

NATIONAL SUSTAINABLE DEVELOPMENT STRATEGY

SPECIALIST REVIEW: COASTAL & MARINE PHYSICAL ENVIRONMENT

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Trends and Forecasts

Three main issues affect the physical marine and coastal environment of South Africa, these being Climate change, Marine pollution and Modification/Loss of habitat. A brief discourse on trends and forecasts for each of these is provided below.

Climate change

The effects of global climate change are becoming increasingly apparent through resulting effects on key atmospheric and oceanographic parameters around the world (e.g. increasing frequency and intensity of extreme weather events and rising sea levels). Long term monitoring of sea surface temperatures, mean sea level and rainfall in South Africa indicates that changes in the local environment are similar to those of global patterns. Many of these changing parameters are likely to have significant consequences for marine ecosystems and the fisheries they support, predicted to most severely impact on subsistence and small-scale fishing sectors. Clark (in press 2005) proposes the key parameters expected to most greatly impact on the marine environment are rising sea surface temperatures, rising mean sea level, decreasing rainfall, changing pressure/wind fields, increasing CO₂ concentration, and increasing UV radiation.

Sea surface temperatures off southern Africa are reported to have increased by 0.25°C per decade over the past four decades (Schumann *et al.* 1995). Data collected from Voluntary Observing Ships (VOS) in the southwestern Cape region over the past 100 years (1903 – 2004) confirm these patterns of rising sea surface temperatures (Fig. 1). The effects of rising sea temperatures on marine organisms and fisheries are likely to be far reaching as the majority of marine organisms are thermo-conformers (i.e. their body temperature is prescribed by the water temperature in which they occur) and respond directly and immediately to any change in ambient temperature (Clark in press 2005). Changes in sea surface temperatures will affect physiological processes at the organism level, leading to changes in marine species distribution patterns, breeding, feeding and recruitment, eventually impacting on entire ecosystems (Clark in press 2005).

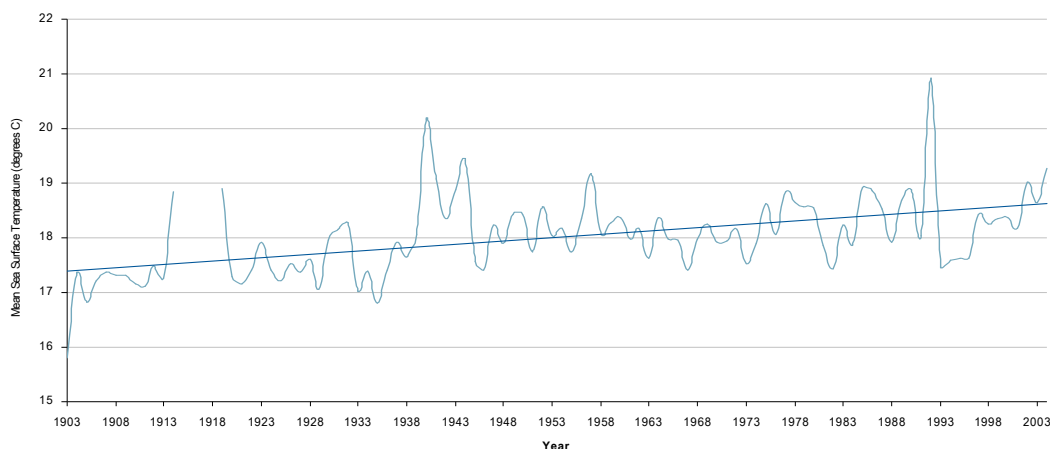


Figure 1. Mean annual Sea Surface Temperature collected from Voluntary Observing Ships (VOS) between Struisbaai to Knysna up to 60 nautical miles offshore, 1903 to 2004. Gaps in data are years where the data are not available. Source: Southern African Data Centre for Oceanography.

Increasing global mean temperatures are correlated with a rise in sea level (a function of the thermal expansion of the ocean and melting of polar ice caps), with global measurements over the past century indicating an increase of between 10 and 15 mm (Brundrit 1995). The potential impacts of sea-level rise on coastal environments include increased coastal erosion, inundation, increased salt water intrusion, raised groundwater tables and increased vulnerability to extreme storm events (Klein and Nicholls 1999). Coastal lagoons and estuaries are expected to be most severely affected by rising sea levels. Species occurring on rocky shores are also likely to suffer as a consequence of rising sea levels, being forced to shift their distribution patterns and/or zones, with some intertidal areas (e.g. wave-cut platforms and flat reefs) becoming permanently submerged, thus no longer available to intertidal species. The current trend of rising sea level is expected to accelerate in the future, with recent estimates indicating a 12.3 cm rise by 2020, 24.5 cm rise by 2050 and a 40.7 cm rise by 2080 (Nicholls et al. 1999).

Along the coastal region of South Africa, an overall decrease in the amount of rainfall is the most likely scenario predicted as a result of climate change. Most authors project a reduction in annual precipitation over most parts of the country of up to 25%, except in the north eastern regions where increase of up to 5% are expected (Hulme 1996, Schulze *et al.* 2001, Ragab and Prudhomme 2002). Reduced rainfall results in reduced freshwater flow which has a direct negative impact on estuaries, with concomitant effects on marine biota that utilize these systems (Clark in press 2005). Based on projected changes in rainfall provided above, Clark et al. (2000) estimated that runoff from rivers on the west and south coasts would decline by 11-84%, while those on the east coast would change by anything from -21 to +10%. Migrant birds, fish and prawns extensively utilize South African estuaries where they seek shelter for feeding and breeding. The majority of estuaries in South Africa have already been severely degraded, primarily through reductions in freshwater input and habitat destruction (Whitfield 1998, Griffiths 2000). The anticipated further reductions in the amount of freshwater entering estuaries in South Africa as a result of climate change are likely to result in deteriorating quality of many systems. Loss or reduction in quality of estuarine habitat is likely to have serious consequences on the subsistence, recreational and commercial fisheries targeting estuarine-associated species (Clark in press 2005). At least 50% of fish occurring in South African estuaries are utilized in fisheries, with many of these species being entirely or partially dependant on estuaries.

Changing pressure fields and hence wind stress as a result of global climate change are also likely to have pronounced consequences for marine biota in South Africa. Many scientists (e.g. Siegfried *et al.* 1990, Brown and Cochrane 1991, Clark *et al.* 2000, Lutjeharms *et al.* 2001) believe that the effects of these changes will be even more pronounced than many of the other effects of climate change such as increasing temperature, sea level rise, changing rainfall and river runoff, because of their influence on large-scale oceanographic processes. Upwelling intensity (the rate at which subsurface water rises to the surface in coastal areas) in many of the world's major upwelling centers has increased, including the Benguela upwelling system, which is a major

physical driver for South Africa's marine environment (Shannon *et al.* 1992). It has been proposed that higher greenhouse gases are inhibiting night time cooling and enhance daytime heating of the land, leading to intensification of onshore-offshore pressure gradients and alongshore winds and accelerated upwelling (Bakun 1990). Intensification of upwelling in the Benguela region is likely to result in increased nutrient availability, enhanced primary production, increased advection of cold upwelled water offshore and reduced rainfall all of which could affect demersal and pelagic food webs and fish production (Siegfried *et al.* 1990). The extent of impact on marine biota as a result of changing wind and pressure fields is uncertain and might be positive in some aspects but negative in others. The increasing incidence of harmful algal blooms and low oxygen water events off the west coast of South Africa may also be a function of increased, intensified upwelling.

Marine Pollution

Pollution of coastal waters can originate from shipping activity (accidental or deliberate discharges, garbage dumping), land-based sources (industrial, municipal, agricultural run-off) and atmospheric gases (Attwood *et al.* 2000). By international standards, coastal waters around South Africa are considered to have very low levels of pollution (Brown 1987, Griffiths *et al.* 2004), but this may well be changing. During the past decade, it is estimated that as much as 82 000 tonnes of oil has been accidentally or deliberately discharged into South African coastal waters. The worst oil spill incident in the past decade that directly impacted on South African shores occurred in 1992 when the *Katina-P* oil tanker sank off the coast of Mozambique, releasing over 67 000 tonnes of oil into the ocean. Several other oil spill incidents have been reported, leading to the release between 1500 and 3000 tonnes of oil into the sea.

Approximately 1.3 million cubic meters of wastewater is discharged through as many as 67 discharge points into South Africa's marine environment on a daily basis (Atkinson and Clark 2005). Over the past five years there has been a significant increase (as much as 62%) in the amount of daily wastewater discharged into the marine environment. More than 50% of the discharge points release effluent into the surf zone with the remaining discharge points releasing effluent into estuaries or offshore. With the ever increasing population placing demands on infrastructure, wastewater pollution of the marine environment continues to deteriorate.

Excessive nitrogen enrichment, from waste and storm water, agriculture and industry is known to result in phytoplankton blooms, sometimes leading to harmful, toxic conditions (Griffiths *et al.* 2004). Harmful algal blooms can cause mass mortality events of fish and invertebrates (e.g. rock-lobster walk outs) with concomitant oxygen depletion leading to anoxic conditions (Pitcher and Calder 2000). The frequency of low oxygen events appears to be increasing along the west coast of South Africa. Similarly, there appears to be a global increase in the frequency and severity of harmful algal blooms. Increases in these events have been related to increased human activities e.g. coastal pollution (Pitcher and Calder 2000). The magnitude of this increase may, however, be a reflection of increased awareness and improved surveillance techniques being employed.



Modification and/or Loss of coastal and marine habitat

Over the past 50 years, coastal cities around the world have grown dramatically and are predicted to continue to do so for the foreseeable future (Tibbits 2002). The general appeal of living at the coast, increased tourism, increased opportunities for coastal retirement and coastal holiday homes and the quest for employment have resulted in increasing populations and development along the coastal regions of South Africa. As much as 40 % of South Africa's population currently (2005) lives within 100 km of the coast, resulting in substantial development pressure for infrastructure, housing, roads etc. The increasing population and development pose severe threats to sustainability of resources in the coastal zone. Conserving the biodiversity of natural or undeveloped coastal areas is increasingly threatened by large-scale urban developments, mostly residential or recreational estates (e.g. golf estates). The construction of new or expansion of existing industrial (e.g. Saldanha Bay, Richards Bay, Port of Ngqura) and recreational (Port Alfred marina, Port Owen marina) harbours and ports facilitates economic development, however, it also irreversibly modifies the coastline. Coastal development resulting in habitat alteration, changing mouth dynamics and sedimentation also threatens the health status of estuaries.

South Africa's marine and coastal environment is mined for heavy metals (titanium and zirconium), fossil fuel (oil) and diamonds (Attwood *et al.* 2002). The process of mining unavoidably results in disruption of the sediment, the extent of which is determined by the type of mining. Titanium and diamond mining cause extensive sediment disturbance, while oil extraction causes only limited sediment disturbance, but poses a significant oil pollution threat. In most instances, mining completely eliminates the biological community in the mining area, including all dune vegetation and animals. Inshore and offshore diamond mining also re-suspends the benthic sediment, resulting in fine sediment plumes that can contain heavy metals and reach toxic levels or settle on reefs and rocky shores, suffocating the organisms living there (Clark *et al.* 1999). Virtually the whole of the South Africa west coast out to the EEZ is included within mining concession area (mostly for diamonds) while large portions of the south and east coasts are also slated for mining at some point in the future (mostly oil and gas). Rapid advances in mining technology are also enabling the mining industry to mine in increasing deeper water and to mine increasingly lower grade ores which will also ensure that virtually no areas are left untouched in the future, unless they are protected by legislation.

Relevant Legislation and Policies

A summary of relevant domestic legislation (National Policy, Regulatory and Strategic frameworks) and International conventions and agreements to which South Africa is signatory, is provided in the table below. The relevance of each legislation or policy to each of the key issues identified above is indicated with an X.

	Climate change	Marine Pollution	Loss / modification of habitat	Key provisions
NATIONAL / PROVINCIAL LEGISLATION				
The Constitution of the Republic of South Africa, 1996	X	X	X	Defines national and provincial powers with respect to environmental management, planning and development functions relevant to coastal management. Marine resources are deemed the responsibility of national government but certain powers relating to marine conservation may be extended to provincial or local government, where the capacity exists. Emphasizes the need for co-operative governance, and the need to devolve management functions to the lowest sphere of government able to undertake them.
National Environmental Management Act, 1998	X	X	X	South Africa's principle environmental legislation; ensures that the environmental rights, provided for in the Constitution, are protected and fulfilled; establishes a framework in which to implement the White Paper on Sustainable Coastal Development, the White Paper for Environmental Management Policy and the White Paper on Integrated Pollution Waste Management; and makes provision for the promulgation of regulations designed to give effect to the purposes and provisions of NEMA, including those controlling the use of vehicles in the coastal zone and those that stipulate requirements for an environmental impacts assessment for certain listed activities (including for example any construction or upgrading of facilities below the high water mark); also addresses environmental issues arising from marine pollution and modification or loss of habitat.
The Environment Conservation Act, 1989		X	X	Largely superseded by NEMA but still provides some legislation pertinent to impacts on the environment and the control thereof, including making provision for declaration of protected natural environments, and identification of activities that may have a detrimental effect on the environment. Regulations to control potentially harmful activities within demarcated sensitive coastal areas were promulgated under this Act with the requirement of environmental impact assessments to be conducted for any listed activity.
National Water Act 1998	X	X		Identifies sustainability and equity as central guiding principles in the protection, use, development, conservation, management and control of water resources; overall responsibility for and authority over water resource management vested with national government; provides for control over discharge of waste-water into any water resource on land and in the sea but lacks legislation directly addressing issues of effluent being discharged into the marine environment; addresses some environmental issues leading to marine pollution and climate change (reduced fresh water flow into estuaries).
The Sea-Shore Act, 1935		X	X	Although dated, this Act remains fundamental to any existing or proposed institutional arrangements for the coast; ownership of the sea and sea-shore is vested in the President for use and benefit of the public; administrative functions of the Act have been largely assigned to the coastal provinces
National Ports Act, 2005		X		Devolves jurisdiction of all national harbours and ports to the National Ports Authority (Pty) Ltd who are hence responsible for port development and land use, regulating and controlling pollution and protecting the environment within the boundaries of the port.
Marine Traffic Act, 1981		X		Provides for the right of innocent passage of any vessel through the territorial waters of South Africa and stipulates regulations for such activities.
South African Transport Services Act 1981, and Merchant Shipping Act, 1951		X		The two Acts together provide for the regulations (including safety checks on storage of dangerous cargo) to be adhered to by all vessels entering South African territorial waters



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Wreck and Salvage Act, 1996		X	X	Stipulates that all salvage operations are to be carried out with due care to prevent or minimize damage to the environment (defined as “substantial physical damage to human health or to marine life or resources in coastal inland waters or areas adjacent thereto, caused by pollution, contamination, fire, explosion or similar major incidents”), and stipulates the nature of financial benefits that accrue to the salvor provided s/he has prevented or minimized damage to the environment to the best of his ability during the salvage operations.
Maritime Zones Act, 1994		X	X	Gives South Africa jurisdiction rights over internal and territorial waters (up to 12 nautical miles), contiguous (up to 24 nautical miles) and exclusive economic zones (EEZs, up to 200 nautical miles) and the continental shelf of the sea within a zone specified by the United Nations Convention on the Law of the Sea 1982; stipulates that the Republic of South Africa may take the necessary measures to protect the coastline or related interests, including fishing, from pollution or any threat of pollution, resulting from a maritime casualty, which may be expected to result in major harmful consequences to the environment.
South African Marine Safety Authority Act, 1998		X		Identifies the South African Maritime Safety Authority (SAMSA) as the relevant juristic authority and details the objectives and duties to be carried out by this authority which include those outlined in the Merchant Shipping Act (1951), Marine Traffic Act (1981), Marine Pollution Act (1981, 1986 and 1987) and the Wreck and Salvage Act (1996). The principle objectives of SAMSA are listed as 1) to ensure safety of life and property at sea, 2) to prevent and combat pollution of the marine environment by ships and 3) to promote South Africa’s maritime interests. Responsibility of matters relating to combating pollution are assigned to the Department of Environmental Affairs and Tourism.
Minerals Act, 1991		X	X	Include provisions for compulsory rehabilitation of the surface of land during and after prospecting and mining operations; requires license holders to prepare and submit Environmental Management Plan Reports (EMPR) to the Department of Mines and Energy (DME) which are supposed to identify and detail mitigation measures to be implemented for all envisaged impacts on the environment.
Mineral and Petroleum Resources Development Act, 2002		X	X	Makes provision for sustainable development of the nation’s mineral and petroleum resources, stipulating that the holder of a prospecting or mining permit must adhere to the general objectives of integrated environmental management and is required to conduct an environmental impact assessment; also identifies the permit holder to be responsible for any environmental damage, pollution or ecological degradation resulting within or outside the boundaries from the mining activity.
The Development Facilitation Act, 1995, and provincial planning legislation			X	Facilitates and fast-tracks implementation of development programmes and projects in relation to land, by laying down general principles governing land development in South Africa, most coastal provinces are preparing new development planning legislation in terms of this Act as a consequence of provisions in the Constitution which state that planning is a provincial responsibility; the Act has relevance in obtaining approval for any permanent structure to be established in the coastal zone.
White Paper for Sustainable Coastal Development in South Africa (2000)		X	X	Provides a framework for coastal management functions and strives for sustainable coastal development maintaining a balance between material prosperity, social development, cultural values and ecological integrity. Objectives of this policy are to promote partnerships between state, private sector and public in coastal management issues, promote public awareness and effective coastal management and planning, to establish and manage a system of coastal protected areas, to rehabilitate damaged or degraded coastal areas, and to implement pollution control measures
White Paper for Environmental Management Policy (1997)		X	X	This is an overarching framework policy that defines the essential nature of sustainable development as the combination of social, economic and environmental factors, projects an integrated and holistic management system for the environment aimed at achieving sustainable development. It aims to integrate and address environmental concerns and environmental sustainability in decision making processes, in the development of policies and programmes, in spatial development planning and in the management of resources and activities.
White Paper on Integrated Pollution Waste management		X		The policy outlined in this White Paper aims to implement cooperative governance of pollution and waste in South Africa and proposes new legislation to address current legislative gaps, and clarify and allocate responsibilities of management within



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(2000)				government. The policy changes the focus of pollution from combating to prevention and details the governments approach to devolving responsibility to provincial and municipal authorities.
National Climate Change Response Strategy	X			The Department of Environmental Affairs and Tourism have begun developing South Africa's National Climate Change Response Strategy. The development of this strategy is hoped to assist in developing formal National Action Plans, leading to government policy to be adopted by business and private sector to address impacts affecting climate change. The strategy aims to support policies and principles laid out in the White Paper on Integrated Pollution Waste Management and other national policies relating to energy, agriculture and water.
INTERNATIONAL CONVENTIONS AND AGREEMENTS				
Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC)	X			Kyoto Protocol is a legally binding document that commits signatory countries to aiming towards reducing the amount of greenhouse gases produced, promoting adaptation to future climate change impacts; developing and submitting information on their national climate change programmes and inventories; cooperating on scientific and technical research; and promoting public awareness, education, and training with respect to issues arising from climate change.
International Convention for the Prevention of Pollution from Ships Act, 1986 (Marine Pollution Act - Prevention of Pollution from Ships)		X		This Act requires signature countries to 1) be conscious of the need to preserve the marine environment in particular, 2) recognize that oil or other harmful substance released by ships is a serious source of pollution, 3) recognize that protecting the environment is to be achieved by protecting the seas and coastal environment from pollution and 4) completely eliminate intentional pollution of the marine environment by oil and other harmful substances and the minimize accidental discharge of such substances.
Prevention and Combating of Pollution of the Sea by Oil Act, 1981 (Marine Pollution Act - Control and Civil Liability)		X		Discharge oil from any vessel is deemed to be an offence in terms of this Act unless it can be proved that 1) it was to secure the safety or prevent damage of the vessel, or to save a life, or 2) oil escaped from the vessel as a consequence of damage and that all reasonable steps were taken to prevent, stop or reduce oil escaping; oil discharge or the likelihood of oil discharge must be reported by the master of the vessel to the authority by means of the quickest communication available; relevant designated Authority (Department of Transport, SAMSA, and Department of Environmental Affairs and Tourism, MCM) must take measures to prevent pollution of the sea where oil is being discharged or is likely to be discharged, must guard against and prevent pollution of the sea by oil, and where the sea has been polluted by oil from vessels, to remove such pollution from the sea.
International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties Act, 1987 (Marine Pollution Act - Intervention)		X		Enables South African authorities to intervene in cases of oil pollution occurring on the high seas i.e. outside of South Africa's territorial waters and to implement the International Convention relating to Intervention on the High Seas in Cases of Oil Pollution Casualties except in the case of warships.
Disaster Management Act, 2002		X		Provides regulations and protocol to manage disasters that may arise as a result of natural or human induced events. Disasters are defined as a progressive or sudden, widespread or localised, natural or human-caused occurrence which causes or threatens to cause death, or disease; damage to property, infrastructure or the environment, and includes major pollution events such as oil spills.
Dumping at Sea Control Act, 1980		X		Provides for the control of dumping at sea of substances listed in the Convention on the Prevention of Marine Pollution by Dumping Wastes and Other Matter, 1972, (known as The London Convention 1972) to which South Africa has acceded.

Key Challenges and Policy Implications

Climate change

There remains a substantial amount of uncertainty around the nature and magnitude of many of the physical aspects of climate change with the implications thereof on marine biota and fisheries still being widely speculative (Clark in press 2005). Policy makers and managers are unsure how to incorporate the potential effects of climate change into their management and decision making models. In spite of the uncertainty, however, some practical measures should be implemented towards addressing the potential affects of climate change on the marine environment and include the following:

Increase general awareness regarding the likely effects and potential impacts of climate change.

Ratification of the Kyoto Protocol of Climate Change and the United Nations Framework Convention on Climate Change (to which South Africa is signatory) requires climate change to be addressed in all relevant social, economic and environmental policies and actions and to educate, train and create awareness about climate change and the implications thereof. A number of South Africa's policy documents refer to climate change broadly, however, none address fisheries specifically. The government has developed a National Climate Change Response Strategy as part of its international obligations, however, implementation thereof has yet to commence and there remains no direct reference to fisheries.

Monitoring of key atmospheric, oceanographic and biotic parameters for early warning of changes.

The impacts of climate change are unlikely ever to be entirely mitigated, however, increasing the lead time to, and understanding the changes expected, allows opportunities to minimize some of the socio-economic impacts that reduced availability of fish may have on industry and coastal communities. South Africa has initiated and actively partakes in several early warning programmes such as the Benguela Current Large Marine Ecosystem Programme and the South African Environmental Observation Network. Continued commitment to and expanding of monitoring programmes are important in addressing and mitigating climate change impacts. Data from such early warning systems needs to be readily incorporated in fisheries management approaches and management must be adjusted accordingly for changes in stock distribution and abundance.

Develop means to reduce reliance on marine resources

Alternative livelihoods opportunities for coastal communities need to be investigated, to divert focus away from the heavy reliance on marine resources. Coastal communities are highly vulnerable to potential reductions in fish abundance and their capacity to accommodate changes in their livelihoods are very limited, resulting in these impoverished communities being greatly affected by climate change induced impacts.

Establish rigorous control measures for development in the coastal zone

All development in the coastal zone needs to be adequately controlled, especially those in low lying areas. The back line (seaward point at which no further development may occur) should be readdressed and obstructive development removed.



Recognize that freshwater is already maximally utilized

Awareness and education is needed to recognize that freshwater reserves will be reduced in many areas as a result of climate change and that it is unlikely that the current measures of securing future freshwater resources (i.e. building dams) are sustainable. Appropriate pricing for water usage should be implemented, the public must be conditioned and educated to recognize the freshwater shortage threat and a greater emphasis should be placed on recycling and re-use of current water supplies.

Marine Pollution

The legislation governing issues of marine pollution are well provided for in South Africa, however, implementation thereof is fragmented and inefficient. As many as five different governing authorities are responsible for implementing various aspects of marine pollution mitigation in South Africa. These are the Department of Environmental Affairs and Tourism, South African Maritime Safety Authority, Department of Water Affairs and Forestry (pipeline discharges from freshwater sources), National Ports Authority and Department of Minerals and Energy (mining related pollution). There is no lead implementing agency to coordinate and administer effective marine pollution prevention and combating pollution (e.g. an oil spill clean up) is often delegated to the nearest municipality or provincial authority, where there is often insufficient capacity to address the issue effectively. There is a strong need for an overarching authority or organization to coordinate and manage all aspects of marine pollution, including monitoring and compliance. Once a permit has been issued to discharge effluent, there is currently no follow-up monitoring of the amount or type of effluent being discharged into the sea. Regular, rigorous control measures and compliance to regulations needs to be implemented and enforced.

Current monitoring measures implemented by government authorities includes the Red Tide Response Team which detects and reports on dangerous toxicity levels of marine species along the west coast of South Africa. Another monitoring programme implemented is the Mussel Watch Programme which regularly assesses the heavy metal concentrations in the tissues of the Mediterranean mussel, *Mytilus galloprovincialis*, at 42 sites in the Western and Northern Cape and was recently expanded to include Durban and East London (Griffiths *et al.* 2004). Mussels are considered good indicator species for coastal water pollution as they are sessile bio-accumulators (i.e. accumulate toxins in their flesh from the immediate area where they exist). Additional similar broad scale monitoring programmes need to be implemented along with site specific effluent discharge monitoring.

Modification and/or Loss of Habitat

Legislation to control development in the coastal zone is fragmented and does not provide clear guidelines for implementation at provincial or municipal levels. Overarching regulations and an administrative body to regulate coastal development at a national level are urgently required. The Coastal Management Bill (currently being drafted) is anticipated to address these issues by providing a legal and administrative framework that will promote



cooperative, coordinated and integrated coastal development and ensure coastal resources are managed sustainably.

Newly introduced mining environmental policies require coastal mining operations to conduct comprehensive rehabilitation throughout the mined area. If conducted in accordance with the specifications, rehabilitated mined areas are expected to recover within several years. Compliance with the new rehabilitation policies is essential, with follow-up monitoring and enforcement of such policies being important for rehabilitation to be realized.

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