

NATIONAL BIODIVERSITY ASSESSMENT 2011: Technical Report

Volume 4: Marine and Coastal Component



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This report forms part of a set of six reports on South Africa's National Spatial Biodiversity Assessment 2011. The full set is as follows:

Synthesis Report

Driver, A., Sink, K.J., Nel, J.L., Holness, S., Van Niekerk, L., Daniels, F., Jonas, Z., Majiedt, P.A., Harris, L. & Maze, K. 2012. *National Biodiversity Assessment 2011: An assessment of South Africa's biodiversity and ecosystems. Synthesis Report*. South African National Biodiversity Institute and Department of Environmental Affairs, Pretoria.

Technical Reports

Volume 1: Terrestrial Component

Jonas, Z., Daniels, F., Driver, A., Malatji, K.N., Dlamini, M., Malebu, T., April, V. & Holness, S. 2012. *National Biodiversity Assessment 2011: Technical Report. Volume 1: Terrestrial Component*. South African National Biodiversity Institute, Pretoria.

Volume 2: Freshwater Component

Nel, J.L. & Driver, A. 2012. *National Biodiversity Assessment 2011: Technical Report. Volume 2: Freshwater Component*. CSIR Report Number CSIR/NRE/ECO/IR/2012/0022/A. Council for Scientific and Industrial Research, Stellenbosch.

Volume 3: Estuary Component

Van Niekerk, L. & Turpie, J.K. (eds). 2012. *National Biodiversity Assessment 2011: Technical Report. Volume 3: Estuary Component*. CSIR Report Number CSIR/NRE/ECOS/ER/2011/0045/B. Council for Scientific and Industrial Research, Stellenbosch.

Turpie, J.K., Wilson, G. & Van Niekerk, L. 2012. *National Biodiversity Assessment 2011: National Estuary Biodiversity Plan for South Africa*. Anchor Environmental Consulting, Cape Town. Report produced for the Council for Scientific and Industrial Research and the South African National Biodiversity Institute.

Volume 4: Marine Component

Sink, K.J., Holness, S., Harris, L., Majiedt, P.A., Atkinson, L., Robinson, T., Kirkman, S., Hutchings, L., Leslie, R., Lamberth, S., Kerwath, S., von der Heyden, S., Lombard, A.T., Attwood, C., Branch, G., Fairweather, T., Taljaard, S., Weerts, S., Cowley, P., Awad, A., Halpern, B., Grantham, H. & Wolf, T. 2012. *National Biodiversity Assessment 2011: Technical Report. Volume 4: Marine and Coastal Component*. South African National Biodiversity Institute, Pretoria.

Executive summary

The marine and coastal component of the National Biodiversity Assessment 2011 is an assessment of the state of biodiversity and ecosystems in South Africa's marine and coastal environment. This report represents a milestone for marine biodiversity in South Africa. Major new contributions include the first national marine and coastal habitat classification and national habitat maps for the coast, ocean floor and the open ocean; a comprehensive review of pressures on marine and coastal biodiversity; and the first data driven assessment of ecosystem threat status and protection levels for 136 habitat types. An overview of the state of knowledge of marine taxonomy, a chapter on marine alien and invasive species and a review of marine genetic biodiversity are included for the first time. Knowledge gaps and research priorities are identified and a detailed set of priority actions are distilled to address the key findings of this assessment.

The area assessed extends 500 m inshore of the coastline and 200 nautical miles offshore to include the mainland Exclusive Economic Zone, excluding the Prince Edward Islands. Both spatial and thematic elements are included in the report which is structured in 17 sections nested within three broad divisions; the spatial assessment, the thematic component, and an overview of key findings, research priorities and recommended priority actions.

The spatial assessment includes three main sets of spatial input layers: habitat types, pressures and protected areas. A national marine and coastal habitat classification and map was developed that defined and mapped 136 marine and coastal habitat types. A total of 27 pressures on marine and coastal biodiversity were reviewed and mapped. A revised Marine Protected Area (MPA) map showing South Africa's 23 MPAs was produced.

The national marine and coastal habitat classification incorporates several key drivers of marine biodiversity pattern: terrestrial and benthic-pelagic connectivity, substrate, depth and slope, geology, grain size, wave exposure and biogeography. The habitat classification revises the bioregions and biozones used in the National Spatial Biodiversity Assessment 2004 to include six ecoregions (Benguela, Agulhas, Natal, Delagoa, Southeast Atlantic and Southwest Indian) and 22 finer scale ecozones that nest within these ecoregions. Each ecozone is considered to have distinct species assemblages that need to be considered in biodiversity assessments and in planning for a representative MPA network. The habitat classification identifies and maps a total of 136 habitat types including 37 coast types, 17 inshore (5-30 m) habitat types and 62 offshore (deeper than 30 m) benthic habitat types. In addition, a separate classification was undertaken to define 16 different offshore pelagic habitat types based on differences in sea surface temperature, productivity, chlorophyll, depth and the frequency of eddies, temperature fronts and chlorophyll fronts.

The National Biodiversity Assessment 2011 drew from recent efforts in mapping human use in coastal and offshore environments and produced 27 maps reflecting the relative intensity of 27 pressures or drivers of ecosystem change. These include 18 types of extractive marine living resource use (13 commercial fisheries, two types of recreational fishing, commercial kelp harvesting, subsistence harvesting and the shark control program), petroleum activities, diamond and titanium mining, shipping, coastal development, disturbance associated with coastal access, waste water discharge, mariculture, invasive alien species and the reduction of freshwater flow into marine

ecosystems. An overview of each pressure was compiled drawing from more than 350 publications to report on the known and potential impact of each pressure in different habitat types.

The marine and coastal assessment did not undertake new analyses to determine priority areas for MPA establishment but draws from other initiatives to present spatial priorities. Offshore Marine Protected Areas, other types of offshore spatial management measures and an MPA in Namaqualand are priorities at a national scale. The proclamation of the Prince Edward Islands MPA remains an urgent national priority. Fine-scale systematic planning in KwaZulu-Natal and the Agulhas region identified several provincial or regional priorities for Marine Protected Area establishment there.

Thematic elements of the assessment address ecosystem services, species of special concern, alien and invasive species, climate variability and change, and the status of taxonomic and genetic knowledge. There is compelling evidence from multiple international sources showing that diverse and healthy ecosystems underpin ecosystem processes, resilience (including resistance, recovery and reversibility), and thus the sustainability of ecosystem services. In a global analysis of the value of ecosystem services, marine and coastal ecosystems had the greatest total global flow value and contributed the highest value compared to all other ecosystems. In South Africa, coastal resources make a significant contribution to South Africa's Gross Domestic Product, including nearly R2.5 billion from fisheries. The people of South Africa are in a strong position to benefit greatly from the many ecosystem services that are freely available from the rich marine and coastal ecosystems in this country. This is mainly because there are still opportunities to restore and protect most marine and coastal habitat types, and South Africa is poised to expand and strengthen the MPA network, which in turn will enhance ecosystem service provision, with long-term sustainability.

Key findings

The key findings of the marine and coastal component of the National Biodiversity Assessment 2011 are highlighted below, including some of their implications. These findings form the basis for the key messages and priority actions that follow.

47% of marine and coastal habitat types are threatened

- Sixty-four of 136 (47%) marine and coastal habitat types are threatened, with 17% of all habitat types critically endangered, 7% endangered and 23% vulnerable.
- Many threatened habitat types have limited spatial extent, so more than 70% of South Africa's total marine and coastal area is least threatened.
- A higher proportion of coastal than offshore habitat types are threatened. In the offshore environment, there are more threatened benthic habitat types than threatened pelagic habitat types.
- All rocky shelf edge and island-associated habitat types are threatened.

- Along the coast, many habitat types in Namaqualand and the southwestern Cape are threatened. Offshore, the Southern Benguela and Agulhas ecoregions have the most threatened habitat types, including productive habitats that support important commercial fisheries.

40% of marine and coastal habitat types have no protection

- Fifty-four (40%) marine and coastal habitat types are not represented at all in South Africa's MPA network.
- Most of these unprotected habitat types are offshore, reflecting the fact that almost all of South Africa's existing MPAs extend only a short distance from the shore.
- Along the coast and inshore, habitat types with no protection include five in Namaqualand and two in the Natal ecoregion.
- A total of 13 habitat types are both critically endangered and have no protection, suggesting that these habitat types are priorities for improved management as well as representation in the MPA network, to reduce human impacts.

Only 6% of marine and coastal habitats are well protected

- Only 9% of coastal and inshore habitat types are well protected.
- Most coastal habitat types are moderately protected, reflecting the fact that in many MPAs there is insufficient protection from fishing (i.e. insufficient representation in no-take zones).
- Only 4% of offshore habitat types are well protected.
- There is poor awareness of the role of MPAs in biodiversity conservation, fisheries management, climate change adaptation and delivery of socio-economic benefits.

Fishing remains the greatest pressure on marine biodiversity

- Fishing is a key driver of change in marine and coastal ecosystems and has the highest impact score in 10 of 13 broad ecosystem groups.
- Key challenges include overexploited resources, substantial and unmanaged bycatch in some sectors, incidental seabird mortalities, habitat damage, concerns around food supply for other species and other ecosystem impacts of fishing.
- Poaching continues to threaten marine biodiversity, resource sustainability and the livelihoods of legitimate fishers.

- The division of the former Marine and Coastal Management branch in the Department of Environmental Affairs into a fisheries branch within the Department of Agriculture, Forestry and Fisheries and the Oceans and Coasts Branch within the Department of Environmental Affairs in 2009 makes the implementation of the Ecosystem Approach to Fisheries management more difficult and costly.

Coastal development is the greatest pressure on coastal biodiversity

- 17% of South Africa's coastline has some form of development within 100 m of the shoreline.
- Coastal ecosystems provide key ecosystem services including:
 - protection from large waves associated with extreme weather events
 - provision of a reserve supply of sand in the dunes to maintain beaches
 - water filtration and nutrient cycling
 - provision of critical nursery areas for important fish species
 - valuable tourism asset.
- The interacting pressures of coastal development and climate change (coastal squeeze) threaten beaches, dunes, other coastal habitats and their underlying processes. This can disrupt critical ecosystem services.
- Inappropriate coastal development compromises ecosystem services and hampers our ability to adapt to climate change.

Freshwater flow reduction impacts marine, coastal and estuarine ecosystems

- Approximately 40% the flow from South Africa's 20 largest catchments no longer reaches the estuaries concerned.
- Freshwater flow reduction can uncouple critical ecological linkages between terrestrial and marine environments and disrupt ecological processes needed to maintain marine habitats, resources and ecosystem services.
- The impacts of reduced freshwater input on marine biodiversity and resources include those on physical habitat, reduced nutrient inputs and alterations to important ecological processes such as nursery functions, foodwebs and energy flow.
- Impacts have occurred along the entire South African coast but are expected to be more severe in the oligotrophic marine environment of the east coast.
- Freshwater input has been linked to marine resource abundance including linefish such as slinger and kob more than 40 km offshore on the Thukela banks in KwaZulu-Natal.

The majority of marine resources are overexploited and several marine and coastal species are threatened

- More than 630 species are caught by commercial, subsistence and recreational fisheries in South Africa.
- Stock status is reported for approximately 6% (41) of these species.
- Of these, 61% (25 of 41) are overexploited.
- Overexploitation and fishing impacts, freshwater flow reduction and the poor state of South Africa's estuaries, pollution and climate change are key threats at the species level.
- South Africa has at least 23 threatened marine species but needs to invest in conservation assessments (such as Red Lists) to systematically and comprehensively assess the status of marine species and prioritises conservation action.
- Several elasmobranchs and linefish are threatened.

Marine alien and invasive species are an emerging pressure

- New research has shown a large increase in the number of known introduced marine species.
- Introduced microbes, parasites and pathogens are an emerging concern that threatens biodiversity, the developing mariculture industry and human health.
- Some harmful algal blooms (HABs) are caused by alien species and these can have severe consequences for human health, fisheries resources and the mariculture industry. Proper ballast water management can reduce the risks associated with HABs.
- There are eight known marine invasive species that are impacting marine and coastal biodiversity and driving up management costs in mariculture facilities.
- The main pathways of introduction include shipping, mariculture and petroleum activities.

Climate change has ecological, fisheries, resource management and socio-economic implications

- Clear climate change trends are difficult to detect and predict, particularly at a local scale, but it is recognised that climate change adds uncertainty and variability, which in turn increases the complexity of research and management in the marine and coastal environment.
- The following changes have been observed in South Africa:

- Changes in sea temperature
- Shifting distributions of rock lobster and small pelagic fish have led to social, ecological and economic impacts. These impacts complicate resource management.
- Increased frequency and extent of coral bleaching
- Sea-level rise
- Increased coastal erosion linked to increased frequency and severity of storms
- The 17% of South Africa's coastline with some development within 100 m of the shoreline is particularly vulnerable to climate change impacts.

Key messages and priority actions

The messages and recommendations below follow from the key findings of the National Biodiversity Assessment 2011. Strategic objectives and priority actions for managing and conserving South Africa's biodiversity are set out in the National Biodiversity Strategy and Action Plan (NBSAP) and the National Biodiversity Framework, both of which are due to be reviewed shortly. Priority actions suggested by the results of the National Biodiversity Assessment 2011 should feed into the review process. They are intended not to pre-empt the process of revising the NBSAP and National Biodiversity Framework but rather to provide science-based input to strengthen the process.

Many opportunities exist to secure South Africa's marine and coastal habitats

Although 47% of South Africa's marine and coastal habitats are threatened, there are still opportunities to restore impacted habitats, secure remaining healthy habitats, prevent further damage and improve marine biodiversity management. South Africa can constrain key emerging pressures through pro-active integrated spatial planning and effective regulation that accounts for sensitive and threatened ecosystems. Sensitive areas and critical habitats for the recovery of key marine and coastal resources should be identified and secured. Marine and Estuarine Protected Areas, Integrated Coastal Management, Fishery Management Areas and other types of ecosystem-based spatial management measures (such as seabed protection zones) are key tools for securing marine and coastal habitats. Collaborative mainstreaming initiatives in the fisheries and mining sectors offer opportunities for improved marine biodiversity management.

South Africa is poised to expand its Marine Protected Area network

South Africa is a global leader in systematic biodiversity planning and has identified several strategic geographic priority areas for the establishment of new Marine Protected Areas and other types of spatial management measures. These include priority areas in KwaZulu-Natal and the Agulhas ecoregion as determined from fine-scale plans and focus areas for offshore protection based on a national analysis. Many of South Africa's most productive offshore habitats that support fisheries are

not included in the current MPA network. The Prince Edward Islands MPA is ready for declaration and a coastal MPA in Namaqualand is an urgent priority.

MPAs are valuable national assets that deliver ecosystem services and socio-economic benefits

South Africa's Marine Protected Area (MPA) network plays a key role in protecting marine and coastal habitats and sustaining fisheries. Coastal protected areas can support rural livelihoods and local economic development through providing jobs and opportunities for ecotourism and conservation-related industries. Protected areas attract foreign and domestic tourists, provide ecosystem services, and safeguard the environment for future generations. Fully protected MPAs help sustain fisheries by protecting breeding resources and by seeding adjacent areas with eggs, larvae or young and adults. South Africa has the opportunity to improve the delivery of ecosystem services from the existing MPA network by implementing new no-take zones, increasing benefits through diversified non-consumptive tourism activities and improving monitoring and management effectiveness. The strengthening of South Africa's MPAs will depend on resolving current resource-use conflicts, reducing current impacts inside existing MPAs (especially fishing) and strengthening management capacity. Building public awareness of the role of MPAs in protecting biodiversity and sustaining fisheries is a priority. Capacity, processes and arrangements are needed to allow stakeholders to participate in MPA design, planning and management.

Overexploited fish stocks can recover and provide long-term food and job security

Although many resources are overexploited, management action can lead to stock recovery. Key elements in securing resource sustainability in the long term include robust stock assessments, effective data management and science-based management action grounded in the realities of resource abundance. The implementation of the Ecosystem Approach to Fisheries management can contribute to resource recovery through protection of spawning and nursery areas and the maintenance of other essential fish habitats. Improved bycatch management offers opportunities to reduce waste and derive benefits from non-target species, through value adding activities that support job creation. Credible third party eco-certification provides an incentive for responsible fisheries and can deliver additional socio-economic benefits through improved market access and security. Current levels of poaching should be reduced to ensure recovery of key resources and to secure livelihoods of legitimate fishers and their dependent communities.

Integrated coastal management supports key ecosystem services and climate change adaptation

Integrated coastal management (ICM) is the process by which multiple uses of the marine and coastal environment are managed so that a wide range of needs are catered for, including both biodiversity protection and sustainable use, allowing all stakeholders to participate and benefit. The relatively high proportion of threatened coastal habitat types (62%) highlights the need for integrated management of the coastal environment, reinforcing the importance of the ICM Act and the tools it has introduced for coastal management. The implementation of ICM can constrain impacts in the sensitive coastal zone and ensure continued delivery of key coastal ecosystem services. These services include protection and buffering from sea-level rise, severe storms and tsunamis. ICM is essential in the wise development and optimal use of South Africa's coastline, including our beautiful beaches, an important investment that is critical to successful coastal tourism.

Healthy natural ecosystems increase society's resilience to the impacts of climate change and ICM is therefore a key element in South Africa's climate change adaptation strategy. Coastal Management Programmes, coastal set-back lines, extending coastal public property, and refining the delineation of the coastal protection zone are required in terms of the Act and will support resilience to climate change. Other tools such as demarcating coastal hazard areas, use of coastal vulnerability indices and coastal land-use planning will further support climate change adaptation. Further coastal ribbon development should be avoided in favour of nodal development, appropriately placed behind scientifically determined set-back lines. This will ensure that coastal impacts are mitigated and managed and allow sections of the coast to remain natural, supporting long term delivery of key ecosystem services and buffering human settlements and activities from climate change impacts.

Fresh water flowing into the sea is not wasted and is critical for ecosystem functioning

Fresh water (including groundwater) flowing into the estuaries and the sea maintains important ecological processes that keep marine resources healthy. Catchments, rivers, estuaries, groundwater and the ocean are linked through freshwater flow and this essential connectivity depends on maintaining these links. Freshwater flow provides nutrients, sediments that form important habitats, and underlies critical ecological processes. These processes include 1) the nursery function of estuaries and areas offshore of rivers and 2) 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. 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. Artificial breaching of an estuary mouth to minimise this risk is expensive and damages estuarine ecosystems. Water running out to sea should not be considered wasted but instead is essential for maintaining a range of coastal and marine ecosystem services.

Early detection, risk assessment and quick management action can prevent future invasions by alien species

South Africa can avoid the ecosystem damage and economic impacts associated with new invasive species through finalisation and effective implementation of the Alien and Invasive Species regulations in terms of the National Environmental Management: Biodiversity Act (Act 10 of 2004), a dedicated monitoring programme to enable early detection, and effective management. Effective management will depend on adequate planning, co-ordination and resources to support preventative management action and early response mechanisms. The developing mariculture industry should be supported to ensure that further invasive species are not introduced and that the management of existing invasive species reduces their economic impacts in this sector. Increased awareness of the risks, impacts and management options for invasive species is needed within the mariculture sector. Co-ordinated cross-sectoral management for ballast water and biofouling vectors is critical to prevent further introductions of alien and invasive species.

Priority actions suggested by the key findings and messages above include the following. As explained earlier, these priority actions should support the upcoming revision of the National Biodiversity Strategy and Action Plan and the National Biodiversity Framework.

Priority Action: Minimise impacts on priority ecosystems

- Prevent further degradation of critically endangered and endangered marine and coastal habitat types.
- Ensure that the refinement of boundaries of the coastal protection zone and coastal public property takes ecological factors into account, in support of the implementation of the ICM Act.
- Develop a map of coastal ecosystem priority areas based on a systematic biodiversity plan that integrates terrestrial, freshwater, estuarine, and marine aspects. This national coastal biodiversity plan should cover the whole coastal protection zone as well as the terrestrial and near-shore areas of coastal public property. The coastal biodiversity plan should identify coastal areas where it is critical to keep natural habitat intact to assist with adapting to the impacts of climate change.
- Identify marine ecosystem priority areas including sensitive habitats and key areas for resource recovery.
- Support the use of coastal and marine ecosystem priority areas in integrated planning, management and decision making across all sectors that impact on marine and coastal ecosystems and their relevant government departments. These include fisheries and mariculture, mining and alternative energy, coastal development, and water resource management.

- Determine and implement the most appropriate tools to manage and conserve coastal ecosystem priority areas. Mandatory tools include Coastal Management Programmes, coastal set-back lines, the extension of coastal public property and refining the delineation of the coastal protection zone. Other potential tools include MPAs, Special Management Areas, demarcating coastal hazard areas, the use of coastal vulnerability indices, coastal land-use planning, and listing of threatened or protected coastal ecosystems in terms of the Biodiversity Act.
- Determine and implement the most appropriate tools to manage and conserve marine ecosystem priority areas. Potential tools include MPAs, Fishery Management Areas, listing of marine ecosystems and collaborative management with offshore industries.
- Explore alternative management mechanisms for biodiversity conservation other than direct regulation (e.g. MPAs), such as incentive-based mechanisms, market-based mechanisms (e.g. eco-certification), awareness initiatives and payment for ecosystem services.

Priority Action: Expand and strengthen the Marine Protected Area Network

- Expand South Africa's MPA network to include currently unprotected habitat types, including proclamation of Offshore MPAs and an MPA in Namaqualand.
- Increase the delivery of the existing MPA network by
 - implementing more no-take zones to contribute to the sustainability of fisheries
 - increasing benefits through diversified non-consumptive tourism activities and
 - improving monitoring and management effectiveness.
- Improve the science base for South Africa's MPAs through species inventories, fine-scale habitat mapping, and coordinated monitoring initiatives. MPAs provide significant research opportunities for scientists, including potential to strengthen stock assessments for linefish.
- Transboundary MPAs between South Africa, Namibia, Mozambique and our neighbours in the Southern Ocean should be pursued and would need clear management agreements.
- Build public awareness of the role of MPAs in marine biodiversity conservation and fisheries management through targeted awareness initiatives, collaborative research and co-management.

Priority Action: Support the recovery of overexploited resources and threatened species

- Ensure that fishing quotas and fishing effort allocations (e.g. number of fishers or vessels) are grounded in the realities of resource abundance.

- Invest in the management of critical data sets (e.g. fisheries research and commercial catch and effort data and observer data) to support fisheries management. Dedicated data managers, better electronic systems for capturing, storing, validating and disseminating data and improved fisheries data with finer spatial resolution will improve place-based resource and ecosystem management. Advanced data policies and adequate resources will need to be developed and secured to achieve this priority.
- Develop and implement resource recovery plans for overexploited species.
- Cap effort on shark fishing and protect shark nursery grounds.
- Identify critical habitats for the recovery of key resources (e.g. spawning and nursery areas, key foraging areas).
- Secure critical habitats through the implementation of spatial management measures including Fishery Management Areas and Marine Protected Areas.
- Manage incidental mortality of seabirds and secure important offshore bird areas.
- Fortify compliance efforts and reduce poaching especially for rock lobster, abalone and linefish.
- Develop and implement a strategy to prioritise and catalyse southern African or national conservation assessments (Red Lists) for marine species.
- Build public awareness about threatened species, with a focus on linefish such as white steenbras and dusky kob.

Priority Action: Prevent further introduction and spread of invasive species

- Prevent future introductions of invasive species introductions through finalising and implementing the Alien and Invasive Species Regulations, including ensuring that all relevant marine species are listed.
- Review South Africa's adherence to international protocols, capability to deal with existing and emerging invasive species and enforcement of law to prevent new invasions.
- Build scientific and management capacity to support the identification of potential marine invasive species, assess risks and develop and implement appropriate management action. Additional capacity will also be needed to enforce regulations.
- Develop capacity and resources to make use of DNA barcoding to identify invasive species.
- Publish and publicise existing lists of known marine invasive species found in the South African marine environments.

- Establish co-ordinated monitoring initiatives to allow early detection of potential invasive species. Such monitoring initiatives need to include a focus on mariculture facilities, offshore oil and gas infrastructure, ports and harbours.
- Secure resources and develop capacity to enable rapid management action to prevent potential invasive species from becoming established when detected through monitoring programmes.
- Explore methods and potential for eradicating the European shore crab *Carcinus meanus* (currently confined to two harbours) and the black sea urchin *Tetrapygus niger* (currently confined to mariculture facilities).
- Ensure that the national strategy for invasive species that is currently being initiated addresses the marine environment comprehensively.
- Support the Department of Transport in the co-ordinated implementation of the conditions of the International Maritime Organisation Ballast Water Management Convention to ensure South Africa's readiness when the convention comes into force.
- Develop technical and management capacity to support the implementation of the conditions of the Ballast Water Management Convention.
- Promote South Africa's work in support of the International Maritime Organization as related to management of ballast water and biofouling. Develop case studies to report on port surveys and management of marine invasive organisms.

Priority Action: Support good environmental practice and effective regulation of the emerging mariculture sector

- Apply global lessons and good practice guidelines in avoiding and mitigating the environmental impacts of mariculture to ensure that wild fish populations and marine ecosystems are not further threatened by this emerging sector.
- Locate mariculture on land, or in ocean areas that have sufficient depth and flushing rates to minimise habitat impacts. Mariculture should be avoided in biodiversity priority areas including Critical Biodiversity Areas, Marine Protected Areas, Estuaries, Fresh Water Ecosystem Priority Areas (including estuaries), critically endangered and endangered ecosystems and other sensitive biodiversity areas.
- Select species for mariculture with full consideration of potential impacts on indigenous species, ecosystems and fisheries. In keeping with the Biodiversity Act, a comprehensive risk assessment and contingency plan should be conducted for all mariculture operations proposing to farm alien or translocated species. For improved cooperative governance, the biodiversity sector should be represented in the mariculture working group.

- Ensure effective management and husbandry of stock, food and feeding, disease control, effluent, waste and interactions with wild stocks and predators to minimise impacts on indigenous species and ecosystems and prevent negative impacts on existing fisheries and other activities (e.g. ecotourism).
- Control incidental introductions with stock or spat of introduced species.
- In order to prevent the introduction of microbes, parasites and pathogens to wild populations, effluent from land-based farms should be filtered and sterilised and sea-farmed stock should be certified disease free prior to stocking. This should also apply to the transport medium for mariculture species, irrespective of whether animals are moved within or imported from outside South Africa's borders.
- To avoid potentially damaging genetic impacts, ensure that the genetic variability of broodstock resembles the genetic profile of the surrounding wild populations.
- Raise awareness about the potential impacts of mariculture and develop management capacity within the mariculture industry sector through increased training in responsible aquaculture methods and best practices.
- Develop capacity for effective regulation of the mariculture sector and to ensure compliance with environmental management plans developed for mariculture enterprises. Regular, inspections of all mariculture enterprises by suitably qualified biodiversity and animal health experts are needed to minimise the risks of the introduction of disease and invasive species into marine and coastal ecosystems.

Priority Action: Strengthen climate change resilience

- Conserve, manage and where appropriate rehabilitate natural ecosystems that play a critical role in climate change adaptation. For example, beaches, dunes, estuaries, mangroves and kelp forests should be maintained in an ecologically healthy and functioning state as they play a critical role in helping humans cope with the impacts of climate change.
- Implement integrated ecosystem-based management including Integrated Coastal Management and the Ecosystem Approach to Fisheries management.
- Ensure MPAs support resilience to climate change through adequate representivity and connectivity by expanding and consolidating the MPA network.
- Improve the knowledge base to support the understanding of climate change in South Africa. Long-term monitoring is a key element in research to understand climate variability and change.
- Further develop scientific capacity to detect and predict changes and provide science-based advice to support climate change adaptation and mitigation.

- Develop adaptive management capacity including enhanced management flexibility to adapt to a changing environment.
- Ensure policies encourage diversification of resource use and income generation to enhance social resilience in the face of uncertainty and variability. This is especially important for the most vulnerable coastal and fisher communities.

Priority Action: Ensure sufficient freshwater flow to the coastal and marine environment

- The needs of coastal and marine ecosystems (water quantity, water quality & sediment) should be taken into account in determining and implementing ecological water requirements for estuaries.

Priority Action: Strengthen institutional arrangements to facilitate integrated ecosystem-based management

- Develop effective institutional arrangements to underpin co-operative governance to support ecosystem based management (including the Ecosystem Approach to Fisheries management) and integrated strategic planning and management (including Integrated Coastal Management).
- Consider the development of an Inter-Departmental Liaison Committee for Marine Ecosystems, similar to the recently established Inter-Departmental Liaison Committee for Freshwater Ecosystems. This could provide opportunities for the various key role-players in marine ecosystem management and conservation to establish shared objectives and to collaborate actively, and to clarify respective roles and responsibilities.
- Strengthen collaboration between DEA and DAFF around the management, sustainable use and conservation of marine ecosystems. Formal co-operation with clear roles and responsibilities is needed to support Marine Protected Area establishment and management, Integrated Coastal Management and other types of effective spatial management. The multiple objectives of MPAs including both biodiversity conservation and fisheries sustainability should be recognised and inter-departmental co-operation is critical to the success of MPAs.

Priority Action: Invest in the knowledge base to support biodiversity assessment and management

- Refine the marine and coastal habitat classification and map based on testing the validity of the current classification, high resolution bathymetric mapping, and systematic marine biodiversity surveys across broad ecosystem groups.
- Collate information and conduct dedicated sampling to develop descriptions of habitat types.

- Establish long-term in-situ monitoring sites across broad ecosystem groups to calibrate the assessment of ecosystem condition and inform responses to emerging impacts.
- Invest in improved baselines through the capture, analysis and management of historical datasets.
- Re-instate and secure the scientific observer program in the long term to improve the knowledge base that supports fisheries management, identification of key biodiversity impacts of fisheries and the development of appropriate mitigation measures.
- Secure resources for, develop and implement a marine biodiversity information strategy. This should support the development and management of appropriate co-ordinated specimen, species and genetic databases and address taxonomic priorities, support conservation assessments and the identification of invasive species.
- Improve co-ordination and collaboration in the collation and management of marine biodiversity data. Encourage data sharing to catalyse increased benefits, application and data security.
- Develop opportunities for all stakeholders to contribute to the assessment and conservation of marine biodiversity. Collaborative mainstreaming initiatives, participatory research, citizen science initiatives & co-management arrangements can help to improve public participation.