the latest data available (October 2020). It is expected that this report will be regularly updated to reflect new data and information.

SUGGESTED CITATION

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FOREWORD

South Africa is an ocean nation: the marine area under South African jurisdiction is greater than the country's landmass. The vast ocean area within the Exclusive Economic Zone is rich in biodiversity and other natural resources, providing significant social and economic opportunities.

These ocean resources sustain numerous industries such as tourism, fisheries, mariculture and mining. Telecommunication cables and other underwater infrastructure are part of the country's critical economic backbone. The ocean and coastal areas are also linked to the country's cultural heritage, and therefore significant for the wellbeing of South Africans and the safeguarding of traditions. In addition, the ocean provides opportunities for future uses such as renewable energy or bioprospecting.

The broad and growing range of these human activities and interests in the ocean requires careful and improved coordination and cooperation in making decisions on the sustainable use, conservation and management of our marine resources. This is reflected in South Africa's Ocean Economy initiative that seeks to boost sustainable ocean development while also managing both impact and the footprint of these activities. An integrated approach to marine planning and management has been adopted, that reflects the connectivity and diversity of marine socio-ecological systems in times of a changing climate and expanding economic interests.

In this context, Marine Spatial Planning (MSP) is introduced in South Africa as a holistic approach that guides when, where and how human activities occur in the sea. The ultimate aim of MSP is to manage human demands in the ocean in ways that integrate conservation, economic and social interests. MSP attempts to unlock the socio-economic growth potential of the ocean while sustaining the provision of ecosystem services in a healthy ocean. Conflicts between sectors are avoided pro-actively, synergies between marine uses are enhanced, and framework conditions for better ocean governance and wealth distribution are established. Currently, the dominating single-sector marine management regimes do not support such transformation towards a systemic approach to planning and management of marine areas.

As one of the critical steps towards realizing MSP in South Africa, the National MSP Working Group has developed the National MSP Data and Information Report (NDIR) – in line with the MSP Act (Act No. 16 of 2018). This report is the first multi-sector document of its kind and establishes the knowledge baseline for planning.It brings together the evidence required for the development of the marine area plans and provides a foundation for guiding future development at sea. The NDIR is considered a living document which will mature over time as our knowledge of the ocean improves. It will therefore evolve to accommodate for change and new information in the years to come. The NDIR serves as the basis for developing the initial set of marine area plans, which will also be periodically revised as prescribed by legislation.

The NDIR is an important milestone in the South African MSP process. It brings together multiple sectors and stakeholders in order to integrate their spatial claims and interests by generating the best possible sustainable ocean development pathway for the country. We are therefore honoured to publish the NDIR and remain committed to working together across sectors for sustainability of South Africa's ocean and coastal economies, and to ensure protection of our ocean and coastal heritage for future generations.

JF Beaumont

JUDY BEAUMONT
DEPUTY DIRECTOR-GENERAL: OCEANS AND COASTS

ACRONYMS

ABNJ	Areas Beyond National Jurisdiction
ADZ	Aquaculture Development Zones
AIS	Automatic Identification System
BBWW	Boat-Based Whale Watching
BCC	Benguela Current Convention
BCLME	Benguela Current Large Marine Ecosystem
BMSL	Below Mean Sea Level
CBA	Critical Biodiversity Area
CBD	Convention on Biological Diversity
CCAMLR	Conservation of Antarctic Marine Living Resources
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
CCS	Carbon Capture and Storage
CCSBT	Commission for the Conservation of Southern Bluefin Tunas
CMM	Conservation and Management Measure
CMTP	Comprehensive Maritime Transport Policy
CPUE	Catch Per Unit Effort
CSIR	Council for Scientific and Industrial Research
DAFF	Department of Agriculture, Forestry and Fisheries
DCDT	Department of Communications and Digital Technologies
DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment
DMRE	Department of Mineral Resources and Energy
DOD	Department of Defence
DOT	Department of Transport
DPWI	Department of Public Works and Infrastructure
DSI	Department of Science and Innovation
DWS	Department of Water and Sanitation
EBSA	Ecologically or Biologically Significant Marine Area
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment

EMP	Environmental Management Plan
ESA	Ecological Support Area
FAO	Food and Agriculture Organisation
GDP	Gross Domestic Product
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
GRT	Gross Registered Tonnage
ICASA	Independent Communications Authority of South Africa
ICCAT	International Commission for the Conservation of Atlantic Tunas
ICM	Integrated Coastal Management
IDGDP	Agriculture, Forestry and Fisheries Integrated Growth and Development Plan
IDZ	Industrial Development Zones
IHO	International Hydrographic Organization
IMO	International Maritime Organization
IOCT	the Indian Ocean Tuna Commission
IUCN	International Union for Conservation of Nature
IUU	Illegal, Unreported and Unregulated (Fishing)
KZN	Kwa-Zulu Natal
LRIT	Long Range Identification and Tracking of Ships
LTL	Lower Trophic Level
MARISMA	Benguela Current Marine Spatial Management and Governance Project
MARPOL	International Convention for the Prevention of Pollution from Ships
MEPC	Marine Environmental Protection Committee of the IMO
MHSA	Mine Health and Safety Act
MLRA	Marine Living Resources Act
MPA	Marine Protected Area
MPRDA	Mineral and Petroleum Resources Development Act
MRE	Marine Renewable Energy
MSC	Marine Stewardship Council
MSP	Marine Spatial Planning
MSY	Maximum Sustainable Yield
MUCH	Maritime and Underwater Cultural Heritage

NATMAP	National Transport Master Plan
NBA	National Biodiversity Assessment
NBSAP	National Biodiversity Strategy and Action Plan
NDIR	National Data and Information Report
NDP	National Development Plan
NDT	National Department of Tourism
NEMA	National Environmental Management Act
NEMBA	National Environmental Management: Biodiversity Act
NEMPAA	National Environmental Management: Protected Areas Act
NERSA	National Electricity Regulator of South Africa
NGP	New Growth Path
NHRA	National Heritage Resources Act
NM	Nautical Miles
NPAES	National Protected Areas Expansion Strategy
NRCS	National Regulator or Compulsory Specifications
NRF	National Research Foundation
NTSS	National Tourism Sector Strategy
OCIMS	Oceans and Coastal Information Management System
OECM	Other Effective Area-Based Conservation Measure
OMP	Operational Management Procedure
ORI	Oceanographic Research Institute
PASA	Petroleum Agency South Africa
PEI	Prince Edward Islands
RFMO	Regional Fisheries Management Organisation
SAAMBR	South African Associate for Marine Biological Research
SACCCS	South African Centre for Carbon Capture and Storage
SADC	Southern African Development Community
SADSTIA	South African Deep-Sea Trawling Industry Association
SAEON	South African Environmental Observation Network
SAHRA	South African Heritage Resources Agency
SAIAB	South African Institute for Aquatic Biodiversity
SAMSA	South African Maritime Safety Authority

SANBI	South African National Biodiversity Institute
SANDF	National Defence Force
SANEDI	South African National Energy Development Institute
SANHO	South African Navy Hydrographic Office
SARChI	South African Research Chairs Initiative
SARIR	South African Research Infrastructure Roadmap
SEA	Strategic Environmental Assessment
SEAFO	South-East Atlantic Fisheries Organisation
SOLAS	International Convention for the Safety of Life at Sea
SPLUMA	Spatial Planning and Land Use Management Act
TAC	Total Allowable Catch
TAE	Total Applied Effort
TNPA	Transnet National Ports Authority
UNCLOS	United Nations Convention on the Law of the Sea
UNESCO	United Nations Educational, Scientific and Cultural Organization
VME	Vulnerable Marine Ecosystem
VMS	Vessel Monitoring System
VTS	Vessel Traffic Service
WSCD	White Shark Cage Diving

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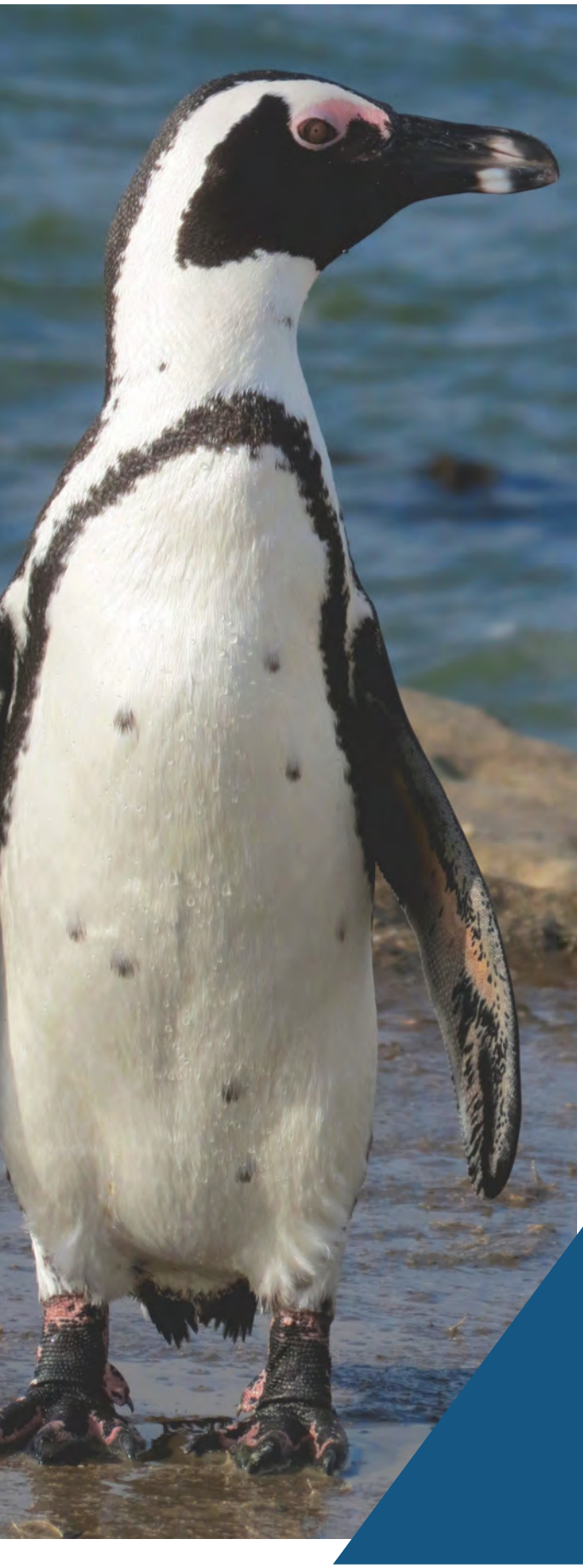


THE PURPOSE OF THE REPORT

The Marine Spatial Planning Act (Act No. 16 of 2018) establishes the regulatory framework for Marine Spatial Planning (MSP) in the Republic of South Africa.

The National Framework for Marine Spatial Planning in South Africa, gazetted in 2017, furthermore provides high-level direction for undertaking MSP in the context of the South African legislation and policies as well as existing planning regimes. Together with the Spatial Management System within South Africa's Marine Area Plans, gazetted in 2019, the approach to MSP is stipulated and described.

Both the MSP Act and the National Framework for MSP provide the reason and foundation for this National Data and Information Report, which serves as the knowledge baseline for advancing MSP in South Africa in the form of Marine Area Plans:

- Section 7 of the MSP Act requires the Minister of Environmental Affairs to "establish a knowledge and information system to house information in order to develop Marine Area Plans".
- Section 5.3 of the National Framework for MSP foresees a national data-gathering activity through which data and information will be compiled to inform the MSP process.

The National MSP Data and Information Report is in line with the steps described in Section 6 of the MSP Act and aligns with the process of MSP as set out by the National Framework for MSP. In essence, this report is an offline version of the online knowledge and information system[1] that houses the best available data and information needed to undertake MSP.

This National MSP Data and Information Report for the South African MSP process gives a description of how the different sectors are currently using the South African ocean space and how they intend to continue using the ocean space in the future in order to meet their sectoral objectives. The document draws together sectoral information in order to generate a better understanding of the current and future interests of relevant marine activities in the South African marine space. In doing so it conveys a multi-sector perspective and serves as the foundation for the development of Marine Area Plans in South Africa.

THE STRUCTURE OF THE REPORT

This National MSP Data and Information Report contains the following:

SUMMARY A high-level **EXECUTIVE SUMMARY** of the report is given at the outset;

SECTION 1 introduces the process of MSP in South Africa;

SECTION 2 describes the context in which planning takes place in the country;

SECTION 3 provides a national overview of the diverse human uses that either occur in or affect the marine space over which South Africa has jurisdictional mandates, their likely future developments and the respective issues MSP needs to consider moving forward;

SECTION 4 identifies the high-level issues which MSP needs to (and can) solve, and provides an overview of the next steps in the MSP process;

SECTION 5 describes the coming marine area planning process;

SECTION 6 provides detailed explanation of data for intensity maps of this report; and

SECTION 7 lists the references used for this report.

THE PROCESS FOR THE DEVELOPMENT OF THIS REPORT

This report was compiled by the National Working Group on MSP, which is established in terms of Section 9 of the MSP Act.

In doing so, the MSP National Working Group was supported by experts of the German Development Cooperation (GIZ) on the basis of the partnership with the Government of the Federal Republic of Germany in the framework of the Benguela Current Convention (BCC).

The report was compiled between 2017 and 2020 through a joint effort by all officials from the numerous departments represented on the MSP National Working Group.

THE OCEANS AND COASTAL INFORMATION MANAGEMENT SYSTEM (OCIMS)

The Oceans and Coastal Information Management System (OCIMS) is a system designed as a 'one-stop-shop' where the public can expect to find data, decision support tools and information relating to South Africa's marine and coastal domains. Initiated through Operation Phakisa, OCIMS is geared at supporting a range of stakeholders in accessing the oceans economy.

The data portal allows users to search for any marine or coastal dataset. The search will return the relevant metadata including the details of the custodian where one will be able to access the data, as not all datasets are immediately available for download (due to licence agreements, embargoes etc.).

The decision support tools (DeSTs) are designed to communicate complex information in a user-friendly manner through interactive mapping applications, including a Marine Spatial Planning (MSP) DeST.

The MSP DeST development is guided by the MSP National Working Group. The onus is on the individual sectors to provide spatial data that will contribute to the MSP process. Each sector is the legal custodian of their data and hence responsible for ensuring that the latest available information is provided for effective MSP.

The OCIMS Marine Spatial Planning Support Viewer can be accessed on:

https://www.ocims.gov.za/marine-spatial-planning-support/

EXECUTIVE SUMMARY

The South African ocean is fundamental for the well-being of its people and provides valuable ecosystem services that benefit its society as a source of food, income and a place for recreation. The country has a coastline of 3,650 km on the mainland which stretches from the Namibian border on the west coast to the Mozambican border on the east coast[2], while the Exclusive Economic Zone (EEZ), including the area around the Prince Edward Islands, is approximately 1.5 million km2 and as such greater than the size of South Africa's land area.

Marine Spatial Planning (MSP) in South Africa is defined as "the governance process of collaboratively assessing and managing the spatial and temporal distribution of human activities to achieve economic, social and ecological objectives".[3] For South Africa, MSP offers a practical way to address specific challenges and to select appropriate management strategies to maintain a good status of ecosystem health that will, in turn, facilitate the advancement of socio-economic development. By embracing MSP, South Africa seeks to achieve the following desired outcomes[4]:

- **GOAL 1:** Unlocking the ocean economy
- **GOAL 2:** Engaging with the ocean
- **GOAL 3:** Ensuring healthy marine ecosystems
- **GOAL 4:** Contributing to good ocean governance

The process of MSP in South Africa is designed to:

- Achieve integration among different objectives and economic sectors;
- Manage competing demands on its ocean space;
- Enable the co-existence of compatible activities wherever possible; and
- Enable co-ordination with terrestrial and coastal planning as much as possible.

The National Department of Forestry, Fisheries and the Environment (DFFE) has been tasked with leading the MSP process and supporting the work of the Marine Spatial Planning National Working Group. The legal requirement to introduce and implement MSP in South Africa is derived from the Marine Spatial Planning Act (Act No.16 of 2018) and corresponds with the legislative, policy and strategic context as described by the 2017 MSP framework. In line with the legislative requirement and to the development of Marine Spatial planning manageable, four planning areas have been defined where Marine Area Plans will be developed for each of these areas through a participatory process that involves all relevant stakeholders.

The current version of the National Data and Information Report (NDIR) for MSP responds to the requirement of developing a knowledge and information system in terms of Section 8 of the MSP Act. The NDIR gives a description of how different sectors are currently using the South African marine environment and how they intend to continue using it in the future. The report prescribes a multi-sector perspective that will serve as a foundation for the development of Marine Area Plans in South Africa. The report is an offline version (as of June 2020) of the online knowledge and information system[5] that houses the most up to date versions of the data and information needed to undertake MSP.

South Africa has a complex, interesting and diverse marine environment that is influenced by the Atlantic, Indian and Southern Oceans. Substantial efforts have been made to better understand and map marine ecosystem types in South Africa, leading to the description of 150 ecosystem types and six ecoregions around the South African mainland (see South Africa's National Biodiversity Assessment 2018[6]). Knowledge on special species and the ecological condition of the various ecosystem types has also improved in recent years, as have assessments of current levels of protection of different ecosystem types and biodiversity. Pressures on the marine environment largely result from human uses, as well as climate change whose impacts are as yet unclear and will require close monitoring.

The South African marine environment is a major focal point for human settlement and socio-economic activities. In the four coastal provinces, the socio-economic context is shaped by the marine and coastal resources and areas which provide opportunities for the various industries. Commercial and recreational use of marine and coastal resources is relatively new in South Africa, dating back only less than 100 years. Key sectors with significant interests in the marine environment and substantial socio-economic impact (e.g. in terms of employment) are fisheries and marine aquaculture, marine and coastal tourism, mining of geological resources (e.g. diamonds) and hydrocarbon (e.g. oil and gas); and maritime transport. Nevertheless, there are other maritime sectors with a role to play in building a sustainable blue economy. The current report therefore considers the current status, strategic policy objectives, key trends and driving forces, and issues to consider of the following sectors and marine activities:

Carbon Capture and Storage

Coastal and Underwater Infrastructure

Environmental Management

Environmental Monitoring and Research

Fisheries

Marine Aquaculture

Marine Renewable Energy

Maritime and Underwater Cultural Heritage

Marine and Coastal Tourism

Maritime Transport and Ports

Mineral Resources Exploration and Exploitation

Naval Defence

Sea and Freshwater Abstraction

Wastewater Discharge

Overall, the report finds that the most prominent driving force in South Africa is Operation Phakisa: Ocean Economy and the national push for economic growth. The expansion of all maritime sectors is politically desired, and direct and indirect job creation in the blue sectors is a declared policy goal in South Africa's agenda for blue growth. Virtually all the maritime sectors are growing in terms of their contribution to the country's economy. The report estimates that fisheries, marine aquaculture, marine and coastal tourism, mining (oil and gas, diamonds) and maritime transport (shipping and ports) are likely to remain the strongest maritime sectors in the near future in terms of direct interest in the marine environment and potential for generating socio-economic impact.

Ecosystem approach is one of the principles of Marine Spatial Planning in South Africa and the environmental sector plays a key role in ensuring that future blue growth in the country is sustainable. Recent Marine Protected Area (MPA) designations and the National Biodiversity Assessment, together with the identification of pressures and vulnerabilities, are important steps in protecting marine biodiversity, as is the recent more precise delineation of Ecologically or Biologically Significant Marine Areas. This spatial understanding of the marine environment is crucial for managing ecological areas sensitive to pressure. An important aspect is that environmental protection is not restricted to protected areas, but extends to the marine environment as a whole.

From a spatial planning perspective, the future economic success of South Africa's blue sector could lead to two types of spatial claims:

- Claims to larger parts of the ocean to enable the sectors to accommodate growth by spatial expansion (e.g. aquaculture),
- More intense use of existing space (e.g. mining, transport).

An important aspect is that South Africa's maritime sectors make use of the marine environment in different ways. Some use marine resources directly (e.g. extraction), others indirectly (e.g. tourism), while others use the sea surface as a medium for their activity (e.g. transport). In addition to the activities that directly use marine resources and/or space, there are others with important supporting functions, such as wastewater discharge and water abstraction. Some sectors depend on access to key resources; others are more flexible in how they can use marine space. A hotspot analysis shows the spatial concentration of marine activities in South Africa's marine area.

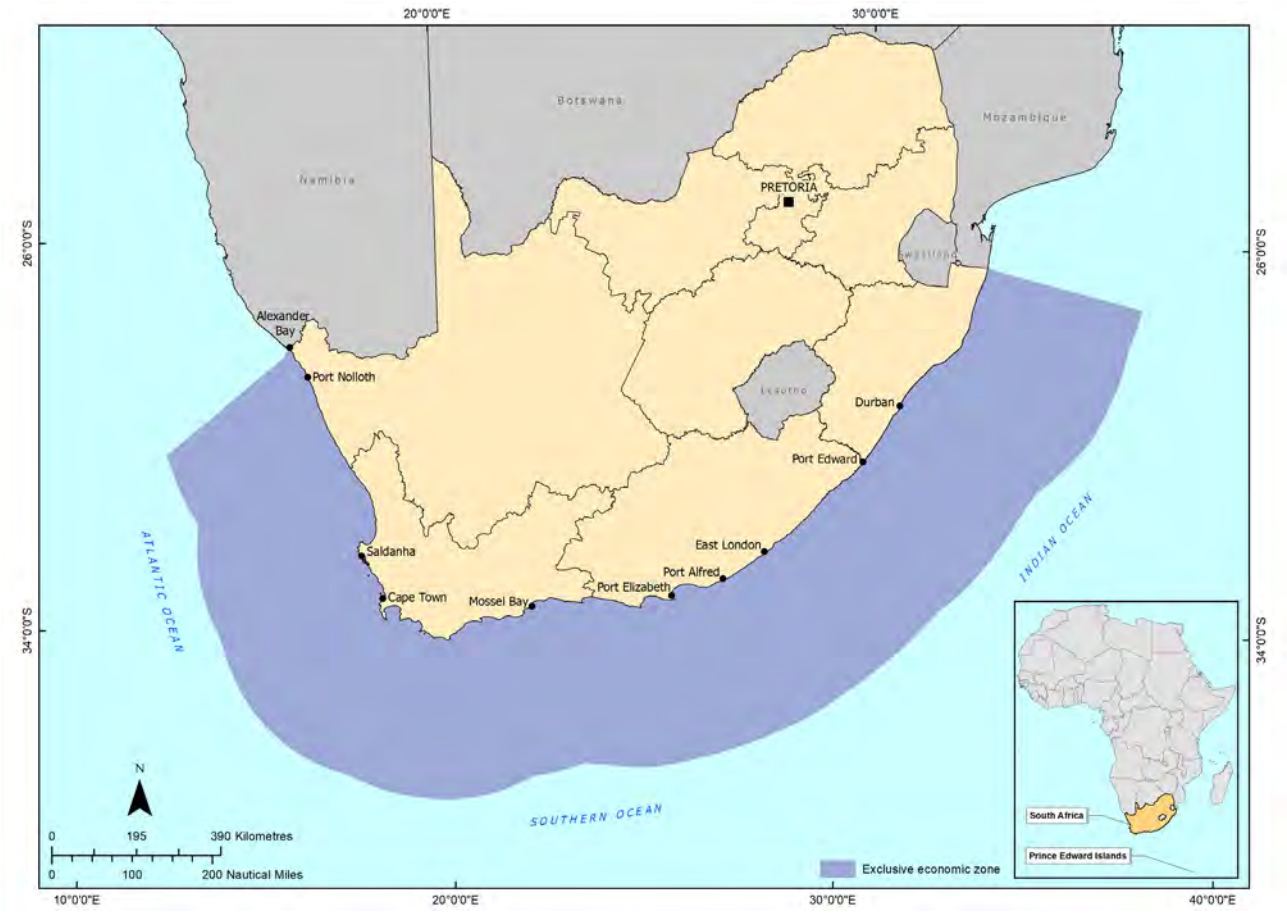
Analysing activities along their spatial compatibility can potentially result in spatial conflicts and the identification of potential areas for co-location which could lead to greater spatial efficiency and more sustainable use of marine space. A compatibility matrix shows the degree to which activities could occupy the same marine space, thus indicating the predisposition of various activities to coexistence or multiple spatial use. The report presents such a matrix as a first and generalised starting point for a much more detailed, comprehensive assessment of coexistence. A separate assessment will be required in each respective planning area that will need to include the views of stakeholders through a participatory public participation process.

As a general conclusion, the report finds that South Africa's marine waters are still moderately used relative to other regions in the world. Nevertheless, it is clear that pressure hotspots exist and that pressures are likely to intensify in the future. This particularly applies to coastal waters and the areas surrounding major ports, but also to areas that have been licensed for mining that may be exploited more intensively in the future. The current assessment of pressures indicates that all the four coastal provinces are affected by increasing pressures of use, but patterns of use and the range of activities differ across the provinces.

The task of the forthcoming planning phase is to build on the work presented in this report and develop Marine Area Plans based on a more detailed, in-depth analysis of the available evidence base.

1. INTRODUCTION

South Africa has a rich ocean wealth which shapes it to be a truly maritime nation bordered by the ocean on three sides – the Atlantic Ocean to west, the Southern Ocean to south and the Indian Ocean to the east.

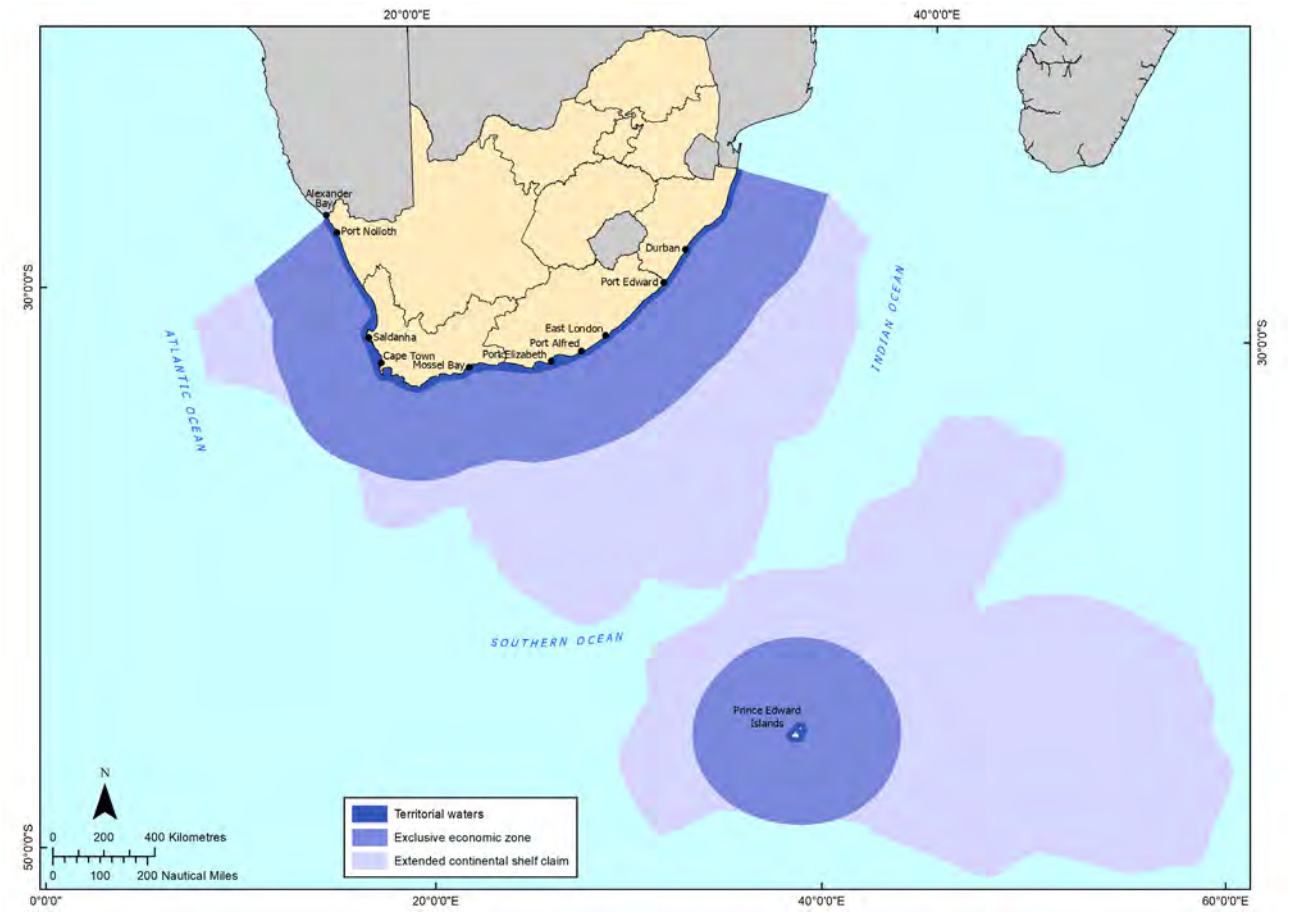


Locality map of south africa — MAP 1

South Africa's sea is fundamental for the well-being of its people and provides valuable ecosystem services that benefit its society as a source of food, income and as a place for recreation.

The country has a coastline of approximately 3,650 km on the mainland.[2] South Africa's Exclusive Economic Zone (EEZ), including the area around the Prince Edward Islands, is approximately 1.5 million km^2 and as such greater than the size of its land area which covers around 1.2 million km^2. Should the extended continental shelf claim be successful, South Africa would assume responsibility to manage a marine area which would be double the size of its terrestrial territory.

The organisation of the use of South Africa's ocean wealth has been through the designation of marine space for human activities by individual departments such as fisheries and aquaculture, oil and gas exploitation, and transport. Such planning and management of human uses in the marine area has usually been pursued on a sectoral basis. Sectoral regulation has however little or no consideration of policies and plans of other sectors or requirements that may be conflicting or compatible.



The South African marine area in relation to its terrestrial territory (including the extent of the continental shelf claim).

MAP 2

In many countries this situation has already caused conflicts among human uses or between the marine environment and human uses, when the effects of human activities on the marine environment are not taken into consideration adequately. Such user-user and user-environment conflicts affect the ability of the ocean to provide the kind of services upon which humans and developing economies depend. This single-sector planning and management approach also limits the capacity of decision-makers to pro-actively shape and plan for the future – rather than reacting and navigating into conflict that minimizes sustainable growth perspectives.

As a response, and as part of the Operation Phakisa: Oceans Economy initiative which seeks to unlock the economic potential of South Africa's oceans, South Africa is now implementing MSP as an approach to improving the rational planning, management and governance of the ocean space and marine resources over which it has jurisdiction. MSP entails sustainable ocean development planning. It is a planning approach for marine areas which more coherently organizes the use of space with the aim to guide single-sector decision-making and provide for comprehensive, integrated and complementary planning and management.

South Africa defines MSP as: "the governance process of collaboratively assessing and managing the spatial and temporal distribution of human activities to achieve economic, social and ecological objectives".[7]

For South Africa, MSP offers a practical way to address both specific challenges and select appropriate management strategies to maintain a good status of ecosystem health that will, in turn, facilitate the advancement of national economic and socio-cultural development. MSP is an emerging process that is being implemented by an increasing number of countries – including South Africa, which is among the first countries on the African continent pursuing MSP.

By embracing MSP, South Africa seeks to achieve the following desired outcomes[8] to obtain economic, social, ecological and governance benefits that will contribute to achieving sustainable development and facilitate the reaching of its national development objectives:

- **GOAL 1:** Unlocking the ocean economy
- **GOAL 2:** Engaging with the ocean
- **GOAL 3:** Ensuring healthy marine ecosystems
- **GOAL 4:** Contributing to good ocean governance

The process of MSP in South Africa will therefore promote a culture of good ocean governance and thereby:

- Achieve integration among different objectives and economic sectors;
- Manage competing demands on its ocean space;
- Enable the co-existence of compatible activities wherever possible; and
- Enable co-ordination with terrestrial and coastal planning as much as possible.

2. THE PLANNING CONTEXT

Marine Spatial Planning in South Africa aims at contributing to the country's national development goals through sustainable ocean development.

It is therefore necessary to consider the status, trends and developments of the natural environment, the socio-economic context, and the relevant legislation and policy context during the MSP process. This context – on the one hand – influences and guides the MSP process as a nation and the development of the four sub-national Marine Area Plans. On the other hand, the context conditions can eventually also be influenced through MSP.

The following chapters provide an overview of the planning context in terms of the natural environment, socio-economics, the regulatory and policy framework, as well as stakeholders.

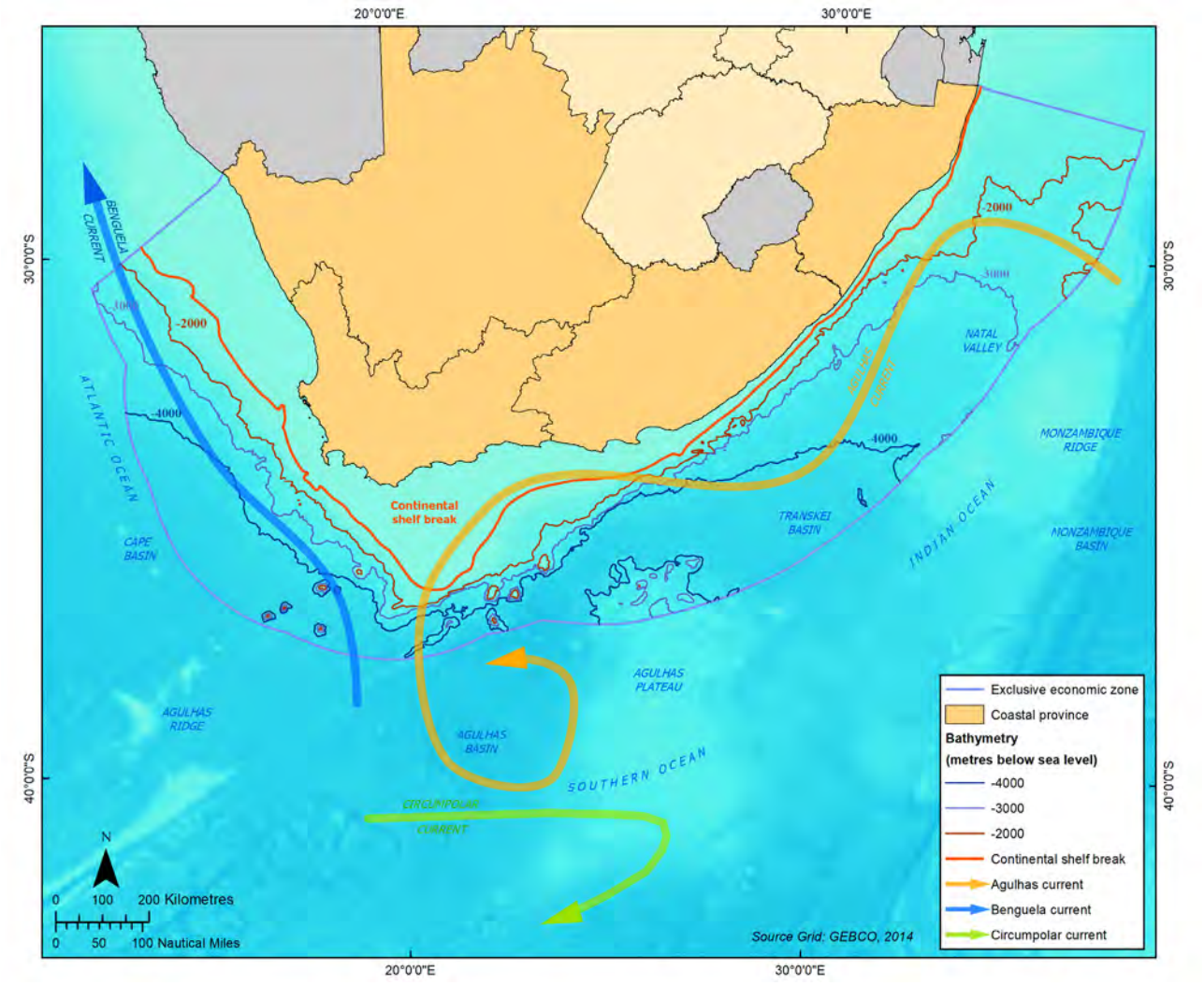
2.1 THE NATURAL ENVIRONMENT: STATUS, TRENDS AND DEVELOPMENTS

2.1.1 THE OFFSHORE ENVIRONMENT

South Africa has a complex, interesting and diverse marine environment. This is largely driven by direct influences from three ocean basins: the Atlantic, Indian and Southern Oceans that all meet at Mallory Escarpment and Trough (approximately 300 km south of Cape Infanta). The currents that originate in each of these ocean basins and sweep through the South African EEZ are strongly contrasting and, in turn, are a key driver of the rich national marine biodiversity. In this section, "offshore" follows the definition in the National Biodiversity Assessment 2018 Marine technical report[9], and refers to the portion of the marine environment that is deeper than the fair-weather wave base (approximately 40–50 m depth; i.e., the mid shelf and deeper) in the mainland EEZ.

The Benguela Current in the Atlantic Ocean brings cool, nutrient-rich polar water up the west coast, with sea-surface temperatures typically between 13˚C and 15˚C. Upwelling cells are characteristic in this area, driving high productivity. Upwelling is the result of ocean and wind interactions bringing nutrients from deep waters to the surface where sunlight stimulates photosynthesis and production of phytoplankton. This forms the basis of a complex food web, in turn increasing the overall volume of biological productivity at all levels.

Areas of upwelling are found where the wind is strongest and where the continental shelf is narrowest and deepest. In fact, the Benguela Current is one of the most productive regions in the world, underpinning many commercial fisheries. The cool ocean conditions also drive aridity along the west coast, with far fewer estuaries and land-based supplies of nutrients and sediment flowing into the sea; however, the Orange River is a notable exception to this.



Oceanography of South Africa's exclusive economic zone with ocean currents. MAP 3

In contrast, the Agulhas Current system from the Indian Ocean on the east coast becomes established between Southern Mozambique and Durban. The Agulhas Current is a fast-flowing western boundary current that brings warm (ca. 25°C), nutrient-poor tropical water from the equatorial region of the Western Indian Ocean down the South African east coast. It comes close inshore along the eastern seaboard because of the narrow continental shelf on this side of the country. It gets pushed further offshore southwards of East London, where the continental shelf widens, and meets the Benguela Current at Cape Agulhas, where it retroflects (turns) and flows eastward back toward the Indian Ocean. Although these warm waters have low nutrient levels, they support very diverse biota from the species-rich Indo-Pacific region. However, upwelling of cold, deep, nutrient-rich water onto the shelf can occur as cyclonic lee eddies move downstream along the inshore edge of the Agulhas Current, which in turn enhances phytoplankton biomass and subsequent productivity on the shelf. Coral reefs, mangroves and large river inputs from estuaries along the east coast characterize the shelf waters. The latter is a result of the South African east coast and adjoining interior having a higher rainfall than that on the west coast. This is because heat and moisture (from the Agulhas Current) are transferred from the ocean to the atmosphere, resulting in higher rainfall and thus, more estuaries and terrigenous inputs flowing into the sea than that along the west coast.

Because the water in the Agulhas Current is so nutrient poor, delivery of land-derived nutrients to the sea by these estuaries are very important, particularly from large estuaries such as the uThukela Estuary that in turn underpin marine communities as far offshore as the continental shelf in some places.

Although each current itself is interesting, it is the confluence of the Agulhas and Benguela Currents along the south coast that is important for large-scale oceanic and climate processes. Warm, salty water from the Agulhas Current leaks through into the Benguela Current, mostly in the form of Agulhas rings (but also eddies and filaments) that pinch off at the point where the Agulhas Current turns on itself to flow back into the Indian Ocean (the point of retroflection), in a process that appears to be wind driven. This leakage provides a significant source of salt and heat for the Atlantic Ocean, influencing the Atlantic meridional overturning circulation, and in turn, influencing large-scale climate patterns[10].

The Southern Ocean brushes the southern extent of South Africa's mainland EEZ, meeting the other two ocean basins around Mallory Escarpment and Trough. It plays a role in the origin of the Benguela Current that influences the South African west coast, but has a more direct influence on South Africa's sub-Antarctic territory: the Prince Edward Islands (see below for details). The Antarctic Circumpolar Current and associated Antarctic and sub-Antarctic Polar Fronts are highly productive and are important for generating the productivity that supports the islands' myriad of top predators[11,12].

The strong contrasts in temperature, productivity and depth from east to west, and offshore, results in six ecoregions around the South African mainland, including four shallow and shelf ecoregions: the Southern Benguela; Agulhas; Natal; and Delagoa; and two deep ocean ecoregions: the Southeast Atlantic (western oceanic); and Southwest Indian (eastern oceanic), with two subregions nested into each of the Southern Benguela and Natal ecoregions[9]. Within each of these ecoregions and subregions is a rich diversity of ecosystem types that range from shallow, subtropical coral reefs to cold-water abyssal habitats that are scattered with seamounts. There has been substantial effort over the last five years to improve the map of marine ecosystem types in South Africa. The latest map draws from historical and new data of bathymetry, oceanography, sediment and biodiversity collected using a range of technologies, e.g., remote sensing, grab sampling, and underwater video surveying[9] using remotely-operated vehicles and/or drop cameras. These data have been used to delineate 150 ecosystem types in much finer detail than ever before, of which 86 types are considered offshore (Map 4 and Map 6)[9]. This is a key advance in our understanding of the marine realm, which was made as part of South Africa's National Biodiversity Assessment 2018, with the following descriptions of the ecoregions drawing heavily from the Marine Ecosystem Classification and Mapping Chapter of the Marine Technical Report[9].

The Southern Benguela ecoregion extends along the entire South African west coast from Namibia to Cape Point, and is sub-divided into a northern Namaqua subregion and southern Cape subregion. The ecoregion comprises of cool temperate ecosystem types with communities that are generally less diverse, but highly productive and have higher biomass compared to those on the east coast. These ecosystem types include kelp forests, cold-water corals, canyons, and a variety of ecosystem types with diverse benthic substrates. The continental shelf on the west coast is strongly influenced by fluvial inputs from the Orange River, and is much wider than the shelf on the east coast.

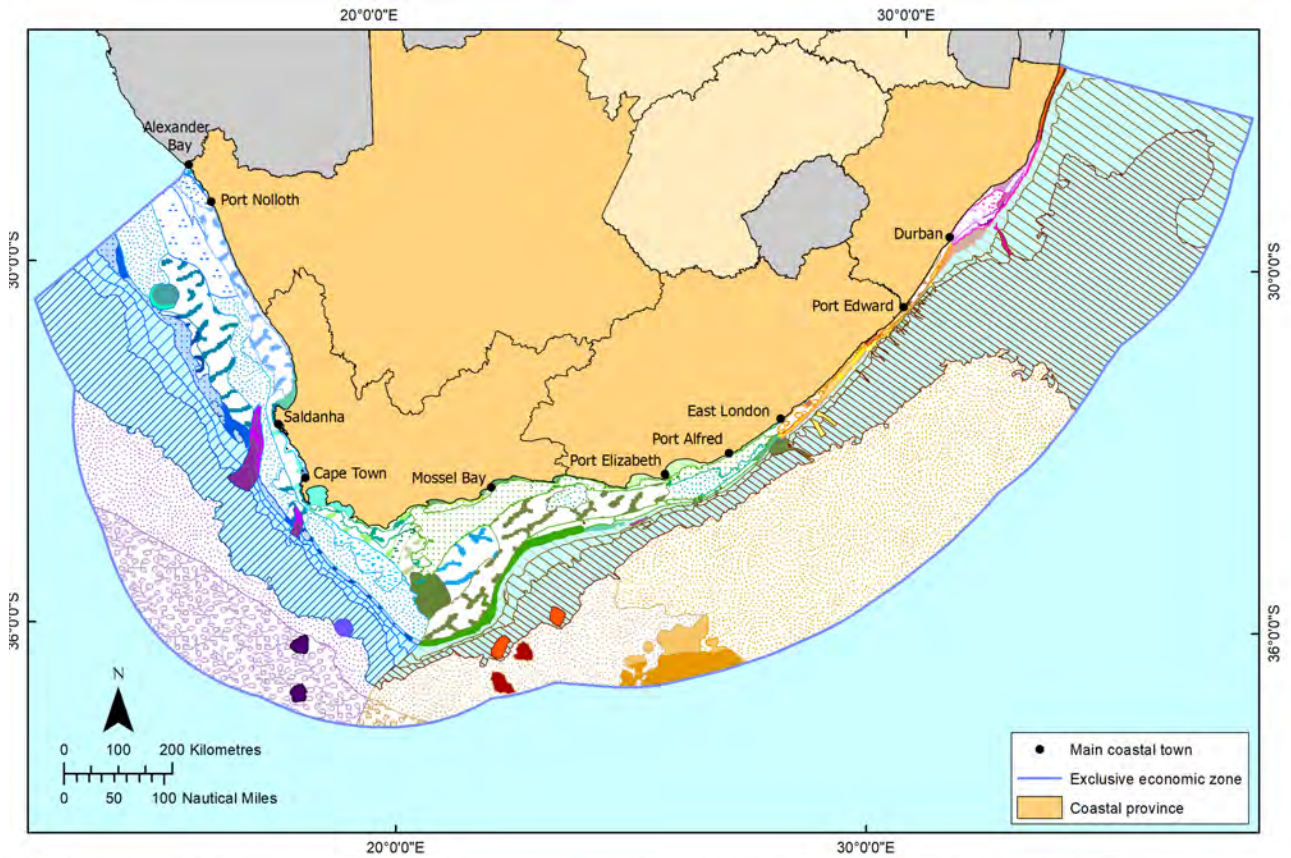
The warm temperate Agulhas ecoregion incorporates the shelf area from Cape Point in the west to the Mbashe River to the east, and includes the central and eastern Agulhas Bank bounded by the Agulhas Falklands Fracture Zone. The complexity of the oceanography and geology in this area at the southern tip of Africa gives rise to a rich diversity of features and warm temperate ecosystem types, such that this is generally the ecoregion of highest species endemism in the South African marine realm[11]. It includes the full range of benthic substrates, from muds to rock and reef, and interesting features like the Agulhas, Alphard and Browns Banks (that form the widest part of the national continental shelf), seamounts, Mallory Escarpment and Trough, and the recently discovered Kingklip Koppies and Kingklip Ridge. The Agulhas Bank is shallower than -150 m in the east and slopes gently towards the south. Sea surface temperatures over most of the Agulhas Bank are generally 16˚C in winter and 21˚C in summer. Concentrations of nutrients over the Agulhas Bank are not as high as on South Africa's west coast but are sufficient to support a productive marine biological community. The region is important for numerous ecological processes including spawning, larval retention, recruitment,

connectivity and provision of nursery and foraging areas for a variety of species[13], some of which are commercially important. Examples of these species include invertebrates, fish, whales, sharks and turtles.

The narrow, subtropical Natal ecoregion on the east coast extends from the Mbashe Estuary up to Cape Vidal. It comprises two subregions: the river-influenced KwaZulu-Natal Bight subregion in the north; and Southern KwaZulu-Natal and Wild Coast subregion in the south. This ecoregion contains key features like coral reefs and canyons, and a range of shelf ecosystem types driven by diverse types of benthic substrates. Notably, the uThukela River delivers substantial volumes of sediment and nutrients to the marine environment and is the key driver of the KwaZulu-Natal Bight subregion[14]. Consequently, there are many muddy ecosystem types in this area and the continental shelf is wider here than the rest of the South African east coast.

The Delagoa ecoregion extends northwards from Cape Vidal to Bazaruto Island in Mozambique. The South African portion of this tropical ecoregion is characterised by a very narrow continental shelf, several submarine canyons and no riverine inputs, with only two groundwater-fed estuaries. The result is clear nutrient-poor waters where algae and zooxenthellate corals, particularly soft corals, dominate shallow reefs.

Further offshore are two deep water ecoregions: the Southern Indian ecoregion to the east, and Southeast Atlantic ecoregion to the west. The bathymetry of the Southern Indian ecoregion slopes down from north to south, with the Southwest Indian Mid Slope flanking the border with Mozambique, gently dropping through the lower slope to the abyss along the eastern edge of the national EEZ. Bathymetry through the Southeast Atlantic ecoregion slopes similarly to that in the Southwest Indian ecoregion, with the shallower lower slope in the north and deeper abyss in the south. The abyssal habitat in both ecoregions is interrupted by various seamounts that play a key role in elevating local productivity.



Marine coastal ecosystem types

- Agulhas Basin Abyss
- Agulhas Basin Complex Abyss
- Agulhas Blues
- Agulhas Boulder Shore
- Agulhas Coarse Sediment Shelf Edge
- Agulhas Dissipative-Intermediate Sandy Shore
- Agulhas Dissipative Sandy Shore
- Agulhas Exposed Rocky Shore
- Agulhas Exposed Stromatolite Rocky Shore
- Agulhas Inner Shelf Mosaic
- Agulhas Inner Shelf Reef
- Agulhas Intermediate Sandy Shore
- Aghulhas Island
- Agulhas Kelp Forest
- Agulhas Lower Canyon
- Agulhas Mid Shelf Mosaic
- Agulhas Mid Shelf Reef Complex
- Agulhas Mixed Shore
- Agulhas Muddy Mid Shelf
- Agulhas Muddy Outer Shelf
- Agulhas Outer Shelf Reef Sand Mosaic
- Agulhas Plateau
- Agulhas Plateau Mosaic
- Agulhas Reflective Sandy Shore
- Agulhas Rocky Outer Shelf
- Agulhas Rocky Plateau
- Agulhas Sandy Inner Shelf
- Agulhas Sandy Mid Shelf
- Agulhas Sandy Outer Shelf
- Agulhas Sheltered Rocky Shore
- Agulhas Stromatolite Mixed Shore
- Agulhas Upper Canyon
- Agulhas Very Exposed Rocky Shore
- Agulhas Very Exposed Stromatolite Rocky Shore
- Aliwal Shoal Reef Complex
- Alphard Bank
- Amathole Hard Shelf Edge
- Amathole Lace Corals
- Browns Bank Rocky Shelf Edge
- Cape Bay
- Cape Basin Abyss
- Cape Basin Complex Abyss
- Cape Boulder Shore
- Cape Exposed Rocky Shore
- Cape Island
- Cape Kelp Forest
- Cape Lower Canyon
- Cape Mixed Shore
- Cape Rocky Inner Shelf
- Cape Rocky Mid Shelf Mosaic
- Cape Sandy Inner Shelf
- Cape Sheltered Rocky Shore
- Cape Upper Canyon
- Cape Very Exposed Rocky Shore
- Central Agulhas Outer Shelf Mosaic
- Childs Bank Coral
- Childs Bank Plateau
- Delagoa Deep Shelf Edge
- Delagoa Lower Canyon
- Delagoa Lower Canyon
- Delagoa Mixed Shore
- Delagoa Rocky Mid Shelf
- Delagoa Sandy Inner Shelf
- Delagoa Sandy Mid Shelf
- Delagoa Shelf Edge
- Delagoa Upper Canyon
- Delagoa Very Exposed Rocky Shore
- Durnford Mid Shelf Reef Complex
- Durnford Inner Shelf Reef Complex
- Eastern Agulhas Bay
- Eastern Agulhas Outer Shelf Mosaic
- False and Walker Bay
- Kei Fluvial Fan
- Kei Reef Mosaic
- Kingklip Koppies
- Kingklip Ridge
- Kosi Coral Community
- KZN Bight Deep Shelf Edge
- KZN Bight Mid Shelf Mosaic
- KZN Bight Mid Shelf Reef Complex
- KZN Bight Muddy Inner Shelf
- KZN Bight Muddy Shelf Edge
- KZN Bight Outer Shelf Mosaic
- KZN Bight Sandy Inner Shelf
- Leadsman Coral Community
- Namaqua Exposed Rocky Shore
- Namaqua Kelp Forest
- Namaqua Mid Shelf Fossils
- Namaqua Mixed Shore
- Namaqua Muddy Sands
- Namaqua Muddy Mid Shelf Mosaic
- Namaqua Sandy Inner Shelf
- Namaqua Sandy Mid Shelf
- Namaqua Sandy Middle Shelf
- Namaqua Sheltered Rocky Shore
- Namaqua Very Exposed Rocky Shore
- Natal Boulder Shore
- Natal Deep Shelf Edge
- Natal Delagoa Dissipative Intermediate Sandy Shore
- Natal Delagoa Intermediate Sandy Shore
- Natal Delagoa Dissipative Sandy Shore
- Natal Delagoa Reflective Sandy Shore
- Natal Exposed Rocky Shore
- Natal Lower Canyon
- Natal Mixed Shore
- Natal Upper Canyon
- Natal Very Exposed Rocky Shore
- Orange Cone Inner Shelf Mud Reef Mosaic
- Orange Cone Muddy Mid Shelf
- Port St Johns Inner Shelf Mosaic
- Port St Johns Muddy Shelf Edge
- Port St Johns Muddy Mid Shelf
- Protea Mid Shelf Reef Complex
- Sodwana Coral Community
- Southeast Atlantic Lower Slope
- Southeast Atlantic Mid Slope
- Southeast Atlantic Seamount
- Southeast Atlantic Slope Seamount
- Southeast Atlantic Upper Slope
- Southern Benguela Dissipative Sandy Shore
- Southern Benguela Dissipative Intermediate Sandy Shore
- Southern Benguela Intermediate Sandy Shore
- Southern Benguela Muddy Outer Shelf Mosaic
- Southern Benguela Muddy Shelf Edge
- Southern Benguela Outer Shelf Mosaic
- Southern Benguela Reflective Sandy Shore
- Southern Benguela Rocky Shelf Edge
- Southern Benguela Sandy Outer Shelf
- Southern Benguela Sandy Shelf Edge
- Southern Benguela Shelf Edge Mosaic
- Southern KZN Inner Shelf Mosaic
- Southern KZN Mid Shelf Mosaic
- Southern KZN Shelf Edge Mosaic
- Southwest Indian Lower Slope
- Southwest Indian Mid Slope
- Southwest Indian Seamount
- Southwest Indian Slope Seamount
- Southwest Indian Upper Slope
- St Helena Bay
- St Lucia Mid Shelf Mosaic
- St Lucia Sandy Inner Shelf
- St Lucia Sandy Mid Shelf
- Transkei Basin Abyss
- Trafalgar Reef Complex
- uThukela Canyon
- uThukela Mid Shelf Mosaic
- uThukela Mid Shelf Mud Coarse Sediment Mosaic
- uThukela Outer Shelf Muddy Reef Mosaic
- Western Agulhas Bays
- Wild Coast Mid Shelf Mosaic
- Wild Coast Inner Shelf Mosaic
- Wild Coast Shelf Edge Mosaic
- n/a

Map of the marine ecosystem types nested into six ecoregions, with two (Southern Benguela and Natal ecoregions) split further into two subregions. Data from the National Biodiversity Assessment (NBA) 2018[9].

MAP 4

2.1.2 THE INSHORE ENVIRONMENT

The inshore marine environment includes the shores along South Africa's 3,650-km long mainland coastline[2] and the inner shelf, which extends to the fair-weather wave base at approximately 40-50 m depth[9]. South Africa has microtidal (<2 m tide range), mostly exposed shores with waves ranging about 1-4 m in average conditions, and semidiurnal tides (two tidal cycles per day). The strongly contrasting oceanographic and climatic conditions from west to east, as described above, are similarly apparent along the South African inshore region, giving rise to a plethora of coastal ecosystem types[15], with a concomitantly rich biodiversity that has high rates of endemism[16]. Note that the four shelf ecoregions and subregions, described above, also include inshore ecosystem types.

The west coast of South Africa is cold and dry, forming the cool temperate Southern Benguela ecoregion. However, only some of the inshore broad ecosystem groups split into the two subregions, e.g., rocky and mixed shores split, but not sandy shores[9]. Dunes along this coast are much smaller given the limited rainfall and limited delivery of terrigenous sediment from only a few estuaries. The Orange River in the north western corner of the country is a notable exception: it is a significantly large system with substantial fluvial inputs to the marine environment. The country's longest dissipative beaches are found along the west coast, with other interesting ecosystem types including Langebaan Lagoon, several important bays (e.g. St Helena Bay and Saldanha Bay), kelp beds, temperate reefs, and small islands that support top predator colonies. Robben Island is the largest island in the country's mainland EEZ, and is a cultural World Heritage Site. As for the offshore ecosystem types, diversity is generally lower on the west coast compared to the rest of the country's inshore area. However, it has the highest productivity; communities on the west coast thus have the largest biomass[17]. Notably, though, much of the north west coast has been modified by mining diamonds that are part of the fluvial deposits of the Orange River.

The inshore component of the Agulhas ecoregion includes a series of log-spiral bays along the south coast, with each bay historically connected to the next by a headland bypass system: rivers of sand that used to flow over the land in large wind-blown dune-sheets. These headland bypass systems have almost all been stabilised with invasive trees and coastal development, resulting in sand-starved beaches downstream, and consequently, accelerated coastal erosion[18,19]. Given the prevailing wind and wave direction, the western arcs of the bays are generally more sheltered compared to the eastern ends that are much more exposed, with the bays themselves serving as retentive systems. The capes of these bays tend to be exposed rocky shores, with a notably rocky, cliff-backed section of coast around Tsitsikamma. Given that the Agulhas ecoregion includes the confluence of the Agulhas and Benguela Currents, the rates of endemism here are particularly high for coastal species[17,20]. Key ecosystem types along the south coast include kelp beds and temperate reefs, and small islands that support colonies of top predators, such as seabirds and seals. There are also large transgressive, barchan and barchanoid dunes in this ecoregion: all massive sheets of fine, wind-blown sand lining the shores, particularly to the south east. The most impressive of these is the Alexandria dunefield in Algoa Bay (east of Port Elizabeth) that extends 50 km along the shore, and 2 km inland at its widest point, and is the largest mobile active coastal dunefield in the southern hemisphere.

The Wild Coast in the Natal ecoregion is a very rocky portion of the South African shoreline, largely comprising a combination of rocky shores, boulder shores, and rocky cliffs, incised by small estuaries and pocket beaches. For many species, this part of the coast is a transition zone between the warm temperate Agulhas and subtropical Natal ecoregions. As noted already, the Agulhas Current brings warm conditions to the east coast and is a key driver of the abundant rain in this region. The result is that most of the country's 290 estuaries[21] flow into the sea along these eastern shores, delivering much terrigenous sediment and nutrients to the coast and adjacent marine environment. Together with rainfall and wind, this supports formation of some of the largest parabolic dunes in the country, rising almost 200 m high, covered and backed by dense coastal forest[22], particularly in the Delagoa ecoregion and northern part of the KwaZulu-Natal Bight subregion. Furthermore, it results in more sandy shores on the east coast compared to the rest of the country that has proportionately more rocky shores[23]. The east coast also supports subtropical coral reef and seagrass communities, especially on the north-east coast. The Delagoa ecoregion also includes beaches that serve as the only turtle nesting grounds in South Africa.

2.1.3 SOUTHERN OCEAN

In addition to the mainland, the South African territory and jurisdiction includes the Prince Edward Island Group (comprising Marion Island and Prince Edward Island) that lies approximately 2 000 km south-east of South Africa. The Prince Edward Island Group is the westernmost of islands that form the Kerguelen Province, which also includes Îles Crozet, Îles Kerguelen (France), and Heard and McDonald Islands (Australia). Both Marion Island and Prince Edward Island are shield volcanoes that rise from depths of 5 000 m. They are linked by a saddle, where the water depth is about 200 m. Sea-surface temperatures around the islands range from 4–7 ˚C. These islands face extreme weather patterns and are used by large colonies of seabirds and seals for breeding purposes, and by penguins in their moulting period. A significant portion of the Southern Ocean falls within South Africa's EEZ.

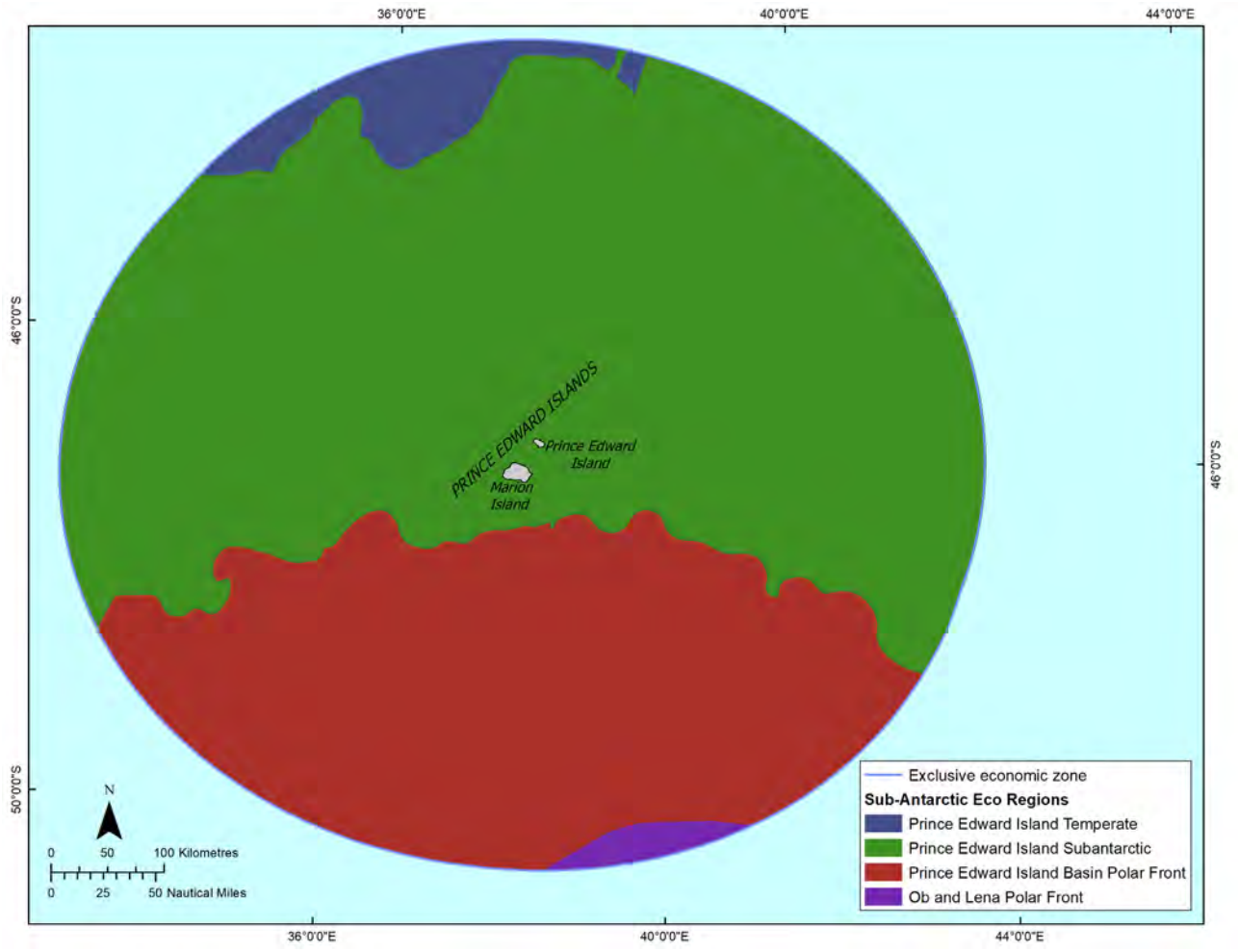
The first attempt at mapping South Africa's sub-Antarctic marine ecosystems was based on existing spatial layers for the region from international and local sources and published in 2019. In the Southern Ocean, large-scale processes and features play a significant role in creating ecological patterns and variations in ecosystems (Griffiths et al. 2009, Proud et al. 2017)[24,25]. Existing biogeographic classifications for the Southern Ocean identify benthic 'Ecoregions' (Douglass et al. 2014)[26] and pelagic 'Bioregions' (Raymond 2011)[27]. Following the hybrid approach of Koubbi et al. (2012)[28], the Southern Ocean Benthic Classification (SOBC) of Douglass et al. (2014) was evaluated in relation to the pelagic bioregionalisation of Raymond (2011). There are 23 SOBC ecoregions based on a comprehensive set of biotic and abiotic data including bathymetry, geomorphology, seabed temperatures, and benthic species distributions and endemism. South Africa's sub-Antarctic territory intersects three large benthic ecoregions: Del Cano, Atlantic Basin, and the Ob and Lena.

Pelagic regionalisation by Raymond (2011) identified 20 circumpolar pelagic bioregions using sea surface temperature, depth and sea ice cover. Six are represented within South Africa's sub-Antarctic territory, of which three are driven by large-scale oceanographic divisions between Temperate, Sub-Antarctic and Antarctic waters. The close alignment of benthic and pelagic divisions resulted in the delineation of four composite bentho-pelagic ecoregions (see Table 1).

TABLE 1

The PEI combined bentho-pelagic ecoregions developed based on integration of the Southern Ocean Benthic Classification (SOBC) ecoregions (Doughlas et al. 2014)[26] and pelagic classification bioregions (Raymond 2011)[27].

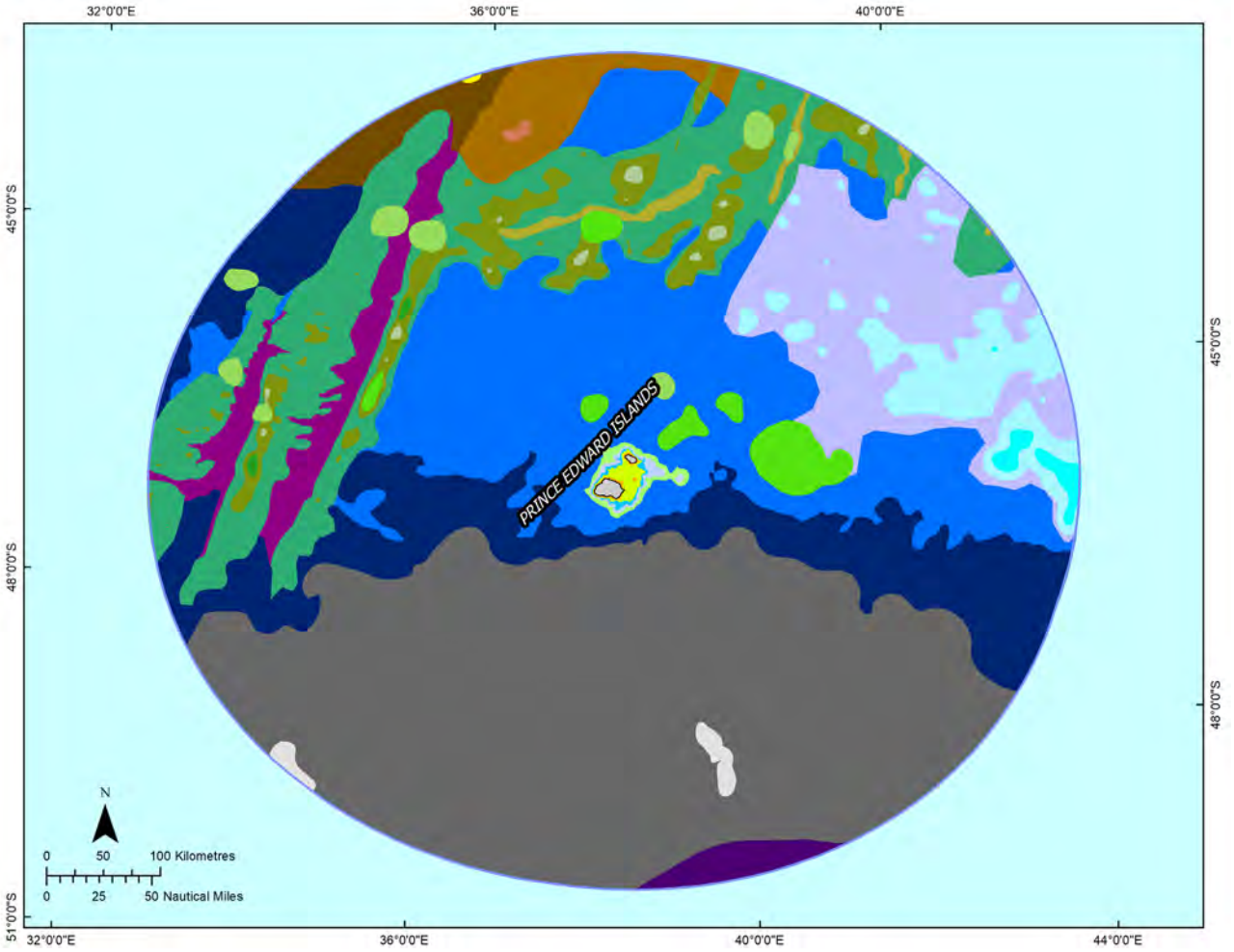
SOBC ECOREGIONS	SOBC DESCRIPTION	SO PELAGIC BIOREGIONS	PEI BENTHO-PELAGIC ECOREGIONS	PEI DESCRIPTION
Del Cano	Shallow, warmer seabed within the sub-Antarctic zone including parts of the South West Indian Ridge seamounts, the Del Cano Rise and the Prince Edward Islands.	Temperate	PEI Temperate	Warmer, north of SAF and SWIR boundary.
		Sub-Antarctic	PEI Sub-Antarctic	Shallow, heterogeneous geomorphology between SAF and APF, includes SWOR seamounts, PEI.
Atlantic Basin	The very deep and very cold rugose ocean floor and abyssal plain of the South Atlantic Ocean Basin and Weddell Sea.	Antarctic Polar Front	PEI Polar Front	Deep, cold areas, geomorphologically homogeneous and abyssal south of APF.
Ob and Lena	Shallow, warm seabed in the Polar Frontal zone, including the Ob and Lena banks and the seamounts to their east.	Antarctic Polar Front	Ob and Lena Polar Front	Extreme limit of Ob and Lena ecoregion south of APF.



Map of the four bentho-pelagic ecoregions within South Africa's Prince Edward Islands EEZ.

MAP 5

The sub-Antarctic territory marine ecosystem map captures 11 broad ecosystem groups by integrating spatial layers of key environmental data with biological information and patterns. Through these intersections, the map identifies four bentho-pelagic ecoregions (map above) and 29 distinct marine ecosystem types (map below) that nest within regions defined by bathymetry.



Sub Antarctic Marine Ecosystem Types

- PEI SA* Least Exposed Mixed Shore
- PEI SA Least Exposed Cliff & Broken Shore
- PEI SA Exposed Cliff & Broken Shore
- PEI SA Highly Exposed Cliff & Broken Shore
- PEI SA Inner Shelf
- PEI SA Outer Shelf
- PEI SA Shelf Edge
- PEI SA Upper Slope
- PEI SA Mid Slope
- PEI SA Lower Slope
- PEI SA Abyss
- PEI SA Shallow Seamount
- PEI SA Seamount
- PEI SA Lower Spreading Ridge
- PEI SA Mid Spreading Ridge
- PEI SA Lower Rift Valleys & Troughs
- PEI SA Deep Rift Valleys & Troughs
- PEI SA Lower Plateau
- PEI SA Mid Plateau
- PEI SA Shallow Plateau
- PEI SA Shallow Spreading Ridge
- PEI SA Upper Spreading Ridge
- PEI Polar Front Seamount
- PEI Polar Front Abyss
- PEI TM* Abyss
- PEI TM Lower Slope
- PEI TM Mid Slope
- PEI TM Seamount
- Ob And Lena Polar Front Abyss

Ecosystem types within South Africa's Prince Edward Islands EEZ. Data from NBA 2018.

MAP 6

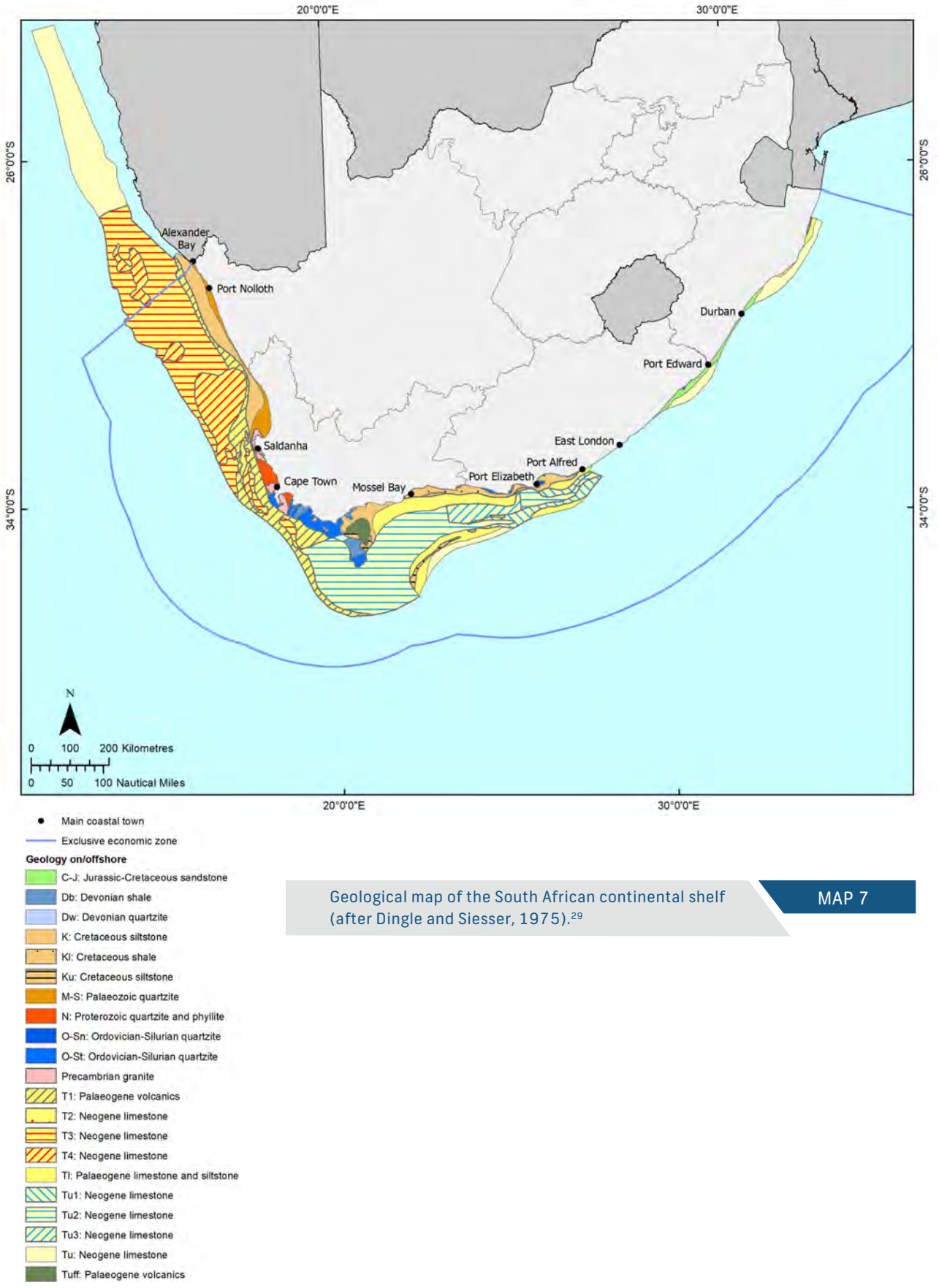
The PEI Temperate ecoregion is the northern-most biogeographic unit in the sub-Antarctic territory and encompasses four ecosystem types. This ecoregion is dominated by lower slope and abyssal ecosystem types, with the only raised geomorphological features being a single isolated mid slope ecosystem type and a small seamount on the northern boundary of the EEZ. The PEI Temperate Lower Slope characterises the eastern half of the ecoregion while the PEI Temperate Abyss dominates western half. These are the largest and second largest ecosystem types in the Temperate ecoregion. Both ecosystem types are characterised by soft sediment plains and a gently sloping sea floor. Rising from lower slope habitats is a small slightly elevated area of soft seafloor classified as the PEI Temperate Mid Slope ecosystem type, which covers mid slope depths of between 1000 -1800 m.

The PEI Temperate Seamount ecosystem type identifies a small seamount composed of hard substrate that rises from the surrounding deep abyssal habitat to within the upper slope depth range of 250 -500 m. While there are no records of VME indicator taxa from this ecoregion, it is an important foraging area for top predators including White-Chinned Petrels (Procellaria aequinoctialis), Orcas, and Sooty, Wandering and Indian Yellow-Nosed Albatrosses.

The PEI Polar Front Ecoregion is almost entirely composed of deep abyssal plains and is strongly influenced by the Polar Front and colder waters to the south of the islands. The PEI Polar Front Abyss is the dominant ecosystem type within the Polar Front ecoregion and forms the largest continuous area of abyssal habitat in the sub-Antarctic territory. It is characterised by flat or slightly undulating plains of soft sediment, all deeper than 3500 m. There are no records of VME indicator taxa from this area but the productive pelagic environment of the Polar Frontal Zone is used by transiting and foraging top predators. There are two isolated seamounts in the ecoregion that were classified as PEI Polar Front Seamount. The hard substrate and emergent nature of these features differentiates them from the surrounding abyss. Although there are no records of VME indicator taxa from these features, the associated pelagic environment serve as important foraging areas for top predators (Table 9).

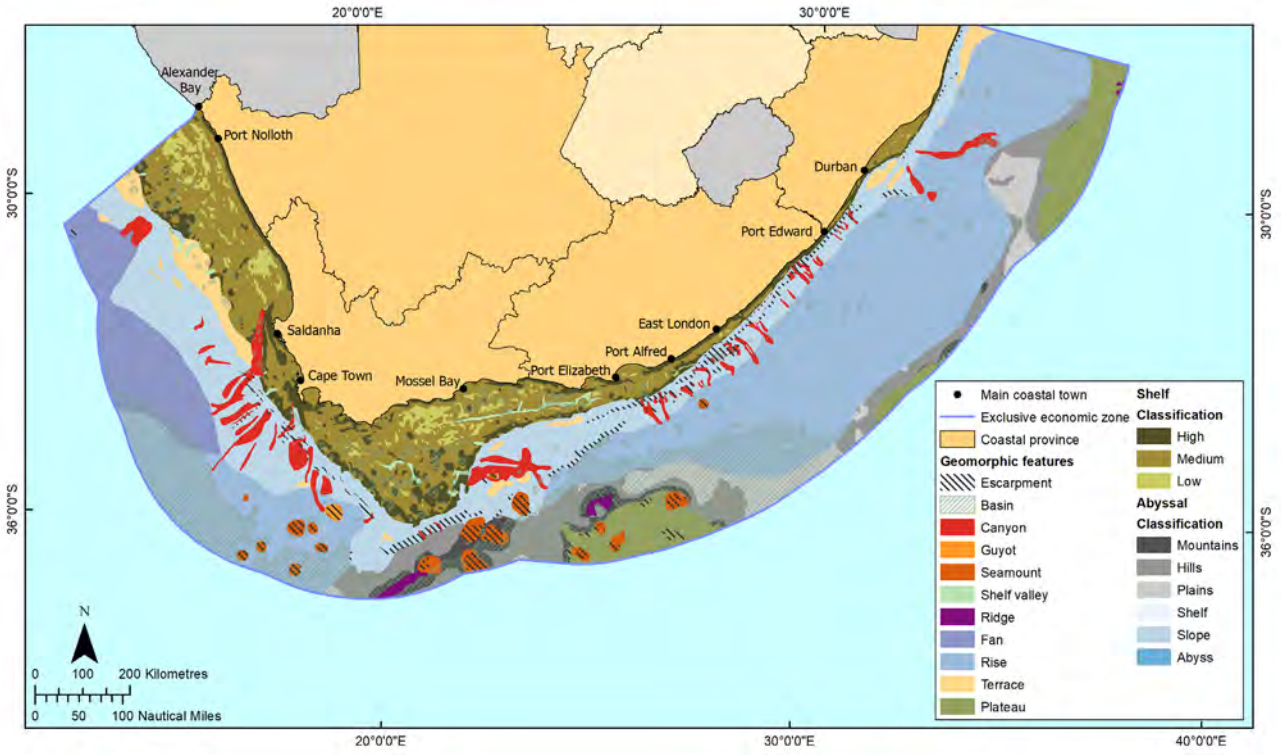
The Ob and Lena Polar Front ecoregion is the southernmost biogeographic unit in the sub-Antarctic territory. It is the smallest and least complex ecoregion, having a single ecosystem type, the Ob and Lena Polar Front Abyss. It is composed of soft, flat or gentle undulating plains typical of abyssal habitats but is distinguished from the surrounding abyss as it is influenced by the regionally defined Ob and Lena seamount ecoregion to the east of the sub-Antarctic territory (Douglass et al. 2014).

2.1.4 GEOMORPHIC FEATURES



Geological map of the South African continental shelf (after Dingle and Siesser, 1975).[29]

MAP 7



Seafloor geomorphic features in the South African mainland EEZ (data from: bluehabitats.org). MAP 8

The geomorphology of the South African mainland seabed includes a myriad of interesting and complex features that result from an interplay of the underlying geology (Map 7), overlying ocean currents, and land-sea connections through rivers and estuaries. The continental shelf is narrow along the east coast, broadens along the south coast to its widest point on the Agulhas Bank, and remains comparatively wide on the west coast. The uThukela River on the east coast and Orange River on the west coast provide substantial fluvial inputs to the marine environments, driving portions of relatively wider continental shelf in their areas of influence. There are many canyons that cut into the slope, some of which are shelf-incising. The largest canyon in the country is Cape Canyon, offshore of approximately Cape Columbine to Cape Town, extending more than 150 km long and nearly 50 km wide at its widest point (Map 8). The continental slope around the country is steeper on the east coast compared to that on the west coast, with the most interesting slope feature at the southern tip of the continental shelf in the Agulhas-Falkland Fracture Zone. Within this zone, the Mallory Escarpment and Trough are remarkable features, with the escarpment sloping as much as 20° in some places[30], which is rare globally. There are numerous named and unnamed seamounts scattered in the area surrounding the Mallory Escarpment and Trough into the abyss, mostly in the southern portion of the EEZ. The most notable of these are the Protea Seamount Complex and the Shackleton Seamount Complex, west and east of the Mallory Trough respectively, with other seamount clusters further east in the Agulhas Front.

The Southern Oceans geomorphology is focussed on a series of spreading ridges, deep rifts valleys and troughs associated with the mid-oceanic ridge (see Map 6). Numerous seamounts are associated with the volcanic activity along the ridge, and some of these seamounts reach close to the sea surface. In fact, Marion and Prince Edward Islands are just volcanic seamounts which have grown above sea level.

2.1.5 SPECIAL SPECIES

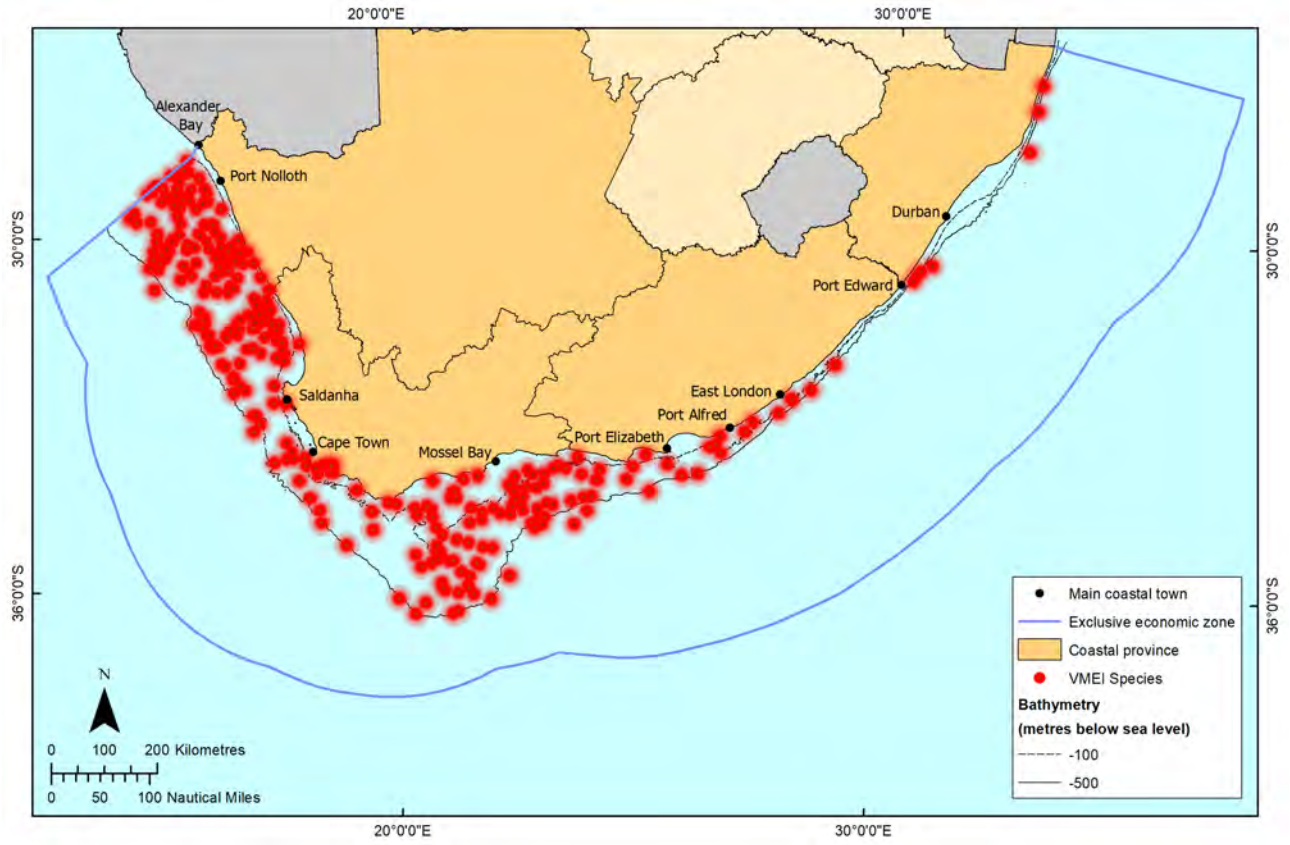
The barrier-free junction of three ocean basins, diverse oceanographic conditions, and rich productivity provide suitable habitat for a myriad of top predators and megafauna that frequent South African mainland waters, including both resident species and migrants. These include numerous species of shorebirds, seabirds, seals, dolphins, whales, sharks and turtles. Most of the bird species use the mainland coast and islands for resting and breeding. The seabirds particularly form large colonies on the islands on the south and southwestern coast of South Africa, with only a few mainland colonies. For example, Endangered African Penguins breed largely on islands (e.g., Seal Island, Dyer Island, Geyser Rock, St Croix) but also have two mainland-based colonies (Boulders Beach, Stony Point)[31]. There are nearly 20 breeding colonies of Cape Fur seals along the South African west and south coasts, the bulk of which are island based[32]. Islands in mainland South Africa thus represent critical habitat for top predators, with the surrounding waters equally important as foraging grounds for these birds and marine mammals. The value of the foraging grounds has been particularly demonstrated in recent population declines of island-breeding Cape gannets in response to rapid shifts in the distribution of their preferred prey items in the Western Cape[33].

The Prince Edward Islands in the Southern Ocean are particularly important breeding grounds for colonial seabirds and seals. Because of the paucity of land masses in the Southern Ocean, the islands host a wide variety of species and are critical to conservation supporting large populations of seabirds, seals and penguins. At least 5 million breeding seabirds of twenty-nine different species are found including five species of albatross (of which all are either threatened or endangered) are known to breed on the islands, including the wandering albatross, dark-mantled, light-mantled, Indian yellow-nosed and grey-headed albatross. Four penguin species are found, including king penguins, Eastern rockhoppers, gentoos and macaroni penguins. Three species of seal breed on the islands, including large numbers of southern elephant seal, Antarctic fur seal, and Sub-Antarctic fur seal. Most of these species make use of the rich Sub-Antarctic and Polar Front marine areas to forage.

Cetaceans, sharks and turtles tend to have much larger home ranges than the other marine megafauna, although these species also have substantial variation in lifestyle. Humpback dolphins, for example, are Endangered, resident coastal cetaceans that spend time close to the shore, foraging in the surf and on the inner shelf[34,35]. In contrast, species such as humpback whales and southern right whales migrate between Antarctica and South/southern African waters, with the latter using South African waters to calve, nurse their young, and possibly mate[36]. There are also numerous shark species that inhabit South African waters that also have diverse movement ecology. White sharks, for example, have resident behaviour, showing preferences for certain areas over sustained periods of time[37], but can also undergo transoceanic migrations[38]. These sharks are known to forage, transit and breed in South African waters. Other iconic megafauna in South Africa are turtles. The country supports four species of turtles, two of which nest in iSimangaliso Wetland Park and then migrate to foraging grounds mostly in Mozambique, but also in northern Madagascar, along the South African south coast and, in the case of leatherbacks, into the Agulhas Retroflection and Benguela Current[39]. Green turtles and hawksbills are also present, largely along the warmer east coast, but these are juveniles and sub-adults that use South African reefs, seagrass beds and occasionally mangroves as developmental and foraging grounds[40]. Occasionally, olive ridley turtles also frequent the South African EEZ, but these animals are considered vagrants. Key megafauna in the Southern Ocean, in addition to the seabirds and seals, include the Patagonian Toothfish *(Dissostichus eleginoides),* and several species of whale, especially orcas.

One of the most well-known phenomena regarding South African mainland top predators is the annual Sardine Run. During winter, sardines migrate from the Agulhas Bank to southern KwaZulu-Natal in large shoals, which attracts a myriad of sharks, cetaceans, seabirds and gamefish[41]. The Eastern Cape coastal waters play a critical role in this ecological process, with the formation of cyclonic eddies, break-away eddies and the Natal Pulse providing counter-currents that assist the sardines' northward migration, especially at Waterfall Bluff[42].

2.1.6 VULNERABLE MARINE ECOSYSTEM INDICATOR SPECIES



Locations of known Vulnerable Marine Ecosystem Indicator Species for mainland South Africa. Data from SANBI.

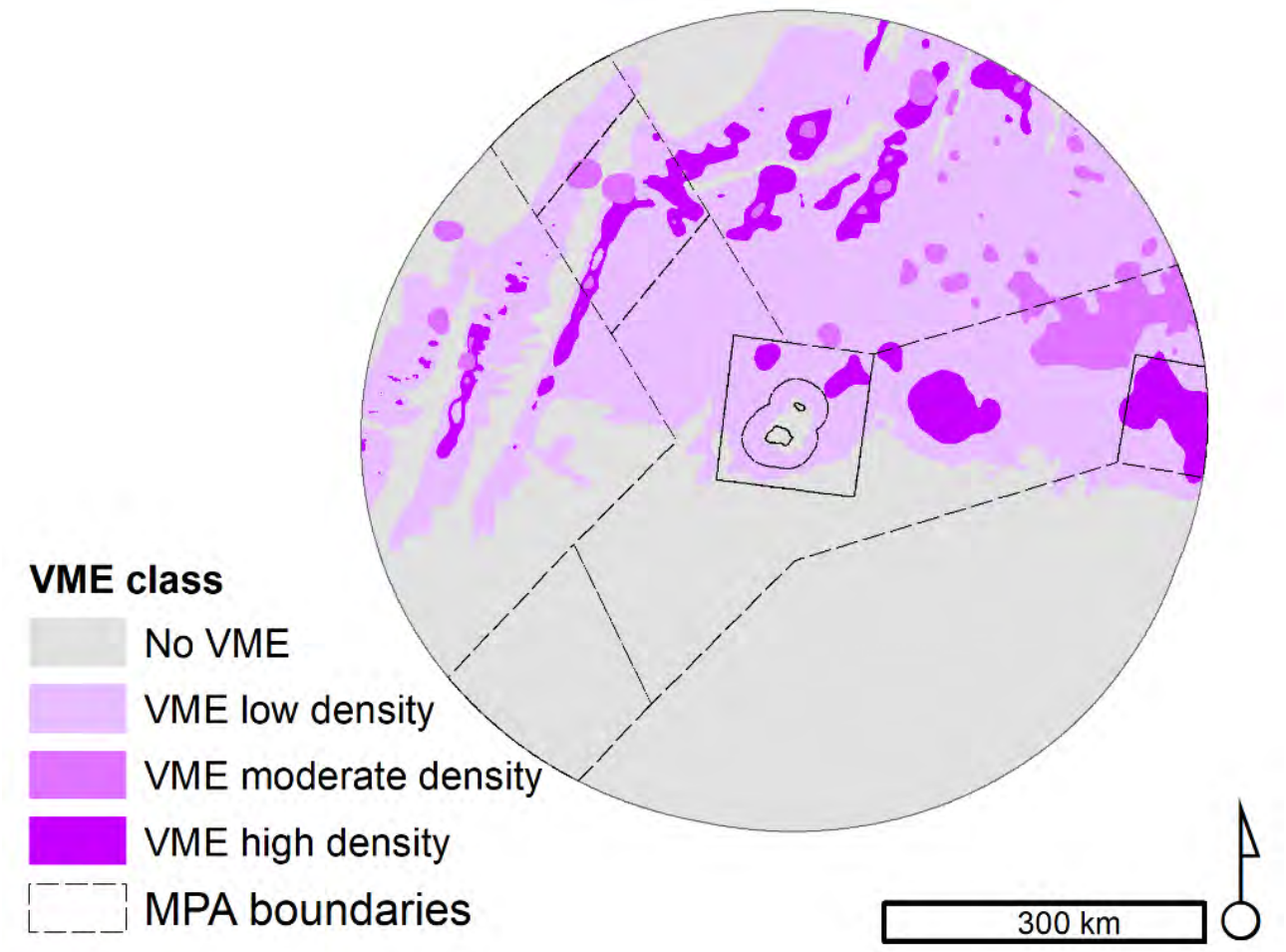
MAP 9

Vulnerable Marine Ecosystems (VMEs) are areas in the ocean that are characterised by their structural functionality and their vulnerability to bottom contact fishing gear.

The concept of VMEs was developed particularly in the context of protecting biodiversity in the high seas from the impacts of fishing. In 2006, the United Nations General Assembly[43] resolved to "[call] upon States to take action immediately, individually and through regional fisheries management organizations and arrangements, and consistent with the precautionary approach and ecosystem approaches, to sustainably manage fish stocks and protect vulnerable marine ecosystems, including seamounts, hydrothermal vents and cold water corals, from destructive fishing practices, recognizing the immense importance and value of deep sea ecosystems and the biodiversity they contain". The Food and Agriculture Organization (FAO) developed a set of criteria by which VMEs could be identified, which are: uniqueness or rarity; functional significance of the habitat; fragility; life-history traits of component species that make recovery difficult; and structural complexity[44].

In some instances, the presence of certain species can be used as indicators of VMEs. Corals, sea pens, anemones, sponges, sea squirts, crinoids (sea lilies) and lace corals are examples of generally slow-growing, long-lived animals that have intricate structural complexity. Their fragility makes them highly susceptible to damage from fishing practices such as bottom trawling, and sites where there are aggregations of such species are designated as VMEs[44]. These species are also generally recognised as ecosystem engineers, such that their presence has profound implications for the ecology of the site, e.g., areas where mesophotic gorgonian forests are present have been found to contain significantly higher biodiversity and elevated ecosystem functioning compared to habitats without these forests[45].

Further, overexploitation of ecosystem engineers (either directly, or indirectly from habitat damage during fishing) can alter sites substantially given the key role these species play in the ecosystem architecture and functioning[46].



Areas of high, moderate and low density of Vulnerable Marine Ecosystems in the sub-Antarctic territory.[11]

MAP 10

Recognising that the VME concept was developed for the high seas, the principle of protecting these sensitive ecosystems and constituent fragile species and communities should still apply in areas within national jurisdictions. Sites containing VME indicator species have been located all around the South African continental shelf, with much higher densities on the west and south coasts given how much wider the continental shelf is in this area, and how much sampling (or fishing) has taken place there as a result of the higher productivity of the Benguela Current. Further, there has been much less sampling (and benthic fishing) in slope and abyssal habitats compared to the much shallower shelf and shelf edge because of the challenges of reaching the seabed in the deeper waters, and the same can be said for South Africa's Sub-Antarctic territory with a great reliance on global datasets to identify areas with VME species. Some recent advances have been made in our knowledge, with the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) advancing the information for mapping of potential VMEs in the sub-Antarctic territory since 2007. Areas where these fragile cold-water corals, sponges, lace corals, sea pens and other species occur need to be protected from fishing practices that interact with the seabed.

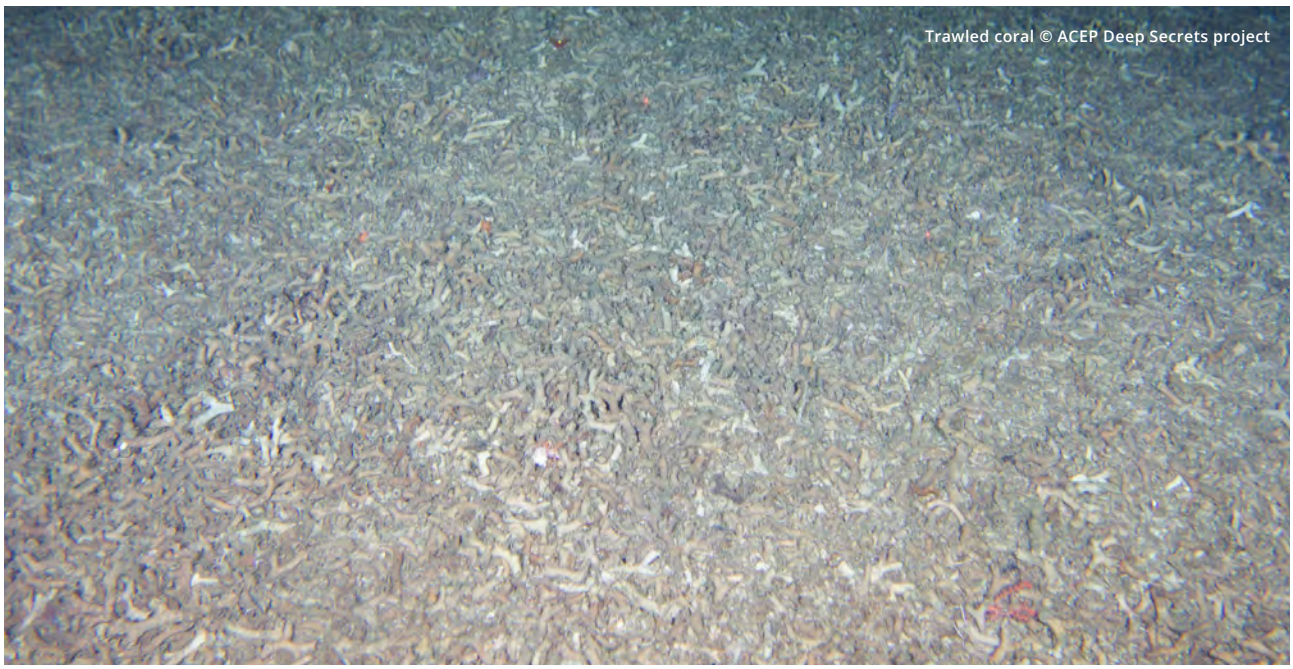
2.1.7 ECOLOGICAL CONDITION

The NBA 2018 Marine assessment used a cumulative pressure assessme ion:

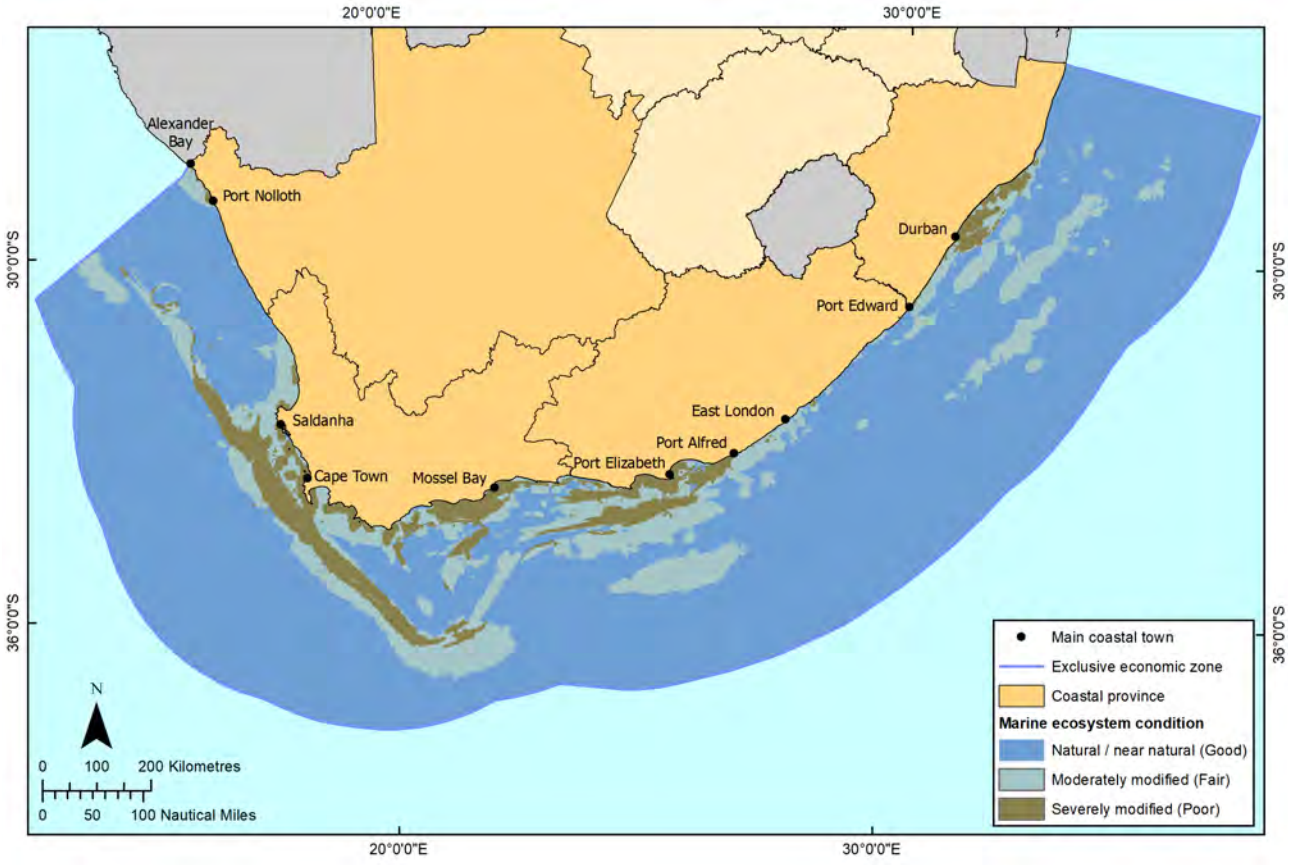
- NATURAL / NEAR-NATURAL:
  These are areas in good ecological condition with little or no evidence of human impact. These sites are expected to have both biodiversity pattern and process largely intact and hence can be considered to be in a largely intact state. These areas are concentrated in deep water (i.e., beyond the shelf edge) and the west coast shelf (north of St Helena Bay), offshore of the Wild Coast and offshore of St Lucia in the Delagoa ecoregion. Coastal areas in this condition class are mostly in the Wild Coast and in the Delagoa ecoregion.

- MODERATELY MODIFIED:
  These areas are in fair ecological condition, and are often found on the inner shelf, shelf and shelf edge. These areas tend to have single important pressures or a range of pressures at moderate intensities driving some degradation of natural habitat. Although these areas are not considered to be pristine, they are likely to be in a largely functional state, and have some level of degradation.

- SEVERELY / CRITICALLY MODIFIED:
  These areas are in poor and very poor ecological condition. Many coastal areas in close proximity to metropolitan areas, sections of the shelf edge and areas offshore of the southern Cape coast are in this category. The most severely impacted areas (often associated with trawl grounds) include the shelf edge from Cape Town to the Agulhas Bank, the shelf edge offshore of Port Elizabeth and sections of the KwaZulu-Natal Bight. Often these areas have single very high intensity pressures or a number of important pressures that drive severe degradation of natural habitat. These sites have been severely degraded from their natural state, causing significant loss of biodiversity pattern, disrupted ecological processes and there is often likely to be major physical disruption of habitat.



Trawled coral © ACEP Deep Secrets project



MAP 11

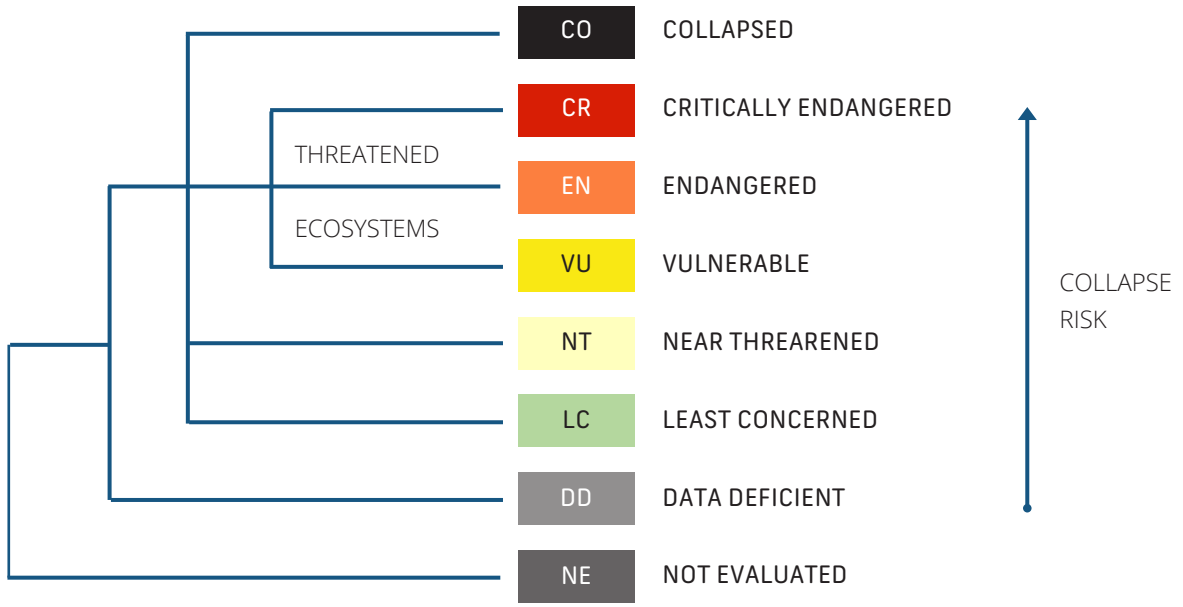
Map of ecosystem condition showing the spatial distribution of marine areas in a natural/ near-natural state, a moderately modified state and a severely / critically modified state. The NBA 2018 used cumulative impact scores to develop a condition map for marine and coastal ecosystems.

Areas of high cumulative pressures, or where single pressures have very high impacts, are assumed to translate into areas of high degradation i.e., they are severely / critically modified (Map 11). All bays have high cumulative pressures, with the highest cumulative pressure recorded in Saldanha Bay. Additional high-pressure areas include the area offshore of the Orange River, the shelf edge on the west and south coast, large portions of the Cape inner and mid shelf, the Agulhas Bank and the KwaZulu-Natal Bight. Despite this, 81% of the ocean around South Africa remains in natural or near-natural ecological condition[47]. The areas with the highest cumulative pressures, and in turn, poor ecological condition, are often those that have highest accessibility (i.e., are closer to land, with ocean access provided by nearby ports and harbours). Key pressures[48] on the shelf edge that lead to poor condition in this area include the offshore hake trawl fishery, the mid-water trawl fishery, the crustacean trawl fishery in KwaZulu-Natal and the large pelagic long linefishery. In the KwaZulu-Natal Bight, inshore crustacean trawl fisheries, intensive linefishing and freshwater flow reduction have degraded the ecological condition of marine ecosystem types. Overall, fishing is the greatest cause of ecological degradation in the offshore environment, whereas coastal development and fishing are the greatest pressures on inshore ecosystem types[47].

In the Sub-Antarctic region, the ability to assess ecosystem or ecological condition is hampered by the lack of sufficient data, however it is known that the main drivers of change in this region are the presence of invasive species on Marion Island itself (which can directly impact breeding marine species), and drivers of declining condition in the marine space driven by the Patagonian Toothfishery and anthropogenic climate change.

2.1.8 ECOSYSTEM THREAT STATUS

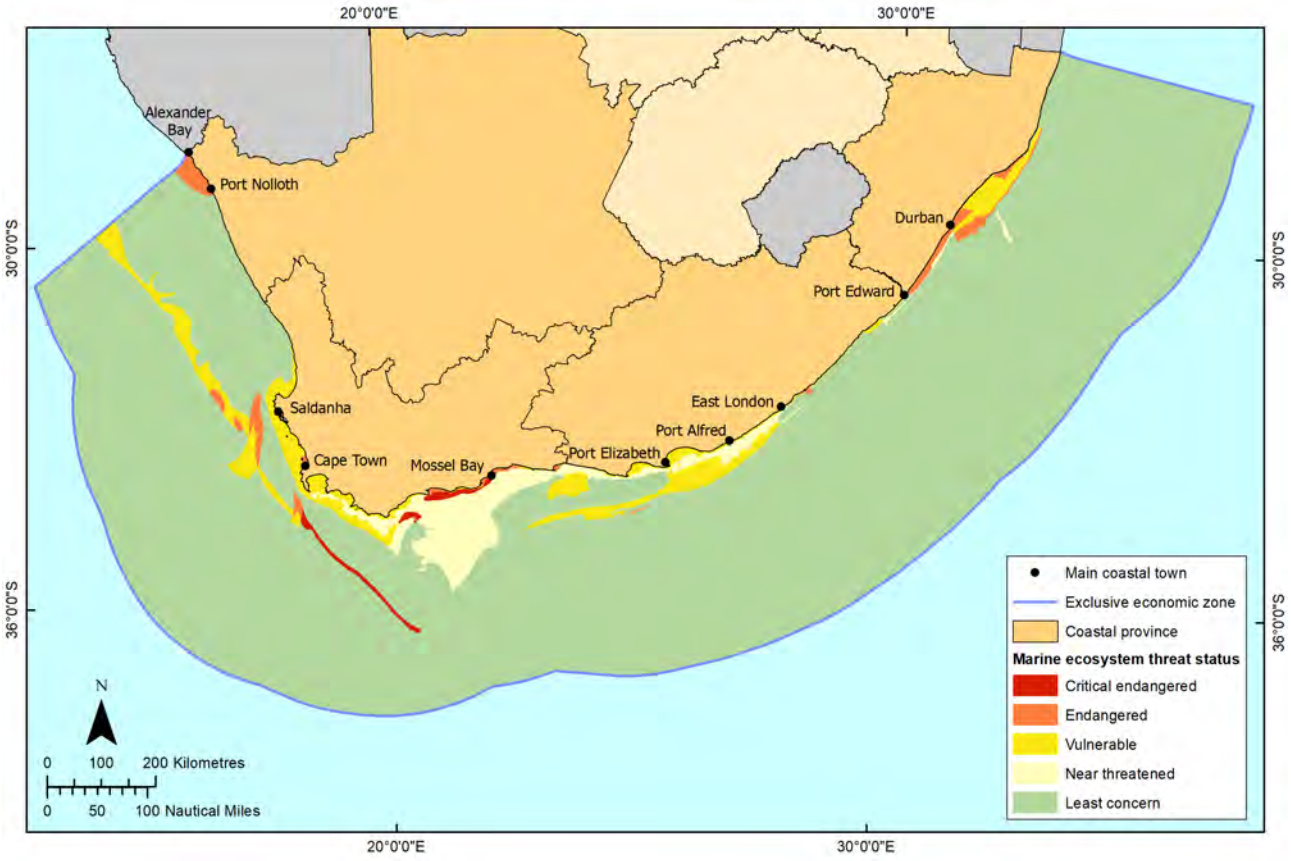
Ecosystem threat status is one of two headline indicators used in the National Biodiversity Assessment to track the status of biodiversity in South Africa. The NBA 2018 applied the IUCN Red List of Ecosystems approach[49,50,51], which is the global standard for assessing the threat status of ecosystems. The Red List of Ecosystems evaluates whether ecosystems have reached the final stage of degradation (a state of Collapse), whether they are threatened at Critically Endangered, Endangered or Vulnerable levels, or if they are not currently facing significant risk of collapse (Least Concern) (Figure 1). It is based on a set of criteria for performing evidence-based, scientific assessments of the risk of ecosystem collapse, as measured by reductions in geographical distribution or degradation of the key processes and components of ecosystems.



The IUCN Redlist for Ecosystems was applied in the NBA 2018 to identify current risk of collapse for marine ecosystems (after Bland et al., 2017)[50].

FIGURE 1

The ecosystem threat status of 150 marine ecosystem types in the mainland EEZ, and 29 ecosystem types in the Sub-Antarctic territory was assessed (Map 12, Figure 2). In the mainland, a total of 75 ecosystem types (50%) are considered threatened, with 1% of ecosystem types Critically Endangered (n=2), 15% Endangered (n=22), 34% Vulnerable (n=51), 11% Near Threatened (n=17) and 39% Least Concern (n=58)[47]. Although 50% of ecosystem types are considered threatened, the overall area of threatened ecosystem types is only 5% of the EEZ. The two Critically Endangered ecosystem types are the Agulhas Muddy Mid Shelf and Browns Bank Rocky Shelf Edge. Endangered types include shelf mosaics, bays, muddy shelf, hard grounds (on the mid and outer shelf, shelf edge and canyons), as well as some rocky shore types. Vulnerable types are mostly the remaining bays, remaining hard grounds (on the mid and outer shelf, shelf edge and canyons), kelp types, most mixed shores, many of the remaining rocky shores, and a number of different shelf types. Near Threatened types include a number of sandy shore types, rocky shore types and various shelf types. Ecosystems of Least Concern are mostly in deeper water, the shelf on the West Coast, and coastal types along the Wild Coast (see Sink et al. 2019[47] for full details).



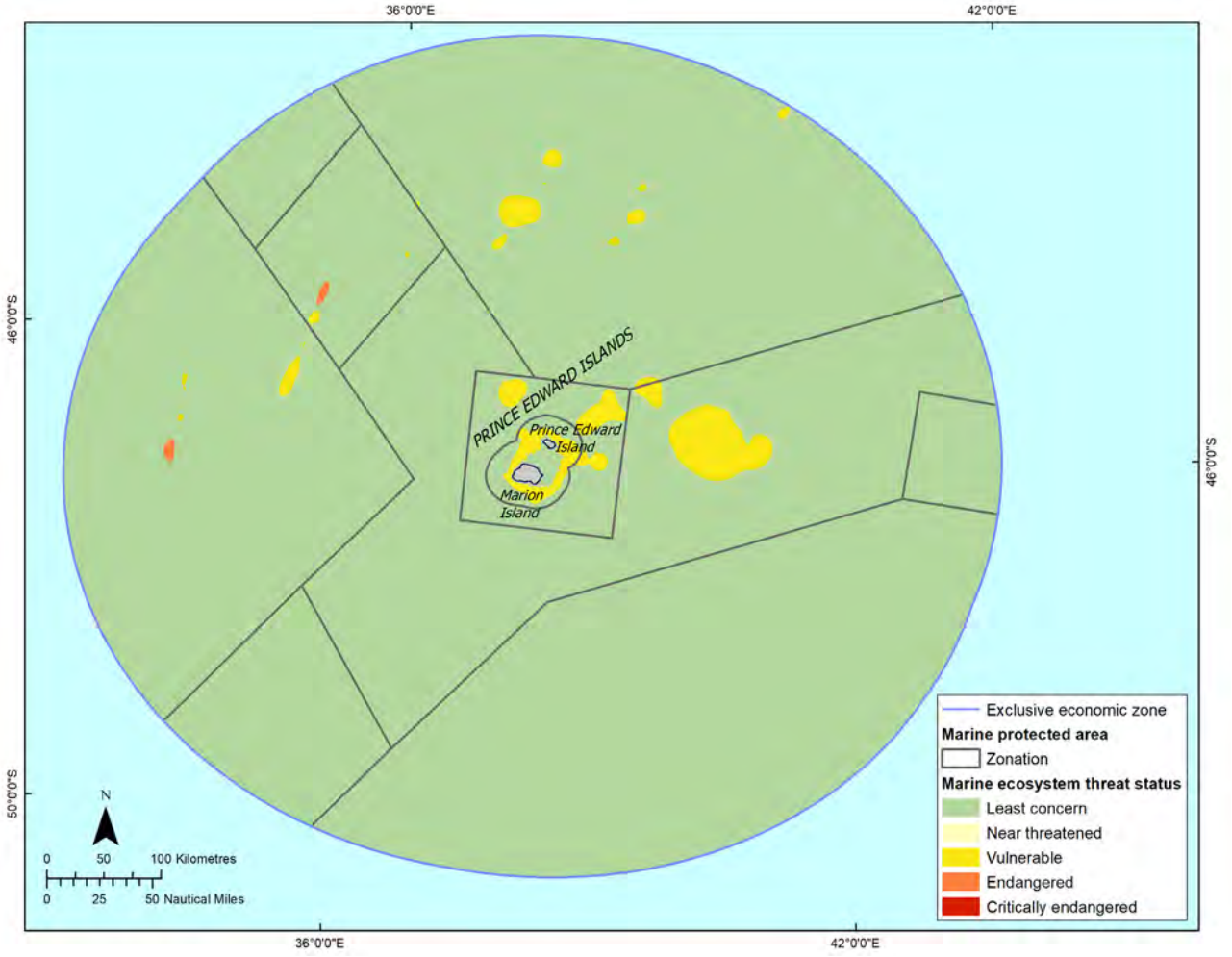
Map of Ecosystem Threat Status following the IUCN Red List for Ecosystems approach undertaken by the NBA 2018.

MAP 12

Summary of ecosystem threat status for individual ecosystem types in broad ecosystem groups[52]. The numbers refer to the number of types in each category.

FIGURE 2

In the Sub-Antarctic region, the National Biodiversity Assessment 2018 identified that, of the 29 marine ecosystem types, six (21%) are threatened by fishing (including the effects of historical illegal fishing). There are five Vulnerable ecosystem types including the Prince Edward Islands (PEI) Shelf Edge, Upper Slope and Mid Slope, which were threatened by historical fishing within the 12 nm territorial Sea (now a sanctuary zone of the marine protected area). More than 65 % of the PEI sub-Antarctic Shallow Seamount and Upper Spreading Ridge are fished, making them Vulnerable. Only one ecosystem type is considered Endangered, the PEI sub-Antarctic Shallow Spreading Ridge, which has been fished over its entire extent. The remaining marine ecosystem types have been fished over less than half of their extent and so are considered Least Concern at this stage (see von der Meden et al. 2019 for full details)[53].



Map of Ecosystem Threat Status of marine ecosystems around the Prince Edward Islands undertaken by the NBA 2018. The analysis used the IUCN Red List for Ecosystems approach.

MAP 13

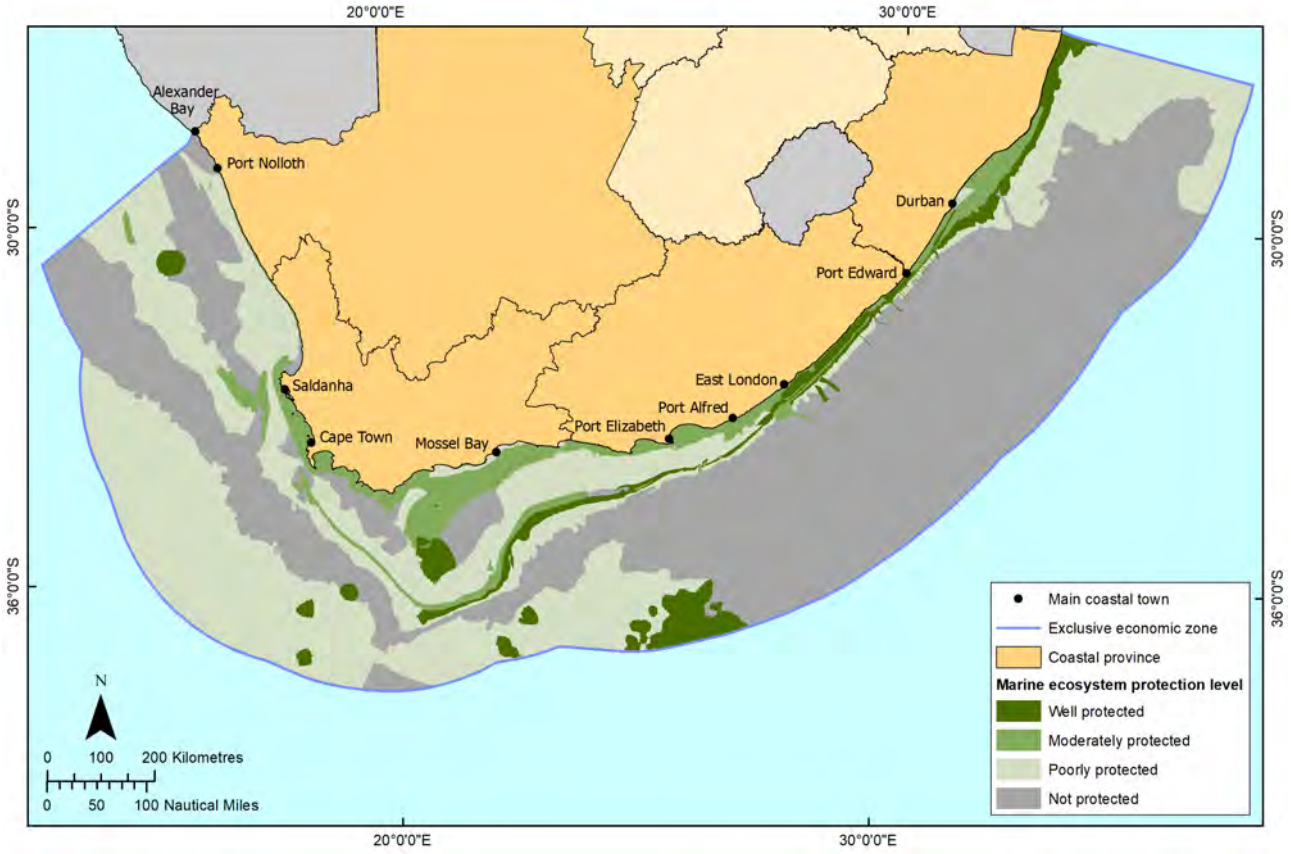
2.1.9 PROTECTION LEVEL

Internationally, protection of ecosystems through Protected Areas and other effective conservation measures (OECM) has proven to be the most effective way of securing biodiversity. The National Protected Area Expansion Strategy 2016[54] sets out South Africa's objective to secure an eventual 20% of each ecosystem type in a protected area. The National Biodiversity Assessment 2018[55] highlighted how the year 2018 was a significant year for Marine Protected Area (MPA) expansion in South Africa, with 20 new MPAs approved for declaration by the South African cabinet. These MPAs were proclaimed in 2019 increasing the number of South African MPAs from 26 to 42, inclusive of the Prince Edward Islands MPA in the Southern Ocean, and noting that some existing MPAs were expanded, or merged and expanded, in the new MPA network. Protection of the marine environment around mainland South Africa increased from 0.46% (25 MPAs, 4 748 km^2) in 2018 to 5.4% (41 MPAs, 57 943 km^2) in 2019[55]. In the Southern Oceans, the Prince Edward Islands MPA is South Africa's largest protected area (169 966 km^2 or 36% of the Prince Edward Islands EEZ).

Ecosystem Protection Level is the headline indicator calculated to assess the extent to which ecosystem types are represented in South Africa's protected area network. To calculate this indicator, inclusion those portions of ecosystem types in good ecological condition in MPAs was calculated and compared against the standard 20% biodiversity target as set out in the National Protected Area Expansion Strategy 2016[54]. Protection level was determined on a scale that ranged from Not Protected (<0.2% of an ecosystem type in the protected area network) to Well Protected (≥20% of an ecosystem type in good condition in the protected area network). The NBA 2018[55] highlighted current levels of marine protection and the significant progress towards achieving the biodiversity targets for marine ecosystems by comparing the ecosystem protection level statistics for 2018 and 2019, respectively before and after expansion of South Africa's MPA network:

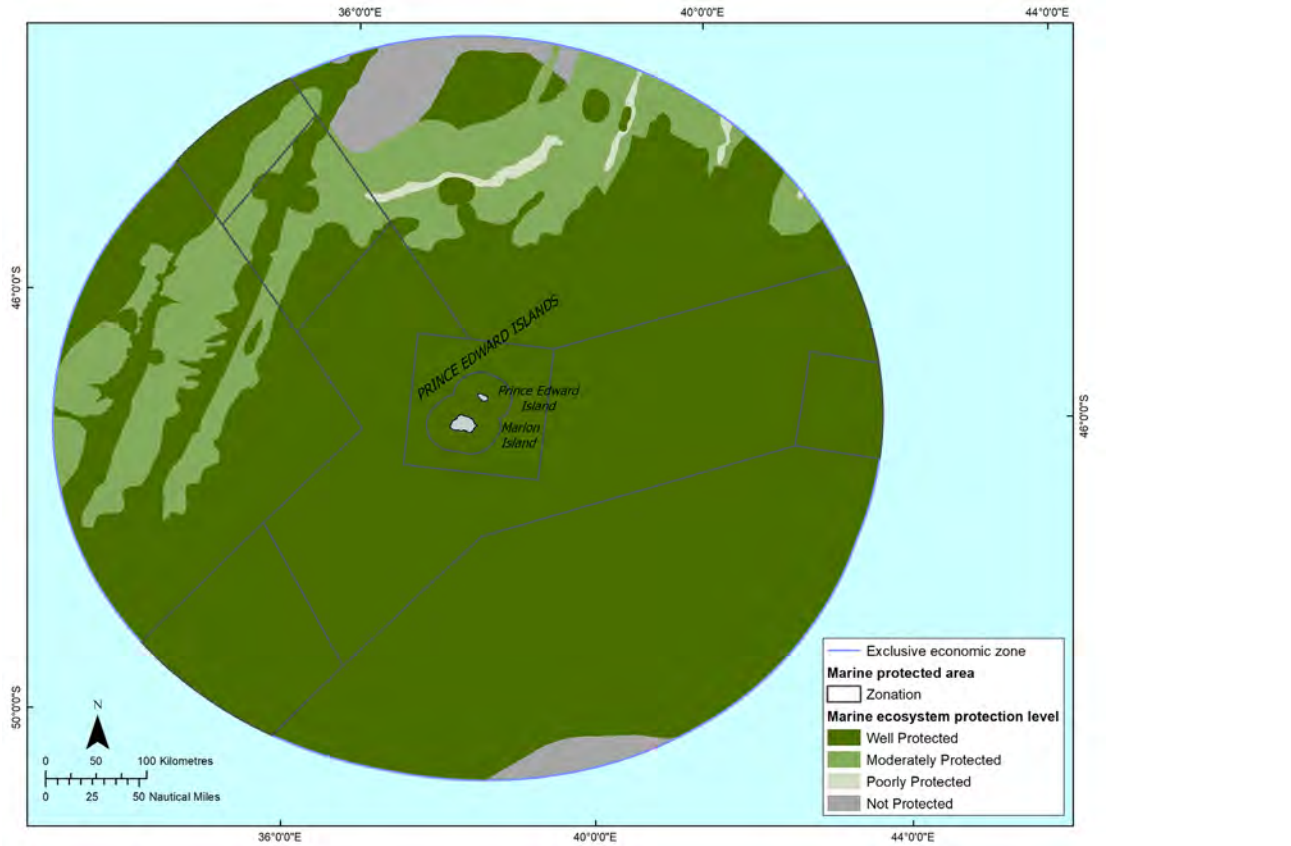
- A total of 47 (31%) marine ecosystem types are **WELL PROTECTED**, an increase of 11% since 2018.
- A total of 62 (41%) marine ecosystem types are **MODERATELY PROTECTED**; an increase of 19% since 2018. Most of these ecosystem types are inshore or on the shelf edge.
- A total of 22 (15%) marine ecosystem types are **POORLY PROTECTED**. This is up from 11% in 2018, and includes 16 (of 150) ecosystem types that improved from Not Protected to Poorly Protected since 2018. Note that most of the ecosystem types in this category are very large, e.g., the Cape Basin Complex Abyss in the Southeast Atlantic is 73 071.65 km^2 and the Southwest Indian Mid Slope ecosystem is 78270.72 km^2.
- A total of 19 (13%) ecosystem types remain **NOT PROTECTED**. However, this is a significant decrease from the 47% of types that fell into this category in 2018. These ecosystems are largely offshore and include some of the largest ecosystem types, e.g., Transkei Basin Abyss (210 710 km^2) and Southwest Indian Lower Slope (197 988 km^2).

Overall, in the Sub-Antarctic, 86% of marine ecosystem types are afforded some protection by the MPA network. Ten marine ecosystem types are Well Protected (35%), 14 are Moderately Protected (48%), one is Poorly Protected (4%) and four are Not Protected (14%).



Map of Ecosystem protection level of marine ecosystems. Data from the NBA 2018[9].

MAP 14



Map of Ecosystem protection level of marine ecosystems around the Prince Edward Islands undertaken by the NBA 2018.

MAP 15

2.1.10 OTHER MARINE RESOURCE ISSUES

Exploited non-living marine resources include gas, diamonds and salt. Although salt production has a major impact on the site, it is a renewable form of mineral extraction. In contrast diamond resources have been largely depleted along the shoreline in the Northern Cape Province. The 100-year diamond mining legacy has left large tracts of coastline severely modified while other areas remained relatively pristine due to the access restrictions. Phosphate deposits exist and exploitation is being considered.

Tourism is one of South Africa's fastest growing industries. Beach activities are the most popular biodiversity-related tourism activity for domestic overnight tourists and among the most popular for domestic day travellers, with 3.2 million overnight trips to beaches and around 460 000 day trips in 2016[56]. Visiting a beach ranks similar in popularity to undertaking wildlife activities for foreign tourists[57]. Beaches provide a diversity of tourism activities, such as bathing, swimming, fishing, surfing, kayaking, walking, sunbathing, picnicking, beach-related sports, and observing marine life, birds and mammals. Healthy beaches are a prerequisite for growth in coastal tourism[58]. Poorly planned tourism development is a threat to the marine environment and the tourism sector itself.

There are different scenarios on how and where the changing climate might have an impact in the South African marine area. However, the detail and reliability of the existing scenarios varies enormously and can only be flagged for future attention at this stage. Climate change impacts on the status of the natural environment will have to be monitored and considered in the future as the quality and predictability of the scenarios improve.

2.2 THE SOCIO-ECONOMIC ENVIRONMENT: STATUS, TRENDS AND DEVELOPMENTS

The marine environment of South Africa is an asset of great importance and a major focal point for human habitation and socio-economic activities. As a maritime nation with jurisdiction over one of the largest EEZs in the world and with a large portion of South Africa's population dependent on a wide variety of marine resources for their income and well-being, the ocean represents a significant socio-economic asset with high potential for the unlocking of further contributions for socio-economic development.

People have lived at various places along the South African coasts since the early Stone Age.[59] Evidence that coastal inhabitants supplemented their diet with intertidal shellfish, fish and seabird eggs along the east and south coast dates back to at least 100,000 years and to 50,000 years along the west coast.[60] Until today, subsistence use of coastal marine living resources continues throughout South Africa and still plays a significant role in the lives of many. Colonisation had a significant spatial impact on patterns of coastal use among the inhabitants that had been living along the South African coastline.[60]

Today, South Africa's coastline lies across the four Provinces of the Northern Cape, Western Cape, Eastern Cape and KwaZulu-Natal. There is great diversity between these provinces in social, cultural, economic and institutional terms given their different histories[61]:

- The Northern Cape is South Africa's largest province, taking up almost a third of the country's total land area. However, the province is sparsely populated with only about 1.2 million people. Mining is an important industry with diamond mining occurring in the ocean along the coast.

- Situated on the south-western tip of the African continent, the Western Cape with its wide beaches and breathtaking scenery, complemented by a rich variety of cultures, historical landmarks, world-class restaurants and entertainment, is a world-famous tourist destination. With approximately 6.7 million people, around 12% of the South African population lives here. Some 75% of all South African fishing takes place along the Western Cape coastline. The ports of Saldanha Bay and Cape Town are strategically located to serve as maritime trade hubs.

- The Eastern Cape is South Africa's second-largest province after the Northern Cape, taking up 13.9% of the total land area. The province has a population of more than 6.5 million people. Recreational, small-scale and commercial fishing as well as maritime transport are important sectors.

- KwaZulu-Natal is one of the country's most popular holiday destinations. It includes South Africa's lush subtropical east coast, stretching from Port Edward in the south to Mozambique in the north. More than 11 million people live here, making up approximately 20% of the South African population. KwaZulu-Natal has a diverse industrial sector, with industries associated with imports and exports having developed around the ports of Durban and Richards Bay.

Coastal provinces, major settlements, key terrestrial infrastructure.

MAP 16

The socio-economic context is shaped by the marine and coastal resources and areas which provide opportunities for the various industries. Commercial and recreational use of marine and coastal resources is relatively new in South Africa, dating back only less than 100 years. Key sectors with significant interests in the marine environment and substantial socio-economic impact (e.g. in terms of employment) are:

- Fisheries and marine aquaculture;
- Marine and coastal tourism;
- Exploitation of geological resources (e.g. diamonds) and hydrocarbon (e.g. oil and gas); and
- Maritime transport.

Virtually all of these sectors are growing in terms of their contribution to the country's economy on an annual basis.[62] The South African Government, in an effort to strengthen its support to the growth of these sectors, established several Industrial Development Zones (IDZ), which are geographically designated areas in which industrial development is encouraged and enabled. All of the IDZs are located in or around major ports: the Coega, Richards Bay, East London, Saldanha Bay, and Durban with linking road, rail and aviation infrastructure. For example, the 861 km long heavy-haul Sishen – Saldanha railway line connects iron ore mines near Sishen in the Northern Cape with the port of Saldanha Bay in the Western Cape while the Mpumalanga – Richards Bay line, the second largest coal railway in the world, delivers more than 62 million tonnes of coal. This economic trend of industrial growth leads to an intensified use of the living and non-living resources the ocean provides, including increasing maritime-based import and export.

There has been an increased focus on development of non-consumptive marine resource use in South Africa, with notable contributions to the economy and for job creation. In 2013, shark cage diving created approximately 249 jobs and had a direct value of R113 million (overall value estimated around R571 million) (DEA 2015)[63]. The contribution of the tiger shark *(Galeocerdo cuvier)* diving industry in Aliwal Shoal MPA was estimated at over R12 million per annum in 2008 (Dicken and Hosking 2009)[64], and in Gansbaai, great white shark *(Carcharodon carcharias)* cage diving generated about R3.5 million in 2003 (Hara et al. 2003)[65]. Tourism centred on viewing and snorkelling with seals employed at least 30 people in 2013 and had a direct value of R5 million (estimated overall value of R25 million) (DEA 2015)[63]. This is similar to the value of the annual sardine run (R5.4 million) generated by tourists and special-interest travellers, e.g., commercial divers, academics and filming professionals. Boat-based whale watching is also offered by numerous operators (DEA 2017a)[66] in designated areas all around the country (DEA 2017b)[67]. In 2013, boat-based whale watching provided employment to 184 people and attracted 42 812 tourists with a direct value of R21 million (overall value of R105 million), and land-based whale watching was valued at R80 million (overall value of R400 million) (DEA 2015)[63]. Tourist expenditure in Simon's Town is R160 million, of which 35% is spent by tourists vising the Boulders Beach penguin colony (Lewis et al. 2012)[68]. Tourists can also participate in turtle tours in iSimangaliso Wetland Park during the nesting and hatching season (October-March) that notably employs members of the local community to serve as tour guides[69].

The four major coastal cities of Durban, Cape Town, East London and Port Elizabeth are home to the majority of the coastal population where approximately 40% of the South African population lives.

Unemployment in South Africa remains high and changes in employment levels over the past year have been marginal, with unemployment at 27.2% in the second quarter of 2018[70]. In the third quarter of 2019 the unemployment rate was 29.1%[71]. Given the significant economic development along the coastline, opportunities for employment are often better at the coast. Among other factors, this leads to an influx of people settling at the coast, often in and around the major cities. According to the 2016 Census, in the human population of these four major coastal cities grew by approximately 2.5 million people in the 20 years between 1995 and 2015.[72] This is an increase of around 45% at a rate of approximately 125,000 people per year. In turn, this trend of a growing coastal population leads to intensified development along the coastline in terms of housing and infrastructure – with diverse impacts on the marine and coastal environment.

The coast is furthermore valued as a place of identity for both citizens living at the coast and those residing inland. The sea forms part of the cultural, spiritual and aesthetic wealth and is a crucial source of socio-economic development and human well-being. With the increasing population along the coastline, these intangible values of the marine and coastal environment are set to become even more relevant for social development.

Marion Island, the larger of the PEIs, has a revolving team that spends approximately 14 months on the island. Although research has been conducted to assess the impacts of potential tourism to the island (e.g. Wheeler et al. 2009)[73], this has not been implemented as yet. This may become a viable opportunity in the future, as there is some interest in highly specialized birding tours to the PEI and surrounds[74].

2.3 THE LEGISLATIVE, POLICY AND STRATEGIC ENVIRONMENT

The South African marine area is regulated and guided by the country's Constitution, Legislation, overarching sectoral policies and strategies. South Africa is also a signatory to several international declarations, treaties, conventions and agreements that have informed its current legislative, policy and strategic environment.

The need and authority to introduce and implement MSP in South Africa is derived from the MSP Act and corresponds with the legislative, policy and strategic context as described by the National Framework for MSP.

MSP seeks to contribute to the following overarching policies and strategies of the country. Sectoral policies and strategies inform MSP and their implementation will in turn be supported to the extent possible by the forthcoming Marine Area Plans. Sectoral legislation will be relevant to MSP in that it provides a framework for the implementation of the regulations that come with the Marine Area Plans.

South Africa's National Development Plan 2030 identifies certain priorities relevant to the marine environment. These include developing strategies to increase off-shore renewable energy sources, off-shore oil and gas and investing in marine engineering initiatives. The New Growth Path sits alongside the National Development Plan and provides the framework for South Africa's economic policy as the driver of the country's jobs strategy. It seeks to promote growth and employment from new opportunities such as the green economy, exports of goods and services to growing African markets, offshore oil and gas and the identification of realistic and sustainable options for diversification of the economy.

The Operation Phakisa: Oceans Economy initiative was launched in 2014 to fast track the implementation of solutions on critical development issues highlighted in the National Development Plan. Achieving sustainable ocean development and the unlocking of the ocean economy through the sustainable use of living and non-living marine resources for economic and social development – including through MSP – is a key pillar of Operation Phakisa.
Relevant sectoral policy documents include but are not limited to the:

- National Environmental Management of the Ocean (2014);
- Small Scale Fisheries Policy (2012);
- National Aquaculture Policy Framework (2013);
- The Comprehensive Maritime Transport Policy (2017);
- National Tourism Sector Strategy (2017);
- Mining Charter (2018); and
- Integrated Resource Plan (2018).

South Africa is also signatory Party to a number of relevant international instruments in relation to the marine environment which have been translated into the national policy, strategic and legislative framework. These include but are not limited to the:

- United Nations Convention on the Law of the Sea (UNCLOS);
- Safety of Life at Sea Convention (SOLAS);
- Convention on Biological Diversity (CBD); and
- International Convention for the Prevention of Pollution from Ships (MARPOL).

UNCLOS is the key framework convention from which South Africa derives rights and responsibilities and provides the country with far-reaching sovereign rights to regulate the use of all resources in its territorial waters and EEZ including mineral resources of the continental shelf. UNCLOS is domesticated through the Maritime Zones Act (Act No. 15 of 1994). There are various relevant instruments that South Africa has committed to implement on the basis of its national legislation and policies as listed above is on this basis that national strategies, such as the National Biodiversity Strategy and Action Plan (NBSAP), have been developed. These sectoral strategies aim to support implementation of the above policies, including through related legislation.

Sectoral legislation, including specific regulations of certain acts, is crucial to guide where and when human activities occur in the ocean space and will be used to enable implementation of the forthcoming marine area plans. Such legislation includes but is not limited to the:

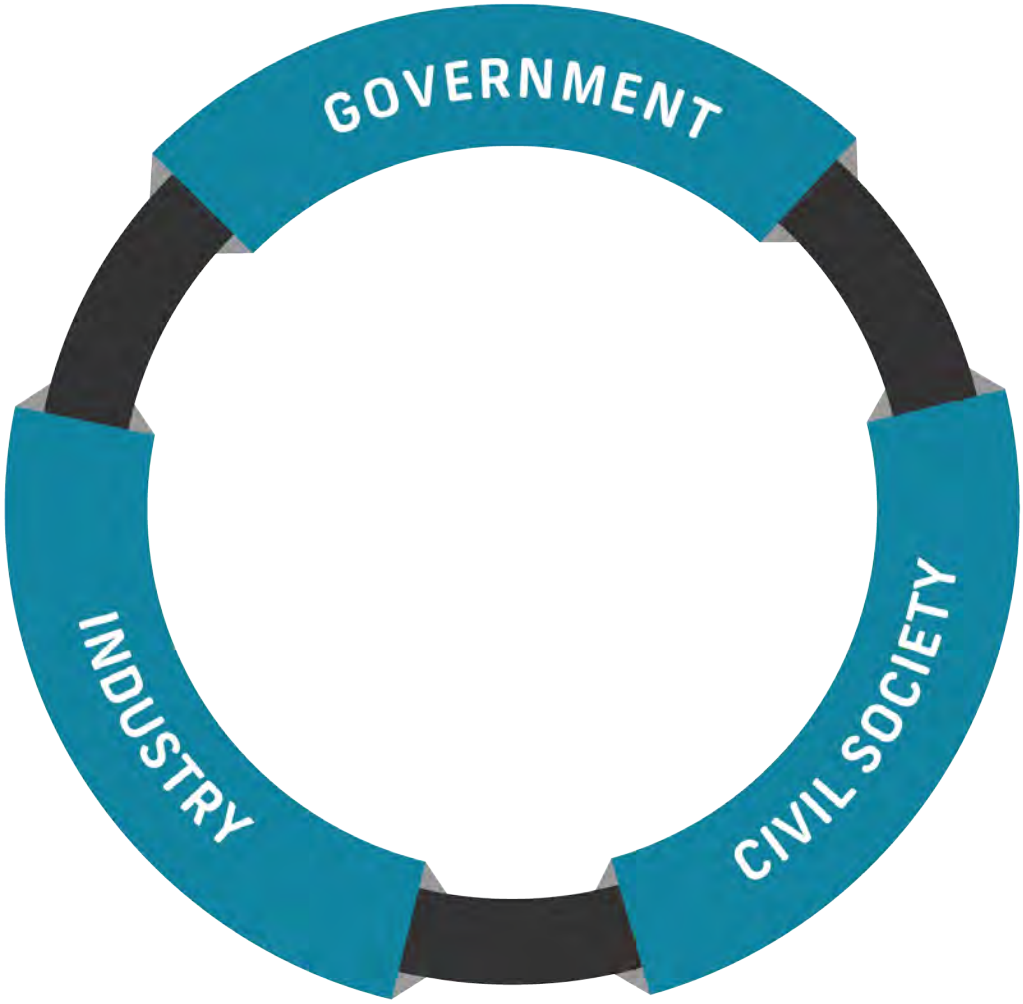
- National Environmental Management Act (Act No.107 of 1998);
- National Environmental Management: Protected Areas Act (Act No.57 of 2003);
- Integrated Coastal Management Act (Act No.24 of 2008);
- Marine Living Resources Act (Act No.18 of 1998);
- Mineral and Petroleum Resources Development Act (Act No.28 of 2002);
- Marine Traffic Act (Act No.2 of 1981)
- Tourism Act (Act No.3 of 2014); and
- National Heritage Resources Act (Act No.25 of 1999).

2.4 STAKEHOLDERS

The MSP process necessitates stakeholder involvement. Section 8 of the MSP Act accordingly states that "the National Working Group must ensure that all relevant stakeholders are adequately consulted in the development of the Marine Area Plans". The National Framework for MSP also provides further guidance in terms of stakeholder engagement in the MSP process.

A stakeholder in the context of MSP is understood as being any person or group with an interest or stake in the coastal and marine environment, and/or affected by the Marine Area Plans and associated planning and plan implementation processes.

Stakeholders have already been and will continue to be engaged in the MSP process. They represent three broad categories as illustrated in Figure 3:



The three broad types of stakeholders involved in MSP in South Africa. FIGURE 3

line with the MSP Act and the National Framework for MSP, the following relevant stakeholders will be adequately consulted as part of the MSP process, including:

- Government:
  - Departments
  - Affected organs of state
  - Institutional coastal planning bodies
  - State-owned enterprises
- Industry:
  - Industrial representative bodies from the various affected sectors
- Civil society:
  - Representative organisations of affected persons and institutions representing non-governmental and public interests
  - The general public

In addition to the requirement for the MSP National Working Group to consult stakeholders in the MSP process, the various participating departments also assume the responsibility to "ensure that their respective stakeholders are properly consulted" as per Section 8 of the MSP Act.

The range of interests and users profiled in this report will be engaged in the MSP process as far as practically possible. As the MSP process evolves, any new and relevant stakeholders and their interests and views will be taken into account accordingly.

3. HUMAN USES AND INTERESTS: CURRENT CONDITIONS AND FUTURE DEVELOPMENTS IN THE SOUTH AFRICAN MARINE AREA

All parties using the ocean space and living or non-living marine resources are connected in one way or another with MSP. This connection may be strong and in other cases it may mean less spatial links.

This chapter provides an overview of all of these sectors, and the various activities that use, depend on and impact the marine environment: either by using marine resources directly (e.g. extraction) or indirectly (e.g. for tourism), by using marine space (e.g. transport), or by affecting the marine environment (e.g. wastewater discharge).

Each section follows a similar structure: It begins with a brief definition of the use, followed by an overview of its current status in the context of South Africa's ocean. This considers legal mandates and responsibilities, its socio-economic importance, the key spatial interests or – in some cases – the distribution of the uses' resource, as well as the environmental impact of the use. The second part of each section looks towards the future, considering strategic policy objectives, key trends and driving forces relevant for or in the sector, and conflicts and synergies with other activities. Each section concludes with a brief overview of the key issues MSP should consider from the perspective of each use.

3.1 CARBON CAPTURE AND STORAGE

3.1.1 BACKGROUND

Carbon Capture and Storage (CCS) is a technology designed to prevent anthropogenic carbon dioxide (CO2) emissions resulting from the burning of fossil fuel for energy generation from entering the atmosphere. CCS involves transporting the CO2 in liquid form by pipeline or ship and subsequently injecting them into geological formations deep underground where it is permanently stored below the earth's surface.

South Africa as one of the major emitters of C02 has committed to reduce its C02 emissions and has identified CCS as one of the long-term mitigation options in fulfilling its international obligations and addressing climate change.

Carbon storage in the ocean currently does not exist in South African marine waters; attention is given to CCS on land at this stage. Nevertheless, the potential for it is being explored since the offshore marine environment has been identified to have the largest potential for CO2 storage when compared to the terrestrial environment.[75] This may lead to dedicated areas for this emerging use in the marine environment to be declared in the mid-term future.

3.1.2 LEGAL AND POLICY FRAMEWORK

The Department of Mineral Resources and Energy (DMRE) it is mandated to lead the policy, legal and regulatory development for enabling CCS in South Africa. The South African National Energy Development Institute (SANEDI), which reports to the Minister of Mineral Resources and Energy and for which the Minister has oversight responsibilities, hosts the South African Centre for CCS (SACCCS). SACCCS was launched in 2009 to analyze and advance the technical aspects of CCS including to lead South Africa's efforts on CCS from a technical point of view.

Currently there is no specific set of legislation for CCS in South Africa but the DMRE has initiated steps towards the development of a legal regime for CCS. The primary governing framework on CCS that currently guides DoE includes but is not limited to the:

- National Climate Change Response Strategy White Paper (2011); and
- CCS Roadmap (2012).

The Climate Change Response Strategy White Paper presents the South African government's vision for an effective climate change response and the long-term, just transition to a climate-resilient and lower-carbon economy and society. It identifies CCS as one of the medium-term mitigation options with the biggest mitigation potential. CCS is one of the near-term priority flagship programmes implemented as an integral part of this policy.

Cabinet approved CCS Roadmap provides the overarching direction for work on CCS and aims at enabling the implementation of commercial CCS deployment.

The National Development Plan supports CCS as one of the measures to mitigate climate change and as a necessary activity to move to a different energy context by 2030 through the promotion of cleaner coal technologies, taking into account the economic, environmental and technological considerations associated with this method.

3.1.3 STRATEGIC POLICY OBJECTIVES

CCS in the ocean is recognized as a possible avenue for South Africa as part of the country's energy policy framework. In the long run, the ambition is that all energy produced is clean. The capture, use and storage of CO2 are a temporary solution during the transition to a fully renewable energy supply only.

Currently, no specific targets are defined concerning CCS in the seabed. The CCS policy objective centres on assessing and mapping the offshore storage potential. The objective is to develop and test the technology on land first in order to advance their deployment in the future.

3.1.4 POTENTIAL AND AREAS OF INTEREST

South Africa has vast potential for the geological storage of carbon under the seabed.[75,76,77] Geological reservoirs suitable for storage of CO2 are classified according to whether they contain (or have contained) oil, gas, or saline water. Saline aquifers have the largest storage potential but there is uncertainty about the storage capacity of individual sites. Nevertheless, it is estimated that South Africa has a CO2 storage capacity of 150 gigatons in locations that are both offshore and on land. The offshore space amounts to 98% of available CCS potential in the country. Further research may result in a different estimate of this potential.

CCS still represents a major technological challenge as this emerging technology must demonstrate its economic and technical feasibility and would have to prove that the storage of CO2 in geological formations is, in effect, permanent because the concept will not work if CO2 leaks back to the surface even after many hundreds of years in storage. These challenges come with cost uncertainties and regulatory issues that would still need to be resolved.

In order to facilitate CO2 capture and storage, a pipeline infrastructure will have to be developed or existing infrastructure complemented. Existing oil and gas pipelines or wells can only be used once the fields in question have been completely exhausted or wells are de-commissioned.

3.1.5 SOCIO-ECONOMIC POTENTIAL

CCS in the seabed could support the reaching of South Africa's climate change objectives, strengthens energy security as it allows continued use of coal within the energy mix, and would enable the country to participate in an emerging sector.

3.1.6 POSSIBLE ENVIRONMENTAL IMPACTS

CCS as emerging use may have considerable impact on the marine environment if deployed in future, as evidence from abroad and research shows. Yet, the degree of the environmental impact depends on a number of factors including but not limited to the extent to which it is possible for CCS activities to use existing pipelines, installations and wells.

The use of salt caverns for CCS involves the injection of water and the possibility that brine (salt in solution) could flow up the well, which may form a dense layer across the seabed. This may be highly toxic to marine organisms. Furthermore, the leakage of CO2 could cause local acidification with a permanent effect on marine habitats if it persists. Leakage into sea could change pH and affect microbial ecosystems and plankton dynamics. Solvents used in CCS and any discharged waters may carry contaminants. Finally, CCS may lead to habitat changes for the installation of CCS-associated infrastructure (e.g. dredging).[78]

3.1.7 POSSIBLE SPATIAL CONFLICTS AND SYNERGIES WITH OTHER USES AND INTERESTS

Possible conflicts may arise with conservation and fishing on the basis of the potential environmental impacts associated with CCS. It may also mean that CCS may require restricting (seabed) use by other users (such as mining).

CCS in the ocean could possibly use existing pipelines and infrastructure no longer required for oil and gas.

Non-spatial synergies exist with the policy objective to mitigate climate change and to create employment opportunities through development of CCS as a globally emerging sector.

3.1.8 KEY ISSUES FOR MSP TO CONSIDER

The following key issues should be considered by MSP concerning the emerging use of CCS:

- Having sufficient space for CO2 storage in vacant gas and oilfields or in aquifers and for the accompanying pipelines is a prerequisite for CCS in the ocean. This could potentially be done throughout the EEZ and territorial waters, but preferably nearshore given the high costs for the infrastructure network. Preceding testing of the CCS technology at pilot sites is however needed. Space for CCS at one selected suitable priority area should therefore be reserved.

3.2 COASTAL AND UNDERWATER INFRASTRUCTURE

3.2.1 BACKGROUND

The South African coastline is in many parts a highly used section of the country. There are many activities that occur within the coastal environment including urban and rural development, transport, energy generation and transmission, food production and mineral extraction. Land on the coast is often limited. Decisions made about coastal land development can also impact on the marine area along the coast.

The on-land transport infrastructure enables connection between coastal towns, cities, provinces and the South African inland. This connects the hinterland – destinations of consumption and production points for goods in the country and beyond in the Southern African Development Community region – with the maritime infrastructure, the country's ports, which provide the transport infrastructure link between land and sea.

Seawards, the coast provides the link to underwater infrastructure such as telecommunication cables and pipelines.

There are several submarine cable systems which serve South Africa's telecommunications needs by carrying telephone calls, internet connections and data. South Africa is currently connected to the rest of the world through a number of submarine cables that include but are not limited to the West African Cable System (WACS)/SAT-3/SAFE, and the Seacom Eastern African Submarine Cable System (EASSy) and Africa-1. There are more than five active cables in South Africa's ocean with a combined length of more than 70,000 km.

Pipelines are used for oil and gas in the offshore marine environment of South Africa, extending over 155 km from land to offshore platforms and over 170 km from platform carrying products to Gas-to-liquids plants.[79,80] There are also pipelines close to the coastline used to discharge wastewater into the marine environment.[81] No submarine power cables exist.

3.2.2 THE CURRENT SITUATION

3.2.2.1 LEGAL AND POLICY FRAMEWORK

Coastal spatial planning, land use planning and coastal development

The development of the country's coasts concerns a huge variety of sectors, related regulatory frameworks and mandated governing authorities. Two overarching legal and policy frameworks govern spatial and land use planning as well as coastal development:

- The Spatial Planning and Land Use Management Act (Act No. 16 of 2013); and
- The Integrated Coastal Management Act (Act No. 24 of 2008).

The national responsibility for the Spatial Planning and Land Use Management Act, Act No. 16 of 2013 (SPLUMA) lies with the Department of Agriculture, Rural Development and Land Reform (DARDLR). The Department of Forestry, Fisheries and the Environment (DFFE) is mandated to oversee implementation of the Integrated Coastal Management Act, Act No. 24 of 2008 (ICM Act). Both legislations are implemented and regulated together with the provincial and local authorities who have mandates and functions in relation to the management and facilitation of spatial and land-use planning as well as coastal management.

Whereas SPLUMA provides a framework for spatial planning and land use management in the country (including along the coast), the ICM Act establishes a system of integrated coastal and estuarine management in South Africa to ensure that development and the use of natural resources within the coastal zone is socially and economically justifiable and ecologically sustainable.

Underwater infrastructure

The management and development of the country's internationally connected telecommunication cables system, including in the marine environment, falls within the responsibility of the Department of Communications and Digital Technologies (DCDT). The Independent Communications Authority of South Africa (ICASA), an entity under the Ministry of Communications and Digital Technologies and for which the Minister has oversight responsibilities, is the official regulator of the South African communications sector. The Minister of Communications and Digital Technologies is responsible for making policy and issuing policy directions to ICASA and for making key regulatory decisions regarding licensing.

The primary governing framework on submarine telecommunication cables that guides DCDT and ICASA is the Electronic Communications Act (Act No. 36 of 2005). This Act is the primary legislation regulating the electronic communications industry, networks and services. It deals with a number of areas including licensing. An electronic communications network services (ECNS) licence authorises the landing of a submarine cable in South Africa. Although no special rules currently govern the landing of submarine cables, there are other regulatory requirements applicable, such as those under the National Environmental Management Act for an Environmental Impact Assessment, and under the National Environmental Management: Integrated Coastal Management Amendment Act (Act No. 36 of 2014) for coastal use permits.

Pipelines for oil and gas as well as for the discharge of wastewater fall within the responsibility of the DMRE and the DFFEa.[82]

3.2.2.2 KEY SPATIAL INTERESTS

Coastal infrastructure

South Africa's major coastal settlements and related infrastructure covers most of South Africa's coastline in a fine woven grid of settlements, road, rail, aviation, maritime transport and energy-related infrastructure (see Map 16).

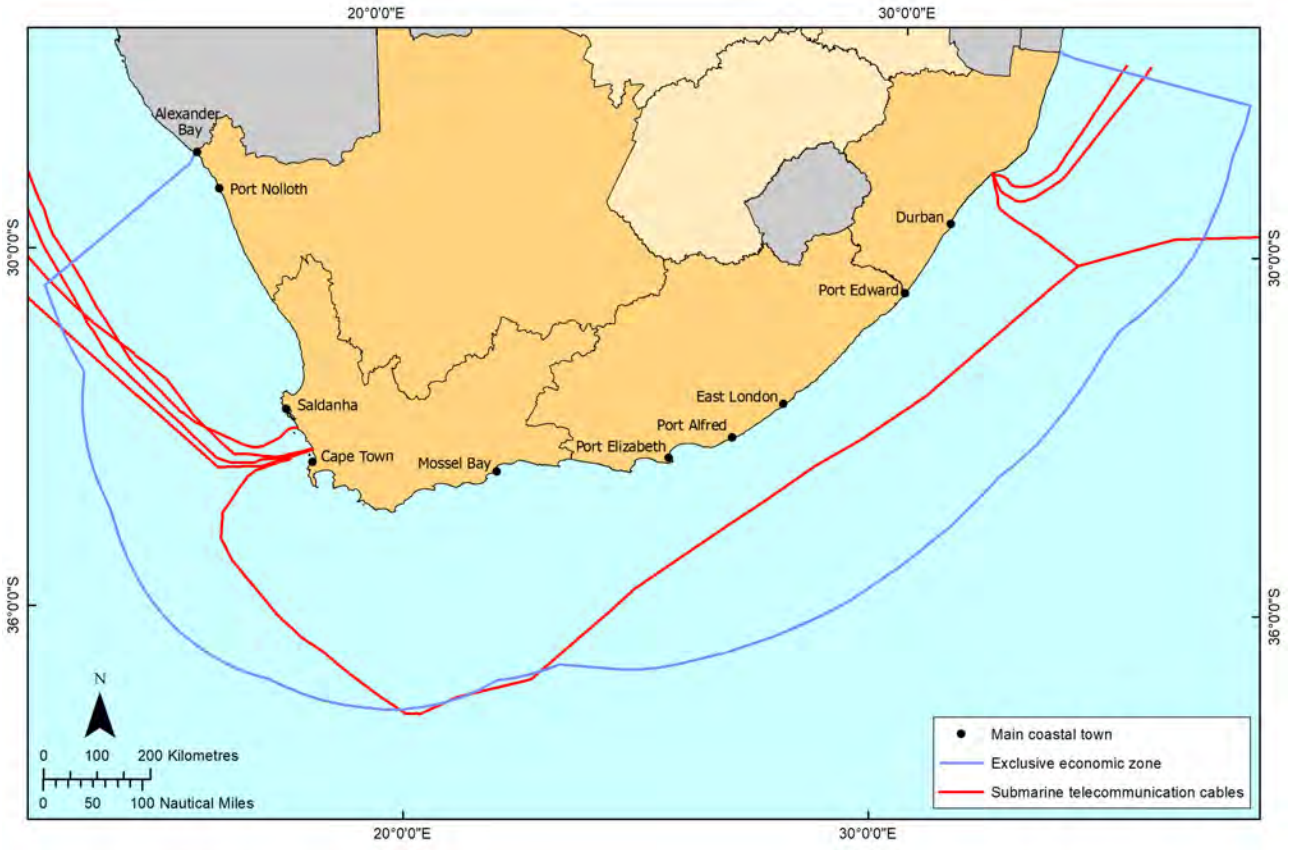
Close to settlements and economically important areas, coastal protection and flood defence infrastructure ensure the protection of assets and infrastructure.

Underwater infrastructure

An international network of telecommunication cables passes through South Africa's ocean connecting the country to West and East Africa, Madagascar, Mauritius, La Réunion and Asia further East as well as Latin America via Brazil. These cables tend to be laid on seabed with a shallow gradient and soft sediment, often meandering to find the most suitable route around any seabed obstructions. The South African sections of the international cables lie on the seafloor and are not buried; the greatest cable depth is 6,000m.[83]

In addition, a system of pipelines for oil and gas exists.

A system of designed marine outfalls also exists to enable the discharge of wastewater into the marine environment.



Underwater cables.

MAP 17

3.2.2.3 SOCIO-ECONOMIC IMPORTANCE

Both – coastal and underwater infrastructure – are a key prerequisite for the functioning of our modern society and a backbone of South Africa's society and economy. It is therefore impossible to estimate the direct use and socio-economic value of the coastal and underwater infrastructure.

3.2.2.4 ENVIRONMENTAL IMPACTS

Coastal infrastructure

The development of coastal areas for humans and the associated demand for and use of space for buildings, structures and facilities goes hand in hand with impacts on the coastal environment and the linked marine environment. Terrestrial biodiversity, habitats and species, may be severely disturbed by coastal development. Particular effects on marine biodiversity from coastal land development, including for coastal protection, can encompass but are not limited to:

- destruction and disturbance of foreshore and seabed, and other coastal habitats through reclamations, structures, vegetation clearance, and harvesting;
- sedimentation, contamination and eutrophication of coastal waters including estuaries, harbours, coastal lakes from point and non-point source discharges;
- the introduction and spread of alien and invasive plants, domestic animals and pests in the coastal environment associated with increasing activities on the coast; and
- migratory species (particularly seabirds that use coastal land) are vulnerable to loss of any of the habitats they require, and/or obstructions along their migratory route.

Underwater infrastructure

Environmental impacts of submarine cables and pipelines will take place during design and exploration work, particularly during construction, but also during possible dismantling after termination of use. Investigations for the planning of the underwater infrastructure are generally associated with possible impacts caused by underwater noise from hydrographic and other survey vessels and disruption of habitats through extraction for sampling purposes. The main impacts occur during construction stages: The laying of cables and pipelines leads to seabed disturbance and associated impacts (damage, displacement or disturbance) on flora and fauna, increased turbidity, remobilisation of contaminants from sediments and alteration of sediments. Along with noise and visual disturbance, these effects are generally temporary. In addition, their spatial extent is limited to the cable corridor.[84,85]

While pipelines are one of the safest modes of transporting oil and gas, and have failure rates much lower than the railroads or highway transportation, failures do occur. In such case, significant impacts on the marine environment may however occur if the pipeline system is damaged or fails and oil or gas discharged into the sea.

The impact on the marine environment during construction phases will also be higher in biologically or ecologically sensitive marine areas – both for submarine cables and oil and gas as well as wastewater discharge pipelines.

3.2.3 LOOKING TO THE FUTURE

3.2.3.1 TRENDS AND DRIVING FORCES

Coastal infrastructure

Given the growing population along the coast and the coastal-based industries, the trend of increasing coastal development will accelerate. Growing demand for space will lead to more coastal land being developed for buildings, structures and facilities.

With the rise in sea-levels and a predicted increased risk of storm surges, the country's coastal infrastructure may be placed under increasing threat. This will likely increase the demand for coastal defence infrastructure. The impacts of climate change will also lead to the construction of new desalination plants along the coast of South Africa, particularly in the Cape Provinces.

An increase in marine and coastal tourism may also lead to developing coastal and tourism-associated infrastructure in certain sections along the coast. This includes the development and upgrade of the country's maritime transport infrastructure: boat launch sites, small harbours, marinas and the commercial ports, which are necessary elements of the tourism cruise ship sector, all of which are also a pre-requisite to other human uses of the ocean such as fisheries and mining.

Underwater infrastructure

The communications sector and its contribution to the South African economy is an important factor for the country's future development. Submarine cables will remain to be a critical component in the future. The extent to which any new cables will be laid in the marine waters of South Africa cannot be determined at this stage.

In case that marine renewable energy production sites will be developed, submarine power cables may need to be installed in the medium to long term.

With the intended growth of the offshore oil and gas sector in South African waters, an extension of the existing system of pipelines is to be expected.

Given the growth in coastal population and industries, new wastewater discharge outfall pipelines may need to be installed in future.

3.2.3.2 SPATIAL CONFLICTS AND SYNERGIES WITH OTHER USES AND INTERESTS

Underwater infrastructure

Conflicts:

Considering the low number and the relatively small spatial extent of telecommunication cables in South Africa's ocean space, few to no conflicts between submarine cables and other marine activities exist. In theory, submarine cables and pipelines (oil, gas and wastewater) can be damaged by other marine users. Fishing and anchoring can damage cables particularly when skippers are unaware of the location of cables, or anchors drag within prohibited zones. In turn, they can also have environmental impacts.

Synergies:

The existing system of submarine cables provides a set of underwater infrastructure corridor which may be developed over time and complemented with new telecommunication (or, in the mid to long term, marine renewable energy power) cables or pipelines. In the long-term, existing pipelines no longer used for oil and gas might be used by carbon capture and storage activities rather than being dismantled.

3.2.4 KEY ISSUES FOR MSP TO CONSIDER

The following key issues should be considered by MSP concerning coastal and underwater infrastructure:

- Unlocking the economic potential of South Africa's oceans relies on the coastal infrastructure and its gradual upgrade. This requires space on land for the various sectors.
- The existing network of underwater infrastructure – cables and pipelines – needs to be maintained. The routeing of the existing submarine telecommunication cables and pipelines should be considered when new cables or pipelines are installed, for example, through bundling and laying in parallel to existing structures.
- When selecting new routes for cables and pipelines in the future, special attention sho should be paid to avoid conflicts with other uses and the interest of environmental protection.

3.3 BIODIVERSITY MANAGEMENT

3.3.1 BACKGROUND

South Africa is a maritime nation with a rich diversity of oceanic and coastal resources and ocean current systems that are highly productive and play a vital role in influencing local and regional climate and weather patterns. Oceanic and coastal ecosystem services deliver important benefits to society because many of these services are the basis for human well-being and economic development. Some of the valuable benefits provided by marine ecosystems include provisioning services from the exploitation of living marine resources (e.g., fisheries and aquaculture) and exploitation of non-living

marine resources (e.g., energy, minerals, oil and gas). There are also intangible benefits provided by coastal and marine biodiversity relating to supporting and regulating services (e.g., water filtration and nutrient cycling, heat distribution through the oceans, oxygen production and carbon dioxide absorption thereby contributing to climate regulation) and cultural services that play an important role in human health and well-being (e.g., cultural and spiritual practices, and recreational activities)[58,86].

The South African Constitution provides for the protection, conservation and sustainable use of environmental resources (including marine resources) for the benefit of current and future generations. Marine resources provide a significant socio-economic development opportunity for current and future generations of South Africa. Socio-economic opportunities exist in sectors such as conservation, fishing, shipping, heritage, health, energy, mining, tourism and agriculture. All sectors are dependent on well-functioning marine ecosystems for long-term provision of the related benefits.

3.3.2 THE CURRENT SITUATION

3.3.2.1 LEGAL AND POLICY FRAMEWORK

The South African Constitution (Act No. 108 of 1996) is the supreme law in the country and provides the foundation for all subsequent legislation. Section 24 of the Constitution provided the legal basis for environmental management in South Africa through the promulgation of the National Environmental Management Act (Act No. 107 of 1998) which serves as the umbrella legislation that provides the framework for all related environmental legislation. Reed[87] (2018) investigated spatial management options by reviewing current legislative tools for spatial management in South African marine environment (including fisheries). The review revealed seven spatial legislative tools that may be used to improve place-based environmental management in the ocean. These tools are summarized in Table 2.

Legislative tools for spatial ocean environmental management. TABLE 2

ACT OR BILL	LEGISLATIVE TOOLS RELEVANT TO SPATIAL OCEAN ENVIRONMENTAL MANAGEMENT
National Environmental Management Act, 1998 (No. 107 of 1998)	The National Environmental Management Act (Act No. 107 of 1998) (NEMA) gives effect to environmental rights at a framework level as well as through Specific Environmental Management legislation that is introduced through under its umbrella. Furthermore, NEMA gives effect to the principles of Co-operative Governance to allow all spheres of Government to have a responsibility in the management and use of environmental resources. NEMA promotes sustainable development in the context of integrated environmental management and aims to include the promotion of a coordinated approach to matters affecting the environment by ensuring that co-operative governance as well as coordinating mechanism and institution are implemented as key principles for the effective management of the environment of South Africa. NEMA further allows the Minister responsible for environmental affairs to identify geographic areas based on environmental attributes (Environmental authorisation "no-go" areas for listed activities under (Section 24(2A)) as well as developing spatial development tools (e.g., Bioregional plans based on Critical Biodiversity Area Maps).

ACT OR BILL	LEGISLATIVE TOOLS RELEVANT TO SPATIAL OCEAN ENVIRONMENTAL MANAGEMENT
National Environmental Management: Integrated Coastal Management Act, 2008 (No. 24 of 2008)	The National Environmental Management: Integrated Coastal Management Act, 2008 (Act No. 24 of 2008)(ICM Act) provides for the conservation of the coastal environment and the sustainable use of natural resources within the coastal zone in an economic, socially and ecologically sustainable manner for the benefit of all South Africans. The ICM Act further determines the responsibilities of organs of state in relation to coastal areas, incineration at sea, dumping at sea, pollution in the coastal zone and inappropriate development of the coastal environment. The ICM Act also provides for the development of national, provincial and local coastal management programs that supports an integrated, coordinated and uniform approach to coastal management by responsible organs of state. The Minister is also empowered to declare Special Management Areas and Coastal Planning Schemes in the coastal zone in terms of the ICM Act.
The National Environmental Management: Biodiversity Act, 2004 (Act No.10 of 2004)	The National Environmental Management: Biodiversity Act, 2004 (Act No.10 of 2004) (NEMBA) provides for the management and conservation of biological diversity. NEMBA provides for the management of biodiversity and includes regulating certain protected marine species, and the management of alien invasive species. The Minister is also empowered to manage activities such as Boat-Based Whale Watching and White Shark-Cage-Diving and further has the responsibility for developing biodiversity management plans that cater for marine ecosystems and species. The Act obligates the Minister to develop a National Biodiversity Framework to provide for an integrated, coordinated and uniform approach to biodiversity management in South Africa. NEMBA further allows the Minister of Environment to determine a geographic region as a bioregion if that region contains whole or nested ecosystems and is defined by particular attributes. The Minister is required to develop bio-regional plans and to enter into biodiversity management agreements with relevant organs of state. The Minister is also tasked with ensuring that bio-regional plans be aligned with any other spatial planning in the defined geographic region.
National Environmental Management: Protected Areas Act, 2003 (No. 57 of 2003)	The National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003) (NEMPAA) provides for the declaration and management of protected areas in South Africa. NEMPAA enables the establishment of a representative network of marine protected areas that play a role in not only sustaining livelihoods but protecting marine and coastal habitats.
Mineral and Petroleum Resources Development Act, 2002 (No. 28 of 2002)	This legislation includes provisions for declaration of Mining and petroleum resources “no-go” areas under (Section 49) which can be used as a sector-specific spatial management mechanism.

ACT OR BILL	LEGISLATIVE TOOLS RELEVANT TO SPATIAL OCEAN ENVIRONMENTAL MANAGEMENT
Marine Living Resources Act, 1998 (No. 18 of 1998)	The Act allows for Fisheries Management Areas, priority fishing areas and small-scale fishing areas and zones, all of which can be used to secure some environmental outcomes and have a role in overall spatial environmental management.
Marine Spatial Planning Act, 2018 (No. 16 of 2018)	This Act aims to provide a framework for marine spatial planning in South Africa; to provide for the development of marine spatial plans; and to provide for institutional arrangements for the implementation of marine spatial plans and governance of the use of the ocean by multiple sectors. The Act has numerous objects relevant to environmental management: ■ conserve the ocean for present and future generations; ■ facilitate responsible use of the ocean; ■ give effect to South Africa's international obligations in South African waters (some of which are environmental).

3.3.2.2 SOCIO-ECONOMIC IMPORTANCE

The South African marine environment is a rich and diverse national asset that provides important social and economic opportunities for all. There is a rich history of social and cultural interactions with the South African marine environment.

The marine environment provides many valuable ecosystems services which are vital for the development of the country's economy and sustaining livelihoods in local coastal communities. The exploitation of marine resources has provided the South African population with economic opportunities in different sectors that include tourism, transport, conservation, mining, energy, fisheries and aquaculture .The total ocean sector is valued at contributing approximately 4.4% to South Africa's Gross Domestic Product and supports a great number of jobs and livelihoods (DEA 2012)[88].

In 2000, the White Paper on Sustainable Coastal Development recognized the value of the South African marine environment by taking into account direct benefits accrued from all goods and services provided by the coast. The value was estimated at approximately R168 billion annually, which was equivalent to 35% of South Africa's Gross Domestic Product.

Although the value of the marine ecosystems cannot be totally quantified in monetary terms, marine ecosystems services are not only essential for unlocking economic potential from the ocean but are also necessary for societal wellbeing. The South African Government permits the South African population to sustainably utilize the marine environment for recreational, cultural and educational purposes and it also ensures that members of the public have safe and equitable access to the marine environment through the establishment of sufficient coastal access land. For more details on the myriad of benefits of coastal and marine biodiversity and the contribution to the national economy, livelihoods, society, human health and well-being, see Harris et al. (2019)[86] and van der Bank et al. (2019)[58], respectively.

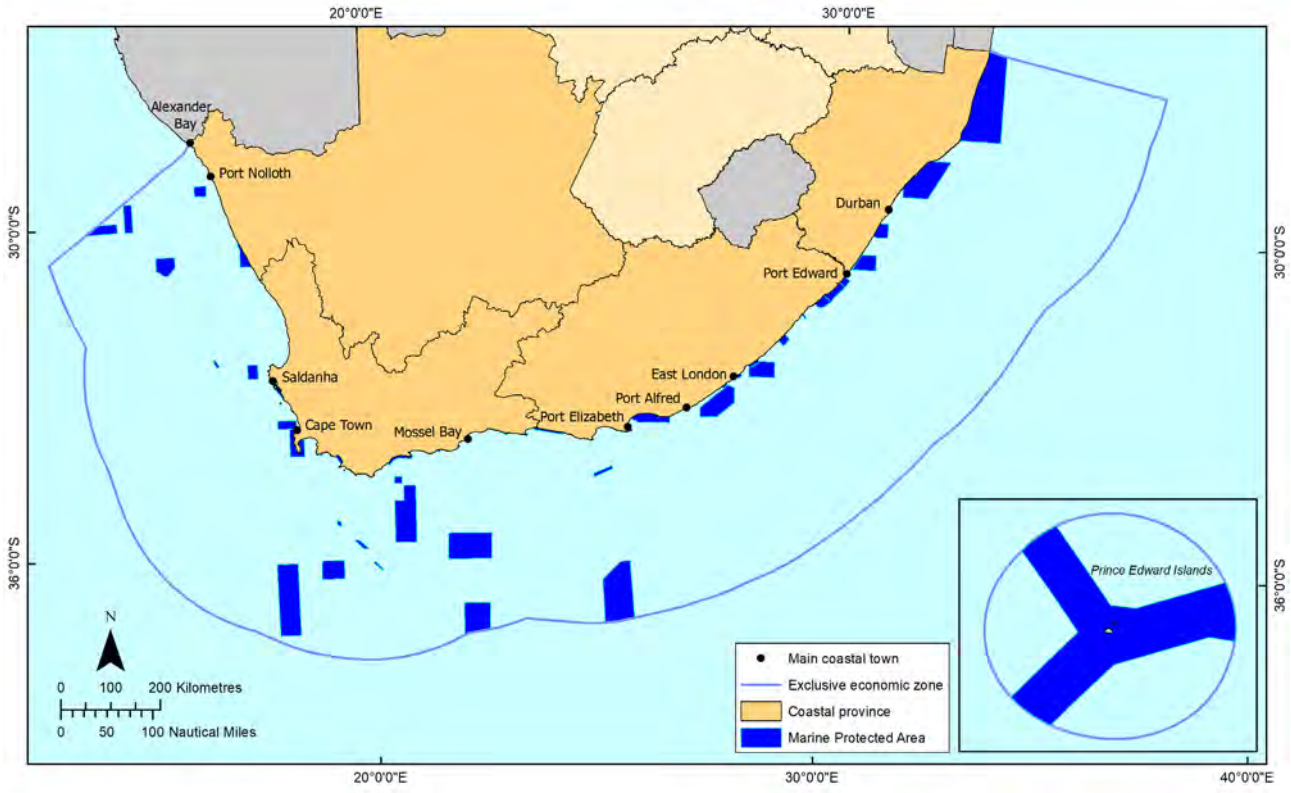
3.3.2.3 KEY SPATIAL INTERESTS

MARINE PROTECTED AREAS (CURRENT AND FUTURE)

South Africa's Marine Protected Area (MPA) network plays a role in protecting marine ecosystems and delivering significant socio-economic benefits. MPA networks are an important part of the global movement towards a more holistic management approach that considers entire ecosystems and acknowledges multiple sectors and many management objectives. Representative MPA networks are recognized as a critical component of commitments related to the Convention on Biological Diversity, the World Summit for Sustainable Development and the World Parks Congress. If properly designed and managed, MPAs play a vitally important role in protecting the marine environment and therefore, a leading role in maintaining the sustainability of marine resources.

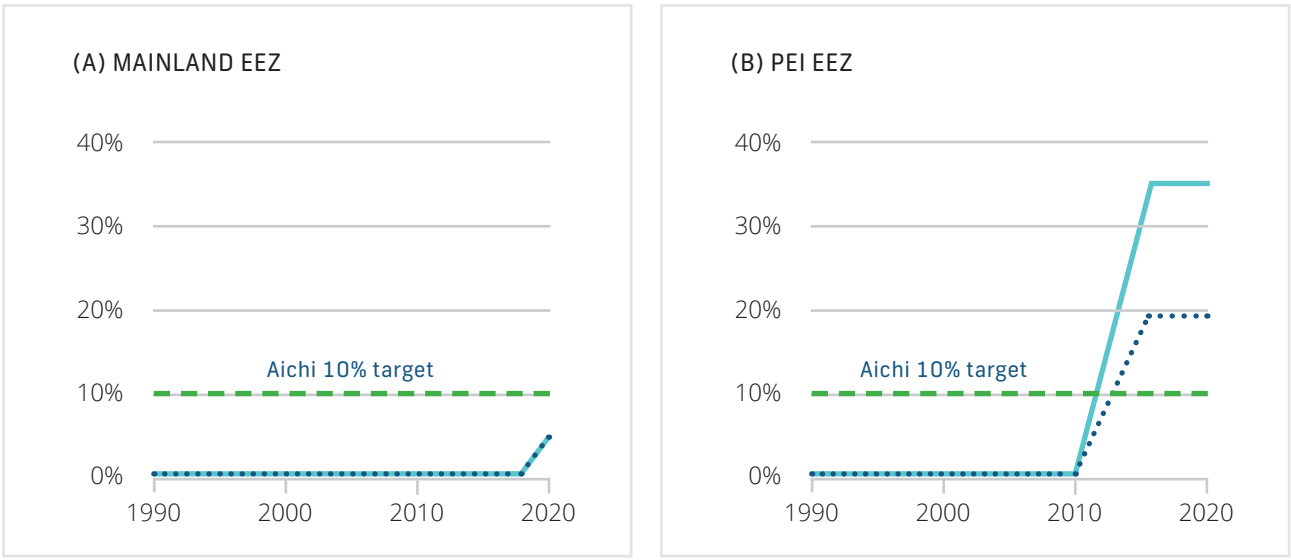
The MPA network has expanded considerably as a result of the Operation Phakisa Oceans Economy MPA Initiative and ongoing efforts in the biodiversity sector. Phase 1 of Operation Phakisa aimed to proclaim a representative network of MPAs that protects at least 5% of mainland South Africa's EEZ, which has now been achieved: a network of 20 new MPAs and revisions to some existing reserves, added 53 195 km^2 to the country's marine protected area estate in 2019, advancing protection from <0.5% of the EEZ to 5.4% of the EEZ[55]. The systematically identified priorities were based on assessments for the Offshore Marine Protected Area Project 2011[89], the West Coast of South Africa[90] and assessments associated with the NBA 2011[91]. Biodiversity features targeted included Ecologically or Biologically Significant Marine Areas (EBSAs), under-protected ecosystem types, sensitive habitats, and threatened ecosystems and species, as well as key nursery, spawning and feeding areas. The careful planning processes followed have resulted in a highly efficient MPA network design with strong emphasis on ecosystem representation, such that 87% of South Africa's 150 marine ecosystem types have at least some representation in an MPA, in an area covering just 5.4% of the EEZ[55] (Map 18 & Figure 4). Despite this spatial efficiency, the new MPA network still falls short of the 10% internationally agreed Aichi target and the 20% target set out in South Africa's National Protected Area Expansion Strategy[54], and only 31% of ecosystem types meet their biodiversity targets and are considered Well Protected[55]. South Africa's sub-Antarctic territory (PEI and surrounding Exclusive Economic Zone – EEZ) are well covered by protected areas. Marion Island and Prince Edward Island were proclaimed as a Special Nature Reserve in 1995, and a large MPA was proclaimed in 2013 covering 35% of the ocean area around the islands (Map 18 & Figure 4). Considered together, 88% (30 of 34) of the terrestrial (5) and marine (29) ecosystem types comprising South Africa's sub-Antarctic territory are represented in the protected area network; only four marine ecosystem types are Not Protected.

Further, priorities to advance protection to 10% of the EEZ will be identified during 2019/2020 (see the section on Marine Critical Biodiversity Areas). The MPA network will contribute to meeting long-term ocean protection commitments and will also bolster the natural capital that underpins South Africa's rapidly growing marine economy. MPA networks will also support sectors that are major economic drivers, including fishing and tourism, and the jobs and livelihoods that these sectors sustain.



South Africa's marine protected area network. The inset map shows protected areas in South Africa's sub-Antarctic territory: the Prince Edward Islands.

MAP 18



Expansion of South Africa's protected area estate with progress towards achieving the Aichi targets for marine ecosystems surrounding (a) the continental landmass and (b) the sub-Antarctic territory around Prince Edward Islands. Each panel shows the MPA estate as a percentage of the relevant marine territory (solid line), the Aichi biodiversity target (dashed line) and progress towards achieving the target in a representative fashion (dotted line) (i.e. not counting ecosystem representation beyond the biodiversity target for any ecosystem type). Data and figures from the NBA 2018[92]

FIGURE 4

OTHER EFFECTIVE AREA-BASED CONSERVATION MEASURES (OECMs)

Other Effective Area-Based Conservation Measures (OECMs) provide an alternative to protection via Marine Protected Areas (MPAs) designated under the NEMA Protected Areas Act. The Convention on Biological Diversity (CBD) defines OECMs[93] as a geographically defined area other than a Protected Area, which is governed and managed in ways that achieve positive and sustained long-term outcomes for the in situ conservation of biodiversity with associated ecosystem functions and services and where applicable, cultural, spiritual, socio–economic, and other locally relevant values.

OECMs can be used to secure high value biodiversity areas using a range of targeted legal designations and regulations in combination with MSP zoning in instances where MPAs are not feasible or necessary. Similar to MPAs, areas recognized or designated as Other Effective Area-Based Conservation Measures (OECMs) have a management imperative to maintain the area in natural or near-natural ecological condition. These areas need to be governed and effectively managed to achieve a long-term sustained and effective contribution to in situ conservation of biodiversity, though this does not have to be the primary objective of these areas (unlike MPAs) and a conservation outcome may be a secondary result of other actions. Areas would be controlled under appropriate specific legal mechanisms that control key pressures/impacts on biodiversity, IN ADDITION to the zone regulations as per the legally binding Marine Area Plans. Examples could include exclusions of specific damaging fisheries under fisheries sector regulations or Section 49 Exclusions under the Minerals Act in mining areas, or *de facto* exclusions of activities from military areas.

The risk is that OECMs are used as a poor or limited alternative to MPAs. This is recognized as a risk and bad practice internationally, and therefore the requirements for recognition as an OECM are in many ways stricter than those for MPAs. Key specifications are:

- Positive outcomes: effective at delivering in-situ conservation of biodiversity over the long-term.
- Long-term and year-round: governance mechanism and management systems must be sustained.
- Viable Size: for the biodiversity value.
- Ecosystem functions and services must be secured, along with cultural, spiritual, socio-economic and other locally relevant values.

ECOLOGICALLY OR BIOLOGICALLY SIGNIFICANT MARINE AREAS (EBSAs)

Ecologically or Biologically Significant Marine Areas (EBSAs) are areas that provide important services to one or more species/populations of an ecosystem or to the ecosystem as a whole, compared to other surrounding areas or areas of similar ecological characteristics, or otherwise meet at least one of the following seven EBSA criteria:

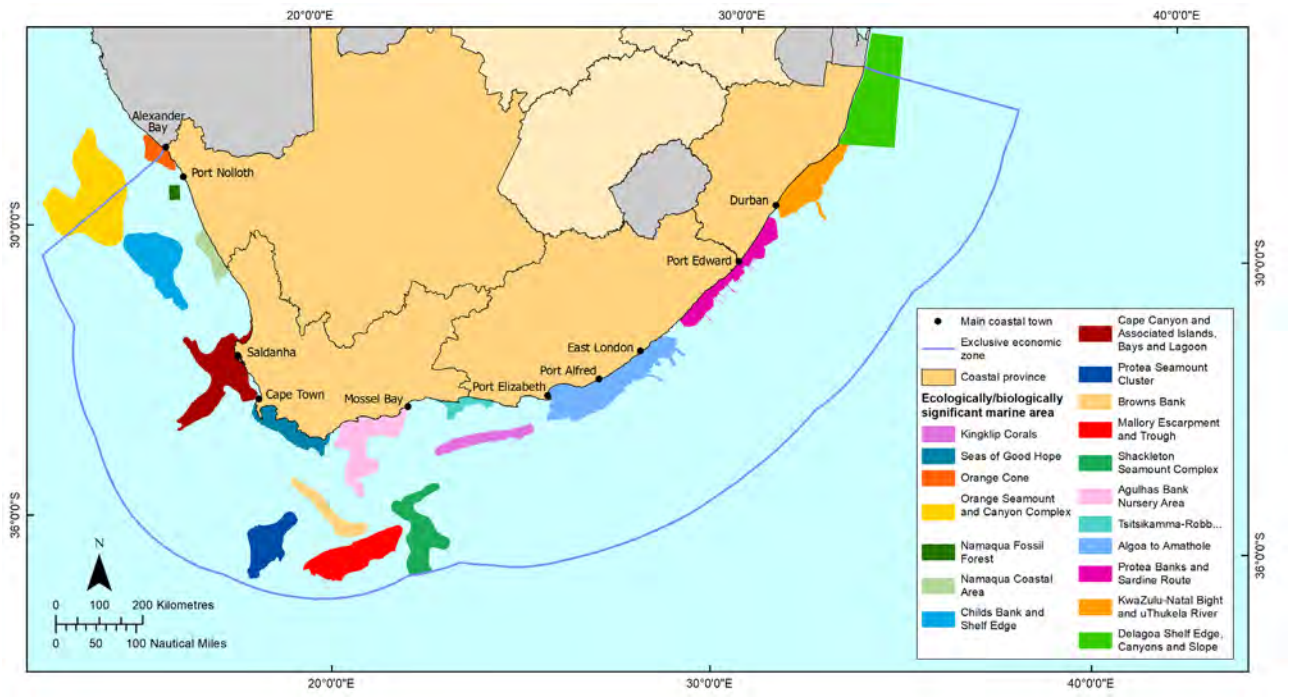
- **UNIQUENESS OR RARITY:** Area contains either (i) unique, rare or endemic species, populations or communities; and/or (ii) unique rare or distinct habitats or ecosystems; and/ or (iii) unique or unusual geomorphological or oceanographic features.
- **SPECIAL IMPORTANCE OF LIFE HISTORY STAGES OF SPECIES:** Areas that are required for a population to survive and thrive.
- **IMPORTANCE FOR THREATENED, ENDANGERED OR DECLINING SPECIES AND/OR HABITATS:** Area containing habitat for the survival and recovery of endangered, threatened, declining species, or area with significant assemblages of such species.
- **VULNERABILITY, FRAGILITY, SENSITIVITY OR SLOW RECOVERY:** Areas that contain a relatively high proportion of sensitive habitats, biotopes or species that are functionally fragile (highly susceptible to degradation or depletion by human activity or by natural events) or with slow recovery.
- **BIOLOGICAL PRODUCTIVITY:** Area containing species, populations or communities with comparatively higher natural biological productivity.
- **BIOLOGICAL DIVERSITY:** Area contains comparatively higher diversity of ecosystems, habitats, communities, or species, or has higher genetic diversity.
- **NATURALNESS**: Area with a comparatively higher degree of naturalness as a result of the lack of or low level of human-induced disturbance or degradation.

EBSA are a formal mechanism of the Convention on Biological Diversity (CBD), and are subject to international review and approval processes. South Africa has 22 identified Ecologically or Biologically Significant Marine Areas (EBSA) that are entirely or partially located within the territory of South Africa. These EBSA have either been included on the CBD list or have been reviewed and are pending final submission. EBSA are shown in Map 19 and summarized in Table 3.

At the 10th Conference of the Parties to the CBD, it was noted that "areas found to meet the [EBSA] criteria may require enhanced conservation and management measures, and that this can be achieved through a variety of means, including marine protected areas and impact assessments" (UNEP/CBD/COP/DEC/X/29). In South Africa, EBSAs are currently being split into two proposed zones, with the uses of the zones and compatible and non-compatible activities being defined together with stakeholders. It is envisaged that EBSA and their zoning will form an important input into marine spatial planning processes. These two zones are informed by the national Coastal and Marine Critical Biodiversity Area Map (Map 20), with the Critical Biodiversity Areas (CBAs) informing the EBSA Conservation Zone, and the Ecological Support Areas (ESAs) informing the EBSA Impact Management Zone given the alignment in the overarching management objectives between the CBAs/ESAs and the respective EBSA zones.

- **CONSERVATION ZONE:** Required to secure core areas of key biodiversity features in natural / near-natural ecological condition. Strict place-based biodiversity conservation is thus aimed at securing key biodiversity features in a natural or semi-natural state, or as near to this state as possible. Activities or uses that have significant biodiversity impacts should be prohibited. Where possible and appropriate these areas should be considered for formal protection e.g., Marine Protected Areas or other effective area-based conservation measures (OECM).

- **IMPACT MANAGEMENT ZONE:** Required to manage negative impacts on key biodiversity features where strict place-based measures are not practical or not essential. In this zone, the focus is management of impacts on key biodiversity features in a mixed-use area, with the objective to keep biodiversity features in at least a functional state. Activities or uses which have significant biodiversity impacts should be strictly controlled and/or regulated. Within this zone, there should be no increase in the intensity of use or the extent of the footprint of activities that have significant biodiversity impacts. Where possible, biodiversity impacts should be reduced.



MAP 19

South African Ecologically or Biologically Significant Marine Areas (EBSAs) , including proposed revisions and editions that have been reviewed but have not yet been submitted to Convention on Biological Diversity (CBD).

TABLE 3

Summary of EBSA criteria rankings for EBSAs in the mainland EEZ. Criteria ranks (red = High (H); orange = Medium (M); yellow = Low (L); grey = Data Deficient (DD)). # = Transboundary EBSA; * = Proposed EBSA. See previous page for a fuller description of the EBSA criteria.

EBSA	SIZE (KM²)	UNIQUENESS OR RARITY	IMPORTANCE FOR LIFE HISTORY STAGES	IMPORTANCE FOR THREATENED SPECIES AND/OR HABITATS	VULNERABILITY, SENSITIVITY, SLOW RECOVERY	BIOLOGICAL PRODUCTIVITY	BIOLOGICAL DIVERSITY	NATURALNESS
# Orange Seamount and Canyon Complex	29396.9	L	M	H	M	M	H	H
# Orange Cone	3134.2	H	H	H	M	M	M	M
Namaqua Fossil Forest	831.6	H	DD	DD	H	M	DD	DD
Childs Bank and Shelf Edge	13586.7	H	L	M	H	L	M	H
Namaqua Coastal Area	3507.2	L	M	H	M	H	L	H
Cape Canyon and Associated Islands, Bays and Lagoon	16593.6	M	H	H	H	H	M	M
* Seas of Good Hope	6745.5	M	H	H	M	M	M	L
* Protea Seamount Cluster	9019.5	M	M	H	H	M	M	H
Browns Bank	5657.7	H	H	H	M	M	L	M
Agulhas Bank Nursery Area	13619.9	H	H	H	M	M	M	M
Shackleton Seamount Complex	11981.1	M	H	M	H	H	H	H
Mallory Escarpment and Trough	13073.0	H	H	M	H	H	H	H
Kingklip Corals	5442.5	H	H	L	H	H	M	M
* Tsitsikamma-Robberg	2643.6	M	H	H	H	M	H	M
Algoa to Amathole	19656.4	H	H	H	M	H	H	M
Protea Banks and Sardine Route	9344.9	H	H	M	M	M	M	L
KwaZulu-Natal Bight and uThukela River	10579.6	M	H	H	M	H	M	M
# Delagoa Shelf Edge, Canyons and Slope	24891.1	M	H	H	M	M	H	H

MARINE CRITICAL BIODIVERSITY AREAS AND ECOLOGICAL SUPPORT AREAS

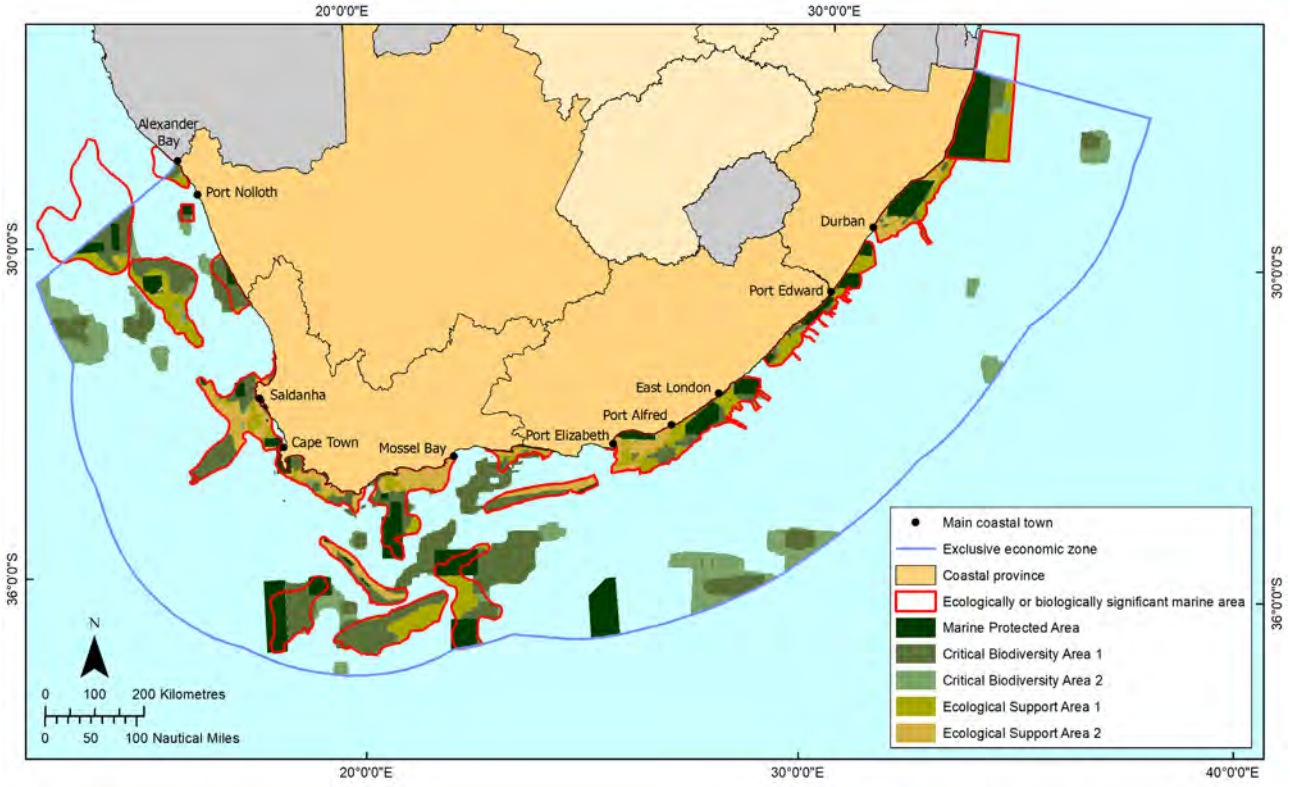
A Critical Biodiversity Area Map (CBA Map) comprises a portfolio of systematically selected sites that represent the biodiversity sector's spatial priorities in a land- or seascape. They fully incorporate other spatial priorities, such as existing MPAs and EBSAs. Priority sites are shown as three main feature classes on the map: Marine Protected Areas (MPAs), Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) that are jointly "important for the persistence of a viable representative sample of all ecosystem types and species as well as the long-term ecological functioning of the landscape [or seascape] as a whole"[94]. CBAs and ESAs are each sub-divided into two categories, with the split between CBA and ESA classes respectively depending on feature irreplaceability and ecological condition. The distinction among these categories is important for guiding the management objective of the priority sites (Table 4). Note that management objectives of MPAs are determined by their gazetted regulations and management plans. A CBA Map therefore presents a spatial plan for the natural environment, designed to inform multi-sectoral planning, assessment and decision-making in support of sustainable development, and can be formalised under the National Environmental Management: Biodiversity Act (Act No. 10 of 2004).

TABLE 4

Definition and management objectives of Protected Areas, Critical Biodiversity Areas and Ecological Support Areas.

MARINE PROTECTED AREAS	DEFINITION	MANAGEMENT OBJECTIVEMANAGEMENT
Marine Protected Areas	Formal Protected Areas secured under appropriate legislation. These areas contribute to meeting biodiversity targets. Ideally PAs should be natural or near-natural.	Maintain according to specifications in MPA management plan.
Critical Biodiversity Area 1	Site contains irreplaceable or near-irreplaceable features with no or very few other options for meeting biodiversity targets for these features. Ideally sites should be natural or near-natural, but can be in a more modified state if there are no other options available.	Maintain the site in natural or near-natural ecological condition.
Critical Biodiversity Area 2	Sites that are the best option for meeting biodiversity targets for features. Ideally sites should be natural or near-natural, but can be in a more modified state if there are no other options available.	Maintain the site in natural or near-natural ecological condition.
Ecological Support Area 1	Sites that are important for meeting targets for biodiversity and ecological processes but are not CBAs, and are in natural or semi-natural ecological condition.	Retain in at least a fair ecological condition.
Ecological Support Area 2	Sites that are important for meeting targets for biodiversity and ecological processes but are not CBAs, and are in a severely modified ecological condition but still have sufficient functioning to fulfil the purpose for which they were selected.	Prevent further deterioration in ecological condition.

Although terrestrial CBA Maps are well established and embedded in land-use planning and other processes, the first draft of the National Coastal and Marine CBA Map has only recently been produced[95] (Map 20). Importantly, it consolidates several current initiatives to provide a coherent map of the marine spatial biodiversity priority areas in South Africa. The Marine Protected Area (MPA) category includes the existing Marine Protected Areas (MPAs) and those recently proclaimed under the Operation Phakisa: Oceans Economy MPA Initiative. The CBAs and ESAs include aligned biodiversity priorities with the revised Ecologically or Biologically Significant Marine Area (EBSA) network, and can inform recommendations for the next 5% of the ocean to be proclaimed as MPAs under the Operation Phakisa Oceans Economy MPA Initiative. Further work on the National Coastal and Marine Spatial Biodiversity Plan (CBA Map and accompanying sea-use guidelines) is underway, with plans to strengthen conflict avoidance with key industries, include more data on species and key ecological infrastructure, and improve alignment with coastal terrestrial and estuarine priority areas. The National Coastal and Marine Spatial Biodiversity Plan (CBA Map and accompanying sea-use guidelines) is thus the biodiversity sector's consolidated spatial prioritisation to inform the multi-sectoral MSP process in support of sustainable development of South Africa's oceans economy.



MAP 20

Draft Coastal and Marine Critical Biodiversity Area Map. The maps highlights the network of Marine Protected Areas (MPAs), Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) that are jointly important for the persistence of a viable representative sample of all ecosystem types and species as well as the long-term ecological functioning of the seascape as a whole. This set of areas represents the best current summary of the spatial ask required by the environment that need to be secured through the MSP process.

3.3.2.4 ENVIRONMENTAL IMPACTS

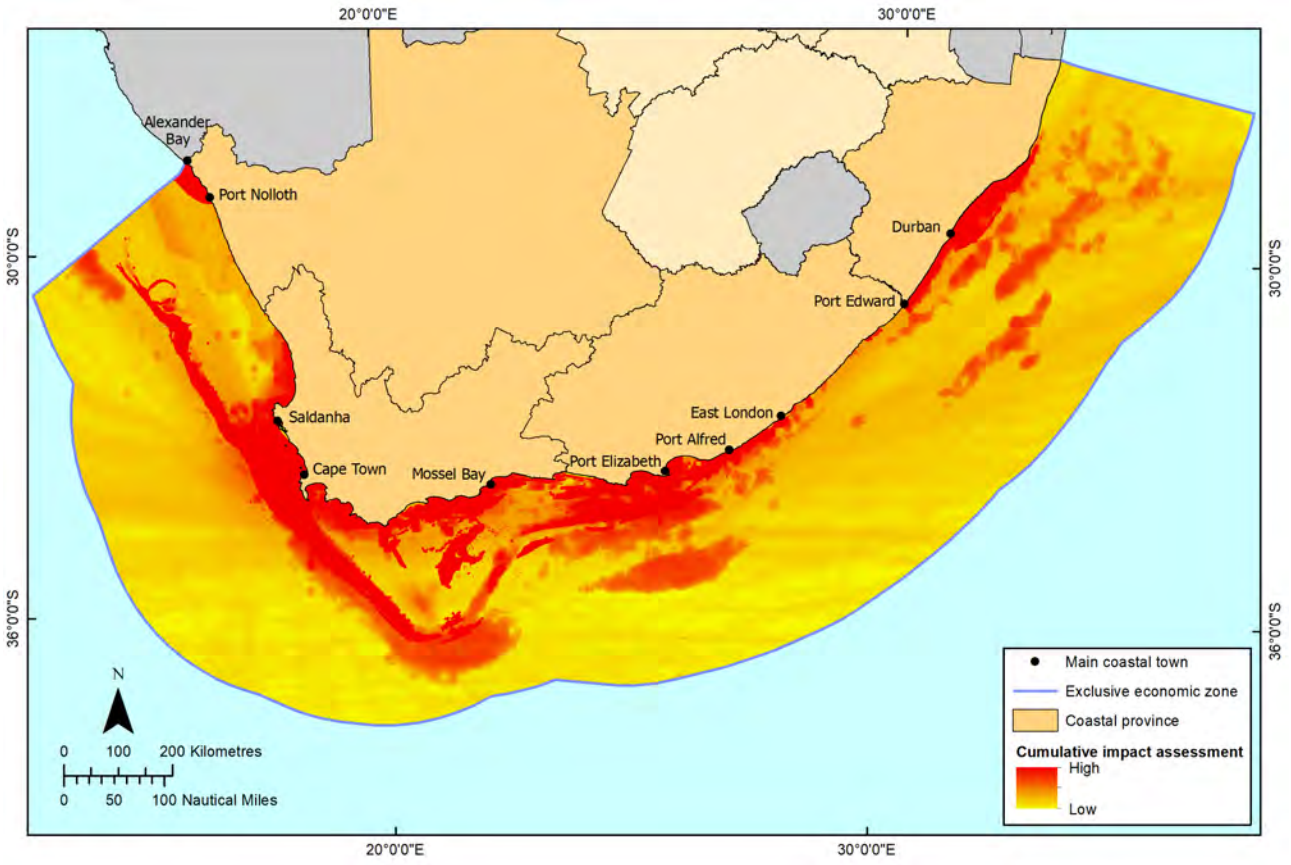
Conservation, protection and the sustainable use of marine resources by definition have positive effects on the environment, and contribute to ensuring continued provisioning of intact ecosystem services and delivery of key benefits for current and future generations.

3.3.3 LOOKING TO THE FUTURE

3.3.3.1 LEGAL AND POLICY FRAMEWORK

A key focus of the NBA 2018 has been identifying and mapping the most important pressures on marine ecosystem types, with 31 pressures included in the assessment[48]. There are very specific spatial patterns in pressures which are summarized in Map 21, that in turn impact numerous marine species (Figure 5). Key focus areas for high levels of cumulative pressure include:

- Coastal ecosystems especially in proximity to the major metropolitan areas with associated ports and harbours.
- Bays have a range of pressures acting at high intensities, with Saldanha Bay having the highest cumulative impact score in South Africa.
- Inshore areas such as the KwaZulu-Natal Bight are a focus for high-impact activities such as crustacean trawling.
- River-influenced ecosystems (e.g., those adjacent to the Orange, Breede and uThukela Estuaries) have been highly impacted by freshwater flow reduction.
- The shelf edge, especially in the Benguela system, off the Agulhas Bank and off Port Elizabeth are targeted by a range of large-scale fisheries.



Map of cumulative impact of 31 pressures on marine ecosystems. Map from data in National Biodiversity Assessment 2018[48].

MAP 21

Coastal development, mining, trawling and marine aquaculture have the highest impact scores among the 31 pressures included in the NBA 2018 marine assessment, and led to higher cumulative impacts in some areas. Fishing is the greatest cause of ecological degradation in the offshore environment, whereas coastal development and fishing are the greatest pressures on inshore ecosystems. Fishing pressures are either in terms of physical damage to ecosystems or in terms of harvesting pressures and/or associated bycatch. Freshwater flow modification is also a key pressure impacting the marine environment, as well as pollution (especially in retentive areas such as bays) and alien invasive species. Ports and harbours are also salient pressures; despite having localised impacts, the access they bring to the adjacent ocean resources drives cumulative degradation to surrounding marine areas, as well as burgeoning urban development with associated impacts to coastal ecosystem types. Brief overviews of some of the key pressures to the marine environment are as follows; see Majiedt et al. (2019)[48] and Harris et al. (2019)[19] for more details:

COASTAL DEVELOPMENT:

Population growth and economic growth have been putting pressure on South Africa's marine resources. Since the 1980s, the four major coastal cities, namely Cape Town, Port Elizabeth, East London and Durban have shown the fastest economic growth of all cities in South Africa South Africa's marine environments and their associated resources have shown signs of over-exploitation and degradation. 17% of South Africa's coastline had some form of development within 100 m of the shoreline.

MINING:

Most marine mining is concentrated on the West Coast where diamond mining is the dominant pressure.

PORTS AND HARBOURS:

Ports and harbours are hubs of activity and points of access to the ocean, thus there is a myriad of pressures associated with them. These include sites of accumulating pollution (in numerous forms), high-risk entry points and refugia for alien and invasive species either from ship hulls or ballast water (which is where most introduced marine species (62 taxa) have been recorded), local habitat modification and degradation from anchorage, maintenance dredging and dredge dumping. Furthermore, ports and harbours provide points of access to ocean resources, which can lead to declines in the ecological condition of marine ecosystem types in the surrounding area, as well as burgeoning industrial and residential infrastructure development on the landward side.

MEAN ANNUAL RUNOFF REDUCTION:

Freshwater flow reduction has severe consequences for marine biodiversity and resources through impacts on physical habitat, reduced nutrient inputs and alterations to important ecological processes. In South Africa, reduced river inputs have a significant impact on estuarine, marine and coastal ecosystems around the entire South African coastline; and are a key trigger of ecosystem threat offshore of the Gariep River, Breede, Mzimvubu and KwaZulu-Natal Bight areas. Important processes that can be compromised through altered freshwater flow include nursery functions, environmental cues, productivity and food web processes, and can alter catch composition and decrease the economic returns of fisheries such as linefish, prawns, sole and kob.

RECREATIONAL SHORE FISHING:

Recreational line fishing is a popular activity in South Africa, and has shown major increases in the number of participants and advancements in fishing technology. The recreational linefishery may be divided into shore- (approximately 450 000 participants), boat- (12 800 participants) and spearfishing (7 000 participants). Target species vary around the coast with more than 150 species harvested by recreational fishers in South Africa.

SMALL SCALE FISHERIES:

Small scale fishing, here subsistence fishing, includes various fishing methods targeting more than 30 species from a range of habitats. The dominant activity on the east coast is the harvesting of intertidal and subtidal invertebrates including mussels, oysters, redbait and limpets, crabs and octopus as well as fish. On the west coast, boat-based harvesting of near-shore subtidal species such as fish and lobsters is the dominant activity.

LINEFISHING:

The South African commercial linefishery is a multispecies fishery which stretches from Port Nolloth on the west coast to Cape Vidal on the east coast. Linefishing is particularly an issue in the south and east coast where reef fish are targeted, leading to serial overfishing and a rising number of over-exploited and collapsed species.

Prawn Trawling: This localized industry is largely focused on the KwaZulu-Natal Bight. The industry targets a range of prawn species, but the main biodiversity issues are physical disturbance of a range of benthic habitats, a diverse and substantial bycatch, high rates of discarding, impacts on nursery habitats and juvenile fish, concerns about impacts on sharks, rays and overexploited linefish, and incidental mortality of turtles.

DEMERSAL TRAWL: INSHORE:

The inshore demersal trawl sector targets Agulhas sole *Austroglossus pectoralis* and shallow-water hake *Merluccius capensis*, but may be more accurately described as a multi-species fishery (Attwood et al. 2011). The inshore trawl fishery operates between Cape Agulhas in the west, to the mouth of the Kei River in the east. Biodiversity concerns and potential ecosystem impacts of the inshore trawl sector include damage to seabed habitats and vulnerable marine ecosystems, and a diverse and substantial bycatch which includes overexploited linefish species and high catches of juvenile silver kob and geelbek.

DEMERSAL TRAWL: OFFSHORE:

The industry targets the shelf edge from approximately 300 m depth off Hondeklipbaai on the west coast southwards to the southern tip of the Agulhas Bank. Effort diminishes closer to the Namibian border reflecting increasing fuel costs associated with increasing distance from port. On the south coast, offshore trawlers concentrate fishing effort on the offshore edge of the Agulhas Bank with highest effort offshore of Port Elizabeth, which yields high catches of kingklip. The offshore trawl fishery primarily targets deep-water hake *M. paradoxus*, with valuable bycatch species of the offshore demersal trawl fishery include monk *(Lophius vomerinus)*, kingklip *(Genypterus capensis)*, angelfish *(Brama brama)*, snoek *(Thyrsites atun)* and horse mackerel *(Trachurus trachurus capensis)*.[83] Impacts on benthic habitats are also poorly understood with particular concern for hard ground habitats including deep reefs, submarine mounds and canyons and hard areas of shelf edge. The incidental mortality of threatened and other seabirds is a concern.

SMALL PELAGIC FISHERY:

South Africa's small pelagic fishery uses purse-seine nets to targets adult sardine *Sardinops sagax,* juvenile anchovy *Engraulis encrasicolus* and adult redeye *Etrumeus whitehead*i. Purse-seine fishing operations are highly selective and target shoals of fish near the surface of the water column. Key environmental issues relate to the important role that these fish play in marine foodwebs and in supporting threatened seabirds: these include dumping of bycatch of juveniles, depletion of the sardine stock, and the potential impact of fishing on the food availability for predators such as seabirds especially penguins.

HAKE LONGLINING:

This industry focusses on the shelf edge especially off Cape Point, near Cape Canyon off Cape Columbine, offshore of Tsitsikamma and near Port Elizabeth. Although the industry targets hake, it has historically had a significant impact on kingklip stocks. Additional biodiversity issues include incidental mortalities of seabirds (especially white chinned-petrel, yellow nosed albatross, Cape gannets and shearwaters), sharks and turtles.

PELAGIC LONGLINE:

This industry is largely on- and offshore of the shelf edge. The industry targets various tunas and swordfish. Biodiversity issues include concern for swordfish stocks in the Indian Ocean, global concern about the conservation status of Southern bluefin tuna, bycatch of sharks (including threatened species), seabird and turtle mortality.

MIDWATER TRAWL:

This industry is focused on the Agulhas Bank and south coast shelf edge. The midwater trawl fishery targets Cape horse mackerel *Trachurus capensis* on the Southern Cape shelf-edge. Current biodiversity issues are uncertain status of this resource, uncertain bycatch, and incidental entanglement and potential mortalities of seabirds, sunfish, sharks, dolphins and seals.

SHIPPING:

The main biodiversity impacts associated with shipping stem from oil spills, as a result of underwater noise, dumping of waste materials, shipping accidents, invasive alien species introduced through ballast water discharge and hull fouling, and through ship strikes i.e. collisions between vessels and large marine animals such as whales and basking sharks.

PETROLEUM ACTIVITIES:

The impacts of petroleum activities on coastal and offshore marine biodiversity span the impacts from exploration to production, including seismic surveys, the direct impact of infrastructure installation and drilling, and indirect effects such as light pollution. While numerous impacts to biodiversity are noted, the most important are due to potential oil spillage: small accidental oil spills arising during routine operations, large spills arising after incidents such as the grounding of an oil tanker or collisions with other vessels, and offshore production accidents such as 'blowouts' of wells and pipeline ruptures

ALIEN INVASIVES:

These are a very important pressure on rocky and mixed shores on the mainland. Research has shown a large increase in the number of known introduced marine species. The number of marine alien invasive species are on the rise, are mostly introduced via ship fouling and/or ballast water, and most prevalent in harbours. Marine alien and invasive species are an emerging pressure and the main pathways of introduction include shipping, marine aquaculture and petroleum activities. The mice on Marion Island are the most concerning pressure on the PEI.

In addition to the above pressures there are some additional **EMERGING PRESSURES** which are likely to have increasing impacts, but which were not spatially evaluated in the NBA 2018. The most notable of these is climate change, which is not only a threat to marine systems itself, but is also expected to amplify the impacts of other pressures. Climate-change induced effects on oceans will change biological and physical interactions leading to different environmental patterns and regime shifts. Marine ecosystems will have to adapt to a changing climate. At the same time, resilient marine ecosystems play a key role in supporting ecosystem-based adaptation of the society to climate change. The NBA 2018 Coast report also noted several emerging or poorly mapped pressures, including those such as: **PLASTIC, LIGHT, NOISE AND CHEMICAL POLLUTION, AND DISRUPTED SAND FLOWS TO BEACHES**[19].

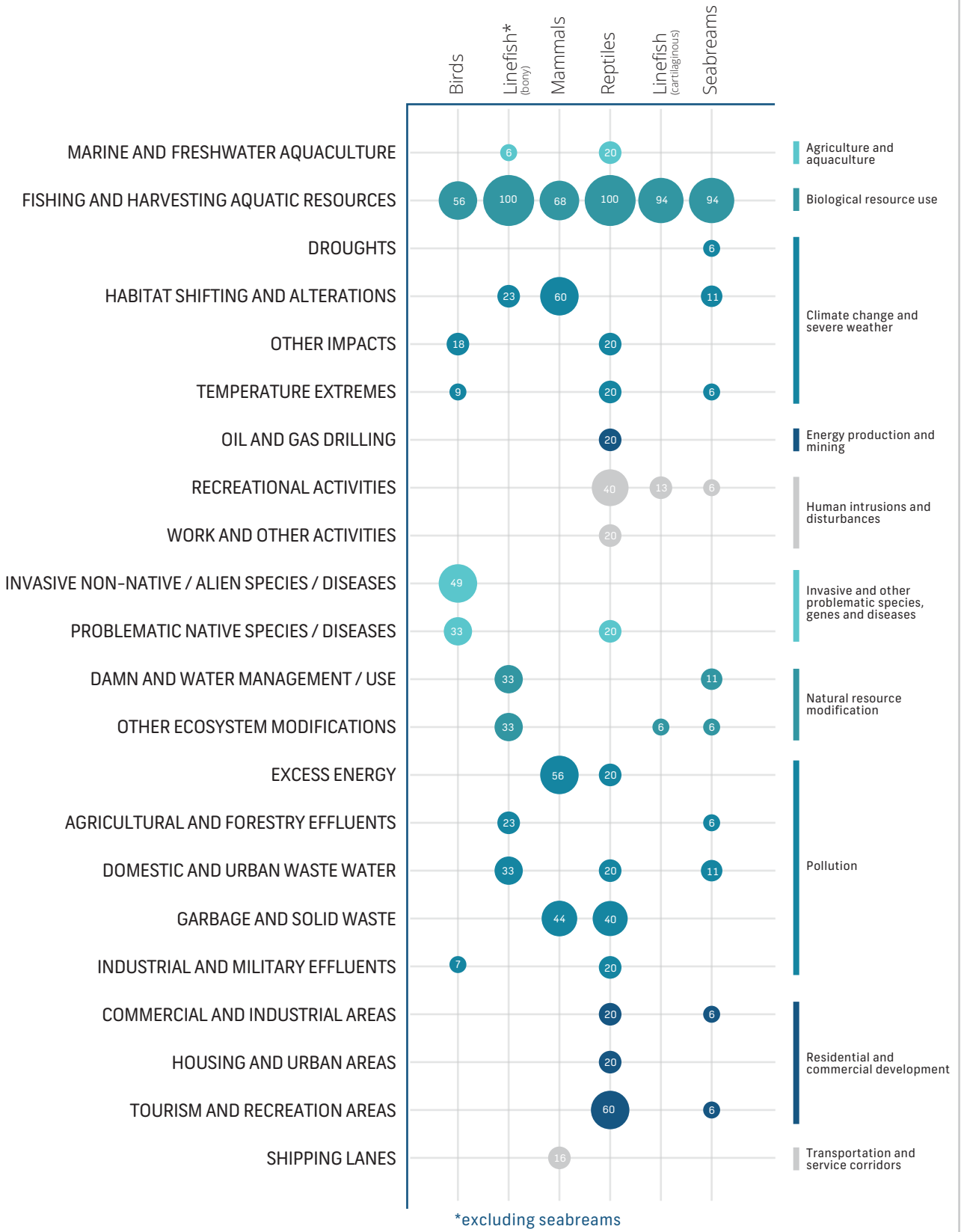


FIGURE 5

The key pressures for taxa of conservation concern in the marine realm based on a meta-analysis of the South African Species Red List Database. The size of the bubble corresponds to the percentage of taxa of conservation concern in the taxonomic group that is subject to each pressure. The pressures categories follow the IUCN threat classification system. Source: NBA 2018[47,55].

3.3.3.2 STRATEGIC POLICY OBJECTIVES

The practice of environmental management is guided by the following strategic objectives with direct spatial relevance:

SPECIFICATIONS IN THE MARINE SPATIAL PLANNING FRAMEWORK.

The framework stipulates that MSP in South Africa seeks to ensure healthy marine ecosystems by using MSP to contribute to protecting, conserving and restoring South Africa's rich marine biodiversity through integrating biodiversity objectives in relation to conservation and sustainable use into decision-making. It therefore allows for the identification and reduction of conflicts between human uses and nature, the allocation of ocean space for in-situ conservation and the reduction of the cumulative effects of human activities on marine ecosystems.

NATIONAL PROTECTED AREA EXPANSION STRATEGY (2016).

The goal of the National Protected Areas Expansion Strategy (NPAES) is to achieve cost-effective protected areas expansion for ecological sustainability and increased resilience to climate change (NPAES, 2016). The NPAES sets targets for protected area expansion and provides maps of the most important area for protected area expansion. The National Protected Area Expansion Strategy (2016) has set a 20-year target to formally protect 20% of the Exclusive Economic Zone and therefore the MPA network established through Operation Phakisa is a meaningful contribution to meeting this target.

NATIONAL ENVIRONMENTAL MANAGEMENT OF THE OCEAN POLICY (2014).

The National Environmental Management of the Ocean Policy (White Paper) envisages the preparation of an Ocean Act aimed at improving the regulation and coordination of the environmental management and development of South Africa's ocean space. This includes promoting sustainable use of resource, conservation, protection and sustainable development. The Ocean Policy promotes the establishment of an integrated ocean sustainable development and conservation plan through the undertaking of environmental impact assessments and the use of spatial planning tools.

NATIONAL COASTAL MANAGEMENT PLAN (2015–2019)[96].

The plan sets out numerous relevant environmental management priorities including effective planning for coastal vulnerability to global change (including climate change), ensuring equitable public access in the Coastal Zone, and managing pollution in the Coastal Zone.

NATIONAL BIODIVERSITY STRATEGY AND ACTION PLAN (NBSAP 2015–2025)[97].

The NBSAP includes Objective 1.1: The network of protected areas and conservation areas includes a representative sample of ecosystems and species and is coherent and effectively managed. This objective is spatially operationalised through the National Protected Areas Expansion Strategy (NPAES) and the Critical Biodiversity Areas Map.

ECOLOGICALLY OR BIOLOGICALLY SIGNIFICANT MARINE AREAS.

EBSA are a formal mechanism of the Convention on Biological Diversity (CBD), and are subject to international review and approval processes. South Africa has highlight 22 identified Ecologically or Biologically Significant Marine Areas (EBSA) as being of global significance, and has hence committed to take appropriate actions to manage these areas using national legal and planning instruments. Management would largely be achieved through appropriate incorporation of EBSA, their proposed zones and required management guidelines into the MSP process.

3.3.3.3 POSSIBLE SPATIAL CONFLICTS AND SYNERGIES WITH OTHER USES AND INTERESTS

Table 5 summarizes the potential environmental conflicts with other activities based on the NBA 2018. As mentioned in the previous section, this list does not represent the full suite of pressures on biodiversity and additional pressures and improvements to current pressures data is expected in the near future. The most important potential conflicts with environment for spatial planning are:

- LARGE-SCALE FISHING: Industrial-scale fishing can cause significant direct (e.g., destruction of habitats through bottom-trawling) and indirect (e.g., reduction in food availability for top predators through removal of small pelagic fish) impacts. Impacts are not only linked to scale, but also to target species (e.g., fishing for threatened reef species has a different impact to fisheries targeting non-threatened pelagic species) and fishing method (e.g., bottom trawling is particularly destructive to demersal habitats and some fisheries have significant bycatch).

- SMALL SCALE FISHERIES: Local small-scale fisheries can have specific impacts e.g. gill net fishing.

- MINING: Mining can cause significant local habitat destruction, while noise from prospecting (sonar) can impact larger areas for specific periods.

- COASTAL DEVELOPMENT: Port expansions and associated dredging and underwater noise; coastal housing/ other infrastructure development and related impacts such as waste-water discharge and desalination brine effluent all can have significant impacts on coastal ecosystems.

- TRANSPORT: Marine shipping can cause significant underwater noise; oil spills (actual and potential); dumping and other marine debris (e.g. plastics); can cause direct harm to larger species (e.g. cetacean strikes); and can result in introduction of invasive alien species through ballast water and on hulls.[91]

- DEFENCE: Ammunition dumping grounds, military practice exercises and underwater noise by sonars can all cause local impacts on the environment.

Apart from the underlying fact that a secure environment is a critical basis for most marine activities, there are a number of specific spatial synergies:

- FISHERIES:
  Marine Protected Areas and other place-based mechanisms can help secure key ecological infrastructure required to support fisheries (e.g. spawning grounds).

- TOURISM:
  Environmental protection requirements provide the resource base for industries such as shark and whale watching, scuba diving, recreational fisheries, and other coastal tourism, and also supports education and awareness-raising.

- MILITARY:
  Closed areas for military exercise may have overall environmental benefits.

TABLE 5

Summary of compatibility of each type of activity with environment for each ecosystem type. This summary is based on NBA 2018[55]. Values range from 0 (Blank squares indicate combinations of activities and ecosystems where the activity is not likely to be present), to low impact combinations (greens), through to 100 (Reds squares where activities have a very significant potential impact on an ecosystem type).

	Abyss	Bay	Estuarine shore	Hard mid and outer shelf, shelf edge and canyons	Island	Kelp	Mixed shore	Muddy shelf	Reefs	Rocky shore	Sandy shore	Seamount	Shelf mosaic	Slope	Soft inner shelf	Soft mid, outer shelf, shelf edge	All relevant PEI Ecosystems
Abalone		35			35	50	35		35	35							
Ammunition disposal	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	
Change in Mean Annual Runoff (River Influenced A)				80				80	80				80		80		
Change in Mean Annual Runoff (River Influenced B)		40		40				40	40				40		40	40	
Coastal Development		90	100		100		90			90	100						
Coastal Disturbance			35		70		35			30	35						
Crustacean Trawl				100				90	100				90	80	90	80	
Demersal hake Longlining	55	55		75	65			55	75			75	60	55	55	55	
Demersal Trawl: Inshore		90		100	100			90	100				90	80		80	
Demersal Trawl: Offshore				100				80					75	65		65	
Dredge disposal		70		70	70			60	70				70	60	60	60	
Invasive species		50			50		50			50							
Kelp Harvesting						20	30			20							
Linefishing: EC & SC		85		80	80	80		60	80				80	60	80	60	
Linefishing: WC		50		45	45	45		45	45				45	45	45	45	
Midwater Trawl	70	70		70	70	70		70	70			70	70	70	70	70	
Mining		80	80	90	90	60	80	90	70	60	80	90	80	75	75	75	
Netfishing: Beach Seine		30	30								30						
Netfishing: St Joseph (Gill net)		30	30								30						
Oysters: Cucculata							25			25							
Pelagic Longlining	55	55		55		55		55	55			55	55	55	55	55	
Petroleum		60		60				50	60				60	50	50	50	
Port proximity and anchorages		60	60	60	60	60	60	60	60	60	60		60		60	60	
Recreational Fishing: Shore LineFishing East Coast		50	50		50	50	50			50	50						
Recreational Fishing: Shore LineFishing West Coast		30	30		30	30	30			30	30						
SCRL		35		50	50			35	50				50	35	35	35	
Sea-Based Aquaculture		75	70	70	70	70	70	70	70	70	70		70	70	70	70	
Shark Control			75	75			75	75	75	75	75		75	75	75	75	
Shipping	30	30		30	30			30	30			30	30	30	30	30	
Small Pelagics	55	55		55	55	55		55	55			55	55	55	55	55	
Squid		20	20	20	20		20	20	20	20	20		20	20	20	20	
Subsistence Fishing			20				60			60	20						
Toothfish																	55
Tuna Pole	35	35		35	35			35	35			35	35	35	35	35	
Waste water: Effluent			30	40	30	50	30	40	50	20	30		50	40	50	40	
WCRL		30		45	50	45			45				45				

3.3.4 KEY ISSUES FOR MSP TO CONSIDER

The following key issues should be considered by MSP concerning conservation interests and sustainable use of the natural environment:

- MARINE PROTECTED AREAS (MPAs):
  - Ensure current Marine Protected Areas are fully secured and that MSP processes do not result in any negative impact to these areas either directly or from adjacent areas.
  - Support the identification of required future MPAs necessary to ensure that the next 5% of targets are met in the short term, and that eventually National Protected Areas Expansion Strategy and full CBD commitments are met. MSP processes should strive to secure the priority areas for this protected area expansion prior to declaration.
  - Additional MPAs will need to be established to represent the 19 ecosystem types that are still Not Protected and to advance Poorly and Moderately Protected ecosystem types towards Well Protected.
  - There is opportunity to advance many of the Moderately Protected ecosystem types to Well Protected through ecosystem restoration, re-zonation of existing MPAs to reduce ecosystem degradation and other activities that can improve condition within MPAs.
- ECOLOGICALLY OR BIOLOGICALLY SIGNIFICANT MARINE AREAS (EBSAs):
  - Ensure biodiversity features within EBSAs are appropriately protected in MSP zoning. Most importantly, this requires the long-term exclusion of the identified non-compatible activities from the Conservation Zones of EBSAs, and to a lesser extent exclusion of the identified non-compatible activities from Impact Management Zones. Similarly, appropriate management controls need to be formalized for restricted activities in both zones.
- MARINE CRITICAL BIODIVERSITY AREAS (CBAS) AND ECOLOGICAL SUPPORT AREAS (ESAs):
  - The CBA Map integrates the environmental marine spatial requirements into a single map. The categories on this map (with their accompanying sea-use guidelines of compatible and non-compatible activities / uses) need to be secured in the MSP process and embedded in the agreed zoning.
  - CBA 1 and CBA 2 sites should be maintained in a natural or near-natural ecological condition. Non-compatible activities need to be excluded.
  - ESA 1 sites should be maintained in at least fair ecological condition, non-compatible activities need to be excluded and other impacting activities carefully managed.
  - ESA 2 sites should be carefully managed to prevent further deterioration in ecological condition.

3.4 ENVIRONMENTAL MONITORING AND RESEARCH

3.4.1 BACKGROUND

As a maritime nation with responsibility for about twice as much ocean as land, South Africa has a long history of marine monitoring and research. Monitoring and research activities are carried out throughout the South African coastline, in the marine area and on and around the Prince Edward Islands.

A number of organizations are involved in monitoring and research relating to the marine environment. Public authorities include but are not limited to the DFFE and its associated parastatal, the South African National Biodiversity Institute (SANBI). Further marine research focused entities include the South African Environmental Observation Network (SAEON) and the South African Institute for Aquatic Biodiversity (SAIAB). There are further provincial authorities engaged in marine monitoring and research such as Cape Nature or Ezemvelo KZN Wildlife.

The Department of Science and Innovation (DSI) provides core funding to research entities such as academic affiliated institutions which include a number of universities such as the Nelson Mandela University that hosts the country's first dedicated ocean sciences campus. The National Research Foundation (NRF) promotes marine related research, including through the joint DSI-NRF South African Research Chairs Initiative (SARChI). It is designed to attract and retain excellence in research and innovation at South African public universities through the establishment of Research Chairs on emerging topics. The Council for Scientific and Industrial Research (CSIR) undertakes research activities on behalf of public authorities and other clients.

Civil society organizations also carry out marine monitoring and research activities, and include the South African Associate for Marine Biological Research (SAAMBR) and its Oceanographic Research Institute (ORI).

South Africa cooperates with a number of international partners such as the Norwegian Institute for Marine Research (IMR) or the Alfred-Wegener-Institute for Polar and Marine Research in Germany.

3.4.2 THE CURRENT SITUATION

3.4.2.1 LEGAL AND POLICY FRAMEWORK

The DSI is the lead authority on the strategic development, acquisition and deployment of research infrastructure as a necessary enabler for research, development and innovation in South Africa. However, sector-specific research falls within the mandates of the respective Departments.

The South African Research Infrastructure Roadmap (SARIR) is a high-level strategic and systemic intervention to provide research infrastructure across the entire public research system, building on existing capabilities and strengths, and drawing on future needs.

3.4.2.2 KEY SPATIAL INTERESTS

A number of monitoring moorings and research transects exists within the marine jurisdiction of South Africa and in areas beyond national jurisdiction, measuring key oceanographic variables:

3.4.2.3 SOCIO-ECONOMIC IMPORTANCE

Marine environmental monitoring and research is a critical component of a developing ocean economy and the South African society in that it:

- informs marine management and underpins conservation and sustainable use;
- supports skills development and education of new generations of experts working in marine sectors;
- fosters innovation (e.g. new technologies); and
- enhances human well-being.

As monitoring, research and education do however not generate a physical, measurable output, it is difficult to establish an accurate figure of its value and contribution to the economy.

3.4.2.4 ENVIRONMENTAL IMPACTS

Depending on the type of monitoring and research, there may be environmental impacts such as through the extraction of biomass. The impacts will however be very limited in space and time.

3.4.3 LOOKING TO THE FUTURE

3.4.3.1 TRENDS

Environmental monitoring and research will inform future marine policy development and implementation. It will also identify knowledge gaps and influence the country's priority research areas to investigate and there is likely to be a need for collaborative research efforts and a new emphasis on understanding the socio-economics of marine activities.
It is likely that new knowledge will emerge on:

- marine bio-resources, including novel chemicals, new and sustainable food supplies and bio-energy;
- increased and new forms of sub-sea oil and gas or other geological resources recovery and the potential re-use of oil and gas fields for carbon capture and storage (CCS) in the future;
- new technologies for introducing marine renewable energy production in the mid-term;
- the seabed and its resources and biodiversity, especially in deep waters through increasingly detailed maps; and
- new approaches to planning, management and governance in the marine and coastal realm.

3.4.3.2 SPATIAL CONFLICTS AND SYNERGIES WITH OTHER USES AND INTERESTS

There are few possible conflicts which are that monitoring and research activities may restrict other uses in areas with overlapping interests. However, these would generally be limited in space and time.

3.4.4 KEY ISSUES FOR MSP TO CONSIDER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Unlocking the economic potential of South Africa's oceans and maintaining a healthy marine environment for the benefit of society and industry depends on environmental monitoring and research.

The existing spatial activities and areas of interest for monitoring and research, including the protection of areas that serve as reference sites and which have not been impacted by human use must be secured and integrated in the forthcoming Marine Area Plans.

3.5 FISHERIES

3.5.1 BRIEF DESCRIPTION AND DEFINITION

South Africa's marine waters are rich in living marine resources. Some of these resources have been exploited for many centuries, with evidence dating back 125,000 years. Industrialization of fisheries started just before the turn of the 20th century. Today, South Africa is one of the leading capture fisheries nations in the world and the 2nd largest African marine capture fisheries nation after Morocco. South Africa is a net exporter of fishery products, primarily wild capture resources.

South Africa has a well-established fisheries sector that covers three types of fishery: commercial, recreational, and small scale. Whereas commercial fishing is fishing for marine species for commercial gain, recreational fishing means any fishing done for leisure or sport and not for sale, barter, earnings or gain.[98] Small scale fishing means the use of marine living resources on a full-time, part-time or seasonal basis in order to ensure food and livelihood security.[99]

The commercial fishery component is well established and has 22 recognized commercial fisheries with major fishing grounds situated along the continental shelf between St. Helena Bay and Port Elizabeth. Commercial fisheries are managed by restricting the total amount permitted to be caught by the permit holder (Total Allowable Catch, TAC), restricting the amount of effort (vessels, fishers or hours) applied to a particular resource (Total Applied Effort, TAE), or a combination of the two.

The demersal (bottom) trawl and long-line fisheries, targeting the Cape hakes and the purse-seine fishery targeting small pelagic species, yield the highest economic value and greatest landed tonnage. The traditional line fishery refers to a long-standing hook and line fishery based on an assemblage of 35 different species, particularly snoek. The mid-water trawl sector targets horse mackerel whereas hand-jig fishery targets chokka squid exclusively on the South Coast. Crustacean fisheries is comprised of a trap and hoop net fisheries, targeting West Coast rock lobster, a line trap fishery targeting the South Coast rock lobster, and a trawl fishery based solely on the Kwa-Zulu Natal coast targeting penaeid prawns, langoustines, deep-water rock lobster and red crab. Highly migratory tuna and tuna-like species are caught in areas beyond national jurisdictions and seasonally within the EEZ by the pelagic long-line and pole fisheries.

The wild capture fishery sector is an important part of the nation's food supply, supports the livelihood of many coastal communities and is an avenue for economic opportunities. South Africans consume over 310 million kilograms of fish annually, ±50% of this is locally caught. Fisheries contribute roughly R9bn to the country's GDP (Figure 7), which equates to roughly 0.1% of the country's GDP. Although this is relatively small in comparison to other sectors, fisheries is however more important for economic development in the Western Cape where 11 of the 13 proclaimed fishing harbours are situated. These contribute more the 5% to Gross Provincial Domestic Product.[100] It is estimated that the direct employment in the industry constitutes at least 41,000 jobs, while an additional 81,000 people are indirectly (net building, bait preparing, etc.) employed in industries that are at least partially dependent on the fishing sector.


Hake trawl catch by commercial vessel

© Fisheries Resources Research

Since then, catches in several South African fisheries have exceeded sustainable yields: In 2016, a total of 52% of stocks were considered not to be of concern, while 48% of stocks were of concern.[101] The MSP process will be advantageous in implementing possible future spatial closures intended to assist in the recovery of certain stocks and ongoing sustainability of those fisheries.

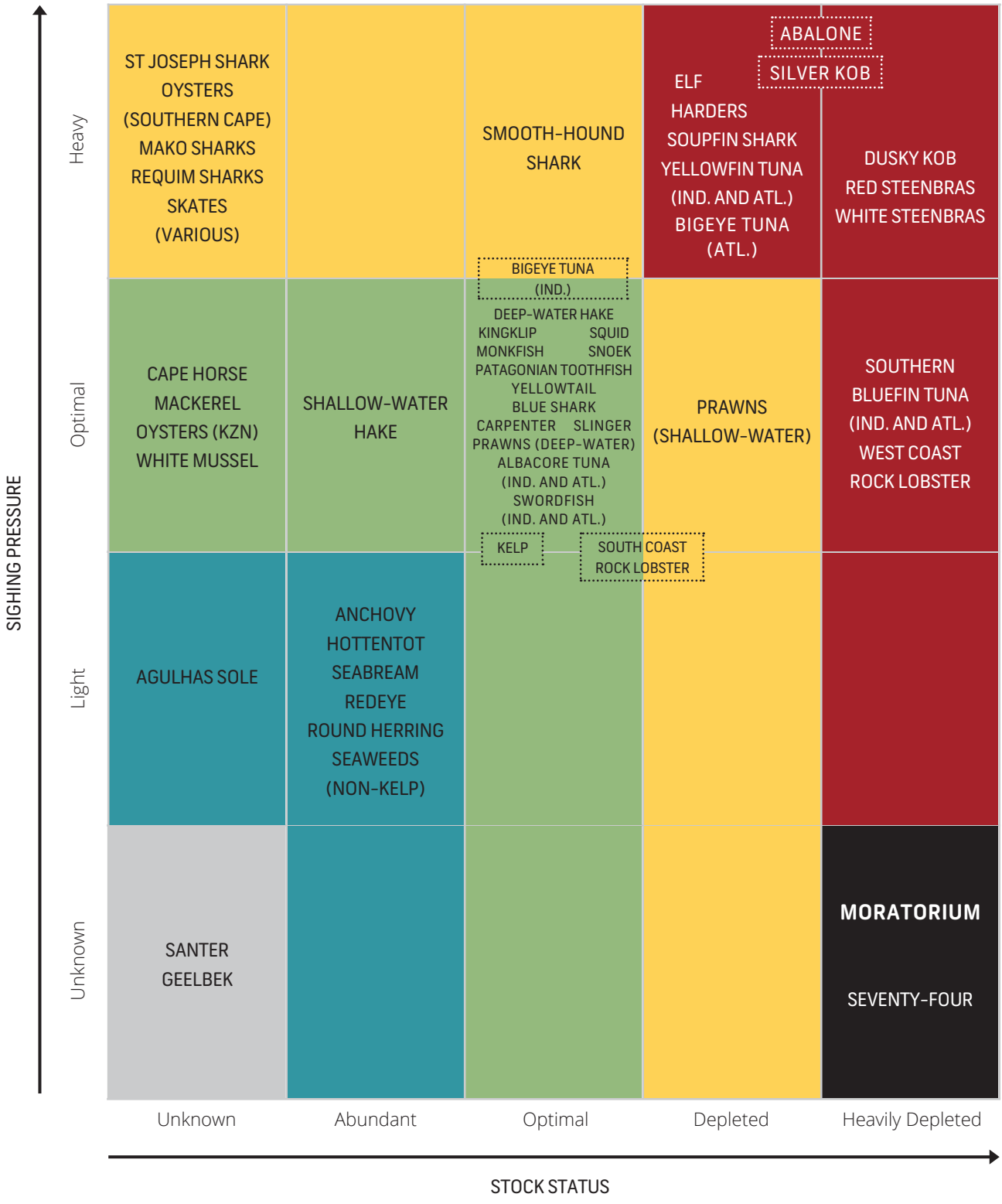


FIGURE 6

A summary matrix of stock status and fishing pressure. Stock status categories are defined by the present biomass level (B) relative to the biomass level at which maximum sustainable yield (MSY) is achieved (B_{MSY}) hence: Abundant ($B > B_{MSY}$), Optimal ($B \approx B_{MSY}$), Depleted ($B < B_{MSY}$) and Heavily depleted ($B << B_{MSY}$). Fishing pressure categories are defined by the present fishing pressure (F) and the fishing pressure level at which MSY is obtained (F_{MSY}) hence: Light ($F < F_{MSY}$), Optimal ($F \approx F_{MSY}$), Heavy ($F > F_{MSY}$) (DEFF, 2016)[101].

3.5.2 THE CURRENT SITUATION

3.5.2.1 LEGAL AND POLICY FRAMEWORK

The management, regulation and development of the wild fishery sector in South African marine waters fall within the responsibility of the Department of Forestry, Fisheries and the Environment (DFFE). The legislative mandate of DFFE is derived from Sections 24(b)(iii) and 27(1)(b) of the Constitution.

The Minister of Forestry, Fisheries and the Environment, as a member of the Cabinet, is responsible for fisheries management according to relevant legislation. The Minister provides the DFFE with strategic direction and sets out political priorities to be pursued by DFFE. The execution of these priorities enhances the effective realisation of the mandate relating to fisheries.

The primary legislation and policy for DFFE governing wild fisheries management includes but is not limited to the:

- Marine Living Resources Act (Act No. 18 of 1998); and
- Small Scale Fisheries Policy (2012).

The 1998 Marine Living Resources Act "provides for the conservation of the marine ecosystem, the long-term sustainable utilization of marine living resources and the orderly access to exploitation, utilization and protection of certain marine living resources; and for these purposes to provide for the exercise of control over marine living resources in a fair and equitable manner to the benefit of all the citizens of South Africa; and to provide for matters connected herewith".[102]

The 2012 Small Scale Fisheries Policy provides a framework for the recognition of the rights of small scale fishers and a mechanism for the allocation of fishing rights to small scale fishing communities to ensure equitable access to marine living resources for these communities.[103]

South Africa is a member of several regional fisheries management organisations and related international treaties, which South Africa has ratified, whose objective is the management and conservation of shared fish stocks. These include but are not limited to the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), the Commission for the Conservation of Southern Bluefin Tunas (CCSBT), the International Commission for the Conservation of Atlantic Tunas (ICCAT), the Indian Ocean Tuna Commission (IOTC), or the South-East Atlantic Fisheries Organisation (SEAFO).

Fisheries – in particular the small scale and commercial sectors – is an important vehicle to achieve South Africa's development objectives as stipulated by the National Development Plan and its Vision 2030, which highlights the role of fisheries in contributing to food security as a key measure to addressing poverty, unemployment and inequality.

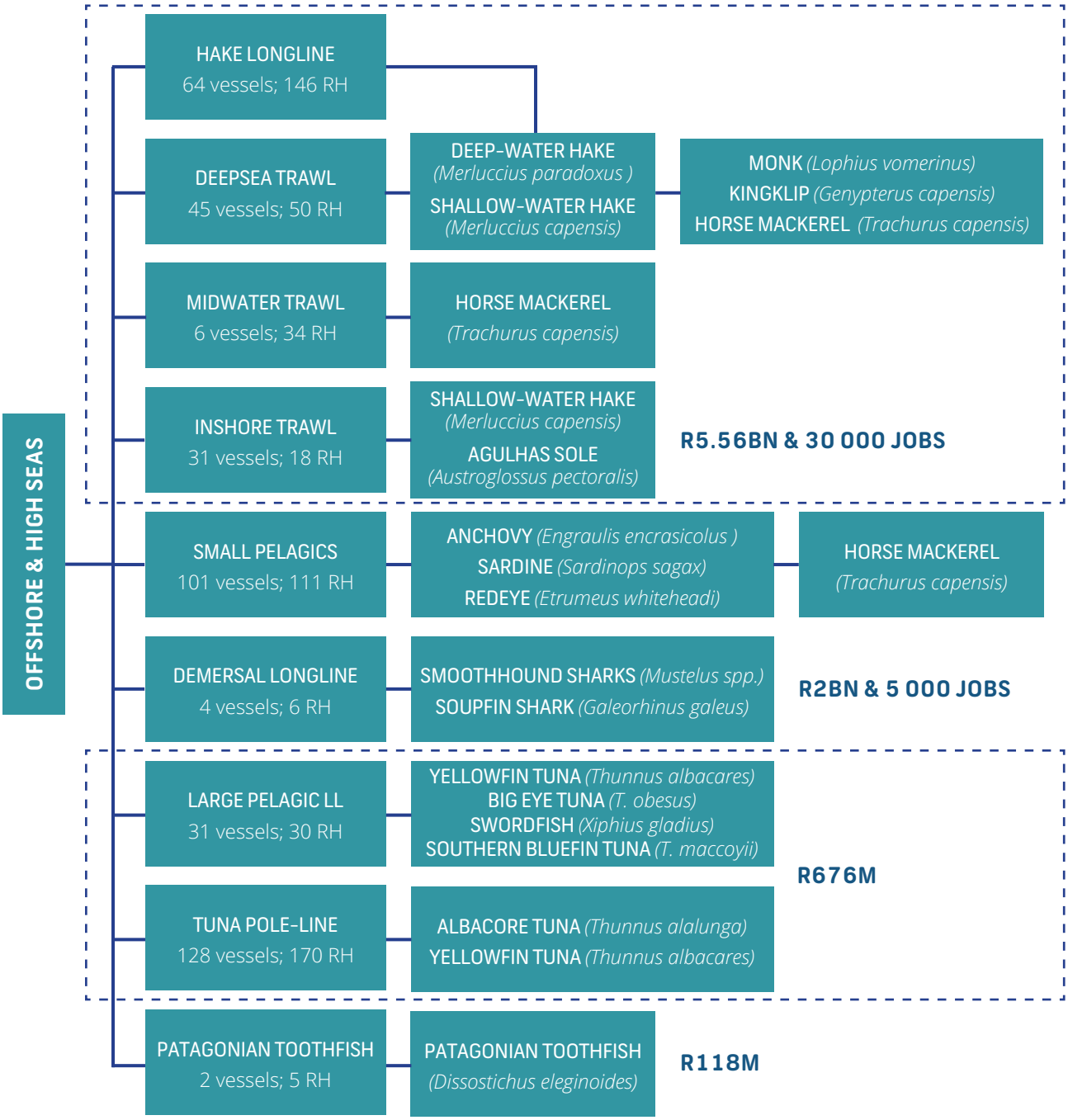
Operation Phakisa, a government initiative, aims at fast-tracking the implementation of solutions to overcome critical development issues in pursuit of the NDP. The unlocking of the socio-economic potential of South Africa's ocean wealth as part of Operation Phakisa: Oceans Economy has been identified as one of the key areas of work with the development of small scale harbours and coastal fisheries-relevant infrastructure being one of the growth areas.

3.5.2.2 LEGAL AND POLICY FRAMEWORK

Fisheries resource management distinguishes between "offshore and high seas" and "inshore" resources.

3.5.2.2.1 OFFSHORE AND HIGH SEAS SECTORS

The offshore and high seas comprises highly industrialised, capital-intensive sectors operating either offshore, largely within the EEZ or even beyond in Areas Beyond National Jurisdiction (ABNJ), with few sectors also transcending into the territorial waters. Figure 7 illustrates these sectors with information about the number of operating vessels, number of rights holders (RH) as well as the approximate number of jobs sustained and/or the estimated annual value generation. Each of the sectors is described in the following sections in more detail.



Overview of the offshore and high seas fisheries sectors. FIGURE 7

3.5.2.2.1.1 SECTOR: DEMERSAL TRAWL (HAKE LONGLINE, DEEPSEA, MIDWATER AND INSHORE TRAWL)

OVERVIEW OF THE SECTOR

Demersal trawling started at the beginning of the 20th century. At the time (1900) fishing effort was limited to side trawlers and steam-driven vessels[104]. The fishery developed in the nearshore areas of the south coast (Agulhas Bank) initially targeting Agulhas sole (*Austroglossus pectoralis*) and operations rarely fished deeper than 300m. This changed over time as vessel capacity increased, technology improved and effort systematically moved into deeper water. Currently the demersal trawl fleet regularly fishes at up to 800 m water depth. Hake is now the primary target species, and the hake trawl fishery is currently the most valuable fishing sector in South Africa.

The target species are the two hake species (commonly referred to as "Cape hake"). In the context of their spatial distribution, the deep-water species *Merluccius paradoxus,* is caught in waters deeper than 300 m, while the shallow-water hake *M. capensis* is caught from 50-300 m. There is some overlap between these species in the depth range 250-350 m (approximately). Secondary or bycatch species make up an important component of the hake-directed trawl fishery, in particular monkfish *(Lophius vomerinus)*, kingklip *(Genypterus capensis)* and horse mackerel *(Trachurus capensis)*. An important development in the hake fishery was the capping of catch using a Total Allowable Catch (TAC) which started in the mid 1970's. Later (in the 1990's) precautionary upper catch limits (called PUCLs) were set for both kingklip and monk.

From the mid-1980's the hake catch in the inshore trawl sector became increasingly important as other stocks declined and "white fish" markets developed on a global scale. Currently (2018) the inshore trawl sector, although still important, has shrunk in size with only a few small sole-directed vessels and some larger hake-directed vessels. A fundamental management measure was the adoption of "vessel restrictions" which constrained vessel power and vessel length (max. 30 m); further to that the "capacity management" model limits sea days per vessel according to the quantum of catch assigned to the vessel by the cluster managers.

In the offshore sector, the fishery comprises of both freezer and wetfish trawlers (about 45 in total) operating primarily out of Cape Town and Saldanha Bay. This fleet mostly catches deep-water hake and has also maintained Marine Stewardship Council (MSC) certification since 2004[105].

STOCK DYNAMICS

Hake spawning areas have been difficult to accurately identify however there appear to be two areas of the western Agulhas Bank where hake spawn, namely inshore (100-300m deep) and offshore (400-1000m deep)[106,107]. In addition a hake nursery area off Cape Columbine has been proposed by several studies ([108,109,110]). Smith and Japp (2009)[111] collated available information mainly on collection of hake roe by the commercial fleet to infer the location of spawning of the two species, and suggested a number of "hotspots" generally located near or over the shelf edge for both species (*M. capensis* tending to spawn shallower than *M. paradoxus*), although aggregations of ripe *M. capensis* were also encountered in shallow areas on the Agulhas Bank and off the Orange River mouth. The paucity of "ripe-and-running" hake in catches made using demersal trawl gear suggest that hake spawn in the water column rather than in close proximity to the sea bed.

It is considered feasible that there are several potential hake stocks, although their existence is not conclusive. Historically the identification of hake stocks has shifted sequentially from the assumption that a single stock and single species existed in South African waters (in the Benguela and Agulhas ecosystems), to the separation of species (shallow and deep), to two stocks (Benguela and Agulhas) and more recently to a single deep-water stock that extends from South Africa into Namibia and separate shallow-water *M. capensis* stocks on the South African south coast and the west coasts of South Africa and Namibia. These hypotheses have obvious implications for management and stock assessments, in particular in a transboundary context between South Africa and Namibia.

CURRENT SPATIAL AND TEMPORAL MEASURES

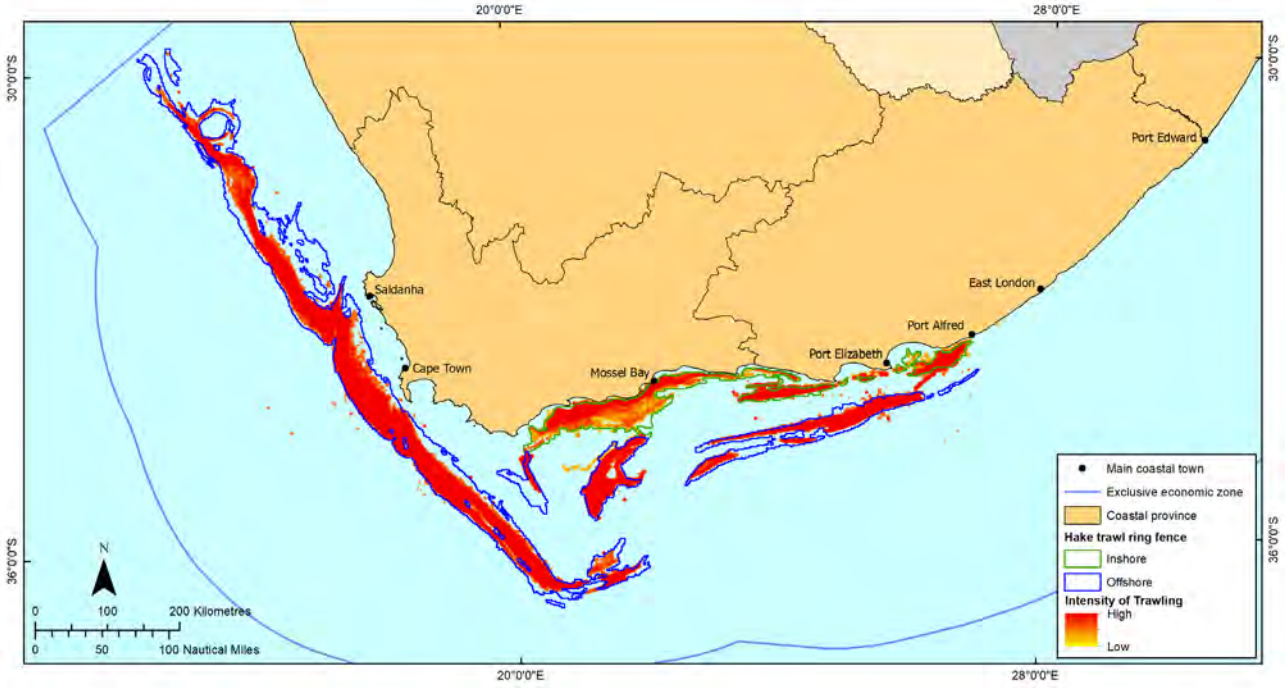
The following spatial measures apply to the hake trawl fishery:

- Trawl permits are valid only in South African waters (excluding tidal lagoons, tidal rivers and estuaries), with closed areas and marine protected areas stipulated in Chapter 3 of Marine Living Resources Act (MLRA) Regulations.
- No fishing shall take place within False Bay, north of a straight line drawn from the lighthouse at Cape Hangklip to the lighthouse at Cape Point.
- In the area east of 020°E longitude, no fishing shall take place in water depths of less than 110m or within 20 nautical miles from the coast, whichever is the greater distance from the coast (Introduced in 1978) - Agulhas/East coast sole (A. Pectoralis) distribution from 0-100m. 100-110m acts as a buffer zone. Protection of the Agulhas bank from heavily industrialised offshore demersal trawl and foreign trawl fleets.
- In the area west of 020°E longitude, no fishing shall take place within 5 nautical miles of the coast.
- Kingklip Spawning Box: During the period 1 September to 30 November, no fishing shall take place between longitudes 24°E and 250 E and Latitudes within the quadrilateral described by lines joining the following four points: A : 34.8 S 24E; B: 34.63 S 25E; C:34.73S 25E; D:34.95S 24E.
- No fishing may take place outside of the areas defined as the "Hake Trawl Ring Fence" (this ringfencing relates to MSC conditions that restrict the trawl fishery to grounds that have been systematically fished in the past, where the benthos has already been altered).

KEY SPATIAL INTERESTS

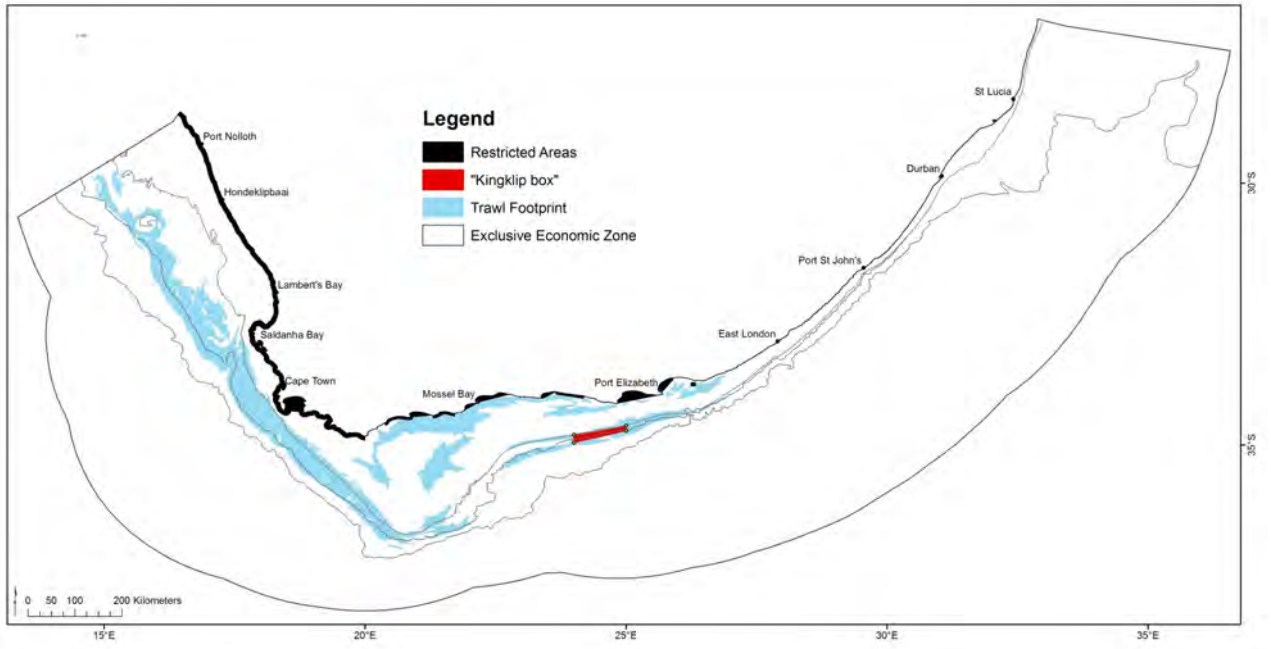
Trawling grounds for hake have been well described (Map 22). There are clear areas of trawling intensity, as shown in Map 23. The fishery has some very clear spatial signals that could be defined as Priority Fishing Areas (PFAs) as follows:

- **AREA 1:** Due west of Hondeklip Bay – this is an area known as the Karbonkel or Child's Bank;
- **AREA 2:** Due west of Saldanha Bay – this is an area known as the Dassen Hole and is part of a feature known as the Cape Canyon;
- **AREA 3:** An extensive area extending from due west of Cape Town to due south of Danger Point, also referred to as "Browns Bank";
- **AREA 4:** An area due south of Cape Agulhas extending towards the southern-most part of the Agulhas Bank;
- **AREA 5:** South of Port Elizabeth and Cape St Francis in an area known as the Chalk Line;
- **AREA 6:** A shallow area inshore between Mossel Bay and Struisbaai.



Spatial distribution of intensity of use ("effort" expended) by the inshore and offshore demersal trawl sector for the years 2008 to 2016, and delineation of the permitted hake trawl ringfence (since 2015). The map is based on relative effort in hours of trawling (see Annex for details).

MAP 22



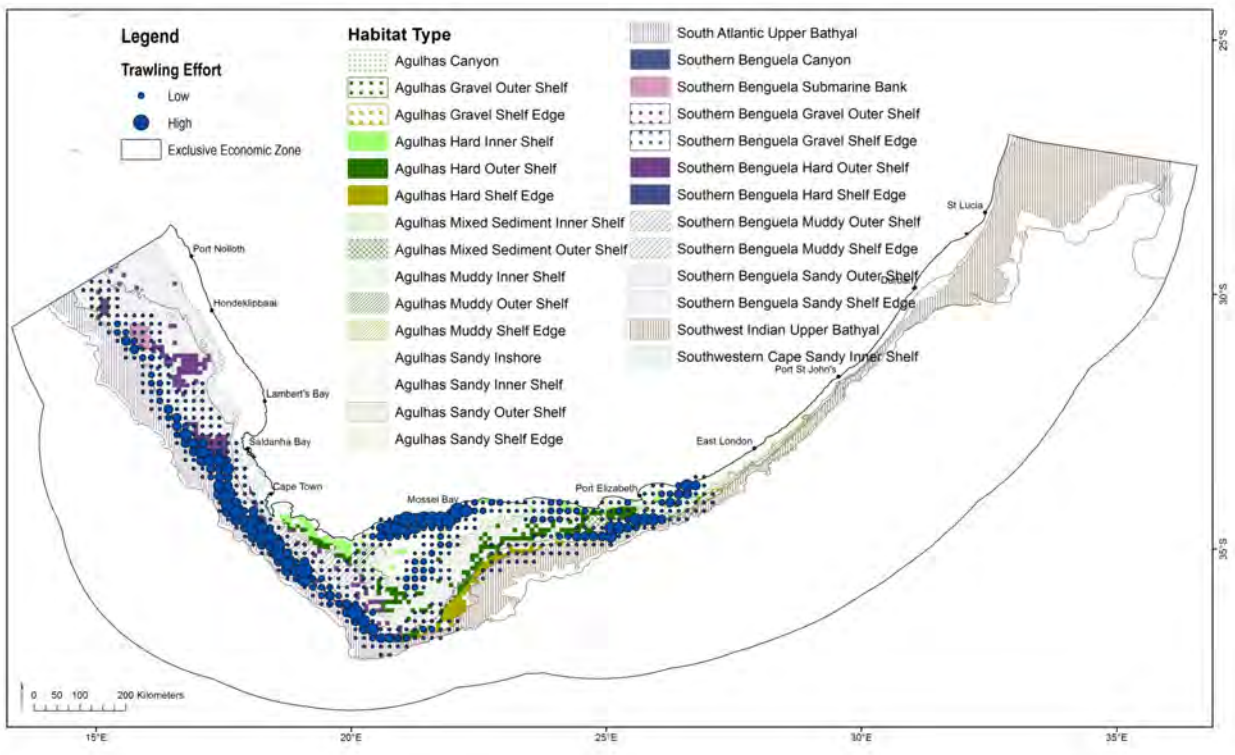
Spatial extent of the hake trawl fishery (light blue) showing the nearshore protected areas (black) and the kingklip spawning box (after Smith & Japp, 2009)[111].

MAP 23

The overlap of the trawl fishery with known habitat types has been described by both Wilkinson and Japp (2005)[112] and Sink et al. 2012[104]. Broadly, the trawl fishery focuses on benign trawling grounds – relatively flat areas or areas with low profiles, and of sandy substrate. These areas are preferred because of the low risk of fouling gear. The fishery does however extend beyond these areas, in particular to muddy substrates (area 5) where Agulhas sole is targeted, and in areas adjacent to "hard" ground where species that prefer rocky, coral or more diversified substrate types and niches occur. Wilkinson and Japp (2005) also described in detail the overlap of trawling intensity with substrate type (Map 24).

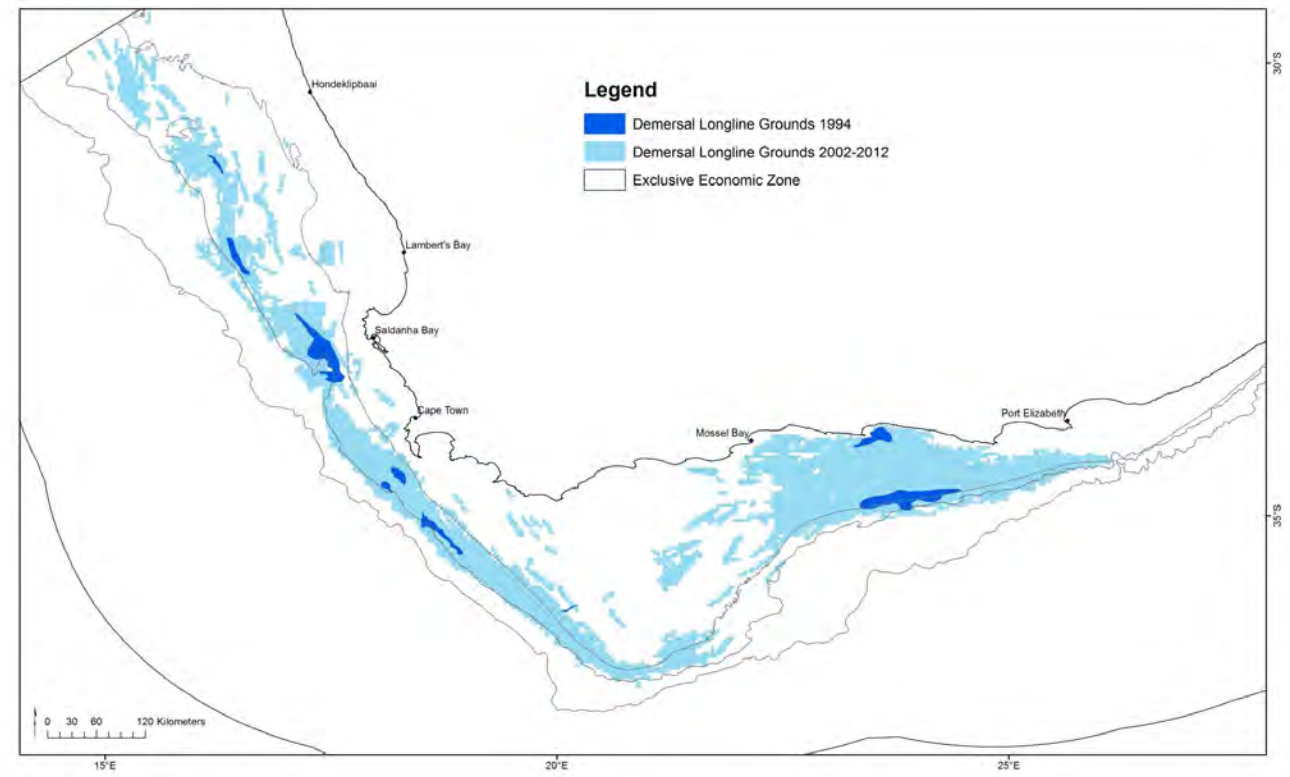

RV Africana by Sharon du Plessis © Fisheries Resources Research

The spatial distribution of trawling and in particular trawling intensity is of interest with regard to the protection of biodiversity and habitat types.[104] The MSC certification conditions for the South African Deep-Sea Trawling Industry Association (SADSTIA) hake fishery also required that the impact of trawling on habitat be investigated and in this regard prompted the ongoing research on trawling impacts in the Childs Bank area on the west coast.



Distribution of hake-directed trawling effort around the South African Coast showing areas of highest trawling intensity overlaid on known habitat types (after Sink et al., 2012)[104].

MAP 24



Consolidation of longline areas showing the expansion of effort from the 1994 experimental period to the total area as exploited between 2002 and 2012 (after Norman et al., 2018, data after Massie et al., 2015)[113,114].

MAP 25

SPATIAL CONFLICTS WITH OTHER USES AND INTERESTS

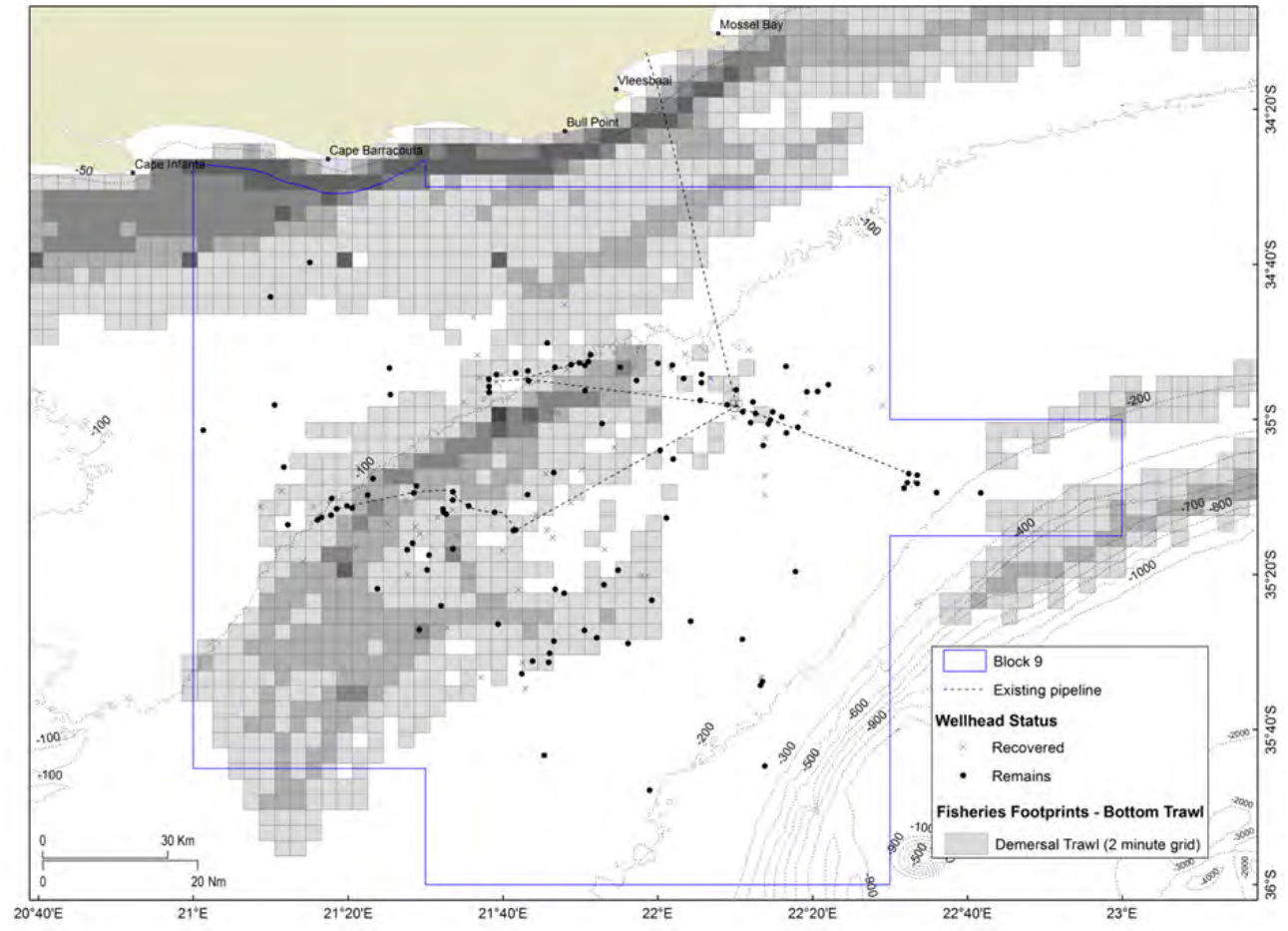
There are numerous areas of conflict between hake trawl and other users of the sea. These include:

Trawl and longline

Conflict between hake trawl and hake longlines arose with the introduction of hake-directed longlining and the gradual growth of the longline sector. The user conflict relates primarily to gear type with longline sets increasingly drifting onto trawl grounds, or more commonly hake longliners now setting gear on trawl grounds (Map 25).

Trawl and well-heads

Trawl nets can become entangled on wellheads (Map 26) and other structures on the seafloor (either active or inactive structures). This has been comprehensively reported on by PetroSA (see Japp & Wilkinson, 2015[115]). This is an area of conflict which may expand, but which has been addressed between PetroSA and the trawling industry.



MAP 26

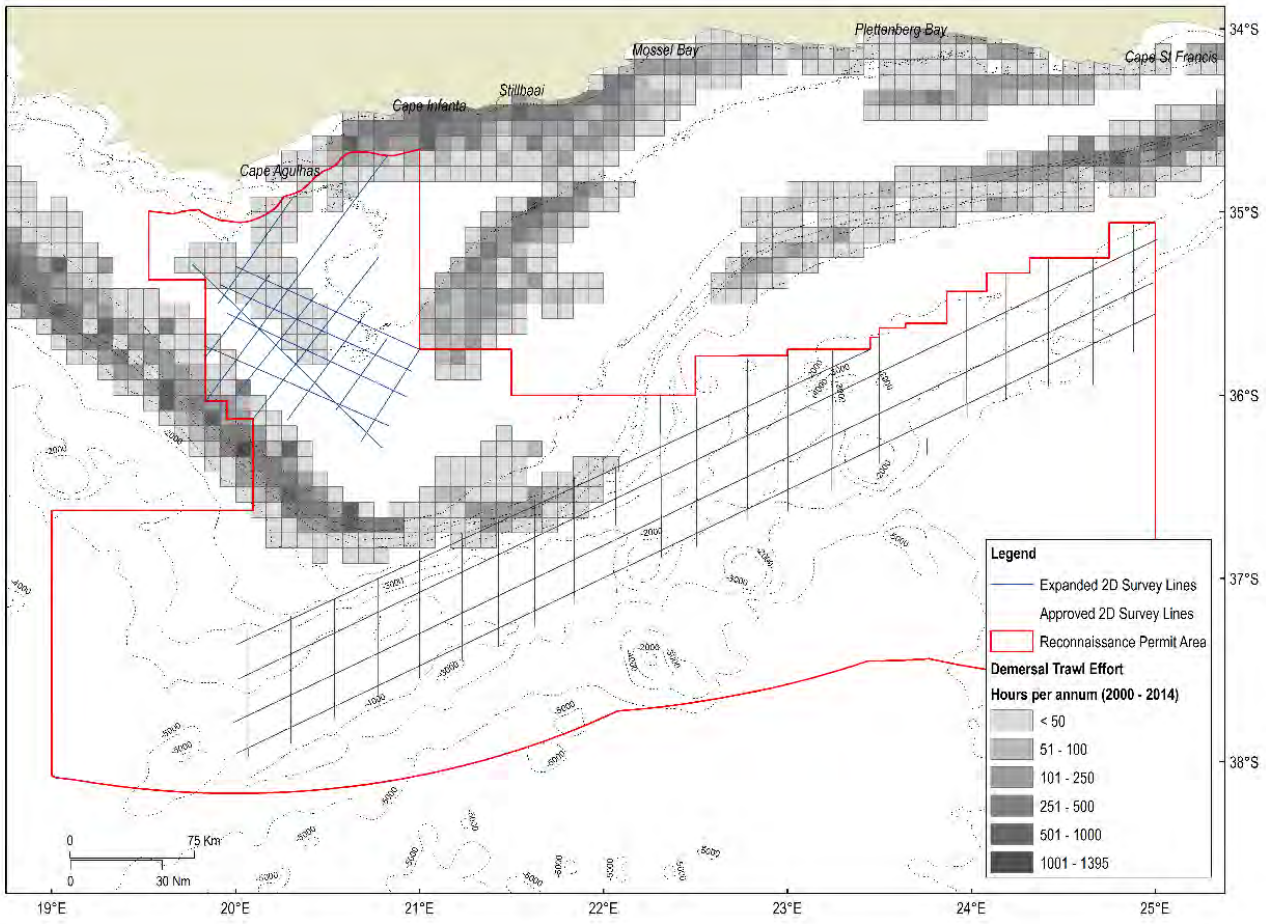
Spatial distribution of the effort expended by the demersal trawl sector in relation to the wellheads in Block 9. Effort is displayed on a 2 x 2 minute grid as the average annual number hours trawled between 2000 and 2014 (after Japp & Wilkinson, 2015)[115].

Seismic surveys and well-heads

There is ongoing conflict between the trawling industry and the conducting of a) seismic surveys and b) well drilling. The concerns relate primarily to:

- Exclusion from fishing grounds (short-term or long-term)
- The actual impact the surveys or drilling and or establishment of oil and gas infrastructure might have on the trawling and the demersal trawl species fished.
- Short- to medium-term declines in catch rates

Seismic surveys, which can cover large areas (Map 27) require mitigation and communication between the survey operators and the fishing industry.



MAP 27

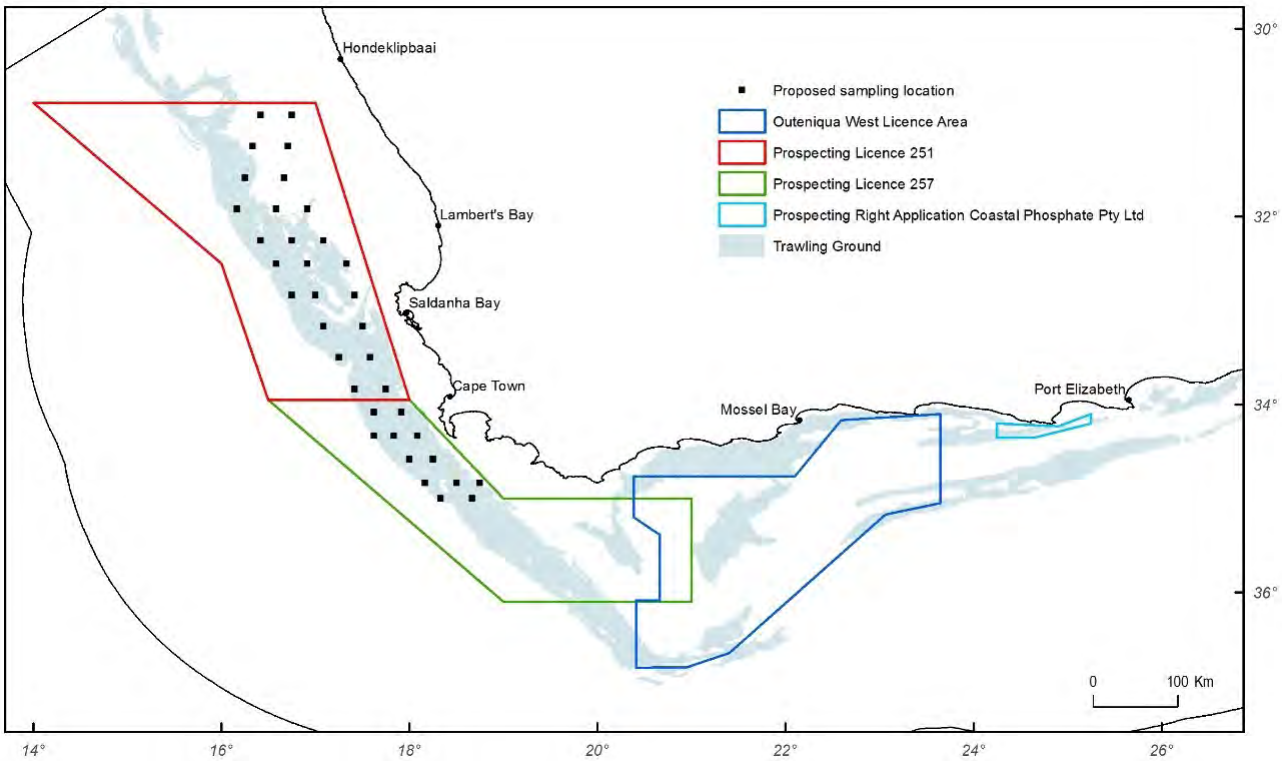
Petroleum Geo-Services application for a reconnaissance permit to conduct a 2D seismic survey in relation to the average annual demersal trawl sector fishing effort for 2000 – 2014 (Japp & Wilkinson, 2015)[116].

Seabed mining

Similar to the oil and gas conflict, the development of mining activities offshore is increasing. Currently the principal sector involved is marine diamond mining, but exploratory surveys for potential bulk sediment mining of phosphates have commenced. This is an area of considerable concern for the trawling industry because of:

- Exclusion from trawling areas
- Environmental impacts
- Potential reduction in allowable catches due to stock declines associated with ecosystem effects[117]

Brick and Hasson (2017)[117] overlaid annual demersal trawl catch data, for the period 2000–2014, with marine phosphate prospecting areas. As evident in Map 28, there is substantial overlap between the trawl grounds and marine phosphate prospecting areas. Between 2000 and 2014, on average, 77% of the demersal trawl catch has fallen within one of the prospecting areas. While there is potential for exclusion from mining areas and a very realistic threat of negative ecosystem impacts if large-scale mining were to take place, the current large areas assigned for prospecting are not indicative of the scale of future mining activities that would realistically be conducted at select locations within the prospecting rights areas (Map 28).



MAP 28

Spatial distribution of the inshore and offshore demersal trawl sectors (trawl ringfence indicated by the blue shaded area) in relation to the offshore phosphate mining prospecting areas Green Flash Trading (251 & 257), the Outeniqua West License Area and the prospecting area granted to Coastal Phosphate (Pty) Ltd. Proposed sampling locations have been announced for license areas 251 and 257 as indicated on the map (Currie, 2013)[118].

3.5.2.2.1.2 SECTOR: DEMERSAL HAKE LONGLINE

OVERVIEW OF THE SECTOR

Hake-directed demersal longlining is a relatively new fishery, having started in the early 1990's. The fishery went through a trial experimental period between 1994 and 1996, was formerly established through medium term rights in 1998 and then long-term (15 years) rights were allocated in 2004 that were synchronised with the hake deepsea trawl sector.

The impact of hake longlining on the hake stocks and the fishing industry as a whole remains relatively poorly understood. Japp and Wissema (1997)[119] provided a brief overview of the hake longline experiment. One of the more important outcomes of the experiment was that the longline gear selectively caught proportionately larger hake than trawl gear, that the proportion of females was higher than in trawls and that longline gear could be deployed in hard ground areas generally not accessible to trawls. These features of hake-directed longlining clearly differentiated the fishery from demersal trawl spatially. Further, as the fishery evolved, it became clear that the selective size characteristic of the longline fishery (i.e. ability to target large fish) was probably related to the access the fishery had to hard grounds not fished by the trawlers.

As the fishery developed, the grounds fished using longlines expanded (Map 25) to a point where currently there is near complete overlap of the hake longline and demersal trawl fisheries. This has resulted in user conflict as pointed out above. The size of longline-caught hake appears to have decreased, providing subjective evidence that the hake availability on the harder grounds initially fished by the longliners, has declined and the size distribution of hake in longlines is now similar to that of trawl (without the large juvenile component in the trawl fishery). This observation suggests that the hard grounds not previously fished by trawlers provided a form of sanctuary for larger hake. The longline fishery is a relatively selective fishery with a low bycatch.

The kingklip longline experiment which preceded the hake longline experiment between 1983 and 1989 also raised many questions around the spatial management of kingklip (Japp, 1989)[120]. The decline in the kingklip stock and the clear spatial separation of the longline fishery into areas where kingklip are targeted (Figure 8) strongly suggested the need for spatial management of the kingklip and resulted in the implementation of the "kingklip box"[121]. Further evidence now suggests that the east coast area, where large aggregations of kingklip were targeted, may be a preferred habitat for kingklip and in fact is an area of high biological activity (Sink pers comm.).[122]

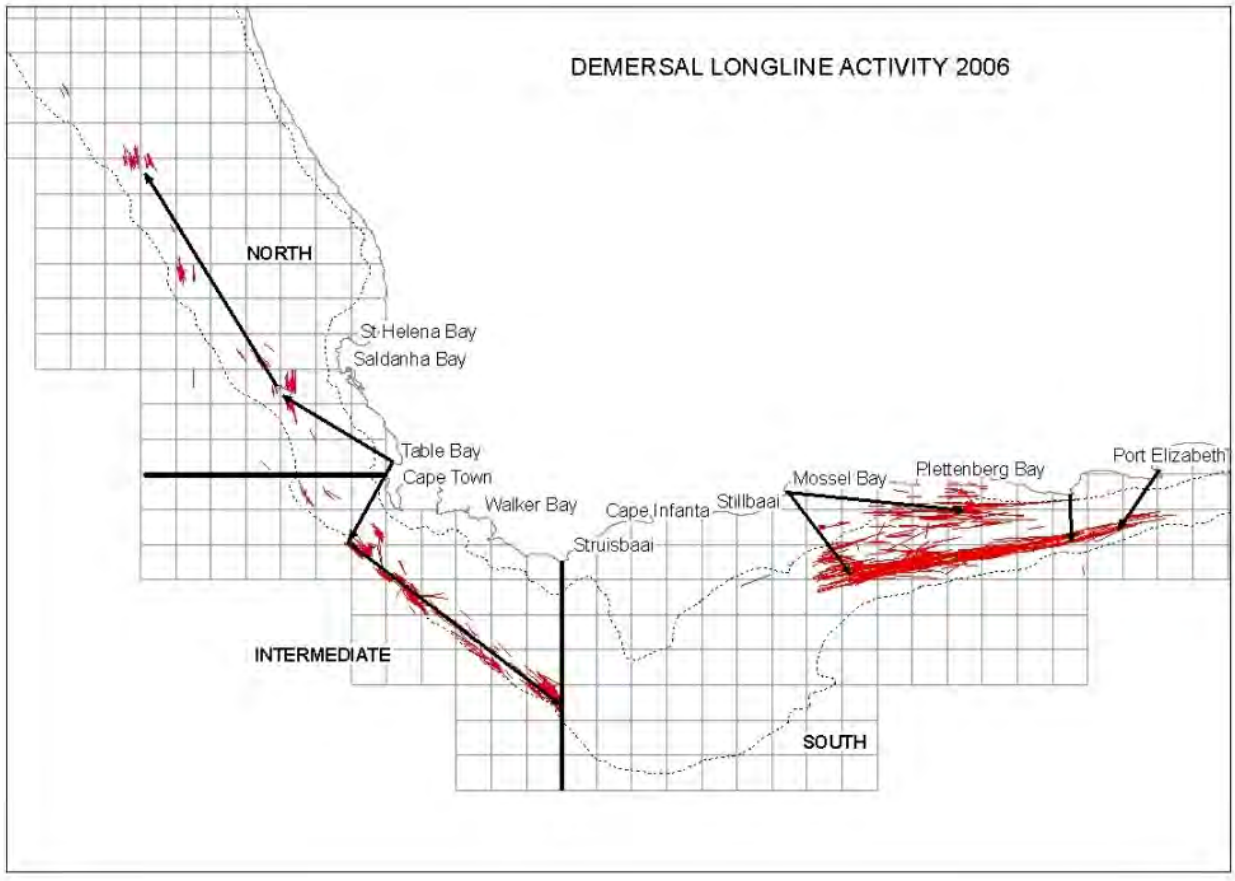


Illustration of typical long-line directed effort in 2006 showing clear separation of fishing areas (Japp, 2007)[123].

FIGURE 8

STOCK DYNAMICS

Stock issues relating to hake are similar for both trawl and demersal longline. Although longline-directed hake is the designated target species for the fishery and falls under the allowable catches and fishery measures for hake and hake trawl, kingklip remains the primary bycatch of the fishery. As with numerous other demersal stocks (e.g. hake) the stock structure of kingklip is somewhat uncertain. Abundance of kingklip is strongly area and habitat dependent and the existence of stocks that are habitat dependent with specific aggregating areas remains a fundamental question.

CURRENT SPATIAL AND TEMPORAL MEASURES

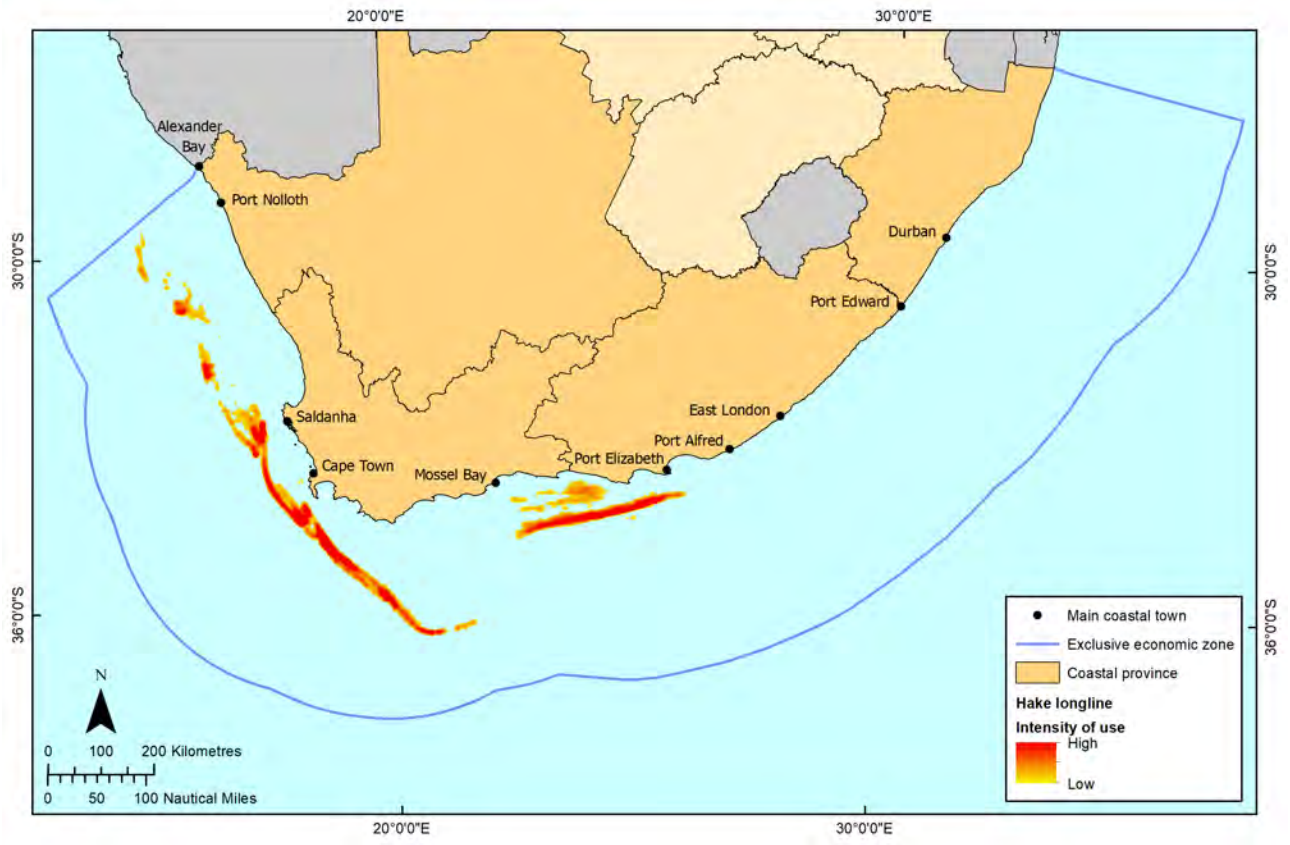
The spatial and temporal measures applied to hake trawl also apply to the hake directed longline fishery. In the earlier years of the management of the fishery, area-based separation of hake longline was applied – i.e. splitting of the TAC between "East Coast" and "West Coast" and also inshore-offshore separation similar to the inshore and deepsea trawls. Separate rights are still (2018) allocated for the west and south coasts, with the south coast fishery being restricted to inshore areas within 20 nm of the coast or in waters shallower than 110 m (whichever is furthest from the coast). The hake longline apportionment is less than 10% of the TAC and increasingly longline allocation is being converted to trawl. The fishery nevertheless remains a key part of the hake fishery, mostly because it has many rights holders with relatively small allocations.

As the longline fishery is not part of the MSC certification, it does not have the ring-fence restrictions that apply to the trawl fishery.

KEY SPATIAL INTERESTS

The priority fishing areas (Map 29) are also similar to the trawl fishery as follows:

- **AREA 1:** Due west of Hondeklip Bay – this is an area known as the Karbonkle or Child's Bank;
- **AREA 2:** Due west of Saldanha Bay – this is an area known as the Dassen Hole and is part of a feature known as the Cape Canyon;
- **AREA 3 :** An extensive area extending from due west of Cape Town to due south of Danger Point, also referred to as "Browns Bank";
- **AREA 4:** An area due south of Cape Agulhas extending towards the southern-most part of the Agulhas Bank;
- **AREA 5:** South of Port Elizabeth and Cape St Francis in an area known as the Chalk Line.



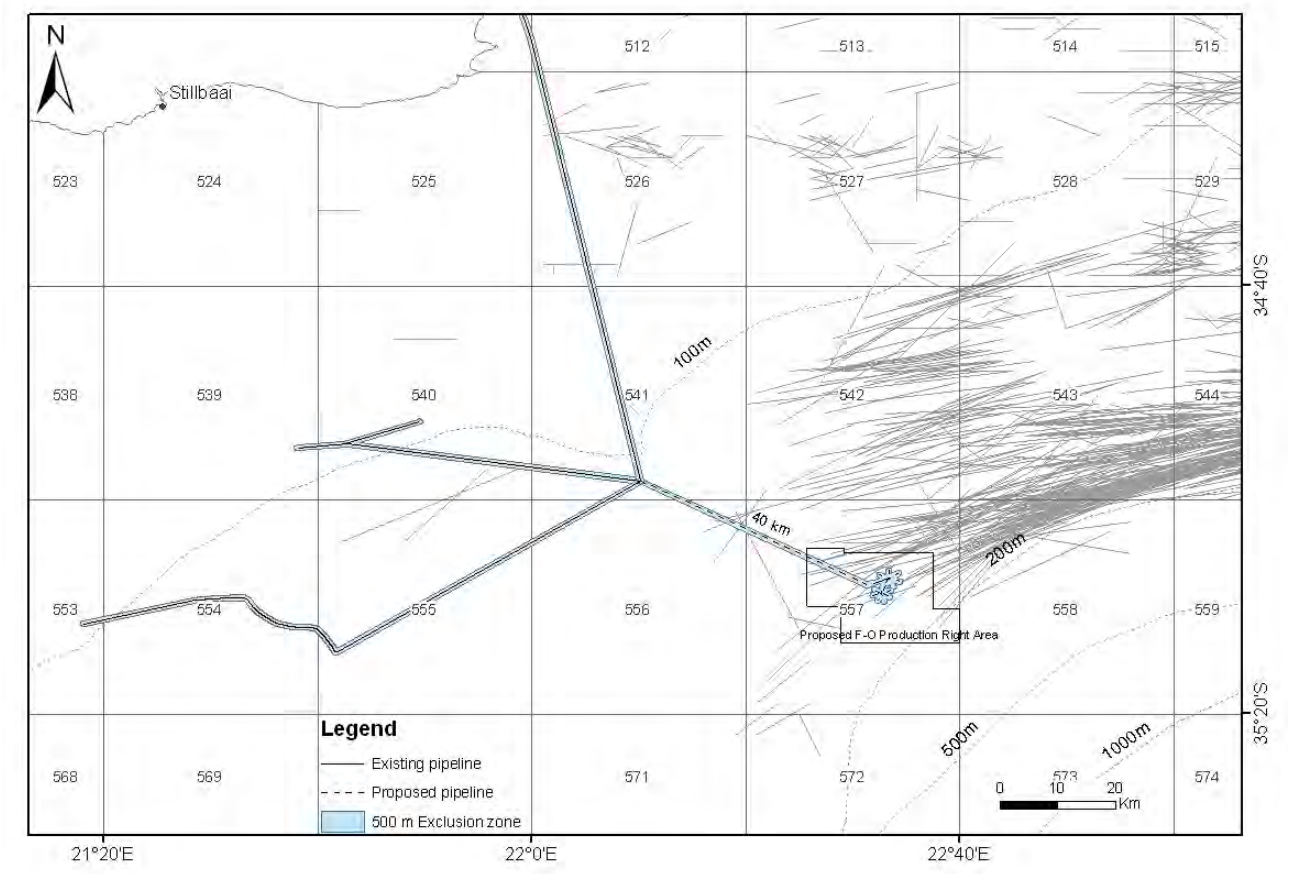
MAP 29

Spatial distribution of intensity of use ("effort" expended) by the demersal hake longline sector for the years 2000 to 2017. The map is based on relative catch in kg / km² over the data period (see Annex for details).

The overlap of the hake longline fishery with benthic habitat types is similar to demersal trawl[124]. The exception is however that demersal longlines are also set over hard ground effectively extending the area fished with known habitat types as described by both Wilkinson and Japp (2005)[112] and Sink et al. 2012[104]. Broadly, the longline has the ability to fish on both the trawl grounds (flat sandy areas mostly) and also on hard grounds (reef, high profile, hard). Longlining (which can set up to 20 000 hooks on a line up to 20 km long) nevertheless has constraints. Gear is vulnerable to fouling on the bottom, can be difficult to set and haul in strong currents and is regularly fouled by trawlers. Impacts on habitat by longlines is relatively low (compared to trawling) although gear loss is common.

SPATIAL CONFLICTS WITH OTHER USES AND INTERESTS

Similar areas of conflict occur as with the hake-directed trawling. Longline gear, as with trawl gear, can overlap with offshore oil and gas and offshore mining activities (Map 30). Impact on the longline sector is less intrusive than for trawl as the gear can be set over structures on the seabed.



Overview of the spatial extent of the Demersal Longline Fishery (grey lines) in Relation to the proposed FO Gas Field Development and the current South Coast Gas Development (Japp & Wilkinson, 2010)[125].

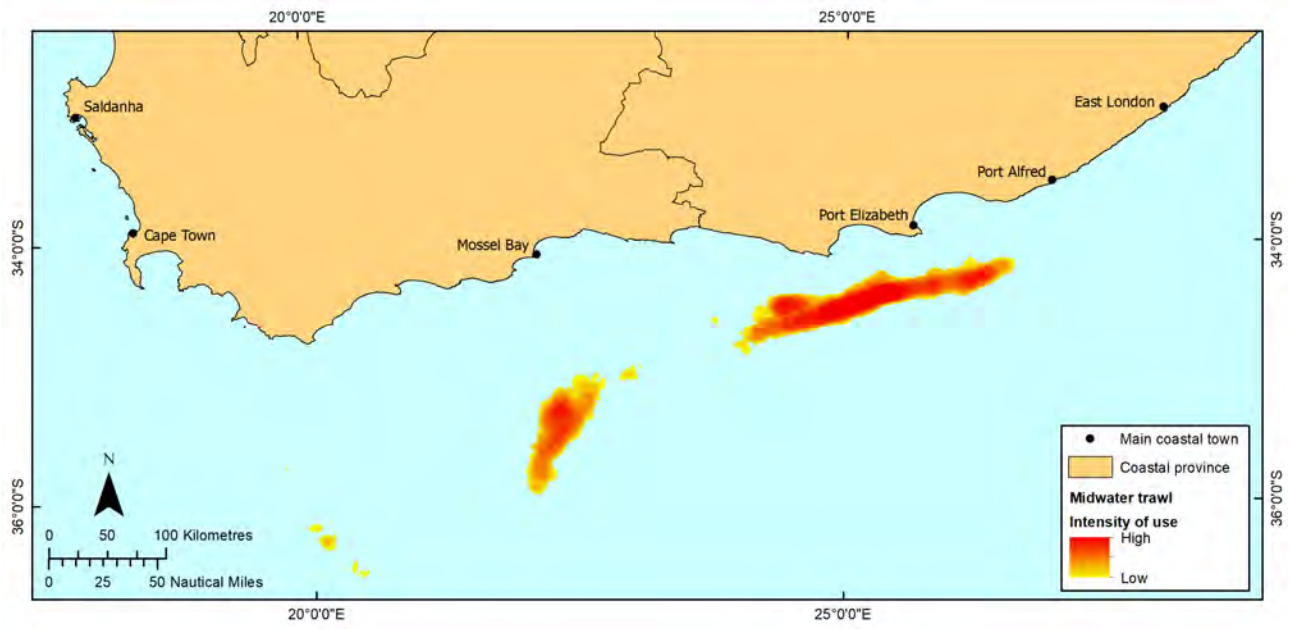
MAP 30

3.5.2.2.1.3 SECTOR: MID-WATER TRAWL

OVERVIEW OF THE SECTOR

Cape horse mackerel (*Trachurus capensis*) are semi-pelagic shoaling fish that occur on the continental shelf off southern Africa from southern Angola to the Wild Coast. They exhibit a distinct diurnal vertical migration rising to feed on plankton in the water column, at which time adults from the population are targeted by a directed midwater trawl sector (Map 31). Horse mackerel are also caught as a bycatch in the small pelagic fishery (primarily juveniles) and hake demersal trawl sectors. The midwater trawl sector is dominated by a single, large midwater trawler (the *FV Desert Diamond*), which started operating on the south coast in 2003. The sector also consists of a number of offshore hake trawlers (smaller than the *Desert Diamond*) that carry both hake and horse mackerel rights that enable them to opportunistically target horse mackerel (primarily on the west coast) with midwater trawl gear, in addition to fishing for hake at other times using demersal trawl gear.

Horse mackerel is managed using annual Total Allowable Catches (TACs) for the midwater trawl fishery, Precautionary Upper Catch Limits (PUCLs) for the small pelagic fishery and a bycatch reserve for the demersal trawl fishery. Recommendations on allowable catches of horse mackerel are derived from application of an Operational Management Procedure (OMP), which provides rules to guide the determination of an annual, fluctuating TAC, which allows for increased catches during periods of high abundance and a decrease in TAC when abundance decreases[126].



MAP 31

Spatial distribution of intensity of use ("effort" expended) by the dedicated midwater trawler for the years 2008 to 2016. The map is based on relative effort in hours of trawling (see Annex for details).

CURRENT SPATIAL AND TEMPORAL MEASURES

The *FV Desert Diamond* was, until recently, restricted to the south coast, east of 20° E (the Agulhas Bank). This spatial management measure was intended to constrain the fishery to catching only adult horse mackerel while protecting juvenile horse mackerel, which are found inshore and predominantly on the west coast. Currently, the *FV Desert Diamond* is doing trial trawls west of 20°E to test the availability of horse mackerel in an experimental area between the 20°E line of longitude and the line drawn due westwards from Cape Point (34°20'S). In addition to the existing permit conditions i.e. 100% observer coverage, no fishing in depths less than 110 m or within 20 nautical miles from the coast (Table 6), DFFE

have also set conditions that include strict limitations on bycatch. Concerns regarding the likely increased bycatch within this experimental area were raised necessitating restrictions on key bycatch species, namely hake, sardine, redeye round herring, sunfish, Cape fur seal, heaviside dolphin, common dolphin, dusky dolphin, African penguin, turtles, requiem sharks, hammerhead sharks and manta rays. If the limits are reached for any one of these species, midwater trawling by the vessel would be suspended immediately and the historical spatial limits reinforced i.e. 20°E restriction[127].

Fishing and restricted areas for vessels operating midwater trawl gear. TABLE 6

SECTION B: FISHING PERMIT CONDITIONS FOR: HAKE; AGULHAS SOLE; HORSE MACKEREL AND DEMERSAL SHARK	
FISHING SEASON: 2017	
3	Fishing and Restricted Areas
3.1	This permit is valid only in South African waters (excluding tidal lagoons, tidal rivers and estuaries), closed areas and marine protected areas as stipulated in Chapter 3 of MLRA Regulations
3.2	No fishing shall take place within False Bay, north of a straight line drawn from the lighthouse at Cape Hangklip to the lighthouse at Cape Point
SECTION C: SECTOR SPECIFIC PERMIT CONDITIONS: HORSE MACKEREL	
FISHING SEASON: 2017/2018	
2	Fishing and Restricted Areas
2.1	This permit is valid only in South African waters (excluding tidal lagoons, tidal rivers and estuaries) east of 020°E longitude
2.2.	No fishing shall take place in water depths of less than 110m or within 20 nautical miles from the coast, whichever is the greater distance from the coast.
SECTION C: SECTOR SPECIFIC PERMIT CONDITIONS: HAKE/HORSE MACKEREL	
FISHING SEASON: 2017	
2	Fishing and Restricted Areas
2.1	This permit is valid only in South African waters (excluding tidal lagoons, tidal rivers and estuaries).
2.2.	In the area east of 020°E longitude, no fishing shall take place in water depths of less than 110m or within 20 nautical miles from the coast, whichever is the greater distance from the coast.
2.3	In the area west of 020°E longitude, no fishing shall take place within 5 nautical miles of the coast.
2.4	During the period 1 September to 30 November, no fishing shall take place within the "Kingklip Box"
2.5	No fishing may take place outside of the areas defined as the "Hake Trawl Ring Fence"

The midwater trawl sector operates throughout the year and thus there are no seasonal variations in catch landings. There is however, in addition to the TAC allocations, an effort limitation strategy imposed on the midwater trawl fleet (including the dual right holders).

KEY SPATIAL INTERESTS

The Cape horse mackerel is a highly nomadic species with its distributions largely driven by environmental conditions. The shoals are usually concentrated in a small area and migrate seasonally[128], greatly limiting this fishery. Juveniles are largely planktivorous, feeding on copepods in the water column near the surface (and are thus captured in the small pelagic seine-net fishery), whereas adults are opportunistic feeders preying on euphasids, polychaetes, crustaceans and other small fish in the midwater and benthic environs. Horse mackerel and Cape hakes are of similar size and feed on similar prey items resulting in the potential for interspecific competition between these species[129]. The directed midwater trawl sector is focused on the Agulhas Bank, particularly on the shelf edge on the south and east coasts. It is only in these areas that viable catches of horse mackerel are made.

Five fishery priority areas for the directed midwater trawl sector were identified during a spatial management workshop held earlier this year[130]. These include:

1. **AREA 1:** east coast offshore of Port Elizabeth;
2. **AREA 2:** south of Danger Point;
3. **AREA 3:** Blues (20°E);
4. **AREA 4:** Blues (21 - 22°E); and
5. **AREA 5:** eastern Agulhas Bank

The directed midwater trawl sector is not considered to have significant impacts on habitat, provided that it adheres to the definition of midwater trawling by not coming into contact with the sea floor.

SPATIAL CONFLICTS WITH OTHER USES AND INTERESTS AND BYCATCH CONCERNS

Midwater trawl vessels tow their net at a higher speed than demersal trawl vessels and for this reason have higher potential for entanglement of sea birds, sharks, dolphins and seals when near the surface[131]. Sea birds and small mammals are known to forage on fish escaping from trawl nets and frequently get tangled in the net as it is being hauled. Sunfish (*Mola mola*) are also known to be captured in midwater trawl nets as bycatch, although currently very little information exists on the frequency and extent of impact this has on sunfish populations.

3.5.2.2.1.4 SECTOR: SMALL PELAGIC PURSE SEINE

OVERVIEW OF THE SECTOR

Management of the small pelagic sector is probably the most complex of all the main commercial fisheries in South Africa. The three main species that fall under this management regime are the anchovy (*Engraulis encrasicolus*), sardine (*Sardinops sagax*) and redeye round herring (*Etrumeus whiteheadi*) which are targeted off the west (all species) and south (sardine only) coasts and caught using purse-seine nets. Collectively these species are often referred to as Lower Trophic Level (LTL) species as they are near the bottom of the food chain and are important prey for many other fish species such as hake, snoek and the seasonal (migratory) tuna, as well as some marine mammals and seabirds. There are other LTL species in South African waters, including the mesopelagic lantern and light fishes, which also provide feed for many demersal (bottom) and pelagic (surface) feeding fish. Adding to the complexity of the fishery is the by-catch of juvenile horse mackerel (*Trachurus capensis*) and occasionally chub mackerel (*Scomber japonicus*) and the operational constraint that anchovy catches result in unavoidable bycatch of juvenile sardine – resulting in a trade-off between directed anchovy catches and future directed sardine catches. An experimental fishery for mesopelagic lantern fish that are also reduced to fish meal and oil fishes operates primarily around Cape Columbine. Because this is the largest of South Africa's fisheries sectors in terms of landed catch, and because of the ecological importance of the target species, the importance of the small pelagic sector cannot be underestimated.

The majority of the fleet of 63 vessels operate on the West Coast from St Helena Bay, Laaiplek, Saldanha Bay, Hout Bay and Gans Bay, with fewer vessels operating on the South Coast from the harbours of Mossel Bay and Port Elizabeth. Ports of deployment correspond to the location of canning factories and fish reduction plants along the coast. Anchovy and redeye round herring are reduced to fish meal and oil, and sardine are canned or frozen for human consumption and pet food; and also frozen for bait. The dynamics of the stocks exploited are reflected in the nature of the fishery operations, both spatially and temporally. The fishery is multi-species with what can be defined as "target sectors" viz:

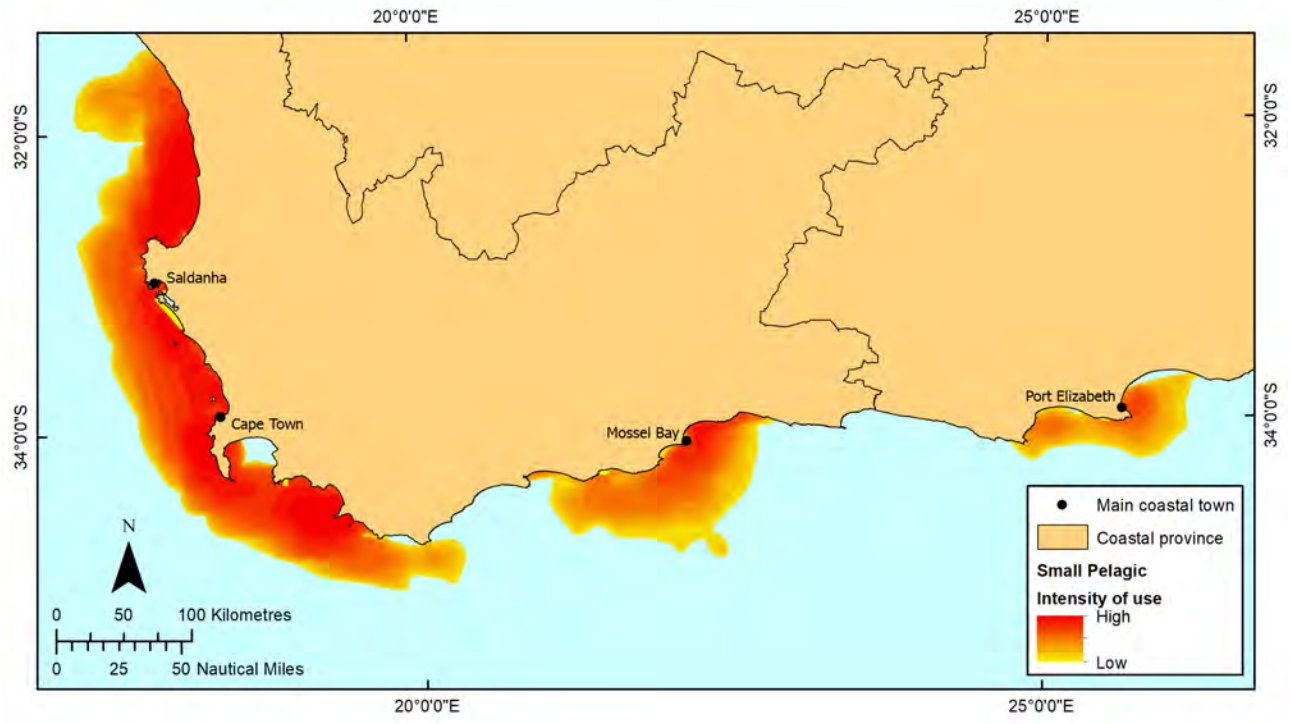
- TARGET FISHERY 1: Sardine directed with occasional anchovy, redeye round herring and horse mackerel bycatch
- TARGET FISHERY 2: Anchovy directed with juvenile sardine, redeye round herring, horse mackerel and chub mackerel bycatch
- TARGET FISHERY 3: Redeye round herring directed with sardine and horse mackerel bycatch)
- TARGET FISHERY 4: Bait fishery for sardine with little bycatch


Example of small pelagic fish sample for ground truthing acoustic reading

© Fisheries Resources Research

In combination these fisheries overlap spatially and seasonally, and have limits on bycatch and other measures relating to mesh size and area controls, including temporary closure of areas in which the bycatch of horse mackerel is high, etc. This would make spatial management a critical aspect of the management of the fishery (Map 32). The current fishery management measures have evolved over time and those that remain in place were implemented in the early days of the fishery (see recent catch history in Figure 9).

More recently, however, there have been some important developments, in particular the experimental closure to purse seine fishing in the vicinity of islands on which there are penguin breeding colonies in order to determine the extent to which catches may influence penguin breeding success. There has also been ongoing research on the population structure of sardine and the identification and delineation of semi-discrete stocks.



MAP 32

Spatial distribution of intensity of use ("effort" expended) by the Small Pelagic purse-seine sector for the years 2000 to 2016. The map is based on relative catch in kg / km^2 over the data period. Note, that no fishing actually extends into False Bay or Hout Bay, and that that this is a mapping artefact based on the relatively coarse grids used for data collation and the analysis method applied (see Annex for details).

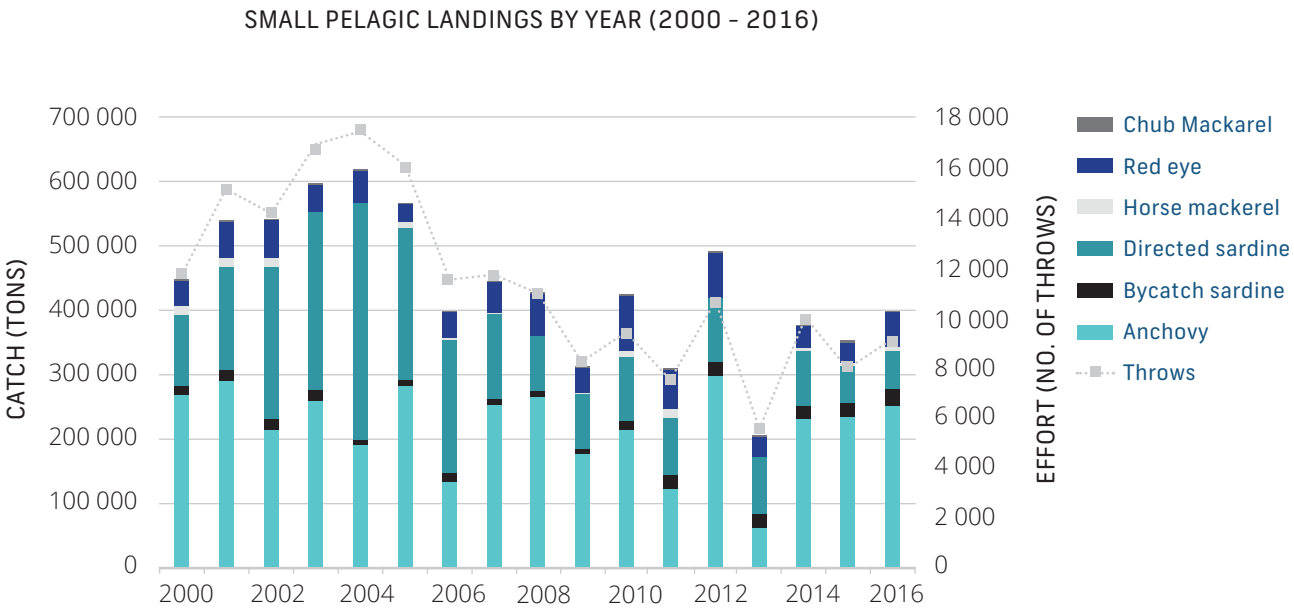


FIGURE 9

Graph showing national catch of small pelagic species by the purse-seine fleet for the years 2000 to 2016. Annual effort expenditure is indicated as the number of recorded sets (data after Norman et al., 2018)[113].

STOCK DYNAMICS

Despite many years of intensive research on sardine some uncertainty still remains about how many stocks of sardine exist. Current research suggests that that there are actually three semi-discrete stocks of sardine: one each on the west coast, south coast and east coast (van der Lingen et al., 2015[132]). The west and south coast 'stocks' are the most important for the sardine fishery. These are not totally isolated from each other and there is thought to be movement of fish between them, with recruitment from the more productive 'west stock' to the 'south stock' thought to be particularly important for maintaining the productivity of the latter (Coetzee et al., 2008[133]; de Moor et al., 2017[134]).

The relatively recent awareness of different stocks and the relationships between them has important implications for management because it means that care must be taken not only to ensure that the population as a whole is not over-exploited and reduced below thresholds at which future recruitment could be threatened, but also that the separate stocks are similarly maintained above critical thresholds. In 2015 and 2016 this was done through an informal agreement between DFFE and the fishing industry that the proportion of the TAC that could be caught west of Cape Agulhas would not exceed 70% and 45.6%, respectively. In formulating this agreement, the underlying rationale was that overall sardine recruitment was primarily dependent on spawning products from the area to the west of Cape Agulhas reaching the West Coast nursery area. Hence it was considered that there was a need to ensure a sufficiently large spawner-biomass in this western area. Formal spatial management measures have been introduced more recently. The economic and operational implications of a spatially divided TAC are profound, whether this is done directly by the Operational Management Procedure (OMP) or subsequently through a set of rules. Failure to take a spatial approach could, however, have major negative impacts on the resource and the ecosystem given the current spatial mismatch between the distribution of the sardine resource and the location of the major landing and processing facilities.

Potential adaptation by the industry is further complicated by likely variability in the distribution of the two stocks between the west and the south coasts, which could make planning of, for example, future infrastructure development difficult.

The status of the African penguin (*Spheniscus demersus*), which is highly dependent on sardine and anchovy as forage, remains an urgent concern and the population numbers are continuing to decline. There are a number of factors considered to be contributing to the decline in penguin abundance, one of which is that pelagic fishing in the vicinity of islands used by penguins for breeding could be having a negative impact on the breeding success of penguins through resource competition. This possible impact is being examined through an experiment, initiated in 2008, that involves alternately opening and closing to purse-seine fishing the areas around two pairs of islands, Robben and Dassen Islands on the West Coast and Bird and St Croix Islands on the south coast, and testing to see whether there is a measureable difference in breeding success between those periods when an island is closed to fishing compared to when fishing is allowed in the vicinity. In parallel with this process, a complementary study of the economic impacts of closing the areas around Robben and Dassen Islands was undertaken[135]. The results from the study suggest that the cost to the fishery of alternately closing Dassen and Robben Islands would be between ZAR 9.5 million and 50 million per year with an average estimate of ZAR 24 million.

CURRENT SPATIAL AND TEMPORAL MEASURES

The following spatial measures apply to the small pelagic fisheries. (Section B: Permit Conditions: Pelagic Fish Sardine & Anchovy Fishery: 2017). All Marine Protected Areas as declared under section 43 of the Marine Living Resources Act (MLRA) and all closed areas as declared under section 77 of the MLRA.

No person shall use any purse seine net for fishing or any other purpose in the following areas:

- "Voorsteklip" on the Plaat to the beacon marked M1 at Mudge Point, near Hawston; and
- The lighthouse on the southern breakwater in the fishing harbour of Gansbaai and a beacon marked M1 at Mudge Point, during period 1 December to 31 January
- Landward of a straight line joining Cape Vacca and The lighthouse at Cape St Blaize and Gericke Point and the lighthouse at Cape St Blaize;
- At present, areas around St Croix Island (and Riy Bank) on the South Coast and Robben Island on the West Coast are closed to purse-seine fishing (see below), but areas around Bird Island (South Coast) and Dassen Island (West Coast) may be closed in the near future. These are specific to the island closure experiment and are on a three-yearly rotational basis with Bird and Dassen Island.
- Purse-seine fishing is prohibited within a 10.799 nm radius around St. Croix Island, with the centre of the island being used as the position. VMS guidelines are provided.
- Purse-seine fishing is prohibited within a 2.699 nm radius around Riy Bank, with the centre of the Riy Bank being used as the centre position. VMS guidelines are provided.
- Purse-seine fishing is prohibited within a 10.799 nm radius around Robben Island, with the centre of the island being used as the centre position. VMS guidelines are provided.

Even though the fishery management would seem complex, the spatial measures (other than for the Island Closure experiment) are relatively simple and focus on Marine Protected Areas. The fishery applies other measures to control catch, in particular limits on bycatch, TAC and Precautionary Catch Limits for some species e.g. redeye round herring, sardine and juvenile horse mackerel.

The fishery catch reporting is also done on a smaller scale than the demersal trawl and uses a 10'x10' grid allocation and has move-on rules when bycatch of horse mackerel or other bycatch species (including juvenile sardine) is high.

KEY SPATIAL INTERESTS

There is an established seasonal pattern that reflects the migration and inter-annual growth of the small pelagic resources exploited (Figure 10). The fishery operates throughout the year with a short break from mid-December to mid-January. The geographical distribution and intensity of the fishery is largely dependent on the seasonal fluctuation and distribution of the targeted species. The small pelagic fleet concentrates effort in a broad area extending southwards from Lambert's Bay past Saldanha and Cape Town towards Cape Point, and between Cape Point and Cape Agulhas on the West Coast, and in the vicinities of Mossel Bay and Port Elizabeth on the South Coast (Map 32). The anchovy-directed fishery takes place predominantly on the South-West Coast from Lambert's Bay to Kleinbaai (19.5°E) and similarly the intensity of this fishery is dependent on fish availability and it is most active in the period from March to September. Redeye round herring (a non-quota species) is targeted when available and specifically in the early part of the year (January to March) and catches are distributed from Lambert's Bay to south of Cape Point. This fishery typically extends further offshore than the sardine and anchovy-directed fisheries.

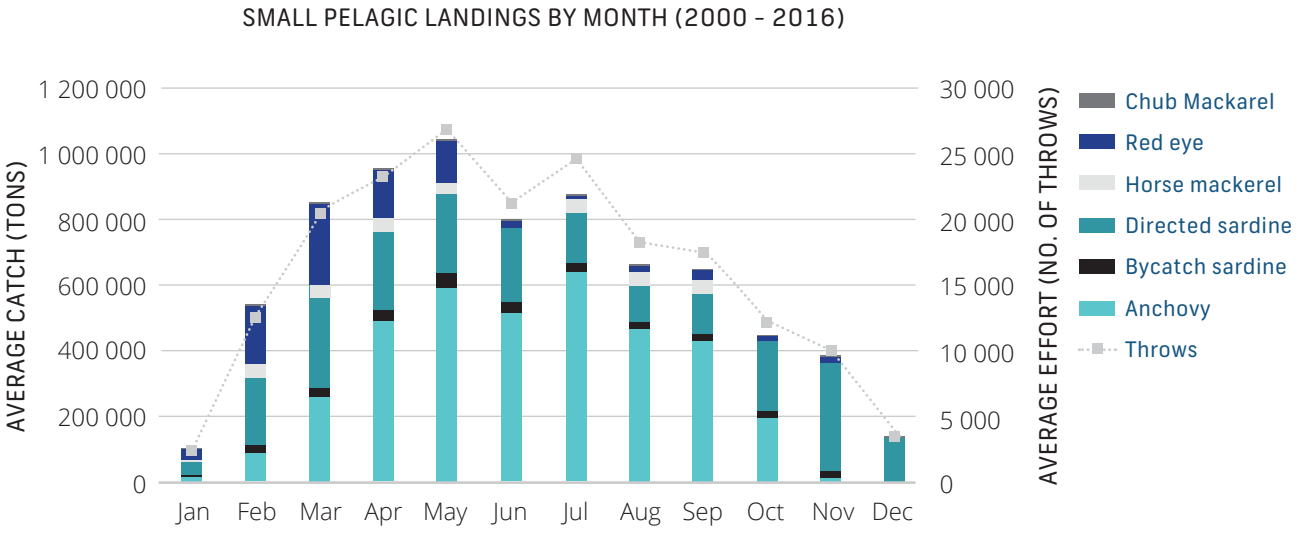


FIGURE 10

Graph showing average monthly catch (tons) and effort (number of sets) reported for the small pelagic purse-seine fleet over the period 2000 to 2016 (data after Norman et al., 2018)[113].

No inference is made regarding the overlap of the small pelagic fishery with habitat as the purse seine gear is a surface / midwater gear and has no reported interaction with the substrate.

SPATIAL CONFLICTS WITH OTHER USES AND INTERESTS

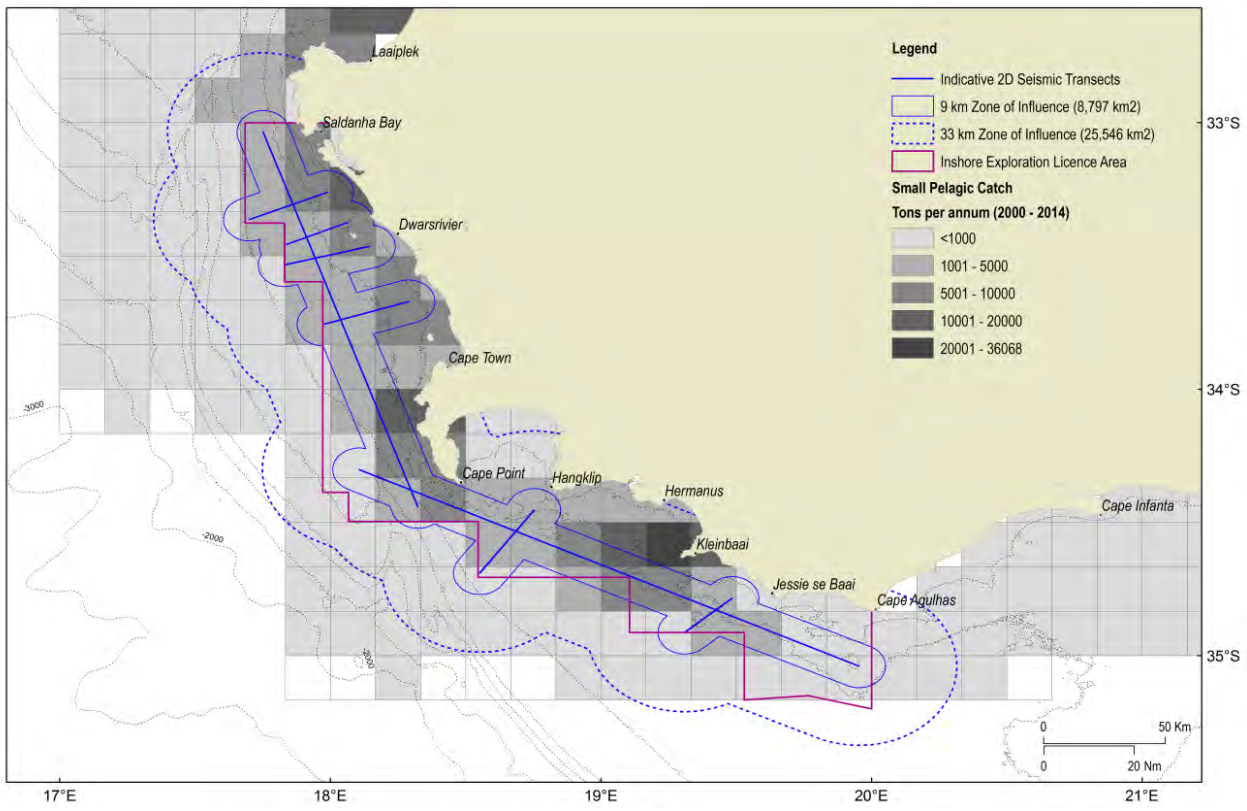
As with other fishery sectors, the small pelagic fishery can be directly impacted by seismic surveys and will also be excluded from areas should offshore infrastructure be developed in areas fished for small pelagic species. Of more concern than the short-term operational closures for the fishery, is the possible impact on the distribution of the small pelagic species and also the possibility of mortality of larvae and or adults possibly associated with the airgun discharge.

Oil drilling and seismic surveys

There is ongoing conflict between the small pelagic industry and the conducting of a) seismic surveys and b) well drilling. The concerns relate primarily to:

- Exclusion from fishing grounds (short-term or long-term).
- The actual impact the surveys or drilling and or establishment of oil and gas infrastructure might have on the small pelagic species.
- The possibility of oil spills is also an additional risk to not only the fishery directly but also the pelagic ecosystem a whole.

These surveys, which can cover large areas (Map 33) require mitigation and communication between the survey operators and the fishing industry.



MAP 33

Spatial distribution of catch reported by the South African small pelagic purse-seine fishery (2000 – 2014) in relation to the inshore exploration licence area and proposed 2D seismic survey transects. The 9 km and 33 km zones of influence around the proposed 2D transects are also indicated (Japp & Wilkinson, 2015)[136].

3.5.2.2.1.5 SECTOR: DEMERSAL SHARK LONGLINE

OVERVIEW OF THE SECTOR

In 2005 the shark longline sector was split into a demersal shark longline component, which predominantly targeted soupfin (*Galeorhinus galeus*) and smooth-hound sharks (*Mustelus spp.*); and a pelagic shark longline component (seven vessels), which predominantly targeted shortfin mako (*Isurus oxyrinchus*) and blue sharks (*Prionace glauca*). The pelagic component were catching tunas and swordfish as bycatch. This fishery was split as a precursor to phasing out the targeting of pelagic sharks due to the concern over the local stock status of some species and the poor performance on tuna and swordfish.

The pelagic shark fishery operated under exemptions from 2005 until March 2011, when South Africa incorporated the pelagic shark fishery into the tuna/swordfish longline fishery, now termed the Large Pelagic Longline sector. Six of the seven shark exemption holders were issued with tuna/swordfish rights in March 2011. These vessels are undergoing a phase-out period to reduce shark targeting and focus on tuna and/or swordfish catches. Pelagic sharks are currently managed as bycatch in the tuna and swordfish longline fishery.

The demersal longline fishery uses bottom-set gear in inshore environments (shallower than 100m). Targeting of bull sharks (*Carcharhinus leucas*), hammerhead sharks (*Sphyrna spp.*), oceanic sharks such as blue, shortfin mako, oceanic whitetip (*Carcharhinus longimanus)* and thresher sharks (*Alopias spp.*), is prohibited.

Demersal shark longline vessels may not fish east of East London to protect the more diverse and less numerous shark fauna on the East Coast.

3.5.2.2.1.6 SECTOR: LARGE PELAGIC LONGLINE

OVERVIEW OF THE SECTOR

Fishing for tunas and swordfish with pelagic longline gear was initially attempted in the early 1960's, but interest quickly declined in favor of other more lucrative fisheries. An experimental fishery was licensed from 1997 to 2005 – this included predominantly swordfish-targeted vessels that experienced drastic declines in CPUE during the period. The commercial pelagic longline fishery was formalised in 2005, with the issuing of 18 swordfish-directed and 26 tuna-directed fishing rights valid for 10 years. The fishery was restricted to 50 permits (one permit per vessel) through Total Applied Effort (TAE) control.

In 2014 the decision was taken to no longer refer to the fleet as two different fishing strategies, tuna-directed and swordfish-directed, since the fishing behavior of the local fleet has been shifting from exclusive swordfish targeting to include tunas and sharks. The fishery is now referred to as the Large Pelagic Longline fishery and includes vessels that target tunas, swordfish and sharks as by-catch. The 10-year long-term rights granted in 2005 expired in February 2015. The new large pelagic longline fishing rights were provisionally allocated in February 2017 for a period of 15 years.

The fishery has and continues to allow an interim period for foreign vessels to charter in this sub-sector as a means of skills development and a means of acquiring suitable vessels. Foreign vessels, mainly from Japan and Chinese-Taipei, fished in South African waters through the issuing of bi-lateral agreements in the 1970s, and re-negotiated these agreements in the 1990s until 2002 (Sauer et al., 2003). Joint-venture agreements with Japan have been underway since 1995, whereby these foreign-flagged vessels are permitted to fish under a South African rights holder. The vessel is required to adhere to South African legislation, including but not limited to, the Marine Living Resources Act (Act No. 18 of 1998) and Regulations promulgated thereunder, including large pelagic longline sector specific policy. The catch from these vessels accrues to South Africa.

During the 2017-2018 fishing season 34 domestic South African registered vessels and three chartered vessels were authorised by DFFE to take part in the Large Pelagic Longline fishery. Apart from the national DFFE management measures the fishery is subject to the Conservation and Management Measures (CMMs) of the three tuna Regional Fisheries Management Organisations (RFMOs) to which South Africa is signatory. The applicable CMMs are listed in the permit conditions but do not impose any additional spatial restrictions on the sector.

CURRENT SPATIAL AND TEMPORAL MEASURES

The permit conditions for the sector restrict its movement to within the South African EEZ, unless operating in conjunction with a high seas vessel license (Table 7). Special consideration is given to the KwaZulu-Natal coastline where vessels are restricted from setting lines within 20 nm from the coast. This condition is in place to protect known migratory routes for both sea turtles and whales, and in addition may be a means of reducing conflict with offshore prawn-trawl vessels. The conditions are updated annually at Large Pelagic Management Working Group Meetings hosted by DFFE and open to affected stakeholders that include representatives of Recognised Industrial Bodies (RIBs) and NGOs.

Fishing and restricted areas for the large pelagic longline sector for the 2018/2019 fishing season. TABLE 7

SECTION B: PERMIT CONDITIONS: LARGE PELAGIC LONGLINE FISHERY	
FISHING SEASON: 2018/2019	
3	Fishing Areas
3.1	Valid in South African waters excluding tidal lagoons, tidal rivers and estuaries
3.2	Setting and retrieving of longlines can be conducted in the SA EEZ, excluding within 12 nautical mile area along the entire South African coastline
	excluding within 20 nautical miles along the KwaZulu-Natal coastline
	excluding within MPAs
3.3	Fishing will be permitted both east and west of 020°E after notification has been sent to the Department VMS Office
3.4	Fishing in SANPARKS areas is subject to regulations promulgated under the National Parks Act (Act. No. 57 of 1976) as amended.
3.5	No fishing is permitted within the EEZ of other countries

The fishing season is defined as the period from 01 February to 31 January the following year. The fishery is largely dependent on sea conditions, more so the domestic vessels with short range and limited capacity to fish in rough weather. Although the fishery operates all year round the nature of the tuna resource, that forms a large proportion of the catch, is such that there are two distinct seasons of increased effort. Yellowfin (*T. albacares*), bigeye (*T. obseus*) and longfin (*T. alaunga*) tunas are seasonal migrants into South African waters that peak in abundance in May and October each year. Catches of southern bluefin tuna (*T. maccoyii*) all occur during the winter months between May and September (as seen in commercial catch statistics and observer records). There are however no temporal management measures currently in place guiding or restricting the large pelagic longline sector.

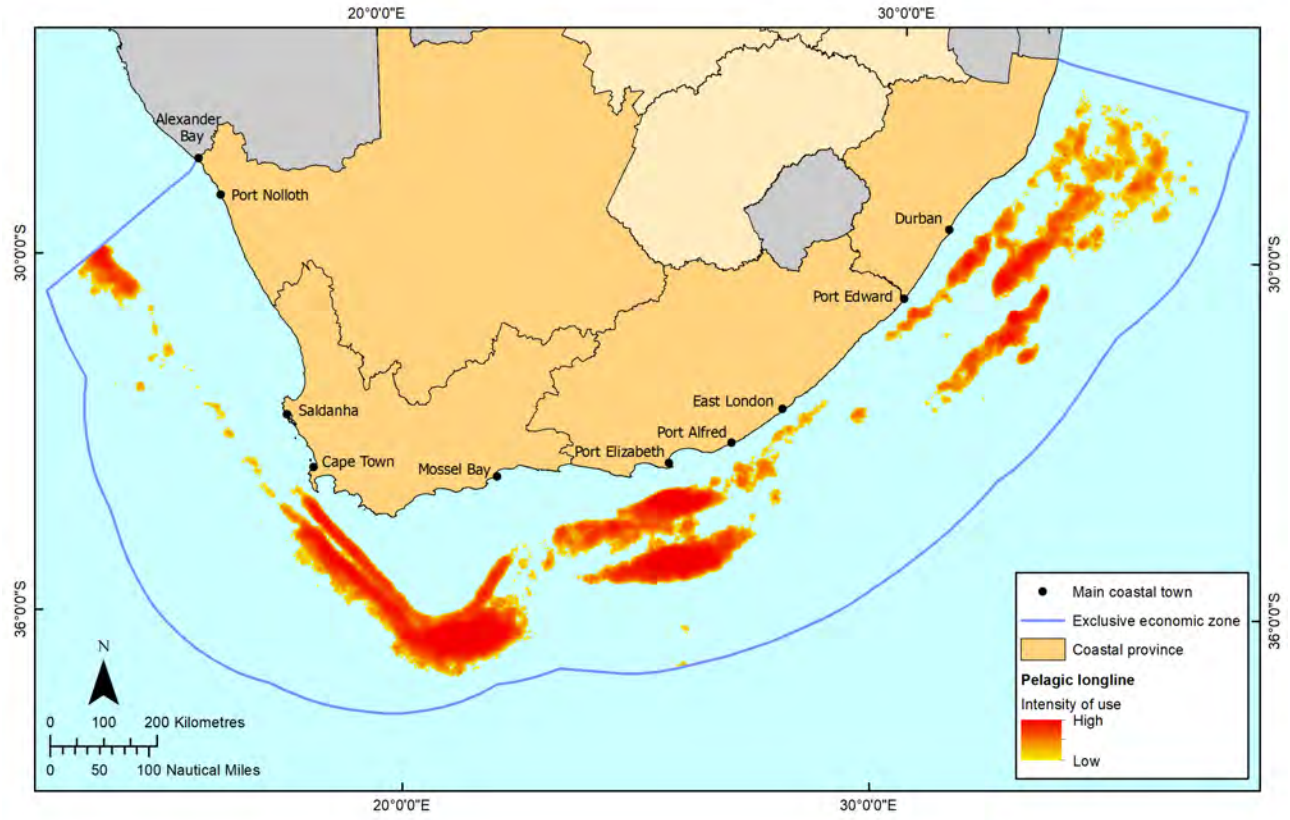
KEY SPATIAL INTERESTS

The fishery operates extensively within the South African EEZ, primarily along the continental shelf break and further offshore. The industry can be divided into two distinct groups: the local and the foreign (bi-lateral agreement) owned vessels. The local longline vessels have gear configured to target swordfish[137] and the catches are split between the target swordfish and tropical tunas[138] (bigeye and yellowfin tunas) and bycatch species, the sharks (mako and blue sharks). Lines are set at night (to reduce seabird mortality) and depending on the vessel size, 700 – 1500 hooks are set per line. Stainless steel hooks and wire traces are prohibited to phase out targeting out large make sharks. The larger, generally foreign owned vessels target tropical tuna and southern Bluefin tuna and are able to fish further offshore and differ slightly in their gear setup. These vessels set up to 3000 hooks per set with a combination of fish and squid bait, using deeper branch lines and varying hook numbers per basket to influence the setting depth. The smaller longline vessels carry ice whereas the larger vessels have freezers.

The spatial distribution of cumulative effort (number of hooks set) by the large pelagic longline sector for the years 2000 to 2014 provides an approximation the extent of the fished area (Map 34). Although not immediately apparent there is a degree of separation of the two fleets, small/domestic and large/foreign-flagged vessels, that can be seen when looking at the spatial distribution of catches of target and bycatch species (Appendix 3). The majority of catches taken in the north east of the EEZ, off Durban, are attributed to the joint-venture vessels (currently Japanese) that are capable of fishing in the turbulent waters of the Agulhas Current due to their larger size (~50m). These vessels have in recent years (since 2011) shifted their effort exclusively to the Indian Ocean part of the EEZ in response to the movement of southern Bluefin tuna (*Thunnus maccoyii*) and bigeye tuna (*T. obesus*).

The domestic component of the fleet historically fished out of Durban and Richards Bay harbours but vessels now operate predominantly out of the Cape Town and Hout Bay harbours. The vessels currently in operation are typically small fibreglass or wooden hulled and have a maximum range of two-weeks. This small size (~24m) and short range of vessels limits the extent of their operations. DFFE is focusing on development of this sector, with a total of 34 (out of a possible 50) vessels operating in the sector, following the completion of the 2015 fishing rights allocation process and issuing of long-term Rights in 2017, there is scope for expansion.

Large Pelagic survey 2015 tagging a shark © Fisheries Resources Research



Spatial distribution of intensity of use ("effort" expended) by the large pelagic longline sector for the years 2006 to 2016. The map is based on relative effort in hooks / km^2 over the data period (see Annex for details).

MAP 34

SPATIAL CONFLICTS WITH OTHER USES AND INTERESTS

Drifting longlines can extend for up to 100 km. The lines are weighted and not visible on the surface except at the position of the floats and radio buoys. There is some conflict with the deep-sea demersal trawl fishery as a result of lines being "broken" when trawlers steam across set lines. Lines are retrieved by locating the nearest radio buoy which can sometimes require hours of searching. As the name suggests, longlines drift with the currents and their movement is unpredictable, lines can drift to shallow inshore areas where they are likely to become entangled with other sectors fishing gear and also with seismic survey gear that can result in conflict.[139]

SECTORAL ISSUES FOR MSP TO CONSIDER

- The nature of the highly migratory species (yellowfin, bigeye, longfin tunas, swordfish) targeted by the large pelagic longline sector and their sporadic availability do not lend support to the delineation of priority fishing areas for the sector. Tunas and billfish are predominantly driven by their search for suitable feeding habitat that is dependent on water temperature, salinity, colour and primary production that are the driving forces behind the absence or presence of their prey. The variable nature of the South African, Agulhas and Benguela convergence, oceanic environment means that the location of these fish is highly unpredictable. In addition, the fish do not aggregate to spawn in South African waters but are present during feeding migrations from the tropics.

- Alternate target species such as blue shark (Prionace glauca) and shortfin mako shark (Isurus oxyrinchus) are less migratory and the presence of pregnant females and small/juvenile fish of each species in the catches lends support to the rationale that there is breeding habitat within the South African EEZ. Designation of this habitat as a fishery/ecological support area would contribute to the security of the sector but additional research needs to be undertaken in order to define the location of spawning for both shark species.

3.5.2.2.1.7 SECTOR: TUNA POLE-LINE

OVERVIEW OF THE SECTOR

The sector traditionally targets albacore or longfin tuna (*T. alalunga*) and operates in waters up to 1000 km off the south and west coasts[140]. Longfin are highly migratory and typically appear in South African waters from October to May, catches approximate to 4000 tons per annum, a significant volume in the south Atlantic Ocean. When available the sector will preferentially target yellowfin tuna (although some operators do not switch strategy from targeting longfin) which comprises on average 529 tons of the catch per annum.

CURRENT SPATIAL AND TEMPORAL MEASURES

The tuna pole-line sector is permitted to fish in South African waters outside of Marine Protected Areas (Table 8).

TABLE 8

Fishing and restricted areas for the tuna pole-line sector and restrictions on live-bait fishing as per permit conditions for the 2018/2019 fishing season.

SECTION B: PERMIT CONDITIONS: TUNA POLE-LINE FISHERY	
FISHING SEASON: 2018/2019	
3	Fishing Areas
3.1	The permit is valid in South African waters (excluding tidal lagoons, tidal rivers and estuaries) and may be used on the high seas in conjunction with a high seas vessel license.
3.2	The Permit Holder or any of his/her or its employees shall not undertake fishing, or take or destroy any fauna and flora, or in any way disturb alter or destroy the natural environment, or carry on any activity which may adversely impact on the ecosystems in Marine Protected Areas except where so permitted by the Minister in writing.
3.3	Fishing in other marine areas controlled by the South African National Parks, is subject to regulations, promulgated under the National Parks Act, 1976 (Act No. 57 of 1976) as amended.
3.4	No person shall use any purse-seine net for fishing for live bait or any other purpose in the following area:
a)	East of Cape Point, east of 18°29.865' E.
b)	Within a 10.799 nm radius around Dassen Island, with the light house at the centre of the circle.
c)	All Marine Protected Areas and all closed areas as declared under section 77 of the MLRA and the National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003).

Fishing is permitted to take place throughout the year. The fishery is seasonal with vessels active predominantly between November and May and peak catches recorded from November to January.

Effort fluctuates according to the availability of fish in the area, but once a shoal of tuna is located a number of vessels will move into the area and target a single shoal which may remain in the area for days at a time. The fishery is dependent on window periods of favourable conditions relating to catch availability.

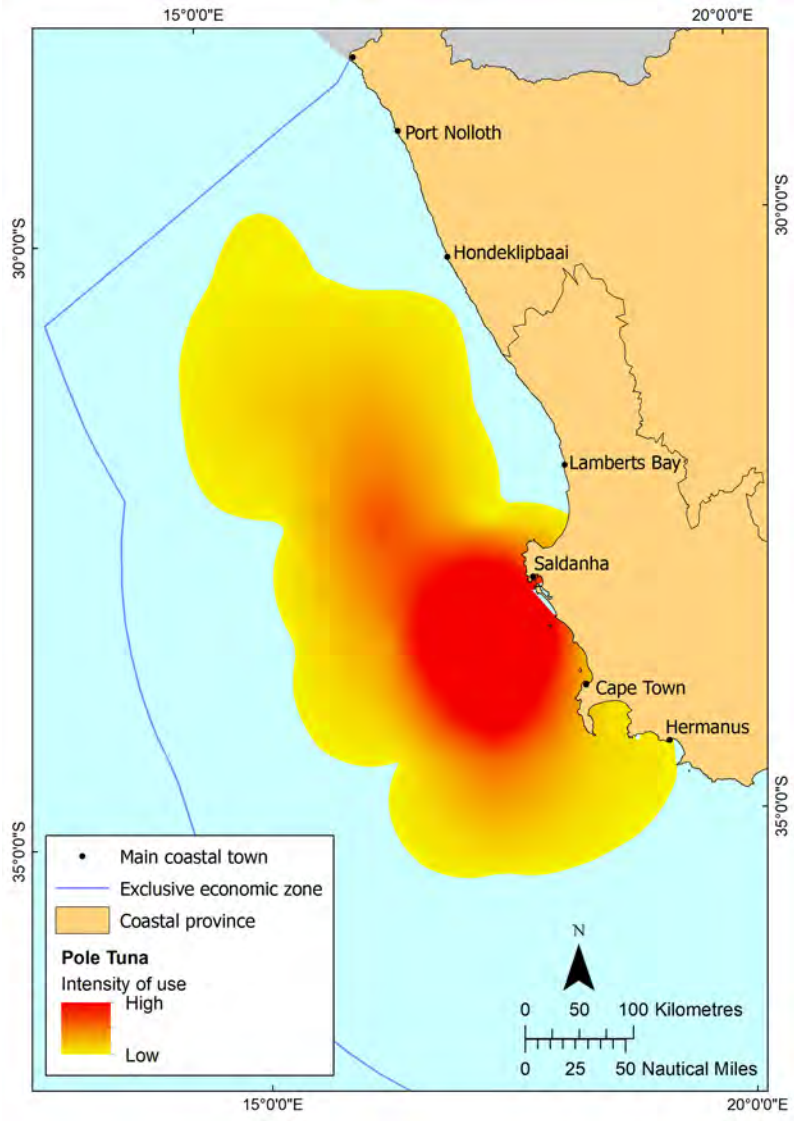
KEY SPATIAL INTERESTS

Vessels in the pole-line sector target albacore tuna (*T. alalunga*) that appear seasonally in Cape waters. The bulk of the fleet operates out of Cape Town and Hout Bay harbours and fishes within a 100 nm radius of those locations (Map 35). Smaller vessels typically conduct short trips of 5-7 days and have a specialised crew of 8-10 fishermen equipped with long poles and gaffs to haul tuna on-board. Effort is concentrated in the Cape Canyon area. Larger vessels with crew of 20 or more are capable of fishing further from port and operate along the entire west coast to the Namibian border targeting albacore. Coupled with throwing dead-, or in the case of larger vessels, live-bait in to the water, water is sprayed onto the surface adjacent to the boat to imitate the activity of a school of bait fish. Fish are drawn to the surface by the activity and gaffed from the water one at a time.

Yellowfin tuna are targeted seasonally when they appear close inshore, spatial mapping has been carried out by DFFE research scientists focusing on the yellowfin component of the catches indicating that the bulk of catches are taken within a single 1x1 degree grid block centred off Cape Town (-34°S, 18°E). This is despite the fishery having a relatively high amount of effort further up the west coast of South Africa, where albacore are generally more abundant. When targeting yellowfin or bigeye tunas the vessels will troll lines, either baited or with artificial lures, behind the vessel at speeds of 6-9 knots.

Reporting of monthly catch statistics has been compulsory since 1985 and includes daily catch (kg) per species per boat. The fishing positions are also recorded and coded according to a 1×1 degree geographic position. Recently the reporting has been improved to fulfil international RFMO data obligations and to facilitate analyses and includes information on fishing hours, number of crew, use of life-bait, sea-surface-temperature and target.

RV Ellen Khuswayo © Fisheries Resources Research



MAP 35

Spatial distribution of intensity of use ("effort" expended) by the Tuna Pole-Line sector for the years 2007 to 2016. The map is based on relative catch in kg / km^2 over the data period (see Annex for details).

SPATIAL CONFLICTS WITH OTHER USES AND INTERESTS

There is potential for conflict with other fisheries sectors that operate in the Cape Canyon area but the nature of the fishing operation does not generate conflict through gear interactions. The highly migratory resources that the sector targets are managed on a regional scale by the tuna RFMOs so the sustainability of the sector is largely dependent on the stock in the south Atlantic and southern Indian Oceans and compliance with catch limitations and CMMs by other Member nations targeting the same stocks.

Conflict with the traditional linefishery is being addressed through permit conditions and concessions to allow for targeting of yellowtail north of Cape Columbine but enforcing strict limitations on yellowtail in the traditional linefish areas of operation south of there.

The acknowledgement that core grounds exist for this sector is important as an example of territorial use rights when prioritising future developments that may encroach or exclude the pole-line sector from certain areas or at certain times of the year.

SECTORAL ISSUES FOR MSP TO CONSIDER

The sector is dependent on highly migratory tunas that are managed by RFMOs. Further spatial management or recognition of priority fishing areas nearshore around Cape Town (Cape Canyon and Cape Columbine) would likely benefit the sector.

3.5.2.2.1.8 SECTOR: PATAGONIAN TOOTHFISH

OVERVIEW OF THE SECTOR

Patagonian toothfish (*Dissostichus eleginoides)* occur at depths between 70 and 1 600 m around remote sub-Antarctic Islands and seamounts, mainly between 40ºS and 55ºS. Patagonian toothfish fetch a high price on markets in the United States and Japan and have consequently been the target of extensive fishing, primarily using longline gear. Surveillance of this resource is difficult, and the species has been subjected to substantial illegal, unreported and unregulated (IUU) fishing.

A longline fishery for this species developed in the South African Exclusive Economic Zone around the Prince Edward Islands (PEI-EEZ) and the adjacent CCAMLR areas. In 2006, five long-term fishing rights were allocated. At the start of the commercial fishery there were two active vessels, one representing the largest right-holder and a second, larger vessel operating for a consortium of the other four right-holders. The consortium soon withdrew their vessel from the fishery, and the vessel was only replaced in late 2010. Various gear configurations have been employed to exploit the resource since the inception of the fishery.

The implementation of a catch documenting scheme that enables buyers to identify product from legal fisheries has led to a marked reduction in levels of IUU fishing. During the two years prior to the start of the experimental fishery, the Patagonian toothfish resource in the Prince Edward Islands area was subjected to heavy exploitation by a fleet of illegal vessels that ranged throughout the Southern Ocean. The estimated IUU catch during those initial two years was more than double the total legal catch taken over the subsequent 20 years. The IUU activity in the area declined in response to reduced catch rates and the establishment of the legal fishery, and the last recorded IUU activity in the PEI-EEZ was the sighting of a single vessel in 2004. Although there has been no indication of IUU activity since 2004, there is a possibility that IUU activity could go undetected because of the limited presence of legal vessels in the PEI-EEZ. Consequently assessments of the PEI toothfish resource conducted prior to 2013 assumed a continued, constant IUU take of 156 t per annum (i.e. the same level as that estimated in 2004) over the period 2005–2009. On the basis of information that subsequently became available, recent assessments of the resource (2013 onwards) have assumed no IUU catches in the PEI-EEZ after 2005.

CURRENT SPATIAL AND TEMPORAL MEASURES

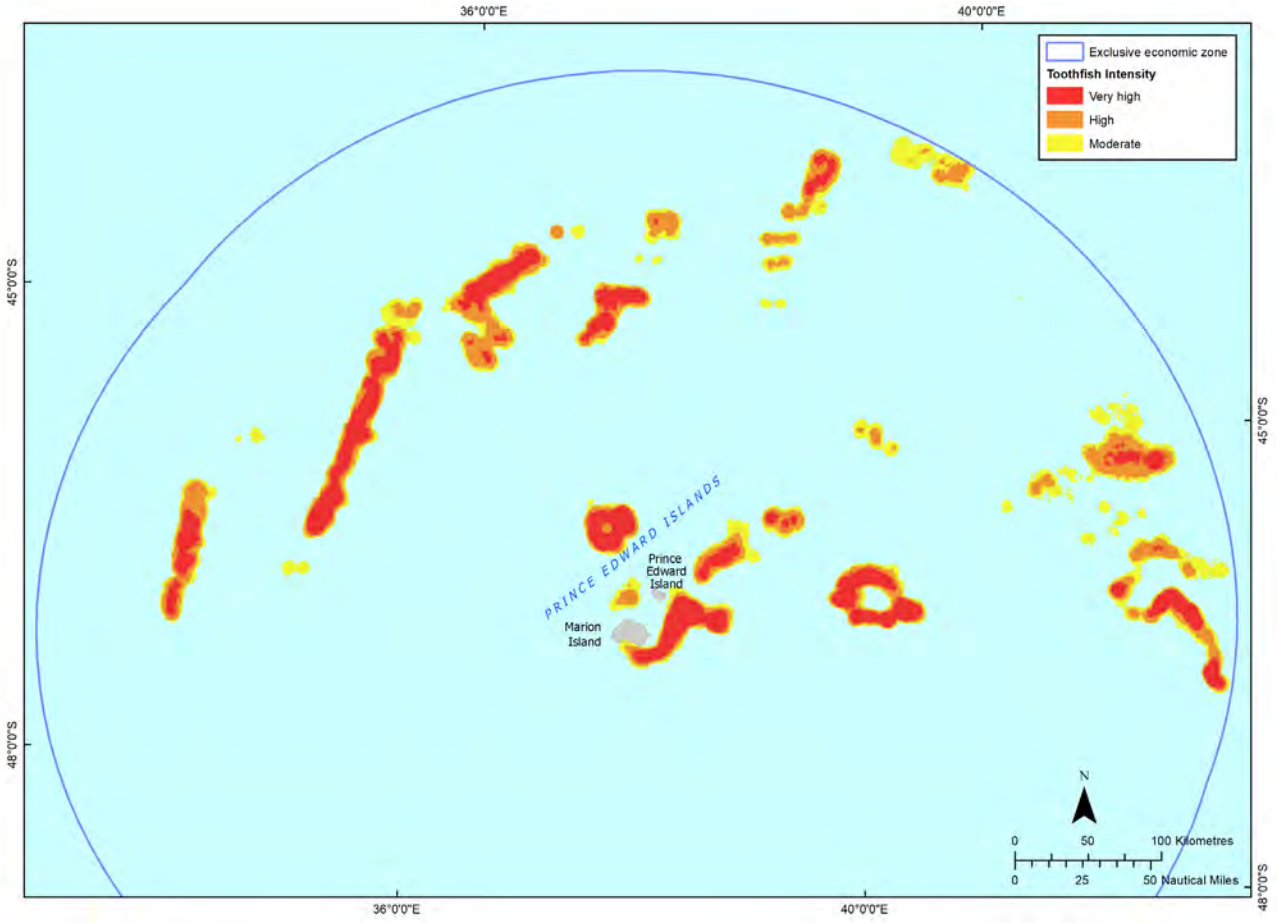
Most of the Patagonian toothfish distribution falls within the area managed by the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR). As an original member of CCAMLR, South Africa remains committed to its objectives, and has voluntarily applied the CCAMLR conservation measures within the PEI-EEZ. These include 100% observer coverage, move-on rules to limit bycatch and specifications for mandatory bird scaring lines (tori lines).

In addition the total catch of rattails (Macrourus spp.) and skates (Rajiidae) may not exceed 16% and 5% of the toothfish TAC respectively. Since 2010, the total catch per fishing season for rattails has ranged between 7 and 28 t and for skates between 0.1 and 3 t. There have been no reported seabird mortalities for the past three years.

A Marine Protected Area (MPA) in the PEI-EEZ that contains a no-take area within 12 nautical miles of Prince Edward and Marion Islands, and three limited-access areas, was promulgated in 2013.

According to CCAMLR CM 32-01, "the fishing season for all Convention Area species is 1 December to 30 November the following year"; thus a split-year fishing season applies within the PEI-EEZ.

KEY SPATIAL INTERESTS

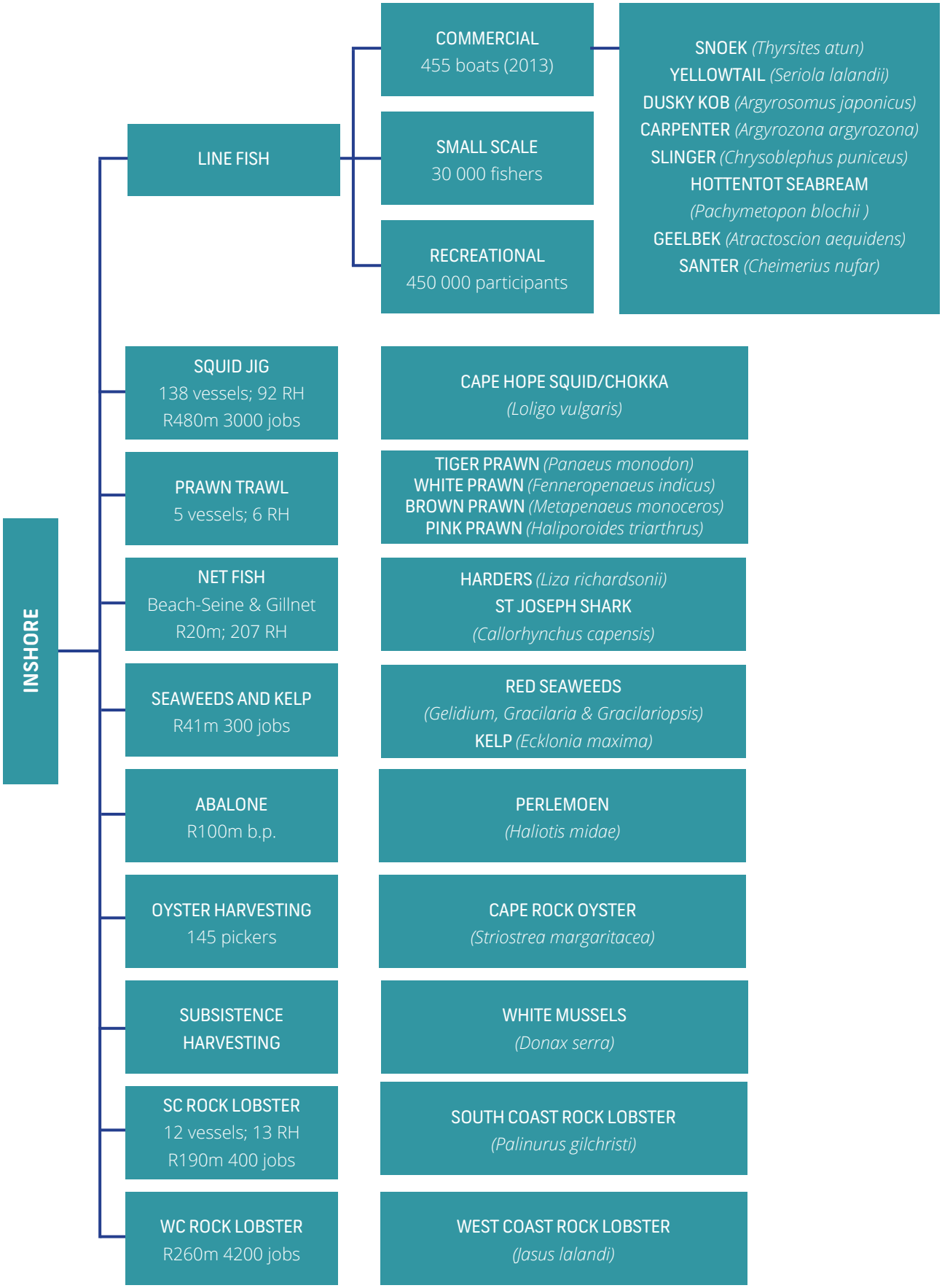


Spatial distribution of effort by the Patagonian toothfish sector for the years 1997 to 2018. The analysis is based on relative number of hooks / km2 for the data period (see Annex for details).

MAP 36

3.5.2.2.2 INSHORE FISHERIES SECTORS

Inshore fisheries comprise the shore-based and near-shore sectors operating either exclusively within or slightly outside the territorial waters or along the coastline. Figure 11 illustrates these sectors with information about the number of operating vessels, number of rights holders (RH) as well as the approximate number of jobs sustained and/or the estimated annual value generation. Each of the sectors is described in the following sections in more detail.



Overview of the inshore fisheries sectors.

FIGURE 11

3.5.2.2.2.1 SECTOR: LINE FISH

OVERVIEW OF THE SECTOR

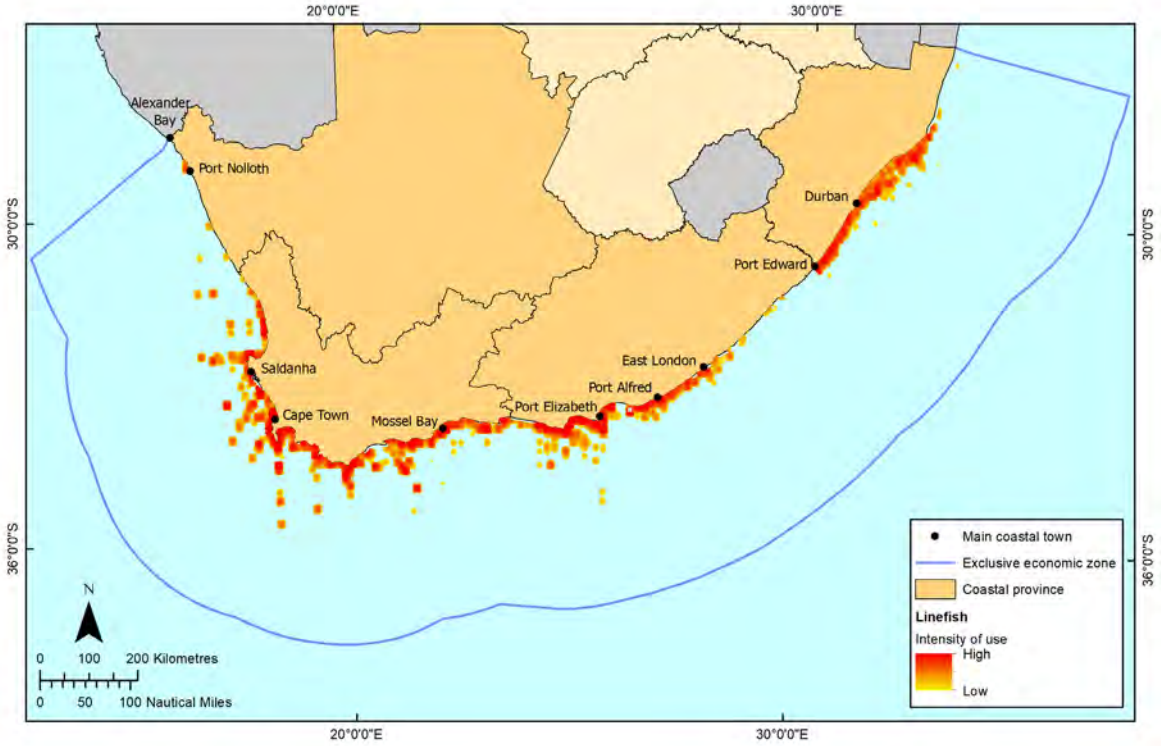
Linefishing in South Africa is defined as the capture of fish with hook and line, but excludes the use of longlines. Together, the three sectors of the linefishery (commercial, recreational and subsistence) target between 95 and 200 of South Africa's 2 200 marine fish species. Species targeted in the linefishery display diverse life-history strategies, including many tactics that cause populations to be particularly vulnerable to overfishing, including long lifespans (>20 years), estuarine-dependence, sex change and aggregating behaviour. Many of the species are endemic to South Africa and are not shared with our neighbours. Target species include temperate reef-associated seabreams (such as roman *Chrysoblephus laticeps,* hottentot seabream *Pachymetopon blochi*, santer and slinger *Chrysoblephus puniceus*), coastal migrants (such as geelbek *Atractoscion aequidens* and dusky kob) and nomads (such as snoek and yellowtail); 90% of the current catch is made up of the aforementioned eight species.

Linefish species are typically predatory in nature, and include a number of apex predators such as sharks, groupers, tunas and red steenbras. The commercial linefishing sector is exclusively boat-based. The total number of registered vessels operating in this sector was estimated at 700 in the late 1990s, which accounted for 37% of all boats operating in marine fisheries in South Africa. From 2006 until the end of 2013, 455 boats have been in operation.

Linefishing is a low-earning, labour-intensive industry, important from a human livelihood point of view. Employing an estimated 27% of all fishers, it has the lowest average employment income of all South African fisheries. Although the commercial linefishery has the largest fleet, it contributes only 6% of the total estimated value all South African marine fisheries. After the introduction of the towable skiboat in the late 1940s, the recreational boat-based sector expanded rapidly, with an estimated minimum number of 4 000 vessels. Landings from this open-access recreational fishery are not reported throughout the region, and for some areas and species the total catch from this sector could be equivalent to that reported by the commercial sector. The recreational linefishery has by far the largest number of participants (more than 450 000) of all fishery sectors in South Africa and consequently has great economic value. This is especially important to coastal regions dependent on the tourist trade, but also to industries associated with the small craft, outboard motor, fishing tackle and bait trades.

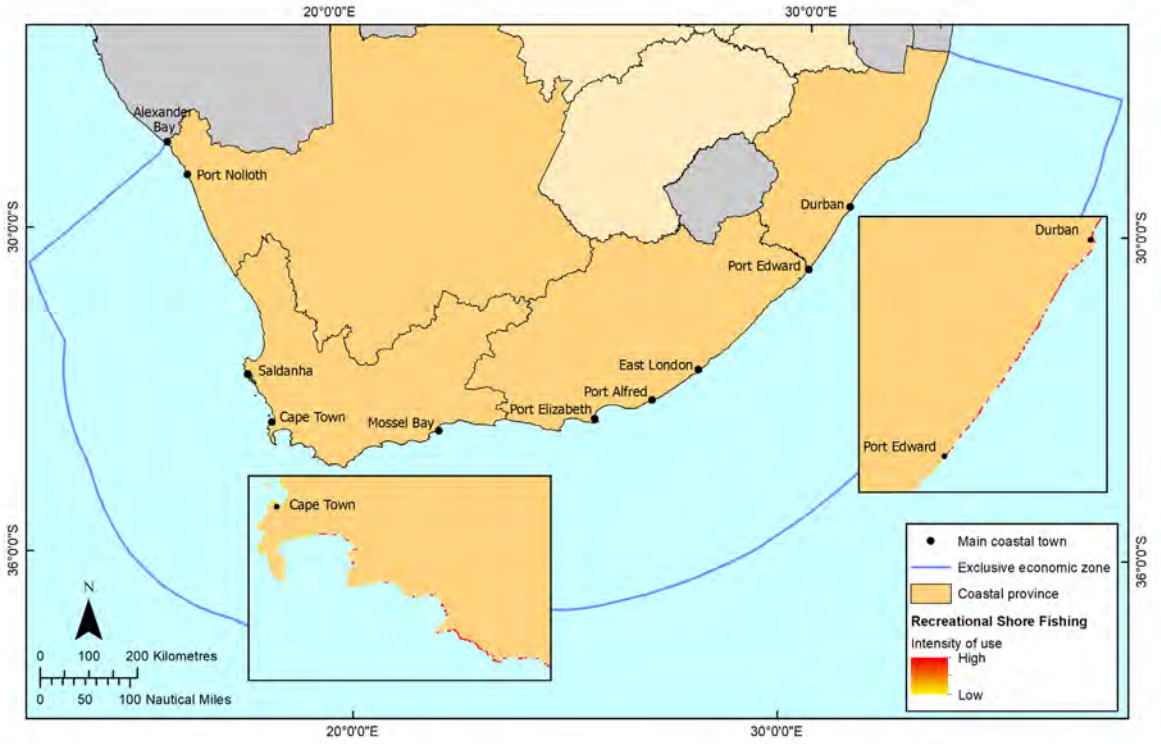
The small-scale/subsistence sector was legally created to recognise those fishers who depend on marine living resources for direct food security, usually very poor coastal communities or those using simple traditional methods. There are an estimated 30 000 small-scale fishers active along the South African coastline, 85% of whom harvest linefish. The small-scale fishers will be organised into co-operatives that target a 'basket' of species that includes many linefish resources.

KEY SPATIAL INTERESTS



Spatial distribution of catch by the linefish commercial sector for the years 2000 to 2016. The map is based on relative catch in kg / km² over the data period (see Annex for details).

MAP 37



Spatial distribution of intensity of use ("effort" expended) by the Recreational Shore Angling sector; this is widespread over a very narrow section of the coast and as such is not visible here without zooming in. Please refer to OCIMS for a scalable version of the map. The map shows relative density per km2 of recreational fishermen, based on surveys collected before 2000 and contained within the NBA 2011. Unfortunately, more up to data national surveys are not available (see Annex for details).

MAP 38

SECTORAL ISSUES TO CONSIDER FOR MSP

Given the relatively selective nature of linefishing, the bycatch in the linefishery is negligible. Fishing with rod and line on high-biodiversity habitats such as temperate or tropical reefs will yield a range of species, some of which it is undesirable to catch because of their highly depleted status (such as the dageraad, the red steenbras and the seventy-four, as well as a number of shark and grouper species). Although captured fish can be released, there might still be significant mortality due to barotrauma and hook damage. Temporal (closed season, night fishing restrictions) and spatial (MPAs) management might be the only way to mitigate against these undesirable effects of multi-species linefishing.

As many as 80 species caught in the linefishery are associated with estuaries and rely on these for feeding, refuge or reproduction. Consequently, the wellbeing of these fish is linked to the status of the estuaries. Reduced or regulated freshwater input, coastal development and pollution are altering estuarine habitats and threaten the wellbeing of the dependent fish populations.

3.5.2.2.2.2 SECTOR: SQUID JIG

OVERVIEW OF THE SECTOR

The commercial squid jig fishery was established in 1984 and developed rapidly due to large foreign demand and good catches.[141,142] Fishing effort was initially concentrated on spawning aggregations inshore at depths of no more than 40 m. With vessel upgrades over time fishing effort shifted further offshore onto the feeding grounds, thus enabling catches to be made throughout the year[143]. The greater shelf region serves as feeding grounds for both adult and juvenile chokka[141]. Data from research trawl surveys spanning the years 1985-2008 indicate that chokka squid are not restricted only to shallow waters for spawning although the species does prefer the eastern Agulhas Bank for spawning and that the area of greatest spawning activity occurs between 23° and 27°E[143]. Roberts et al. 2012 also attempted to delineate the importance of inshore versus offshore spawning grounds (between 24.3 and 25.7°E) and found the former to be strongly favoured, with the contribution of inshore eggs and deep spawned eggs to total biomass estimated at 82% and 18% respectively.

Total allowable effort (TAE) is the main management measure in place for this fishery, with a restriction on the total number of crew permitted to operate in the fishery. The fleet is divided into vessel categories and a maximum crew complement is specified for each vessel category. Currently the fleet consists only of deck boats, of which there are 138, and a crew complement of 2423 fishers (DFFE Permit Conditions 2017/2018). Vessel sizes range in length from 10 to 20 m.

CURRENT SPATIAL AND TEMPORAL MEASURES

The fishery is excluded from Marine Protected Areas but otherwise is licensed to operate in the South African EEZ, as stipulated in permit conditions (Table 9).

The spatial restrictions imposed on the squid jig fishery as stipulated in Permit Conditions for the 2017 fishing season.

TABLE 9

SECTION B: PERMIT CONDITIONS: SQUID (COMMERCIAL FISHERY)	
FISHING SEASON: 2017/2018	
3	Fishing Areas and Restricted Areas
3.1	This permit is valid only in South African waters (excluding tidal lagoons, tidal rivers and estuaries).
3.2	The Permit Holder or any of its employees or agents shall not undertake fishing, or take or destroy any fauna or flora, or in any way disturb, alter or destroy the natural environment, or carry out any activity which may adversely impact on the ecosystems in Marine Protected Areas (MPA's) except where so permitted by the legislation.
3.3	A vessel is not allowed to enter; fish or carry fishing gear on board in any Marine Protected Area, or any other similar marine protected or conservation area
3.4	In the case of an emergency, the Permit Holder shall notify the Department before the fishing vessel enters or intends to enter into a Marine Protected Area or any other area closed for fishing. The notification shall describe the nature of the emergency and the reason requiring the vessel enter the MPA.
3.5	Fishing and the removal or disturbance of any marine life in the Tsitsikamma National Parks Marine Protected Area is prohibited. Fishing in other marine and estuarine areas controlled by the South African National Parks, is subject to regulations promulgated under the NEMPA

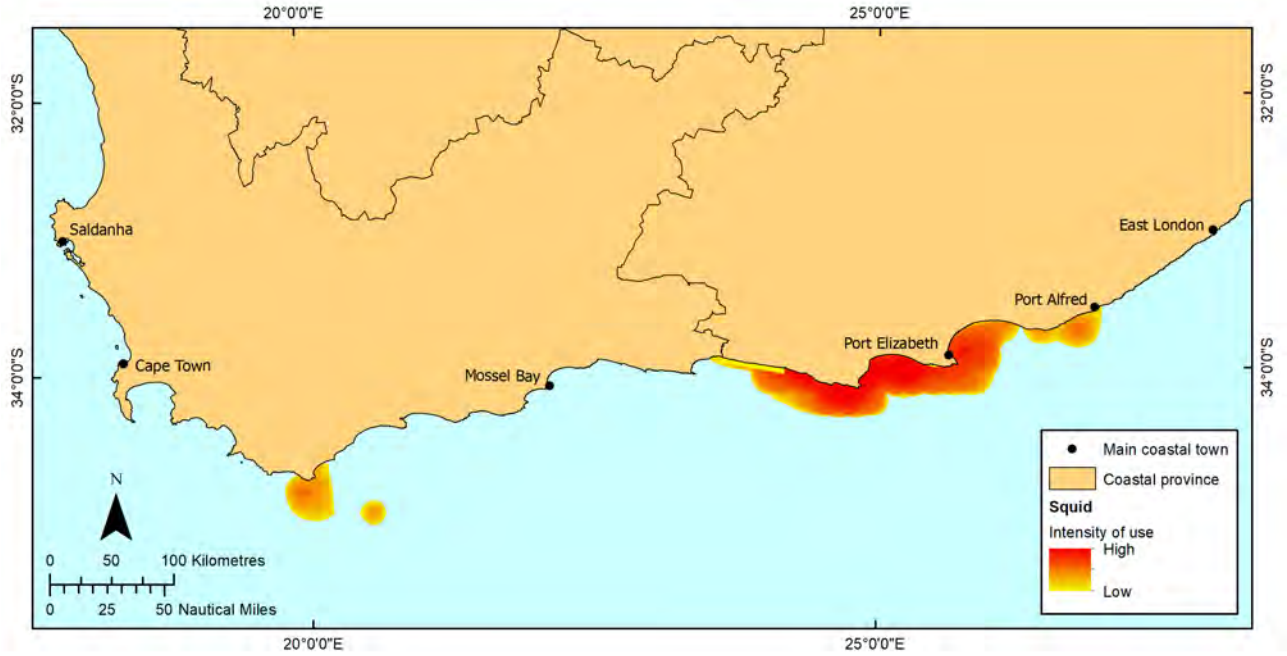
In 1986, a 6-week closed season was introduced, with the main fishing grounds being closed to vessels not registered in the area. Since 1988, the fishery has been closed once a year for approximately four weeks over the spawning period[144]. Currently this closed period extends from 19 October to 23 November. In 2014 an additional closed season was introduced with the aim of preventing the TAE (in terms of person-days) from being exceeded given the existing crew complement at that time and the fact that results from an updated assessment indicated that the resource was less productive than was previously predicted.

KEY SPATIAL INTERESTS

Chokka squid is distributed from the border of Namibia to the Wild Coast. It occurs extensively on the Agulhas Bank out to the shelf edge, increasing in abundance towards the eastern boundary of the South Coast, especially between Plettenberg Bay and Algoa Bay[145]. The fleet operates out of St. Francis and Port Elizabeth and targets aggregations near those ports (Map 39). Freezer vessels have a longer range and have shifted some of their effort eastwards. The fishery targets mostly adult squid in spawning aggregations, the locations of which have been shown to be concentrated in the inshore areas (between 20 m and 130 m depth) of the east coast (Map 40). When night fishing takes place bright deck lights are used to attract the squid. The fleet targets squid on the offshore grounds during winter and at times when there is high turbidity in the inshore grounds. Larger boats drifting on "parachute" are required to fish further offshore due to stronger currents and sea conditions.

The fishery has very clear spatial priorities, which could be defined as the Priority Fishing Areas as follows[130]:

- **AREA 1:** Agulhas Inshore – this area around Struisbaai to depths of 100 m;
- **AREA 2:** The Core grounds – Plettenberg Bay – Central – Port Alfred;
- **AREA 3:** Offshore of the Core grounds – winter fishing area/reserve biomass;



Spatial distribution of catch by the squid jig sector for the years 2012 to 2016. The map is based on relative catch in kg / km² over the data period (see Annex for details).

MAP 39

Shallow water and a rocky/sandy substrate combination provides ideal habitat for spawning squid to lay eggs. The substrate chosen for egg laying is mostly fine sand or flat reef, frequently in large and relatively sheltered bays. Some spawning sites are used repeatedly within a particular year and in subsequent years[146]; reviewing fishermen's marks suggest squid return to similar locations in following years (Greg Christy pers comm). The most important spawning grounds are between Plettenberg Bay and Algoa Bay, these having been linked to specific spawning habitat requirements.[147,148] Reverse current eddies allow for better retention of eggs and larvae in the core grounds. The deep water spawning grounds provide lower successful recruitment but are considered a "reserve" of squid for the fleet.

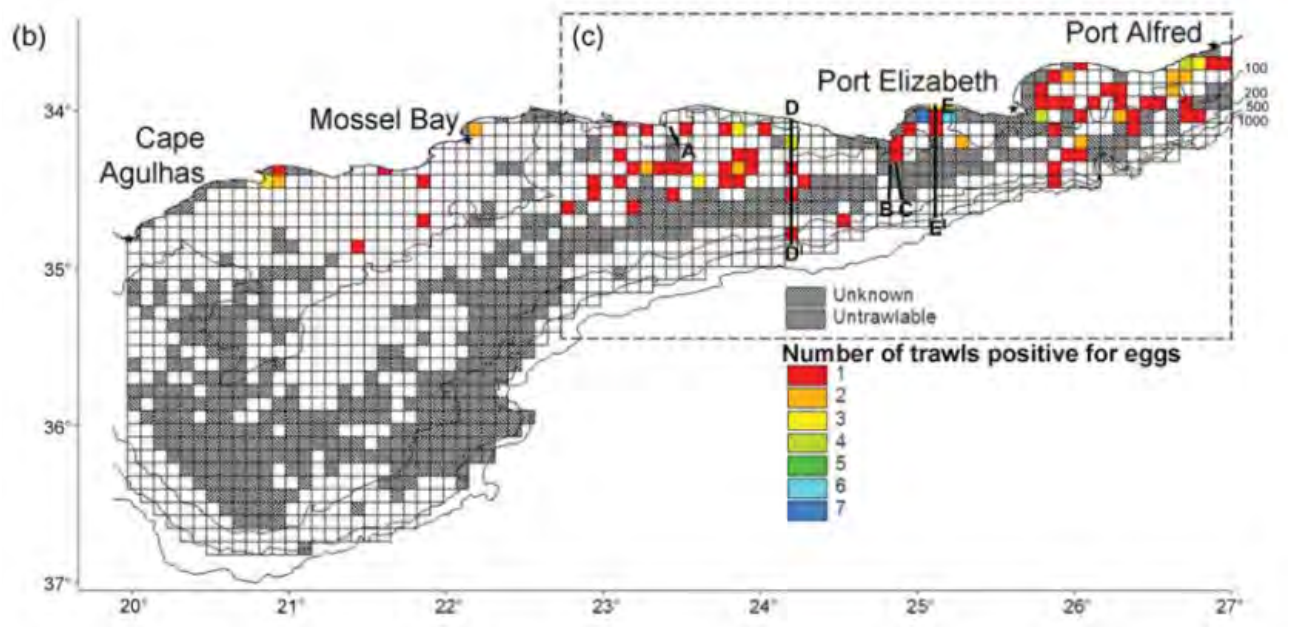
SPATIAL CONFLICTS WITH OTHER USES AND INTERESTS

There has been an issue with coastal residents complaining about the bright lights used by the vessels at night to attract squid[149].

There is a high probability of conflict with seismic exploration activity and the squid fishery has voiced concerns over the impact of the survey operations on squid. A recent regional 2D survey of the south and east coasts was undertaken and the location of the survey with respect to the squid jig fishing grounds is shown in Map 41.

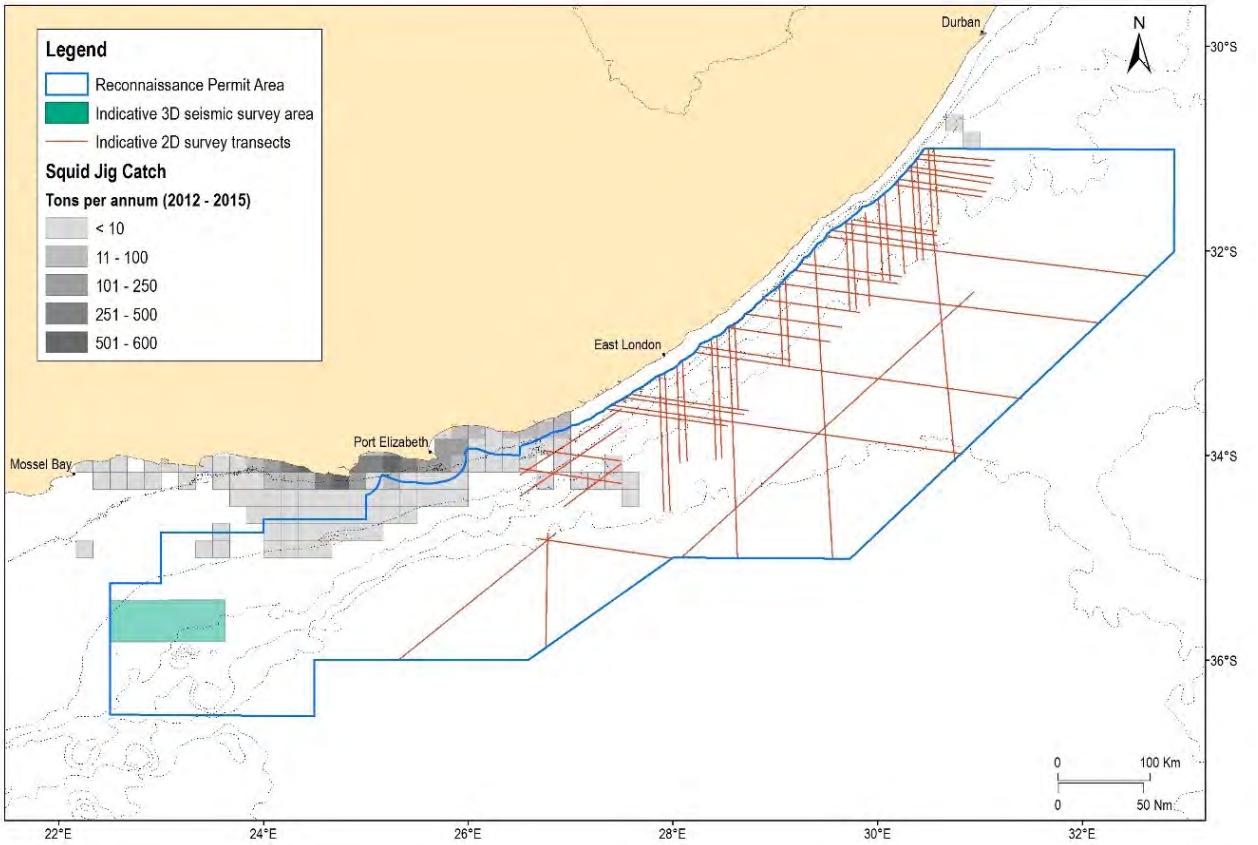
Future proposed surveys are set to take place over the offshore grounds that are considered by the sector as a source of cryptic or reserve biomass. Recent applications to the Department of Mineral Resources and Energy (DMRE) for offshore seismic exploration have been met with legal objection from the squid jig fishing industry during the impact assessment phase.

The new Addo MPA is within the priority fishing areas of the squid sector but controlled zones that will be open to the squid sector have been agreed.



The occurrence of chokka squid spawning as detected by eggs trawled during biomass surveys on the south coast from 1985 to 2008 (Roberts et al., 2012)[143].

MAP 40



Location of squid jig fishing grounds relative to a 2D survey that took place between January and May 2018 (Japp & Wilkinson, 2017)[150].

MAP 41

SECTORAL ISSUES FOR MSP TO CONSIDER

- The squid jig target fishery has very definite areas of operation that have not shifted appreciably since the 80's when the fishery began. Some seasonal and annual variation in the core grounds exists as a result of movement of spawning aggregations in response to sea temperature, turbidity and other habitat variables, however the primary areas of operation remain between Plettenberg Bay and Algoa Bay (as seen from spatial mapping of cumulative commercial catch and effort statistics[130]).

- The strong link between the spawning habitat and the target species delivers a predictable spatial pattern of fishing operations. This lends itself towards identification of priority fishing areas or life-history stage support areas within the permitted area of fishing.

- The new marine section of the Addo MPA in Algoa Bay contributes to protection of squid spawning habitat and also accommodates squid fishing.

- Important fishing areas also exist outside of the core fishing grounds, the offshore grounds illustrate this clearly.

- Additional nursery habitat was identified in False Bay that acts as a paralarvae catchment area. Those alternate grounds are subject to multiple user interests that create the potential for conflict.

- The identification of Priority Fishing Areas can support the introduction of new spatial measures.

- There is some indication that seismic activities have a negative effect on zooplankton that includes squid larvae[151] and further focused research should be undertaken in South Africa to resolve this. In addition the effects on spawning aggregations of squid in shallow-water areas needs further research to support legal objections filed to prevent future seismic surveys.

3.5.2.2.2.3 SECTOR: PRAWN TRAWL

OVERVIEW OF THE SECTOR

The fishery is managed using a Total Applied Effort (TAE) strategy, which limits the number of vessels permitted to fish on the inshore and offshore grounds. Currently there are five vessels operating within the inshore grounds and two vessels restricted to working in the offshore grounds. The fleet comprises steel-hulled vessels ranging in length from 25 – 40 m and up to a Gross Registered Tonnage (GRT) of 280 tons. Most vessels are single otter trawlers, deploying nets from the stern or side at a speed of two to three knots. Trawl net sizes range from 25 m to 72 m footrope length, with a minimum mesh size of 60 mm. The duration of a typical trawl is four hours. Trip lengths range from three to four weeks and vessels may carry a crew of up to 20. White prawn (*Fenneropenaeus indicus*, >80% of the catch), Brown prawn (*Metapenaeus monoceros)* and Tiger prawn (*Panaeus monodon*) make up the catch of the inshore fishery. The deep-water fishery targets pink prawns (*Haliporoides triarthrus*), red prawns (*Aristaemorpha foliacea*) and the langoustines (*Metanephrops mozambicus* and *Nephropsis stewarti*)[152].

CURRENT SPATIAL AND TEMPORAL MEASURES

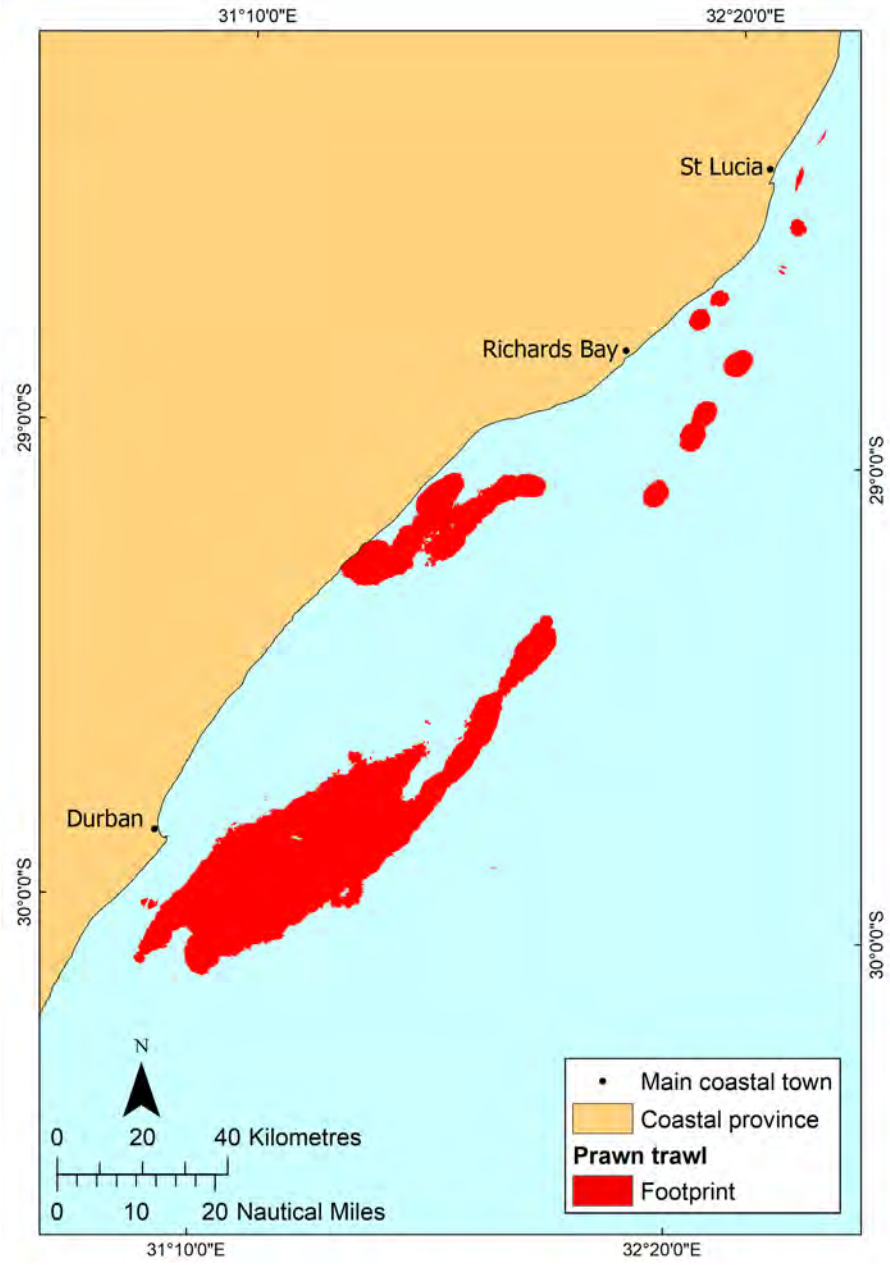
The crustacean trawl fishery is confined to the province of Kwa-Zulu Natal (KZN) on the east coast (Table 10).

TABLE 10

Fishing and restricted areas for KZN Prawn Trawl Fishery, 2017 fishing season (DEFF, 2017)[127].

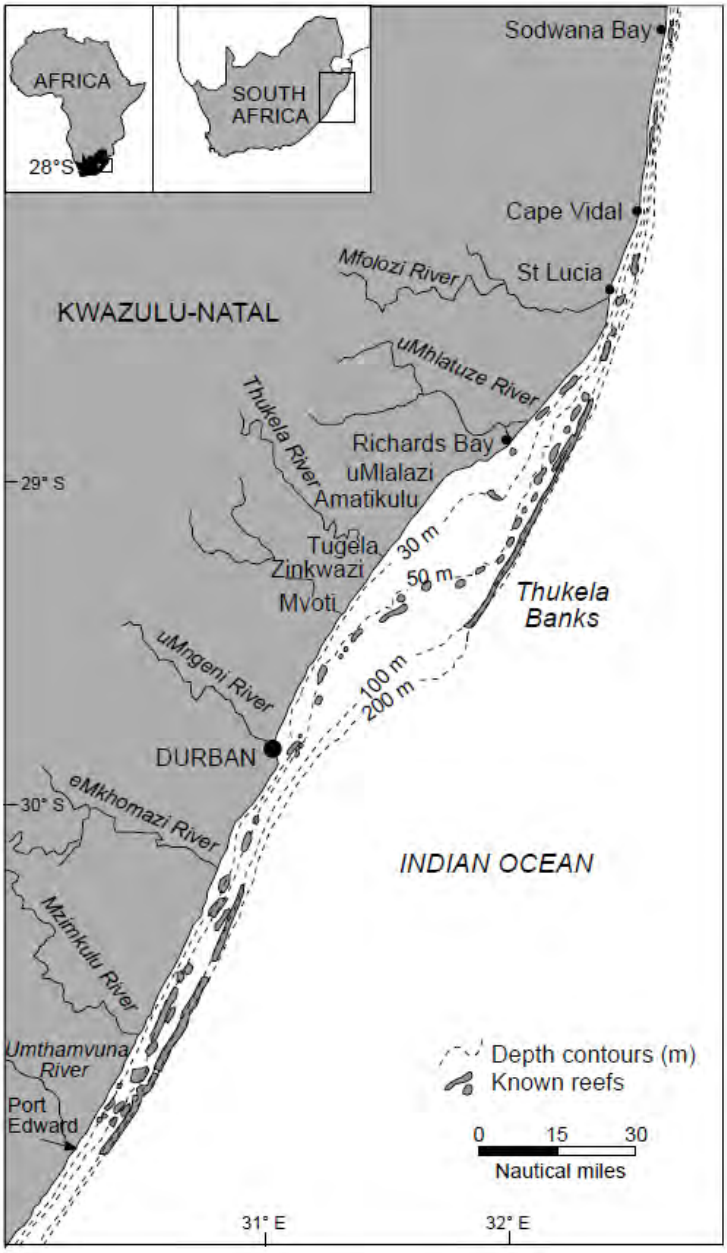
PERMIT CONDITIONS: KWAZULU-NATAL PRAWN TRAWL FISHERY (COMMERCIAL FISHERY)	
FISHING SEASON: 2017	
3	Fishing Areas
3.1	According to this permit, the authorised vessel may only engage in fishing in waters adjacent to the coastline of the Province of KwaZulu-Natal (KZN), defined as the area, from the high-water mark, between, as a northern boundary, a line (110° true bearing) drawn from the lighthouse at Ponto do Ouro, situated approximately 1 nautical mile south of Ponta do Ouro, as indicated on chart SAN 134, and; as a southern boundary, a line (130° true bearing) drawn from the mouth of the Mtamvuna River, as indicated on chart SAN 130.
3.2	Fishing is prohibited on the Tugela Bank, defined as the area within 7 nm of the high-water mark, and between the northern boundary line (090° true bearing) drawn from the lighthouse at Cape St Lucia and southern boundary , a similar line drawn from the mouth of the Mvoti River, from September to February.
3.3	Fishing is prohibited in the St Lucia Marine Protected Area, defined as the area between the high-water mark and a line 3 nautical miles seawards of the high-water mark and between the northern boundary, a line (090° true bearing), drawn from the beacon marked N3, situated approximately 11 km to the north of the Ngoboseleni Stream at Sodwana Bay and, as a southern boundary, a similar line drawn from the beacon marked N4, situated approximately 1 km to the south of Cape Vidal
3.4	Fishing is prohibited in the Maputaland Marine Protected Area, defined as the area between the high-water mark and a line 3 nautical miles seawards of the high-water mark , and between, as a northern boundary, a line (090° true bearing), drawn from the beacon marked N7, situated at the South Africa-Mozambique border and, as a southern boundary, a similar line drawn from the beacon marked N3, situated approximately 11 km north of the Ngoboseleni Stream at Sodwana Bay
3.5	Permit Holders with inshore permits may fish the Tugela Bank from 01 March 2017 to 31 August 2017. Fishing is prohibited within 0.5 nautical miles of the high-water mark.
3.6	Permit Holders with offshore permits may not fish the area within 7 nm from the high-water mark, between the northern boundary, a line (090° true bearing) drawn from the lighthouse at Cape St Lucia and, as a southern boundary, a similar line drawn from the lighthouse at Green Point.

Inshore trawling is seasonal due to seasonal variations in abundance of the target species as well as a mandatory closed period, while the offshore trawling takes place year-round. Fishing on the Tugela Bank is prohibited from September to February to protect juvenile squaretail kob (*Argyrosomus thorpei*)[37].



MAP 42

The Footprint of the Kwa-Zulu Natal Prawn Trawl Fishery for the period 2001-2017. The map is based on effort in hours of trawling per $km^{2,}$ with all areas above 25hrs considered to be within the trawled footprint (see Annex for details).



MAP 43

Location of the Thukela Banks off the coast of KwaZulu-Natal[152].

KEY SPATIAL INTERESTS

The footprint for the sector is mapped (Map 42). Offshore vessels are not permitted to fish inshore, inshore vessels may, however, fish offshore. The boundary between the inshore and offshore fisheries is situated seven nautical miles from the shore between the St. Lucia lighthouse (28° 30.9'S 32° 24.0'E) and Zinkwazi Green Point (30°15.0'S 30° 46.8'E). The shallow water fishery operates at depths of 10-45m on the Thukela Banks, approximately 300 km^2 in extent, as well as on the smaller St. Lucia ground to the north[25]. The deep-water fishery operates at depths of 100-600 m along the shelf edge between Cape Vidal and Amanzimtoti, covering an area approximately 1000 km^2 (Map 43).

For the shallow water fishery Champion (1970)[153] and De Freitas (1980)[154] recorded white prawn (*Fenneropenaeus indicus*) spawning activity on the Tukhela Bank and both assumed recruitment of larvae to be via southward Agulhas current transport from Mozambique. The Lake St Lucia and Richard's Bay areas were shown to be nursery grounds for white prawn[155]. Peak sub-adult emigration from the St. Lucia nursery grounds occurs in autumn and again in spring/summer[156]. Proposed local spawning populations further support the commercial penaeids off the east coast. These prawn species grow fast and have a life-span of approximately one year.

Larvae hatch during the second half of the year, and are transported by currents into estuaries along the KZN coast, where they remain up to the first quarter of the following year and grow into sub-adults. Sub-adult prawns move out of estuaries and recruit onto the mud banks, where they grow to maturity and reproduce. The importance of the estuarine and mangrove environments as nursery grounds has been emphasized, as well as the relationship between the amounts of fresh water runoff into those estuaries with catches been investigated by Turpie and Lamberth (2010).

The Tugela Banks are also known to serve as a nursery area for the endangered scalloped hammerhead shark (*Sphyrna lewini)*, slinger (*Chrysoblephus puniceus*) and black mussel cracker (*Cymatoceps nasutus*), and five species of dasyatid rays[157]. The Banks serve as a spawning area for (amongst others) bull shark (*Carcharhinus leucas*), ragged-tooth shark (*Carcharias taurus*), king mackerel (*Scomberomorus commerson*), and as a spawning and migration route for sardine ('sardine run')[158,159,160,161]. In addition, the area offshore of St Lucia provides spawning habitat for spotted grunter (*Pomadasys commersonni*), natal stumpnose (*Rhabdosargus sarba*) and various perch and mullet species.

SPATIAL CONFLICTS WITH OTHER USES AND INTERESTS

Teleost and chondrichthyan bycatch are significant in the fishery[157,162,163]. About 75% of the inshore catch and 70% of the offshore catch is discarded[164]. Fennessy (1994a) found a total of 108 species of teleosts caught by the inshore fishery at depths of 20-45 m, six of which accounted for 80% of the total by number. Chondrichthyans number 22 in the inshore bycatch, with an additional 4 species suspected to be caught and the fishery operates in what is recognised as a shark biodiversity hotspot[162,163]. Conflict between the crustacean trawl fishery and the commercial and recreational linefish sectors exists, whether the conflict is justified is less certain. Atkinson and Sink, 2008 reported that the only species in common between the linefish and trawl sectors was the squaretail kob and noted also that declining fishing effort on the inshore grounds has reduced this conflict.

SECTORAL ISSUES TO CONSIDER FOR MSP

- Bycatch and habitat issues are the concern for the fishery.
- The trawl grounds have been identified and effort is restricted both spatially and temporally by sector specific permit conditions.
- Additional bycatch limits could be considered for the sector to reduce conflict with commercial and recreational linefish-fishermen and also protect vulnerable marine species such as threatened demersal sharks.
- The new uThukela MPA may support habitat and bycatch management for this sector.

3.5.2.2.2.4 SECTOR: NETFISH (BEACH SEINE AND GILLNET)

OVERVIEW OF THE SECTOR

There are a number of active beach-seine and gillnet fisheries throughout South Africa. By far the biggest are the fisheries for harders (or mullet) *Liza richardsonii*, with 28 and 162 right-holders respectively from False Bay to Port Nolloth on the West Coast. This fishery is managed on a Total Allowable Effort (TAE) basis with a fixed number of operators in each of 15 defined areas. Permits are issued solely for the capture of harders, St Joseph shark *Callorhynchus capensis* and species that appear on the 'bait list'. The exception is False Bay, where right-holders are allowed to target linefish species that they traditionally exploited. All evidence points towards the harder resource being over-exploited, and sector conflict arises due to real and perceived impacts on linefish resources from associated bycatch.

CURRENT SPATIAL MEASURES

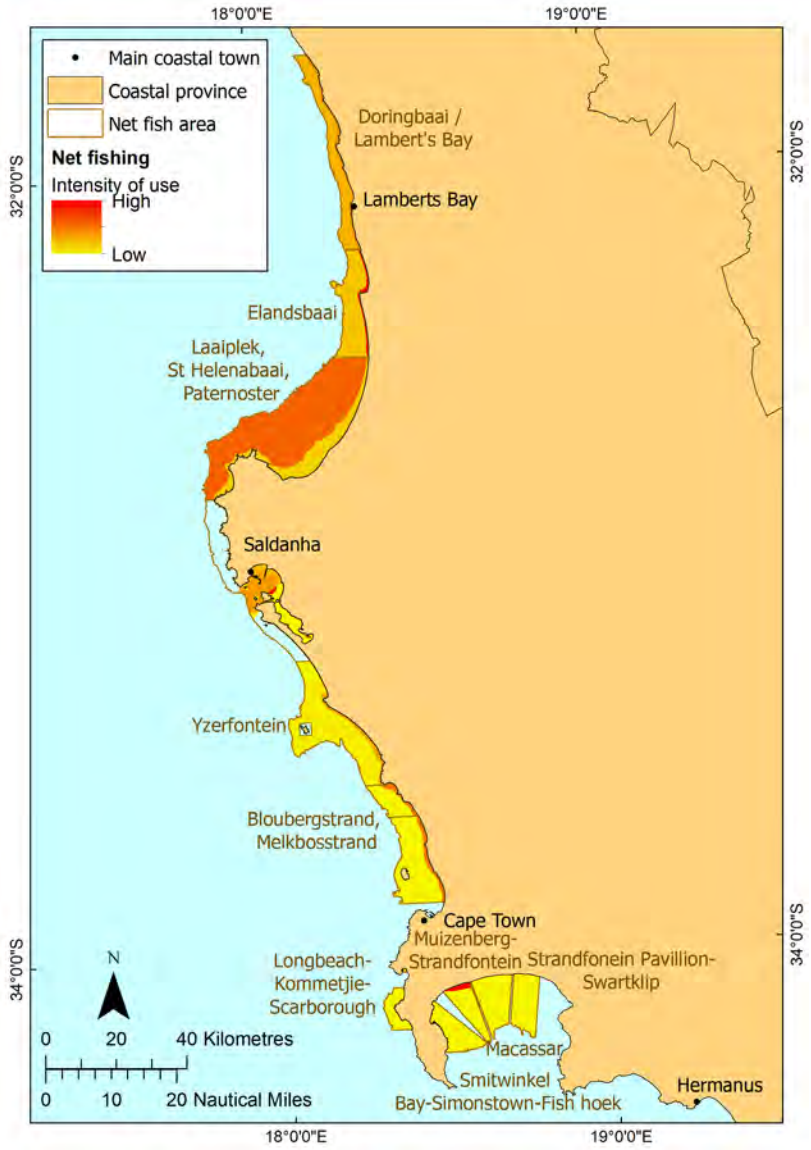
Recognising that estuarine gillnetting was severely compromising the nursery function of estuaries and having a negative effect on the fisheries for many other species, the management policy was to phase out all estuarine gillnets in the long-term. This has been implemented in all estuaries with the exception of the Olifants Estuary on the West Coast.

More recently, in 2010, by order of the Equality Court, three Interim Relief gillnet exemptions were issued to 15 fishers in Langebaan and two beach-seine exemptions, one in Struisbaai and one in Simonstown. The latter has not been activated.

Net fishing in the beach
© Fisheries Resources Research

KEY SPATIAL INTERESTS

MAP 44



Spatial delineations of management zones for the beach-seine and gillnetting sectors with TAE (rights allocated) in 2016-7 for each area. Coverage extends from coastline seawards to the 10m depth contour; calculated as an intensity seine rights/km² over the period. Spatial delineations of management zones for the Gillnet sector with TAE (rights allocated) in 2016-17 for each area. Coverage extends from coastline seawards to the 50m depth contour; calculated as a relative intensity based on gill net rights/km² over the period (see Annex for details).

Most South African estuaries are important nurseries for exploited marine and estuarine species before they recruit into marine fisheries and more than 90% of the beach-seine and gillnet catches comprise estuary-dependent species. This is illustrated by the declines in the harder stock and marine gillnet fishery catches on the West Coast, which have been directly attributed to recruitment over-fishing (the removal of too many fish so that they are unable to reproduce effectively and replenish their populations) in the Olifants and Berg estuaries.

Fishing aside, the health of estuarine habitats determines juvenile fish recruitment, survival and ultimately catches in the sea. Estuarine health is largely driven by catchment management and the quantity and quality of freshwater reaching the estuary and sea. Reductions in freshwater flow are accompanied by declines in primary production, shrinkage of the warm water plume entering the sea, narrowing of the stream channel, and an overall reduction in available habitat and refugia and loss of estuary nursery function for juvenile fish. There are only nine estuaries on the West Coast, of which only three, the Orange, Olifants and Berg are large and permanently open to the sea. Overall, there has been an approximate 40% reduction in freshwater flow and 60% loss of floods to these estuaries. In the present day juveniles of obligate estuary-dependent fish such as springer / flathead mullet (*Mugil cephalus*) and white steenbras (*Lithognathus lithognathus*) in West Coast estuaries have declined in abundance to less than 10% of pristine (or 'baseline' levels) and are likely to decline to less than 5% of this level under future flow projections.

ISSUES TO CONSIDER FOR MSP

Climate change, hydropower demands and freshwater abstraction are likely to contribute to even greater loss in required habitats for the fishery in the future.

3.5.2.2.2.5 SECTOR: SEAWEED AND KELP

OVERVIEW OF THE SECTOR

The South African seaweed industry is based on the commercial collection of kelps and the red seaweed *Gelidium*, and small quantities of several other species. All commercially exploited seaweeds are found between the Orange and Mtamvuna rivers. In the Western Cape and Northern Cape, the South African seaweed industry is currently based on the collection of beach-cast kelps and harvesting of fresh kelps. Beach-cast gracilarioids (agar-producing red seaweeds of the genera *Gracilaria* and *Gracilariopsis*) were collected in Saldanha Bay and St Helena Bay, but there has been no commercial activity there since 2007. Gelidium species are harvested in the Eastern Cape. The sector is small compared to many other fisheries, but is estimated to be worth at least R35 million annually and to provide at least 300 jobs.

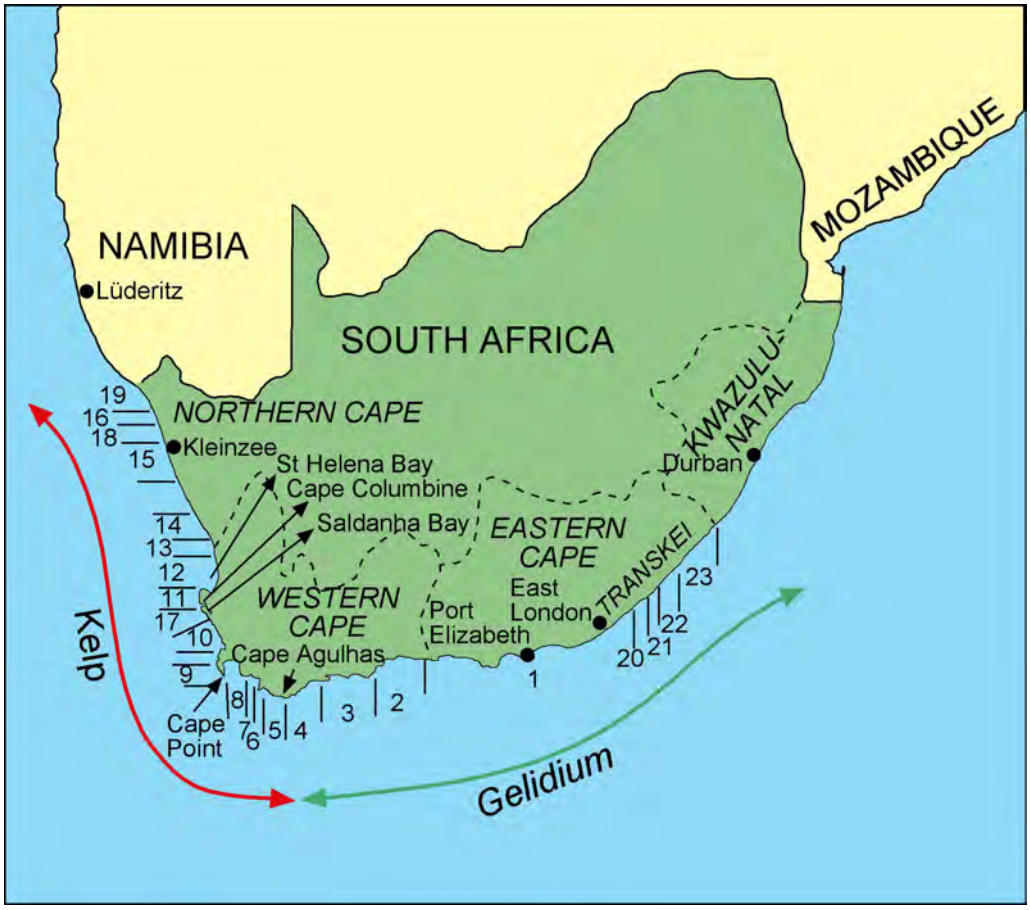
Assessment of the Gracilarioid resource is performed on an ad hoc basis, because only beach-cast seaweed is collected and there is therefore no direct effect on the living resource.

Fresh kelp is now harvested in large quantities (about 5 000 t fresh weight per annum) in the Western Cape as feed for farmed abalone. This resource, with a market value of over R6 million, is critically important to local abalone farmers. Fresh kelp is also harvested for high-value, plant-growth stimulants that are marketed internationally and nationally.

The status of kelp resources therefore varies geographically: from well/almost completely exploited in some areas to almost completely under-exploited in others. Monitoring, visual inspections and reports from right-holders show that the kelp resource is stable and healthy.

CURRENT SPATIAL AND TEMPORAL MEASURES

The coastline between the Orange and Mtamvuna rivers is divided into 23 seaweed rights areas. In each area, the rights to each group of seaweeds (e.g. kelp, *Gelidium*, or gracilarioids) can be held by only one company, to prevent competitive over-exploitation of these resources. Different companies may hold the rights to different resources in the same area.

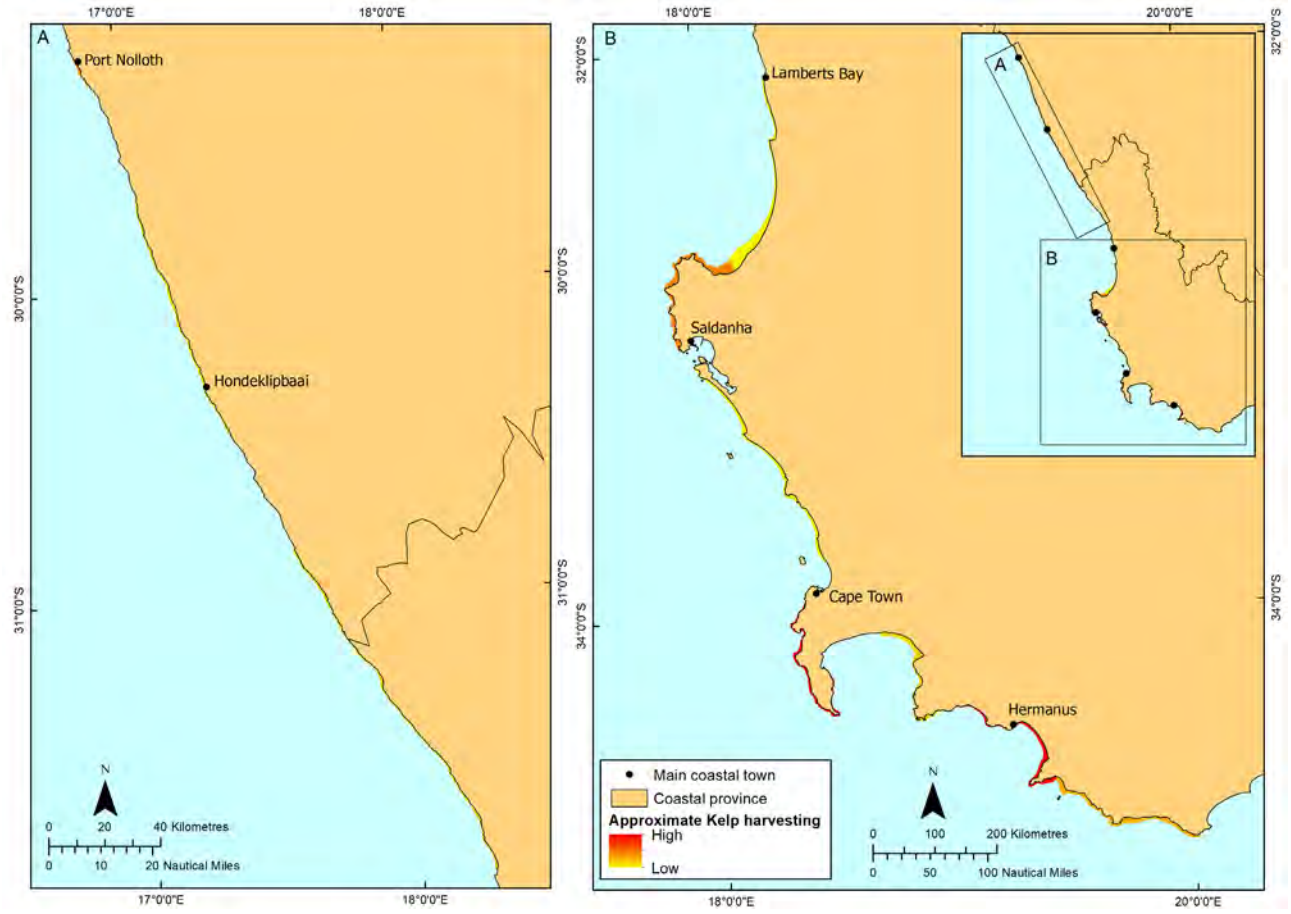


Seaweed rights map[101]. FIGURE 12

Management of most seaweed resources is based on Total Allowable Effort (TAE), except for fresh kelp, for which a Maximum Sustainable Yield (MSY) is set in annual permit conditions. It should be noted that, since 2012, the commercial season for permits and reporting of seaweed harvests was changed from a calendar year to 1 April of year 1–31 March of year 2.

KEY SPATIAL INTERESTS

Kelp harvesting intensity (kg/km^2) down to the 10m depth isobath over the period 2000- 2017 (Map 45). There are 14 areas in which kelp rights were held in 2014. No commercial activity was reported in five of these areas: in two of them right-holders could not access the resource. In some areas, harvests were well below MSY. The under-harvest is a result of lower demand for kelp in some areas and/or the use of alternative abalone feeds, and is not a reflection of the status of the resource in those areas. This substantial and potentially harvestable biomass ('spare' MSY) would allow for the expansion of abalone farms in such areas.



MAP 45

DEFF kelp harvesting data (2000- 2017) for each concession area; mapped as being down to the 10m depth isobath. The four types of kelp harvesting values were aggregated into a total take in kg and calculated as a relative intensity kg / km^2 over the period (see Annex for details).

In the case of *G. pristoides* in Area 1, which makes up the bulk of the Gelidium harvest, considerable research has shown that harvesting, as currently practised, has negligible ecosystem effects. Ecosystem effects of kelp harvesting have been dealt with in a few studies, and are the subject of ongoing research. Results so far indicate that they are slight; harvesting never exceeds natural mortality (about 10% of biomass), recovery of beds is rapid, and previous research showed no measurable effects on plants and animals living under the kelp canopy.

3.5.2.2.2.6 SECTOR: ABALONE

OVERVIEW OF THE SECTOR

Abalone *Haliotis midae*, locally called 'perlemoen', is a large marine snail that is a highly prized seafood delicacy in the Far East. Abalone are slow-growing, reaching sexual maturity at around seven years of age, and take approximately 8–9 years to reach the minimum legal size of 11.4 cm shell breadth (SB). They reach a maximum size of 18 cm SB, and are believed to live to an age of greater than 30 years.[101]

Historically, a commercial fishery was supported for about 65 years between Cape Columbine and Quoin Point, where abalone was most abundant. Abalone was sparsely distributed and discontinuous along the East Coast, resulting in no commercial fishery being implemented.

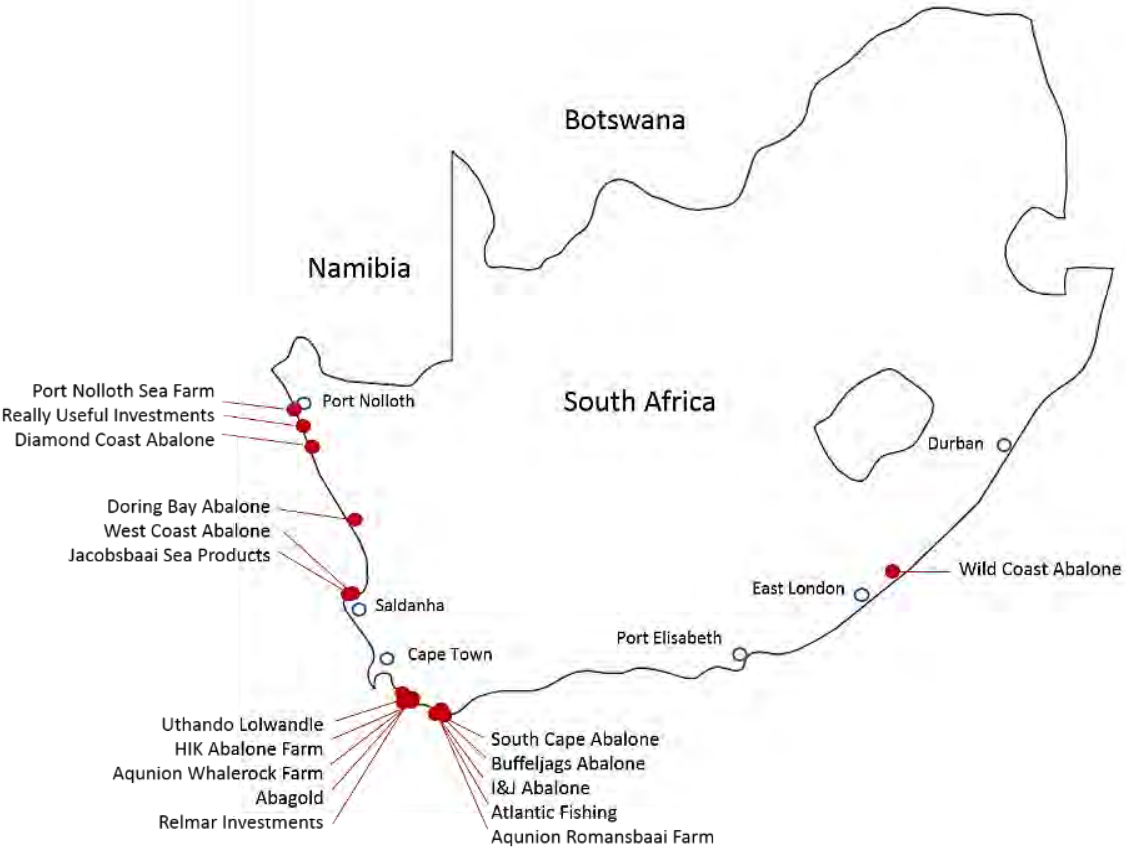
Experimental and subsistence permits were however allocated along the East Coast in the past, and new experimental allocations were awarded from 2012 to 2015. The recreational sector also caught abalone for many years, but due to illegal fishing and the decline in the resource, this component of the fishery was suspended in 2003/2004.

Due to illegal fishing and poaching abalone stocks continued to decline and the once profitable commercial fishery resulted in the total closure of the fishery in February 2008. The commercial fishery subsequently reopened in July 2010.[101]

STOCK DYNAMICS

Studies have shown that abalone in South Africa breeds between March and October and spawning will be highest between April and June with the preferred water temperature at 18°C.[165] Spawning frequently occurs early in the evening or at dawn, however, when one abalone (male or female) releases their reproductive cells (either sperm or eggs) it can trigger all surrounding abalone to spawn. In addition 18 abalone farms were identified in 2015 and these farms are distributed along the Cape coastline (Figure 13). All abalone farms are land based with the exception of 1 farm which is sea based. The geographic distribution and location of the abalone farms along the coastline indicates that the cooler sea temperatures and associated climates are best suited for abalone production. Due to the high sea temperatures from the warm Indian Ocean, the Kwa-Zulu Natal coastline is not suitable for abalone production.[166]

In South Africa there are seven companies that have been awarded rights for abalone ranching however, production of significant quantities may only be possible from 2023 due to the lengthy process involved.[167] There are currently 3 abalone ranching pilot projects in the Northern Cape, 4 abalone ranching pilot projects in the Eastern Cape, and there is currently no abalone ranching taking place in the Western Cape.



Distribution of abalone farms along the South African coastline. Adapted from DEFF, 2017[168].

FIGURE 13

CURRENT SPATIAL AND TEMPORAL MEASURES

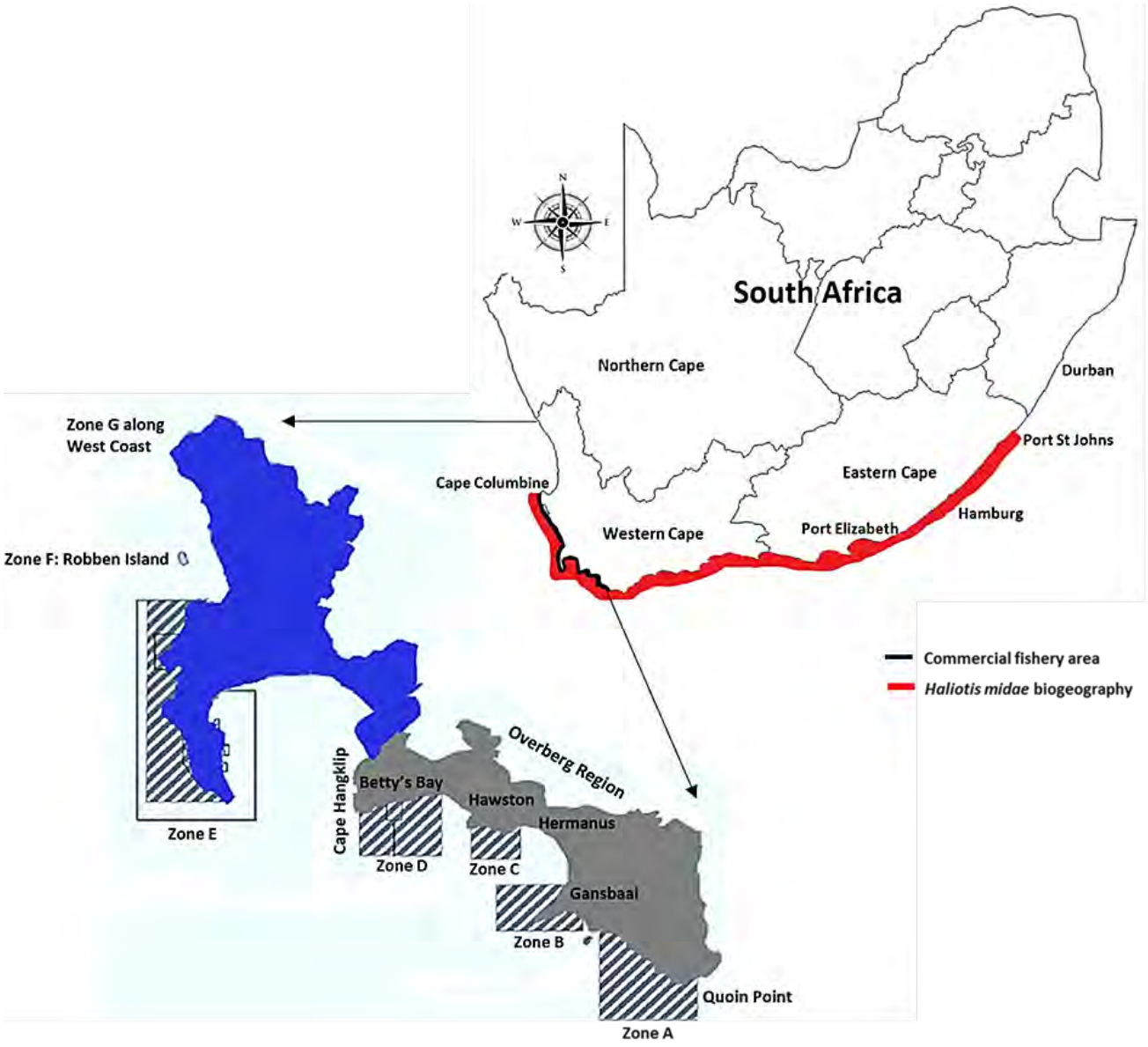
Since the early 1990's the combined effect of poaching and ecological changes has resulted in the severe decline of abalone and recruitment pattern of abalone in Zones C and D. This also affected the Betty's Bay MPA, situated within Zone D, meaning the loss of the main conservation area. Dyer Island has been closed to commercial fishing since the 2003/2004 season to function as a refuge area for abalone. In 2015 full population surveys were conducted together with the abalone industry and the results confirmed that there has been no recovery in the recruitment of juvenile abalone in Zone C, with similar results for Zone D, resulting in zero commercial catch allocation being maintained in these Zones.

KEY SPATIAL INTERESTS

The abalone commercial fishery extends from Cape Columbine to Port St. Johns and this area is divided into 7 fishing zones i.e. Zones A – G (Figure 14). These fishing zones have clear spatial boundaries as follows:

- **ZONE A:** Die Dam (Quoin Point) to Pearly Beach
- **ZONE B**: Uilskraalmond to De Kelders, Gansbaai
- **ZONE C:** De Kelders to Hawston slip - (currently a closed area)
- **ZONE D:** Kleinmond East Side to Cape Hangklip (marker pole) - (currently a closed area)
- **ZONE E:** Sandvlei Mouth to Cape Town Breakwater
- **ZONE F:** Robben Island

Abalone densities mainly occur in waters less than 5 - 10m deep and together with its high commercial value, they are particularly vulnerable to over-exploitation due to easy access.[169] Extensive poaching and overfishing has had a daunting effect of abalone densities along the coastline (see Map 46), causing the resource to be under severe fishing pressure.



Map of the South Africa and the Western Cape, showing the biogeographic range of abalone (Haliotis midae) and the spatial extent of the commercial abalone fishery. Adapted from Raemaekers et al. (2011)[170].

FIGURE 14

MAP 46

Map of South Africa showing the degree of areas impacted by abalone poaching. Source: Expert Based Assessment: no reference found (see Annex for details).

Abalone are found in shallow waters (20m depth but highest in waters less than 5m) and seem to prefer rocky surfaces. The large invasion of the West Coast rock lobster in the 2 most productive fishing areas, caused a change in the ecosystem which heavily impacted the abalone resource.[171]

According to Blamey et al. (2010)[172] the rock lobster *Jasus lalandii* expanded its centre of distribution south-eastwards into an area known as 'East of Cape Hangklip' on the south-west coast of South Africa in the early 1990s. The lobsters have now altered the ecosystem by consuming large numbers of sea urchins as well as most other invertebrate species, including juvenile abalone. Sea urchins perform the important function of providing protection for juvenile abalone.[101]

A recent study found that there was a substantial increase in rock lobster, seaweeds and sessile species in Zone D, with a substantial decline in grazers such as abalone. The current ecosystem state in Zone C is similar to Zone D.[101] In Zones A and B the ecosystem state differs to Zones C and D, with very few lobsters present, a lower biomass of seaweeds and sessile species, more encrusting corallines, and urchins and grazers still present in relatively high abundance. The combined effect of poaching and ecological changes has resulted in severe declines in the abalone resource in Zones C and D.[101]

CONFLICTS WITH OTHER USES AND INTERESTS

The early 1990s saw the booming of the recreational fishery, and a significant increase in illegal fishing activities. Continued high levels of illegal fishing and declines in the resource led to closure of the recreational fishery in 2003/2004. Transformation of the fishery in post-apartheid years sought to increase participation in the fishery, particularly by people who had been previously marginalised. Subsistence rights were introduced in 1998/1999, and were replaced by two-year medium-term rights. In 2003/2004, 10-year long-term rights were allocated, broadening participation in the fishery to some 300 right-holders. At this time, the previous management zones were replaced with Territorial Use Rights in Fisheries (TURFs) (see Figure 15)[101], aimed at developing a sense of ownership of the resource by the new right-holders. This process would encourage co-management of the resource and improve compliance with regards to illegal fishing activities.

Illegal fishing, however, remained high despite the introduction of TURFs and increased compliance effort, including strengthening of the compliance fleet, introduction of stricter penalties for offenders, and controls on international trade. Although illegal fishing of abalone occurs in all areas, its concentration has shifted from one area to another over the years in response to resource abundance and law enforcement presence.

Map of the abalone fishing Zones and sub-zones (TURF's)[101].

FIGURE 15

SECTORAL ISSUES TO CONSIDER FOR MSP

- The current spatial measures in place for the abalone fishery are consistent with management requirements of the DFFE.
- Zones C and D should remain a refuge for abalone until further studies suggest otherwise.
- Due to the degree of poaching and the decline of the abalone resource, a 0 TAC has been recommended for Zones A and B but this recommendation has not been implemented.
- It is suggested that further studies regarding the changes in ecosystem, spatial measures, abalone recruitment and densities are done in all zones to ensure its sustainability.

In the case of *G. pristoides* in Area 1, which makes up the bulk of the Gelidium harvest, considerable research has shown that harvesting, as currently practised, has negligible ecosystem effects. Ecosystem effects of kelp harvesting have been dealt with in a few studies, and are the subject of ongoing research. Results so far indicate that they are slight; harvesting never exceeds natural mortality (about 10% of biomass), recovery of beds is rapid, and previous research showed no measurable effects on plants and animals living under the kelp canopy.

3.5.2.2.2.7 SECTOR: OYSTERS HARVESTING

OVERVIEW OF THE SECTOR

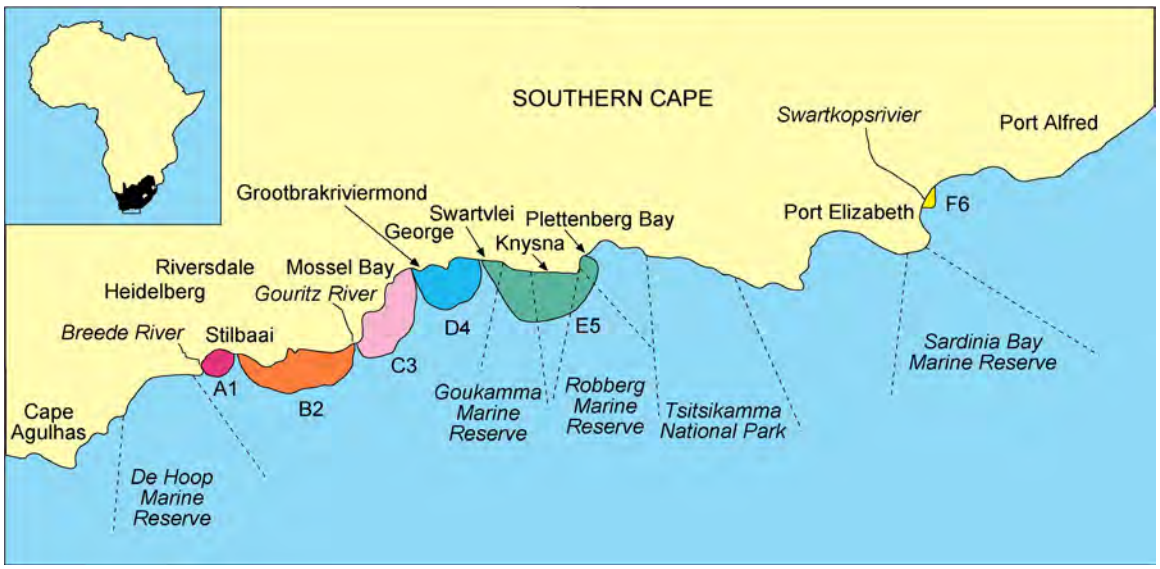
The Cape rock oyster *Striostrea margaritacea*, which is targeted in this fishery, has an extensive geographic distribution and occurs on rocky reefs from Cape Agulhas to Mozambique. These oysters are found in the intertidal zone down to about 6 m water depth. The Cape rock oyster occurs naturally and is sold in South African restaurants. Cape oysters along the KwaZulu-Natal (KZN) coast have been found to take 33 months (almost three years) to reach marketable size (60 mm right valve length). Oysters are broadcast spawners and those along the KZN coast spawn throughout the year, with peaks during spring and summer.

The commercial fishery for oysters' dates back to the late 19th century. Prior to 1998, a handful of individuals (less than 8 people) held concessions to harvest oysters and employed large numbers of 'pickers' to assist with collections. In 2002, rights were redistributed and medium-term (four-year) rights were allocated to 34 right-holders, the majority of which held limited commercial rights and were allowed to work with up to three pickers each. A few right-holders held full commercial rights and were allocated a maximum of 10 pickers each. In total, 114 pickers were permitted to harvest oysters during this period. In the 2006 rights allocation process, the sector was further transformed and 3-year commercial rights were allocated to 121 individuals. A large number of pickers were accommodated in this process, the idea being that pickers were granted rights as a means of empowering those who were dependent on oyster harvesting for their livelihood. In this system, rightholders are required to harvest the oysters themselves and are no longer allocated additional effort (pickers) to assist with harvesting.

Currently, the overall TAE is 145 pickers. In the last few years, however, less than 50% of the TAE has been issued or utilised. The status quo is being maintained until further data become available.

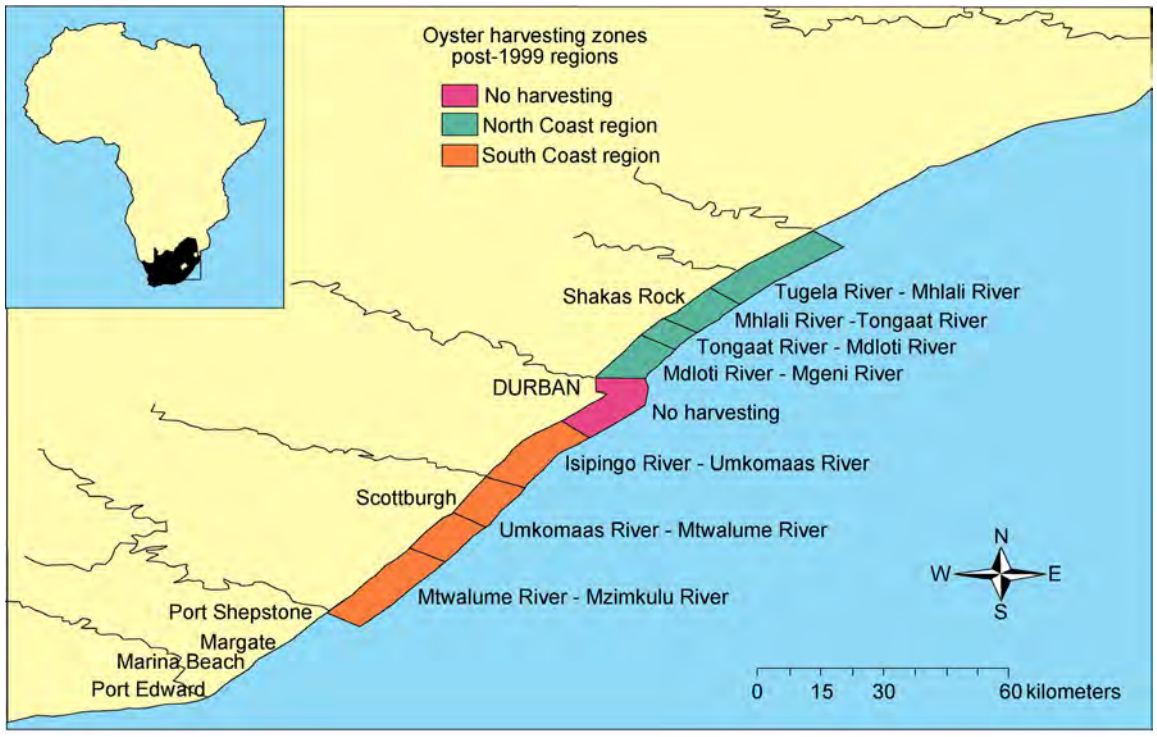
CURRENT SPATIAL AND TEMPORAL MEASURES

The oyster fishery was previously managed as two separate fisheries related to their areas of operation, namely the Southern Cape Coast (see Figure 16) and the KZN Coast (see Figure 17). Since 2002 the oyster fishery has been managed as a national fishery. Under the new management system, four commercial oyster-harvesting areas were officially recognised, namely the Southern Cape, Port Elizabeth, KZN North and KZN South. Regional differences regarding regulations and harvesting patterns have been retained. No harvesting is permitted from the sub-tidal beds, which are considered to seed the intertidal oyster reefs.



Western extent of Oyster fishery in the Southern Cape. The colour-coded areas indicate dedicated oyster collection zones[101].

FIGURE 16

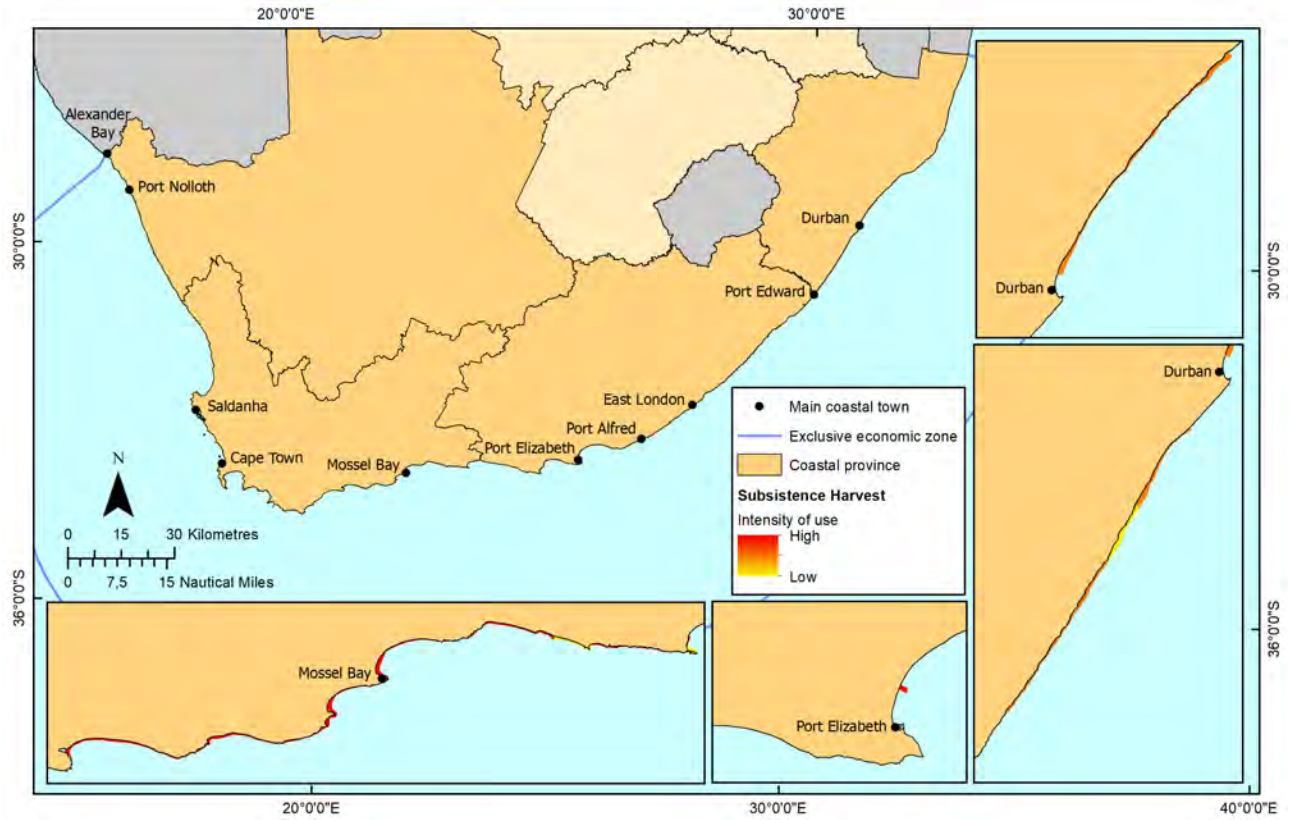


Eastern extent of Oyster fishery in KwaZulu-Natal[101].

FIGURE 17

Harvesting takes place during spring low tides and has traditionally been restricted to the intertidal zone. In recent years, however, this has gradually been expanded towards the fringes of the sub-tidal zone (see below). Oysters are dislodged from rocks by means of a pointed steel crowbar (oyster pick). Harvesters are allowed to wear a mask, snorkel and weight-belt, and commonly use an oyster pick to dislodge oysters from the rocks. The use of fins and artificial breathing apparatus is not allowed.

KEY SPATIAL INTERESTS



MAP 47

Spatial distribution of intensity of use by oyster harvesting sector for the years 2000 to 2017. The map is based on relative harvest in oysters / km² over the data period (see Annex for details).

The harvesting of rock oysters involves the direct picking of individual organisms from the rocks, and the use of diving masks by pickers allows more precise fishing, thereby reducing the potential for dislodgement of non-target species. Harvesters are allowed to use a crowbar or steel blade to remove oysters from the rocks, which causes localised physical damage (De Bruyn 2006)[173]. Due to the relative low value of this industry, it has not been prioritised for research effort and management (Sink et al. 2019)[174].

3.5.2.2.2.8 SECTOR: SUBSISTENCE HARVESTING (WHITE MUSSELS)

OVERVIEW OF THE SECTOR

White mussels of the species *Donax serra* are found in the intertidal zone of sandy beaches. They occur from northern Namibia to the Eastern Cape of South Africa; their abundance is highest along the West Coast. The lifting of the commercial upper catch limit in 2006 led to a steep increase in the number of white mussels collected by this sector over the last few years.

It should be noted that not all the areas allocated are being harvested, and that the largest component of the overall catch of white mussels is by the recreational sector, but these catches are not monitored. There are also information gaps on the level of exploitation by Interim Relief harvesters and the levels of illegal take. The current research programme will help to gather sufficient data to allow for proper assessment of the white mussel resource in the medium term. Comprehensive fishery-independent surveys are required in each of the areas and these surveys will take at least 3–5 more years to yield sufficient information for meaningful assessment. Uncertainty therefore remains regarding the current status of the white mussel resource.

CURRENT SPATIAL AND TEMPORAL MEASURES

Since 2007 the commercial sector has been managed by means of a Total Allowable Effort allocation (TAE) of seven right-holders (a right-holder may have up to seven 'pickers') each harvesting within only one of the seven fishing areas along the West Coast. The Interim Relief sector started in 2007. During the 2013/2014 season, 1 995 Interim Relief permits were issued for the Western and Northern Cape combined. This sector is subject to a limit of 50 mussels per person per day. The recreational sector is also limited by a daily bag limit of 50 mussels per person per day. For all sectors, a minimum legal size of 35 mm applies.

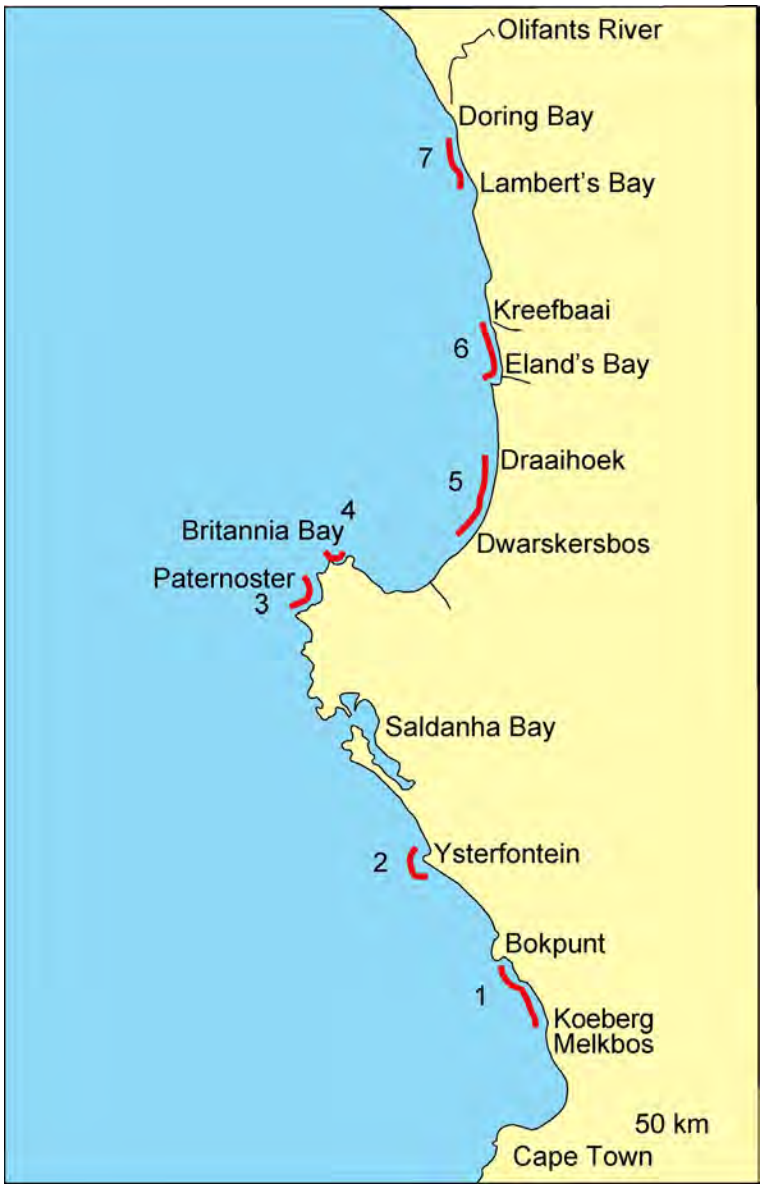
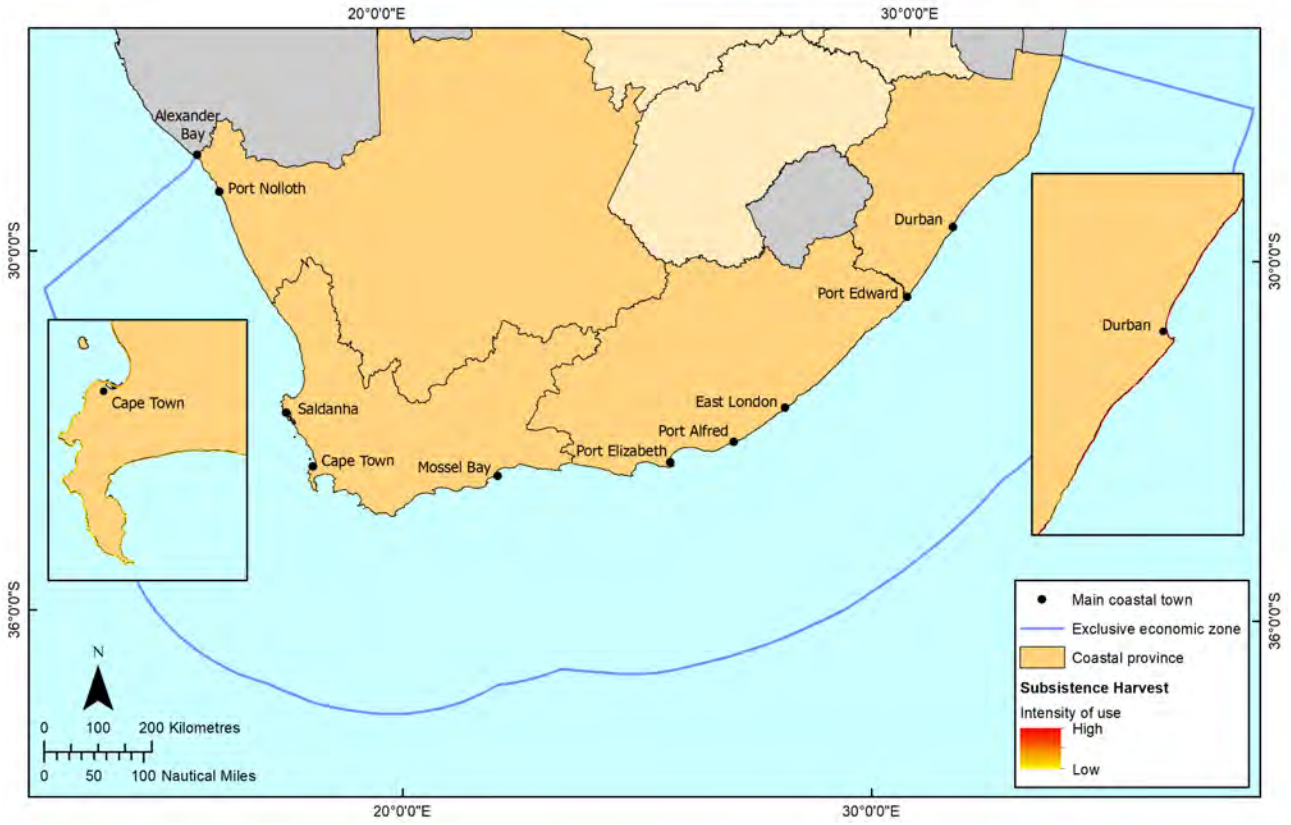


FIGURE 18 Mussel fishery areas[101].

The fishery for white mussels started in the late 1960s as part of the general commercial bait fishery and was suspended in 1988 when the bait rights were revoked. Prior to 2007, each right-holder was limited to a monthly maximum catch of 2 000 mussels. However, due to unreliable data from the fishery from under-reporting and difficulties with catch monitoring, catch limits were not considered as an adequate regulatory tool to monitor this fishery. Therefore, as of October 2006, the monthly catch limit was lifted with the aim of removing constraints and thereby improving the quality of catch-and-effort data for use in future resource assessments.

KEY SPATIAL INTERESTS



MAP 48

Spatial distribution of intensity of use by small scale/subsistence harvesting this is widespread over a very narrow section of the coast and as such is not visible here without zooming in. Please refer to OCIMS for a scalable version of the map. The map shows relative density per km^2 of small scale/subsistence fishermen (see Annex for details).

The harvesting of rock oysters involves the direct picking of individual organisms from the rocks, and the use of diving masks by pickers allows more precise fishing, thereby reducing the potential for dislodgement of non-target species. Harvesters are allowed to use a crowbar or steel blade to remove oysters from the rocks, which causes localised physical damage (De Bruyn 2006)[173]. Due to the relative low value of this industry, it has not been prioritised for research effort and management (Sink et al. 2019)[174].

3.5.2.2.2.9 SECTOR: SOUTH COAST ROCK LOBSTER

OVERVIEW OF THE SECTOR

The deep-water rock (or spiny) lobster (*Palinurus gilchristi*) is endemic to the south coast of South Africa where it occurs on rocky substrata at a depth range of 50 - 200 m between Cape Point and East London[175]. The stock is targeted by the commercial longline trap-fishery which has been in operation year-round since 1974[176].Since 2000/2001 the fishery has been managed using a combined TAC and TAE strategy, primarily to prevent under-reporting[177]. The TAC is based on an annual resource assessment, whereas the TAE is measured in fishing days allocated to each vessel. A vessel may fish until its fishing days expire or its quota is filled, whichever occurs first. Catch and effort levels have historically at times risen above sustainable levels, but the fishery has responded to management action and the species is currently considered to be optimally exploited (DEFF, 2016). An OMP for recommending the TAC for south coast rock lobster was first developed and implemented in 2008. A number of further OMPs have been developed since for the management of this resource.

CURRENT SPATIAL AND TEMPORAL MEASURES

Vessels are restricted by permit conditions to operating in the area between parallel lines of longitude passing through the mouth of the Great Kei River and Cape Hangklip and bounded by the South African Exclusive Economic Zone. Spatial restrictions as stipulated for the 2017/2018 fishing season are highlighted in Table 11. Fishing grounds extend between 20°E and 28°E at an approximate depth range of 50 m to 180 m.

Spatial restrictions on the south coast rock lobster fishery as stated in the Permit Conditions for the 2017/2018 fishing season. TABLE 11

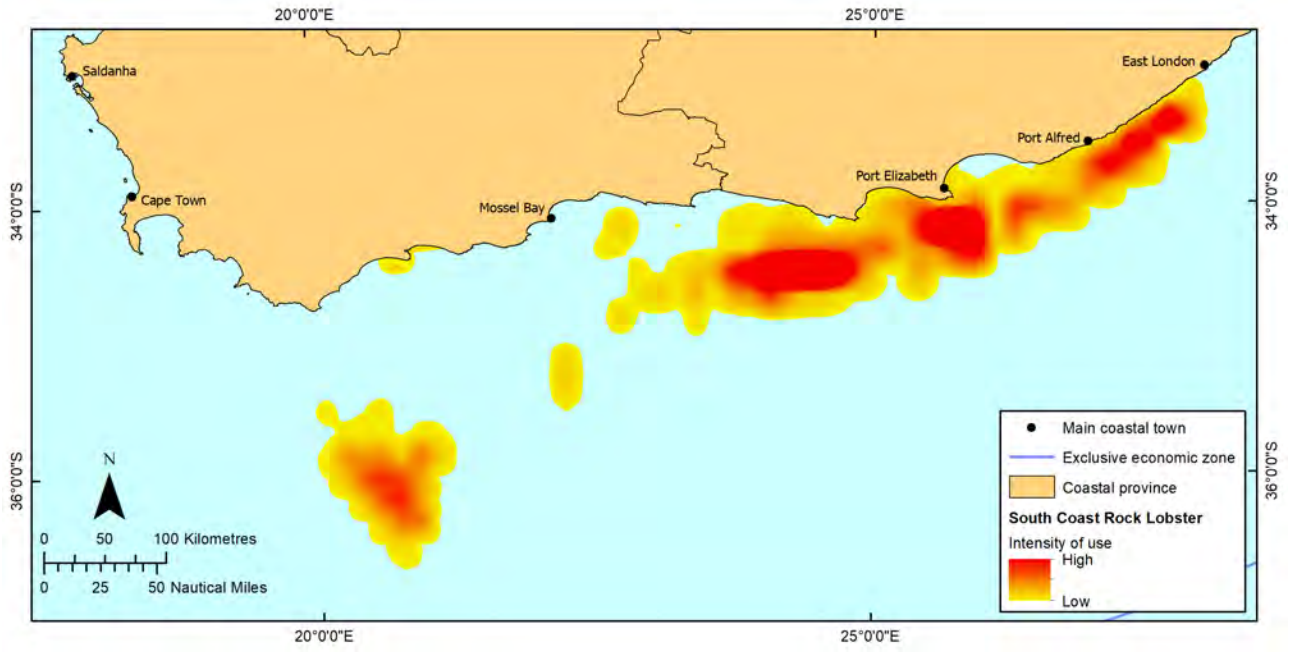
SECTION B: PERMIT CONDITIONS: SOUTH COAST ROCK LOBSTER FISHERY	
FISHING SEASON: 2017/2018	
3	Fishing Areas and Restricted Areas
3.1	The Permit Holder shall only harvest South Coast rock lobster in the area between parallel lines of longitude passing through the mouth of the Great Kei River and Cape Hangklip and bounded by the South African Exclusive Economic Zone.
3.2	Should the Department reasonably suspect that the Permit Holder has fished for South Coast rock lobster outside the above described fishing area, the Department may initiate legal proceedings (which may include section 28 proceedings and or criminal proceedings)

KEY SPATIAL INTERESTS

The fishery is restricted to a commercial sector as it is capital intensive and requires large-ocean going vessels (30m to 60m in length). Those that have on-board freezing capacity will remain at sea for up to 40 days per trip, while those retaining live catch will remain at sea between 7-10 days before discharging at Cape Town or Port Elizabeth (Map 49).

P. gilchristi is fished in two broad areas off the South Coast, where stocks are present in commercially viable quantities. The first is on the Agulhas Bank at an approximate offshore distance of between 70 km and 240 km, and the second is within 50 km of the shoreline between Mossel Bay and East London (Map 49). The fishery is restricted by permit conditions to operating within an area extending between the mouth of the Great Kei River and Cape Hangklip. The Agulhas Current restricts the fishery from operating within certain areas that experience strong current speeds.

Incidental bycatch of the fishery is largely dominated by *Octopus* spp. (likely *O. vulgaris*) and a small amount of slipper lobster (*Scyllarides elisabethae*).



MAP 49

Spatial distribution of catch by the south coast rock lobster trap sector for the years 2006/7 to 2015/6. The map is based on relative catch in kg / km^2 over the data period (see Annex for details).

Deep-water rock lobster is targeted on rocky substrata, at a depth range of 50 m to 200 m between Cape Point and East London[175]. It is assumed that the species spawns throughout its distribution as studies on breeding period[176] and fecundity[178] sampled the full range of the species and found females in berry at all sites and throughout the year. The peak in spawning occurs between July and November, although large females also bear eggs in March[175]. Juveniles migrate eastwards following westward dispersal of pelagic larvae by the Agulhas Current[179]. Lifetime egg production per recruit and fecundity are shown to be greater between the Agulhas Bank and Algoa Bay than at Port Alfred and that coincides with greater average lobster size and greater size at maturity[175,176]. The inshore area between Danger Point and Cape Agulhas is an important settlement area for juveniles, which migrate to adult habitats further offshore[179].

SPATIAL CONFLICTS WITH OTHER USES AND INTERESTS

There have been occasional reports of whales and turtles becoming entangled in rock lobster trap lines. Trap loss, ghost fishing and anchor and trap damage to coral habitat have been raised as minor concerns for this sector.

The stock is targeted over rocky substrata using traps set on long-lines. There is little potential for conflict with trawl fisheries as rocky substrata are largely inaccessible to trawl gear. There is history of spatial overlap with the Petroleum and Gas industry where traps can run across seafloor pipelines (much the same as for the demersal sector).

There is a high potential for conflict between the south coast rock lobster trap fishery and seismic survey vessels. Survey vessels tow a survey array just below the sea surface which would present a definite snagging risk to any demersal fishing gear that is connected to sea surface marker buoys via dropper lines. Gear fouling could result in costly downtime to the survey operation as well as damage to or loss of fishing gear. As such, any survey operation would require an area to be clear of fishing gear before transiting through the target area. Fishing vessels would be requested to clear the area of fishing gear prior to the survey vessel entering fishing grounds, which could lead to temporary displacement of vessels from favoured fishing areas and a possible loss of fishing time. There is currently no formal mechanism in place determining right of way for fishing activity over seismic survey operations.

SECTORAL ISSUES TO CONSIDER FOR MSP

- The strong habitat association of *P. gilchristi* infers that the resource has a predictable distribution and that the fishing industry has a vested interest in protecting important habitat for the species and maintaining access to associated fishing grounds.
- Identification of important resource areas that contribute to the south coast rock lobster fishery would provide support for further spatial management measures in the sector.
- Designation of priority fishing areas may help to resolve conflict between the fishery and seismic exploration activities by providing guidance or preference to the fishing sector or seismic operation accordingly.
- There is also overlap with phosphate mining prospecting areas and management should ensure that the sustainability of this fishery is not compromised by new mining endeavours.
- The new Agulhas Bank and Offshore Amathole MPAs may contribute to habitat protection and resource sustainability. Both MPAs are zoned and accommodate this fishery in some portions of the MPA (see Appendix 3).

3.5.2.2.2.10 SECTOR: WEST COAST ROCK LOBSTER

OVERVIEW OF THE SECTOR

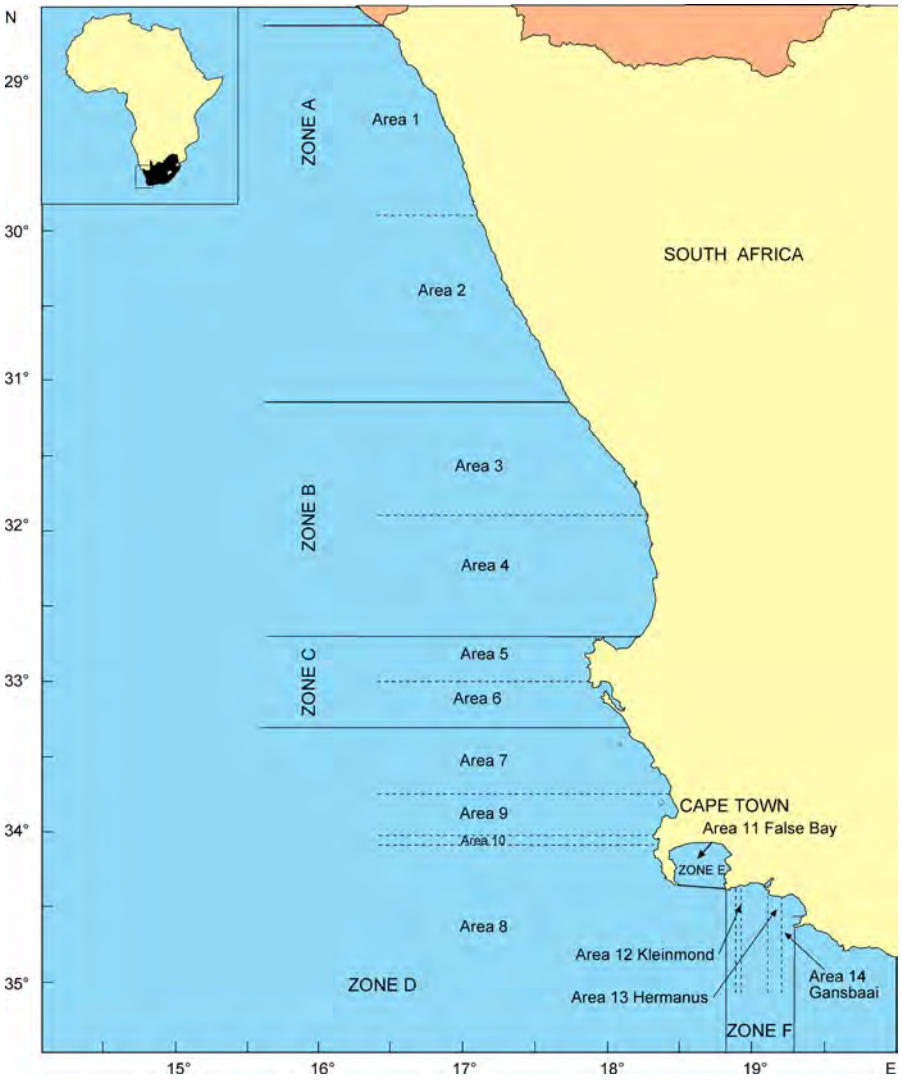
The West Coast rock lobster *Jasus lalandii* fishery is the most important rock lobster fishery in South Africa due to its high market value (more than R 260 million per annum) and its importance in providing employment for over 4 200 people from communities along the West Coast. It is a cold-water, temperate spiny lobster species that occur from Walvis Bay in Namibia to East London in South Africa.

Currently, 20% of the resource is harvested by hoop nets from 'bakkies' in the nearshore region up to one nautical mile offshore and 80% by offshore trap vessels operating up to water depths of greater than 100 m. The resource in the nearshore region is also harvested by recreational fishers and small-scale or subsistence fishers operating exclusively in the nearshore region during the summer months.

The invasion of West Coast rock lobsters in to the traditional abalone fishing zones east of Cape Hangklip marked the onset of the eastward shift in their distribution. Commercially viable quantities of lobster in this area resulted in the opening of three new lobster fishing areas (Areas 12–14). However, the fishery on the West Coast, which historically landed the bulk (60%) of the lobster catch, now lands only 40% of the total catch annually. This decline in catch had a devastating effect on coastal communities with economic hardships experienced by most fishers on the West Coast. In the face of resource decline an OMP was developed that aims to rebuild the stock to sustainable levels.

CURRENT SPATIAL AND TEMPORAL MEASURES

Under the TAC management system, annual catch limits were subdivided for the 10 traditional West Coast fishing areas (Zones A–D). A new fishing ground in False Bay (Zone E) was opened in 1987, and Zone F was opened in 1999 following the eastward migration of lobster to the area east of Cape Hangklip. Currently, the stock is managed on a per zone (super-area) basis. The resource in Zones A, E and F are exclusively harvested by fishers operating with hoop nets in the nearshore region.

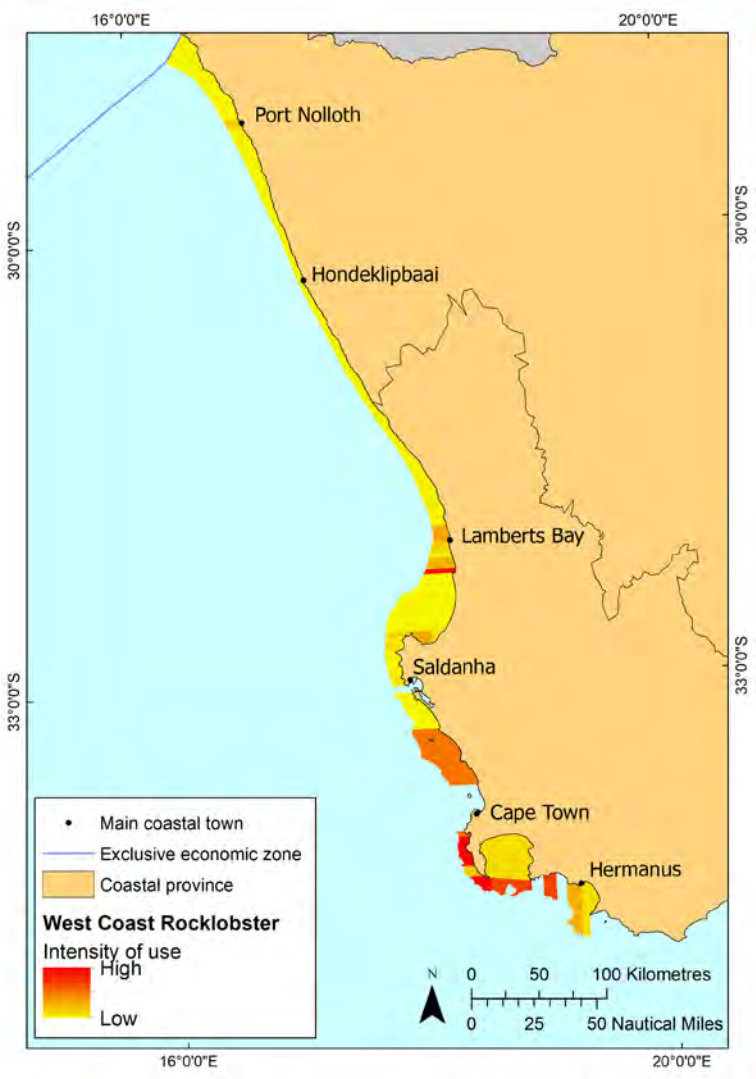


West coast rock lobster areas[101].

MAP 50

A number of management measures have been put in place during the history of the fishery; various minimum size limits (1933, 1959, 1970) and a tail-mass production quota (1946) was replaced by a whole lobster quota (1979) which led to the introduction of the TAC management system (1980s). Other management controls applied included protection of females with eggs (berried females) and soft-shelled lobsters, a closed winter season, and a daily bag limit for recreational fishers.

KEY SPATIAL INTERESTS



Total catch per km² (2006-2016) within West Coast rock lobster management zones extended to 20m depth contour. The map is based on relative catch in kg / km² over the data period (see Annex for details).

MAP 51

In South Africa, the commercial fishery operates between the Orange River Mouth and Danger Point in waters up to 100 m deep. This slow growing species inhabits rocky areas and exhibits a seasonal inshore-offshore migration governed by its biology and environmental factors.

SECTORAL ISSUES FOR MSP TO CONSIDER

Bycatch is not an issue of concern in this fishery. There are, however, negative interactions between lobster fishing gear (traps, ropes and buoys) and whales, with entanglements reported each season. The reported number of these incidences has reduced over the past few seasons as a result of an awareness programme directed at encouraging lobster trap fishers not to leave excess trap rope untied during fishing operations.

The general decline in lobster abundance (especially in shallow reef areas) and the distributional shift in the lobster population has been linked to the decline in the numbers and breeding success of the endangered bank cormorant (*Phalacrocarax neglectus*), which relies on lobsters as a major food source. In recent years there has been a major southward shift in lobster distribution including the movement of lobster into the area east of Cape Hangklip (or Zone F) with major implications for the benthic ecology in that area. Recent studies have shown that the situation in this area is stable with no further eastward movement.

3.5.2.3 OVERVIEW OF THE GENERAL ENVIRONMENTAL IMPACTS

Fishing inevitably has an impact on the marine environment. Yet, as described for each of the fisheries sectors above, the degree of environmental impact depends on a number of factors including, but not limited to, the type of fishing, regulation of the sector, effectiveness of enforcement, the fishing method, type of fishing gear used, and the nature and robustness of species and habitats exposed to the fishing activity (of which some are more vulnerable than others to overfishing or disturbance). Nevertheless, some generic environmental impacts can be described.

The universal impact is on the targeted species, though some industries such as bottom trawling may have bycatch and habitat damage issues that may be worse than the impacts on the target species. This environmental impact generally reduces the target species' biomass and therefore negatively impacts other species predating on these resources. This can disturb the balance of processes in the food web and hamper healthy ecosystem functioning. For example, overfishing and targeting of juveniles (especially sardine) in the small pelagic fishery are considered to have substantial impacts on the ecosystem structure and function in altering the composition and spatial distribution of these populations[180], with unexpected consequences for the African Penguin, and spatial measures are required to minimize competition between the commercial sector and this charismatic species that plays a role in ecotourism.

Fishing also has impacts on non-target species. This occurs most commonly through bycatch, where species are accidentally (and in some instances, intentionally) caught and either retained or discarded. In the 22 commercial sectors discussed above, there is a fair amount of "overlap" where species are caught in multiple fishing sectors. For example, horse mackerel is targeted by midwater trawl, and is a bycatch species of the hake trawl and pelagic purse seine fisheries. Net-based fisheries are most prone to bycatch owing to the low level of selectivity of the fishing method, and species of concern have been identified for the trawl sector including biscuit skate.[181] The inshore hake trawl fishery, for example, is known to encounter a substantial high-diversity bycatch as a result of high fish diversity occurring on the Agulhas Bank with the majority of these species retained.[182] Other sectors, like the tuna pole fishery is a highly targeted fishery with virtually zero unintentional bycatch. Other bycatch impacts are found in the longline fishery, as it has deemed responsible for the declining populations and threatened conservation status of several shark, sea bird and turtle species.[183] Improved seabird bycatch mitigation measures have reduced seabird mortality[184]; shark, turtle and marine mammal bycatch continue to be a concern that is being addressed.

Fishing using mobile gear also has impacts on habitats, most notably sea floor (benthic) habitats and associated biota on account of bottom trawling due simply to the nature of the fishing activity, which involves dragging a net over the sea floor. The extent of impact is influenced by the size of the trawled area, frequency of fishing effort and the habitat type. Structurally complex habitats (e.g. cold water coral reefs) and habitats that are relatively undisturbed by natural perturbations (e.g. deep-sea benthic environments) are highly susceptible to impacts from trawl gear.[185]

Unintentional impacts on other species can be caused by lost gear that results in ghost fishing, although this issue is understudied in South Africa.

The 2018 National Biodiversity Assessment identified two principal ecological concerns which apply to a greater or lesser degree to all of the sectors: benthic habitat damage and the large bycatch of diverse fauna. Information specific to each sector is detailed in the NBA 2018.

The Top 10 Priority Actions to Improve the State of Marine Biodiversity are detailed in the 2018 NBA Report and all of them are relevant to fisheries:

1. Implement ecosystem-based Marine Spatial Planning and fortify Environmental Impact Assessments informed by Critical Biodiversity Area maps to mitigate pressures in priority areas.

2. Develop and implement effective fisheries management plans to secure food and job security and reduce ecosystem impacts of fisheries.

3. Strengthen Marine Protected Area (MPA) financing and governance to enhance equitable flow of benefits from South Africa's MPA network.

4. Ensure sufficient freshwater flow to the marine environment and improve water quality in priority areas.

5. Effectively communicate the value of South Africa's marine biodiversity through improved coordinated messaging that articulates benefits, in order to build support for marine conservation and mobilise people to sustainably use marine biodiversity.

6. Develop a marine invasive species response plan and secure resources for rapid action to prevent invasions.

7. Invest in solutions to restore, maintain and secure marine ecological infrastructure to strengthen climate resilience and sustain ecosystem services.

8. Enhance co-operative governance for improved, coordinated compliance and marine biodiversity management.

9. Modernise and integrate data collection, storage and access to improve species, specimen, fisheries, ecosystem, oceanographic and climate data for better assessment, analysis, and monitoring of marine biodiversity, and to improve compliance with and evaluation of management actions.

10. Address critical knowledge gaps that limit the assessment of marine biodiversity and decision making for a sustainable oceans economy.

The fishing industry also affects the nearshore environment and water quality as a result of organically polluted sea- and freshwater discharges from fish processing plants.[186]

In addition, waste discharge and plastics pollution from fishery vessels occurs.

3.5.3 LOOKING TO THE FUTURE

3.5.3.1 OVERALL STRATEGIC POLICY OBJECTIVES

The fisheries sector has – despite the declining status of some of the country's major marine fishery resources – a key role in contributing to enhanced food security and socio-economic development. Given the significance of wild fisheries in sustaining jobs and livelihoods of hundreds of thousands of South Africans through commercial, recreational and small scale fisheries, a central strategic policy objective for the sector is therefore improved fisheries management, including improved place based protections to ensure the industry is sustainable, regulation, monitoring and compliance in order to progressively rebuild depleted fish stocks. We need to ensure that the spatial requirements for supporting the rebuilding of fish stocks are properly built into the MSP requirements. This will require an improved representative network of MPAs designed to support the requirements of each fishery. This could also include fisheries exclusion zones, protection of spawning sites and exclusion zones for specific fishing sectors. It is a national objective to develop an equitable, diverse, viable and competitive fisheries sector over time through sustainable use of the marine living resources.[187]

The development of the wild fishery sector is guided by the following strategic objectives with direct spatial relevance:

- National Development Plan (NDP) 2030

The NDP aims at well protected and sustainably managed marine living resources.

- Agriculture, Forestry and Fisheries Integrated Growth and Development Plan (IGDP)

Strategic goal SG3 of the 2012 IGDP aims for improved sustainable natural resource management through the enhanced protection of environmental assets and natural resources. This includes a) the extension of marine protected areas to protect larger areas of marine habitat that are also important for the sector e.g. as fish spawning grounds, and b) the application of an ecosystem approach including through integrated management and (spatial) planning.

- Operation Phakisa: Oceans Economy

This policy initiative indirectly targets the fisheries sector over the five years (2014-2019) by enhancing coastal fishery-relevant infrastructure. This is to be achieved through focus area on the development of small harbours which will contribute to a more viable fishery sector.

3.5.3.2 TRENDS AND DRIVING FORCES

While the global and local demand for fish products is increasing due to population growth, related food security needs and employment requirements, as such wild fisheries sectors are under pressure. Overall, a total of 52% of the stocks assessed in 2016 of the country's major resources are considered not to be of concern, while 48% of stocks are of concern. The number of stocks which are considered to be in an optimal state has increased from 15 in 2012 to 16 in 2014, and 20 in 2016. The number of stocks which are considered to be of concern has remained the same from 2014 to this report. However, the number of stocks considered to be over-exploited has continued to increase from 12 in 2012 to 13 in 2014 and to 15 in 2016.[101]

The only real avenue for fisheries is therefore to enhance sustainability. Consequently, public awareness and support as well as political will to improve fisheries management is a key trend observed – driven by the need to grow sustainably in order to cater for an increasing population which demands food and income.[188]

The reforms of the post-apartheid fisheries sector transformation process and the implementation of the 1998 Marine Living Resource Act are argued as not having reached the expected aims of sustainability, equity and stability.[189] Many traditional fishers have been excluded from the new fisheries management framework and consequently were left without fishing rights and adequate support.[190] This imbalance was addressed through the 2012 Small Scale Fisheries Policy, and allocation of rights are underway.[189,191]

3.5.3.3 OVERALL SYNERGIES WITH OTHER USES AND INTERESTS

The following current and possible spatial synergies exist between:

- FISHERIES MANAGEMENT AND ENVIRONMENTAL PROTECTION:
  Well and appropriately designed conservation measures, including place based measures such as MPAs in key biodiversity areas (such as the EBSAs) may contribute to maintaining a healthy marine environment, and ensuring conservation and sustainable use of habitats and linked marine living resources that are important for both the fisheries sector and for the environmental protection interest.

- RECREATIONAL FISHERIES AND TOURISM:
  A healthy marine environment enables and supports habitats and species that are targeted by recreational fishers.

Non-spatial synergies potentially exist with various other sectors concerning data collection and monitoring. Particular synergies with respect to monitoring control and surveillance exist with the Navy. In addition, marine tourism and recreational fishing provides an opportunity for raising environmental awareness and understanding.

3.5.3.4 OVERALL ISSUES FOR MSP TO CONSIDER

The following key issues should be considered by MSP from a fisheries point of view:

- The sector needs continued access to the key areas where the resources are located that are exploited (see maps in the above sections on key spatial interests); but, given that a number of stocks and industries are depleted / depressed, it is clear that for fisheries reasons:
  - Additional spatial closures of some areas that are currently accessed will be necessary to support the recovery of key industries and stocks. There may be a need for large areas of temporary closure to allow key stocks to recover.
  - Carefully protection of spawning grounds may be necessary, and this may limit access to some current key areas.
  - Additional more extreme spatial measures may be necessary, including the establishment of MPAs with a specific fisheries recovery and support focus.
  - Protection of key sites for species such as reef fish will necessary for the linefish industry to recover. A network of linefish breeding sites needs to be protected in order to allow juveniles to be available to colonize fished reefs.

- Key habitats and associated species for the fisheries sector should be protected from adverse effects. The MSP process should therefore also examine in how far important biodiversity areas with the associated conservation interests can be aligned with fisheries management and integrated with other human uses in the wider surrounding area. The following sites would need to be secured for fisheries protection reasons:
  - Key spawning sites.
  - A network of reefs to ensure that species breed and that juveniles are available to support fisheries.
  - Key areas important for supporting processes linked to commercially important species need to be protected. These include estuaries and estuary mouths, key reefs etc.
  - A network of MPAs needs to be established purely for the purposes of securing a long-term stable fishery.
  - Certain areas, such as areas supporting vulnerable marine ecosystem indicator species need to be designated as off limits for certain fisheries in order to ensure that these fisheries retain certification.
  - Current fisheries zones and management areas need to be fully built into the MSP requirements – e.g. the trawl footprint limits.

- MSP should aim at a good overall ecosystem health and coastal water quality, especially also for fish processing.
- The current capacity limitations of the Branch Fisheries, which in turn has affected the development of policies and long-term planning.

RV Africana trawl survey in rough weather
© Fisheries Resources Research

3.6 MARINE AQUACULTURE

3.6.1 BACKGROUND

The 2013 National Aquaculture Policy Framework for South Africa defines aquaculture as "the farming of aquatic (marine or freshwater) organisms including fish, mollusks, crustaceans and plants in controlled or selected aquatic environments, with some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. Farming also implies individual or corporate ownership of the stock being cultivated. This definition includes ranching and stock enhancement as aquaculture activities".

Aquaculture in the marine environment ("mariculture" or "marine aquaculture") therefore means "the farming of marine plants and animals which is conducted in the open ocean, in enclosed sections of the ocean, or in tanks, ponds or raceways which are filled with seawater".[192] This means that marine aquaculture sites are either directly located in the marine environment (so called sea-based marine aquaculture) or located on land which abstract/utilise seawater to cultivate the produce in suitable facilities (so called land-based marine aquaculture).

The species cultured by the marine aquaculture sector in South Africa comprise mainly finfish, shellfish and seaweed. These include mainly indigenous species such as abalone (*Haliotis midae*), dusky kob (*Argyrosomus japonicus*), silver kob (*Argyrosomus inodorus*), yellowtail (*Seriola lallandi*), and alien species such as the Mediterranean mussel (*Mytilus galloprovincialis*), Black mussel (*Choromytilus meridionalis*) and Pacific oyster (*Crassostrea gigas*), as well as indigenous seaweed species (*Ulva, Gracilaria* and *Porphyra*) which are mainly used as a feed supplement in abalone farming.[193]

Marine aquaculture operations can be found across South Africa's coastline in all coastal provinces. In South Africa, finfish are cultivated in land-based marine aquaculture sites and on a pilot scale in sea-based operations. Shellfish are produced in sea-based marine aquaculture areas, while abalone ranching involves the seeding of abalone in its natural habitat in the marine environment using hatchery-reared abalone cultivated on land. Ranching therefore is a type of marine aquaculture where mariculture products are intentionally released, without restriction, into the marine environment for the purpose of harvesting them when they mature.

Total aquaculture production in South Africa amounted to approximately 5,600 tons in 2017.[194] Of this, marine aquaculture species accounted for approximately 69.9%, with mussels and abalone contributing the largest share at approximately 2,100 tons and 1,300 tons respectively.[194] This is equivalent to less than 1% of South Africa's total wild fish catch which is in the order of 700,000 tons per annum. In the same year (2017), the Western Cape was the leading producer of marine aquaculture species. The province accounted for approximately 88.2% of marine production, followed by the Eastern Cape at 9.7%, the Northern Cape at 1.3% and KwaZulu-Natal at 0.8%.[195]

South Africa is not a traditional fish eating nation but its consumers have become more aware of the growing range of aquaculture products. Abalone and oysters are the only South African cultivated aquaculture products that are sold internationally. The rest are consumed locally including by tourists visiting the country.

The South African aquaculture industry contributes to the economy in providing employment opportunities in rural coastal areas and as such supports poverty reduction, empowerment and the sustainable use of coastal and inland resources to the benefit of local communities.

There is significant potential for growth given the expanding national consumption and international markets as well as the large number of suitable, but currently unused, production sites. These include both land-based and sea-based sites, however, in line with international trends, the limited sheltered bays in South Africa and the high number of user conflicts in these areas may result in exploration of offshore aquaculture zones in the future.

3.6.2 THE CURRENT SITUATION

3.6.2.1 LEGAL AND POLICY FRAMEWORK

The management, regulation and development of the aquaculture sector in South Africa fall within the responsibility of the Chief Directorate Aquaculture and Economic Development of the DFFE. The legislative mandate of DFFE is derived from Sections 24(b)(iii) and 27(1)(b) of the Constitution.

The Minister of Forestry, Fisheries and the Environment, as a member of the Cabinet, is responsible for aquaculture according to relevant legislation. The Minister provides the DFFE with strategic direction and sets out political priorities to be pursued by DFFE. The execution of these priorities enhances the effective realisation of the mandate relating to aquaculture.

The primary legislation and policy for DFFE governing (marine) aquaculture includes but is not limited to the:

- Marine Living Resources Act, 1998 (Act No. 18 of 1998);
- Policy for the Development of a Sustainable Marine Aquaculture Sector in South Africa (2007);
- National Aquaculture Strategic Framework (2012); and
- National Aquaculture Policy Framework (2013).

Marine aquaculture is managed under the Marine Living Resources Act of 1998 (MLRA). A "right to engage in marine aquaculture" (15 year duration) is granted in terms of section 18 of the MLRA by DFFE for the undertaking any commercial marine aquaculture activity. An exemption is granted, in terms of section 81 of the MLRA, if – in the opinion of the Minister – there are sound reasons for doing so (e.g. in the absence of a rights allocation process). No person shall exercise any right granted in terms of section 18 of MLRA or perform any such activity without a valid permit granted in terms of section 13 of MLRA.[196]

Marine aquaculture permits are valid for 12 months and renewable, which include the following:

- Permit to engage in marine aquaculture (i.e. brood stock collection, hatchery, and/ or grow out);
- Permit to export and/ or import marine aquaculture fish and fish products (e.g. live or frozen products(s));
- Permit to operate a marine aquaculture fish processing establishment (FPE);
- Permit to engage in marine aquaculture scientific investigations and practical experiments (e.g. research);
- Permit to transport marine aquaculture product(s); and
- Permit to possess and sell undersized cultured product(s) by a local retailer and/ restaurant (e.g. abalone and kob).

The 2012 National Aquaculture Strategic Framework provides a road map that facilitates the development of the aquaculture industry as prompted by the 2007 Policy for the Development of a Sustainable Marine Aquaculture Sector. It identified the need for Government to undertake a legislative review and where appropriate, remove constraints to diversify and promote sustainable aquaculture development.

The 2013 National Aquaculture Policy Framework has been developed in response to the strategic framework and establishes policy priorities.

It is on this basis that the DFFE undertook a "Review of legislation and institutional arrangements governing aquaculture in South Africa" in 2013, which highlighted that the current legislative framework for aquaculture is fragmented and rarely addresses aquaculture in particular; there is no national legislation governing the freshwater sector and marine aquaculture is regulated as a fishery in terms of the rights allocation process. The legislative review identified the need for promulgation of a dedicated Aquaculture Act. An Aquaculture Development Bill is therefore currently being developed and was approved by Parliament for further consultations.

The key aim is to provide a legislative framework for the development of the sector. Given the current institutional setting with fragmented policies, strategies and responsibilities across the three spheres of government (national, provincial, local), this Bill is intended to create a harmonised enabling regulatory environment, and to improve coordination in the regulation of the aquaculture sector. The Bill also foresees the declaration of so called Aquaculture Development Zones (ADZ's) as areas dedicated for aquaculture use.

Aquaculture is an important vehicle to achieve South Africa's development objectives as stipulated by the National Development Plan and its Vision 2030, which highlights the role of aquaculture in contributing to food security as a key measure to addressing poverty, unemployment and inequality.[197] Operation Phakisa: Oceans Economy aims at fast-tracking the implementation of solutions to overcome critical development issues in pursuit of the NDP. The unlocking of the socio-economic potential of South Africa's ocean wealth has been identified as one of the key areas of work with aquaculture being one of the growth areas.

3.6.2.2 SOCIO-ECONOMIC IMPORTANCE

The South African marine aquaculture industry contributed 0.029% to the country's GDP in 2017 with a production value of approximately R0.88 million.[198] In 2017, marine aquaculture produced a total of 3,908 tons, accounting for 69.93% of the total production having decreased by 232.42 tons (5.61%) from 2016.[199]

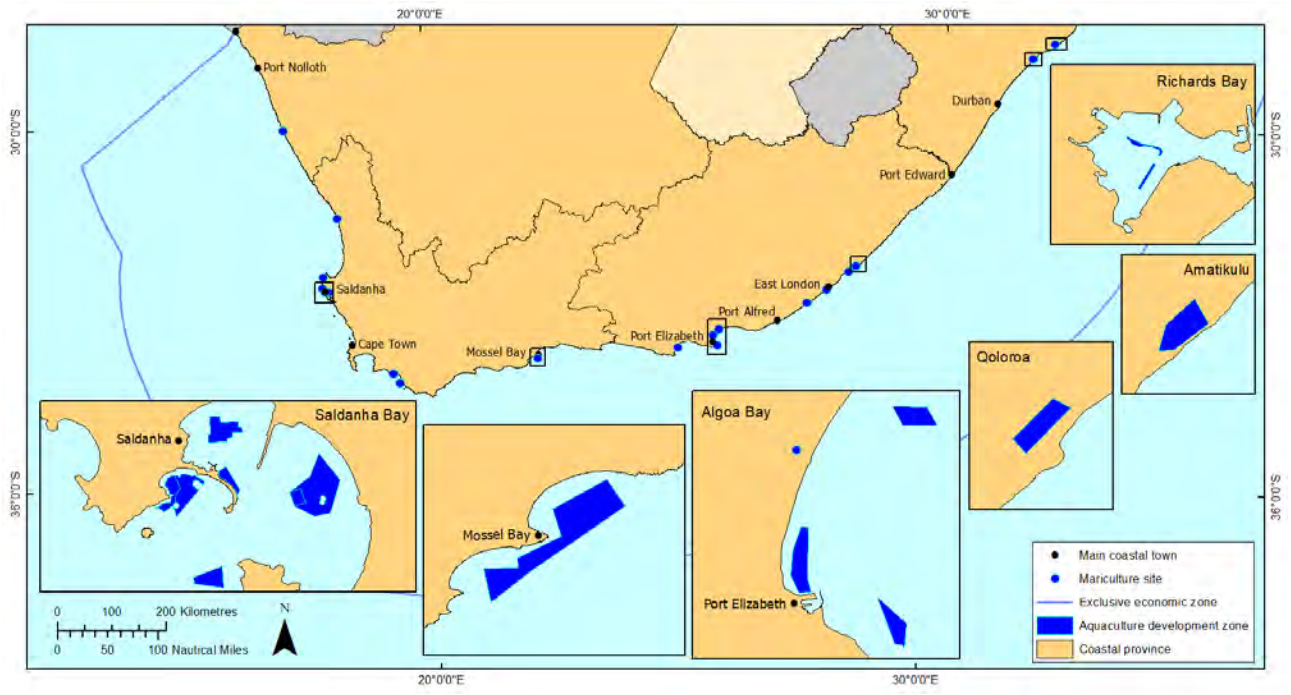
In 2010, the marine aquaculture sector has recorded a total of 1,556 employees on a permanent basis, increasing to 1,607 jobs in 2011. In 2012, both the marine and freshwater sectors collectively recorded 2,227 jobs and a total of 2,831 in 2013. Available statistics reveal that employment has increased by approximately 17% during this period.[200]

From 2016 the number of jobs increased from 4,448 to 4,862 in 2017.[201]

A total of 38 marine aquaculture farms were operational in 2017. This represented a decrease on the reported 41 farms in operation during 2016. The Western Cape recorded the highest number of farms with a total of 24, followed by the Eastern Cape and Northern Cape with each six farms and Kwa-Zulu Natal with two farms. These farms comprise of 18 abalone farms, followed by ten oyster farms, five mussel farms and five finfish farms.[202]

3.6.2.3 KEY SPATIAL INTERESTS

The existing marine aquaculture facilities in operation (38) – both land-based and sea-based – are located unevenly throughout South Africa's coastline, with the majority being in the Western Cape Province.[203]



Location of existing marine aquaculture sites. MAP 52

Due to the high-energy coastline of South Africa, suitable areas for sea-based marine aquaculture are limited to naturally sheltered sites. In addition, cultivated species also depend on good water quality. These candidate areas are therefore of key interest to the sector and required to achieve the industry's growth targets.

AQUACULTURE DEVELOPMENT ZONES (ADZ'S)

In 2009, the DFFE initiated a process of identifying suitable state owned land and sea space for the establishment of marine ADZ's. The process resulted in various proposed ADZ's which are at different stages. The land-based ADZ's include the following:[204]

- Qolora ADZ (Eastern Cape) – all environmental authorisations received;
- Amatikulu ADZ (Kwa-Zulu Natal) – EIA still underway;
- COEGA ADZ (Eastern Cape) – all environmental authorisations received; and
- East London Industrial Development Zone (Eastern Cape) – environmental authorisations received and supporting infrastructure in place.

In 2012, during the process of undertaking the Environmental Impact Assessment (EIA) for Algoa Bay's sea-based ADZ, alternative sea-based inshore and offshore aquaculture sites for marine finfish were re-assessed for the whole of the South African coastline and marine area on the basis of a Strategic Environmental Assessment (SEA).[205] Expansion of existing or new inshore sea-based aquaculture sites are underway in the following bays as a result of this process:

- Saldanha Bay ADZ (Western Cape) for oysters, mussels and marine finfish – all environmental authorisation received and is currently being implemented;
- Algoa Bay ADZ (Eastern Cape) for marine finfish and oysters – EIA has been granted but was taken under appeal;
- Richards Bay ADZ (Kwa-Zulu Natal) for marine finfish – feasibility study completed, Basic Assessment process to be initiated; and
- Mossel Bay ADZ (Western Cape) for marine finfish – previous EIA for I&J has lapsed, new EIA to be undertaken.

In addition, the assessment identified potential offshore sea-based aquaculture zones which will be investigated going forward in line with international trends.

The DFFE undertook a broader SEA which was completed in 2019[206]. The purpose of this SEA was to promote and support the growth of the aquaculture industry in South Africa through: (i) identifying suitable areas where environmentally sustainable aquaculture development can be prioritised and incentivised; and (ii) providing a streamlined and integrated management and regulatory framework to reduce compliance complexities and improve decision-making processes. The SEA was conducted at a national scale and includes all nine provinces. The SEA assessed the identified environmental attributes, specific siting criteria and key impacts associated with both marine (salt water) and freshwater related activities of aquaculture planning, development and operations. The assessment considered natural (offshore, inshore and inland) and "artificial" or land-based systems operating in cold/temperate and warm waters. Candidate species considered during the assessment include abalone, mussels, oysters, prawns, seaweed, tilapia, trout and marine finfish (e.g. cob and salmon). The SEA process reviewed existing legislation, including licensing/permitting and authorisation procedures currently governing marine and freshwater aquaculture on a national and provincial scale.

The key purpose and objectives of the SEA included:

- To promote and support the responsible and sustainable growth of the developing aquaculture industry in SA contributing towards job creation, food security and economic investment opportunities.
- To undertake a strategic scientific analysis of opportunities and constraints influencing aquaculture development in South Africa.
- The SEA achieved its purpose in two ways:
  - (a) to identify strategic marine and freshwater Aquaculture Development Zones (ADZs) or "suitable focus areas" using multi-layered spatial analysis of the receiving environment, and
  - (b) to provide the Competent Authorities with a streamlined and integrated management and regulatory framework to reduce compliance complexities and improve decision-making processes pertaining to these identified and assessed ADZs.

The key outputs of the SEA included:

- Strategic Marine (x8) and Freshwater (x9) Aquaculture Development Zones (ADZs) in South Africa.
- Environmental Compliance Framework (e.g. standards) with screening & risk assessment protocols for streamlined and integrated decision-making to reduce (or limit) the need for permitting & authorisations in ADZs.
- Generic Environmental Management Plan (EMP) for the management of aquaculture activities in South Africa.
- Biodiversity Risk & Benefit Assessments in terms of the Alien and Invasive Species Regulations (GN R 598 of 01 August 2014) for 7 alien invasive fish species (trout, tilapia, catfish, oysters, mussels, marron).
- Mapping of Trout and Nile tilapia presence in SA waterbodies.

Aquaculture will not be prohibited in areas outside of the areas assessed during the SEA.

Marine Aquaculture Right holders also require land-based areas for the processing of the cultivated produce. Allocation of such associated land-based areas falls under the jurisdiction of the local authorities and Department of Public Works and Infrastructure (DPWI) but also requires permits from the DFFE and the National Regulator or Compulsory Specifications (NRCS).

3.6.2.4 ENVIRONMENTAL IMPACTS

Marine aquaculture depends on suitable environmental quality for efficient production, health of stocks and product quality. If not properly designed, managed and operated in terms of mitigation of environmental risks, marine aquaculture activities can impact the coastal environment.

Farming of finfish can have a significant but localised environmental impact. Potential environmental impacts of finfish aquaculture are:[207]

- The discharge of organic waste and their interactions in the marine environment;
- The effects of other discharges such as therapeutants;
- Disease and parasite impacts on wild and farmed stocks;
- Escape of genetically distinct fish that compete and interbreed with wild stocks that are often already depleted;
- The visual impact created by the presence of fish farms;
- Fish cages pose a physical hazard to cetaceans and other marine species that may become entangled in ropes and nets;
- Chemical pollution of marine food chains due to the use of therapeutic chemical in the treatment of cultured stock and antifouling treatment of infrastructure;
- Piscivorous marine animals attempt to remove fish from the cages and may become tangled in the nets and damage nets leading to escapes and stress or harm the cultured stock; and
- Localised habitat alteration and impacts such as wave action and sediment transport.

It is against this background that the regulator applies high standards of environmental protection at every stage of fish farm planning, operation and regulation. Any planned commercial marine aquaculture facility must obtain an environmental clearance certificate on the basis of an EIA or an exemption (based on scale) prior to becoming operational, and is required to implement site-specific environmental management and impact monitoring plans.

Shellfish are filter feeders and require no feeding or medicinal treatments. Therefore, the environmental impacts of shellfish production are minimal as long as overstocking effects on phytoplankton are avoided and harvesting is undertaken without damage to the seabed.

However, both shellfish and sea-based finfish aquaculture could lead to entanglement of marine species in the devices used.

3.6.3 LOOKING TO THE FUTURE

3.6.3.1 STRATEGIC POLICY OBJECTIVES

Aquaculture has the potential to contribute to food security, job creation and economic development and to create export opportunities for South African businesses. The strategic policy objectives for marine aquaculture are therefore aimed at growing the sector within a sustainable development framework.

It is a national development objective to promote the development of an equitable, diverse, viable and competitive aquaculture sector. This is to be achieved by creating an enabling regulatory environment (such as the Aquaculture Development Bill), ensuring market access through globally recognised monitoring and certification systems, the establishment of an aquaculture development fund to provide catalytic financial support to aquaculture projects, capacity development, and enhanced marketing and consumption.

The development of the marine aquaculture sector is guided by the following strategic objectives with direct spatial relevance:

- 2013 National Aquaculture Policy Framework

The policy identifies environmental integrity and the development of an environmentally friendly sector as a top priority. This will be achieved inter alia through adequate site selection on the basis of SEAs and EIAs, as well as compulsory environmental management and impact monitoring plans.

- Operation Phakisa: Oceans Economy

This policy initiative has established as targets for the aquaculture sector over the five years (2014-2019) to increase the annual revenue from the sector from R0.67 billion to R3 billion, to accelerate the production of 20,000 tonnes per annum of fish, and to create a maximum of 15,000 additional jobs.[208] This is to be achieved primarily through 24 projects which will comprise of both new farms and the expansion of existing farms.

- Establishment of Aquaculture Development Zones

The DFFE continues to work towards creating an enabling environment to facilitate the development and growth of the South African aquaculture sector through the establishment of ADZ's. The locations of ADZ's are based on the availability of state-owned land, as well as suitable space in the marine environment conducive for the cultivation of various aquaculture species, in and along coastal provinces. These suitable areas are subject to undergoing EIA processes and receiving Environmental Authorisation prior to being declared ADZ's.

The SEA identifies suitable areas where sustainable aquaculture development can be prioritised and incentivised (see above section on key spatial interests). It is intended that through a pre-assessment of the environmental sensitivities within these ADZ's, certain aquaculture activities could be excluded from requiring environmental authorisation based on the implementation of aquaculture standards. In addition, within the ADZ's, the management and legislative framework must also be streamlined and integrated to reduce complexity and to incentivise environmentally sustainable aquaculture.

- Abalone Ranching

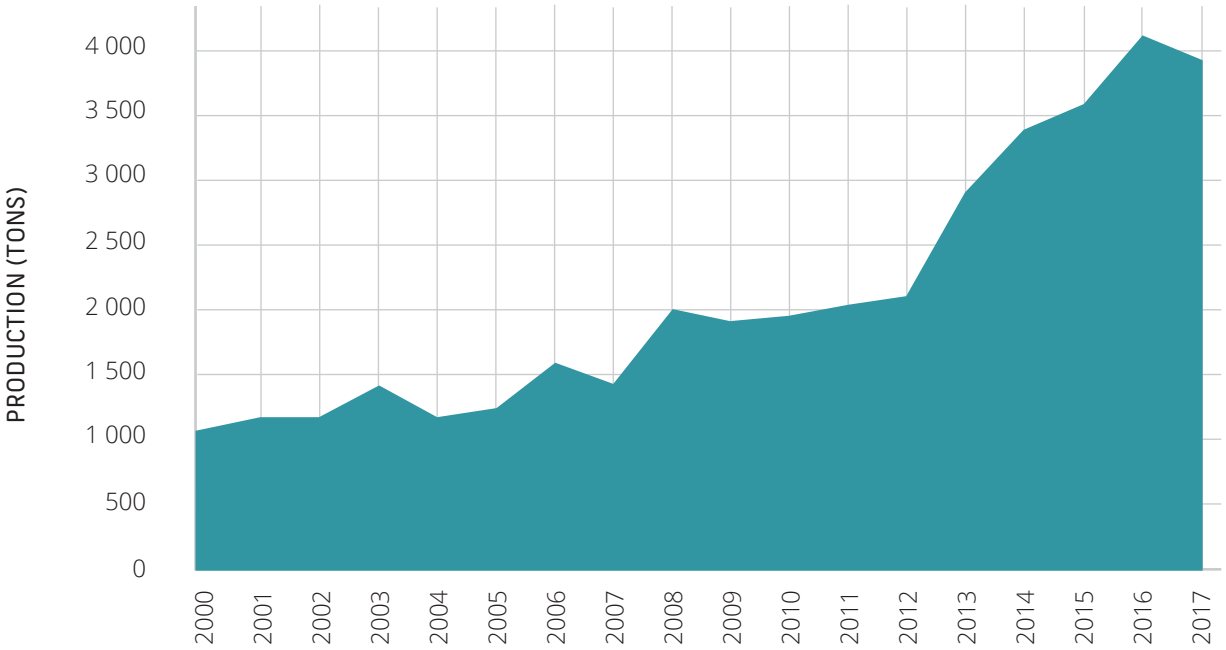
Given the critical status of the abalone resource, which continues to decline due to illegal and over-exploitation[101], and on the basis of its high market value, a strategic objective of the DAFF is to enhance the ranching of abalone in order to achieve a sustainable production. Abalone ranching thereby involves the seeding of abalone in its natural habitat using hatchery-reared abalone. A number of abalone ranching pilot project have been initiated and rights have been granted for 10 years by the then DAFF in 2013 to right holders in the Northern Cape and Eastern Cape. In 2018, the first harvest permit from the then DAFF for sea-grown abalone was issued.

3.6.3.2 TRENDS AND DRIVING FORCES

While the global demand for aquatic products is increasing due to population growth, related food security needs and employment requirements, wild harvest fisheries are under considerable pressure and their growth is either stagnant or declining. In South Africa, most wild capture fisheries are peaking at their maximum sustainable yields and the only real growth avenue for fisheries is aquaculture. It is now internationally accepted that the increased supply of fish products to meet this demand will be sourced through aquaculture.[209] Consequently, aquaculture (marine as well as fresh water) is one of the fastest growing food production systems in the world.[210]

Since the formal management and regulation of the marine aquaculture sector in South Africa production has continued to record a steady increase. Total marine aquaculture production has increased by 240% from 2000 to 2015 (see Figure 19).[211] This reflects an increase of over three-fold within a period of 16 years.

Although sea-based marine aquaculture operations are currently confined to coastal areas and especially naturally sheltered sites, aquaculture in the sea may move offshore to less sheltered waters as technology develops and suitable areas nearshore become less.



Growth in marine aquaculture production in South Africa (after figures from the Aquaculture Yearbooks 2016 and 2018[211, 195]).

FIGURE 19

3.6.3.3 SPATIAL CONFLICTS AND SYNERGIES WITH OTHER USES AND INTERESTS

CONFLICTS:

A number of conflicts occur with other uses and interests on the basis that:

- sea-based marine aquaculture demands space in the ocean;
- land-based marine aquaculture uses seawater and requires space on coastal land close to the sea;
- aquaculture requires good water quality
- and both – sea- and land-based marine aquaculture operations – have environmental impacts.

These conflicts frequently take place due to the limited number of naturally sheltered sites and the spatial constraints within these areas due to the various other uses and interests in these sheltered inshore areas. Spatial conflicts currently arise or may transpire (more intensively) in future with:

- Land- and sea-based pollution and its impact on water quality;

- Maritime traffic: Although no direct conflicts currently exist with shipping lanes, space within sheltered inshore areas, that are also a prerequisite for the location of ports and harbours, is limited and leads to increasing conflicts. Specific conflicts could occur, for example, with drifting or anchoring vessels close to aquaculture sites or as a result of any oil or other spills at sea. Maritime transport and ports associated activities and their environmental impacts (such as through dredging and de-bunkering) also has potential to impact adjacent aquaculture and has to be managed carefully given the close spatial proximity of both uses.

- Recreation and leisure: Water sport activities (e.g. sailing) are also bound to the coast and take place in sheltered bay which likewise have significant aquaculture potential. The tourism sector perceives marine aquaculture sites as potential threats that may limit sport activities (e.g. hindering sport events such as the Ironman South Africa in Algoa Bay) or as attracting large predators (e.g. sharks). The perceived threat could cause significant resistance against aquaculture expansion or growth.

- Mineral resources exploration: The environmental impacts of mining disturbs the natural environment. Areas such as the Northern Cape coastline has been similarly earmarked for mining and abalone ranching. Abalone ranching requires suitable reef areas and is very sensitive to sedimentation.

- Conservation: Exclusionary (no-go) marine protected areas along the coast often overlap with suitable areas for sea-based marine aquaculture and therefore restrict marine aquaculture interest's in suitable sheltered bays. This has become apparent in the EIA that was undertaken for Algoa Bay where due to the space required for shipping lanes, two out of nine sites were investigated in detail. One site overlaps with a proposed MPA and the other is close to a popular tourism beach. In addition, important marine habitats (e.g. reefs) with nature conservation values further limit sea-based marine aquaculture interests. This spatial conflict also occurs on land along the coast in the case of land-based marine aquaculture operations in or near to coastal protected areas.

- Fisheries: Although no direct spatial conflicts currently exist with the wild fisheries sector, possible conflicts may occur in areas of high fishing value where access would be reduced for commercial fishing operators through establishment of fixed aquaculture operations.

- Maritime heritage: Sunken vessels and other sites of heritage interest overlap with areas that are also suitable for marine aquaculture.

SYNERGIES:

Spatial synergies exist with tourism, e.g. boat tours operators, using the marine aquaculture sites as an attraction. Tourists are also a target audience for marine aquaculture produce in South Africa along the coast. Furthermore, marine aquaculture offers an environmental education opportunity for locals and visitors.

Spatial synergies may also exist with the small-scale fisheries sector, for which sea-based marine aquaculture devices may attract fish.

Despite the conflicts with minerals exploration as described above, dis-used mining sites can also offer new space and habitats for marine aquaculture (e.g. ponds that were created along the coast due to former diamond mining activities can now be used for cultivation of marine species).

Non-spatial synergies exist with other sectors concerning similar requirements concerning good water quality and marine environmental status as well as water quality monitoring. This may be of interest to port authorities as well to ensure bio-indicated good water quality within and around maritime transport infrastructure. Marine aquaculture species such as oyster and mussels are also used a bio-indicators of pollution and therefore can work in synergy with the needs and requirements of environmental and public health.

Marine aquaculture can also be used as a carbon sink in the instances such as culture of sea weed, oyster and mussels. Seaweed aquaculture requires nutrients for growth and mussels and oysters natural filter feed from algal production which is fuelled by high nutrients in the sea.

3.6.4 KEY ISSUES FOR MSP TO CONSIDER

The following key issues should be considered by MSP from a marine aquaculture point of view:

- Aquaculture is a growing and increasingly important industry which helps to underpin sustainable economic growth in rural and coastal communities. Securing the available and suitable areas for new and/or expanding marine aquaculture operations (particularly sea-based marine aquaculture) – taking into account possible climate change associated impacts on cultivated species and locations – is therefore a requirement for the sector, primarily inshore but also offshore as a future option. This includes spatial recognition of abalone ranching areas. In turn, this means that marine aquaculture may require restricting (seabed) use by other users.

- Irrespective of whether marine aquaculture sites are sea- or land-based, they require rigorous long-term maintenance of good environmental standards and absence of pollution from any other source and future development.

- As with any type of development, sea-based marine aquaculture facilities and their associated land-based infrastructure may have a potential visual impact on coastal locations. This should be taken into consideration as part of the alignment between coastal and marine development planning.

- While aquaculture may not attract the investment of sectors such as mining, it provides good sustainable employment and ownership opportunities in rural coastal areas.

3.7 MARINE RENEWABLE ENERGY

3.7.1 BACKGROUND

Throughout history, human beings have always depended on and used different sources of energy. With the overwhelming evidence for anthropogenically induced climate change caused by the production of greenhouse gases from burning fossil fuels as a key driver, countries worldwide have recognized renewable energy resources within their energy policy as an alternative to finite fossil fuel resources. They also seek to achieve future energy security and aim to mitigate the effects of climatic change induced by human activities.

South Africa currently relies on fossil fuel-based energy sources to meet close to 90% of its energy demands.[212] The Government of South Africa is therefore committed to cutting down carbon dioxide (CO2) emissions and is putting increased focus on renewable sources of energy. This change in energy policy is in numerous ways prompting new human uses of space throughout the world and in South Africa – including in the ocean. One such use is the installation of technologies and associated infrastructures on land and at sea to win renewable energy.

Currently, only offshore wind energy has – internationally – reached an acceptable level of development to be considered competitive. However, there are other less developed technologies that harness naturally occurring non-depletable sources of energy from the oceans, including through wave and tidal energy, energy from currents, ocean thermal energy and salinity gradient energy.

South Africa's marine environment is endowed with vast reserves of renewable energy due to the oceanic conditions and the geographic positioning of the country. With a coastline of over 3,000 km in length and being situated at the tip of Africa, the South African coastline is exposed to the warm waters of the Agulhas current to the east, the cold waters of the Benguela current to the west and the full power of the Southern Ocean on the south.

Although no Marine Renewable Energy (MRE) production currently takes place in South African marine waters, the ocean has been identified as a potential source of such MRE. This drive towards quantifying the South African marine energy potential has generated interests in the spatial allocation of dedicated areas for deployment of MRE technologies in the marine environment.

3.7.2 LEGAL AND POLICY FRAMEWORK

Marine renewable energy falls within the responsibility of the Clean Energy Branch of the Department of Mineral Resources and Energy (DMRE) which is mandated to manage and facilitate the development and implementation of clean and renewable energy initiatives.

The primary legislation and policy for DMRE governing renewable energies includes but is not limited to the:

- National Energy Act (Act No. 34 of 2008);
- Electricity Regulations Act (Act No. 4 of 2006);
- National Environmental Management Act (Act No. 107 of 1999);
- White Paper on Energy Policy (1998);
- White Paper on Renewable Energy Policy (2003);
- Integrated Resource Plan (2010);
- Integrated Energy Plan (2016); and
- National Climate Change Response Strategy White Paper (2011).

The National Energy Act (Act No. 34 of 2008) is the enabling legislation that empowers the Minister of Mineral Resources and Energy to ensure that diverse energy resources are available in sustainable quantities and at affordable prices in the South African economy to support economic growth and poverty alleviation, while also taking into account environmental considerations.

The 2006 Electricity Regulation Act, as amended, establishes a national regulatory framework for the electricity supply industry and makes the National Electricity Regulator of South Africa (NERSA) the custodian and enforcer of the national electricity regulatory framework. The Act provides for licences and registration as the manner in which generation, transmission, distribution, trading and the import and export of electricity are regulated.

The National Environmental Management Act (Act No. 107 of 1999) has a direct impact on legislative and other measures to reduce carbon emissions, increasing energy efficiency, and mitigation of the impact of the generation/refinement and use of energy on the environment.

The 2003 White Paper on Renewable Energy Policy supplements the 1998 White Paper on Energy, which recognizes that the medium and long-term potential of renewable energy is significant and key to securing supply through diversity. The Renewable Energy Policy provides the guiding framework for the development of renewable energy in South Africa as it sets out government's vision, policy principles, strategic goals and objectives for promoting and implementing renewable energy in South Africa. It has a number of objectives that include: ensuring that equitable resources are invested in renewable technologies; directing public resources for implementation of renewable energy technologies; introducing suitable fiscal incentives for renewable energy; and creating an investment climate for the development of renewable energy sector. Both the 2010 Integrated Resource Plan and the 2016 Integrated Energy Plan take these objectives into account so as to facilitate intensified development of renewable energy production.

The Climate Change Response Strategy White Paper presents the South African government's vision for an effective climate change response and the long-term, just transition to a climate-resilient and lower-carbon economy and society. Renewable energy is one of the near-term priority flagship programmes implemented as an integral part of this policy.

The National Development Plan and its Vision 2030 highlights the important role of renewable energy development as a key measure to achieving energy security, mitigating climate change and simultaneously contributing to socio-economic development.

3.7.3 STRATEGIC POLICY OBJECTIVES

MRE is recognized as a long-term viable option for South Africa as part of the country's energy policy framework. Currently, however, no specific targets are defined concerning electricity production by means of MRE.

The MRE policy objective therefore focuses on the exploration of the ocean's potential for the installation of devices to harness wave and tidal energy, energy from currents, thermal energy and salinity gradient energy. Simultaneously, the objective is to develop and test MRE technologies in order to advance their deployment in the mid-term future.

3.7.4 POTENTIAL AND AREAS OF INTEREST

Given the geographical position of South Africa and its oceanographic, hydrographic and meteorological conditions, there is good potential for renewable energy generation around the country's coasts.[213] The four energy sources ocean currents, waves, offshore wind, and thermal all have potential:

- CURRENTS: The Agulhas Current, in theory, provides favourable conditions for production of energy.
- WAVES: South Africa is exposed to the full power of the Southern ocean and has a high energy coastline. The theoretical coastal wave power of southern Africa is amongst the highest in the world and exceeds in some instances even reaches up to 100 kW/m.
- WIND: Offshore winds tend to be stronger than winds on the adjacent land. While substantial wind resources are likely available offshore, South Africa has few areas of relatively shallow continental shelf areas adjacent to the coastline which are necessary for the deployment of infrastructure.[214]
- THERMAL: Ocean thermal energy utilises the temperature difference between sea surface water and deeper water to drive a heat engine to generate power. Oceanic conditions for utilising the temperature differential between surface waters and t those at depths of around 1000m appear suitable off the northern coast of Kwa-Zulu Natal.

Tidal energy does not have any prospect of generating appreciable power in South Africa due to tidal ranges being too small to be exploited.[215]

The deployment of MRE devices comes with major technological challenges for South Africa as the industry and expertise in the country is not developed well. In addition, there are cost uncertainties and regulatory issues that would need to be resolved.

Scientific initial assessments to examine areas with a theoretical potential for MRE production are underway but have not yet identified possible sites.

3.7.5 SOCIO-ECONOMIC POTENTIAL

Energy development is the essential driver for the South African economy and for the upliftment of the poor through job creation. A growing marine renewable energy sector in South Africa has the potential to:

- Contribute to local job creation, also in coastal rural areas;
- Provide opportunities for manufacturing and construction;
- Enhance skills and technology development; and
- Provide opportunities for industrial tourism through potential visitor centres.

In addition, it would diversify the electricity supply and contribute to meeting energy policy objectives and climate change targets.

3.7.6 POSSIBLE ENVIRONMENTAL IMPACTS

The emerging use MRE may have a considerable impact on the marine environment if deployed in future, as evidence from abroad and research shows. Yet, the degree of the environmental impact depends on a number of factors including but not limited to attributes of the deployed device (e.g. static or dynamic), the type of device (e.g. wave or current), and the spatial scale of the installations (e.g. single device or arrays).

On the contrary, studies suggest that – if appropriately managed and designed – MRE devices may also increase local biodiversity and potentially benefit the wider marine environment. Installations could act as both artificial reefs and fish aggregation sites, and de facto marine protected areas as they limit other resource extracting uses in the area; with associated positive effects on biodiversity and fisheries.[216]

The key environmental impacts from offshore wind installations are noise, from construction and operation, and the collision risks for sea birds.[217] For devices capturing energy from waves or currents, the key environmental impacts are the potential for collision with cetaceans and fish, species disturbance through the creation of electromagnetic fields and underwater noise.[218] Habitat loss may occur on the basis of construction of any marine renewable energy device.

Physical systems act as drivers for the sustainability and health of organisms in the marine environment. The installation of marine renewable energy devices may affect the system by changing natural flow patterns around installations, which can alter sediment distribution and transport. In addi-tion, energy removal may change the operation of a waterbody. A small number of devices will not create measurable changes, but large commercial arrays might alter the system over time.[218]

3.7.7 POSSIBLE SPATIAL CONFLICTS AND SYNERGIES WITH OTHER USES AND INTERESTS

If MRE devices would be installed in future, impacts on or displacement of other users of the South African marine waters, for example fishing, could occur. Given the environmental impacts, a possible conflict could exist with the interest of conservation.

Possible spatial synergies could exist with fisheries and biodiversity due to the potentially positive effects of MRE devices. In addition, tourism could be developed, with visitors experiencing and learning about MRE at production sites. In addition, arrays of MRE devices could possibly provide some coastal defence benefit.

Non-spatial synergies exist with the policy objective to mitigate climate change, increase energy security through diversity, and create employment opportunities through development of MRE as an emerging sector. In addition, installed MRE devices could support environmental monitoring and contribute to our understanding of the oceanic environment through collection of data, and serve as objects for environmental awareness-raising.

3.7.8 KEY ISSUES FOR MSP TO CONSIDER

The following key issues should be considered by MSP concerning the emerging use of MRE:

- Reserve space for MRE devices harnessing wind, wave and current energy at selected near-shore priority areas to test single devices and scale installations gradually.
- Consider offshore energy projects within eventual mining/oil and ga gas areas if possible to contain activities that cause potential harm to the living environment.

3.8 MARITIME AND UNDERWATER CULTURAL HERITAGE

3.8.1 BACKGROUND

South Africa's ocean space is filled with a rich and diverse maritime and underwater cultural heritage that includes shipwrecks, submerged pre-historic landscapes of palaeontological and archaeological significance, pre-colonial stone-walled and woven intertidal fish traps, and sacred sites to which oral traditions are attached.

During the 15th century trading between Europe and the East expanded rapidly and the shipping trade route became increasingly busy and important as demand for exotic goods increased. South Africa's geographical position at the mid-point on this route became fundamental to the continuation of trade and, as such, its recent history is inextricably linked to the history of the rest of the world.[219]

Over time, colonies, ports, and refreshment stations were established along the coast, with the oldest being what is today known as Cape Town, which then expanded to other areas of southern Africa and beyond. The popularity and dangers of the maritime trading route is reflected in the approximately 2,800 historical shipwrecks of different nationalities that are scattered around South Africa's coast. In addition to these wrecks, our maritime heritage includes many other associated sites such as the country's maritime infrastructure like lighthouses, historical harbours, and dockyards.

The record of South Africa's long association with the ocean and the country's coastline is however much broader than just shipwrecks and maritime structures, and it extends far back into pre-history. The archaeological record that constitutes this heritage includes large numbers of coastal fish traps, submerged pre-historic landscapes, maritime-themed rock paintings, and archaeology associated with coastal natural sites. Acheulean hand axes which may be up to 1.5 million years old have been recovered from the seabed in Table Bay near Cape Town and may be indicative of submerged prehistoric landscapes dating from when sea levels were considerably lower during past glacial periods.[220] A handful of rock art depictions of sailing vessels believed to have been painted by South Africa's indigenous San and Khoi populations' hint at contact between local people and early European mariners. [221] Stone walled fish traps are also often found along the South African coastline and, though there is some debate regarding their origin,[222] they are an intrinsic part of the country's rich maritime heritage and provide a unique insight into the development of innovative fishing technology.

The archaeological record of exploitation of marine resources such as shellfish by humans stretches back 160,000 years from the present day[223] and is indicative of South Africa's long and enduring relationship with the ocean and its resources. The maritime and underwater cultural heritage is of national and international significance as it reflects the country's rich cultural history. Such heritage places or objects require protection, maintenance, preservation, and sustainable use to safeguard their cultural significance.

3.8.2 THE CURRENT SITUATION

3.8.2.1 LEGAL AND POLICY FRAMEWORK

All archaeological artefacts and sites in South Africa, including the country's maritime and underwater cultural heritage, are protected by the National Heritage Resources Act (Act No. 25 of 1999) (NHRA). The NHRA provides for an integrated and interactive system for the identification, assessment, and management of South Africa's national heritage resources.

The NHRA also established the South African Heritage Resources Agency (SAHRA). SAHRA is an agency of the Department of Sport, Arts, and Culture and is mandated to co-ordinate and promote the management of national heritage resources, thus setting and maintaining national standards of managing South Africa's heritage resources. SAHRA maintains a record of maritime and underwater heritage sites in South Africa's maritime and internal waters. In addition to recorded wrecks, SAHRA also keeps records of reported occurrences of maritime and underwater cultural heritage resources which cannot yet be linked to a named wreck, or which represent possible pre-colonial elements of this heritage, such as stone-walled intertidal fish traps. The SAHRA Wreck Resources Permit Policy protects and prohibits the commercial exploitation and salvage of wrecks of historical significance (60 years of age or older).

Although the NHRA established a three-tier system for heritage resources management in South Africa, with management occurring at national, provincial, and local levels, maritime and underwater cultural heritage resources are managed exclusively at a national level. All maritime and underwater cultural heritage resources are managed by the maritime and underwater cultural heritage (MUCH) unit at the South African Heritage Resources Agency. The mandate of the MUCH unit is rooted in Sections 2 and 35 of the NHRA, which together state that SAHRA is responsible for the protection of cultural heritage resources in South Africa's territorial waters and maritime cultural zone: an area of more than 124,000 square kilometres of ocean, along 3,000 kilometres of coastline and around the Prince Edward Island group. The MUCH unit's responsibility thus includes, but is not limited to, archaeological material such as "wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa (…) and any cargo, debris, or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation."[224] The unit's responsibilities also extend to maritime and underwater cultural heritage-themed rock art older than 100 years, intertidal sites such as fish traps, coastal shell middens, shipwreck survivor camps, maritime infrastructure in ports and harbours older than 60 years, submerged prehistoric sites in and on the seabed, maritime memorials, and any maritime and underwater cultural heritage-related sites that are formally protected in terms of Section 27 of the NHRA.

The World Heritage Convention Act, 1999 (Act No. 49 of 1999) exists to incorporate the World Heritage Convention and associated site management plans into South African legislation. It thus allows enforcement and implementation of the World Heritage Convention in South Africa towards the recognition and establishment of World Heritage Sites in the country. This Act authorizes and grants additional powers and duties to existing heritage organs of state, especially those safeguarding the integrity of World Heritage Sites.

South Africa furthermore accepted the 2001 UNESCO Convention on the Protection of the Underwater Cultural Heritage and became a signatory thereto in 2015. As the State's implementing agent for the 2001 UNESCO Convention, SAHRA is bound by international trends and standards of practice in the management of maritime and underwater cultural heritage resources.

South Africa thus has a firm legal and policy framework for the management and protection of maritime and underwater cultural heritage resources, but it must be noted that implementation of this framework is lacking due to capacity constraints.

3.8.2.2 SOCIO-ECONOMIC IMPORTANCE

Maritime and underwater cultural heritage creates a link between the past, the present and the future. These resources provide information about the past and offer South Africans and other nations the opportunity to understand their history as well as preserving their legacies for future generations. It is therefore pertinent that these resources are managed, maintained and protected as part of the nation's shared history.

Shipwrecks and various resources that went down with the ship provide valuable insights and narratives into the past. Such narratives may reveal information of the time during which the vessel set sail, reveal characteristics, culture, or nationality of the people on board the ship, trading merchandise of the time, the wars or conflicts of that era, scientific information of shipbuilding techniques and seafaring practices of the time.[225] Such facts reinforce the need for protection considering the priceless value of these irreplaceable resources. Maritime and underwater cultural heritage resources are priceless, fragile, and irreplaceable and must therefore be given protection through adequate legislation and management.

It is challenging to estimate the direct use and socio-economic value of maritime and underwater cultural heritage. However, these heritage resources contribute indirectly to the GDP through synergies with other sectors such as tourism and biodiversity conservation where they provide economic opportunities. Effective management of cultural heritage has the potential to garner international interest in South Africa's heritage resources and thereby has an indirect impact on driving the economy through tourism. Locations of shipwrecks and important heritage sites such as Robben Island attract large numbers of tourists daily and ultimately contribute to job creation. The public has the opportunity to enjoy and benefit from maritime and underwater cultural heritage sites and celebration of this heritage assists in bringing about national social cohesion.

3.8.2.3 KEY SPATIAL INTERESTS

SHIPWRECKS

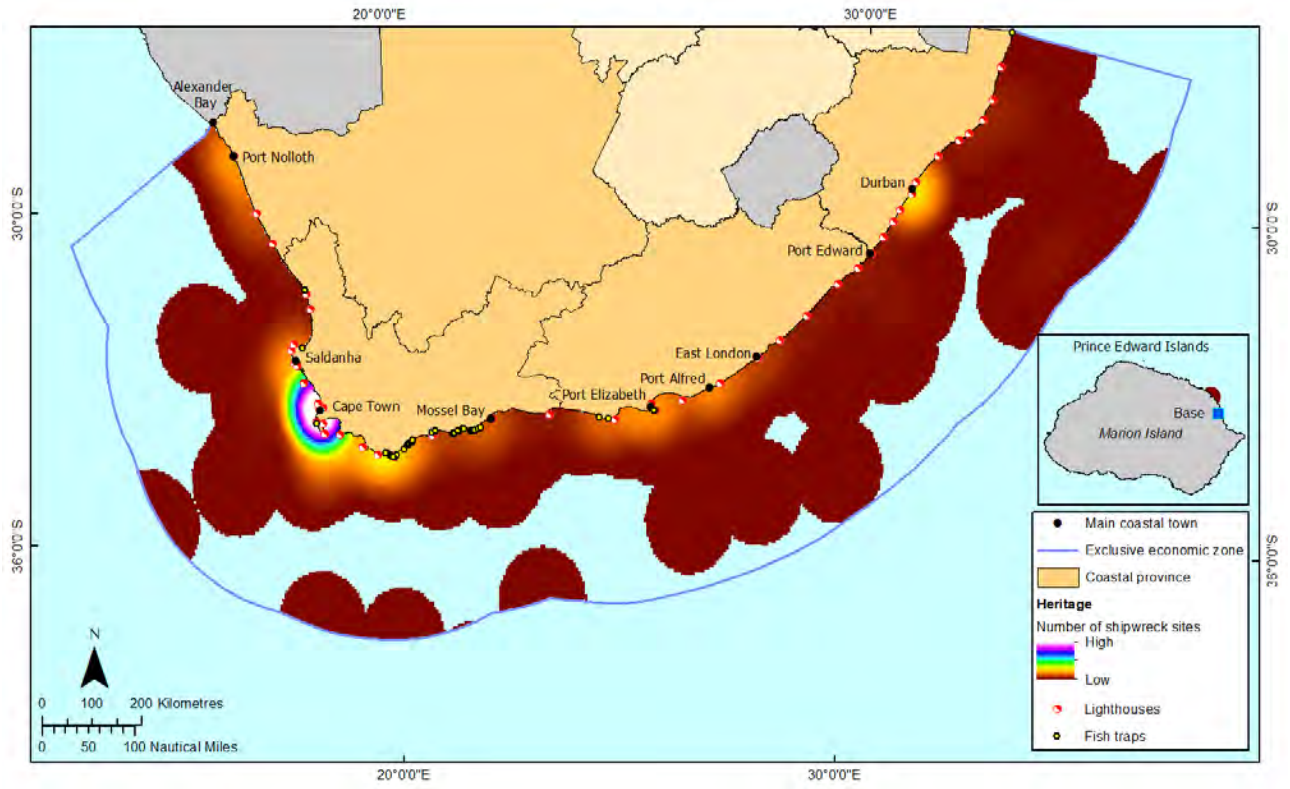
South Africa has around 2,800 shipwrecks strewn along its approximately 3,000 km coastline and in the waters surrounding the Prince Edwards Islands, thus representing one of the richest and most diverse records of maritime trade and global expansion in the world. South Africa's marine waters are filled with shipwrecks of various periods and types. It is therefore crucial to protect these heritage resources. After the introduction of the NHRA in 1999 and its implementation in 2000, all wrecks older than 60 years were classified as archaeological, affording them the same legal status and protection as archaeological sites and heritage resources on land. While most known shipwreck sites are clustered around major historical ports, it is important to note that this may be an artefact of better record-keeping at these places, including increased development activity which has provided important seabed data, and is in no way indicative of the prevalence of shipwrecks elsewhere in South Africa's waters. Sites beyond the 1 nautical mile buffer zone exist, although due to the relative depth and technical nature of obtaining information about these sites not much is known about their precise location, nature, or condition. It is thus crucial to bear in mind that historical shipwrecks and the wreck of aircraft throughout the Maritime Cultural Zone, whether mapped or unmapped, are protected in terms of the general provisions of NHRA and may not be disturbed without a permit.

TABLE 12

The number of known and mapped shipwreck sites, and the number of fish trap sites by main coastal area. This table does not include known historical shipwrecks that have not been mapped.[226]

MAIN COASTAL AREA	NUMBER OF KNOWN AND MAPPED SHIPWRECK SITES (30% OF SHIPWRECK SITES IN SOUTH AFRICAN WATERS)	NUMBER FISH TRAP SITES WITH ONE OR MORE FISH TRAPS (AND TYPE)
ALEXANDER BAY – SALDANHA	105	2 (stone-walled)
SALDANHA – CAPE POINT	300	3 (stone-walled)
CAPE POINT – HERMANUS	38	0
HERMANUS – MOSSEL BAY	116	53 (stone-walled)
MOSSEL BAY – PORT ELIZABETH/GQEBERHA	73	4 (stone-walled)
PORT ELIZABETH/GQEBERHA EAST LONDON	65	0
EAST LONDON – DURBAN	103	0
DURBAN – MOZAMBIQUE	29	1 (woven)
PRINCE EDWARD ISLANDS	1	0

Wreck of the Arniston (1815) near Arniston. © SAHRA



The prevalence of known and mapped shipwreck sites (approximately 30% of shipwreck sites in South African waters), as well as the location of sites with one or more intertidal fish traps. This figure does not include known historical shipwrecks that have not been mapped.

MAP 53

MARITIME AND UNDERWATER CULTURAL HERITAGE SITES

The maritime and underwater cultural heritage record includes over 60 sites with stone-walled and woven intertidal fish traps, numerous submerged pre-historic landscapes, coastal shell middens, historical harbours and dockyards, lighthouses, and sacred sites to which oral traditions are attached. All these sites are protected in terms of the provisions of the NHRA.

NATIONAL HERITAGE SITES

South Africa has five maritime and underwater cultural heritage sites that have been declared as National Heritage Sites by publication in the Government Gazette in terms of the provisions of Section 27 of the NHRA. These sites may not be altered, disturbed, damaged, or interfered with in any way without a permit from SAHRA, and no development may take place near them without proper authorisation. Of these sites, three are in the marine space: The São José slave shipwreck off Clifton, Western Cape; the Pietermaritzburg shipwreck of Millers Point, Western Cape and the Noordkapperpunt Stone-Walled intertidal Fish Traps in Still Bay, Western Cape.

WORLD HERITAGE SITES

Out of the eight UNESCO world heritage sites found in South Africa, two are coastal/marine world heritage sites, that is, Robben Island (Cultural) and iSimangaliso Wetland Park (Natural).

Stone-walled intertidal fish traps at a National Heritage Site near Still Bay. © SAHRA

3.8.3 LOOKING TO THE FUTURE

3.8.3.1 STRATEGIC POLICY OBJECTIVES

TIt is the government's objective to ensure the adequate conservation and accessibility of South Africa's maritime and underwater cultural heritage resources for the benefit of current and future generations through:

- Heritage promotion and advocacy (including awareness-raising and education, signage projects, social media engagement, youth programmes, field schools, university courses, publication of promotional material);
- Enhancing public access to, and enjoyment of, maritime and underwater cultural heritage sites and objects through targeted projects;
- Identification of, and research into, maritime and underwater cultural heritage resources;
- Protection and conservation of maritime and underwater cultural heritage resources through the permitting and development application processes;
- Adequate monitoring and inspection of maritime and underwater cultural heritage resources;
- Initiatives that seek to build capacity (human and financial) in the field of maritime and underwater cultural heritage;
- Enhanced regional and international cooperation (especially through networks established in terms of the 2001 UNESCO Convention on the Protection of Underwater Cultural Heritage; and
- Demonstrating the role of maritime and underwater cultural heritage resources management in driving inclusive socio-economic development through exploring synergies with the tourism and culture sectors.

3.8.3.2 TRENDS AND DRIVING FORCES

The significance of maritime and underwater cultural heritage is not always recognized, because it is often not as readily visible as other tangible terrestrial cultural heritage resources. As a result, these resources have been neglected in heritage conservation worldwide and in South Africa. Repeated reductions in the human and financial capital of implementing agents such as SAHRA, coupled with increased responsibilities due to the ratification of international management instruments such as the 2001 UNESCO Convention on the protection of underwater cultural heritage have had negative consequences for South Africa's ability to manage and promote this heritage effectively.

There are limited public programmes that raise awareness and facilitate public participation.[219] The current museum exhibitions and signage at wreck sites alone are not sufficient. More needs to be done to educate the wider public on the importance of maritime and underwater cultural heritage and thereby, forge a culture of appreciation and preservation of such resources.[227] There is therefore a need to not only improve conservation measures but to improve public's perception and knowledge about maritime and underwater cultural heritage resources and to demonstrate its significance to South Africa's history of development as a nation.

3.8.3.3 SPATIAL CONFLICTS AND SYNERGIES WITH OTHER USES AND INTERESTS

CONFLICTS:

Maritime and underwater cultural heritage resources, including shipwrecks, intertidal sites, and submerged archaeology and palaeontology, can be damaged by marine space users from other sectors.

Many techniques used for the development or exploitation of resources in this space can have negative impacts on heritage resources through their destructive nature; fishing (particularly trawling) and anchoring can damage shipwrecks, especially when skippers are unaware of the location of the sites, and anchors drag across such sites. Beach mining, often involving the construction of coffer dams, as well as offshore grab sampling, oil, and gas extraction, remote lay-down of pipelines for telecommunications or similar and dredging near harbours all have the potential to lead to the destruction of sites. It is therefore crucial that impacts to heritage resources are adequately assessed in the case of all work which triggers such an assessment in terms of the NHRA or the National Environmental Management Act No. 107 of 1998 and its regulations, in order to safeguard the heritage resources and to prevent damage to equipment used to carry out this work.

Fishing bans imposed within certain Marine Protected Areas can have a negative impact on the use and maintenance of living heritage sites such as stone-walled intertidal fish traps. These sites are maintained by local fishers using age-old methods that are slowly being lost as there is no longer any financial incentive in using the traps due to severe restrictions on fishing.

Commercial salvage of shipwrecks which has historically and recently occurred within South African waters creates grey areas for heritage protection since salvors are not always mindful of the fact that sites older than 60 years may not be disturbed without a permit. The tenets of commercial salvage of historical shipwrecks are contradictory to the principles of conservation enshrined in the NHRA and the 2001 UNESCO Convention.

SYNERGIES:

Conserving the country's maritime and underwater cultural heritage is beneficial to the marine and coastal tourism sector as an attraction for visitors to the coast. Sites protected in terms of environmental legislation, such as in National Parks or Marine Protected Areas, can provide an important opportunity to improve the management of cultural heritage within the same location as such areas are already frequently monitored to prevent poaching and other unlawful activities. The time and resources could be expanded to be used for heritage sites. The principles of conservation and minimal interference used to manage many natural environments can thus be beneficial to heritage sites as they benefit from the same treatment and in situ conservation of heritage resources is considered the first option. Protected heritage sites, in turn, can have positive effects on biodiversity and the surrounding marine environment as human use is restricted to non-invasive activities. Many shipwrecks form important artificial reefs which can allow endangered species of marine invertebrates and corals to flourish.

Seabed surveys carried out prior to commencing offshore development have an important role to play in the identification and management of maritime and underwater cultural heritage sites. Given that only around a quarter of shipwreck sites have been mapped, these surveys have the potential to generate invaluable data to help inform the spatial planning process with regards to heritage resources, provided that such data is given to SAHRA.

3.8.4 KEY ISSUES FOR MSP TO CONSIDER

The following key issues should be considered by MSP concerning maritime and underwater cultural heritage:

- South Africa's maritime and underwater cultural heritage is a key building block when it comes to the unlocking of the economic potential of South Africa's oceans and coasts. Synergies between the conservation of these heritage resources and other sectors, especially tourism, should be strengthened to contribute towards the country's socio-economic development.
- The known shipwrecks and other heritage sites must be protected from developments and human uses with adverse effects through enhanced protection measures.
- In the context of protecting the interests of the heritage sector, it is critical that all offshore developments triggering an impact assessment in terms of any of the provisions of Section 38 of the NHRA are submitted to SAHRA for input to ensure the protection of our unique and finite maritime and underwater cultural heritage resources.

3.9 MARINE AND COASTAL TOURISM

3.9.1 BACKGROUND

South Africa has an astonishingly diverse variety of natural habitats, flora and fauna, histories, cultures and traditions. Its scenic 3,000 km coastline and abundant marine resources and cultural resources are key natural assets that have enabled the country to become one of the prime marine tourism destinations on the African continent.

Coastal tourism refers to land-based recreational activities taking place on the coast for which the proximity to the sea is a condition including their respective services, whereas marine tourism refers to sea-based recreational activities as well as their land-based services. Coastal and marine tourism therefore focuses on recreational activities along the coastal zone on land bordering the marine environment and/or in the marine environment itself.

Coastal and marine recreational activities range from walking on a beach to participating in fishing or marine wildlife cruises. A significant coastal tourism sector takes advantage of historic sites, picturesque fishing villages, vast and desolated beaches, coastal protected areas, and linked golf courses.

The tourism industry in South Africa has grown considerably since the country's first democratic elections in 1994. The number of foreign tourist arrivals increased from just more than 3 million in 1993 to over 10 million international tourists in 2016. 74.3% of these international tourists arriving in South Africa come from the SADC region. In addition, 28 million domestic tourism trips were recorded in 2014.[228] Coastal provinces receive approximately 25% of the international tourists visiting South Africa.

In recent years, a thriving wildlife tourism industry has established itself in areas around South Africa, allowing visitors to experience cetaceans, seabirds and dramatic coastal scenery. A growing boat-based whale watching (BBWW) exists, associated with the massive recovery of Southern Right and Humpback Whale populations along the coast. South Africa is internationally known for its white shark cage diving (WSCD).[229] Dive tourism is also a niche but growing tourism sector in South Africa.[230] The cruise industry is also a sector that has grown considerably over the past years and has the potential to contribute significantly to the South African economy.

A clean and healthy coastal and marine environment is therefore fundamental to a successful coastal and marine tourism industry in South Africa.

There is little standardized information on the coastal and marine tourism sector. Yet, the following sea- and land-based activities occur around South Africa:

a) Tourism activities in coastal areas, which encompass estuaries, coastal dunes, rocky coasts, sandy beaches and coastal cliffs, include[231]:

- Coastal wildlife tourism such as land-based whale watching, coastal avi-tourism, and marine turtle tours;
- Sand/beach activities such as kite-flying, beachcombing, and sand-dune surfing;
- Coastal heritage events such as local seafood and cultural tourism, and cultural history;
- Sightseeing such as lighthouse tourism, cycling, and marathons;
- Educational and scientific excursions, for example to aquariums;
- Spiritual experiences; and
- Purely recreational activities such as dining out or shopping.

b) Tourism activities in marine areas, which encompass waters that are saline and tide-affected and cover coral reefs, kelp forests, rocky reefs, continental shelves, sea-mounts and open oceans, include[231]:

- Marine wildlife tourism such as BBWW, WSCD, and observation of seals, dolphins, turtles and birds;
- Recreational fishing such as boat-based fishing, spear fishing and fishing competitions;
- Scuba diving/snorkeling;
- Water sports such as big-wave surfing, yachting, water-skiing and kite-surfing;
- Ocean experience such as cruise tourism, island tourism and underwater archaeology; and
- Events such as marine competitions (e.g. Volvo Ocean Race).

The South African coastal and marine tourism industry contributes to the economy, provides employment opportunities in (rural) coastal areas and as such supports poverty reduction, empowerment and the sustainable use of coastal and marine resources to the benefit of local communities.

There is significant potential for growth given the expanding national, regional and international tourism sector as well as the rich and diverse resources the country has to offer to visitors.

3.9.2 THE CURRENT SITUATION

3.9.2.1 LEGAL AND POLICY FRAMEWORK

The Government has created a modern and enabling legal, policy and institutional framework that regulates, enables and promotes coastal and marine tourism. The National Department of Tourism has a mandate and is the over-riding authority for tourism in South Africa and is also responsible for the management and development of the sector in the coastal and marine realm. The Department's mission is to grow an inclusive and sustainable tourism economy.

The primary legislation for the National Department of Tourism that also applies to coastal and marine tourism is:

- The Tourism Act, 2014 (Act No. 3 of 2014); and
- The National Environmental Management Act (Act No. 107 of 1998).

This legal framework provides the regulatory framework for the promotion and regulation of the tourism industry.

The Tourism Act of 2014 aims to:

- promote responsible tourism for the benefit of the Republic and for the enjoyment of all its residents and foreign visitors;
- provide for the effective domestic and international marketing of South Africa as a tourist destination;
- promote quality tourism products and services;
- promote growth in and development of the tourism sector; and
- enhance cooperation and coordination between all spheres of government in developing and managing tourism.

The National Environmental Management Act, 1998 (Act No. 107 of 1998) provides the overarching legislation through which the BBWW and WSCD sector is regulated.

The National Development Plan (NDP) 2030 recognises tourism as one of the main drivers of employment and economic growth. The New Growth Path (NGP) includes tourism as one of the six pillars of economic growth.

The 2017 final draft of the National Tourism Sector Strategy (NTSS) provides a reviewed blueprint of the 2011 – 2020 NTSS for the tourism sector in the pursuit of growth targets contained in the NGP.

The 1996 White Paper on the Development and Promotion of Tourism provides a framework and guidelines for tourism development and promotion in South Africa.

Operation Phakisa: Oceans Economy is a government initiative to fast-track the implementation of solutions to overcome critical development issues. The unlocking of the socio-economic potential of South Africa's ocean wealth has been identified as one of the key areas of work. The following six growth areas have been identified:

- Marine Protection Services and Governance
- Offshore Oil and Gas Exploration
- Marine Transport and Manufacturing
- Aquaculture
- Small Harbours
- Coastal and Marine Tourism

The National Department of Tourism is mandated to lead and coordinate Operation Phakisa: Oceans Economy's coastal and marine focus area to unlock the tourism potential. A set of cross cutting initiatives will be implemented under the coastal and marine focus area across the nodes (see key spatial interests below), which include marketing, events and routes, skills development, beach and infrastructure development, or regulations and permitting processes.

3.9.2.2 SOCIO-ECONOMIC IMPORTANCE

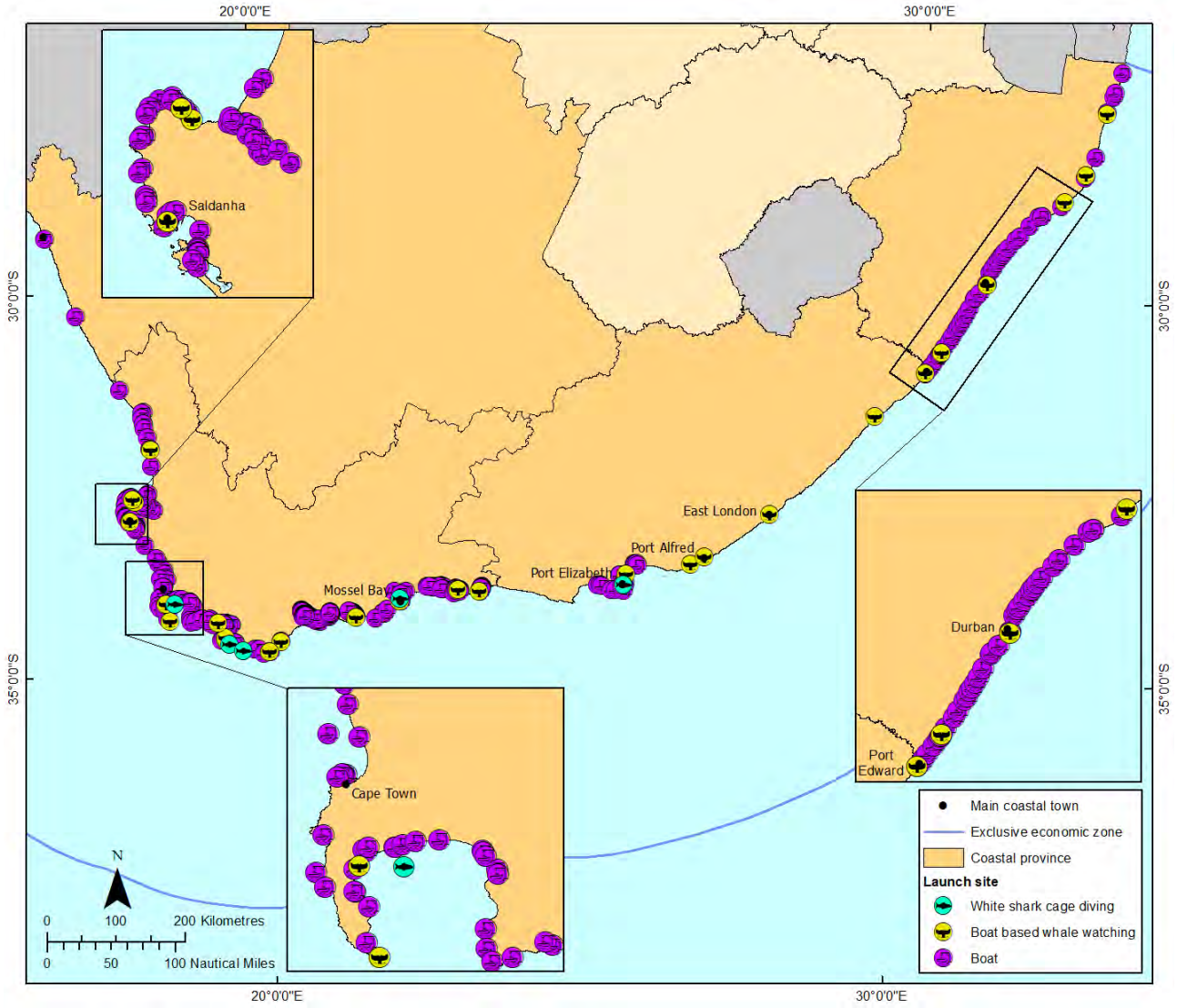
The South African tourism economy is one of the best performing economic sectors in South Africa. In 2017, tourism contributed R136.1 billion, about 2.9% of the country's total GDP and directly and indirectly supported about 1.5 million jobs which equates to 9.5% of total employment. Factoring indirect and induced benefits across a very broad value chain of the tourism sector, the total contribution amounts to R412.5 billion, or 8.9% of the GDP.[232] Tourism also makes a significant contribution to the country's export earnings (at R115 billion in 2015).[233]

Although there is only little available and standardized information on the coastal and marine tourism sector itself, it is estimated that the coastal and marine tourism sector generated approximately 58,000 jobs in 2014.[231] In 2007, there were approximately 2.5 million recreational anglers in South Africa, contributing approximately R18.8 billion to the GDP.[234] The WSCD industry, as one specific sub-sector of the industry, which is rapidly growing, generates over R30 million annually in the Gansbaai area alone. Approximately 500,000 people participate annually in BBWW.[234] In 2000, the passenger numbers in domestic cruising in South Africa were at 50,000 in a single season and in 2014 it sat at around 130,000 passengers for the cruise season.[234]

3.9.2.3 KEY SPATIAL INTERESTS

Marine recreational activity is widely distributed around South Africa's coastline. The greatest concentration of marine tourism activities is generally in the marine area out to around three nautical miles.

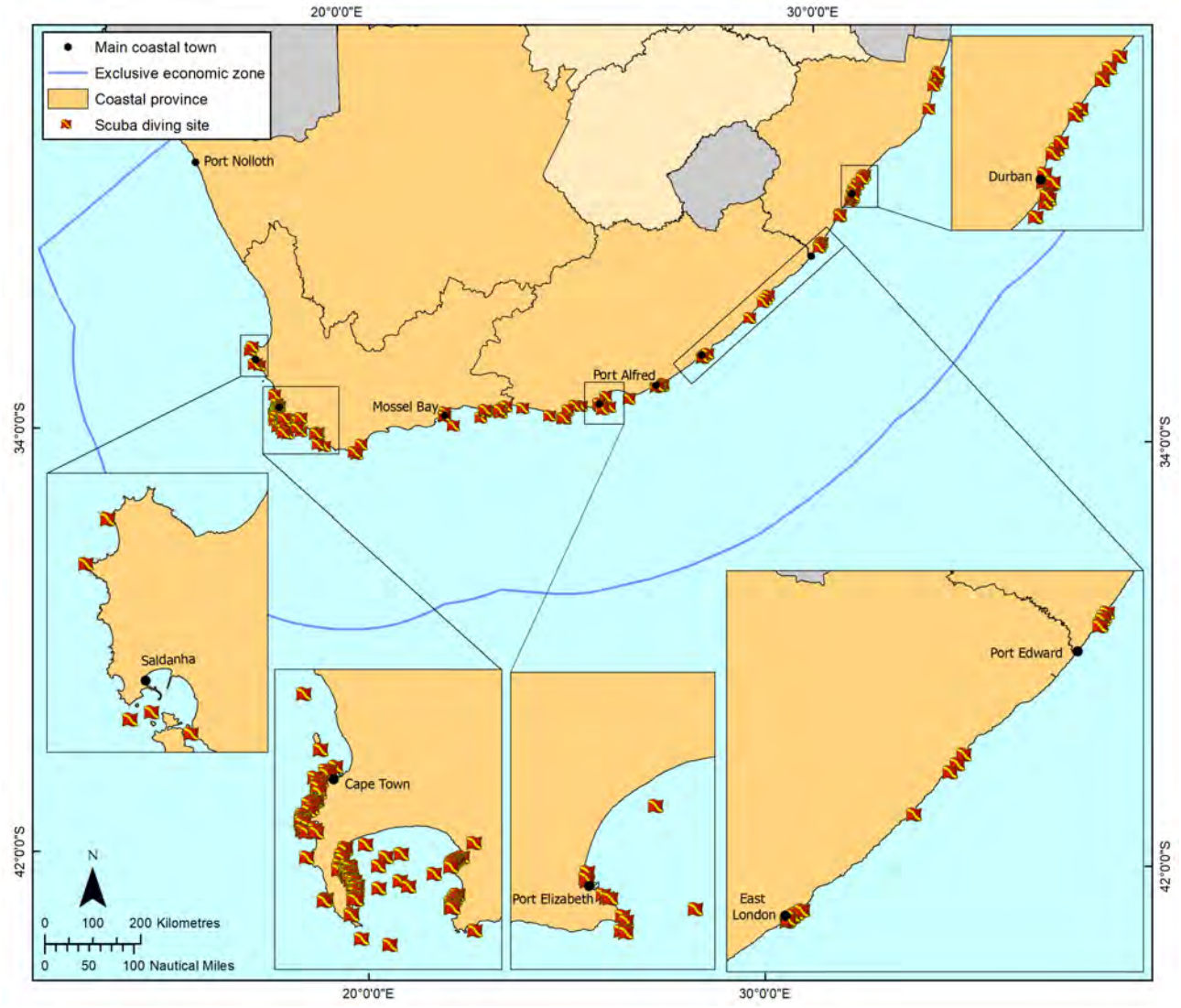
The potential for BBWW is highest along the Western Cape Province, and the western parts of the Eastern Cape Province. There are 20 areas for which permits are granted. There are furthermore more than 15 areas where WSCD permits have provisionally been granted in.[235]



Location of boat-based whale watching and white shark cage diving sites.

MAP 54

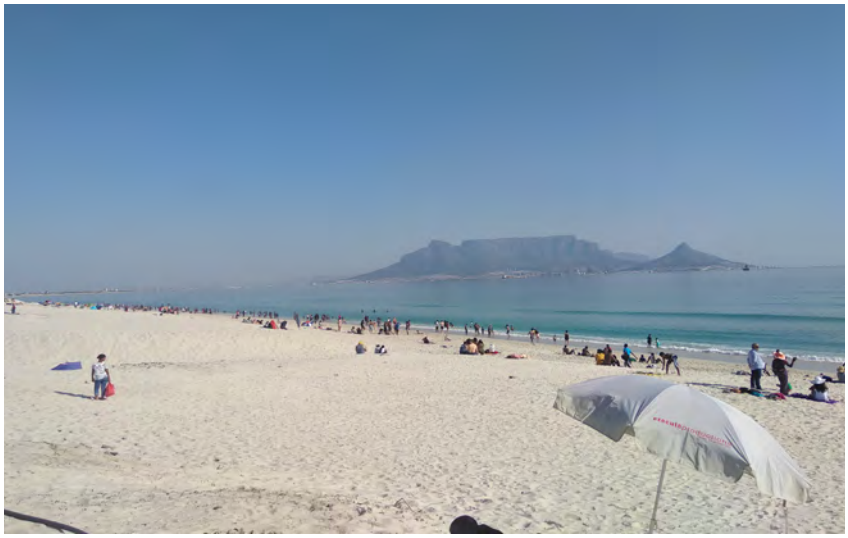
A huge number of sites that attract scuba-divers exist around the country:

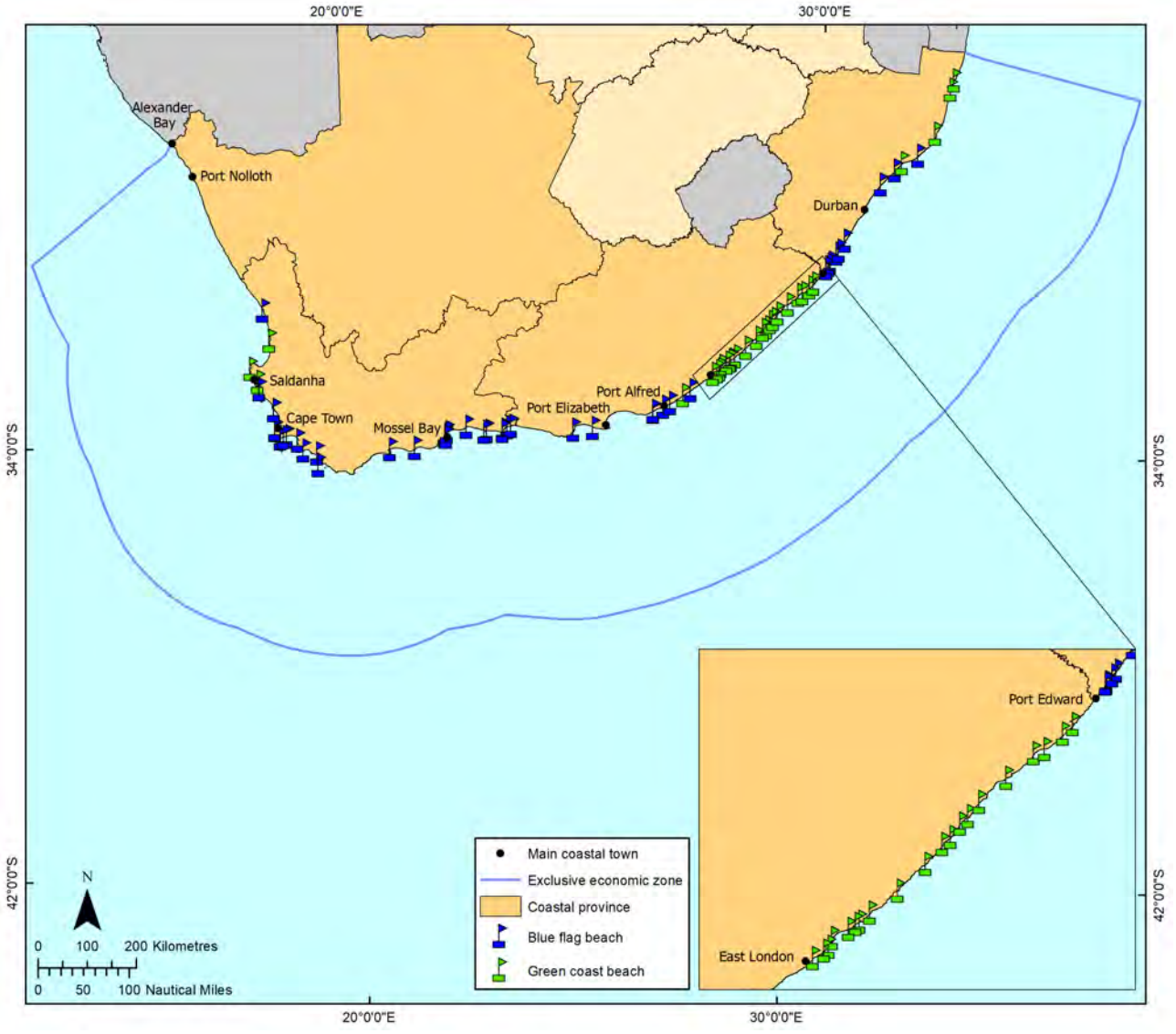


Location of recreational scuba-diving sites.

MAP 55

South Africa also has many beautiful beaches which attract visitors for recreational purposes. Some of these beaches have been awarded the so called "Blue Flag" eco-label. Such beaches qualify for the Blue Flag because they meet and maintain stringent environmental, educational, safety, and accessibility criteria.[236] In South Africa, 43 beaches are "Blue Flag" labelled and 30 are "Green Coast" beaches:

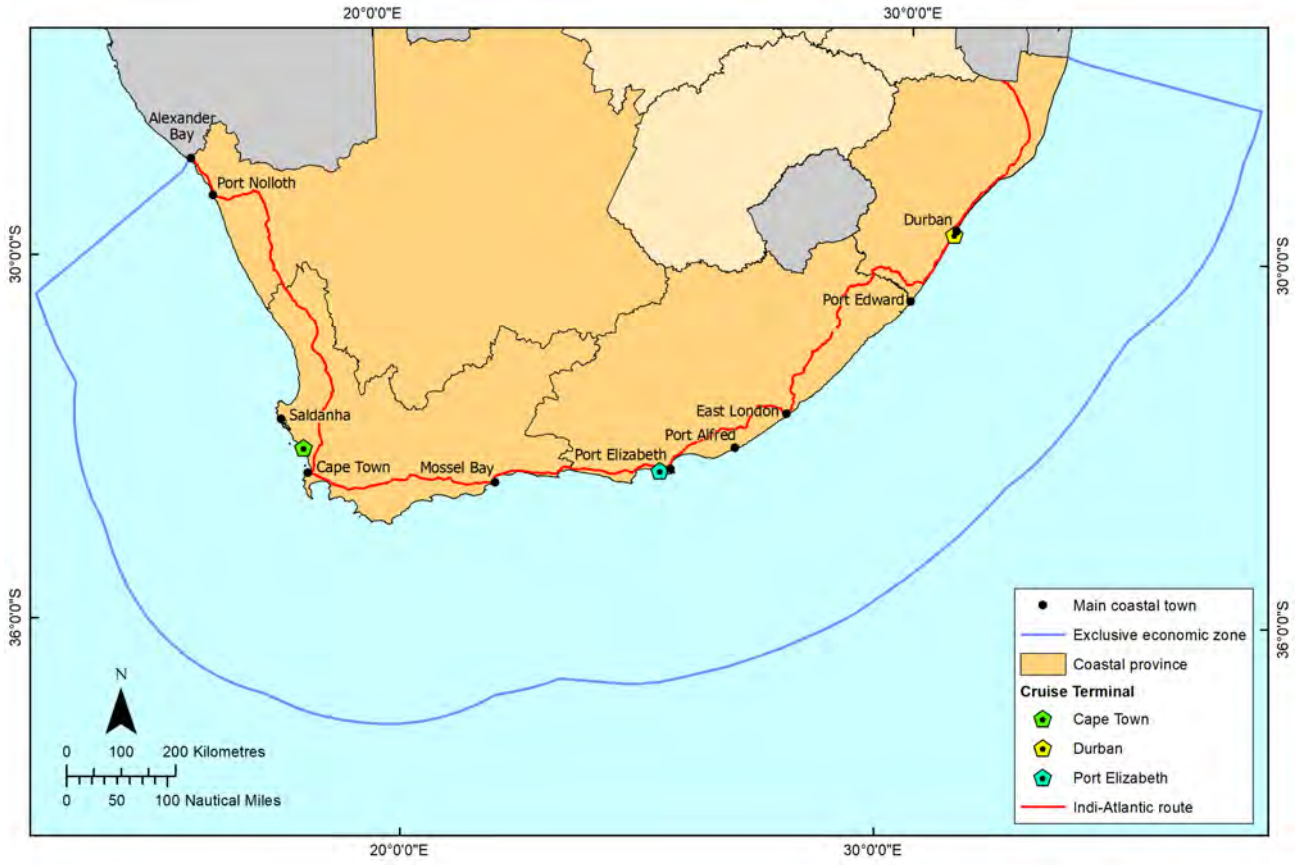




Location of blue flag beaches.

MAP 56

In addition, a large number of coastal attraction sites, hiking and cycling trails and routes exist, which area associated with tourism-related coastal infrastructure such as marinas, boat launch sites, or existing and planned cruise terminals:



Location of Indi-Atlantic route and cruise terminals. MAP 57

The identified nodes/clusters in the 1st phase (0 - 5 years) of the Operation Phakisa coastal and marine tourism growth area encompass the following geographic areas of primary interest:

- Durban and surrounds (KwaZulu-Natal);
- Umkhanyakude including Umhlabuyalingana and surrounds (KwaZulu-Natal);
- Port St Johns to Coffee Bay (Eastern Cape);
- East London, Port Elizabeth and surrounds (Eastern Cape);
- Cape Town and surrounds (Western Cape); and
- West Coast and surrounds (Northern Cape).

3.9.2.4 ENVIRONMENTAL IMPACTS

Recreational activities can have an impact on the coastal and marine environment, such as:

- Habitats and species disturbance/damage
  - Recreational boats can act as a vector for introducing alien species around coastal waters
  - Coastal development and expansion of maritime tourism-related infrastructure (e.g. marinas, small harbours)
- Waste from boats and land-based recreational activities
- Additional stress on limited freshwater resources through increasing numbers of tourists and associated infrastructure development

3.9.3 LOOKING TO THE FUTURE

3.9.3.1 STRATEGIC POLICY OBJECTIVES

The NDP 2030 recognises tourism as one of the main drivers of employment and economic growth, and seeks to further develop the country as an international tourist destination by emphasising its biodiversity, cultural diversity and scenic beauty.[237] The NGP includes tourism as one of the six pillars of economic growth.

The NTSS 2011 – 2020 (strategic objective 2.2.4) acknowledges that South Africa's natural environment is one of its greatest tourism resources, and that the tourism industry therefore needs to be actively involved in conserving and protecting it. The aim is to encourage visitors – both domestic and international – to participate in the protection and conservation of South Africa's natural environment, and to enjoy a responsible travel experience while in South Africa, helping the various tourism businesses in the country to achieve the triple bottom-line, namely economic growth, ecological sustainability and social responsibility.[238]

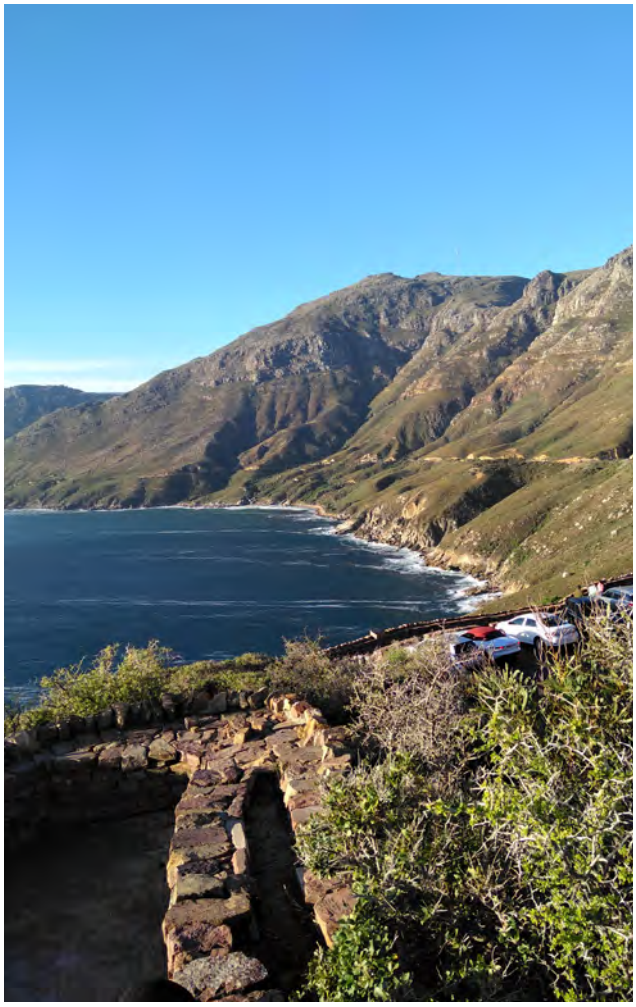
The vision in relation to coastal and marine tourism under the Operation Phakisa is to grow a world class and sustainable coastal and marine tourism destination that leverages South Africa's competitive advantages in nature, culture, and heritage. The strategic objective for coastal and marine tourism under Operation Phakisa: Oceans Economy is to reach a R21.4 billion direct contribution to South Africa's GDP and double the number of jobs to 116,000 by 2026.

The 2017 Cabinet approved Coastal and Marine Tourism Implementation Plan aims at a nodal/cluster approach that seeks to:

- prioritise destinations rather than individual tourism projects/products;
- support the enhancement of the general environment in which attractions and products are located;
- strengthen the linkages between attractions and improves the quality of the tourist experience within destinations; and
- strengthen the linkages with other areas of Operation Phakisa.

The Department therefore integrates the implementation of its coastal and marine tourism work with other sector Departments as follows:

- Department of Public Works on small harbours;
- Department of Environmental Affairs on boat-based whale watching and white shark cage diving;
- Department of Agriculture, Forestry and Fisheries on aquaculture projects and land use legislation;
- Department of Transport on cruise terminals in the ports; and
- Department of Arts and Culture on creative industry.



3.9.3.2 TRENDS AND DRIVING FORCES

Tourism is one of the fastest growing industries in South Africa: The tourism industry is expected to grow a further 4.9% per annum between 2015 and 2025.[239] There is potential to grow employment in the sector from 1.5 to 2.1 million jobs within this period.

Cruise passenger levels to South Africa are projected to climb to between 200,000 to near 1 million by 2025. The contribution of this sub-sector to GDP is estimated to increase from R681.8 million in 2010 to R14.1 billion in 2025.[240]

The development of the South African (ocean) economy leads to increasing pressures on the marine environment. This is associated with the environmental effects of land- and marine-based human uses and their impact on the coastal and marine biodiversity. Population growth, in particular in the metropolitan areas at the coast, adds additional pressure including through coastal development and land-based pollution. The diverse human impacts cumulate to impact negatively on the marine ecosystem health. Loss of biodiversity and a degrading functionality of the ocean to provide the needed ecosystem services are observed.[241] This increasingly threatens the ability of the marine environment to benefit the coastal and marine tourism industry, which requires a healthy marine environment as a prerequisite to serve tourist demands.

Climate change and other natural phenomena may cause changes in the distribution of habitats and species, which serve either as attraction for visitors or which are used for other recreational purposes (e.g. fishing). This could imply that both coastal and marine tourism locations and spatial use patterns will change over time.

3.9.3.3 SYNERGIES AND CONFLICTS WITH OTHER ACTIVITIES AND INTERESTS

CONFLICTS:

Tourism – Environment:

- Habitats and species disturbance/damage
  - Underwater noise affects in particular those marine species that the tourists come to see
  - Municipal developments close to the shoreline disturb both sea and shore birds
  - Increase in number of permits and tourists, exceeding the carrying capacity in relation to boat-based whale watching and shark cage diving sites
  - Waste from recreational boats, cruise ships and land-based leisure activities
  - Future conflicts may also arise with intensified coastal development encroaching into the coastal protected areas

SYNERGIES:

Tourism – Environment:

- Conservation and sustainable use of habitats and species helps maintain a healthy environment which is a prerequisite for successful nature-based marine tourism
- Tourism offers environmental education opportunities (non-spatial)

Tourism – Fisheries:

- Sustainable use of living marine resources and related ecosystem/habitats enables fishing-related tourism

Tourism – Transport:

- Ports and small harbours are the maritime infrastructure backbone for marine tourism and its growth as a tourism attraction

3.9.4 KEY ISSUES FOR MSP TO CONSIDER

The following key issues should be considered by MSP from a coastal and marine tourism point of view:

- Sustainable marine and coastal tourism requires a healthy marine environment and profits from nature conservation measures such as species and habitat conservation (e.g. through declaration of multiple objective marine protected areas)
- Ensure continued access to the marine and coastal resource for leisure and recreational use
- Ensure the potential impact on marine recreational activities of a new development in the coastal or offshore area is considered as part of the development decision
- Maintain existing and develop new maritime infrastructure such as slipways, piers, moorings, marinas and anchorages, especially in connection with small harbours
- Improve available (spatial) data on marine leisure and tourism industry interests and activities undertaken
- Conduct research to understand the socio-economic impacts of coastal and marine tourism
- Sustainable tourism provides an ideal platform for environmental education

3.10 MARITIME TRANSPORT AND PORTS

3.10.1 BACKGROUND

South Africa is a maritime nation with several major ports. South Africa occupies a geostrategic position on a major, globally significant sea-trading route that lies at the heart of the South-South trade and connects the markets of Asia, Europe and the Americas.

Maritime transport is an integrated system that involves the design, construction, operation, management, servicing and maintenance of merchant, leisure and other ships in the service of seaborne trade, conducting offshore operations and transporting people and cargo by sea. The country's ports provide the transport infrastructure between land and sea and are critical to enabling the movement of goods and people, connecting to the hinterland through a port, connected roads and rail infrastructure to and from destinations of consumption and production points in the country; throughout the region and into the world. Ports are a key part of the South African maritime navigation infrastructure.

There is a high concentration of vessels moving off the South African coastline with vessels not necessarily calling at a South African port.[242]

The amount of cargo transported around the Cape of Good Hope is significant: An estimated 7,000 vessels pass around South Africa's coastline annually, of which many are laden tankers carrying in excess of 30 million tonnes of crude oil. There are approximately twelve thousand cargo vessels calling at the South African ports annually. The commercial ports are Richards Bay, Durban, East London, Ngqura (Coega), Port Elizabeth, Mossel Bay, Cape Town, Saldanha Bay and Port Nolloth. 58% of South Africa's gross domestic product (GDP) is based on trade and 98% of South Africa's trade volume moves by ships. In addition, the country generates a significant 3.5% of the world's seaborne trade volume.[243]

The types of shipping include containers, vehicles, general cargo, bulk (iron-ore, coal, etc.), and tankers (oil, fuel, sulphuric acid, etc.).

There are twelve proclaimed fishing harbours in South Africa. The DPWI is tasked with the management thereof, with the DFFE as the anchor tenant.

3.10.2 THE CURRENT SITUATION

3.10.2.1 LEGAL AND POLICY FRAMEWORK

The importance of maritime transport and ports infrastructure, as well as the significant volume of maritime traffic warrants a modern and enabling legal and policy framework that regulates and controls shipment of goods and people to and from South Africa, as well as passage through its ocean space. Ensuring safe passage, managing and developing ports, preventing shipping accidents and mitigating other environmental impacts are some of the key regulatory functions.

The Department of Transport (DoT) is mandated as the over-riding authority for maritime transport and ports in South Africa and responsible for overseeing the management and development of the country's shipping sector and ports infrastructure.[244]

The primary legislation for DoT in relation to shipping and ports are:

- Merchant Shipping Act, 1951 (Act No. 57 of 1951, being updated and reviewed);
- Marine Traffic Act, 1981 (Act No. 2 of 1981);
- Marine Pollution (Prevention of Pollution from Ships) Act, 1986 (Act No. 2 of 1986);
- Marine Pollution (Intervention) Act (Act No. 64 of 1987);
- Maritime Zones Act, 1994 (Act No. 15 of 1994);
- South African Maritime Safety Authority (SAMSA) Act, 1998 (Act No. 5 of 1998); and
- National Ports Act, 2005 (Act No. 12 of 2005).

The 1996 White Paper on National Transport Policy paved the way for the development and adoption by Government of several significant pieces of policies and legislation in maritime transport, namely the SAMSA Act of 1998 and the National Ports Act of 2005. These formed the foundational basis for establishing SAMSA in 1998 and the Ports Regulator in 2005. This has allowed Government to assign some regulatory and operational aspects of maritime transport policy to these agencies established for defined purposes.

Government has devolved responsibility for regulation of shipping activity to SAMSA, who is responsible for regulating shipping activity and any shipping-related incidents arising in South Africa's EEZ. The objectives of the Authority are to:

- ensure safety of life and property at sea;
- prevent and combat pollution of the marine environment by ships; and
- promote the Republic's maritime interests.

SAMSA is responsible for providing advice to the Minister of Transport on maritime issues affecting South Africa, maintaining relevant legislation and policy, liaising with other government and international institutions, and managing pollution prevention and response capacity.

Transnet is the state-owned freight transport enterprise established in 1990. The Transnet National Ports Authority (TNPA) is one of five operating divisions of Transnet. TNPA provides port infrastructure and marine services at the eight commercial seaports in South Africa: Durban, Port Elizabeth, Nqgura (Coega), Saldanha Bay, Mossel Bay, Richards Bay, Cape Town, and East London. It operates within a legislative and regulatory environment created by the National Ports Act 2005. TNPA is responsible for the safe, effective and efficient economic functioning of the national port system, which it manages in a landlord capacity. In line with the provisions of the National Ports Act, the core functions of TNPA are to:

- plan, provide, maintain and improve port infrastructure
- provide or arrange marine-related services;
- ensure the provision of port services, including the management of port activities and the port regulatory function at all south African ports; and
- provide aids to navigation and assistance to the manoeuvring of vessels within port limits and along the coast.

The National Ports Act also establishes the Ports Regulator of South Africa whose key function is economic regulation of the ports system in South Africa, in line with the strategic development context of the state.

The Comprehensive Maritime Transport Policy (CMTP) of 2017 seeks to facilitate the growth and development of South Africa's maritime transport sector to reach its full potential in support of sustainable socio-economic development.

Operation Phakisa: Ocean Economy is a government initiative to fast-track the implementation of solutions to overcome critical development issues, thereby contributing to achieving the National Development Plan 2030. The unlocking of the socio-economic potential of South Africa's ocean wealth has been identified as one of the key areas of work. The following six growth areas have been identified:

- Marine Protection Services and Governance
- Offshore Oil and Gas Exploration
- Marine Transport and Manufacturing
- Aquaculture
- Marine and Coastal Tourism
- Small Harbours

The marine transport growth area seeks to unlock investments in new and existing port facilities in order to grow the sector and create an enabling environment for enhancing South Africa's role in the maritime transport sector.

Other regulatory frameworks that allow for governance over the shipping industry include the International Convention for the Prevention of Pollution from Ships (MARPOL), United Nations Convention on the Law of the Sea (UNCLOS), and regulations set by the International Maritime Organization (IMO), of which South Africa is a member.

The key IMO Conventions are:

- International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended;
- International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto and by the Protocol of 1997 (MARPOL). MARPOL includes regulations aimed at preventing and minimising, both accidental and operational, pollution from ships and currently includes six technical Annexes:
  - Annex I – Regulations for the Prevention of Pollution by Oil
  - Annex II – Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk
  - Annex III – Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form
  - Annex IV – Prevention of Pollution by Sewage from Ships
  - Annex V – Prevention of Pollution by Garbage from Ships
  - Annex VI – Prevention of Air Pollution from Ships
- International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) as amended, including the 1995 and 2010 Manila Amendments; and
- Convention for the Control and Management of Ships Ballast Water and Sediments.

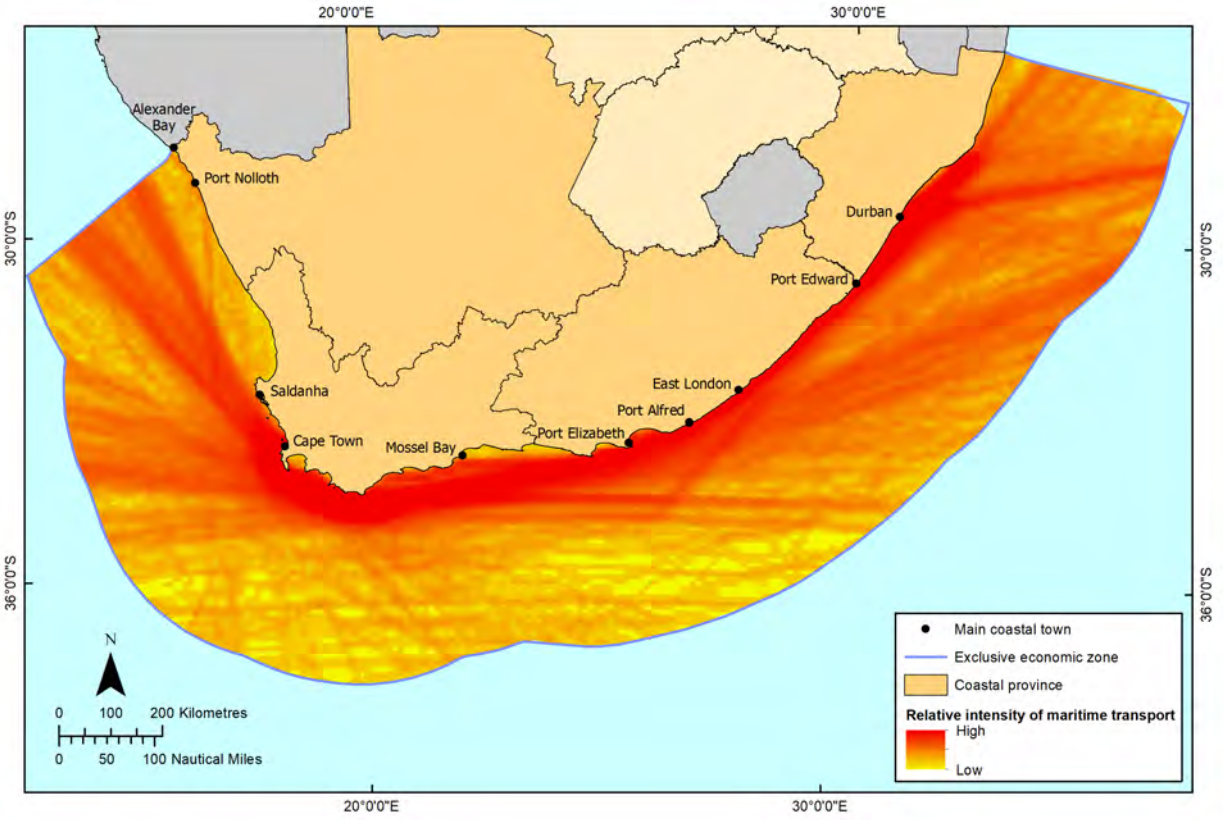
There are various Acts and Regulations in place incorporating the Annexures above into the national legislative framework.[245]

3.10.2.2 SOCIO-ECONOMIC IMPORTANCE

South Africa is a primary goods export-oriented economy and one of the world's top 15 sea-trading nations. Its seaborne trade affects people and industries throughout the entire country, including those living far away from the coasts. The vast majority of all products that consumers regularly consume are conveyed from international destinations by sea, through the nation's ports, where they are distributed through our rail and road transport networks to inland ports, warehouses, retailers and finally to consumers across the country.

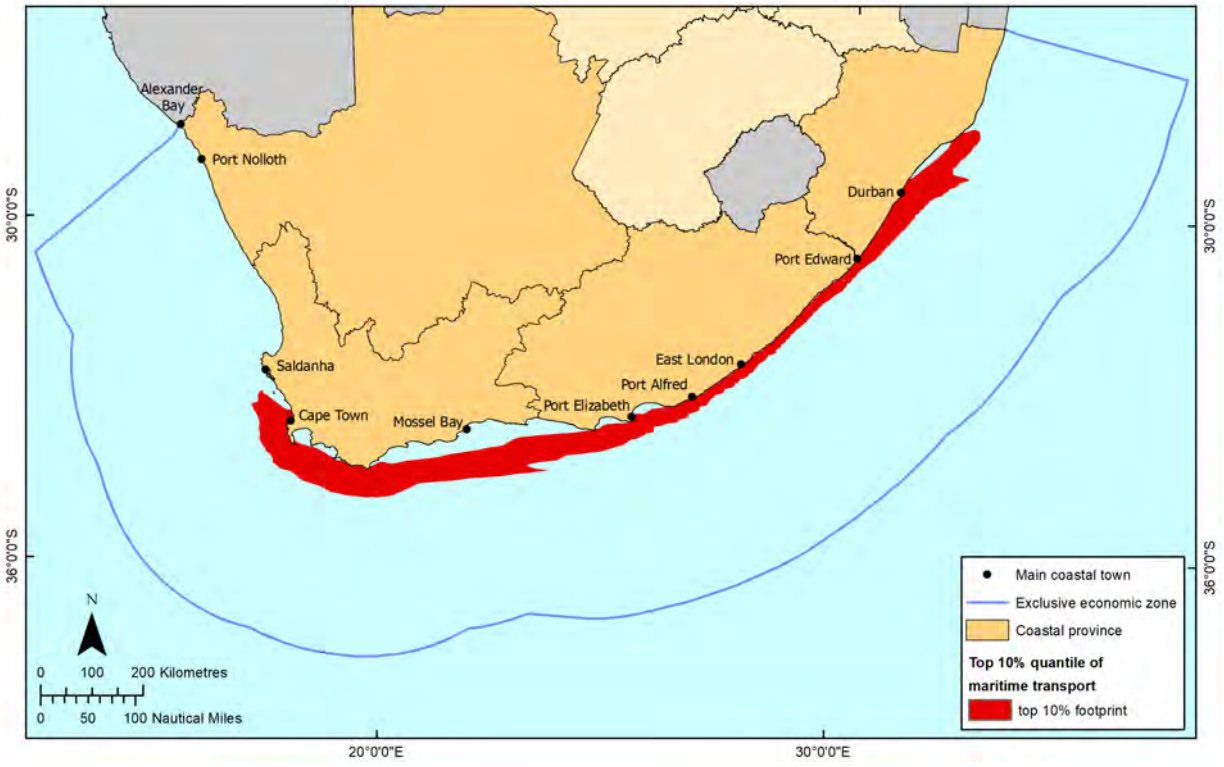
3.10.2.3 KEY SPATIAL INTERESTS

Major international shipping routes agreed under the IMO across South Africa's EEZ and connect with the ports. Areas with high traffic density are observed throughout the South African ocean space.



Relative intensity of maritime transport based on global datasets. The focus is only larger commercial cargo and fishing vessels, but includes any vessel which has an AIS location system (see Annex for details).

MAP 58



Key routes for maritime transport based on global datasets. The key maritime transport routes are defined as top 10% quantile of maritime transport.

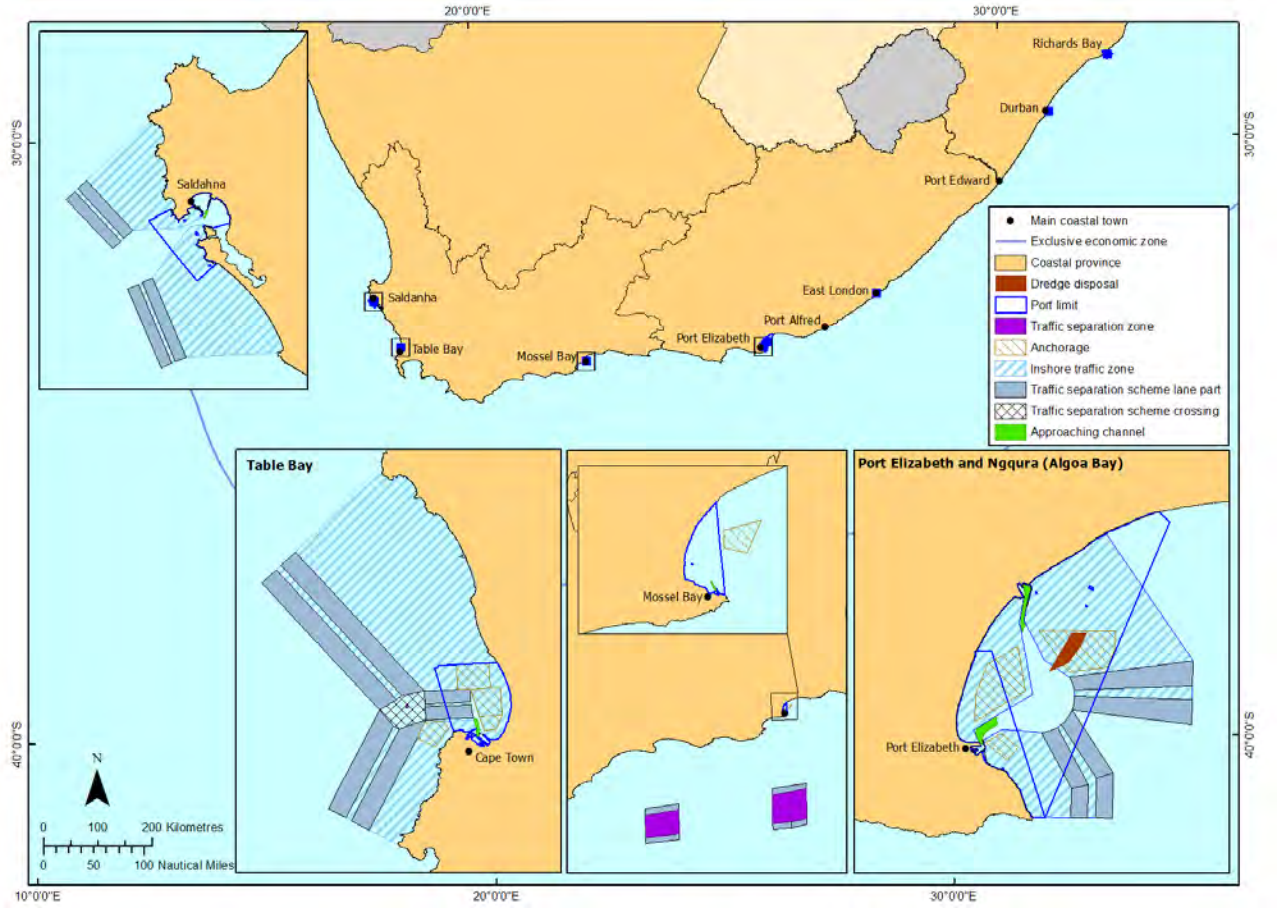
MAP 59

In total, eight commercial seaports, one non-commercial seaport, and twelve proclaimed fishing harbours are located around the entire South African coast.

Anchorage areas exist around each of the commercial ports, as well as St Helena Bay and False Bay. Approach channels enable ports access by vessels to the commercial ports. Spoil-ground locations for the dredging material are in use.

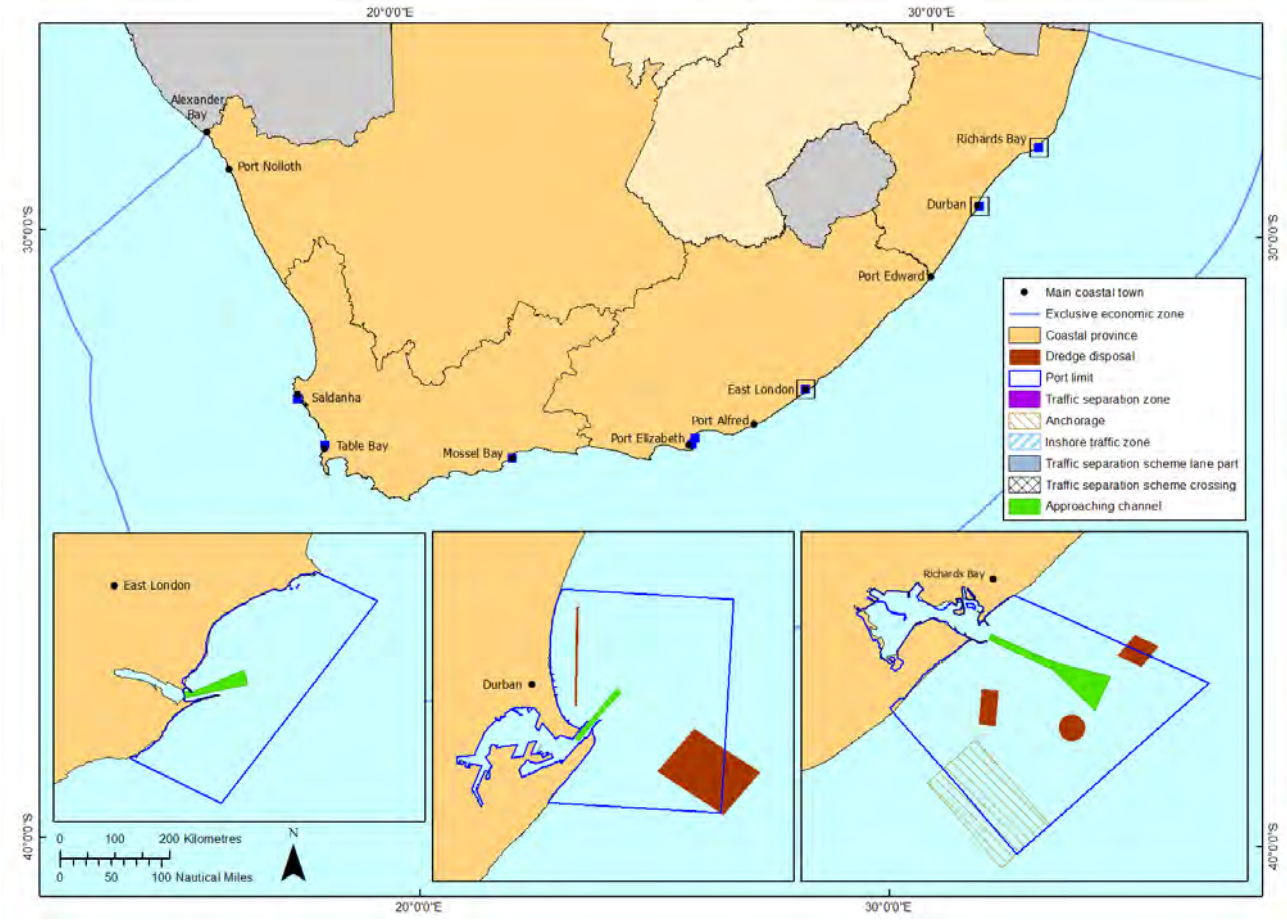
There are charted areas to be avoided in which either navigation is particularly hazardous, or it is exceptionally important to avoid casualties and which should be avoided by all ships, or by certain classes of ships. A portion of South Africa's southern waters approximately 1,500 km in length, and 35 to 135 nautical miles (NM) wide, is declared a Special Area under the International Convention for the Prevention of Pollution from Ships since 2008 to protect wildlife and the marine environment from ship-based operational oil discharges.[246]

There are Traffic Separation Schemes in place to manage traffic in the major and highly frequented shipping areas and ports of South Africa. In implementing Traffic Separation Schemes, South African maritime regulations stipulate that laden tankers should maintain a minimum distance of 20 NM from the shore when westbound, and a minimum of 25 NM from the shore when eastbound. Vessels are also recommended to steer a course allowing safe clearance of the Alphard Banks (35°S and 21°E) and the FA (Mossgas) production platform off the Mossel Bay area. Laden tankers on voyages solely between ports within South Africa's EEZ are exempt from the 20 and 25 NM regulations; they are required, however, to maintain a distance of 10 NM off prominent points of the coast, subject to weather, sea and current conditions.[247]



MAP 60

Maritime transport and ports of Saldanha, Cape Town, Mossel Bay and Algoa Bay. Location of commercial and non-commercial ports and fishing harbours, locations of areas to be avoided for shipping, special areas under the International Convention for the Prevention of Pollution from Ships and location of offshore traffic separation schemes.



Maritime transport and ports of East London, Durban and Richards Bay. Location of commercial and non-commercial ports and fishing harbours, locations of areas to be avoided for shipping, special areas under the International Convention for the Prevention of Pollution from Ships and location of offshore traffic separation schemes.

MAP 61

Within the regional context, the South African transport system is highly developed and is interconnected with the transport systems of other states of the region. In particular, landlocked states in the region have varying degrees of dependence on South Africa's maritime transport system. It is therefore important to consider the maritime transport and ports spatial interests and needs in the context of a well-developed and integrated transport system that connects the maritime infrastructure with the hinterland.

The following systems are in place for monitoring of vessel traffic along the South African coastline:

- Satellite Automatic Identification System (S-AIS);
- Terrestrial AIS;
- Long Range Identification and Tracking of Ships (LRIT); and
- Vessel Traffic Service (VTS).

3.10.2.4 ENVIRONMENTAL IMPACTS

MARINE POLLUTION

Possible impacts of maritime transport and port activities is on the marine environment is marine pollution by ships, Marine pollution and ballast water discharge.

The shipping industry in South Africa has potential to impact on marine biodiversity through oil spills as a result of shipping accidents or deliberate discharge of oil, oily residues or contaminated ballast water.

Ship-to-ship transfers, that is, the transfer of cargo between ships positioned alongside each other, either while stationary or underway, come with a higher risk of accidents, causing marine pollution. Pollution reduces the quality of the ocean, making it less suitable for marine life.

Oil spills can have far-reaching environmental impacts due to the interconnectedness of oceans. A number of oil spill incidents occurred around South Africa per year between 2001 and 2006.[248]

Ballast is required to ensure safety of ships and their operation. Ballast water can however impact the marine environment through the accidental introduction of non-native species when ballast water is discharged. This has been identified as the most important mode of alien invasive species introduction in South Africa, with hull fouling and ballast water contributing to 50% and 37% of introductions respectively.[91] More than 22 million tons of ballast water are discharged in South African ports and harbours annually.[83]

Other pathways of introduction are marine aquaculture and petroleum infrastructure. Invasive species can result in serious ecological and economic problems in marine environments, and a common result as the invasive species proliferate, is the severe depletion of biological diversity.

The majority of invasive alien marine species occur on the West Coast of South Africa, with ports and harbours around the country forming hotspots for the introduction of invasive alien species. In spatial terms, temperate species originating from the northern hemisphere predominate on the West and South Coasts, while species from the southern hemisphere occur largely on the East Coast.[91] Apart from posing a serious threat to coastal and marine biodiversity, invasive alien species can also have serious economic impacts through their detrimental effect on commercial fisheries stocks, including marine aquaculture.[249]

South Africa is party to the IMO Convention for the Control and Management of Ships Ballast Water and Sediments that entered into force in 2017. This Convention aims to prevent the spread of harmful aquatic organisms from one region to another, by establishing standards and procedures for the management and control of ships' ballast water and sediments. The Marine Environmental Protection Committee (MEPC) of the IMO has adopted a set of voluntary guidelines for preventing the introduction of unwanted aquatic organisms and pathogens from ships' ballast water and sediment discharges as an annexure to the MARPOL Protocol. South Africa has not yet implemented these guidelines, but is working towards a strategy for the prevention of accidental invasions. DoT is currently reviewing the draft Bill on Ballast Water Management to cater for the latest guidelines adopted by the MEPC in the 71st session.

NAVIGATIONAL AND PORT EXTENSION DREDGING

Ports have a statutory responsibility to maintain navigation channels for port users, which requires dredging of port sediment to keep the channels functional. Port and port infrastructure expansion developments, navigational dredging and the dumping of dredged material cause loss and/or disturbance of habitat and marine biodiversity through physical smothering or chemical or heavy-metal contamination of disposal sites. South Africa currently have designated dredged material disposal sites located near port cities and coastal towns. There has been an increase in the volume of dredged material disposed between 2006 and 2011.[250] Most of the material was generated as a result of port maintenance dredging operations.

UNDERWATER NOISE

Shipping, dredging and port expansion work leads to underwater noise which may disturb marine wildlife.

AIR POLLUTION AND EMISSIONS FROM SHIPS

Shipping causes air pollution through emissions by the fishing, cargo and passenger transport, tourism, and oil and gas industries. The IMO are seeking global agreement on lowering ship emissions. In terms of NOx, the use of shore-based electricity generation as opposed to that generated by ships would significantly reduce NOx emissions, thereby enhancing air quality especially in and around ports. The IMO set the standards for NOx emissions for international shipping. New regulations were introduced in 2008 under MARPOL, which strengthen the requirements worldwide for all new ships built after January 2011.

Maritime transport is a minor contributor to transport sector emissions in South Africa and the rest of the world, being less than 1%.[251] This is due to maritime transport operating mainly beyond South African boundaries. The international nature of maritime emissions is being discussed under the relevant United Nations agency responsible for maritime safety and the prevention of pollution from shipping, the IMO.

South Africa is a signatory to a number of multilateral conventions relating to climate change for which the IMO is also responsible to implement measures to reduce emissions from maritime transportation, and must ensure that it continues and expands its engagement with these multilateral processes which are responsible for setting important norms of standards for the sector, many of which relate to the environment.

In September 2014 the Minister of Transport on behalf of the Republic of South Africa endorsed the participation of the DoT as a Lead Pilot Country in the project "Transforming the Global Maritime Transport Industry Towards a Low Carbon Future Through Improved Energy Efficiency". The aim of the Global Maritime Energy Efficiency Partnership (GloMEEP) Project is to contribute to a significant reduction of GHG emissions from international shipping via enabling 10 Lead Pilot Countries (LPCs) to take a lead in the respective developing regions to pursue relevant Legal, Policy and Institutional Reforms (LPIR), capacity building and enhance private-public partnerships for innovation and technology deployment. GloMEEP will assist the Department to prioritise the enactment of MARPOL Annex VI to its National Legislation and to build capacity for the implementation of project initiatives.

3.10.3 LOOKING TOWARDS THE FUTURE

3.10.3.1 STRATEGIC POLICY OBJECTIVES

The development of the maritime transport and ports sector is based on the legal and policy framework. It is guided by the following strategic objectives with direct spatial relevance:

- National Transport Master Plan (NATMAP) 2050

The National Transport Master Plan (NATMAP) 2050 identifies key interventions required that will contribute to the expansion of seven of the eight commercial seaports (except Mossel Bay).[252]

- Comprehensive Maritime Transport Policy (CMTP) of 2017

This policy seeks to facilitate the growth and development of South Africa's maritime transport sector and includes ensuring and enabling better regulation, governance and sustainable use of the marine environment, through measures such as enhanced marine pollution surveillance and prevention.

- National Development Plan: Vision 2030

The National Development Plan acknowledges that transport is one of the five infrastructure areas that require targeted investments in order to support the country's medium and long-term objectives.

- 2030 Research, Innovation and Knowledge Management Road Map for the South African Maritime Sector

The Road Map's first objective seeks to create an enabling governance framework for the maritime sector that supports sustainable development. Objective 4 pursues sustainable use and protection of the country's ocean natural resources in the EEZ through reducing levels of pollution at sea, and conducting research to conserve marine resources. Enhancing compliance and enforcement with marine environmental regulations (e.g. in the context of marine protected areas), for example, through investing in new technologies is another priority.

- National Framework for MSP

The National Framework for MSP stipulates that MSP in South Africa will stimulate the sustainable economic growth of South Africa's marine sectors for which maritime transport and ports (including small harbours) are a key enabling factor and prerequisite to unlock the ocean economy by providing the infrastructure between land and sea and are critical to enabling the movement of goods and people.

- Operation Phakisa: Ocean Economy

The marine transport growth area of Operation Phakisa: Ocean Economy aims to unlock investments in new and existing port facilities, refurbish and better maintain existing port facilities; implement prioritised strategic projects in East London and Richards Bay, establishing purpose-built oil and gas port infrastructure in Saldanha Bay, and to accelerate infrastructure investments already planned by TNPA.

3.10.3.2 TRENDS AND DRIVING FORCES

Seaborne trade will remain key for the nation's economy, fostering and driven by growth and social development.

The containerised worldwide trade is set to grow and so is the growth expectation in volumes handled by the ports. This trend and an expected increase in the large-scale bulk, break-bulk cargo volumes and liquid cargo is likely to reinforce the need for a) bigger ships which will require larger and deeper ports, and b) more and better ports, rail and road infrastructure.

This trend will also lead to an increase in navigational dredging as South Africa's ports undergo further expansion to grow the economy and boost competitiveness with other African ports.[253]

The growth of the marine tourism sector will lead to more passenger liners calling at the South African ports. In addition, an increase in more tourists (national and international) will lead to increased recreational traffic along the coast. This increase in visitors comes with a need for more land-based infrastructure to accommodate the tourists within port areas and small harbours.

The intensifying global and South African trade of goods by sea will lead to equal or slightly increased levels of ship densities in the existing shipping lanes.

3.10.3.3 SYNERGIES AND CONFLICTS WITH OTHER ACTIVITIES AND INTERESTS

CONFLICTS:

- Transport – Mining: Fixed structures (e.g. oil rigs) and mining operations in key navigational areas.
- Transport – Environment/Defence: Closure of key navigational areas (e.g. areas of high levels of shipping density, IMO recommended ship lanes) for conservation or military practice purposes
- Transport – Fishing: Fishing in key navigational areas (e.g. areas of high levels of shipping density, particularly around Cape Agulhas) can be a possible cause for disturbance of commercial traffic

SYNERGIES:

- The maritime transport sector provides key coastal infrastructure for all marine activities that require ports, harbours and other coastal launch sites for their operations.

3.10.4 KEY ISSUES FOR MSP TO CONSIDER

Maritime transport infrastructure attracts both development on land and at sea, and, in many respects, the development of our ocean is unlocked by the provision of high-quality, integrated maritime transport infrastructure and services. In other words, maritime transport infrastructure and shipping routes are key ingredients required for the development of all other sectors and therefore a prerequisite to unlock the ocean economy.

Given the above context and considerations, the following are important requirements from a maritime transport and ports point of view that need to be considered in the MSP process:

- Avoid any permanent or temporary developments and restrict other uses in key navigational areas that may restrict transport. These areas are particularly those with high levels of shipping density, the established and possible new Traffic Separation Schemes, other IMO recommended ship lanes, as well as any other navigational areas within the approaches to ports and port limits (i.e. anchorage areas, navigational channels, places of refuge) or offshore.
- Maintenance dredging, deepening of existing channels, and the dredging of new navigational channels must be planned for, including the establishment of new dredge material dumping sites, if needed.
- No developments should be allowed on land to obstruct aids to navigation, e.g., buildings in the vicinity of lighthouses, leading lights, etc.
- Offshore bunkering areas need to be identified and demarcated, where applicable.
- Places of refuge need to be identified and demarcated for the management of vessels in distress or requiring emergency assistance.
- Areas around the major ports where drones are restricted need to be identified and demarcated.
- Safety zones around new fixed infrastructure developments need to be demarcated.
- Conventional and single buoy moorings must be protected as sensitive floating navigational aid infrastructure.

3.11 MINERAL AND PETROLEUM RESOURCES EXPLORATION AND EXPLOITATION

3.11.1 BACKGROUND

South Africa holds rich reserves of minerals and hydrocarbons – especially on land but also at sea. The process of mineral exploration results in finding and mapping concentrations of minerals that would merit commercial exploitation through physical extraction.

The South African mining industry, especially on land, contributes significantly to the country's economy, provides employment opportunities and as such supports poverty reduction and empowerment.

There is significant potential for growth of the sector offshore given the experience and knowledge of the industry and based on the potential of the geological resource base in the sea.

Known mineral resources and hydrocarbons in the South African ocean space are: diamonds, potassium, phosphate, glauconite, heavy metals, manganese, oil and gas.[254] In addition, salt production takes place along the coast of South Africa.

DIAMONDS:

South Africa has a long-standing history in mining diamonds in the terrestrial and marine environment. During the Cretaceous Period (144 to 65 million years ago) diamonds, originating from inland kimberlite pipes, were transported to the coast by rivers and deposited on gravel beaches along the southern African west coast. These diamonds are now located offshore, at depths from the shoreline to approximately 150m below Mean Sea Level (BMSL).[255]

Mining of diamondiferous-gravels in the marine environment was initiated on the Namibian south coast in 1961 by Marine Diamond Company (Pty) Ltd and proved to be successful.[256,255] Shortly thereafter, in 1962, South Africa commenced marine diamond mining offshore Namaqualand, between the present positions of the Orange and Olifants Rivers.

In the early 1970s however, an international diamond market slump resulted in reduced offshore diamond mining activity, especially by smaller companies. A depletion of the lucrative inshore diamond resources during the early 1990s and the availability of improved mining technology, once again resulted in an increase in mining efforts in the offshore areas.[256] Diamonds in the southern African coastal region are concentrated on or near bedrock and are commonly preserved within eroded potholes. Younger, unconsolidated sediments were subsequently deposited above the older bedrock.[257]

Marine diamond mining involves the removal of unconsolidated sediments (overburden) from the sea floor using large, purpose-designed vessels.[242] Overburden sediments, containing diamondiferous gravels, are pumped or airlifted to the surface for on-board processing using one of two methods.[258] The two categories of deep-water marine diamond mining (below 50 m BMSL and up to 120-150 m BMSL) currently employed are:

- Horizontal (crawler) mining where a seabed crawler fitted with a suction head is attached to a tethered hose. This system is designed to operate in overburden deeper than 4 m.
- Vertical (drill) mining where a vertically mounted drill bit (5.2–5.6 m diameter Wirth drill systems) is attached by a drill string. This system is designed to operate in overburden shallower than 4 m.

Both systems are designed to disturb the sediment overburden, effectively reducing compaction, and allowing it to be pumped to the vessel for top-side processing. Oversized boulders and fine tailings are immediately discarded overboard, with almost 90% of the material pumped to the surface being returned directly to the sea. The remaining gravel fraction is separated using a ferrosilicon dense medium separation system, the diamonds extracted from the heavy fraction using an X-ray sorter, and the remaining gravel is discarded in the sea.[255]

In shallow water (< 15 m) the sea floor is constantly re-worked by waves and diamondiferous gravels can be mined by divers. While this method does produce high quality diamonds, it is time consuming and not nearly as productive as deeper water mining methods.

POTASSIUM, PHOSPHATE AND GLAUCONITE:

Extensive potassium and phosphorous-rich deposits occur on the continental shelf of the southern and west coasts of South Africa and Namibia.[259]

The largest known concentration of glauconite in southern Africa occurs west of Saldanha Bay in depths between 200 m and 300 m but is in a palaeo context and is, for the most part, cemented into phosphorite rock. Isolated occurrences of authogenic phosphate pellets and extensive diagenic phosphate rocks occur along the continental shelf-break (200-300 m isobath) off the west coast and Agulhas Bank of South Africa.

HEAVY METALS:

Heavy minerals are those minerals with densities exceeding that of quartz (i.e. > 2.65 g/cm^3). Where heavy minerals are enriched by sedimentary means so as to form economic deposits, they are referred to as placers. Heavy minerals include: ilmenite (and its weathering product leucoxene), rutile and anatase, zircon, monazite, xenotime, staurolite, aluminium silica minerals (i.e. kyanite, andalusite and sillimanite), minerals of the garnet group, magnetite, chromite, cassiterite, tantalite-columbite, wolframite, and scheelite as well as precious metals (e.g. gold and platinum group metals) and gemstones (e.g. diamonds, rubies and sapphires). In South Africa, the economic placer minerals are predominantly ilmenite or its alteration product leucoxene, rutile, zircon and garnet.

In South Africa, mining of heavy minerals takes place in coastal dunes. Though no offshore heavy minerals are currently being exploited, prior investigations have been conducted concerning the concentration and distribution of heavy minerals off KwaZulu-Natal in submerged paleo-coastal dunes. A quantification of this resource is lacking to date.

MANGANESE:

Manganese nodules, enriched in valuable metals such as nickel, copper and cobalt, occur in waters exceeding 3,000 m off the west and south coasts of South Africa.[260]

Exploratory surveys report that the nickel, copper and cobalt contents of most of these manganese nodules fall below the 2% economic cut-off grade, but they have not been mapped or quantified in recent years. Surveys in the area north of 33°S in the Cape Basin and off northern Namaqualand show evidence of mineral grade nodules.

OIL AND GAS:

In 1965, the parastatal Southern Oil Exploration Corporation (SOEKOR) was established and began its search in the onshore areas of the Karoo, Algoa and Zululand Basins. In 1967 a new Mining Rights Act was passed and offshore concessions were granted to a number of international companies, including Total, Gulf Oil, ESSO, Shell ARCO, CFOP and Superior. This led to the first offshore well being drilled in 1968 and the discovery of gas and condensate.

In 1970, SOEKOR extended its efforts to offshore exploration with the intention to search for, and if found, commercially exploit viable oil and gas deposits, both independently or in partnership with foreign companies. Despite some encouraging discoveries, international companies gradually withdrew due to international sanctions at the time. From the mid-1970s until the late 1980s, SOEKOR was the sole explorer operating the entire offshore area of South Africa. In 1994, offshore areas were re-opened to international investors via a new licensing round. In 1999, the South African Agency for Promotion of Petroleum Exploration and Exploitation, known as Petroleum Agency SA (PASA), was established. It has the mandate to ensure optimal development of the natural oil and gas potential of the Republic of South Africa. In 2001, a new State Oil Company, PetroSA, was formed through the merger of SOEKOR and Mossgas. PetroSA is a subsidiary of the Central Energy Fund (CEF) (Pty) Ltd, and owns and manages the South African government's commercial assets in the petroleum industry, including exploration and production off the south and west coasts, and international upstream petroleum ventures.[261] South Africa is actively aiming to expand oil and gas production within the EEZ and the PASA is leading the extended continental shelf claim that, if awarded, would increase the size of South Africa's EEZ and thus provide further access to additional hydrocarbon and mineral resources.

Offshore hydrocarbon exploration involves gravity, magnetic and two- or three-dimensional seismic surveys to investigate subsea geological formations. High level, low frequency sounds are directed towards the seabed from near-surface sound sources towed by a ship and reflected signals from geological discontinuities below the sea floor are recorded by towed hydrophones. The data gained from seismic surveys are used to identify potential hydrocarbon traps. Prospect wells are drilled to test these potential accumulations of oil and/or gas. Over 300 wells have been drilled within the South African EEZ and significant seismic data have been acquired.

The results of these exploration activities have been the discovery of several small oil and gasfields, and the commercial production of oil and gas from the Bredasdorp Basin, although oil production is now suspended. Further gas fields and gas discoveries have been made in the Pletmos Basin, while the Orange Basin off the west coast has yielded one oil and several gas discoveries. One of these discoveries is currently pending development as the Ibhubesi gas field, by Sunbird Energy.[262]

Oil production began in 1997 when the Oribi field in the Bredasdorp Basin produced 25,000 bbl/day to a floating production facility serviced by a shuttle tanker. In 2000, the Oryx field production was added. A third field known as Sable, came into production in 2003. The first two fields are now depleted, while oil production from Sable has been suspended to allow production of the gas cap, to supplement supply to the GTL plant.

The South African oil and gas sector is in an early development phase and a major investment in exploration activity is required before the sector's potential could be realised. This is an area of high risk but with huge economic potential that requires substantial capital investment. Operators range from multi-national oil companies such as Total, Shell, Impact Africa, Eni and Anadarko to smaller locally owned companies such as Sunbird Energy, Sungu and Tosaco. Recent activity has included the acquisition of large multi-client 2D seismic surveys, proprietary 3D surveys, and selective re-evaluation of existing wells.

3.11.2 THE CURRENT SITUATION

3.11.2.1 LEGAL AND POLICY FRAMEWORK

The Government has created a modern and enabling legal, policy and institutional framework that regulates the geological resources exploration and exploitation sector.

The Department of Mineral Resources and Energy (DMRE) is the over-riding authority for minerals exploration and exploitation in South Africa and responsible for the management and development of the country's mining sector. DMRE's mission is to promote and regulate the minerals and mining sector for transformation, growth and development, and ensure that all South Africans derive sustainable benefit from the country's mineral wealth. The Department's mandate is derived from the Mineral and Petroleum Resources Development Act (Act No. 28 of 2002).

The Petroleum Agency South Africa (PASA) reports to the DMRE and is the national petroleum and gas promotion and licensing agency. It has the mandate to facilitate, promote and regulate the exploration for onshore and offshore oil and gas resources and their optimal development on behalf of the government. Its mandate is derived from the Mineral and Petroleum Resources Development Act (Act No. 28 of 2002).

The primary legislative pieces for regulation of the mining and oil and gas industry are:

- The Mineral and Petroleum Resources Development Act (Act No. 28 of 2002)
- The National Environmental Management Act (Act No. 107 of 1998)
- The Mine Health and Safety Act (Act No. 29 of 1996)

The Mineral and Petroleum Resources Development Act (MPRDA) makes provision for equitable access to and the sustainable development of the nation's mineral and hydrocarbon resources and provides rehabilitation in cases of mine closure.

The Mine Health and Safety Act (MHSA) seeks to protect the health and safety of persons at mines.

Currently, the MPRDA, as amended, is in force and aligned with the National Environmental Management Act (NEMA). Any prospecting, mining, exploration, production and any related activities in the marine environment are subject to applicable environmental regulations under the NEMA. Applicants for prospecting, mining, exploration or production rights must obtain environmental authorisations issued in terms of Section 24 of NEMA and its associated EIA regulations

which require that an environmental assessment is undertaken for specific activities listed under the regulations. Environmental Management Programmes are developed and implemented as part of the EIA process to ensure that appropriate mitigation measures are implemented during operations.

NEMA furthermore requires that an applicant for an environmental authorisation relating to prospecting, exploration, mining or production must, before the Minister responsible for mineral resources issues the environmental authorisation, comply with the prescribed financial provision for the rehabilitation, closure and ongoing post decommissioning management of negative environmental impacts. The purpose of these regulations is to regulate the determination and making of financial provision as contemplated in the Act for the costs associated with the undertaking of management, rehabilitation and remediation of environmental impacts from prospecting, exploration, mining or production operations through the lifespan of such operations and latent or residual environmental impacts that may become known in the future.

However, there is currently a Mineral and Petroleum Resources Development Draft Amendment Bill before the Parliament, which may give rise to significant amendments that may have a major impact in the mining industry. Similarly, the anticipated Upstream Petroleum Resources Bill may have material impact on the petroleum and gas industry.

The National Development Plan 2030 seeks to stimulate mining investment and production in a way that is environmentally sound and provides benefits to South Africa's society. The 2010 New Growth Path calls for increased mineral extraction as a means to achieve its aim of enhancing growth, employment creation and equity.

The Minerals and Mining Policy for South Africa (White Paper published in October 1998) ensures the transparent and efficient regulation of the development of South Africa's mineral resources and mineral industry to meet national objectives and bring optimum benefit to the nation.

Operation Phakisa: Ocean Economy is a government initiative to fast-track the implementation of solutions to overcome critical development issues and contribute to achieving the National Development Plan 2030. The unlocking of the socio-economic potential of South Africa's ocean wealth has been identified as one of the key areas of work. The following six growth areas have been identified:

- Marine Protection Services and Governance
- Offshore Oil and Gas Exploration
- Marine Transport and Manufacturing
- Aquaculture
- Marine and Coastal Tourism
- Small Harbours

The offshore oil and gas exploration growth area has several policy goals and seeks to create an investor-friendly environment in order to grow the oil and gas sector. These goals are supported by the anticipated Upstream Petroleum Resources Bill.

3.11.2.2 SOCIO-ECONOMIC IMPORTANCE

South Africa's mining industry to a greater extent than any other industry has played a principal role in transforming the country's economy into an industrial one.

In 2018, mining exports added up to about R312 billion.[263] In 2018, the mining industry contributed 7.3% to South Africa's GDP.[263] Currently offshore marine mining forms a very small portion of this total, with revenues likely to be under R1 billion or 0.3% of the total mining industry and are likely to contribute 0.03% to South Africa's GDP[264]. The mining industry pays royalties as well as income taxes. Royalty payments for the complete sector in the tax years 2017 and 2018 totalled R15.1 million.[263]

In 2018, a total of 3000 people were employed by the two companies involved in active marine mining, though most of these people are involved in terrestrial operations of the companies as both companies are strongly terrestrially focused. More people are employed in the offshore hydrocarbon sector with approximately 1,594 employed in upstream oil and gas production.[265] Turnover of the two companies activity involved in offshore mining is approximately R1 billion.[263] Employment in the minerals and hydrocarbon sector is strongly demand driven, with job generation dependent on active extraction. Extraction, in turn, is dependent on commodity prices on global markets which determine whether the resources merit economically viable exploitation.

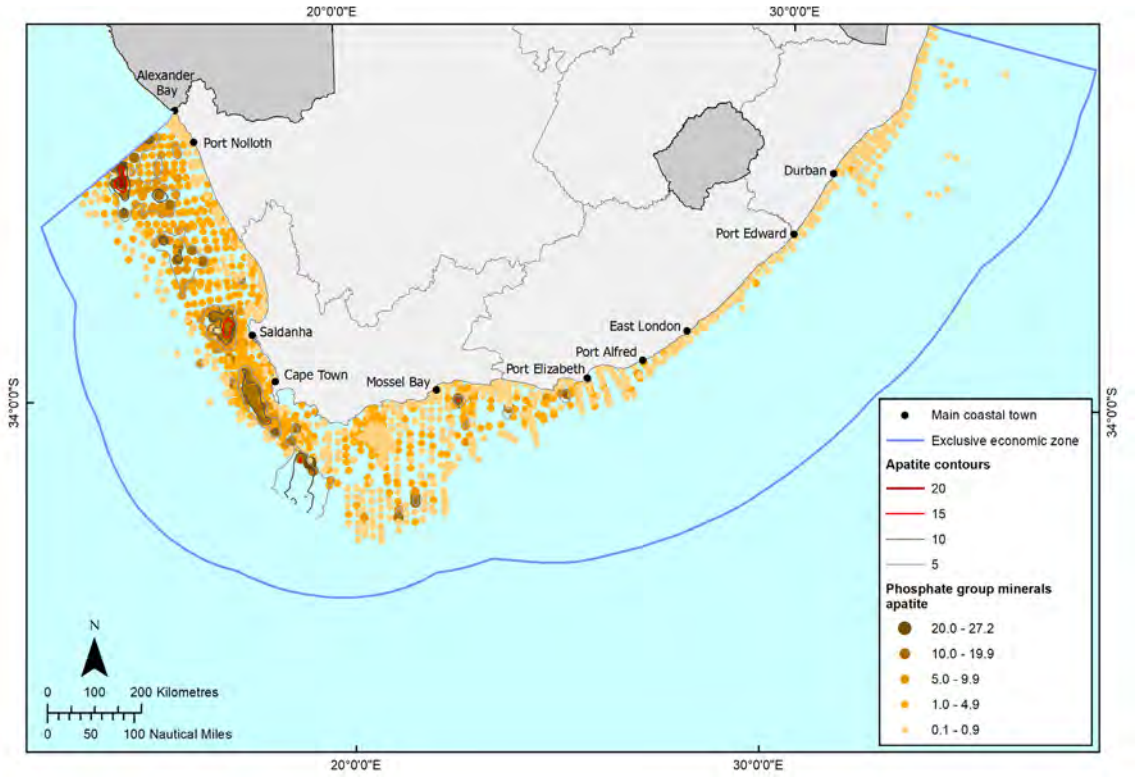
3.11.2.3 KEY SPATIAL INTERESTS

In terms of hydrocarbons, there are currently in 2021 seven (7) offshore production rights and twenty (20) exploration rights, with a number of applications underway.

Hydrocarbon deposits are potentially located throughout the South African marine area, though the exploitable resource remains largely unknown.

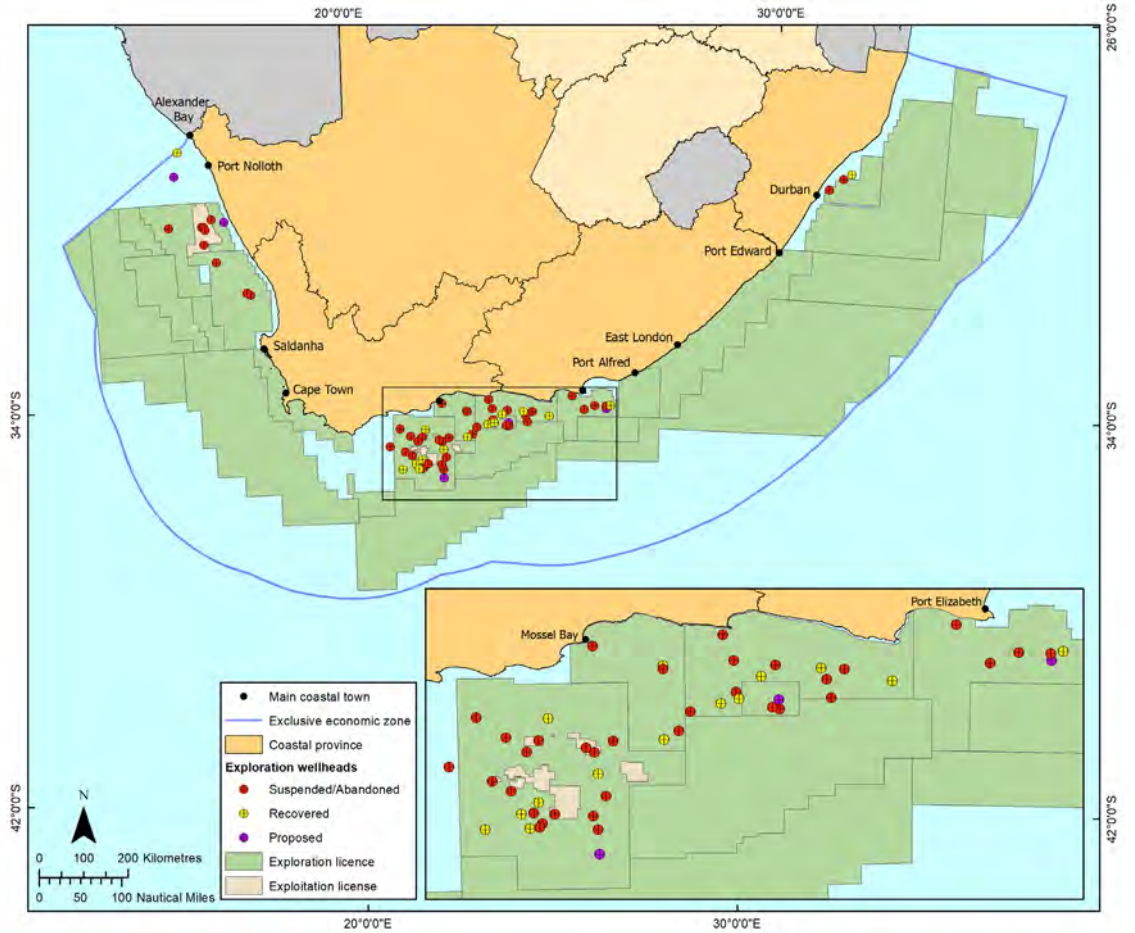
Exploration companies range from multi-national oil companies such as Total, Shell, Impact Africa, Eni and Anadarko to smaller locally owned companies such as Sunbird Energy, Sungu and Tosaco. Recent activity has included the acquisition of large multi-client 2D seismic surveys, proprietary 3D surveys and the development of some exploration wells.

In terms of mineral resources, key areas have been identified by the Government as holding deposits of diamonds, potassium and phosphate, glauconite, heavy metals, manganese, oil and gas. Despite knowledge about these resources, large areas of the South African ocean space are not explored to-date and will require exploration in future to determine whether they hold economically viable deposits.



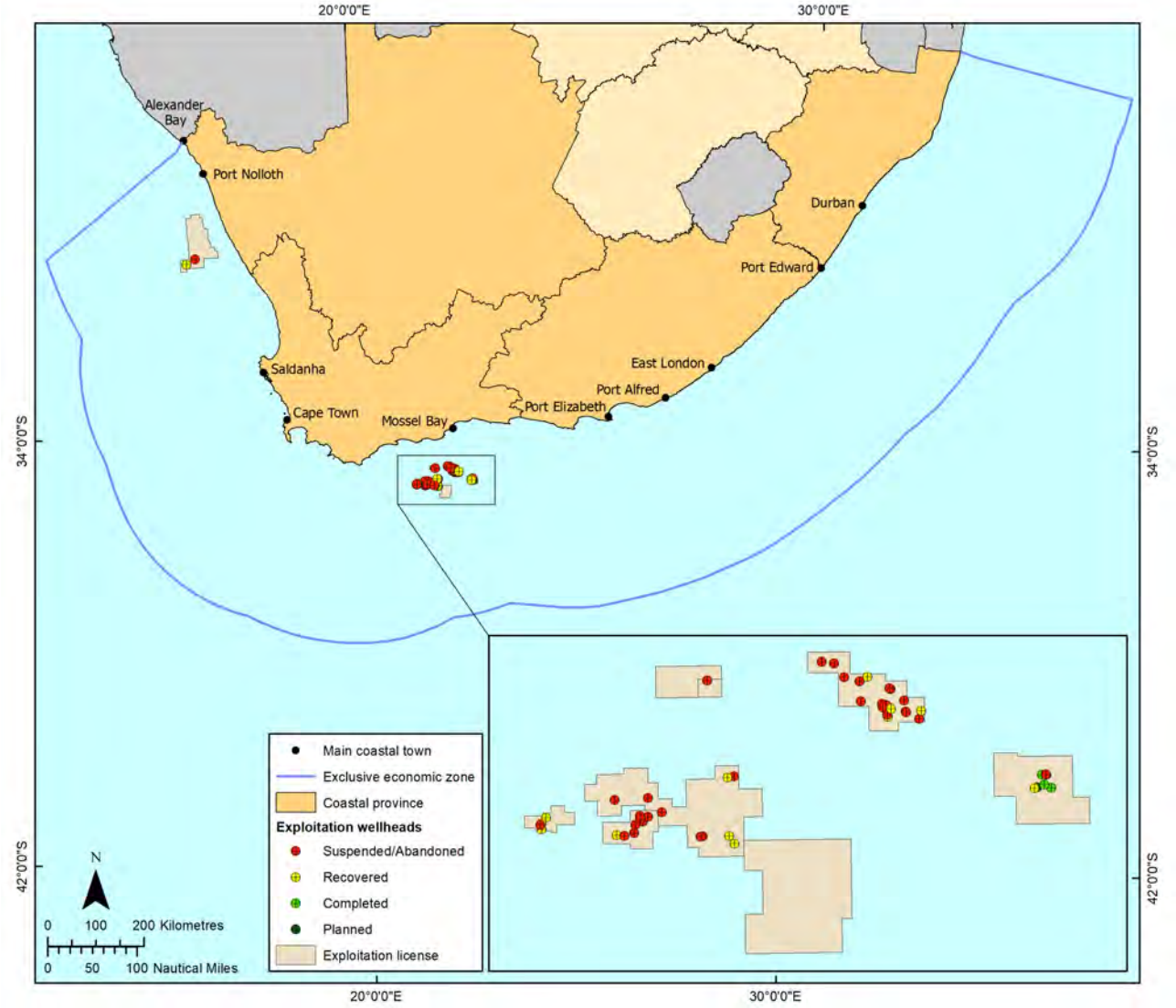
Approximate location of known phosphate deposits.

MAP 62



Location of awarded hydrocarbon exploration licences and wellheads.

MAP 63



Location of awarded hydrocarbon exploitation licences and wellheads. MAP 64

3.11.2.4 ENVIRONMENTAL IMPACTS

The key possible impacts of exploration and exploitation of the above mentioned reserves of minerals and hydrocarbons on the marine environment include:

- Habitats and species disturbance/damage
- Pollution/Contamination
- (Underwater) noise especially during exploration (seismic surveys)

In detail, the environmental impacts are estimated to be:[266]

The impacts of marine diamond mining were first investigated in 1991 when De Beers Marine commissioned a group of specialists to undertake an Environmental Impact Assessment (EIA) of the potential effects of deep-sea diamond mining activities in this area. The overall conclusion of the EIA was that environmental impacts are not of sufficient significance to preclude continuation of mining[258], although several impacts, pertinent to overall marine biodiversity, were identified.

Disturbance of seabed sediments and benthic communities is considered the principal impact of marine mining, with benthic communities being unavoidably destroyed by mining activities.[267,268,269,270] Disturbance of the sediment results in a significantly modified benthic macrofauna community, which can take up to five years to recolonize.[271] Sediment disturbance, such as that imposed by mining activities, may cause changes in species composition.[272] Organic pollution (enriched sediment and potential chemical contaminants in the sediment) can exclude more chemically sensitive macrofauna species. Sediment disturbance is known to result in a decreased abundance and biomass of large, long-lived, slow-growing macrofauna species, whereas small, fast-growing pioneer species increase in abundance and tend to dominate the community composition.[273,274] This shift in community composition is usually associated with a decrease in overall diversity, and can have negative impacts on the overall ecosystem functioning.[275,276] Discharged gravel and fine sediment (tailings) are deposited on the sea floor during the mining process and can alter the sediment composition and/or smother benthic fauna.[277] This impact is largely considered to be minor due to the comparatively small area in which such deposits are believed to settle. Fine sediment plumes extend for a few kms from the mining vessel but the rapid and substantial dilution that occurs through the naturally dynamic nature of the environment, results in a small total area of impact.[255] There has been concern over the re-suspension of heavy metals through mining activities.[278] Heavy metal concentrations in the tailings have been evaluated and are considered to be well below the guideline levels and are thus not considered likely to contribute to toxicity of the environment.[255] Furthermore, the impact on phytoplankton communities (reduction of light), nutrient enrichment, remobilization of contaminants and oxygen consumption (decomposition of organic matter) as a result of sediment plumes, have been found to be limited and localized, and not considered to have extensive environmental impacts. A change in fish communities, as a result of sediment plumes, has also been investigated. However, results indicated that any potential change would be short-lived and some fish species may even temporarily favour the plumes, as they provide shelter from visual predators.[256]

Marine seismic surveys can have adverse effects on some marine life.[279] The impact that petroleum exploration seismic surveys have on baleen whales is of some concern[242]. Baleen whales are known to have good low-frequency hearing which overlaps with the output range of frequencies used for seismic surveys. There is a strong likelihood that the frequency emissions of seismic surveys will negatively impact on whales in the vicinity. Similarly, studies have indicated potential impacts on African Penguins and turtles. The potential impacts of seismic surveys on plankton, invertebrates, fish, turtles, sea birds and marine mammals in South African waters have been assessed as part of generic environmental impact reports for the sector.[280] These indicate that, without mitigation, impacts can be of high significance to certain taxa (e.g. penguins, turtles and cetaceans), in particular areas (e.g. in shallow water, within 25km of the coast or within 25km of seabird colonies) and during particular seasons (e.g. whale breeding seasons); but that, with mitigation, impacts can be reduced to low or medium. Key mitigation measures include avoidance of shallow and coastal areas (e.g. within 25km of the coast); avoidance of colonies (e.g. within 25km of penguin colonies though some studies recommend a 100km buffer); avoidance of breeding seasons of key species (for whales, especially the period July to November between Lambert's Bay and Algoa Bay, and for turtles on the east coast between November and February); and operational measures such as soft starts (to allow mobile species to move out of the area). Recent impact assessments have anticipated low potential impacts to these key taxa after mitigation, particularly in areas and during periods where the species are not present in large numbers. The fishing industry has expressed concerns that seismic activity may affect fish behaviour, distribution and/or changes in fish catches. No quantitative data or evidence thereof is currently available.

Discharge of drilling muds and cuttings have a potentially adverse impact on the environment.[242] Cuttings are discharged overboard throughout the drilling operation and surplus mud is discharged on completion of the well. The impact 'footprint' of these discharges is of concern to benthic biodiversity. Fossil water, trapped within oil-bearing rock has been known to rise to the surface during oil extraction. This 'produced water' is usually the largest aqueous discharge from offshore production platforms and can reach volumes of up to 20,000 m^3 per day. Limited research has been conducted on the properties of produced water. It is likely to contain chemicals which could have adverse effects on marine biota, particularly larval stages. The actual impact of petroleum activities has not been examined in South Africa (although recent impacts assessments indicate low potential impact), but international studies have shown that offshore drilling can result in the following impacts:

- contamination of the marine environment through drilling muds.[281,273] Contamination effects are linked to increased total hydrocarbons, barium, strontium and metals such as zinc, copper, cadmium and lead. In Norway, studies showed that ecologically important prey species (brittle stars) for commercially important fish species (e.g. cod), were reduced by initial pollution impacts and replaced by smaller opportunistic species, believed to be less valuable as a food source. Water-based drilling muds have reduced environmental contamination and biological impact less than oil-based drilling muds;

- disturbance of sediments, habitats and benthic macrofauna by displacement, burial, smothering and sedimentation.[279] These disturbances may impact on other species that are dependant upon such fauna as prey items, while additional mitigation measures can be implemented to ensure that the potential impact on the marine environment by oil-based is reduced;

- localized disturbance of the sea floor by the anchor chain and the anchors will have negative effects on benthic communities[280];

- potential contamination of the marine environment through waste discharges and oil spills;

- other operational activities such as lighting, helicopter operations and flaring could also impact on marine life[282]; and

- physical structures on the seabed can potentially increase the diversity of environments available for benthic organisms, aggregate fish and consequently the biodiversity in the area[275].

Pollution and disturbance can impact on both hard-bottom fauna and benthic infauna from unconsolidated (soft substrate) habitats. The abundance of some invertebrate taxa on deep reef habitats can be significantly reduced at sites of heavy petroleum activity.[283] Analyses of chemical contaminants showed concentrations to be below toxic levels and the observed impacts were thus believed to be linked to physical impacts of increased sedimentation such as disruption of feeding or respiration and burial of settled larvae. Most studies show that drilling impacts are relatively localized but impacts can spread to more than 6 km from platforms.[273]

Impacts of petroleum activities should be assessed in South Africa and in areas where petroleum activities overlap with fisheries, particularly on the Agulhas Bank. There is an urgent need for information about the potential cumulative impacts of all oil and gas activities in concert with the impacts of fisheries, in particular that of bottom trawling. Oil and gas structures, particularly on the Agulhas Bank, have prevented demersal trawling and the petroleum sector motivates that this protection may benefit both biodiversity and fisheries.[284] Elsewhere, oil and gas infrastructure has been colonized by reef biota representing a different type of biodiversity from unconsolidated habitats where drilling usually takes place.[285] Petroleum infrastructure can therefore serve as an artificial reef, increasing biodiversity by providing hard substrate; however, the value of this is controversial. Where cold water coral communities have been heavily impacted by bottom trawling, untrawled artificial reefs may provide habitat for healthy coral colonies.[275]

The greatest environmental concern in exploratory drilling is the possibility of an uncontrolled release of hydrocarbons (a so called "blowout"). The probability of this occurring is, however, low, although the environmental consequences of oil spills are severe. The possibility of an oil spill is perceived as the greatest threat posed by this industry to marine biodiversity.[278] There are no known published studies on the actual physical impacts of oil and gas exploration and development activities in South Africa.

3.11.3 LOOKING TO THE FUTURE

3.11.3.1 STRATEGIC POLICY OBJECTIVES

The exploitation of the country's offshore geological resources has the potential to contribute to job creation and economic development. The overarching strategic policy objectives for the minerals and hydrocarbon industry are therefore aimed at growing the sector which entails prospecting and exploration activities, especially in areas not yet explored, to enable mining of minerals and production of oil and gas where economically feasible, socially sound and with the least environmental impact possible.

The offshore oil and gas growth area of Operation Phakisa: Ocean Economy seeks to create an environment that promotes exploration in order to drill 30 exploration wells within the next 10 years. Eleven initiatives have been identified for implementation until 2024, with the spatially relevant ones being:

- Exploit the broader research opportunities presented by offshore oil and gas exploration. This will unlock a wealth of data on ecosystems, marine resources and ocean-related renewable energy – and ensure this data flows to key data users.
- Develop capability for sub-surface research and data gathering.

The DMRE is also in the process of conducting an in-depth study on the offshore mineral geology which will provide more concrete data on the potential, value and exact location of offshore mineral resources. This is in line with the strategic objectives to conduct exploration activities as a means to strengthen the sector's knowledge on concentrations of minerals that would merit commercial exploitation through physical extraction.

3.11.3.2 TRENDS AND DRIVING FORCES

It is very difficult to assess trends for the geological resource sectors as the industry's growth is highly dependent on global demands. These demand trends are reflected by the commodity prices for minerals, oil and gas. Predicting trends for the sectors or assessing exact developments such as license applications or exploration and exploitation activities that are likely to happen in the coming 10-20 years is not possible.

For some mineral and hydrocarbon resources, the costs of extraction offshore remain prohibitive in comparison to similar resources onshore. However, as terrestrial resources diminish, these deposits may become economically viable. Innovation in mining technology may also lead to increased mining activities as this might allow easier access to deposits and mining of resources and production of oil and gas, which are currently economically non-viable due to their nature, location or form of occurrences. The advancing technology will also assist in minimizing the contamination that could emanate from mining the resources on and under the seabed.

3.11.3.3 SPATIAL CONFLICTS AND SYNERGIES WITH OTHER USES AND INTERESTS

CONFLICTS:

- MINING – ENVIRONMENT:
  Direct damage to ecologically important resources. All environmental impacts: species disturbance, habitat destruction, seismic exploration, pollution.
  Marine Protected Areas and other precautionary closure of areas for conservation purposes can preclude the extraction of deposits of mineral resources worth exploiting.

- MINING – FISHING:
  All environmental impacts that may disturb commercially relevant fish species and destruction of important habitat for the fisheries sector (e.g. spawning areas), sediment plumes.
  Exploration, prospecting, mining and production may disrupt fishing activities (either temporarily or permanently).

- MINING – TRANSPORT:
  Fixed structures (e.g. oil rigs) and mining operations in key navigational areas.

- MINING – DEFENCE:
  Mining operations in or near to ammunition dumping grounds, and military practice exercises.

- MINING – TOURISM:
  Mining can limit tourist access (e.g. as happens in current diamond mining areas), and coastal mining infrastructure can impact on tourism sites.

SYNERGIES:

- MINING – ENVIRONMENT:
  Geoscientific research, including impact assessments, can assist in improving knowledge of species and habitats.

3.11.4 KEY ISSUES FOR MSP TO CONSIDER

Given the above context and considerations, the following are important requirements for the mineral exploration and mining sector that need to be considered in the MSP process:

- Mining and hydrocarbon exploitation should be prioritized in areas with confirmed viable resources.

- Exploration should be possible in areas that have so far remained unexplored.

- Co-existence of exploration and other marine uses and interests should be enabled to the largest extent possible.

In addition, land-based supporting infrastructure for the sector (e.g. current and new/expanded ports) need to be accessible from the sea to ensure effective mining and oil and gas operations and processing of mined resources and produced oil and gas.

3.12 NAVAL DEFENCE

3.12.1 BACKGROUND

South Africa's vast coastline, its territorial waters and its EEZ require military protection. The South African Navy (SA Navy) is the seagoing arm of the South African National Defence Force (SANDF), which has as its primary objective to protect the Republic, its territorial integrity and its people. The SA Navy's earliest beginnings can be traced back to 1861 with the first permanent naval force established in 1922.[286]

The "People's Navy" has three traditional roles that can be directly linked to the approved three military strategic objectives of the SANDF, namely to:[287]

1. enhance and maintain comprehensive defence capabilities (military role);
2. promote peace, security and stability in the region and on the continent (diplomatic and policing roles); and
3. support the people of South Africa (diplomatic and policing roles).

As no conventional military maritime threat against the Republic of South Africa currently exists, most of the tasks that the SA Navy conducts are within the diplomatic and policing roles. The naval force still requires to be prepared for tasks within the military role and to combat unconventional threats as part of the inherent value of the Navy. The unconventional threats that do exist are asymmetric in nature and tend towards acts of criminality and maritime terrorism, for example piracy (especially towards the East and the Mozambique Channel), smuggling and the poaching of resources.[288]

South Africa has a maritime-dependent economy and significant maritime interests which it must defend and protect through:

- a versatile littoral maritime capability inshore along the coast and within the territorial waters;
- a credible deep-ocean capability; and
- maritime domain awareness, which concerns the effective understanding of anything associated with the maritime domain that could impact the security, safety, economy, or environment of South Africa or its forces.

This maritime naval capability must be able to provide an enduring presence in South Africa's areas of maritime interest. The SA Navy is primarily responsible to execute the maritime defence strategy involving deterrence and powerful interdiction through surface, sub-surface and air abilities. This maritime defence strategy is pursued in concentric layers that are focused on South Africa's ports, territorial waters, trade routes and marine resources.[289]

The mission of the SA Navy is therefore to provide combat ready and supported maritime defence capabilities for the defence and protection of the Republic of South Africa.[290]

The SA Navy is a versatile, medium regional projection force. At present South Africa's ability to exercise seapower is however limited both in intensity and scope, with limited capability for sustained operation across the deep waters of open oceans (blue-water capability).[291,292] The surveillance capability of the South African Navy is supported by the maritime patrol aircraft of the South African Air Force.

3.12.2 THE CURRENT SITUATION

3.12.2.1 LEGAL AND POLICY FRAMEWORK

The Department of Defence (DOD) derives its mandate from Section 200(2) of the Constitution of the Republic of South Africa (Act 108 of 1996). The objectives of the DOD are to provide for:

- a structured disciplined military force and the primary objective, which is to defend and protect the Republic, its territorial integrity and its people; and
- the political responsibility and employment of the SANDF.

The Minister of Defence and Military Veterans, as a member of the Cabinet, is responsible for defence. This mandate is given substance by the Defence Act (Act No.42 of 2002), the Defence Review 2015 and delegated legislation. The Minister provides the DOD with strategic direction and sets out priorities to be pursued by the DOD. The execution of these priorities enhances the effective realisation of the Defence mandate.

The DOD comprises of the Defence "Civilian" Secretariat, which is established in terms of Section 204 of the Defence Act and the SANDF established in terms of Section 200(2) of the Constitution. The Constitutional and primary legislative and policy mandates governing the DOD include but are not limited to the:

- Defence Act, 2002 (Act No. 42 of 2002);
- Defence Amendment Act, 2010 (Act No. 22 of 2010);
- White Paper on Defence (1996);
- National Conventional Arms Control Act, 2002 (Act No. 41 of 2002);
- National Strategic Intelligence Act, 1994 (Act No. 39 of 1994); and
- Special Defence Account Act, 1974 (Act No. 6 of 1974).
- International Convention for the Safety of Life at Sea (SOLAS)
- Convention on the International Hydrographic Organization (IHO)
- Hydrographic Act, 2019 (Act No. 35 of 2019)

The Hydrographic Act makes provision for the following:

> To provide for the establishment of the Hydrographic Office within the Department of Defence and Military Veterans under the SA Navy. The South African Navy Hydrographic Office will be the National Hydrographic Office. The Hydrographer is the appointed National Hydrographer for the Republic.

3.12.2.2 SOCIO-ECONOMIC IMPORTANCE

The key significance of South Africa's Navy in terms of the country's and its people's well-being is to enable socio-economic development by ensuring the defence and protection of the maritime-dependent economy and the maritime interests. Guaranteeing peace and stability for a safe operating environment along the coast, the territorial waters and the EEZ, which enables the human use of the maritime zones, the sustainable exploration and exploitation of living and non-living resources it contains, and the sustained provision of the benefits it provides, has immense indirect socio-economic importance.

For example, the Navy, through the South African Navy Hydrographic Office (SANHO), provides professional hydrographic services to the international maritime community by means of hydrographic information and products, essential for safe and efficient navigation and any other seagoing activity that depends on accurate navigation charts and tidal information. This is done in compliance with international hydrographic standards, with South Africa being a member of the International Hydrographic Organisation.[293,294] In addition, the Navy assists with search and rescue operations, and the DFFE with combating illegal, unreported and unregulated (IUU) fishing, thereby supporting the sustainable and fair exploitation of the country's living marine resources.[295]

The SA Navy has around 7,000 employees[296], including highly-trained marines and other combat forces, which supports local communities as well as the private sector.

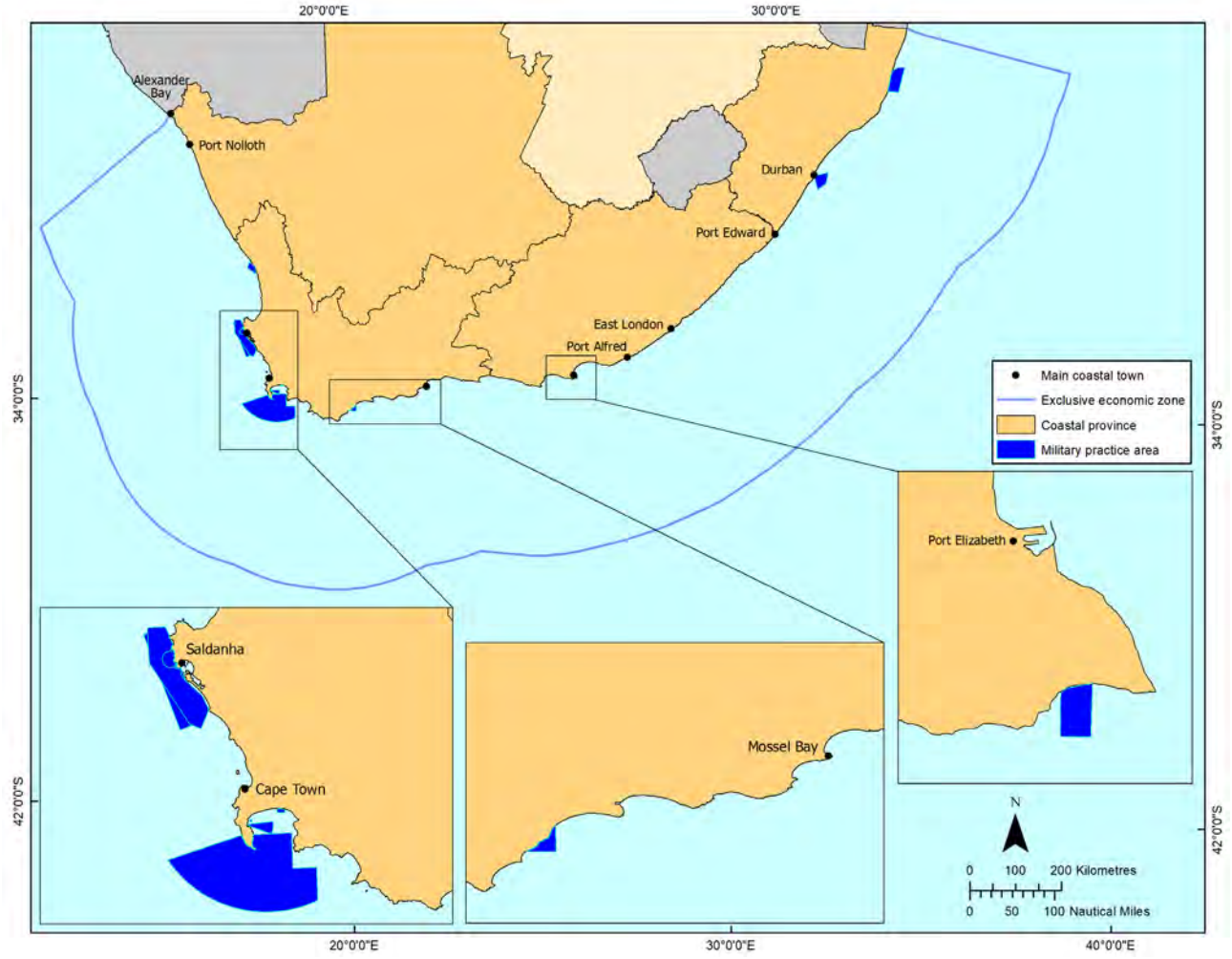
3.12.2.3 KEY SPATIAL INTERESTS

The maritime and spatial interests of South Africa and the SA Navy are derived from the country's unique geographic and geo-political location at the Cape, its economic infrastructure as well as the geo-political aspirations and obligations as a regional maritime power. In principal, the spatial interests of the SA Navy therefore cover all of South Africa's areas of maritime interest that relate to the Navy's roles and require the exercise of control and enforcement of state authority.

Specifically, the Navy has an interest in key maritime transport and trade infrastructure such as the ports, the Republic's territorial waters, and the EEZ. Generally, areas that are important for the various human uses and interests are also of significance to the Navy. These include, but are not limited to, areas essential for ensuring safe passage of ships and goods (i.e. key trade routes and areas of high shipping density), sites of economic interest in terms of the living and non-living marine resources that merit exploitation by the various sectors, and areas of high natural value that require protection to safeguard biodiversity. In addition, the Navy has to ensure sustained patrols in the maritime zones of the Prince Edward Island Group which is the remotest territory of the Republic.

Key areas of strategic interest for the Navy to be able to implement its mission are its naval bases to which the Navy requires unhindered access and in which it needs freedom to operate on the basis of its mandates. The Navy's operational headquarters are at the base in Simon's Town.

In addition, the Navy uses certain areas for military practice:

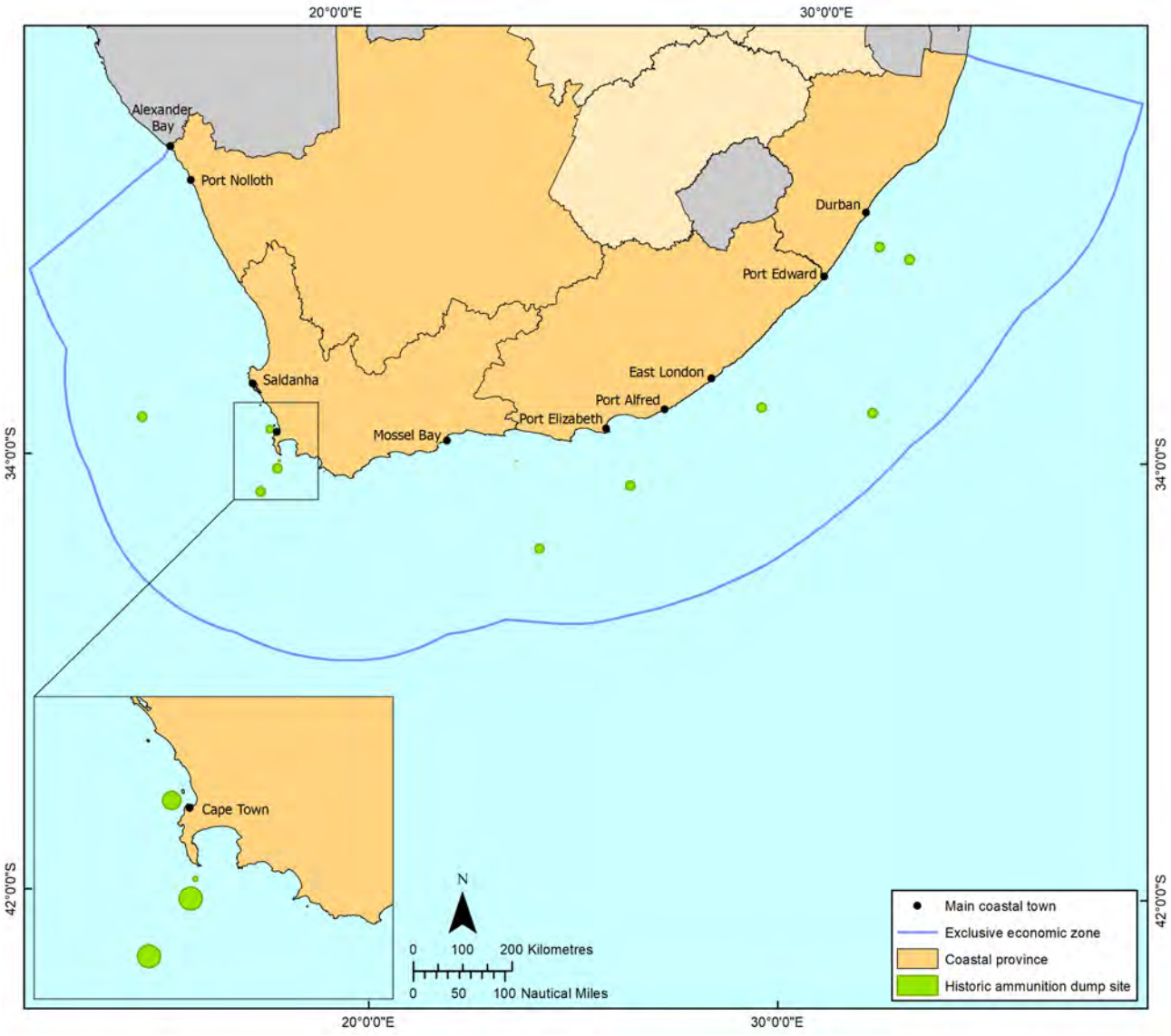


Location of military practice areas.

MAP 65

If practice is planned, notifications to mariners such as navigational warnings are promulgated as to the geographical location of the area that is to be avoided by other users.

Given the history of South Africa and its Navy, there are a number of disused sites where ammunition has been dumped. These sites are no longer used for disposal of ammunition.



Location of historic ammunition dumping sites. MAP 66

The SANHO has a key interest in areas that have not been surveyed to modern standards. This hydrographic priority currently focuses on the area between East London and Durban. In addition, tide gauges are situated at each of the major ports and harbours in South Africa.

3.12.2.4 ENVIRONMENTAL IMPACTS

The SA Navy seeks to minimize the impact of its activities on the marine environment. The Navy's operations could however cause the following environmental impacts:

Possible environmental impacts through naval operations[297]. TABLE 13

PRESSURE THEME	PRESSURE	IMPACT
POLLUTION AND OTHER CHEMICAL PRESSURES	Introduction of non-synthetic substances and compounds	Release of oil and other hazardous substances (from accidental and incidental discharge of cargo or fuel, ammunitions, discharges from port facilities and shipbuilding/ship repair yards) may result in contamination of water and sediments and ecological impacts on wildlife, marine aquaculture and tourism.
	Introduction of radionuclides	Radionuclide contamination
OTHER PHYSICAL PRESSURES	Litter	Ships rarely dispose of fired shell cases at sea due to tight regulations.
	Noise impacts	Noise from ship movements, sonar activity and use of live explosives for practice purposes. Use of live explosives and other exclusive activities may restrict other users which could have an overall positive effect on an area. Noise from practice exercises might negatively impact wildlife, especially marine mammals.
HABITAT CHANGES	Habitat damage, loss and / or abrasion	Infrastructure associated with military activity, such as ports, replaces natural coastline (habitat loss) with man-made structures.
BIOLOGICAL PRESSURES	Microbial Pathogens	Release of sewage introduces pathogens and nutrients into the water, affecting water quality and potentially passing on diseases to humans through contact with contaminated water or consumption of contaminated shellfish.
	Introduction or spread of non-native species	Non-native species may be translocated or spread in ballast water and as fouling organisms on ships' hulls. These may cause habitat modification and competition with native species.

3.12.3 LOOKING TO THE FUTURE

3.12.3.1 STRATEGIC POLICY OBJECTIVES

The geo-strategic position of South Africa and its diverse and rich living and non-living marine resources are primary factors for its growing economy. The key medium to long-term strategic policy objectives of South Africa in relation to defending and protecting its maritime interests are therefore to:[298]

- Continue exercising sovereignty within its territorial waters and ensuring its sovereign rights in its EEZ;
- Enhance South Africa's ability to exercise seapower both in intensity and scope, especially the blue-water naval capability and off-shore territorial control on the open ocean, beyond the reach of littoral forces, shore-based aviation and land-based defence systems;
- Continue securing the right of innocent passage for merchant shipping, and the principle of the freedom of the seas;
- Continue to encounter and support combating direct maritime threats (including maritime piracy and terrorism, armed crimes and illegal activity at sea such as IUU fishing) and indirect threats which include loss of marine biodiversity; and
- Continue performing national and international maritime obligations[299], such as: maritime search and rescue; hydrography; maritime charting; and the naval control of merchant shipping when necessary.

The above includes the enhancement of maritime domain awareness, the extended maritime protection capability, and the hydrographic survey capability of SANHO. In addition, the DOD's 5-Year Strategic Plan (2015-2020) foresees that the Navy spends increased hours at sea as part of achieving these medium to long-term strategic policy objectives.

In order to achieve the strategic objectives, the Navy requires:

- the ability to expand and upgrade its naval bases when needed;
- to use the delineated military practice areas in the sea; and
- cooperative governance and inter-departmental approaches with other maritime stakeholders and organs of state.

3.12.3.2 TRENDS AND DRIVING FORCES

The trend of enhanced utilisation of the oceans with intensifying seaborne trade, and the increasing requirement to protect the marine environment from unlawful and other human-induced impacts places a growing responsibility on the SA Navy. These developments make the Navy's role gradually more significant as the Republic's national maritime interests are closely linked to ensuring a secure and safe ocean space for all users and the country's military forces. This also comes with the need to intensify the Navy's cooperation with other mandated entities to carry out its roles, for example in terms of policing.

Another significant trend is the increasing threat of the illegal movement of people and goods in the maritime domain.

3.12.3.3 SPATIAL CONFLICTS AND SYNERGIES WITH OTHER USES AND INTERESTS

In theory, a conflict may occur in the case of spatial overlap with other use(r)s during Navy practices in the designated areas for military practice.

A possible spatial synergy may exist with environmental protection in the case where other human uses in military practice areas are limited – which may result in positive effects on the marine biodiversity. However, given the environmental impacts that the Navy's operations may cause, a conflict may also be observed with species and habitats of conservation value.

There are also non-spatial synergies which exist: For example, the Navy, and in particular the Hydrographic Office, cooperates closely with the Department of Transport (DOT) and the South African Maritime Safety Authority (SAMSA) to ensure safety of navigation through the provision of nautical charts and the publishing of notices to mariners, prevent and minimize the impacts of possible oil spills, and carry out search and rescue operations. Hydrographic survey data may also be of value to the DFFE and the DMRE by enhancing the understanding of the seafloor and associated features which may be of environmental and economic value. In addition, the Navy supports DAFF in protecting the living marine resources at sea.

3.12.4 KEY ISSUES FOR MSP TO CONSIDER

The SA Navy requires the MSP process to maintain the delineated areas for military practice (during particular times of the year). The Navy also requires flexibility and the continued ability to close areas if and when needed for its operations.

The Navy is furthermore keen to continue and enhance the cooperation with other Departments and stakeholders with the view to serving the Nation and its people through delivering on its mandates.

3.13 SEA AND FRESHWATER ABSTRACTION

3.13.1 BACKGROUND

South Africa is a semi-arid, water stressed country. Rainfall is unevenly distributed throughout the country and coastline with higher rainfall on the East Coast compared to the South Coast with the West Coast harnessing the least rainfall. It is estimated that, based on rising population, economic growth projections, scarcity of resources as well as current use and efficiency levels, South Africa will demand 17% more water than exists by 2030.[300]

The careful monitoring and management of available water resources is critical for the wellbeing of the citizens of the country since South Africa is a water scarce country. Water abstraction is the process of taking or removing water, temporarily or permanently from its natural source for domestic or industrial use. In South Africa, water is abstracted from freshwater sources such as rivers. Increasingly, sea water is also abstracted in South Africa and desalinated due to an increasing demand and – simultaneously – decreasing availability of freshwater.

Reduction of freshwater flow through abstraction has severe consequences for marine biodiversity and resources through impacts on physical habitat, reduced nutrient inputs and alterations to important ecological processes.[91] Abstraction of sea water is not critical but the discharge of the saline brine as a result of desalination is an issue.[301]

3.13.2 THE CURRENT SITUATION

3.13.2.1 LEGAL AND POLICY FRAMEWORK

The management, regulation and control of the abstraction of freshwater falls within the overall responsibility of the Department of Water and Sanitation (DWS). The primary legislation and policy governing freshwater abstraction are the National Water Act (Act No.36 of 1998) and the Water Services Act (Act No. 108 of 1997).

Any abstraction of freshwater from an activity which triggers any of the listing notices in the 2014 Environmental Impact Assessment (EIA) Regulations under the National Environmental Management Act (NEMA) (Act No. 107 of 1998), which provides the overarching framework for integrating environmental management into all development activities, is subject to applicable environmental authorisation.

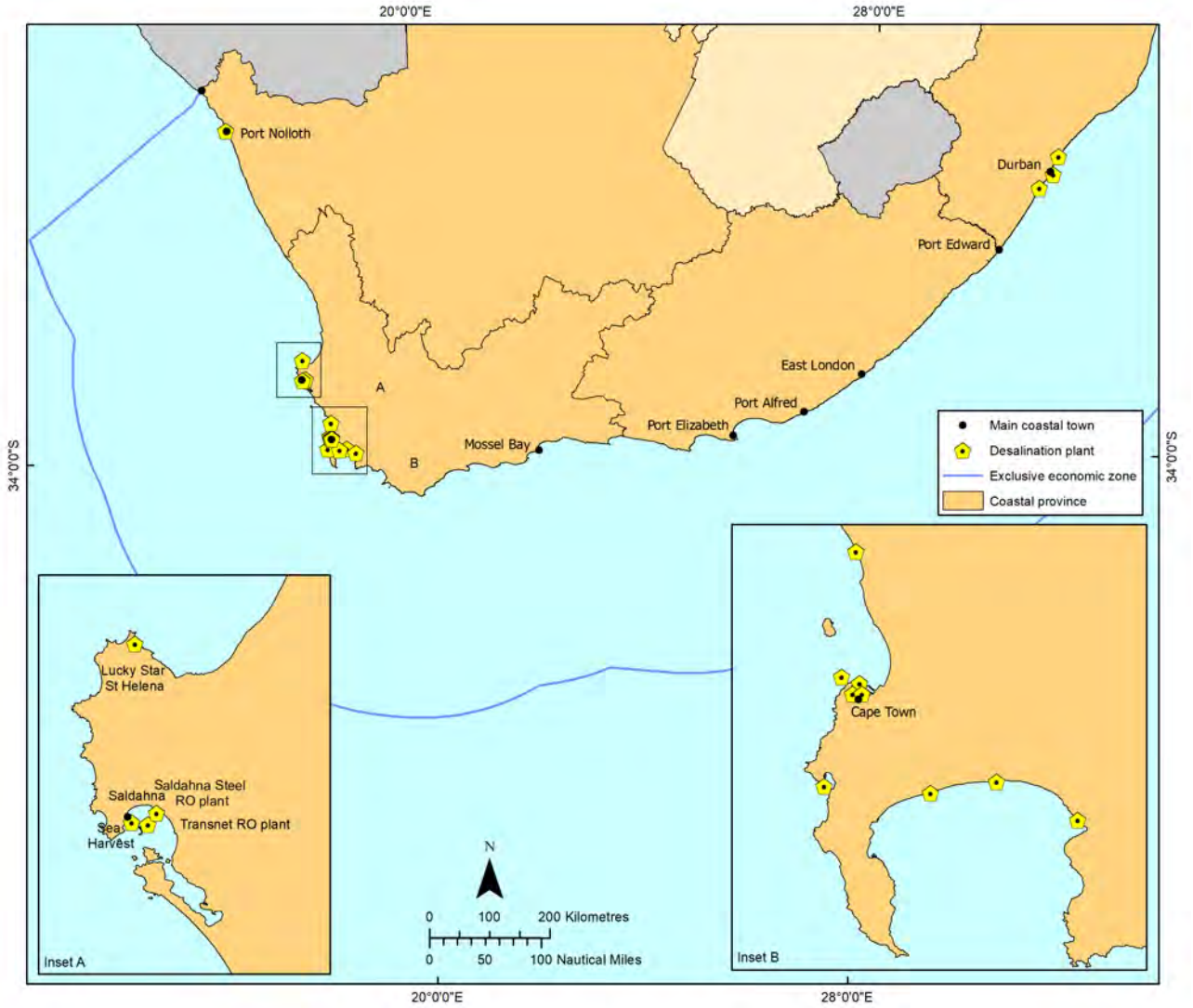
Currently the abstraction of seawater is not regulated in South Africa.

3.13.2.2 SOCIO-ECONOMIC IMPORTANCE

Freshwater availability is a key prerequisite for South Africa's socio-economic development.

Freshwater (including groundwater) flowing into the estuaries and the sea maintains important ecological processes that keep marine resources healthy and maintain linked industries such as fisheries and tourism. Water running out to sea is essential for maintaining a range of coastal and marine ecosystem services.[91] For example, freshwater flow provides nutrients, sediments that form important habitats, and underlies critical ecological processes. These processes include the natural environmental cues needed for spawning, migration and recruitment of key resource species. Freshwater inputs have been shown to affect linefish resources more than 40 km offshore in South Africa. In addition, a certain amount of water is needed to scour the mouth of most estuaries – without this scouring effect, sediments build up at the mouth increasing the risk of back-flooding during storms.

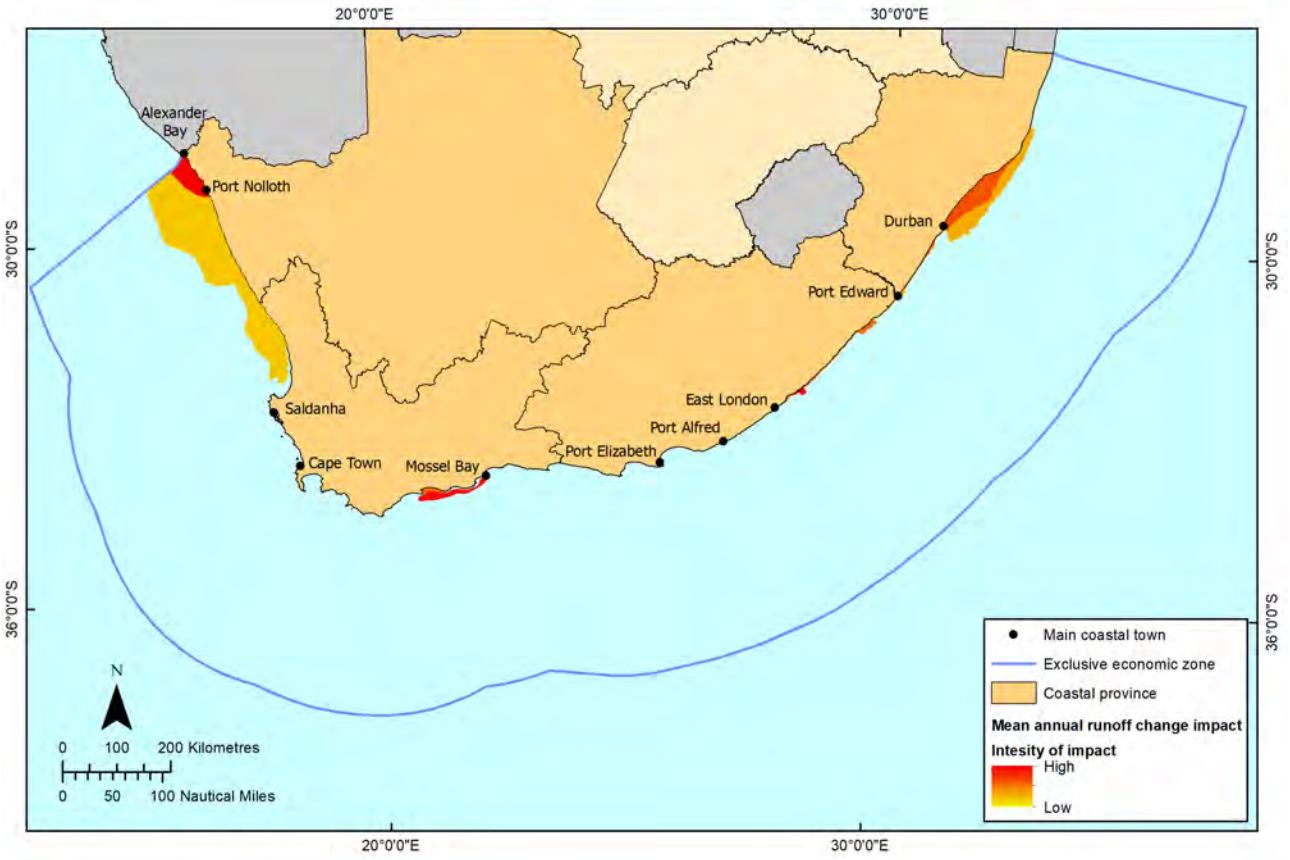
3.13.2.3 SEA WATER ABSTRACTION LOCATIONS



Location of desalination plants in the year 2019. MAP 67

3.13.2.4 (SPATIAL) EXTENT OF FRESHWATER FLOW REDUCTION

In South Africa, reduced river inputs have a significant impact on estuarine, marine and coastal ecosystems around the entire South African coastline although impacts are expected to be more severe in the more oligotrophic marine environment of the East Coast.[302]



MAP 68

Impact of freshwater flow reduction on the marine environment. Map from data in National Biodiversity Assessment 2018[48]. The maps show areas most impacted by reduced inflows of freshwater and sediment due to dams and water abstraction upstream (see Annex for details).

Based on reductions in the 20 largest catchments in South Africa (those that contribute 1% or more of total mean annual runoff in the region), the total freshwater flow to the marine environment has been reduced by more than 11,300 million m^3/ year. The greatest reduction is on the West Coast (approximately 6,900 million m^3/year) but there are significant reductions along both the South (2,900 million m^3/year) and East Coasts (1,500 million m^3/year). The larger river systems that have experienced the greatest flow reduction are expected to have driven the most change in marine ecosystems. These include the Orange River on the west coast, the Thukela and Mzimvubu Rivers in KwaZulu-Natal and the Breë River in the Agulhas Bioregion.

3.13.2.5 ENVIRONMENTAL IMPACTS[91]

Whereas abstraction of sea water for desalination has little to no environmental impacts (discharge of brine has significant impacts though), the reduction of river flow leads to critical impacts on the marine and coastal environment. As such, it leads to a reduced sediment supply to the coast with implications for beach and subtidal habitats. Reduced sediment input can change beach morphodynamic state, altering the beach biodiversity, accelerating beach erosion and can even lead to the loss of beach habitat. In the subtidal environment, riverine inputs provide important sediment inputs for the maintenance of unconsolidated sediment habitats such as mud banks. Reduced river inputs reduce the spatial extent of such habitats, which may have implications for fisheries such as South Africa's sole fisheries. Many of these habitats are also important for ecological processes. For example the endemic and threatened white steenbras *Lithognathus lithognathus* spawns on submarine fluvial fans, a localised habitat of limited extent, associated with mixed mud and sand banks deposited by rivers in the South-East Cape coast. Changes in salinity and water temperature linked to flow alteration also impact thermohaline fronts which affects plankton feeding communities and the fish, birds and mammals that feed on the concentrated food associated with these habitats.

Important processes that can be compromised through altered freshwater flow include nursery functions, environmental cues, productivity and food web processes. Increased frequency of estuary mouth closures and associated conditions due to reduced freshwater flow can also disrupt lifecycles and connectivity and deprive fish and invertebrates of the important nursery function of estuaries. On the South coast, freshwater seepage from dune aquifers constitutes an important source of nitrogen for surf-zone phyoplankton (particularly accumulation-forming diatoms), and researchers caution against the use of groundwater from such aquifers without considering the ecological needs of marine and coastal ecosystems. Sediment delivery is also an important ecological process associated with freshwater input. Sediment provides turbidity and a refuge for fish which is a key component of estuarine, coastal and offshore nursery areas. Reduced turbidity can alter predation pressure and the catchability of fisheries resources. Altered freshwater flow leads to changes in important environmental cues such as those relevant for spawning, recruitment and migration. Changes in spawning intensity have been correlated with altered freshwater flow.

Catchment-derived nutrients are an important component of marine and coastal foodwebs stimulating phytoplankton production. The impacts of reduced nutrient supplies will travel through marine and coastal ecosystems via foodwebs. Reduced detritus may also impact on marine and coastal foodwebs as river-associated detritus and associated epiphytes are believed to be an important food source for microorganisms, filter feeders, detritivorous fish and invertebrates. In KwaZulu-Natal, an isotope study showed that suspended riverine particulate organic matter (terrestrial, aquatic plant material and plankton) plays an important role in supporting inshore filter-feeder communities i.e. intertidal and subtidal assemblages dominated by the sea-squirt known as red bait *Pyura stolonifera*, mussels *Perna perna,* and oysters *Striostrea margaritacea* and *Saccostrea cucullata*. It was found that between 8 and 33% of filter-feeder diets consisted of material introduced to the sea by rivers and concluded that rivers play an important trophic role in promoting filter-feeder biomass in the Natal Bioregion. The links between river, inshore and pelagic ecosystems, highlighting the need for adequate freshwater supplies for the maintenance of the integrity of marine and coastal ecosystems, were also demonstrated.

Changes in freshwater flow and associated variations in turbidity, nutrients and sediment supply can impact fisheries resources, alter catch composition and decrease the economic returns of fisheries. Fisheries resources in South Africa that have or may have been compromised by reduced freshwater input include linefish, prawns, soles and kobs and filter feeding invertebrates such as mussels *Perna perna* and redbait *Pyura stolonifera* in the intertidal and shallow subtidal. Significant relationships between flow and the catches of 14 linefish species (more than 90% of the total catch) on the Thukela Banks in KwaZulu-Natal were identified. Most fish responded negatively with reduced catches correlating with reduced flow (after a lag phase) with slinger *Chrysoblephus puniceus* and squaretail kob *Argyrosomus thorpei* showing a strong relationship to flow alteration.

3.13.3 LOOKING TO THE FUTURE

3.13.3.1 STRATEGIC POLICY OBJECTIVES

It is the government's strategic objective to increase sea water abstraction in order to provide additional freshwater for domestic and industrial use. Given the significant environmental impacts on the marine environment caused by freshwater flow reduction and the associated impacts on industries that depend on marine and coastal ecosystem services, it is the government's strategic objective to prevent or minimise the environmental impacts of freshwater abstraction on marine and coastal ecosystems as much as possible. The needs of coastal and marine ecosystems (water quantity, water quality & sediment) are taken into account in determining and implementing ecological water requirements for estuaries.

3.13.3.2 TRENDS AND DRIVING FORCES

The number of seawater abstraction sites has increased over the past few decades due to economic and coastal population growth and is set to expand further given an increasing demand and – simultaneously – decreasing availability of freshwater caused by climate change induced changing patterns in rainfall, especially in the Western Cape.

This trend of an increasing reduction in freshwater flow in South Africa's catchment areas and major riverine systems is a key contributing factor that leads to the described environmental impacts as reflected in the marine environmental status determined by the National Biodiversity Assessments in 2011 and 2018.[91]

3.13.3.3 SPATIAL CONFLICTS AND SYNERGIES WITH OTHER USES AND INTERESTS

Spatial conflicts between freshwater abstraction exist with the interest of environmental protection, marine aquaculture, fisheries and tourism on the basis of the environmental impacts of freshwater flow reduction into the marine environment.

Spatial conflicts could increasingly occur between seawater abstraction and other uses such as tourism, marine aquaculture, environmental protection or fisheries due to the associated brine effluent into the sea but not on the basis of the abstraction itself.

No synergies appear to exist with other uses and interests.

3.13.4 KEY ISSUES FOR MSP TO CONSIDER

Sufficient freshwater flow to the coastal and marine environment needs to be ensured through aligning MSP with coastal planning and management in an integrated way as part of a coherent management framework that bridges the land-sea interface. This requires that the interest of environmental protection and other uses in the marine environment, which depend on a healthy marine and coastal ecosystem, with sufficient freshwater input, must articulate the needs of coastal and marine ecosystems (water quantity, water quality & sediment) as part of the MSP process so that coastal planning processes can integrate such ecological water requirements for estuaries.

When selecting new seawater abstraction sites in the future, special attention should paid to avoid conflicts with other uses and the interest of environmental protection and other uses which require good water quality and environmental status (particularly marine aquaculture, fisheries and tourism).

3.14 WASTEWATER DISCHARGE

3.14.1 BACKGROUND

Wastewater is water which is no longer needed and which has been generated and adversely modified in terms of quality through human influence after its domestic or industrial use. It is generally a mixture of domestic wastewater from baths, sinks, washing machines and toilets, and wastewater from industry. It will often also contain rainwater run-off from roofs and other impermeable surfaces which often contains oil residues comprising heavy metals, pathogenic microorganisms as well as litter. Wastewater discharge means the disposal of wastewater effluent to the environment.

In South Africa, like in many other countries, the disposal of wastewater originating on land into the marine environment is common and a recognized wastewater management measure. There are statutory requirements that apply to wastewater treatment and disposal with health and environmental quality standards.

Wastewater is discharged on land into riverine freshwater habitats which carry the effluent downstream into the estuarine and marine environment. Wastewater is also discharged directly into estuaries or the marine environment, either inshore (in the so called surf zone, typically at a depth of less than 5m) or further offshore (typically at depths greater than 5m) in so called marine outfalls.

Good water quality is a critical prerequisite for a healthy marine environment. Wastewater treatment is designed to process wastewater whilst protecting the environment and maintaining public health. The proper treatment and well-regulated discharge of wastewater is an important supporting function for some marine industries, particularly fishing, marine aquaculture, and tourism. To prevent environmental damage and poor water quality, the South African government provides and is committed to improving adequate wastewater infrastructure.

There are four types of treatment undertaken at wastewater treatment plants:

- Preliminary treatment is the first stage of the process and involves the removal of coarse solids and large materials.
- Primary treatment is a physical and/or chemical process involving settlement of suspended solids.
- Secondary treatment is a process generally involving biological treatment either with secondary settlement or another process. Secondary treatment is designed to reduce the suspended solids and oxygen demand. It also reduces the bacterial content of sewage.
- Tertiary treatment is the final stage of the process and can include filtration, removal of nutrients such as phosphorous and nitrogen, and disinfection, for example by UV light.

Due to the significant growth in both coastal populations over the past decades and the country's economic development, wastewater has been discharged increasingly throughout South Africa into the marine environment and is likely to continue to grow with an expanding economy.

3.14.2 THE CURRENT SITUATION

3.14.2.1 LEGAL AND POLICY FRAMEWORK

The management, regulation and control of the disposal of land-derived wastewater into the marine environment in South Africa fall within the overall responsibility of the Department of Environmental Affairs (DEA). The primary legislation and policy governing wastewater discharge into the marine environment is the Integrated Coastal Management Act (Act No. 24 of 2008). The promulgation of the ICMA shifted the management of discharge of effluent into coastal waters from the Department of Water and Sanitation (DWS) to the DEA. For estuaries, the DEA retains joint operational responsibility of the management of effluent disposal with the DWS.

Any discharge of land-based effluent into the marine environment from an activity which triggers any of the listing notices in the 2014 Environmental Impact Assessment (EIA) Regulations under the National Environmental Management Act (NEMA) (Act No. 107 of 1998), which provides the overarching framework for integrating environmental management into all development activities, is subject to applicable environmental authorisation. The 2014 National Guideline for the Discharge of Effluent from Land-based Sources into the Coastal Environment provides the framework in terms of the NEM: Integrated Coastal Management Act (ICMA), 2008, as amended in 2014, for assessment of such discharges to the marine environment.

Consultation with the DWS is required in the case of authorising effluent discharge into an estuary. The DWS establishes wastewater quality standards and requirements that have to be complied with, amongst others, when discharging land-based effluent into estuaries.

The National Estuarine Management Protocol (2013) under the framework of the ICMA provides for the management of national estuaries through the development and implementation of individual Estuarine Management Plans (EMPs).

3.14.2.2 SOCIO-ECONOMIC IMPORTANCE

Good water quality and a healthy marine environment are prerequisites for socio-economic development. Appropriate collection, treatment and discharge of wastewater help to protect and improve water quality in rivers and the marine environment. Treatment allows water to be returned to the environment, helping to maintain river flows, which is important for other uses such as downstream abstraction, fisheries, marine aquaculture and coastal tourism.

3.14.2.3 WASTEWATER DISCHARGE LOCATIONS

In 2014, approximately 126 outfalls discharging wastewater in the marine environment of South Africa.[303]

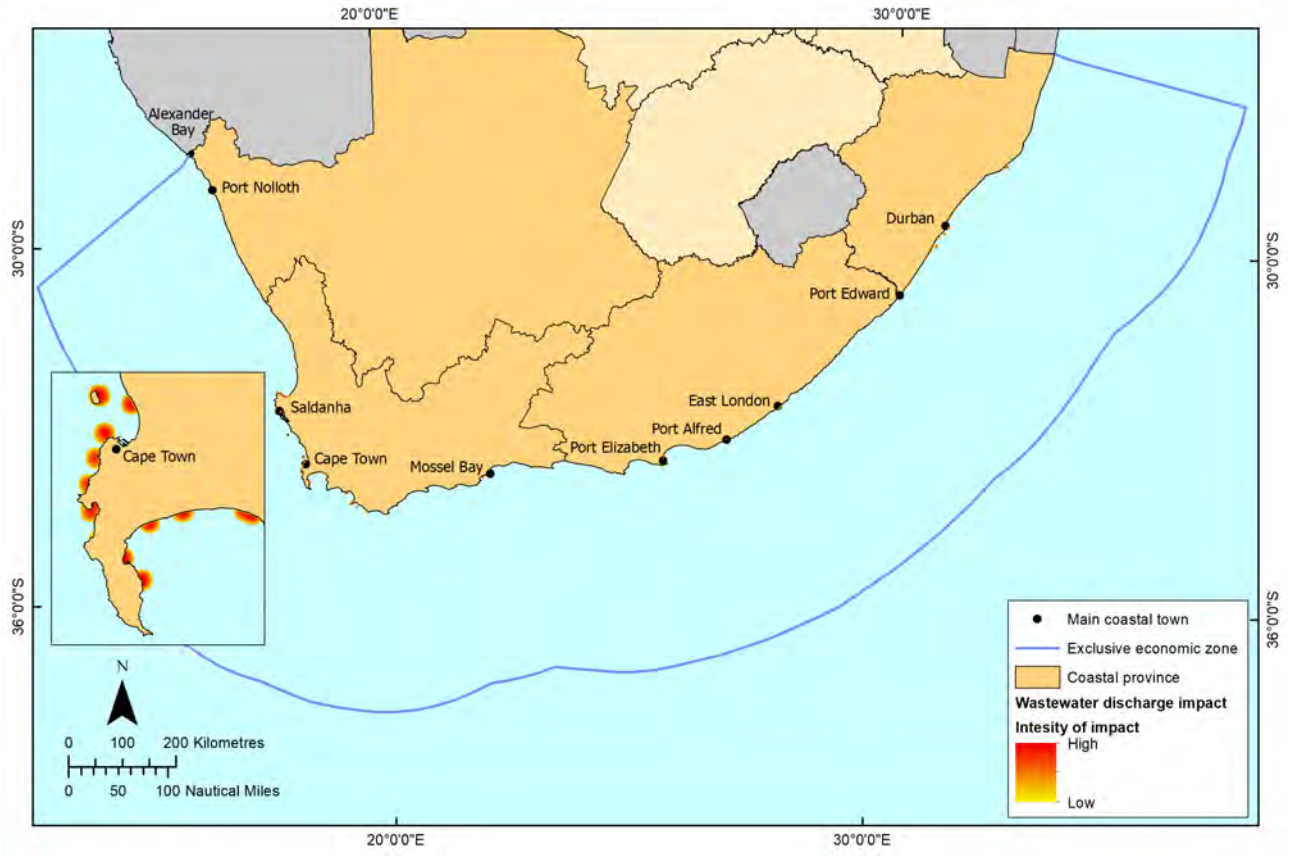
Location of wastewater discharge outfalls. MAP 69

Of the 126 outfalls discharging wastewater into the marine environment, the largest proportion is in the Western Cape (64%), followed by KwaZulu-Natal (17%), the Eastern Cape (13%) and lastly, the Northern Cape (6%) (see Table 14).

Distribution of effluent discharge locations per coastal province. TABLE 14

PROVINCE	NUMBER	PERCENTAGE
NORTHERN CAPE	7	6%
WESTERN CAPE	81	64%
EASTERN CAPE	17	13%
KWA-ZULU NATAL	21	17%

The greatest proportion of the identified wastewater discharge locations, 67 (59%), discharge inshore into the surf zone, with considerably fewer points of discharge into estuaries and offshore (21 and 24) respectively.



MAP 70

Impact of wastewater discharge on the marine environment; this is widespread over a very narrow section of the coast and as such is not visible here without zooming in. Please refer to OCIMS for a scalable version of the map. Map from data in National Biodiversity Assessment 2018[48]. The maps show areas in close proximity to know wastewater outfalls (see Annex for details).

3.14.2.4 ENVIRONMENTAL IMPACTS

Disposal of land-derived wastewater has a significant potential to impact the marine environment. The degree of the impact however depends significantly on the type of wastewater treatment and thereby the quality of effluent discharged, the quantity disposed, and the location of the outfalls which determines the assimilative capacity and sensitivity of the receiving marine environment. Typically, the environmental impacts are:[304]

- Marine pollution including reduced water and sediment quality. This can lead to possible mortality of organisms from organic, metal and radioactive contaminants, especially from industrial discharges.
- Risk of eutrophication through addition of nutrients (e.g. nitrogen, phosphates and derivatives). This can possibly lead to changes in the species composition of phytoplankton communities, toxin producing and harmful algal blooms. Submerged vegetation could be lost through shading, development of hypoxic conditions due to decomposition of excess plant biomass, changes in benthic community structure due to hypoxia or toxic algae, and fatalities of fauna due to oxygen deficiencies caused by the addition of organic matter.
- Litter in wastewater may harm wildlife through ingestion or entanglement.
- Addition of faecal material may lead to pathogens (bacteria, viruses or parasites) causing illness/infection if ingested through recreational water use or consumption of marine aquaculture products (e.g. shellfish).

3.14.3 LOOKING TO THE FUTURE

3.14.3.1 STRATEGIC POLICY OBJECTIVES

It is the government's strategic objective to either prevent or minimise the production of wastewater and to ensure responsible treatment and disposal with as little environmental impact as possible. Maintaining and improving the functionality of the wastewater treatment infrastructure and the meeting of prescribed standards as well as an adequately designed and maintained pipeline network and pumping system is a core policy objective.

3.14.3.2 TRENDS AND DRIVING FORCES

The number of wastewater discharges to the marine environment has increased rapidly over the past few decades due to economic and coastal population growth. In 1984 there were a total of 61 known outfalls discharging into coastal waters. By 2004 the known outfalls had increased to a total of 67 known outfalls. From 2004 to 2014, the number of wastewater discharge outfalls into the marine environment has approximately doubled to 126. This number is likely to increase in the short to mid-term future due to – for example – the need for more desalination plants to encounter the increasing scarcity of freshwater caused by climate change induced changing patterns in rainfall, especially in the Western Cape.

To a large extent, wastewater treatment facilities and procedures are not meeting the prescribed standards: Up to 30% of all large wastewater treatment facilities are in critical condition, discharging increasing quantities of untreated or inadequately treated wastewater into the riverine and marine environments.[305] This trend of a decreasing state of the wastewater treatment infrastructure in South Africa is one of the largest contributing factors that leads to the described environmental impacts as reflected in the marine environmental status determined by the National Biodiversity Assessments in 2011 and 2018.[306]

3.14.3.3 SPATIAL CONFLICTS AND SYNERGIES WITH OTHER USES AND INTERESTS

Spatial conflicts exist with the interest of environmental protection, marine aquaculture, fisheries and tourism on the basis of the impacts of wastewater discharge into the marine environment.

No synergies appear to exist with other uses and interests.

3.14.4 KEY ISSUES FOR MSP TO CONSIDER

The existing network of wastewater treatment infrastructure and associated pipeline and pumping system needs to be maintained, upgraded and expanded to meet the increasing demands caused by economic and coastal population growth as well as effects of climate change. When selecting new sea outfalls for the discharge of wastewater (including brine effluent from desalination plants) in the future, special attention should paid to avoid conflicts with other uses and the interest of environmental protection and other uses which require good water quality and environmental status (particularly marine aquaculture, fisheries and tourism).

4 ANALYSIS

The previous chapters in this report have described the context in which the maritime economy is developing, as well as the various interests that currently exist relating to the sea. These interests have largely been described separately. The intention of this analytical chapter is to provide planners and stakeholders with some general insights on how sectors are using maritime space, which areas might be of particular importance to sectors and why, and the potential for spatial conflict and synergy between different maritime activities. It thus seeks to derive a more holistic overview that sets out the links between the various interests and the environment. The analysis draws on the previous chapters whose information was provided by the respective sector departments, including the current state of knowledge on the state of the marine and coastal environment.

The analysis refers to South Africa's marine environment as a whole, as well as sectors generally. It is therefore necessarily general and only indicative of the topics that will need to be considered in more detail in each of South Africa's four marine area plans.

4.1 KEY ELEMENTS FOR THE ANALYSIS FOR MARINE PLANNING

Detailed understanding of how the various sectors are using the marine environment is an essential foundation for marine planning. Rather than a broad-brush picture of the sectors, planners must develop a solid understanding of the activities each sector is engaged in, and in which parts of the sea these are taking place. The more detailed the understanding of these activities, the better the understanding of the SPATIAL NEEDS of each sector (understood here to mean what type of space is needed and where that space is located). Understanding spatial needs encompasses:

- Understanding the various ways in which the ocean can be used across its four dimensions (five if the temporal dimension is included),
- Understanding the various specific activities that make up each sector,
- Understanding the spatial dimensions of these activities, in particular also the land-sea interactions they entail.

SPATIAL CLAIMS are different from spatial needs in that they also entail an aspirational element. They can be understood both from the perspective of spatial needs – for instance, which spaces are particularly suitable or necessary for activities and therefore priority claims – but also from the perspective of socio-economic driving forces and sectoral development trends. They therefore also look towards the future and potential spatial needs in the mid- and long term.

Another important part of the analysis is to understand how the various sectors and their activities INTERACT WITH THE ENVIRONMENT, and what environmental impacts they may have at what point in time and at which scale. Some of this understanding is already available from South Africa's work on marine biodiversity and the associated pressure maps. Understanding pressures together with interactions of activities can be an indication of which marine areas are hotspots in terms of requiring management, although marine spatial plans are not the only means for mitigating such pressures. Examples of spatial management include siting certain activities away from biodiversity hotspots or from sensitive or vulnerable marine habitats.

Last not least, it is important to understand how the various sectors **INTERACT WITH EACH OTHER**. A useful starting point is a conflict and synergy matrix that highlights how sectors relate to each other in principle and which uses are spatially compatible with each other. Combining this with sectoral trends and driving forces, environmental sensitivities as well as existing hotspots of activity, it is possible to derive a first indication of where the strongest conflict potential may lie and which issues might need particular consideration in the detailed area plans.

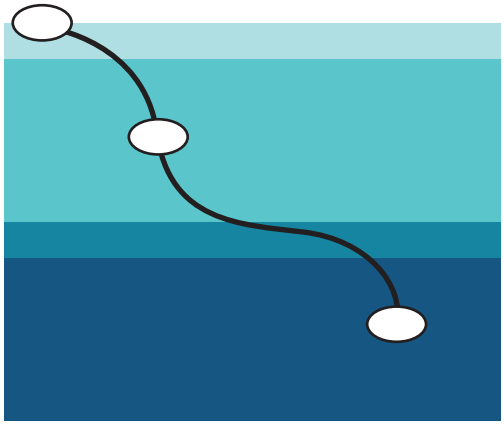
The following sections consider each of these aspects in turn before suggesting next steps in South Africa's MSP process.

4.2 SUMMARY OF SPATIAL NEEDS IN SOUTH AFRICA'S OCEANS

(1) SECTORS USE THE OCEAN'S FOUR DIMENSIONS IN DIFFERENT WAYS

It is evident that South Africa's maritime sectors make use of the marine environment in different ways. The first and most obvious consideration is **WHERE IN THE OCEAN** the various activities are taking place. While some activities, such as fisheries, use the **WATER COLUMN** or **SEA FLOOR** for extracting their resource, others are merely using the **SEA SURFACE AS A MEDIUM** for their activity (such as shipping). Still others (such as mining) are extracting resources from **BELOW THE SEA BED.** To some degree, even the airspace a bove the ocean can become a relevant consideration, e.g. in the case of military installations on the coast that require clear approaches by air; this would prohibit any large-scale installations close to the coast for example. Given the diversity of current uses it is fair to say that all the ocean's four dimensions are equally busy. This emphasises the multi-dimensional nature of ocean use and the need for MSP to account for activities taking place across a total of five dimensions: at different times, and possibly with different intensities at times, on the sea surface, in the water column, on the sea floor, and below the sea floor.

(2) USES OF THE MARINE ENVIRONMENT IS NEVER ONE-DIMENSIONAL



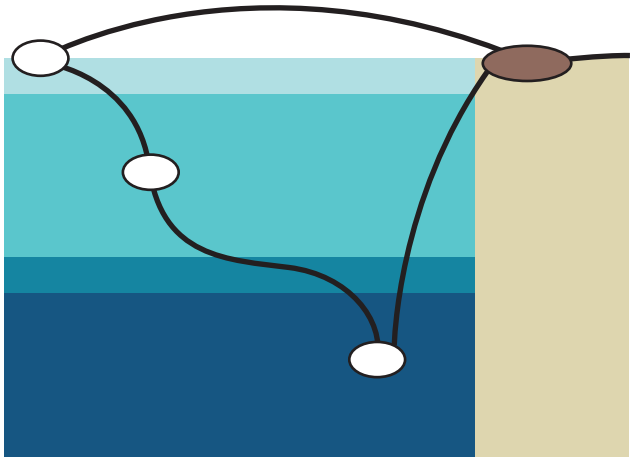
While the above is useful as an initial consideration for planning, it is also obvious that "sectoral use" is too general a category for considering the spatial needs of uses. It is helpful to **THINK OF EACH USE AS A SERIES OF DIFFERENT ACTIVITIES**, each of which has different requirements of ocean space. Pelagic fishing, for example, makes use of the water column to extract the resource, but fishing boats also require space on the sea surface to travel to suitable fishing grounds. Oil and gas extraction makes use of resources below the sea floor, but the attendant infrastructure (platforms, pipelines) requires space on the sea floor, in the water column and on the sea surface. Defence is another sector that is multi-dimensional in its ocean use because it is composed of many different activities (e.g. submarine, sea surface, air space). This picture becomes even more diverse when differentiating between the operational phase of an activity or its initial set-up, such as the installation of an oil and gas platform or aquaculture cages or even small-scale operations such as a shark diving business. When considering the spatial needs of the various sectors, it is therefore important to understand the full range of activities involved in each use.

A breakdown of uses into activities to obtain a more detailed overview of how sectors use the marine environment: The example of oil and gas (operational phase).

TABLE 4-1

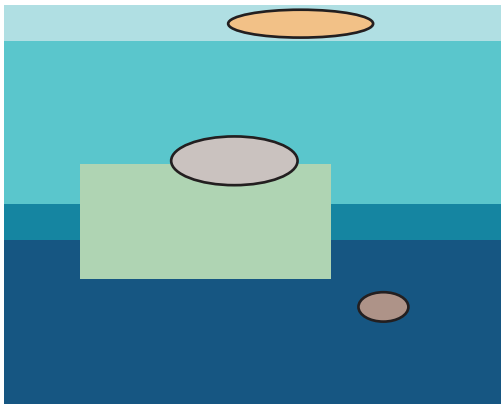
	ACTIVITY
SEA SURFACE	Oil and gas platforms represent stationary infrastructure that in turn require safety zones. Ships are required to maintain this infrastructure and transport crew.
WATER COLUMN	Oil and gas platforms represent stationary infrastructure in the water column where there is a possibility of artificial reef formation.
SEA FLOOR	Pipelines may be required to transport oil to the mainland or to nearby ships. Safety zones are required to prevent damage to pipelines e.g. from anchoring.
BELOW THE SEA FLOOR	Drilling / extraction is taking place below the sea floor.

(3) LAND-SEA CONNECTIONS ARE AN IMPORTANT CONSIDERATION



The sector descriptions make clear that consideration of spatial needs cannot be restricted to the sea. In order to obtain a full picture of a sector's needs, land-sea interactions must come into play. Obviously, all sectors have landward connections, but in some cases they translate into considerable spatial requirements on the shore and beyond. In extreme cases, landward connections may make the difference between a profitable and an unprofitable industry. Extractive industries, for example, often require space in ports in order to land their goods; storage, processing and transport are added considerations. If such prerequisites are not given, industries may not be able to operate successfully, or choose to relocate to places with better facilities. Industries such as tourism and recreation require access to the shore and smaller marinas; the same applies to artisanal fishing. This emphasises the **INTIMATE CONNECTIONS BETWEEN LAND AND SEA** and therefore, the need to link **MSP TO LAND USE PLANNING**, meaning that MSP planners need to think beyond suitable areas in the sea.

(4) THE IMPORTANCE OF LOCATIONAL QUALITIES



The sector descriptions highlight that uses cannot simply take place anywhere in the ocean. In most cases, **ACTIVITIES DEPEND ON PARTICULAR QUALITIES OF MARINE SPACE. EACH SECTOR HAS DIFFERENT CONSTRAINTS AND NEEDS**, and there are different severities and also drivers of constraints.

The most obvious constraint is the **DISTRIBUTION OF RESOURCES** in the marine environment. Geological resource extraction, for example, can only take place in locations with geological resource deposits. Area-based conservation only makes sense in places that meet certain criteria such as high levels of biodiversity or the presence of vulnerable species. While some of these requirements can be easily delineated around "immovable" resources, in other cases it is difficult to precisely locate and delineate the spatial needs of a sector as there may be a need to respond to the variability of the natural environment (e.g. fishing).

Moreover, there are **QUALITATIVE DIFFERENCES** in what the various activities require from the sea in "their" sea space. Shipping, for example, only requires space in the sense of uninhibited access routes to ports and does not depend on ecological status or quality of the marine environment. Fishing and marine aquaculture, on the other hand, strongly depend on good environmental status for their continued existence. Recreation and tourism also rely on a quality of the marine environment, benefitting from clean water and the presence of certain attractive species such as dolphins, whales, or birds. Hence, while it is important for MSP to allocate sufficient space to the various sectors, it is also important to **CONSIDER THE QUALITY OF THAT SPACE AND HOW TO MAINTAIN THAT QUALITY** so that the activities that take place there can continue to thrive. Here, MSP requires the support of other marine policies, such as those dedicated to water quality or environmental protection.

Locational factors not only refer to the resource per se. Understanding the spatial needs of uses also means **CONSIDERING ACCESS** (e.g. the ability of fishing vessels to reach important fishing grounds), **OR ECONOMIC AND PRACTICAL FACTORS** (e.g. distance from the coast, proximity to landing facilities). The best location in terms of environmental or resource qualities is of limited use to a sector if access is too complicated or expensive.

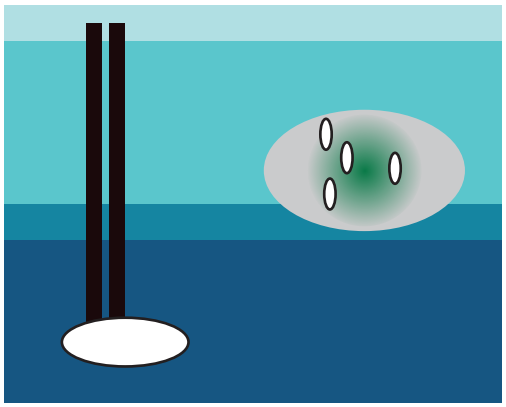
(5) FLEXIBILITY OF SEA USE AS A KEY CONSIDERATION FOR MSP

All of the above ultimately translate into different degrees of flexibility of sea use which is a key consideration for marine spatial planning in terms of spatial needs and claims. The spatial flexibility of maritime sectors is dependent on the distribution of the resource, the type of activity the sector engages in, and the requirements with respect to environmental quality. Added factors that influence the spatial flexibility of a sector include:

- Whether it is extractive or non-extractive,
- Whether there is some degree of flexibility with respect to resource use,
- Whether there is some degree of economic flexibility,
- Whether the sector requires permanent infrastructure in the sea.

NON-EXTRACTIVE SECTORS such as recreation or transport **TEND TO BE MORE FLEXIBLE** from a resource point of view as it may not matter exactly where in the sea they take place. The key constraining factors for tourism and recreation are environmental quality (e.g. water quality for recreation and tourism), distance from and access to the shore, as well as unimpeded shipping routes (for transport).

If a resource is **SCARCE OR PARTICULARLY VALUABLE**, uses will be **MORE STRONGLY CONSTRAINED BY THE LOCATIONS** where it is available; they are also more likely to claim priority access to that location. This is the case for oil and gas and other geological resources but also fisheries. The less resource flexibility there is, and the greater the surrounding constraints, the stronger the attendant spatial claim. In case of competing demands, this may mean less preparedness on the part of the sector to compromise. The degree of flexibility, as well as context-related factors such as the economic pressure a sector is under – therefore also influences the MSP process in the sense that conflicts between sectors can be more or less anticipated.



Another aspect that influences the spatial flexibility of a sector is what is required to extract the resource. While some sectors are mobile and even need considerable spatial flexibility to access their resources, others are reliant on relatively **PERMANENT INFRASTRUCTURE** placed in the sea in order to get to the resource. Fishing is a prime example of the former, while oil and gas extraction is an example of the latter. Shipping is a sector that requires some flexibility (e.g. to deviate from a route for weather reasons) but also a degree of permanence in terms of accessible and efficient shipping routes to allow the sector to minimise costs. Extractive uses that require relatively permanent infrastructure are likely to plan for the long term and, once in place, will not be able to easily move their operations to other areas. Especially large-scale and expensive infrastructure will therefore exist in that location for some time, and the sector will want to ensure its infrastructure is kept safe from damage by other activities. Uses that do not require permanent infrastructure are more flexible to some degree but are still bound by considerations such as access to resources or economic considerations.

Below is a simple classification that cross-compares the nature of activities (extractive and non-extractive), the required infrastructure and the degree of spatial flexibility across the dimensions in the sea where the use is mainly taking place. The examples depicted are shipping and oil and gas.

A simple classification of the spatial needs of shipping. TABLE 15

	EXTRACTIVE	NON-EXTRACTIVE	PERMANENT INFRASTRUCTURE	SPATIAL FLEXIBILITY
SEA SURFACE		✓	Some (buoys/markers)	Some
WATER COLUMN		✓	No	
SEA FLOOR		✓	No but anchoring	Some
BELOW THE SEA FLOOR			No	

A simple classification of the spatial needs of oil and gas extraction. TABLE 16

	EXTRACTIVE	NON-EXTRACTIVE	PERMANENT INFRASTRUCTURE	SPATIAL FLEXIBILITY
SEA SURFACE			✓	No
WATER COLUMN			✓	No
SEA FLOOR	✓		✓	No
BELOW THE SEA FLOOR	✓			No

4.3 SUMMARY OF LIKELY SPATIAL CLAIMS IN THE NEAR FUTURE

As stated in the introductory section, spatial claims are different from spatial needs in that claims are ultimately based on the interests and aspirations of the sectors. Planners need to understand the spatial needs of each sector so that space can be allocated mindful of the constraints and flexibility of each sector. At the same time, planners also need to understand the spatial claims of each sector in order to understand the spatial requirements the sector will have. Understanding spatial requirements ultimately leads to a better understanding of where a sector may be able to compromise and what space in the sea is a "must". In order to understand sector claims, key trends in each sector and their socio-economic driving forces need to be understood. For example, how likely is it that the sector will grow in future, how likely are investments in what type of activity or infrastructure? What are the preferred locations for such investment? What spatial requirements in the sea and on land might this lead to? Is it likely that new technologies will become available, and how might this affect the sector's spatial requirements? Below is a summary of key trends drawn from the sector chapters.

(1) MAIN GROWTH SECTORS

The most prominent overall driving force in South Africa is **OPERATION PHAKISA AND THE NATIONAL PUSH FOR ECONOMIC GROWTH**. The expansion of all maritime sectors is politically desired, and direct and indirect job creation in the blue sectors is a declared policy goal in South Africa's agenda for blue growth. Fisheries, marine aquaculture, marine and coastal tourism, geological resource exploitation (oil and gas, diamonds) and maritime transport (shipping and ports) are likely to remain the strongest maritime sectors in the near future in terms of direct interest in the marine environment and are seen to have the greatest potential for generating socio-economic impact.

(2) WHAT DEMANDS ARE LIKELY TO BE PLACED ON MARINE SPACE IN THE NEAR FUTURE?

Future economic success of South Africa's key blue sectors could lead to two types of spatial claims:

- Claims to larger parts of the ocean to enable the sectors to accommodate growth by spatial expansion (e.g. aquaculture),
- More intense use of existing space (e.g. mining, transport).

Fisheries: Access to large parts of the ocean with possible focus on productive fishing grounds

The fisheries sector is crucial for the livelihoods of many South Africans. All fisheries are STRONGLY DEPENDENT ON ENVIRONMENTAL CONDITIONS and the sustainable management of fish stocks, implying that the constraining factor is the availability and distribution of the resource itself. The fisheries sector has traditionally fished everywhere (in line with sectoral regulations), and will likely wish to maintain its existing flexible access to large parts of the ocean. Nevertheless, areas that are known to be productive fishing grounds may draw specific attention and could be claimed as areas particularly important to the sector. Other spatial claims put forward by the sector may include areas known to be spawning and nursery grounds; here it may be necessary to restrict activities (including fishing) in order to preserve future stocks.

When it comes to spatial claims it is important to differentiate between different types of fishing. SMALL-SCALE ARTISANAL OR SUBSISTENCE FISHING must be given attention as it is crucial for many coastal communities. It is essential for small-scale fishers to reach their fishing grounds; given the smaller size of most boats spatial claims are therefore likely to be situated close to the coast.

Marine aquaculture: Additional spatial claims are likely

Out of the four key maritime sectors, MARINE AQUACULTURE is the one with the most IMMEDIATE GROWTH POTENTIAL, although this depends on the availability of suitable technology and investment. In order to accommodate the planned growth in this sector, ocean space will definitely be required; that same space will also be used intensively from an environmental point of view. Spaces suitable for marine aquaculture are constrained by environmental conditions (e.g. sheltered bays, clean water) but also by the proximity of sensitive and valuable habitats that may be negatively affected by pollution resulting from aquaculture. Aquaculture sites are likely to be close to the coast for ease of operation and service, although the precise locational requirements depend on the type of aquaculture (e.g. closed or open systems, cages or not) and the species cultivated. As a relative newcomer, marine aquaculture is likely to be contentious in some locations if it conflicts with other more established uses including tourism.

Marine and coastal tourism: More intense use of coastal waters

Tourism is a sector that is STRONGLY DEPENDENT ON GLOBAL TRENDS, although there is also growing domestic demand for coastal tourism and recreation. Nature-based tourism is South Africa's fastest growing industry, with many tourists spending time on the coast in order to enjoy marine and coastal wildlife. Poorly planned tourism development is a threat to the marine environment and the tourism sector itself; in turn, tourism – and the image of South Africa as a desirable nature-based tourism destination - could be threatened by a loss of environmental quality.

Most tourism and recreational uses take place on or IN CLOSE PROXIMITY TO THE COAST. Increasing demand is likely to result in more intensive recreational use in key tourist areas, including demands for more coastal infrastructure (e.g. marinas, slipways etc.). There may also be some demand for spatial expansion, e.g. to open up new tourism experiences or recreational facilities. Coastal waters therefore require attention in terms of tourism hotspots and possibilities for expanding facilities, with hotspots likely to develop around established destinations and known attractions.

Mining: Potentially more intense use of existing spaces and exploration of new spaces

Mining is a sector whose GROWTH IS STRONGLY DEPENDENT ON GLOBAL MARKETS. Investment decisions depend on commodity prices, so even when access to a resource has been secured, this does not mean that exploitation will necessarily follow right away. Ultimately, economic policies and MSP can only provide a framework designed to facilitate investment decisions, but whether this decision is taken is entirely dependent on whether it makes economic sense to exploit a resource at a particular time.

Nonetheless, exploitation is already ongoing for various resources, and licences have been awarded for large parts of South Africa's ocean space. Use of spaces could thus intensify, and new areas could be claimed in response to the discovery of new resources.

Mining is a diverse sector encompassing oil and gas exploitation as well as other geological resources (e.g. diamond mining), and a sector where environmental impacts cannot be avoided. It is also a sector where the potential for co-location is limited as a result of safety requirements and the need to exclude other uses from active mining areas. Careful management is therefore required in particular of environmental impacts, especially in the vicinity of known biodiversity hotspots or vulnerable areas.

Maritime transport: More intense use of ocean space

Maritime transport is a growth sector both in terms of the number of vessels and the size of ships. This has impacts in terms of the density of vessels (with attendant impacts on the safety and security of shipping), as well as port infrastructure where expansion is likely required to accommodate more and larger ships as well as their cargo. Like fishing, marine transport is also not restricted spatially, as vessels traditionally have an unlimited right of passage, except for areas where regulations such as traffic separation schemes apply. In practice, vessels are constrained by safety issues resulting from environmental conditions, as well as economics which demand they take the shortest (and most efficient) route to port. Additional spatial claims of the transport sector are therefore likely to be concentrated in and around existing ports including the entrances to ports. More intense use can be expected around the most common shipping routes along the South African coast.

(3) TRENDS AND DEVELOPMENTS LIKELY TO INFLUENCE SPATIAL CLAIMS

Commitment to sustainable development and marine conservation

All maritime sectors in South Africa are committed to the principle of sustainability, and all are aware of the importance of a healthy marine environment for maximising the benefits that can be obtained from the sea. A clean and healthy marine environment is understood to benefit tourism as one of the country's key industries, as well as coastal communities themselves who depend on marine resources for their livelihood. Using the ocean sustainably is therefore likely to be an important aspect for all sectors, although this may more readily translate into sustainable ways of using the ocean rather than restricting spatial claims. Nevertheless, the commitment to sustainable development – and not least growing public awareness and NGO activity surrounding these issues - may also make it more imperative for sectors to accommodate environmental concerns – also in terms of siting - and look for solutions that result in less pressure on the marine environment.

The environmental sector plays a key role in ensuring future blue growth in South Africa is sustainable. Recent MPA designations and the National Biodiversity Assessment, together with the identification of pressures and vulnerabilities, are important steps in protecting marine biodiversity, as is the recent more precise delineation of ecologically or biologically significant marine areas (EBSAs). This spatial understanding of the marine environment is crucial for managing ecological areas sensitive to pressure, as well as securing areas that are still pristine and therefore essential as ecological reference areas. An important aspect is that environmental protection is not restricted to protected areas but extends to the marine environment as a whole. More understanding can be expected in the near future from research relating to biodiversity and, for example, pointing e.g. to the value of marine ecosystem services and how these may be affected by the growing range of uses in the sea.

Research in the marine environment

Although our scientific understanding of the ocean continues to grow, the evidence base is inevitably incomplete due to the difficulties (and expense) of carrying out research in the marine environment. Future research is therefore expected to refine the available knowledge on marine ecology and biology, including the distribution and vulnerability of key habitats, biodiversity hotspots and their interconnections. Specific topics of interest are likely to include research on the changing distribution of habitats and species in a warming ocean, or vulnerabilities of key habitats and features to pressures, but also aspects related to the socio-economic sphere, e.g. the impacts of blue sectors on job creation. The growing evidence base may change some of the current approaches to planning and management in the ocean, and is essential for an adaptive approach to MSP based on regular evaluation and revision of marine spatial plans.

Climate change

One of the key trends that will shape the future use of South Africa's ocean is climate change. Although the precise impacts and timescales are difficult to predict, it is likely there will be changes in biodiversity, expressed for example in changes of fish abundance and distribution, with direct impact on the fishing and conservation sector. There will also be changes in rainfall patterns and freshwater supply, leading to changes in coastal habitats and associated species. Sea level rise could impact coastal settlements and the natural environment of the coast. At the same time, the need to mitigate climate change also leads to growing interest in renewable energies. Given the conditions of the marine environment, wind and wave energy could be technologies that will be of greater interest in the medium term, with attendant spatial requirements.

Coastal urbanisation

One of the key trends outside the marine environment but closely linked to its use is coastal urbanisation. In many provinces coastal settlements are expanding rapidly both for residential and tourism purposes, leading to increasing urban encroachment. Coastal urbanisation also leads to more pollution and water demand and habitat changes of sea dependent species.

Given the growth targets for most of the sectors, there is thus the real possibility for increasing conflicts between sectors (that may suddenly compete for the same marine space, for example), or increasing conflicts between sectors and the environment. Although there is commitment to the principle of sustainability, goal conflicts between economic growth on the one hand and environmental protection on the other could occur. An important part of the MSP process will be to come to a shared interpretation of what this should imply, and where and when precedence may be given to one over the other – and at what costs.

4.4 SPATIAL CONFLICTS AND SYNERGIES

(1) UNDERSTANDING DIFFERENT FORMS OF COEXISTENCE

A key task of marine spatial planning is the handling of conflicts and synergies between marine uses. Different sectoral interests may clash with each other in the same space, but there may also be synergy effects so that different interests can benefit from each other through co-location. Synergies might exist between marine conservation and commercial fishing in terms of protecting spawning and nursery areas, while naval defence interest can mean that marine areas are not accessible to other operations during particular periods of time, thereby effectively acting as conservation areas.

Conflicts and synergies have spatial effects in MSP. For example, a spatial conflict may require two uses to be separated spatially, leading to more sea space being used. Synergy, on the other hand, can lead to more spatial efficiency; synergetic sea use thus supports more sustainable use of marine space.

Conflicts of interest can be difficult to mitigate and are sometimes severe. Geological resource exploitation and trawling, for example, will always have environmental impacts on the sea floor, to the degree that it will not be possible to preserve benthic fauna in the same location. Conflicts usually arise from a trigger, which might be the desire to retain access to space in the face of new spatial demands, and/or the desire for (more or less) exclusive use of marine resources. Conflicts can also become acute as a result of spatial management measures; zoning for example can lead to some activities being displaced and spatial conflicts arising elsewhere as a result.

Figure 20 highlights that conflicts and synergies represent different ends of a scale. Coexistence at the centre is more or less neutral, turning into passive synergy where activities benefit each other without much intervention. Synergies that require pro-active promotion can be classed as cases of active coexistence. Conflicts, in turn, arise where coexistence turns negative and leads to mutual exclusion. Examples for synergies might be fishing and tourism, both of which benefit from nature conservation; examples for conflicts might be seabed mining and the preservation of seafloor habitats for fishing and/or biodiversity interests.

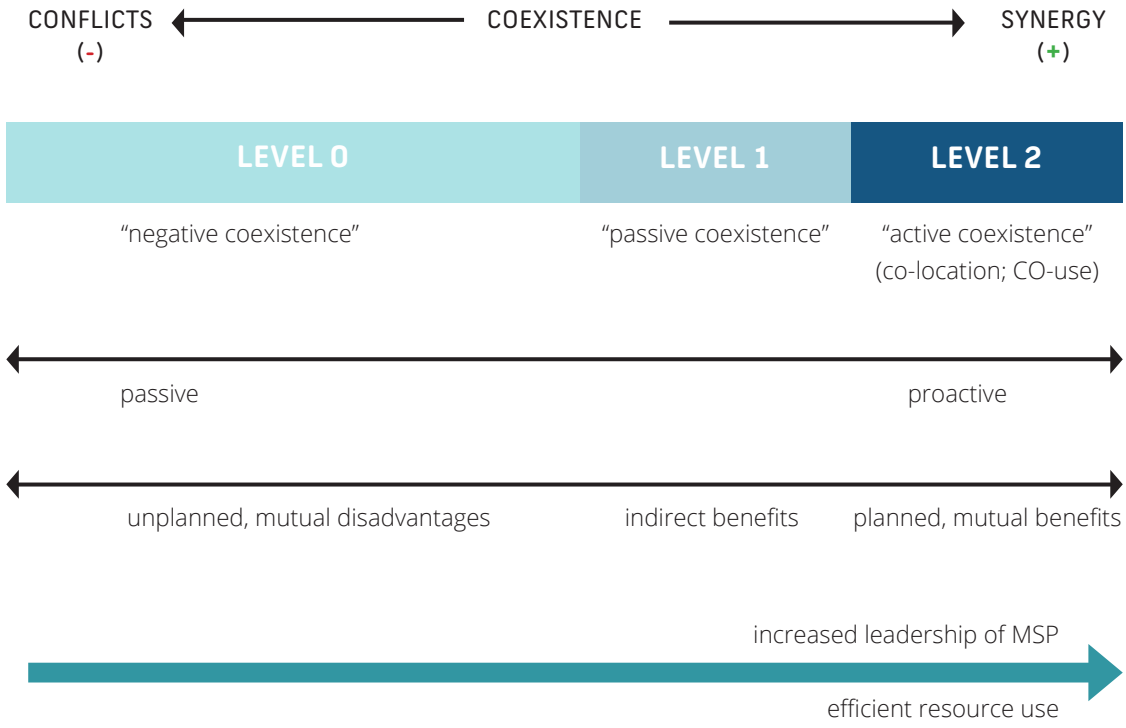
Figure 20 also shows that achieving synergies usually requires some active planning and understanding of the benefits, in contrast to conflicts which are characterised by unplanned, mutual disadvantages. The greater the level of synergy that is achieved between marine activities, the more leadership in MSP is usually required and the greater the efficiency in marine resource use that can be achieved.

Ideally, MSP should seek to promote efficient resource use. It should also highlight situations of “negative coexistence”, that is, conflicts where they occur, and suggest ways of resolving them. This might mean giving precedence to one use over another in a certain area, or defining the conditions under which a particular activity can take place, or imposing temporal restrictions on certain activities in certain areas. In line with the efficiency principle, MSP would also proactively seek to encourage co-use (“level 2” in Figure 20), i.e. the multiple use of sea spaces wherever possible.

It is important to note that marine spatial planning does not have all the tools needed to resolve certain issues. Some issues may be regulated by sectoral law or by international conventions and agreements; some issues such as reducing pollutants in coastal waters may depend on remedial action on land. Still, marine spatial planning can at least indicate where action is necessary.

Conflicts and synergies in the coexistence continuum of MSP (after Kafas 2019)[307].

FIGURE 20



(2) IDENTIFYING PREDISPOSITIONS TO SPATIAL CONFLICT

In line with the above, an important aspect for marine spatial planning is to **DIFFERENTIATE BETWEEN PREDISPOSITIONS TOWARDS SPATIAL CONFLICTS AND ACUTE SPATIAL CONFLICT SITUATIONS**. Identifying predispositions is an activity that can take place at any time and at a fairly general level, while the latter needs to be done as part of a marine spatial planning process.

Spatial compatibilities are often determined with the aid of a **COMPATIBILITY MATRIX** (see below). A compatibility matrix shows the degree to which activities could occupy the same marine space, thus indicating the **PREDISPOSITION** of various activities to coexistence or multiple spatial use. Some uses can gladly co-exist in the same marine area in the sense that they do not interfere with each other, such as sustainable tourism, cultural heritage and environmental protection. Other uses cannot occupy the same space at the same time and are therefore mutually exclusive, such as geological resource exploitation and sea floor protection. Once such incompatibilities have been identified, management measures can be designed to reduce the conflict between two uses.

Table 17 is an assessment of the spatial compatibility of the activities currently taking place in the central planning area. "Compatibility" is understood here as the theoretical ability of the respective activities to take place in the same area at the same time. The table shows a preliminary, general assessment. The table is not comprehensive as there are emerging uses which are not reflected. **THE RATINGS SHOWN ARE RATINGS IN PRINCIPLE**; they do not imply that these activities will necessarily occur in all planning areas or that these same ratings will apply everywhere. Moreover, **EVEN A HIGH DEGREE OF SPATIAL INCOMPATIBILITY DOES NOT MEAN THAT AN ACUTE CONFLICT IS INEVITABLE** between the activities concerned. Once the potential for conflict and the actual spatial conflicts in the planning area are known, spatial management measures can be designed to mitigate these conflicts.

The compatibility analysis INCLUDES BOTH "ACTIVITIES" AND "AREAS". This assumes that certain activities or uses are more spatially definitive than others. Shipping, for example, could be understood as the simple passage of a ship, which could, in theory, occur anywhere in ocean space. In practice, however, ships will prefer the use of certain (shorter) routes, or will need to be assigned certain routes for reasons of safety (e.g. approaches to the harbour, in the form of TSSs). The activity of shipping and the passage of individual ships should therefore be separated from shipping lanes as the spatial expression of shipping activity, acknowledging that shipping lanes are also recognised by international organisations such as IMO and a long-standing concept in this sector. The same applies to nature conservation, where a distinction has been made between habitat protection (based on the assumption that habitats will occupy a certain area) and species protection (which may be less spatially distinct). In a sense, this classification differentiates between activities that are more fleeting and less place-bound, and activities that are more permanent or requiring the use of a certain place.

Table 17 is a CAUTIOUS AND GENERIC ASSESSMENT of the potential for spatial conflicts and synergies in South Africa. It is indicative only and only serves as a STARTING POINT FOR A MUCH MORE DETAILED, COMPREHENSIVE ASSESSMENT of coexistence in the respective planning areas that will likely also need to include stakeholders. Nevertheless, it can provide some first pointers to where spatial conflict potential may lie and where a more refined matrix would be needed with a more detailed list of activities and areas.The assessment will be updated on needs basis.

Table 17 indicates that some activities and uses have a neutral relation to each other. In most cases, this is because spatial overlap is unlikely; in other cases, it is because activities could theoretically coexist in the same space without any obvious synergies (as is the case for some forms of fishing). For example, coastal infrastructure is neutral towards most other marine activities because of a lack of spatial overlap; oyster and abalone farming is compatible with some forms of habitat conservation.

Tourism and recreational activities, customary practices, and marine heritage and species/habitat conservation were generally found to be spatially compatible. If this type of tourism is sustainable and responsible it can even be synergetic with nature conservation and maritime heritage as shipwrecks and the presence of key species can serve as attractions. Non-spatial synergies may also result, as tourists can sample local produce and thereby support the local industry. Species and habitat conservation are also mutually supportive, as are habitat conservation and marine heritage in that the latter may provide artificial reefs.

Spatial incompatibilities also exist. The most obvious example is mining which is incompatible with most other activities due to its environmental impacts, related to its extractive nature and large scale. Mining operations would also exclude some of the more fleeting activities such as fishing, although temporal management measures could be conceivable here. Without appropriate management, shipping lanes are incompatible with all those activities that impede the flow of traffic or represent a safety concern. Shipping could have a negative effect on marine mammals due to noise and ship strikes, while anchorage areas are incompatible with shipping lanes and with underwater heritage and subsea cables as anchors could cause damage. Underwater cables are incompatible with underwater heritage for the same reason. Aquaculture is also incompatible with many other activities as it requires exclusive use of space; some forms of water-based tourism are conceivable such as scuba diving.

Military practice is an activity which is incompatible with most other uses. At the same time, military activity does not always take place, so temporal restrictions on other activities are conceivable.

In some cases, not enough information is available to rate compatibilities with the necessary degree of certainty. As a result, the table should be read with caution. The precautionary principle has been applied throughout.

A draft compatibility matrix for South African marine uses. -2 = highly incompatible, -1= incompatible, 0= neutral, 1=synergy, 2= strong synergy.

TABLE 17

ACTIVITY	Habitat Protection	Species Protection	Shark control (nets)	Waste discharge outfalls	Disused ammunition dumping sites	Spoil grounds (dredge dumping)	Foulgrounds (dangerous areas)	Military exercises (practice areas)	Submarine cables	Pipelines (oil and gas)	Wellheads (Oil and Gas)	Mining	Exploration (e.g. seismic surveys)	Exploitation (drilling)	Anchorage areas	Shipping lanes	Port Expansion/Dredging	Aquaculture (nets and cages)	Bottom trawling	Midwater Trawling	Net fishing	Line fishing	Longlining	Tuna Pole	Rock Lobsters	Purse Seine	Abalone/oyster	Recreational shore and boat-based Angling	Scuba Diving	Shark cage	BBWW	Bathing	Yachting	Customary practices (religious, cultural)	Heritage sites	Renewable energy	Desalination	Carbon sequestration	Coastal infrastructure
Habitat Protection		2	-1	-2	0	0	0	-2	-2	-2	-2	-2	0	-2	-2	0	-2	-1	-2	-2	-2	-2	-2	-2	-2	-2	-2	1	1	1	1	1	1	1	-1	-2	-2	-2
Species Protection	1		-1	-2	0	0	0	-2	-1	-2	-2	-2	-2	-2	1	-1	-2	-1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-1	1	1	1	0	-1	0	1	-1	-2	-2	0
Shark control (nets)	-2	-2		0	0	0	0	-2	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	1	1	0	0	-2	0	0	0
Waste discharge outfalls	-2	-2	0		-1	-1	-1	-2	-1	-1	-2	-2	-2	-2	-1	0	-1	-2	-2	0	0	-2	-2	-2	-2	0	0	-2	0	2	2	-2	0	-2	-2	-2	-2	-2	0
Disused ammunition dumping sites	-2	-1	-1	-1		-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	-2	-2	-2	-1	-2	-2	-1	-2	1	-1	-2	-2	-1	-1	-1	-1	-2	-1	-1	-2	-1	-2	-2
Spoil grounds (dredge dumping)	-2	-1	-1	-1	-2		-2	-2	-2	-2	-2	-2	-2	-2	-2	0	-2	-2	-2	-1	-2	0	-1	0	0	-1	-1	-1	0	0	0	-1	0	-1	-1	-2	-1	-2	-2
Foulgrounds (dangerous areas)	-2	-1	-1	-1	-2	-2		-2	-2	-2	-2	-2	-2	-2	-2	0	-2	-2	-2	-1	-2	-2	-1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-1	-2	-2
Military exercises (practice areas)	-2	-2	-2	-2	-2	-2	-2		-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
Submarine cables	-1	-1	0	-2	-2	-2	-2	-2		-2	-2	-2	-1	-1	-2	0	-1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	0	0	0	-2	-2	0	0	0
Pipelines (oil and gas)	-2	-2	-1	-2	-2	-2	-2	-2	-2		-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	-2	-1	-2	-2	-2	0	-1
Wellheads (Oil and Gas)	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2		-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	-2	-2	-2	0	0
Mining	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2		-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-1	-2	-2	-2	-2	0
Exploration (e.g. seismic surveys)	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2		1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	-2	-2	0
Exploitation (drilling)	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2		-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	0
Anchorage areas	-1	-1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-1	-2		-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-1	-2	-2	-2	-2	-1	-1	-2	-2	-2	-2	0
Shipping lanes	0	0	-2	0	-2	0	-2	-2	0	-2	-2	-2	-2	-2	-2		0	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	-2	-2	-2	0
Port Expansion/Dredging	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	1		-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	0
Aquaculture (nets and cages)	-1	-1	-1	-2	-2	-1	0	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2		-2	-2	-2	-1	-2	-1	-1	-1	-2	-1	0	-1	0	-1	-1	-1	-1	-2	-1	-2	0
Bottom trawling	-2	-1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-1	-2	0	-2		0	0	0	-2	0	-2	0	0	0	0	-1	0	-1	0	-1	-2	-2	0	-2	0
Midwater Trawling	-2	-2	-2	0	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	-2	0		0	0	0	-2	-2	-2	0	0	0	-2	0	-1	0	0	0	-2	0	0	0
Net fishing	0	-1	-2	0	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	-2	0	0		0	0	-2	-1	1	0	0	0	-2	0	-1	0	0	-1	0	0	-1	-1
Line fishing	0	0	0	-2	-2	-2	-1	-2	-1	0	1	-2	-2	-1	-2	-2	0	-1	-1	-1	-1		0	0	0	0	-1	1	0	-2	0	0	0	0	0	1	0	0	0
Longlining	0	0	0	-2	-2	-2	-2	-2	0	0	0	-2	-2	-2	-2	-2	0	-2	-2	-2	-2	0	0		0	1	-1	0	0	-2	0	0	0	0	0	0	0	-1	0
Tuna Pole	0	0	0	-2	-2	-2	-1	-2	-1	0	1	-2	-2	-1	-2	-2	0	-1	-1	-1	-1	0	0	0		0	0	-1	1	0	-2	0	0	0	0	0	0	0	0
Rock Lobsters	0	0	0	-2	-2	-2	-2	-2	0	0	0	-2	-2	-2	-2	-2	0	-2	-2	-2	0	0	0	0		-1	0	0	0	-2	0	0	0	0	0	0	0	-1	0
Purse Seine	1	0	-2	0	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	-2	-2	-2	-2	-2	-2	-2	-2		0	0	0	-2	0	-1	0	0	0	-2	0	0	0
Abalone/oyster	0	0	0	0	-2	-1	-2	-2	0	0	0	-2	-2	-2	-2	-2	-2	0	-2	0	0	0	0	0	0	0		0	0	-2	0	-1	0	0	0	-2	-2	-2	0
Recreational shore and boat-based Angling	0	0	0	-2	-2	-2	-1	-2	-1	0	1	-2	-2	-1	0	-2	0	-1	-1	-1	-1	0	0	0	0	0	-1		0	0	0	0	0	0	0	-2	-1	0	0
Scuba Diving	1	1	0	0	-2	-2	-2	-2	0	0	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	2	-2	-1		1	-2	1	0	-2	0	-1	-2	-1	-2
Shark cage	1	1	0	-2	-2	-2	-2	-2	-1	-2	-2	-2	-1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	2	-2	-1	1		-2	1	0	-2	0	-1	-2	-1	-2
BBWW	1	1	-2	-2	-2	-2	-2	-2	-1	-2	-2	-2	-1	-2	-2	-2	-2	-2	0	0	0	0	0	0	0	0	0	-1	1	1		1	0	-2	0	-1	-2	-1	-2
Bathing	1	1	2	-2	-2	-2	-2	-2	0	0	-2	-2	-1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	2	-2	-1	1	1	-2		0	-2	0	-1	-2	-1	-2
Yachting	1	1	-2	-2	-2	-2	-2	-2	-1	-2	-2	-2	-1	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	0	0	0	-1	0	0	1	0		-2	0	-1	-2	-1	-2
Customary practices (religious, cultural)	1	1	-2	-2	-2	-2	-2	-2	-1	-2	-2	-2	-1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	2	-2	-1	1	1	-2	1	0		0	-1	-2	-1	-2
Heritage sites	1	1	-2	-2	-2	-2	-2	-2	-1	-2	-2	-2	-1	-2	-2	-2	-2	0	0	0	0	0	0	0	0	0	0	-1	1	1	1	1	0	-2		-1	-2	-1	-2
Renewable energy	-2	-2	-1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	1	-2	-2	-2	-2	-2	-2		-2	-2	-2
Desalination	-2	-2	-1	-2	-2	-2	-2	-2	0	-2	-2	-2	-2	-2	-1	0	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	1		-2	-2
Carbon sequestration	-2	-2	-1	-2	-2	-2	-2	-2	0	-2	-2	-2	-2	-2	-1	-1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	1	1		-2
Coastal infrastructure	-2	-2	0	0	-2	-2	-2	-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	0	0	0	

(3) KEY CONFLICTS AND SYNERGIES

Based on the above, current and possible conflicts and synergies between activities were identified. Table 18 highlights which uses have the greatest conflict potential for sectors.

An assessment of the general spatial conflict potential between sectors. TABLE 18

SECTOR	USES WITH THE STRONGEST CONFLICT POTENTIAL
COASTAL AND UNDERWATER INFRASTRUCTURE	■ Coastal habitats/biodiversity ■ Fishing (bottom trawling) ■ Anchoring of vessels ■ Environmental impacts during maintenance and laying
FISHERIES	■ Conservation
MARINE RENEWABLE ENERGY	■ All other sectors due to displacement effects
MARINE AND COASTAL TOURISM	■ Conservation (direct environmental damage, pollution, noise) ■ Aquaculture (similar locational requirements)
MARITIME TRANSPORT	■ Mining (fixed structures impede shipping) ■ Fishing (can disturb commercial traffic) ■ Conservation (closures, environmental impacts) ■ Naval defence (closures)
MINERAL RESOURCE EXPLOITATION	■ Conservation (environmental impacts) ■ Defence ■ Transport (closure of areas) ■ Fishing (pollution, closure of areas) ■ Aquaculture (if spatial overlap)
NAVAL DEFENCE	■ All other sectors during practice exercises ■ Conservation (environmental impacts)

The following potential for synergies can be identified:

An assessment of the general potential for spatial synergy between sectors. TABLE 19

SECTOR	USES WITH THE STRONGEST POTENTIAL FOR SYNERGY
CARBON CAPTURE AND STORAGE	■ Use of existing (redundant) pipelines ting
CONSERVATION	■ Benefits for fishery in terms of preserving key habitats and related marine resources ■ Benefits for tourism in that tourists appreciate a healthy natural environment
COASTAL AND MARINE TOURISM	■ Benefits for conservation in that it requires a healthy natural environment ■ Could have benefits for aquaculture or other small industries through shared coastal infrastructure (ports, marinas)
NAVAL DEFENCE	■ Benefits for conservation as closed practice areas may act as de facto nature conservation areas
MARINE AND CULTURAL HERITAGE	■ Benefits for conservation as shipwrecks represent artificial reefs; areas may be closed to other extractive or destructive activities
MINING	■ Artificial reef effects; salt mining as a bird habitat
MARITIME TRANSPORT	■ Port infrastructure for all other sectors
MARINE RENEWABLE ENERGIES	■ Benefits for conservation as de facto exclusion zones (artificial reefs) ■ Benefits for fisheries for the same reason ■ Benefits for coastal (port) infrastructure and tourism

4.5 HOTSPOT AREAS

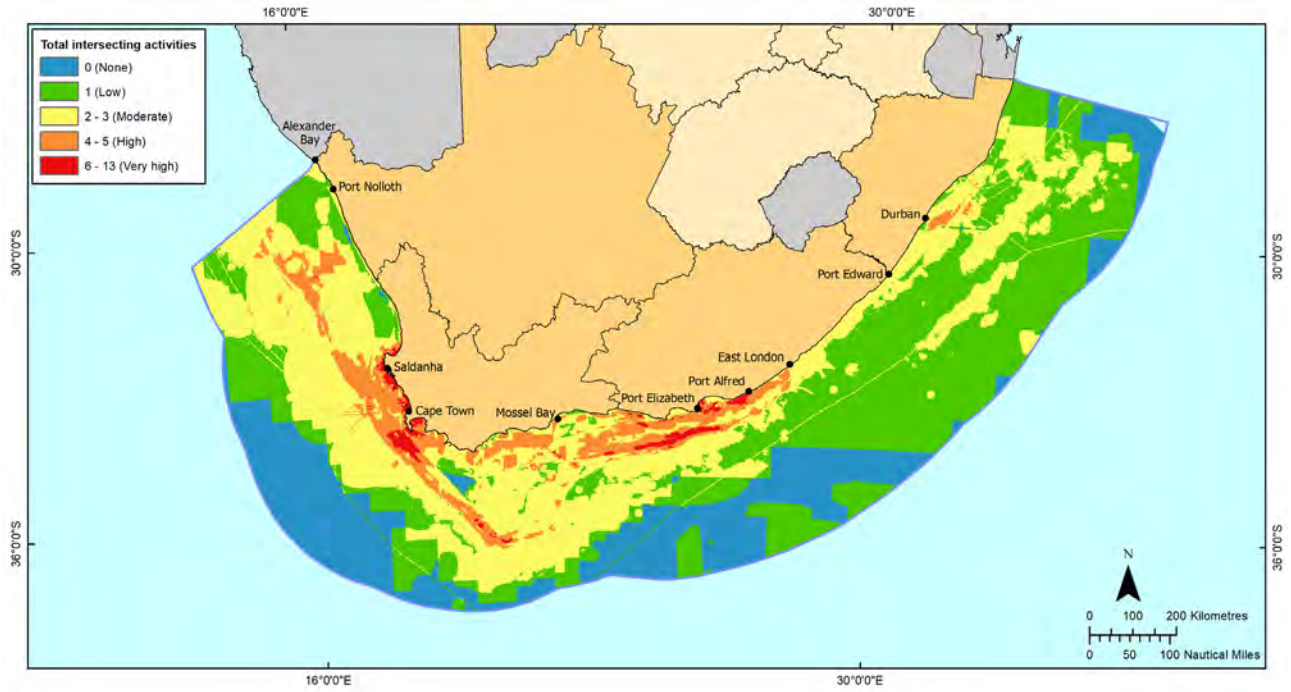
Based on the current activities in South Africa's marine area, a spatial overlay map was produced that shows how many activities occur in any one place at the same time[308]. Its purpose is to help planners identify hotspot areas of current activity for more detailed planning.

The map is based grouping the total range of uses and activities identified in Table 17 into 32 distinct activities and layers. The term "activities" also includes conservation, where the various layers set out in the environmental chapter (MPAs, EBSAs, CBA/ESAs, see chapter 3.3 Environmental Management) were condensed into a single layer. Other sectoral layers have consciously been kept separate in order to reflect distinct activities: The fishing sector, for example, is represented by more than 10 layers. Exploitation of geological resources combines the available layers on oil and gas and includes exploration and exploitation licence areas (see footnote for the full list of layers)[309].

The map is most easily understood as a pressure map, where greater numbers of concurrent activities indicate greater overall pressure. Mere spatial overlap, however, does not imply that the activities occurring in the same area are necessarily conflicting. The map is therefore best regarded as an initial decision aid that can indicate areas of high activity in the ocean. Using the map in conjunction with the conflict matrix allows planners to zoom into areas that need to be given greater analytical focus, and secondly to do an initial analysis of whether the overlapping activities are spatially compatible or not.

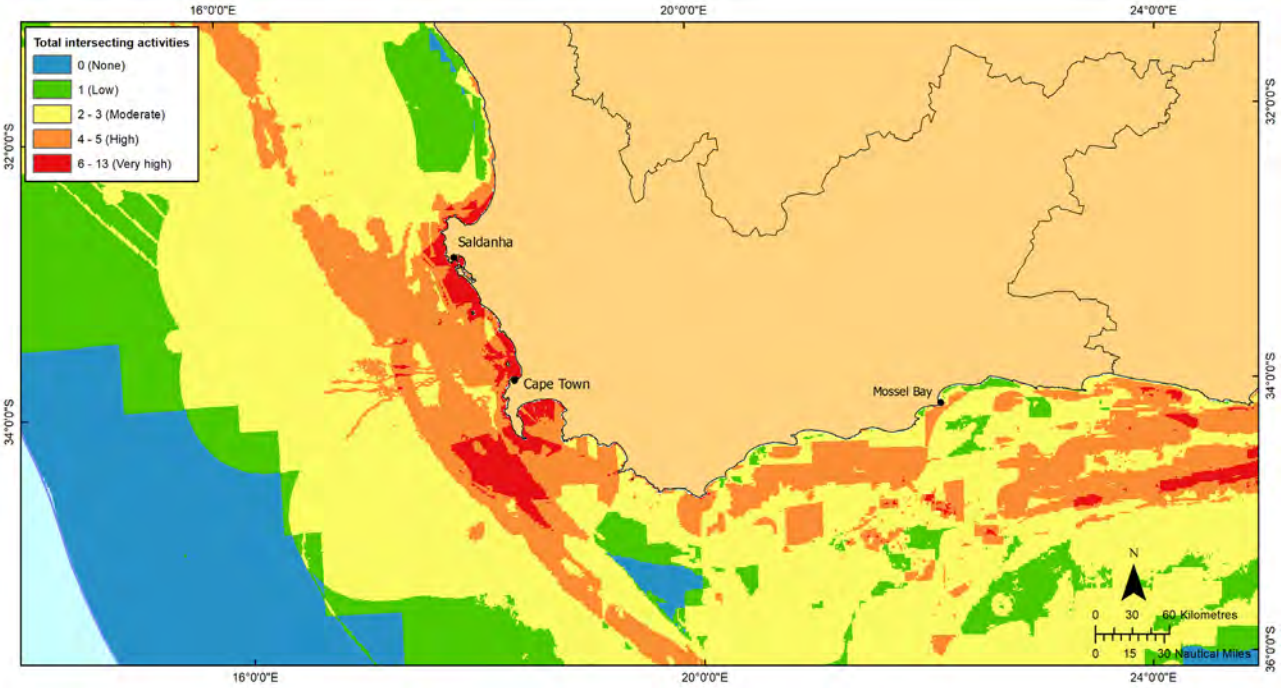
As an initial outcome, the map shows that large parts of the EEZ have relatively low levels of use. Where only one use is indicated, this often represents the conservation or fisheries layers, especially further out at sea. The most common overlays are between the conservation layer, different types of fishing, and shipping. The map reveals that pressures of use are particularly high along the coast, as well as on the key fishing grounds along the continental shelf edge.

The digital version of the map (available on OCIMS) allows each layer to be identified by clicking on it. It is therefore possible for planners to identify which activities overlap, which is a useful feature for analysing whether these activities are compatible with each other or not.



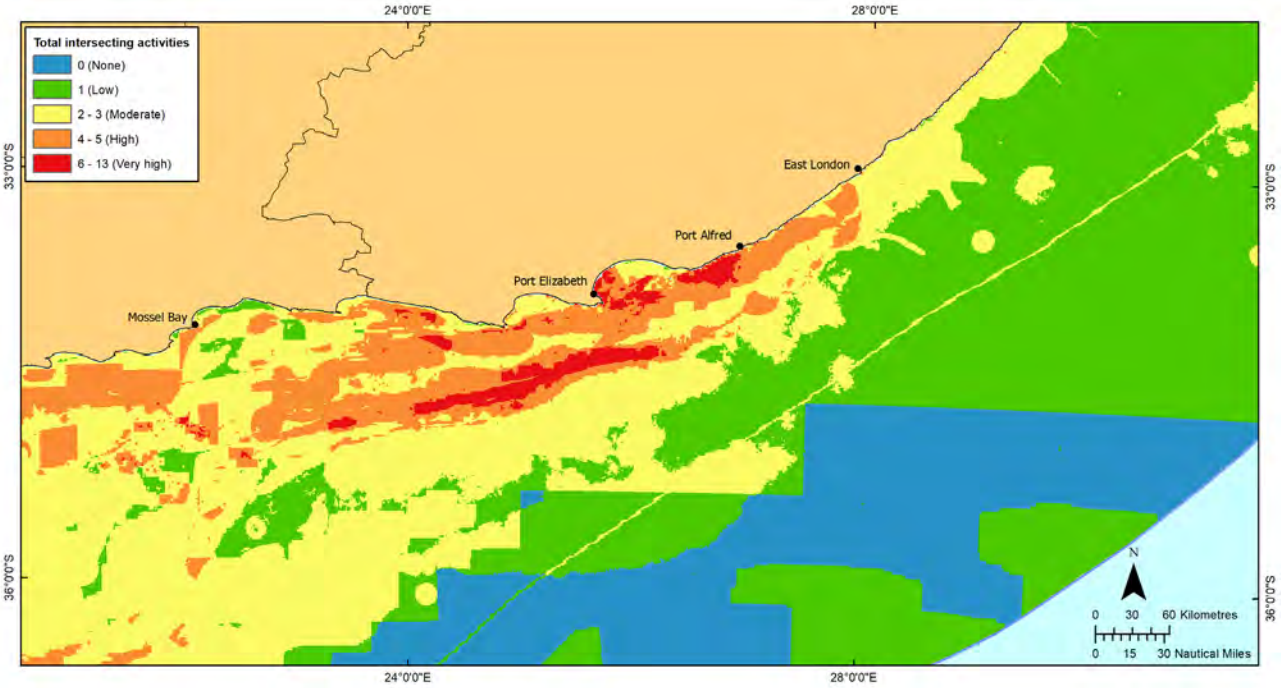
Hot spot map of intersecting activities based on 32 activities.

MAP 71



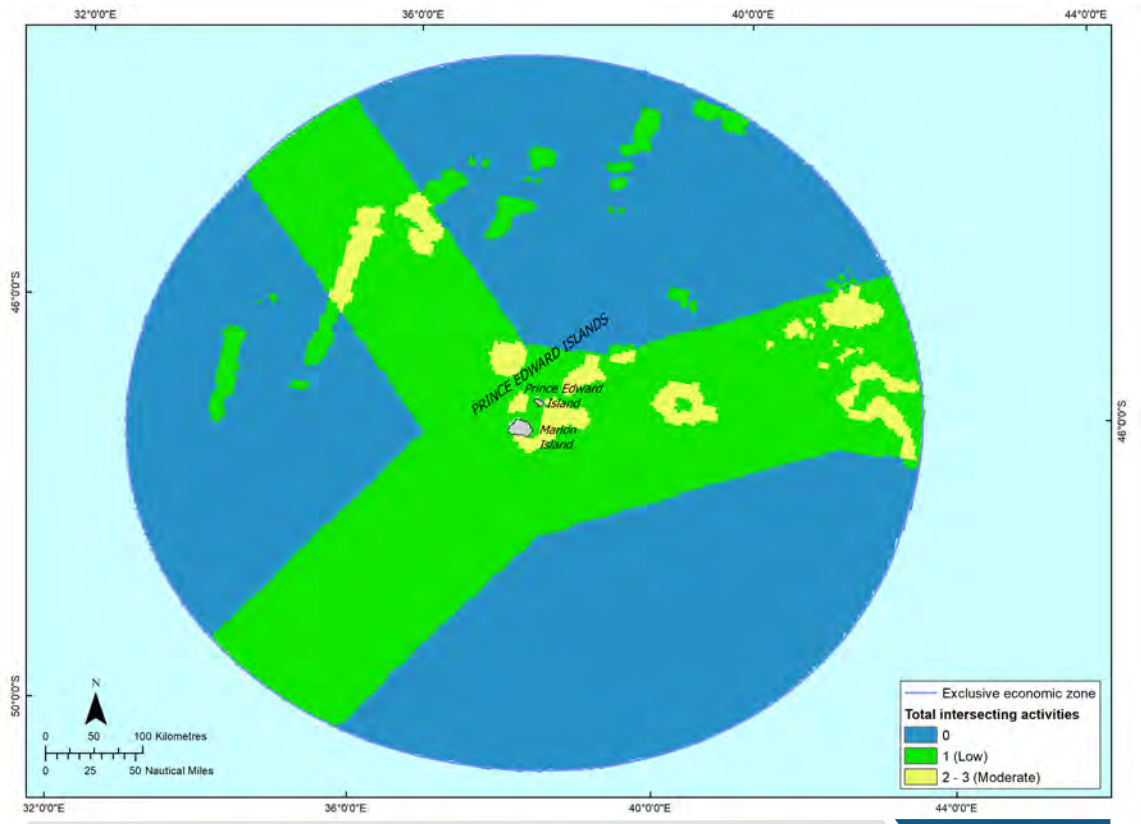
Hot spot map of intersecting activities for the Cape Town area based on 32 activities.

MAP 72



Hot spot map of intersecting activities for the Port Elizabeth based on 32 activities.

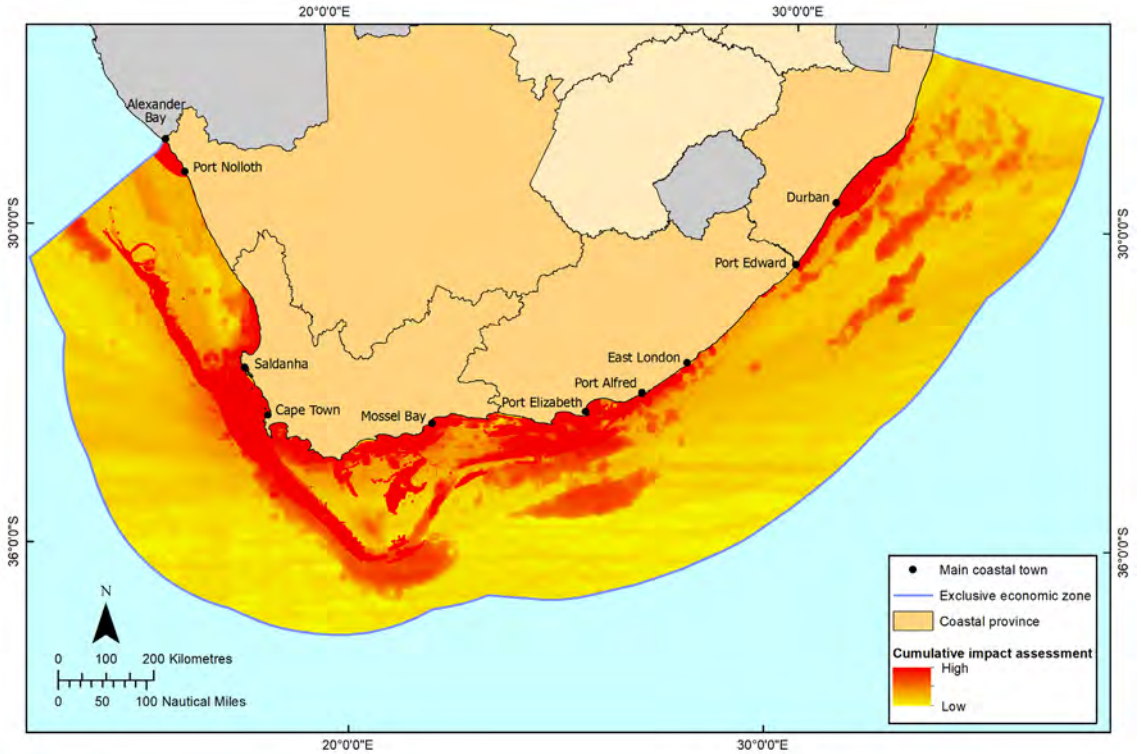
MAP 73



Hot spot map of intersecting activities for the EEZ surrounding the Prince Edward Islands.

MAP 74

Map 75 shows the cumulative impact of 31 pressures on marine ecosystems as identified during the 2018 National Biodiversity Assessment. This is an additional analytical tool that can be used together with the hotspot map and conflict matrix to identify those areas that should be given particular focus when developing South Africa's Marine Area Plans.



Map of cumulative impact of 31 pressures on marine ecosystems. Map from data in National Biodiversity Assessment 2018[48].

MAP 75

4.6 TAKING MSP FORWARD: TOWARDS MARINE AREA PLANS IN SOUTH AFRICA

(1) TOWARDS AREA PLANS

In line with the NDIR report, which takes a national perspective, the analysis presented in this chapter is also high-level. Its intention is to provide a general overview of issues that are likely to apply across South Africa's marine space – issues in other words that are likely to come up in some form in all of the forthcoming planning processes. THE TASK OF THE ACTUAL PLANNING PHASE IS TO BUILD ON THE WORK PRESENTED HERE AND TO PROVIDE A MORE DETAILED, IN-DEPTH ANALYSIS FOR EACH OF THE FOUR MARINE PLANNING AREAS.

The following general conclusions can be drawn from the preceding overview and the initial assessment of current activities.

Compared to intensively used seas in Europe and Asia, South Africa's waters are moderately used. Nevertheless, pressure hotspots exist and pressures are likely to intensify in the future. This particularly applies to coastal waters and the areas surrounding major ports, but also to areas that have been licenced for mining and may be exploited more intensively in the future. The current assessment of pressures indicates that all maritime provinces are affected by increasing pressures of use, but that patterns of use and the range of activities differ across the provinces.

An important advantage of the South African situation is that EBSAs and important biodiversity areas have been identified with high spatial resolution, and that some sea areas are still relatively pristine. Important conservation areas can thus be identified and assessed with respect to their vulnerability and susceptibility to pressures. MSP can be employed in a targeted way to avoid or mitigate pressure on significant ecological or biological features and areas both within MPAs and outside designated conservation areas.

In terms of the four key maritime sectors, fishing probably requires the greatest spatial flexibility due to the mobile nature of its resource. Spatial management measures can be helpful in protecting key fish habitats and resources and for securing key fishing areas if required.

Mining is spatially very extensive as it is determined in its feasibility by the availability and accessibility of the resource. Exploitation depends on economically viable quantities of the respective resource; provisions need to be made to allow such exploitation to take place in areas where concessions have already been awarded. Mining exploitation is likely to occur, but not immediately, so care must be taken to avoid spatial overlap with underwater infrastructure such as cables.

Aquaculture and tourism are likely to be the topics most relevant in coastal waters, as are small-scale fishery, cultural practices, port and harbour development and conservation. Detailed analysis of issues relevant in each planning area is an important prerequisite for the coming planning phase.

Importantly, all the above MAY PLAY OUT DIFFERENTLY IN THE FOUR MARITIME PROVINCES depending on the environment, industries and infrastructures already present there, or in line with new investment opportunities. A sectoral strategy for the expansion of aquaculture, for example, has already carried out an SEA and identified suitable locations for marine aquaculture in the four maritime provinces, where the greatest development potential is seen in the Eastern Cape region.

(2) KEY REQUIREMENTS FOR MSP

Given the trend towards more spatially expansive and intense sea use, **PRIORISATION** will be needed to deal with some of the conflicts identified. In some cases, it may be possible to promote coexistence by means of technological solutions (e.g. closed systems for aquaculture), but in others, planners will need to prioritise one use over another. This will need to be done based on careful weighing of options, bearing in mind that prioritisation, as well as actively facilitating coexistence, always entails a cost. For instance, sectors may need to cope with additional expenses in the case of technical solutions or may be required to accept second best options in terms of resources or access to resources. Inshore and nearshore conflicts will require finer grained analysis and solutions, as well as more comprehensive stakeholder involvement in finding appropriate solutions.

In order to prioritise in the most acceptable way, it is essential to fully understand the locational requirements of each sector. This means a participatory assessment of the degree of spatial flexibility within each sector, considering the distribution of the resource, the quality of the available resource, the accessibility of the resource, the timing of access and supporting infrastructure required, and the cost of any alternatives (e.g. a longer shipping route, a second-best location). Based on this, **A LIST (OR MAP) OF PRIORITY SITES** can be drawn up for each sector. For mining, for example, these would likely be areas with high grade and high value deposits that are also easy to extract. This would then form the basis for any discussion and negotiation in the case of spatial conflicts.

Apart from dealing with conflicts, MSP in South Africa should **SUPPORT THE ABILITY OF SECTORS TO MAKE USE OF OPPORTUNITIES** when such opportunities arise. It should support their expansion if this is sustainable and in line with the ecological carrying capacity of the sea. MSP could be used to support the expansion of aquaculture in suitable areas for example, or to enhance synergies between conservation and fisheries and/or tourism, or to reserve space for potential future uses, such as renewable energy development.

MSP must also recognise a **HEALTHY MARINE ENVIRONMENT AS A KEY REQUIREMENT** not only for conservation, but also growth industries of fishing, tourism and aquaculture. For this, MSP must be linked to biodiversity conservation and identification of critical pressures and impacts resulting from activities on biodiversity areas. The **PRECAUTIONARY PRINCIPLE** should apply throughout, as should the principle of spatial efficiency, meaning that space should be treated as a valuable commodity that should be "spent" cautiously.

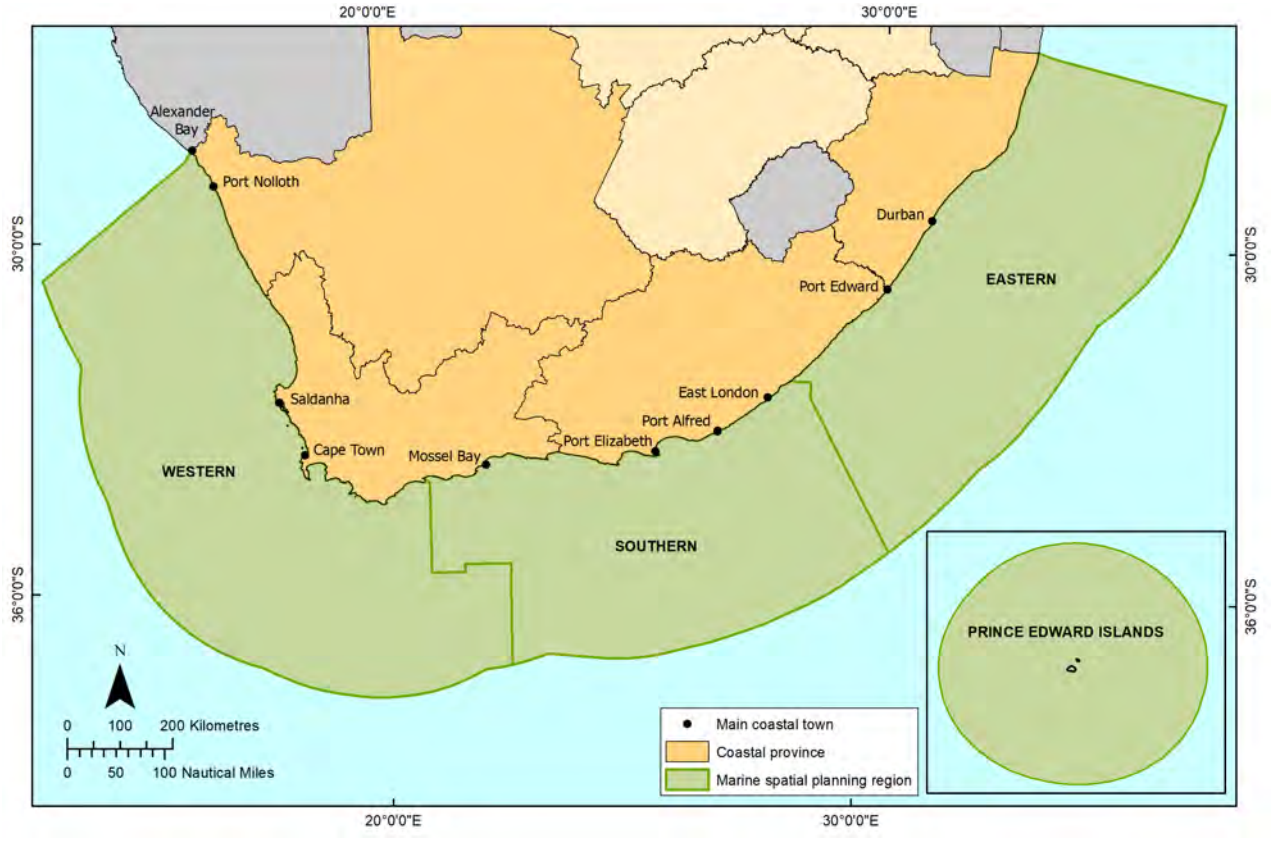
There is a need for MSP to be strategic yet also specific. It is very likely that similar general objectives and targets will apply across all South Africa's marine space, but that it makes sense to allocate priority uses differently in each planning area depending on what makes most sense.

Last not least, the analysis also shows the importance of liaising closely with coastal and land use planning for aspects such as port expansion, land-based pollution/wastewater, or the expansion of coastal infrastructure.

5 THE COMING MARINE AREA PLANNING PROCESS

This National Data and Information Report for the South African MSP process gives a description of how the different sectors are currently using the South African ocean space and how they intend to continue using the ocean space in the future in order to meet their sectoral objectives. In drawing together sectoral information, it conveys a multi-sector perspective to serve as the foundation for the development of Marine Area Plans in South Africa.

MSP will be applied to the ocean area around the mainland of South Africa, and the Prince Edward Islands. The mainland ocean space has been divided into three marine areas, each of which will be covered by a distinct Marine Area Plan (Map 77). Each Marine Area Plan will consider national sectoral priorities, as well as region-specific activities and priorities. Each Marine Area Plan will consist of general development guidelines for marine activities, as well as sector-specific guidelines and a zoning scheme. The zoning scheme allows specific marine areas to be allocated to combinations of use that are particularly suitable for the area concerned. Each zone has a designated priority use, and there may be restrictions on some uses and activities in some zones in order to minimise conflicts of use. Detailed information on the spatial management approach, gazetted in 2019, is provided in South Africa's National Framework for MSP.



South Africa's four marine planning areas. MAP 76

The first plan to be developed will be for the Southern Area around mainland South Africa. The remaining plans will be developed consecutively based on the experiences gained during the first planning process.

As a collaborative process, MSP will consider the inputs of all interested and affected parties in the formulation of the plans. The public, the private sector, government departments and agencies, and non-governmental organisations and entities will all be invited to contribute. Draft plans will be endorsed by the Director-Generals' Working Group on MSP, with the final plan approved at Cabinet level. Each plan will undergo at least two rounds of revision before it is gazetted for public comment and, thereafter, gazetted for implementation. Once a plan has been approved, its regulations are binding. Marine Area Plans will be evaluated and revised every five years.

6 ANNEXES

6.1 DATA STAMPS PER MAP

CHAPTER	MAP	MAP CONTENTS	DATA SOURCE AND DATE
1 INTRODUCTION	Map 1	Locality map of South Africa	DEFF 2020
	Map 2	South African marine area in relation to terrestrial territory, including territorial waters, exclusive economic zone and extended continental shelf claim area	DEA
2.1 THE NATURAL ENVIRONMENT: STATUS, TRENDS, DEVELOPMENTS	Map 3	Oceanography of SA's EEZ	GEBCO
	Map 4	Marine ecosystem types	SANBI - NBA 2018
	Map 5	Bentho-pelagic ecoregions within South Africa's Prince Edward Islands EEZ	SANBI - NBA 2018
	Map 6	Marine ecosystem types PEI	SANBI - NBA 2018
	Map 7	Geological map of the South African continental shelf	Council for Geosciences 07/2020
	Map 8	Seafloor geomorphic features	SANBI - NBA 2018
	Map 9	Vulnerable Marine Ecosystem Indicator Species	SANBI - NBA 2018
	Map 10	Vulnerable Marine Ecosystems density PEI	SANBI - NBA 2018
	Map 11	Marine ecosystem condition	SANBI - NBA 2018
	Map 12	Marine ecosystem threat status	SANBI - NBA 2018
	Map 13	Marine ecosystem threat status PEI	SANBI - NBA 2018
	Map 14	Marine ecosystem protection level	SANBI - NBA 2018
	Map 15	Marine ecosystem protection level PEI	SANBI - NBA 2018

CHAPTER	MAP	MAP CONTENTS	DATA SOURCE AND DATE
2.2 THE SOCIO-ECONOMIC ENVIRONMENT: STATUS, TRENDS, DEVELOPMENTS	Map 16	Coastal provinces, major settlements, key terrestrial infrastructure	DEFF 2020
3.2 COASTAL AND UNDERWATER INFRASTRUCTURE	Map 17	Underwater cables	SANBI
3.3 ENVIRONMENTAL MANAGEMENT	Map 18	Marine Protected Areas including PEI	DEFF 2020
	Map 19	Ecologically or Biologically Significant Marine Areas (EBSAs)	DEA/NMU/MARISMA 2019
	Map 20	Draft Coastal and Marine Critical Biodiversity Area Map	SANBI - NBA 2018
	Map 21	Cumulative impact of 31 pressures on marine ecosystems	SANBI - NBA 2018
3.5 FISHERIES	Map 22	Inshore and Offshore demersal trawl (intensity of use and permitted hake trawl ring fence)	Raw data: DAFF/CapMarine 01/2019 Analysis: NMU - Dr Holness/NBA 2018
	Map 29	Hake Longline (intensity of use)	Raw data: DAFF/CapMarine 01/2019 Analysis: NMU - Dr Holness/NBA 2018
	Map 31	Midwater trawler (intensity of use)	Raw data: DAFF/CapMarine 01/2019 Analysis: NMU - Dr Holness/NBA 2018
	Map 32	Small Pelagic purse-seine (intensity of use)	Raw data: DAFF/CapMarine 01/2019 Analysis: NMU - Dr Holness/NBA 2018
	Map 34	Large Pelagic longline (intensity of use)	Raw data: DAFF/CapMarine 01/2019 Analysis: NMU - Dr Holness/NBA 2018
	Map 35	Tuna Pole-Line (intensity of use)	Raw data: DAFF/CapMarine 01/2019 Analysis: NMU - Dr Holness/NBA 2018
	Map 36	Patagonian Toothfish PEI (intensity of use)	Raw data: DAFF/CapMarine 01/2019 Analysis: NMU - Dr Holness/NBA 2018
	Map 37	Linefish (intensity of use)	Raw data: DAFF/CapMarine 01/2019 Analysis: NMU - Dr Holness/NBA 2018
	Map 38	Recreational Shore Angling (intensity of use)	Raw data: DAFF/CapMarine 01/2019 Analysis: NMU - Dr Holness/NBA 2018

CHAPTER	MAP	MAP CONTENTS	DATA SOURCE AND DATE
3.5 FISHERIES	Map 39	Squid jig (intensity of use)	Raw data: DAFF/CapMarine 01/2019 Analysis: NMU - Dr Holness/NBA 2018
	Map 42	Prawn Trawl (footprint)	Raw data: DAFF/CapMarine 01/2019 Analysis: NMU - Dr Holness/NBA 2018
	Map 44	Netfish (beach seine and gillnet)	Raw data: DAFF/CapMarine 01/2019 Analysis: NMU - Dr Holness/NBA 2018
	Map 45	Kelp Harvesting (intensity of use)	Raw data: DAFF/CapMarine 01/2019 Analysis: NMU - Dr Holness/NBA 2018
	Map 46	Abalone Harvesting	Raw data: DAFF/CapMarine 01/2019 Analysis: NMU - Dr Holness/NBA 2018
	Map 47	Oyster Harvesting (intensity of use)	Raw data: DAFF/CapMarine 01/2019 Analysis: NMU - Dr Holness/NBA 2018
	Map 48	Small Scale / Subsistence Harvesting (intensity of use)	Raw data: DAFF/CapMarine 01/2019 Analysis: NMU - Dr Holness/NBA 2018
	Map 49	South Coast Rock Lobster (intensity of use)	Raw data: DAFF/CapMarine 01/2019 Analysis: NMU - Dr Holness/NBA 2018
	Map 51	West Coast Rock Lobster (intensity of use)	Raw data: DAFF/CapMarine 01/2019 Analysis: NMU - Dr Holness/NBA 2018
3.6 MARINE AQUACULTURE	Map 52	Location of existing marine aquaculture sites	DEFF 10/2020
3.8 MARITIME AND UNDERWATER CULTURAL HERITAGE	Map 53	Approximate location and levels of intensity of shipwrecks	SAHRA/SA Navy
3.9 MARINE AND COASTAL TOURISM	Map 54	Boat-based whale watching and white shark cage diving sites	DEA 2019
	Map 55	Recreational scuba-diving sites	Department Tourism
	Map 56	Blue flag and green coast beaches	Department Tourism 02/2019
	Map 57	Location of Indi-Atlantic route and cruise terminals	Department Tourism 02/2019

CHAPTER	MAP	MAP CONTENTS	DATA SOURCE AND DATE
3.10 MARITIME TRANSPORT AND PORTS	Map 58	Maritime transport (relative intensity)	Raw data: Halpern et al. 2015[310] Analysis: NMU - Dr Holness/NBA 2018
	Map 59	Key routes for maritime transport (top 10% quantile)	Raw data: Halpern et al. 2015[310] Analysis: NMU - Dr Holness/NBA 2018
	Map 60 Map 61	Maritime transport (offshore traffic separation scheme) and ports	SA Navy 05/2019
3.11 MINERAL RESOURCES EXPLORATION AND EXPLOITATION	Map 62	Approximate location of known phosphate deposits	Council for Geosciences 08/2020
	Map 63	Location of awarded hydrocarbon exploration licences and wellheads	PASA
	Map 64	Location of awarded hydrocarbon exploitation licences and wellheads	PASA
3.12 NAVAL DEFENCE	Map 65	Location of military practice areas	SA Navy 06/2019
	Map 66	Location of historic ammunition dumping sites	SA Navy 06/2019
3.13 SEA AND FRESHWATER ABSTRACTION	Map 67	Location of desalination plants	DEA 2019
	Map 68	Freshwater flow reduction (intensity of impact)	Raw data: CSIR Analysis: NMU - Dr Holness/NBA 2018
3.14 WASTEWATER DISCHARGE	Map 69	Locations of wastewater discharge outfalls	DEA 2019
	Map 70	Wastewater Discharge (intensity of impact)	Raw data: DWS & DEA Analysis: NMU - Dr Holness/NBA 2018
4. ANALYSIS	Map 71	Hot spots of intersecting activities (EEZ)	DEFF 2020
	Map 72	Hot spots of intersecting activities (zoom Cape Town)	DEFF 2020
	Map 73	Hot spots of intersecting activities (zoom Port Elizabeth)	DEFF 2020
	Map 74	Hot spots of intersecting activities (PEI)	DEFF 2020
	Map 75	Cumulative impact assessment	SANBI - NBA 2018
5. THE COMING MARINE AREA PLANNING PROCESS	Map 77	South Africa's four MSP regions	DEFF/NMU/MARISMA 05/2020

Data sources for the remaining maps of the fisheries chapter are stated in the respective caption. Further metadata information can be accessed via the OCIMS Marine Spatial Planning Support Viewer.

6.2 EXPLANATION OF DATA FOR INTENSITY MAPS OF THE NDIR

The data provided is based on the work report the National Biodiversity Assessment 2018. The key report is:

- Majiedt, P.A., Holness, S., Sink, K.J., Reed, J., Franken, M., van der Bank, M.G., Harris, L.R., Adams, L., Perschke, M., Miza, S.A., Currie, J., Dunga, L.V., Dunga, L.V., Filander, Z., Green, A., Herbert, D., Karenyi, N., Palmer, R., Pfaff, M., Makwela, M., MacKay, F., van Niekerk, L., van Zyl, W., Bessinger, M., Holness, S., Kirkman, S.P., Lamberth, S., Lück-Vogel, M., 2019. Chapter 4: Pressures on Marine Biodiversity. In: Sink KJ, van der Bank MG, Majiedt PA, Harris LR, Atkinson LJ, Kirkman SP, Karenyi N (eds). 2019. South African National Biodiversity Assessment 2018 Technical Report Volume 4: Marine Realm. South African National Biodiversity Institute, Pretoria. South Africa. http://hdl.handle.net/20.500.12143/6372.

Additional background is provided in:

- Sink, K., Van der Bank, M., Majiedt, P., Harris, L., Atkinson, L., Kirkman, S., Karenyi, N., 2019. South African National Biodiversity Assessment 2018 Technical Report Volume 4: Marine Realm. South African National Biodiversity Institute, Pretoria. South Africa.

- Sink, K.J., Holness, S., Skowno, A.L., Franken, M., Majiedt, P.A., Atkinson, L.J., Bernard, A., Dunga, L.V., Harris, L.R., Kirkman, S.P., Oosthuizen, A., Porter, S., Smit, K., Shannon, L., 2019. Chapter 7: Ecosystem Threat Status, in: Sink, K.J., van der Bank, M.G., Majiedt, P.A., Harris, L.R., Atkinson, L.J., Kirkman, S.P., Karenyi, N. (Eds.), South African National Biodiversity Assessment 2018 Technical Report Volume 4: Marine Realm. South African National Biodiversity Institute, Pretoria. http://hdl.handle.net/20.500.12143/6372.

- Skowno, A.L., Poole, C., Raimondo, D., Sink, K., van Niekerk, L., van Deventer, H., Smith-Adao, L., Harris, L., Tolley, K., Zengeya, T., Midgley, G., Driver, A., 2019. National Biodiversity Assessment 2018: An assessment of South Africa's ecosystems, species and genes. Synthesis Report.

OVERALL SUMMARY OF MAPPING METHOD

Data on the each of the industries / pressures were summarised to 30m grid to facilitate data processing during the spatial assessment. Note that this grid size does not imply that the data should be interpreted or displayed at this scale. For most pressures, pressure values were converted to a 0-100 range using formulas such as p=100*d1/d80, where d1 is the raw pressure value at a site, d80 is the 80th percentile of the pressure values for that entire data set, with resultant values over 100 being assigned a value of 1001. This method was required as some of the datasets are extremely skewed and contained some very high values which would have masked the potential impact of moderate levels of pressure. The compilation of the individual pressure layers into this consistent format and range was necessary to allow spatial patterns of intensity of different pressures to be compared and cumulative pressures to be calculated. Table 20 provides a short summary for the rationale and processing methods used for each of the pressure impact layers.

List of industries / activities / pressures with the method of processing to convert the original data into maps of intensity and then impact. TABLE 20

PRESSURE LAYER	SOURCE DATA	PROCESSING METHODOLOGY
DEMERSAL INSHORE AND OFFSHORE TRAWLING (MAP 22)	Raw data was received for the period 2008-2016 with start and end positions for each trawl event, alongside data for hours of trawling and total catch in kilograms. The offshore trawl sector was defined as trawl areas deeper than 100m. Catch was recorded as the average annual take in kilograms and effort as hours of trawling. THE MAP IS BASED ON RELATIVE EFFORT IN HOURS OF TRAWLING.	■ The data was cleaned to eliminate likely errors. The points that were removed were tracks on land, tracks over 50km long, tracks where values had been rounded off in the underlying dataset and hence had integer start and end points ■ A point density was calculated using a 120m grid cell and evaluating all areas within 2.5km of the cell. Values were calculated as a total per square kilometre. ■ Values were reclassified into 10 quantiles; the lowest intensity quantile (10%) was removed to eliminate remaining very low density and likely error areas. ■ Values were compared to other datasets such as known trawl footprints. ■ Two versions of the intensity layer were produced (namely a continuous variable value showing relative intensity and binary trawled area layer giving trawl footprint based on this dataset). ■ Values were modified using MPA boundaries (where there are trawl exclusions). ■ The ecosystem map and pressure matrix were applied to produce an impact layer.
DEMERSAL LONGLINE (MAP 29)	Point data of start and end positions was received from DAFF for the period 2000-2017, alongside number of hooks per line and the total catch in kilograms. THE MAP IS BASED ON RELATIVE CATCH IN KG / KM^2 OVER THE DATA PERIOD.	■ Raw point data used for total catch of all species (largely hake and kingklip) ■ Data presented as annual average over the period 2000 to 2017. ■ A point density approach was used to add up all catch around an area. A 120m grid was used, with catches within 5000m of each grid cell being aggregated for whole period. Values were calculated in catch / km^2. ■ Low values of under 1000kg/km^2 removed to deal with scatter of inaccurate points and eliminate very low use areas. ■ Due to an extremely skewed distribution, a 100* n/n_{70} method was used to deal with high values. The n_{70} value was 19 914 km^2. After the calculation, we reclassified values over 100 as 100. ■ Values were modified using MPA boundaries (where there are activity exclusions). ■ The ecosystem map and pressure matrix were applied to produce an impact layer.
MIDWATER TRAWL (MAP 31)	Raw data was received for the period 2008-2016 with start and end positions for each trawl event, alongside data for hours of trawling and total catch in kilograms. Catch was recorded as the average annual take in kilograms and effort as hours of trawling. THE MAP IS BASED ON RELATIVE EFFORT IN HOURS OF TRAWLING.	■ Point statistics on effort in hours per square kilometre were calculated (a cell size 0.005° was used, with a 10- cell radius circular search area to determine effort). ■ We used the 100*n/n_{80} method to deal with a c=very skewed data distribution. ■ We removed very low intensity values under 1 which represent any cells with less than 1% of the level of effort of the n_{80} cell. ■ The ecosystem map and pressure matrix were applied to produce an impact layer.

[1] The specific values used in the normalization were n_{80} (80^{th} percentile), n_{90} (90^{th} percentile), and n_{median} (median value). For non-skewed distributions the formaul used a 100*n/n_{max} approach where n_{max} is the maximum value in the dataset. These values are indicated in the table.

PRESSURE LAYER	SOURCE DATA	PROCESSING METHODOLOGY
SMALL PELAGIC FISHERY (MAP 32)	Data was received for the period 2000-2016 and calculated to a 5 min grid by CAPFISH (DAFF/CAPFISH/SANBI) THE MAP IS BASED ON RELATIVE CATCH IN KG / KM2 OVER THE DATA PERIOD.	■ A centroid was used for each grid square, with total catch values for the square being allocated to this centroid. A zero value was allocated to non-fished areas. ■ A natural neighbours interpolation was undertaken for marine areas. ■ Extremely low values with under 200kg catch over the record period were excluded. ■ Reclassified into 10 quantiles (given values from 10-100). ■ Values were modified using MPA boundaries (where there are activity exclusions). ■ The ecosystem map and pressure matrix were applied to produce an impact layer.
PELAGIC LONGLINE (MAP 34)	Point data of start and end positions was received from DAFF for the period 2000-2016, alongside number of hooks per line and the total catch in kilograms. THE MAP IS BASED ON RELATIVE EFFORT IN HOOKS / KM2 OVER THE DATA PERIOD.	■ Base data with line hook numbers (effort) values associated with start and end points ■ A point density approach was used to add up all effort around an area. A 120m grid was used, with areas within 10 000m of a point being evaluated. ■ The effort was calculated in hooks/km2. Low values of under 100 hooks/km2 were removed to deal with scatter of inaccurate points and very low use areas. Reclassified into 10 quantiles (given values from 10-100). ■ Values were modified using MPA boundaries (where there are activity exclusions). ■ The ecosystem map and pressure matrix were applied to produce an impact layer.
TUNA POLE (MAP 35)	Point data collated to a coarse 50nm grid was received for the period 2007-2016. THE MAP IS BASED ON RELATIVE CATCH IN KG / KM2 OVER THE DATA PERIOD.	■ DAFF pole tuna catch data were collated by Capfish / SANBI ■ The reporting used very coarse grid squares of 50 nm. ■ We allocated the total catch records to a centroid for each grid square. Zero values were allocated to all non-fished grids squares. ■ A natural neighbours interpolation was undertaken for marine areas. ■ Extremely low values with under 10 000kg catch over the record period were excluded. ■ A modified 100*n/n99 method used to deal with skewed distributions. The n99 was 1 004 051. After the calculation values over 100 were reclassified as 100. ■ Values were modified using MPA boundaries (where there are activity exclusions). ■ The ecosystem map and pressure matrix were applied to produce an impact layer.

PATAGONIAN TOOTHFISH
 	
(MAP 36)
	Data based on number of hooks per unit area for the period 1996 – 2016.
	
	THE MAPS SHOW RELATIVE INTENSITY OF USE BASED ON NUMBER OF HOOKS PER KM² FOR THE PERIOD.
		■ Start and end points of each set each count as a fishing point
		■ The metric is number of hooks / km² for the data period
		■ These were evaluated within a 5000 metre radius
		■ Very low values were excluded (to remove scatter and clean up some issues, as well as to avoid over estimating footprint). Very low values had a density of under 750 hooks / km² for the data period
		■ Remaining values were split into three quantiles:
		  - 750 – 1565 hooks / period = Moderate intensity impact
		  - +1565 – 3382 hooks / period = High intensity impact
		■ +3382 – 60 598 hooks / period = Very high intensity impact

PRESSURE LAYER	SOURCE DATA	PROCESSING METHODOLOGY
LINEFISH (COMMERCIAL AND RECREATIONAL BOAT-BASED FISHING) (MAP 37)	Point data was received for the period 2000-2016. This layer was also used as a proxy for recreational boat-based linefishing, as the patterns of use are similar to that of the commercial sector and data for actual catch by recreational fishermen was not available. THE MAP IS BASED ON RELATIVE CATCH IN KG / AREA OVER THE DATA PERIOD.	■ Linefish data were summarised to centre points of a 5' grid ■ All values within that grid were added up to give a total kg catch for the grid square. ■ All points with no catch were allocated a 0 kg catch ■ A Natural Neighbour Interpolation was done to produce a smoothed continuous surface of estimated catch. ■ Very low values (under 100kg for the entire period) were excluded. ■ Values were then reclassified into 10 quantiles. ■ Values were modified using MPA boundaries (where there are activity exclusions). ■ The ecosystem map and pressure matrix were applied to produce an impact layer.
RECREATIONAL SHORE-BASED FISHING (MAP 38)	As with recreational boat-based fishing, new data was not available. Therefore, the data from the NBA 2011 was used. The locality data for this activity was estimated to be within 1 km of a beach access point. THE MAP SHOWS RELATIVE DENSITY PER KM2 OF RECREATIONAL FISHERMEN.	■ Intensity calculated as days/km^2 for shore ecosystem types that can be accessed ■ The 100*n/n_{80} method used to benchmark values against the high intensity of use and deal with isolated very high scores (i.e. the skewed distribution). The values over 100 reclassified as 100. ■ Values were modified using MPA boundaries (where there are activity exclusions). ■ The ecosystem map and pressure matrix were applied to produce an impact layer.
SQUID (MAP 39)	Total catch values for the period 2012 - 2016 were collated and calculated into a 5min grid THE MAP IS BASED ON RELATIVE CATCH IN KG / KM2 OVER THE DATA PERIOD.	■ A centroid was developed from the summary grid of total catch for the period. A zero value was allocate to all non- fished grid cells. ■ A natural neighbours interpolation was undertaken for marine areas. ■ Extremely low values with under 10000kg catch over the record period were excluded. ■ Exclude values with under 10000kg catch ■ Values were reclassified into 10 quantiles (given values from 10-100). ■ Values were modified using MPA boundaries (where there are activity exclusions). ■ The ecosystem map and pressure matrix were applied to produce an impact layer.
CRUSTACEAN TRAWL (MAP 42)	The NBA 2011 / OMPA crustacean trawl dataset for the period 2001-2005 was combined with more recent data for period 2006-2017. Catch was recorded as the average annual take in kilograms and effort as hours of trawling. THE MAP IS BASED ON RELATIVE EFFORT IN HOURS OF TRAWLING.	■ Existing NBA 2011/OMPA data cleaning retained. ■ The following analysis was done separately on the NBA 2011 / OMPA crustacean trawl dataset for the period 2001-2005 and the more recent data for period 2006-2017. ■ Results were combined in the final stage. ■ A point density was calculated using a 120m grid cell and evaluating all areas within 2.5km of the cell. Values were calculated as a total per square kilometre. ■ We assumed very low effort (under 25hrs) were errors. This eliminated most points that were unlikely (e.g. on land or deep water). ■ Initial analysis classified the prawn trawl to ten quantiles. This was later revised to a binary footprint layer (trawled / not trawled) due to impacts of industry. ■ Values were modified using MPA boundaries (where there are trawl exclusions). ■ Combined footprint from the two datasets used as a prawn trawl impact layer. ■ The ecosystem map and pressure matrix were applied to produce an impact layer.

PRESSURE LAYER	SOURCE DATA	PROCESSING METHODOLOGY
NETFISHING: GILLNETTING (MAP 44)	Spatial distribution of rights per management sector for 2016/17. THE MAP IS BASED ON RELATIVE EFFORT IN RIGHTS / KM2 OVER THE DATA PERIOD.	■ Spatial delineations of management zones for the beach-seine sector and the gillnet sector with TAE (rights allocated) in 2016-17 for each area. Coverage extends from coastline seawards to the 10m depth contour for the beach -seine sector and the 50m depth contour for gillnet sector. ■ Calculated as an intensity seine rights/km^2 and gill net rights/km^2 over the period ■ A 100*n/n_{max} method used to benchmark values against the highest intensity of use. ■ Values were modified using MPA boundaries (where there are activity exclusions). ■ The ecosystem map and pressure matrix were applied to produce an impact layer.
KELP HARVESTING (MAP 45)	Kelp harvesting data was collated for the period 2000- 2017 for each concession area. Based on expert input, the area of activity was mapped to the 10m depth bathy. THE MAP IS BASED ON RELATIVE HARVEST IN KG / KM2 OVER THE DATA PERIOD.	■ The four types of kelp harvesting values were aggregated into a total take in kg. ■ Values were calculated as an intensity in kg/km^2 over the record period. ■ The 100*n/n_{90} method was used to deal with skewed distributions, with n_{90} = 29316. We reclassified any resulting values over 100 as 100. ■ Values were modified using MPA boundaries (where there are activity exclusions). ■ The ecosystem map and pressure matrix were applied to produce an impact layer.
ABALONE (MAP 46)	The impacts of legal harvesting and poaching were considered in this assessment. Although actual catch data and estimated poaching data was received from DAFF, this data did not reflect the full coverage of abalone distribution nor adequately represent poaching estimates outside of the legal fishing areas. Therefore, the full distribution of abalone as reported in the literature was used as the distribution of fishing effort for both legal fishing and poaching. Intensity of legal harvesting and poaching were allocated using expert judgement supported by the literature across the abalone distribution. THE MAP SHOWS AREAS OF ALL ABALONE HARVESTING (LEGAL AND ILLEGAL).	■ Single expert-based value used for impacted areas/ecosystems ■ Modified by pressure matrix and MPAs ■ Values were modified using MPA boundaries (MPA assessed for effectiveness by expert). ■ The ecosystem map and pressure matrix were applied to produce an impact layer.
OYSTERS (MAP 47)	Average number of oysters collected per year over the period 2000 to 2017 was collated per fishing area. THE MAP IS BASED ON RELATIVE HARVEST IN OYSTERS / KM^2 OVER THE DATA PERIOD.	■ Spatial delineations of management zones for the collection of oysters within the Southern Cape and KZN regions. Coverage extends from coastline seawards to the 10m depth contour. ■ Calculated as a fishing intensity measured in oysters/km^2 over the period ■ The 100* n/n_{90} method used to deal with skewed distributions, with n_{90} = 2008.16. We reclassified any resulting values over 100 as 100. ■ Values were modified using MPA boundaries (where there are activity exclusions). ■ The ecosystem map and pressure matrix were applied to produce an impact layer.

PRESSURE LAYER	SOURCE DATA	PROCESSING METHODOLOGY
SMALL SCALE / SUBSISTENCE FISHING (MAP 48)	NBA 2011 data used as basis (SANBI) THE MAP SHOWS RELATIVE DENSITY PER KM2 OF SMALL SCALE / SUBSISTENCE FISHERMEN.	■ We calculated harvesters per km of coastline ■ The 100*n/n90 method was used to deal with skewed distributions, with 14.64. We reclassified any resulting values over 100 as 100. ■ Values were modified using MPA boundaries (where there are activity exclusions). ■ The ecosystem map and pressure matrix were applied to produce an impact layer.
SOUTH COAST ROCK LOBSTER (MAP 49)	South Coast Rock Lobster harvesting data was collated by for each concession area for the period 2007 to 2016. THE MAP IS BASED ON RELATIVE CATCH IN KG / KM² OVER THE DATA PERIOD.	■ A centroid was developed from the summary grid of total catch. A zero value was allocate to all non- fished grid cells. ■ A natural neighbours interpolation was undertaken for marine areas. ■ Extremely low values with under 713kg catch over the record period were excluded. ■ A 100*n/n_{90} method used to deal with the skewed distribution of values, with n90 = 33 420. We reclassified any resulting values over 100 as 100. ■ Values were modified using MPA boundaries (where there are activity exclusions). ■ The ecosystem map and pressure matrix were applied to produce an impact layer.
WEST COAST ROCK LOBSTER (MAP 51)	West Coast Rock Lobster harvesting data was collated by for each concession area for the period 2006 to 2016 THE MAP IS BASED ON RELATIVE CATCH IN KG / KM² OVER THE DATA PERIOD.	■ Total catch for period for all types of rock lobster fishery were aggregated into the spatial delineations of management zones for the catch of West Coast rock lobster. ■ Coverage extends from coastline seawards to the 20m depth contour. ■ Calculated as an intensity measured in Total catch/km^2 over the period ■ A 100*n/n_{90} method used to deal with skewed distributions, with the n_{90} being 992.28. We reclassified any resulting values over 100 as 100. ■ Values were modified using MPA boundaries (where there are activity exclusions). ■ The ecosystem map and pressure matrix were applied to produce an impact layer.
MARITIME TRANSPORT (MAP 58 AND MAP 59)	Data for maritime transport was extracted from the global dataset published by Halpern et al. (2015)[310]. THE MAPS SHOW RELATIVE INTENSITY OF SHIPPING BASED ON GLOBAL DATASETS. THE FOCUS IS ONLY LARGER COMMERCIAL CARGO AND FISHING VESSELS, BUT INCLUDES ANY VESSEL WHICH HAS AN AIS LOCATION SYSTEM.	■ Global data were resampled to the SA EEZ. ■ The values were in SA were rescaled to South African range (0-100). ■ The 100*n/n_{90} method was used to deal with skewed distributions, with n_{90} = 72.29. We reclassified any resulting values over 100 as 100. ■ Very low values (0-3), were reclassified as 0 ■ The ecosystem map and pressure matrix were applied to produce an impact layer.

PRESSURE LAYER	SOURCE DATA	PROCESSING METHODOLOGY
FRESHWATER FLOW REDUCTION (MAP 68)	Runoff reduction values from Estuary assessment of NBA 2018 were used to develop this layer and the area of influence for this activity assigned to river-influenced ecosystem types from NBA 2018 ecosystem map. THE MAPS SHOW AREAS MOST IMPACTED BY REDUCED INFLOWS OF FRESHWATER AND SEDIMENT DUE TO DAMS AND WATER ABSTRACTION UPSTREAM.	■ Runoff reduction coded was into appropriate ecosystems based on location of river mouths. ■ Runoff could be allocated to smaller systems (primary river influenced systems near the mouths) and to larger broader systems. ■ Runoff reduction values were calculated in million m^3/km^2 based on all rivers flowing into each ecosystem in question. ■ A $100*n/n_{median}$ method was used to deal with skewed distributions, with the n_{median} value being 0.7. We reclassified any resulting values over 100 as 100. ■ The ecosystem map and pressure matrix were applied to produce an impact layer.
WASTEWATER (MAP 70)	Point data on current wastewater discharge was collated from DEA. DAFF provided point data for aquaculture outfalls. Additional discharge points from NBA 2011 were also included. THE MAPS SHOW AREAS IN CLOSE PROXIMITY TO KNOW WASTEWATER OUTFALLS.	■ Based on SANBI expert input, a total impact distance of 2500m was calculated. ■ The values were split into 10 equal distance intervals. Impact was calculated based on Euclidean distance, with 0m distance having a maximum score (100) and 2500m having a score of 0. – The ecosystem map and pressure matrix were applied to produce an impact layer.

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