NATIONAL STATE OF THE ENVIRONMENT PROJECT

MARINE AND COASTAL ECOSYSTEMS

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ACRONYMS

ACEP	African Coelacanth Ecosystem Programme
CSIR	Council for Scientific and Industrial Research
DEAT	Department of Environmental Affairs and Tourism
DST	Department of Science and Technology
DWAF	Department of Water Affairs and Forestry
EEZ	Exclusive Economic Zone
GDP	Gross Domestic Product
HABs	Harmful Algal Blooms
HDI	Historically Disadvantaged Individual
IPCC	International Panel on Climate Change
IUCN	International Union for the Conservation of Nature and Natural Resources (now known as the World Conservation Union but retains original acronym)
KZN	Kwa-Zulu Natal
LMP	Linefish Management Protocol
MAR	Mean Annual Runoff
MARPOL	The International Convention for the Prevention of Pollution from Ships
MCM	Marine and Coastal Management
MLRA	Marine Living Resources Act
MPA	Marine Protected Area
ORV	Off-Road Vehicle
SADCO	Southern African Data Center for Oceanography
SAAMBR	South African Association for Marine Biological Research
SAIAB	South African Institute of Aquatic Biodiversity
SAN-Parks	South African National Parks
SASSI	Southern African Sustainable Seafood Initiative
SCUBA	Self Contained Underwater Breathing Apparatus
TAC	Total Allowable Catch
TRAFFIC	The Wildlife Trade Monitoring Network
UNEP	United Nations Environment Programme
WCNCB	Western Cape Nature Conservation Board
WftC	Working for the Coast
WWF-SA	World Wildlife Fund South Africa

INTRODUCTION

The marine and coastal resources of South Africa are a rich and diverse national asset, providing important economic and social opportunities for an ever-increasing population, that in turn, have developed a strong reliance on these resources for food, recreation, transport and financial gain (Attwood *et al.* 2002). Utilisation of these resources has facilitated general economic upliftment and job creation in coastal communities. However, increasing human and environmental pressures on South Africa's coastal environment have also resulted in changes in the structure of many marine communities, with instances of uncontrolled or mismanaged use of coastal resources leading to overexploitation, degradation or decline (Attwood *et al.* 2002).

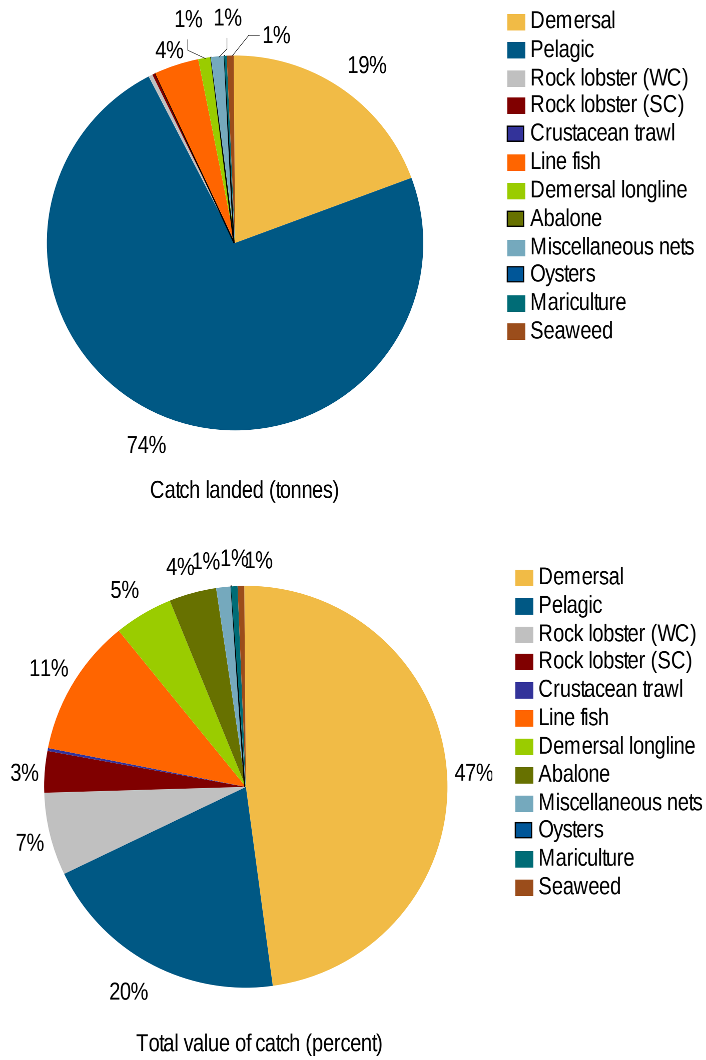
Increasing pressure on the marine environment is associated with an overall decrease in marine biodiversity, mostly as a result of exploitation of naturally occurring resources and the dispersive nature of seawater linking marine populations over vast areas, easily spreading alien species and pollutants (Attwood *et al.* 2002). Most of the South African public, especially coastal stakeholders, are becoming increasingly aware of the value of the coast and the importance of effective coastal management. Protection, in the form of marine protected areas, and improved management of South Africa's coastal and marine resources have received high priority at national and international levels. Global climate change is also predicted to have some negative impacts on marine and coastal resources, however, our understanding of these effects remain speculative, although they may be as severe as that of uncontrolled exploitation (Clark 2005 in press).

South Africa is signatory to a wide range of international treaties and conventions including, MARPOL (prevention of pollution at sea), The Biodiversity Convention, United Nations Convention on the Law of the Sea (management of straddling and migratory fish stocks), the London Convention (regulating the dumping of waste at sea) and the Bonn Convention (conservation of migratory species, including seabirds). The natural environment of South Africa is governed by a wide range of legislative Acts, including the Constitution of the Republic of South Africa (1996), National Environmental Management Act (107 of 1998), the Environmental Conservation Act (73 of 1989) and, of most relevance to marine and coastal resources, the Marine Living Resources Act (18 of 1998). Several of the acts, policies and protocols used to govern the marine and coastal environment of South Africa are either under review or have recently been amended or revised to promote improved management of the marine environment.

STATE OF MARINE AND COASTAL RESOURCES

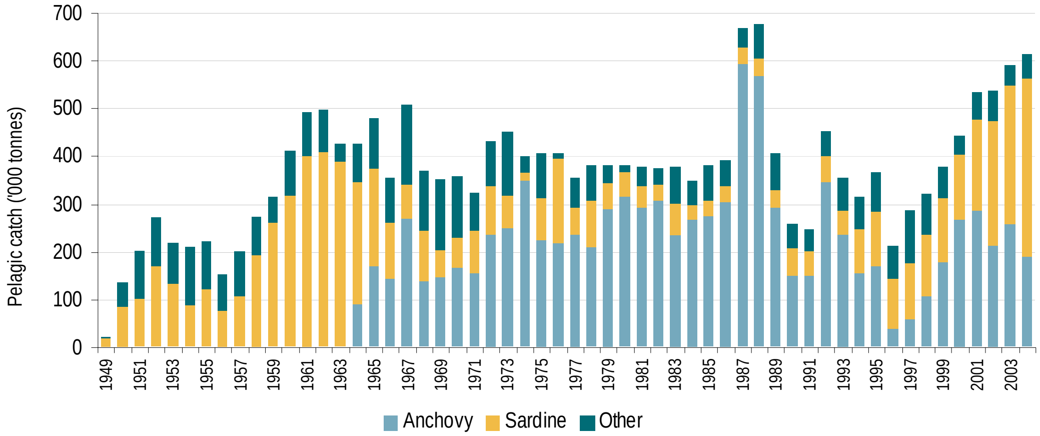
Exploitation of marine & coastal resources

South African commercial and recreational fishers are reported to catch over 250 marine species, although fewer than 5 percent of these are actively targeted and together comprise 90 percent of the catch (Mann 2000). The pelagic purse seine fishery, targeting predominantly sardine, *Sardinops sagax* and anchovy, *Engraulis encrasicolus*, with redeye herring, *Etrumeus whiteheadi* and horse mackerel, *Trachurus* spp. supplementing the catch, supplies the greatest tonnage of fish landed *per annum* (538 000 tonnes in 2002 – Fishing Industry Handbook 2004, Figure 1.1). The contribution of sardine to the total 2004 South African pelagic catch (373 000 tonnes) reflects the current healthy status of the sardine stock, after a near-collapse in the late-1960s (Figure 1.2). The further recovery of sardine stocks since 1999 has also had positive effects on other marine species that feed on sardines such as snoek, yellowtail, marine birds and seals.



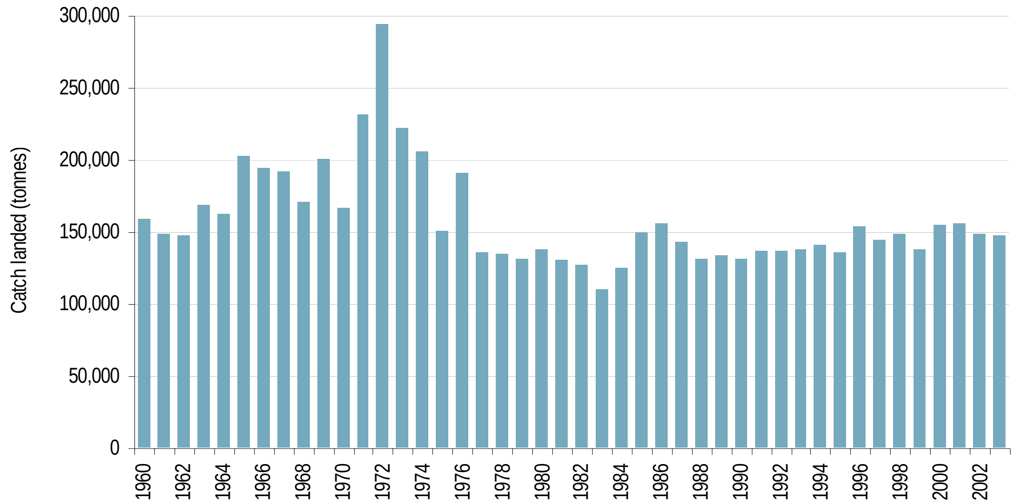
Source: Fishing Industry Handbook 2004

Figure 1.1: Landings of commercial fisheries (tonnes) and the percentage they contribute to fishery value, 2000.



Source: DEAT: Branch MCM - Pelagic Section
Figure 1.2: Pelagic fisheries catches in South Africa 1950 to 2004. Anchovy, sardine and other species (mackerel, round herring and lanternfish)

The demersal trawl fishery, targeting deep and shallow-water hake, *Merluccius paradoxus* and *Merluccius capensis* respectively, sole, *Austroglossus pectoralis* and horse mackerel, *Trachurus trachurus capensis* is South Africa's second largest fishery with respect to amount of fish landed (163 500 tonnes in 2003, Figure 1.3), but is most important in terms of value, contributing approximately R1.6 billion in 2003. In the 1960s, the demersal trawl fishery contributed as much as 90 percent of South Africa's overall fish landings, however, this contribution declined to only 60 percent during the 1990s (Griffiths *et al.* 2004). This was attributed to a shift in focus to mixed species fisheries and increased landings of the by-catch from this fishery. The demersal trawl fishery is a non-selective fishery, yielding a high percentage by-catch and is considered to result in environmental degradation of the seabed. Longline fishing is considered less destructive on the marine environment (although more so for marine birds) and successfully targets most demersal trawl species with limited discarded by-catch. In 1983 an experimental hake longline fishery was first introduced in South Africa (Griffiths *et al.* 2004) but this form of fishing was soon discovered to be most effective in catching a large amount of kingklip, *Genypterus capensis*, also a very valuable and marketable species (Sauer *et al*. 2003). In 1986, catch rates of kingklip began to show notable declines and although a maximum limit of 5000 tonnes of kingklip by-catch was implemented, catches continued to decline further (Sauer *et al*. 2003). By early 1991, all demersal longline fishing was officially stopped, but in 1994 a hake-directed experimental longline fishery was established, with increasing Total Allowable Catches (TACs) being allocated each subsequent year (Sauer *et al*. 2003). Currently hake stocks are targeted by demersal trawl (deep-sea and inshore), longline and handline (from ski-boats) fishing efforts, placing a considerable amount of pressure on the resource. Since 1999, the hake resource has started showing early warning signs of depletion and as a precautionary measure, the TAC has been reduced by between 2000 and 4000 tonnes in recent years. The status of the stocks and the associated environmental parameters are currently being carefully monitored (pers. comm. L. Hutchings – Marine and Coastal Management [MCM]).

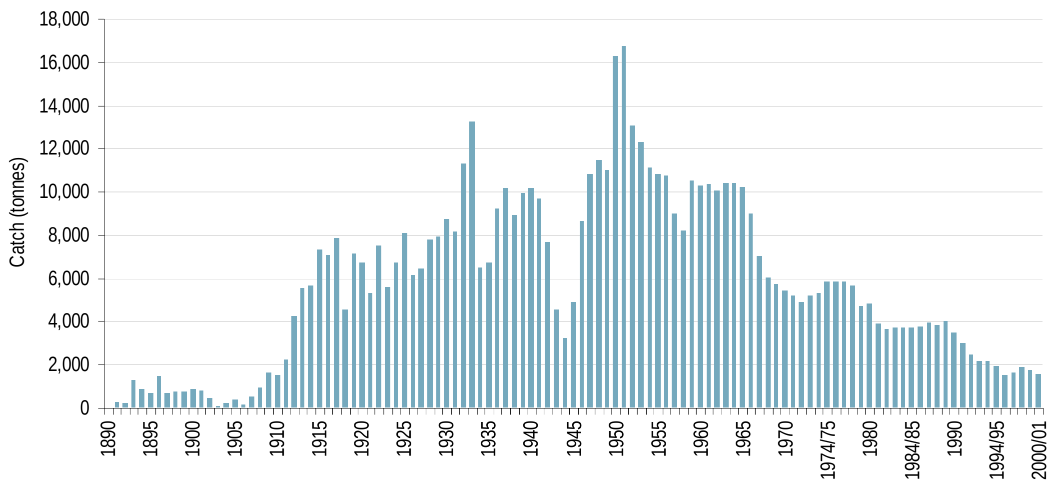


Source: DEAT: Branch MCM, Demersal Section

Figure 1.3: Commercial catch landed for hake fishery (M. paradoxus and M. capensis) from offshore and inshore trawl, handline and longline catches 1960 – 2003.

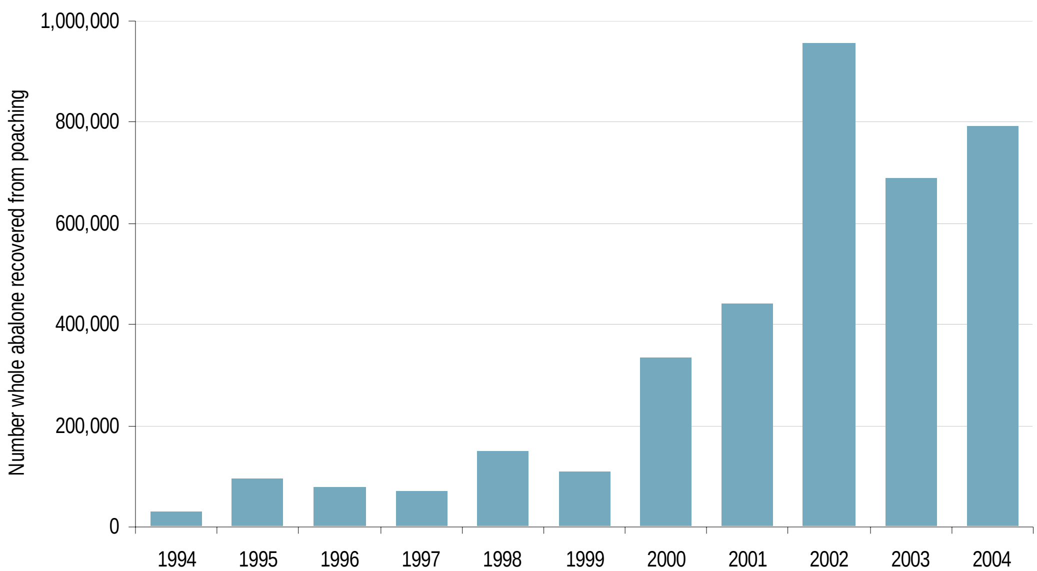
Linefish comprise the third most important South African fishery with respect to total tonnes landed and total value. In 2000, the total reported commercial linefish catch was 24 103 tonnes (Fishing Industry Handbook 2004). However, landings from the open-access recreational fishery are not reported and the total catch from this sector is estimated to be double that of the reported commercial sector. Of the top 27 targeted linefish species, 18 are classified as collapsed, one as over-exploited, 6 as optimally exploited and only 2 are considered under-exploited (Lamberth & Joubert 2005 in review). Factors contributing to the demise of linefish stocks include increased commercial and recreational fishing effort, in conjunction with several life history traits (predictable locality, longevity and late maturity) making these species particularly vulnerable to over-exploitation (Griffiths 2000). Two linefish species currently considered to be optimally exploited are snoek, *Thyrsites atun* and yellowtail, *Seriola lalandii* (Mann 2000). Hottentot, *Pachymetopon blochii*, elf/shad, *Pomatomus saltatrix*, red roman, *Chrysoblephus laticeps* and carpenter, *Argyrozona argyrozona* are some of the species considered to be over-exploited, while some of those considered to be collapsed are silver kob, *Aryrosomus inodorus*, white steenbras, *Lithognathus lithognathus*, red stumpnose, *Chrysoblephus gibbiceps* and slinger, *Chrysoblephus puniceus* (Mann 2000). There has been very little improvement in the status of most linefish species since 1999. In an attempt to address the failure of past regulations in managing the linefish resource, a Linefish Management Protocol (LMP) was developed in 1999. As part of this management protocol, drastic reductions in commercial linefish effort and stringent bag limits for recreational fishers were introduced. New linefish policies, based on the LMP, were gazetted in May 2005 and are hoped to be instrumental in rebuilding linefish stocks.

The west coast rock-lobster fishery of South Africa is considered to be one of the oldest fisheries of the country, dating back to at least 1875 when the first commercial processing plant was established (Griffiths *et al.* 2004). Commercial, subsistence and recreational fisheries target the rock lobster, *Jasus lalandii* and are managed using combinations of TAC quotas allocated for zones along the coast, a minimum size limit, closed seasons, daily bag limits and restricted fishing between 08h00 and 16h00 during seasonal fishing days. The annual commercial landings of rock lobster have decreased since the 1960s (Fig 1.4), indicating that the high landings during these earlier years were simply not sustainable (Griffiths *et al.* 2004). During the 1990s a decrease in growth rate and poor recruitment further reduced total rock-lobster landings, with the TAC being reduced to around half of what it was in the 1980s (Griffiths *et al.* 2004). Currently the South African harvestable rock-lobster biomass (biomass of rock lobsters > 75 mm carapace length) is estimated to be only approximately 5 percent of pre-exploitation levels and the spawning biomass approximately 20 percent of pristine levels (Pollock *et al.* 2000). Although the resource is considered to be in a stable state, the reduced growth increment rate is sufficient cause for implementation of a stock rebuilding strategy. Rock-lobster stocks are considered to be depleted on the west coast. However, there has been a substantial increase in abundance of this resource on the southeast coast (Tarr *et al.* 1996, Mayfield and Branch 2000). This area was traditionally not considered commercially viable for rock lobster fishing, but, after an experimental fishery was introduced in 1999, a limited-scale commercial fishery was implemented (since 2003) in this region with an allocation of 230 tonnes per annum (pers. comm. S. Brouwer, MCM).



Source: Griffiths et al. 2004.
Figure 1.4: Annual commercial landings of west coast rock lobster, Jasus lalandii, in South Africa from 1890 to 2001.

The abalone (perlemoen) resource is presently facing a severe crisis and extreme management measures have been implemented in an attempt to prevent the targeted species, *Haliotis midae*, from becoming commercially extinct. A combination of extremely high international demand and exorbitant prices, coupled with insufficient enforcement capacity within South Africa, has led to the establishment of highly organized illegal abalone fishery syndicates. Illegal harvesting of abalone has always been a factor (abalone occur in shallow water, are easily removed and thus do not require expensive fishing gear), but, since 2000 the levels of abalone poaching have escalated dramatically, to the extent that recent data indicate that the fishery is unlikely to remain sustainable, unless improvements in compliance occur immediately (Figure 1.5, DEAT: MCM). In an attempt to address this crisis, the commercial abalone fishery has been faced with severe (47 percent) TAC reductions (from 500 tonnes in 1999/2000 to 237 tonnes in 2004/2005, pers. comm. A. McKenzie, MCM). Even more dramatic was the complete closure of the recreational abalone fishery for the first time in history for the 2003/2004 abalone fishing season. This is proposed to remain closed for an indeterminate period of time. The abalone resource is considered to have declined substantially since 1999. Compounding the effects of abalone poaching is the ecological change occurring at the centre of the most productive abalone region, between Cape Hangklip and Hermanus in the south western Cape. An increase in rock lobster, *J. lalandii*, abundance in this region was initially detected in 1994 (Tarr *et al.* 1996). Rock lobsters consume small invertebrates, including sea urchins, *Parechinus angulosus*, which provide essential shelter for juvenile abalone (Mayfield *et al.* 2000, Day and Branch 2002). Decreasing abundance of sea urchins, due to increased predation by rock lobster, results in reduced recruitment to the abalone fishery. Intense poaching, combined with ecosystem changes resulting in reduced recruitment, have led to severe declines in abalone density in the main commercial fishing grounds. Data collected from the 1980s until 1998 show densities of between 0.8 and 1.3 abalone per m^2, however, primarily due to poaching, densities in the primary fishing areas are currently below 0.3 abalone per m^2 (Griffiths *et al.* 2004). Being broadcast spawners, abalone require a minimum density to ensure reproductive success. It is not yet known whether the current abalone densities have reached the point where nearest neighbour distances are such that fertilization is unlikely to occur, although it is likely that recruitment success is already severely compromised.



Source: DEAT: MCM - Abalone Section
Figure 1.5: Records of numbers of whole abalone confiscated 1994 to 2004.

Patagonian toothfish, *Dissostichus eleginoides*, also commonly called Chilean sea bass, occur in the South African Exclusive Economic Zone (EEZ) around Prince Edward and Marion Islands. In 1996, the Department of Environmental Affairs and Tourism issued five fishing companies with experimental licenses to harvest Patagonian toothfish from the waters surrounding the Prince Edward Islands. This marine resource is considered one of the most lucrative, being in high global demand, especially in Japan and United States of America. The species is large, slow growing and long lived (up to 50 years), only reaching sexual maturity after approximately 10 years, making it readily susceptible to overfishing. Illegal harvesting is indeed widespread and conservationists have warned that the species could become commercially extinct by the year 2007. The species is considered to be heavily overexploited and the population off the southern African coast considerably reduced.

A host of other marine resources are targeted by commercial, recreational and subsistence fishers along the South African coast, including mullet, *Liza richardsonii* by beach-seine and gill net fishery of the West Coast, prawns, *Penaeus indicus, Penaeus monodon* and *Metapenaeus monoceros* by a trawl fishery in KwaZulu-Natal, squid, *Loligo vulgaris reynaudii* in the Eastern Cape chokka fishery and various seaweed species e.g. *Ecklonia maxima*, *Laminaria pallida* and *Gracilaria* spp.. These fisheries provide important local contributions to fish landings and livelihoods. Most are in a good state of health but some have seen declining catches in recent years (e.g. prawn trawl and mullet fisheries).

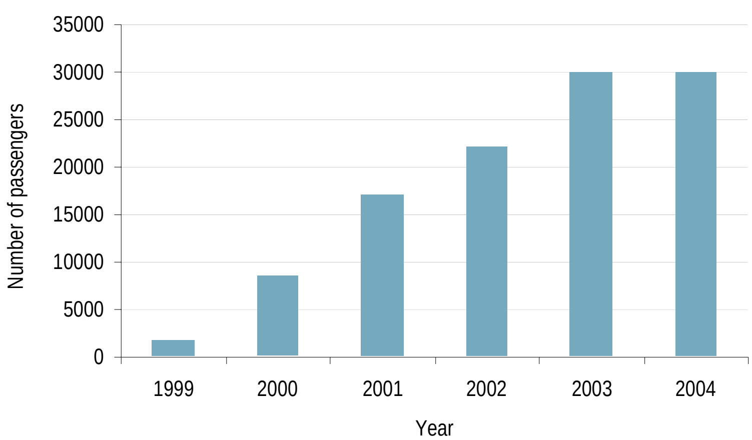
Development of new or experimental fisheries is continually being investigated, receiving far more emphasis since 1999. Possibilities exist for developing a new pelagic fishery sector which will target red-eye round herring (Fishing Industry Handbook 2004). Experimental fishing permits (15) have been issued for octopus, *Octopus vulgaris*, each having an allocated specific catch zone along the coastline. Rights-holders are expected to commence fishing in 2005 (pers. comm. G. Sikiti, MCM).

Mariculture of marine species commenced in the 1950s and has continued to grow within South Africa, with the successful farming of the introduced alien black mussel, *Mytilus galloprovincialis*, in Saldanha Bay, oysters, *Crassostrea gigas*, in Knysna and abalone along the west coast. Mariculture permits have also been issued for prawns and seaweeds. Promising research indicates that certain fin fish species (e.g. salmon and dusky kob, *Argyrosomus japonicus*) are ideal candidates for successful mariculture ventures and experimental farming of Norwegian salmon and turbot is already in progress (pers. comm. G. Sikiti, MCM).

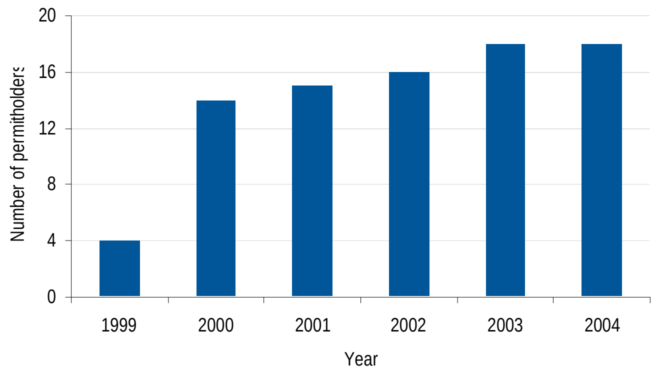
In recent years, there has been an increased focus on development of non-consumptive marine resource use in South Africa, e.g. whale and shark viewing. With rigorous management, these activities can successfully generate interest in marine conservation, socio-economic empowerment and employment opportunities for coastal communities. There are currently 12 permit-holders for shark cage diving activities within South Africa, with a proposed addition of two permit holders in 2005 (pers. comm. M. Meyer, MCM). The overall number of boat-based whale watching permits issued by Marine and Coastal Management has steadily increased since 1999, with a maximum of 18 permits issued for 2004 (pers. comm. M. Meyer, MCM). These positive trends suggest an increasing demand and growth in non-consumptive marine resource use in South Africa.

Box 1.1 Future Opportunities: Non-consumptive Marine Resource use with an example of the Boat-Based Whale-Watching industry in South Africa.

Boat based whale watching began in South Africa in the early 1990s with land-based whale watching at Hermanus, south-western Cape. Whale watching in Hermanus rapidly established the reputation of being among the best land-based whale watching in the world. Increasing demand and international trends led to establishment of legal boat-based whale watching in South Africa in 1998 (Turpie *et al*. 2005). The whale watching industry in South Africa has undergone significant growth in the past decade, largely associated with the recovery of southern right and humpback whale populations along the coast. The number of boat-based whale watching permit holders and the number of passengers have increased each year between 1999 and 2003, remaining stable in 2004 (Figures 1.1.1 and 1.1.2).



Source: DEAT:MCM logbook data and Turpie et al. (2005)
Figure 1.1.1: Total number of passengers aboard boat-based whale watching permit holder boats per annum



Source: DEAT: MCM logbook data
Figure 1.1.2: Total number of boat-based whale watching permit holders per annum

Although many species of cetaceans frequent the shores of South Africa, the whale watching industry here focuses on southern right, *Eubaleana australis*, humpback, *Megaptera novaeangliae*, and bryde's whales, *Balaenoptera edenii*. The large diversity of many other marine species, like dolphins, seals and seabirds, contribute to the overall marine tourism industry in South Africa. Each winter southern right whale populations migrate to the South African coastline, seeking the protection of sheltered bays to mate and calve. The whales occur in greatest concentrations along the south coast, between Kleinmond in the west and Mossel Bay in the east, and generally occur within one nautical mile from the shore. Due to the migratory behaviour of some whales, peak tourism periods and suitable weather and sea conditions, boat-based whale watching is in greatest demand between July and December, although more generalist marine tours supplement the off-peak whale season in several coastal areas (Turpie *et al*. 2005). Humpback and bryde's whales occur along the Garden Route throughout the year and improve the viability of year-round whale watching tours in these regions.

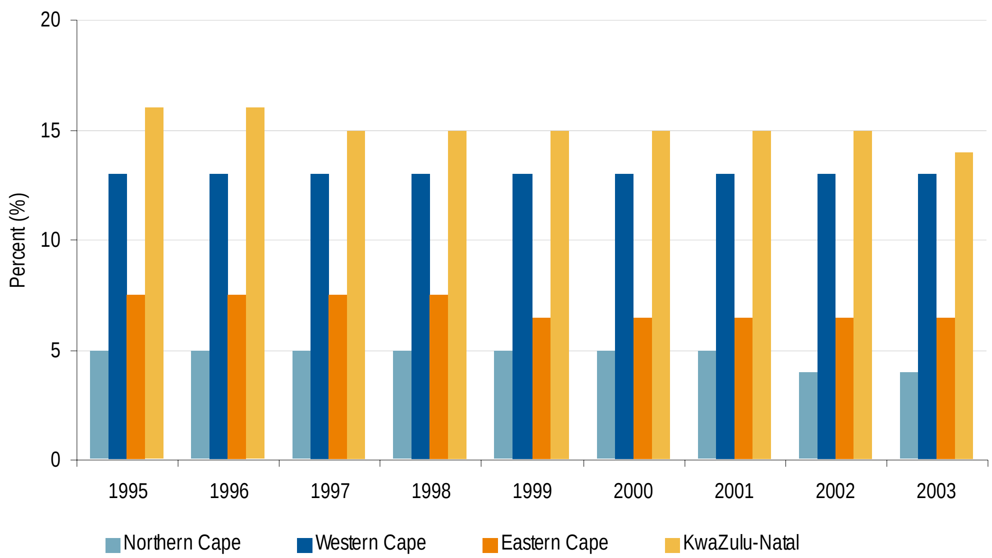
To ensure that the whales are protected from any negative impacts potentially inflicted by the whale-watching industry, this industry has become increasingly regulated around the world. South Africa has among the most stringent regulations on a global scale. The industry in South Africa is regulated by permits which are administered by Marine and Coastal Management and allow permitted boat operators to approach whales to within 50 m for a maximum of 20 minutes. Boats without a whale-watching permit are required to remain a minimum of 300 m from any whale. Mother-calf pairs, however, are not to be approached by any boats and several popular calving and mating grounds have been declared sanctuaries, to prevent excessive disturbance. A strict code of conduct for permit-holders has been established and is supported by the South African Boat-Based Whale Watching Association. Marine and Coastal Management is responsible for policing the industry in South Africa, except in KwaZulu-Natal where Ezemvelo KZN Wildlife takes on this responsibility (Turpie *et al*. 2005). Boat-based whale watching is currently classified as an experimental fishery with permits being annually renewable, however, a new policy for boat-based whale watching is currently being drafted with imminent plans for longer-term permit allocations.

An economic assessment of the boat-based whale watching industry in South Africa established that this industry currently generates about R45 million in tourism expenditure, contributing approximately R37 million to South Africa's Gross Domestic Product per year and has the potential to make an even greater economic contribution (Turpie *et al*. 2005).

This study indicates that the number of boat-based whale watching permits could be increased by at least 20 % (based on existing demand relative to supply), and possibly up to 40 % in the near future (based on the quality of resources and existing, untapped markets). The extent of current boat-based whale watching activities indicates that this industry is an increasingly viable economic venture in many coastal regions in South Africa, adding significant value to the marine tourism industry (Turpie *et al*. 2005). Strong marketing combined with existing tourism growth will undoubtedly lead to growth in demand. In capitalising on the full economic potential of the resource in the future, however, management of this industry will need to address sustainable development in terms of its principle mandate of protecting the resource.

Economic, social and ecological value of coastal and marine environments and resources

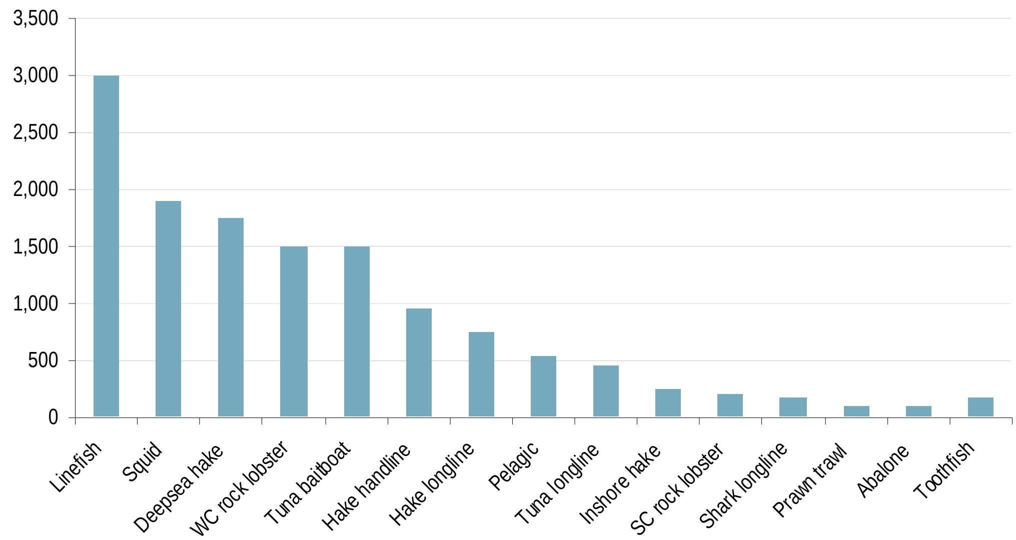
The marine and coastal environment and its associated resources contribute considerable value to the South African economy in terms of employment, recreation and tourism. Since the 1980s, the four major coastal cities, namely Cape Town, Port Elizabeth, East London and Durban have shown the fastest economic growth of all cities in South Africa (White Paper: Sustainable Coastal Development 2000). In 2000, the estimated value of the direct benefits obtained from all coastal goods and services in South Africa was approximately R168 billion, with indirect benefits contributing a further R134 billion (White Paper: Sustainable Coastal Development 2000). The coastal contribution to the economy of South Africa is most frequently measured as the total annual Gross Domestic Product (GDP) emanating from the four coastal provinces. The overall GDP contribution from coastal provinces in 1995 was R322 277 million and has increased steadily to R401 674 million in 2003 (at constant 2000 prices). However, the percentage contribution to South Africa's national average GDP for coastal provinces has decreased from 42.5 percent in 1995 to 38 percent in 2003 (Statistics South Africa 2005). The annual percentage contribution by each coastal province to the national GDP between 1995 and 2003 is presented in Figure 1.6. KwaZulu-Natal has contributed the greatest percentage to GDP since 1995, followed by the Western Cape, Eastern Cape and Northern Cape respectively. The overall percentage contribution from the Western Cape has remained at approximately 13 percent, while that of the other three provinces has declined over time (DEAT & CSIR 2005).



Source: DEAT & CSIR (2005)- calculated from statistics provided by Statistics South Africa 2005

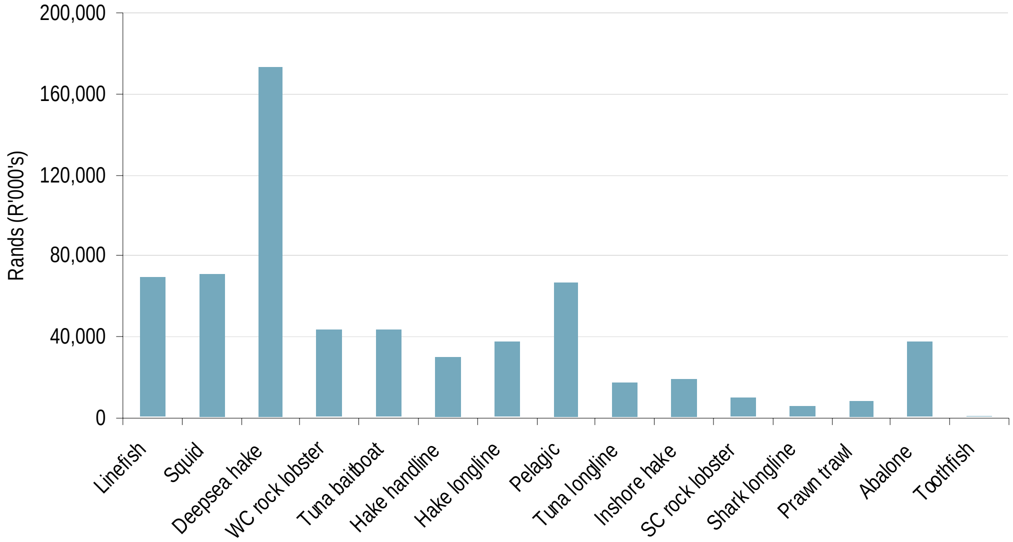
Figure 1.6: Annual Gross Domestic Product (GDP) percentage contribution by coastal provinces of South Africa 1995 to 2003 (at constant 2000 prices)

The fishing industry (primary, secondary and tertiary aspects thereof) is a source of employment for nearly 28 000 people living at or near the coast (Mather *et al.* 2003). In comparison to other employment sectors, the fishing industry is considered to provide high quality employment, generating substantial total incomes (Mather *et al.* 2003). Fishers earn on average R36 000 per year, although gross earnings vary between different skills groups *i.e.* unskilled, semi-skilled, management (Mather *et al.* 2003). The total earnings from South African commercial fishers in 2000 was approximately R1 billion (Mather *et al.* 2003). Commercial fisheries employing the highest number of people are the line, squid, hake trawl and west coast rock lobster fisheries (Figure 1.7). In terms of total earnings, however, the deep sea hake fishery pays the highest wages, followed by squid, linefish and pelagic fisheries (Figure 1.8). The Western Cape Province employs up to 83.2 percent of workers in the fishing industry, followed by the Eastern Cape (13.6 percent), KwaZulu-Natal (2.3 percent) and the Northern Cape (0.9 percent) (Mather *et al.* 2003).



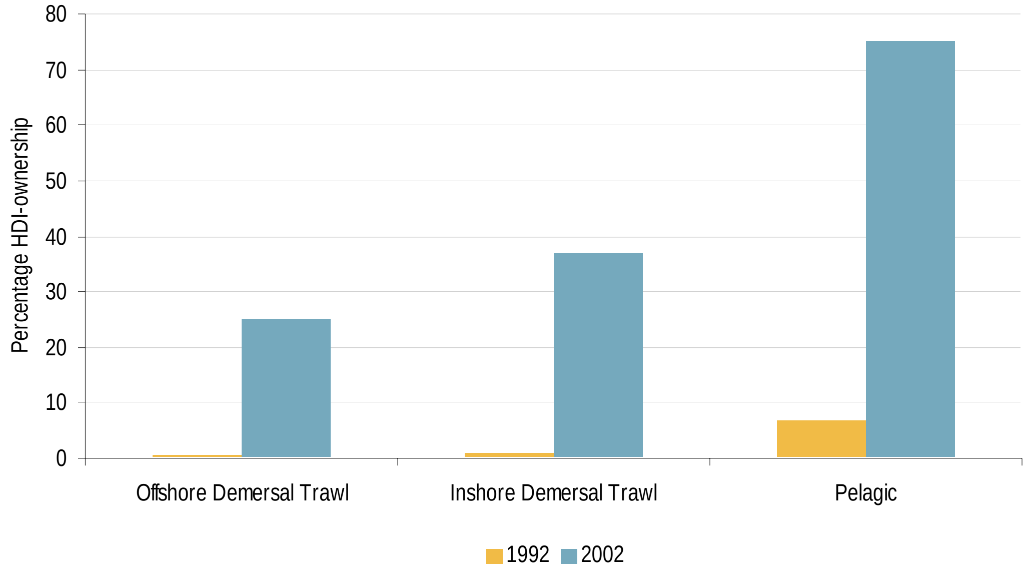
Source: Fishing Industry Handbook 2004
Figure 1.7: Number of people employed per commercial fishing sector (2000)

The value of the total catch landed appears to be linked to the scale of wages paid, although the number of people employed per fishery will also influence the average wages. The deepsea hake (demersal offshore trawl) lands the highest value catch, contributing 44 percent to the total revenue of South African fisheries. The pelagic and line fishery contribute 20 percent and 11 percent respectively (Figure 1.1).



Source: Fishing Industry Handbook 2004
Figure 1.8: Total annual earnings for each commercial fishery (2000)

Following the dismantling of apartheid and introduction of democracy in South Africa in 1994, the fishing industry has undergone several changes, mostly facilitated by the new fisheries policy, the Marine Living Resources Act (MLRA) of 1998 (Branch and Clark in review). This Act, among other requirements, specifies the "need to restructure the fishing industry to address historical imbalances to achieve equity" (Act 18 of 1998). Transformation of the fishing industry is being addressed from three angles. Firstly, fishing rights have been redistributed from a small number of majority white-owned companies (< 300) to a larger number (almost 6000) of smaller companies owned by Historically Disadvantaged Individuals (HDIs). Secondly, established companies have undergone internal transformation, which includes improved employee rights and minimum wages. Finally, subsistence fishers have been formally recognised and management structures are being developed to improve allocations and maintain sustainability through commercial, recreational and subsistence fishing sectors (Branch and Clark in review). The Department of Environmental Affairs and Tourism (DEAT) has estimated that by 2003 at least 60 percent of commercial fishing rights had been allocated to HDIs or HDI-owned and managed companies (DEAT 2004). Small-scale fisheries, such as that of abalone, (which requires minimal infrastructural resources) have been more successful at transformation (88 percent HDI-owned rights holders and 84 percent of TAC with HDI-owned companies), whilst the larger, more capital intensive industries, like deep-sea hake, reflect a smaller degree of transformation (74 percent HDI-owned rights holders and 25 percent of TAC with HDI-owned companies). However, when examining changes within these larger commercial fisheries between pre- and post-apartheid, the level of transformation looks more positive (Figure 1.9). The deep-sea hake fishery HDI-ownership percentage has increased from 0.5 percent in 1992 to 25 percent in 2002 while inshore demersal trawl has increased from 1 percent to 37 percent HDI and the pelagic fishery from 7 percent to an impressive 75 percent HDI (Mather *et al.* 2003).

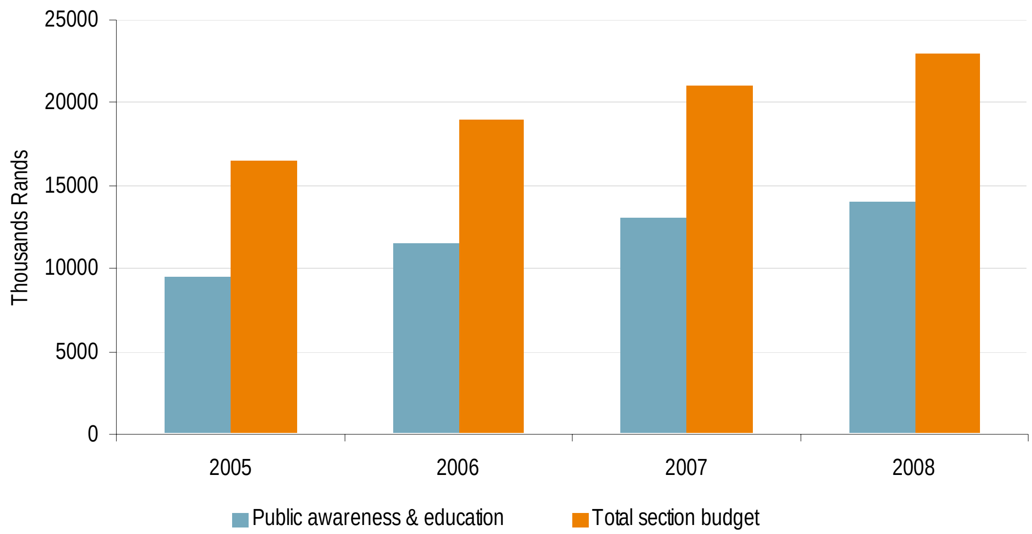


Source: DEAT (2004) - Transformation and the South African Fishing Industry
Figure 1.9: Percentage of Historically Disadvantaged ownership in three largest commercial fisheries of South Africa, 1992 vs. 2002.

The fishing industry of South Africa is considered one of the top three industries showing positive signs of transformation (DEAT 2004), however, achieving this has not been an easy process. Following publication of the MLRA in 1998, annual allocation of fishing rights was introduced in an attempt to initiate transformation. DEAT did not anticipate the dramatic increase in the number of rights applications (< 300 in 1990 to 12 000 in 1999) and there were long delays in issuing rights, accompanied by numerous legal challenges (Branch and Clark in review). It soon became apparent that short-term rights allocations (annually) simply led to increased poaching, financial insecurity, lack of a sense of ownership and destabilisation of the fishing industry. Various procedures were introduced to address these emerging issues and included a Rights Verification Unit, an Appeal Committee and allocation of medium-term (four years) fishing rights (2002 to 2005) (Branch and Clark in review). With these measures in place, applications decreased by 50 percent and medium-term rights have been allocated to most commercial fisheries, litigation has almost ceased and stability has been largely restored (Branch and Clark in review). On 1 March 2005, the Minister of Environmental Affairs and Tourism announced the intention to issue long-term (8 to 15 years) fishing rights imminently. Long-term fishing rights are expected to provide greater security and further stability in the fishing industry of South Africa.

The Marine Living Resources Act (1998) recognises the subsistence fishing sector for the first time and takes cognisance of the fact that many coastal communities of South Africa derive their livelihoods directly from marine resources. The MLRA has greatly improved the parameters of management requirements since 1999, contributing to the overall superior marine legislation. To ensure the sustainability of natural resources around the coast and to secure the future livelihoods of such coastal communities, several Sustainable Coastal Livelihood Initiatives were introduced at provincial level. The majority of these programmes form part of the National Coastal Management Initiative driven by civil society, government (DEAT) and private businesses. The aim of the programme is to identify, promote and assist in establishing non-consumptive or alternative coastal livelihood resources and requires community ownership. A total number of 17 Sustainable Coastal Livelihoods projects have been registered in South Africa since 1999 and have a total estimated value of R360 million.

Awareness and education focussed on the coastal environment and its resources creates public knowledge, concern and ultimately, a sense of responsibility for the marine and coastal environment. Public education and awareness initiatives, aimed specifically at the marine environment, are most actively addressed through the Integrated Coastal Management section of DEAT: MCM. Such initiatives already implemented include the Interpretive and Informative Signage Project, Adopt-a-Beach Programme, SA Coastal Information Centre and the Coastal Indicator Programme. The annual budget allocated for such public education initiatives provides a good indication of the level of community outreach and empowerment being achieved through this means and is predicted to comprise 60 percent of the total annual budget for the Integrated Coastal Management section by the year 2008 (Figure 1.10).



Source: DEAT & CSIR (2005)

Figure 1.10: Proposed annual budget for marine and coastal focussed public awareness vs. total budget.

Box 1.2: The Southern African Sustainable Seafood Initiative

Worldwide, the popularity of seafood is on the increase as consumers see it as a healthier food choice. Despite this there is little information available to consumers about seafood products and related conservation issues. These include legislation, overfishing, habitat and ecosystem damage by fishing methods used, and bycatch and incidental mortality of seabirds, turtles, and marine mammals. Internationally there has been increasing awareness amongst seafood lovers, resulting in mounting pressure on retailers and fisheries to provide consumers with more information. Seafood awareness campaigns are based on the principle that informed consumers may drive changes in seafood markets through their choices. It follows that in order to conserve and sustainably manage the great diversity and variety of marine species that are utilised by the seafood trade in Southern Africa, local consumers should also be informed so that they can start making more sustainable seafood choices. Likewise, dealers in seafood should know the law that applies to this industry.

In order to address this information deficit the Southern African Sustainable Seafood Initiative (SASSI) was initiated in November 2004, with three main objectives: 1) Promote voluntary compliance to the Marine Living Resources Act (MLRA) through education and awareness; 2) Shift consumer demands away from over-exploited species to more sustainable options; 3) Create awareness about marine conservation issues, especially concerning commonly consumed species. The initiative is aimed at all participants in the seafood trade industry, from wholesalers to restaurateurs to seafood lovers, and by 2007 will have established a standardised training network for seafood restaurants and retailers in the major urban centres of South Africa.

The training will focus on enabling seafood dealers to know the legal aspects stipulated in the MLRA, the most important points being that that there are certain "no-sale" species, that fish caught by a recreational fisher (including spearfishers) may never be sold, and that all fish sold by retailers should have been obtained from licensed commercial fishers. Retailers are encouraged to keep the legally required paper-trail for seafood species that are bought and sold (including proof of purchase, license holders name, species of fish and quantities bought).

A public awareness campaign will also be launched to educate consumers, enabling them to make informed and sustainable choices when buying seafood. Consumers will be encouraged to be on the lookout for "no-sale" species that are illegally offered for sale, the most important of these that regularly appear on restaurant menus being white musselcracker *Sparodon durbanensis* and white steenbras *Lithognathus lithognathus*. There are also severely overexploited species that consumers are encouraged to avoid, such as red steenbras *Petrus rupestris* and black musselcracker *Cymatoceps nasutus*. Rather, species that are from relatively healthy and well managed stocks will be promoted, for example yellowtail *Seriola lalandi* and snoek *Thyrsites atun*.

SASSI is core funded and supported by WWF-SA (The Green Trust) and the South African Department of Environmental Affairs and Tourism. Implementing partners of the initiative are Ezemvelo KwaZulu-Natal Wildlife, Two Oceans Aquarium, TRAFFIC and Sea World at uShaka Marine World.

For further information on the Southern African Sustainable Seafood Initiative visit www.wwf.org.za/sassi/ or contact Jaco Barendse (jbarendse@wwf.org.za).

Modification and/or loss of marine and coastal habitat

Coastal cities around the world have grown dramatically over the past 50 years and are predicted to continue to do so for the foreseeable future (Tibbits 2002). Principal reasons for this increase are the appeal of living near the coast, increased tourism, sufficient wealth for coastal retirement opportunities, an increase in coastal holiday-home purchases and the quest for employment and basic livelihoods (Tibbits 2002). As much as 40 percent of South Africa's population live within 100 km of the coast, resulting in substantial development pressure for infrastructure, housing, roads etc. A comparison between the 1996 and 2001 South African census data reflects only a small change in population densities within coastal provinces at a municipal level (Figure 1.11). The changes in coastal population densities between 1996 and 2001 in South Africa are not considered to be dramatic on a national scale, with the most noticeable increase occurring in the Eastern Cape, Nelson Mandela Metropole. There appears to be a reduction in population density in the region between Cape Town and Saldanha Bay, Western Cape between 1996 and 2001. This could be an indirect reflection of reduced rainfall and drier climate being unable to support the same density of people. Overall population growth and increased development continue to pose severe threats to resources of the coastal zone as reported in 1999 National State of the Environment Report.

Using the National Land Cover Database (Thompson 1996), DEAT & CSIR (2005) classifies the current state of coastal land in South Africa as either natural, degraded, urban or agricultural. As would be expected, the majority of urban land use occurs in municipalities containing the three largest coastal cities, Cape Town (25 percent), eThekwini/Durban (27 percent) and Nelson Mandela (12 percent) (Table 1.1). Not surprisingly, the sparsely populated Namakwa region has the highest percentage natural land cover (98 percent) with Cacadu (92 percent), Eden (76 percent) and Amatole (75 percent) districts also having high percentages of natural land. The Nelson Mandela, Namakwa and Overberg regions have only 1 percent degraded land, while the West Coast has a mere 2 percent total landcover classified as degraded. In contrast, the O. R. Tambo region in the Eastern Cape has the highest percentage degraded land (20 percent) in South Africa.

Source: recreated from DEAT & CSIR (2005) using Census 1996 & 2001 data

Figure 1.11: Population density (km^{-2}) in South African coastal municipalities for 1996 and 2001

Table 1.1. Landuse in coastal Metropolitan and District Municipalities.

Coastal Municipalities	Total area of Metro (km^2)	Natural landcover (percent)	Degraded landcover (percent)	Urban landuse (percent)	Agricultural landuse (percent)
Namakwa	126 750	98	1	1	1
West Coast	31 100	67	2	1	30
Cape Town	2 500	40	3	25	32
Overberg	11 400	54	1	1	44
Eden	23 325	76	3	1	21
Cacadu	58 245	92	3	1	5
Nelson Mandela	2 000	74	1	12	13
Amatole	23 580	75	11	3	11
O.R. Tambo	15 950	51	20	4	24
iLembe	3 260	37	14	1	47
eThekwini	2 300	35	11	27	25
Ugu	5 050	50	17	2	31
uThugulu	8 220	55	6	1	37
uMkhanyakude	12 820	71	10	1	17

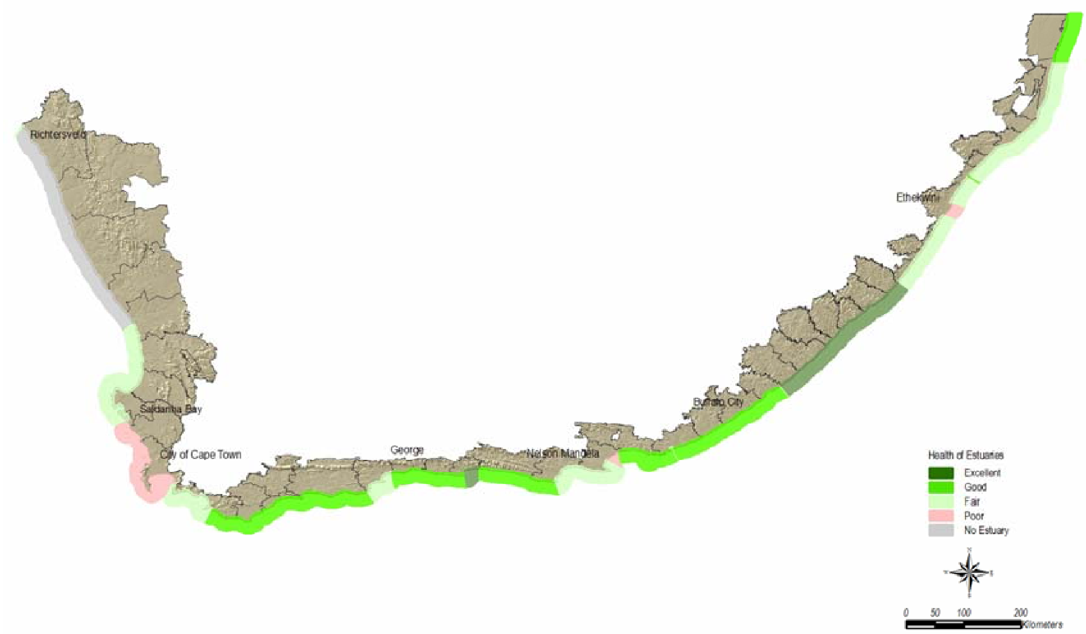
Source: DEAT & CSIR (2005), calculated from the National Landcover Database, Thompson 1996

The areas of natural or undeveloped coastal land in South Africa are increasingly under threat from large-scale urban developments, mostly residential or recreational estates (e.g. golf estates). Numerous new residential estates and at least four new golf estates are currently being planned or already being developed in the Western and Eastern Cape, with the Saldanha

Bay and George local municipalities showing the highest rate of development. The majority of the undeveloped KwaZulu-Natal and Wild Coast regions lie within marine and/or nature reserves, thus development in these regions is greatly restricted.

A prominent component of coastal development is constructing new, or expanding existing international, harbours or ports. South Africa currently hosts seven ports, the most westerly being Saldanha Bay and most easterly, Richards Bay. In 2002 construction of the most recent port development in South Africa, the Port of Ngqura, began in the Eastern Cape. The Port of Ngqura, expected to be operational by the end of 2005, will be South Africa's eighth port and is anticipated to bring significant trade, industry and economic growth to the region.

Turpie (2004) summarised available information on the health of South African estuaries as part of the National Biodiversity Strategy and Action Plan. Estuaries were classified as follows: 28 percent of estuaries were considered to be in excellent condition (in near pristine condition), 31 percent in good condition (minor negative anthropogenic influence only), 25 percent fair (noticeable degree of ecological degradation) and 15 percent poor (major ecological degradation) (Figure 1.12). Estuaries along the south and south east coasts were considered to be in a better state of health than the rest of the country, with those in the former Transkei/Ciskei having the best health (Turpie 2004). Northern KwaZulu-Natal and the major systems of the west coast were considered to be in a good state of health while estuaries around intensively developed areas (Cape south west coast, Port Elizabeth and southern KwaZulu-Natal) were reported to be fair to poor in health (Turpie 2004). The most prominent direct pressures on estuaries are currently considered to be habitat alteration, changing mouth dynamics, overexploitation of resources (e.g. fish), sedimentation, recreational disturbance and pollution (Turpie 2004). Reductions in freshwater input (quantity) and water quality further threaten the health status of the majority of South African estuaries. Compounding the existing threats, climate change poses a potentially serious future threat to estuaries, particularly along the western and southern coasts (Turpie 2004).



Source: Turpie (2004)
Figure 1.12: Average state of health of estuaries per catchment represented spatially.

South Africa's marine and coastal environment is mined in the north-east for heavy metals (titanium and zirconium), in the south for fossil fuel (oil) and in the north-west for diamonds (Attwood *et al.* 2000). An unavoidable consequence of mining is the disruption of the sediment, which ranges from extensive in the case of titanium, to limited in the case of oil (Attwood *et al.* 2000). In most instances, mining completely removes the biological community, which can include vegetation, in-fauna and epi-fauna. Newly introduced environmental policies require coastal mining operations to conduct comprehensive rehabilitation throughout the mined area. If conducted in accordance with the requirements, rehabilitated mined areas can recover within a few years. Coastal dunes in northern KwaZulu-Natal are mined for heavy metals and although rehabilitation of the dune vegetation is considered successful, surrounding wetlands, estuaries and water supplies are negatively impacted. Oil and gas extraction in the offshore marine environment is not considered to cause major benthic disruption (Atwood *et al.* 2000). The possibility of an oil spill is probably the greatest threat posed to the marine environment by this industry. Inshore and offshore diamond mining involves the extraction and re-suspension of benthic sediment, resulting in fine sediment plumes that can contain heavy metals and may reach toxic concentrations (Lane and Carter 1999) or settle on reefs and rocky shores, suffocating the organisms living there (Clark *et al.* 1999). South Africa's Exclusive Economic Zone (EEZ) north of Saldanha Bay to the South African-Namibian border is primarily zoned for diamond mining concessions, although less than 1 percent of this area is currently being mined (Clark *et al.* 1999).

In December 2001, regulations were promulgated which severely restrict the use of off-road vehicles (ORVs) in the coastal zone of South Africa. The use of ORVs within the coastal zone remains a highly controversial and emotive issue within South Africa. Three years after implementing the vehicle ban within the coastal zone, several environmental aspects were noted to be improving. Most conclusive is the increase in successful breeding pairs and overall numbers of African Black Oystercatchers, *Haematopus moquini,* White-fronted Plovers, *Charadrius marginatus* and the 'endangered' Damara Tern, *Sterna balaenarum,* at various breeding locations around the coast (Williams *et al*. 2003). Coastal breeding birds, such as these, were previously negatively impacted on by disturbance or mortality caused by ORV's permitted within the coastal zone. Continued monitoring of other coastal flora and fauna is expected to reveal similar recovery patterns.

Exotic/Introduced species

Marine fauna and flora have intentionally, or more often accidentally, been transported around the globe as a result of human activities (Griffiths *et al.* 2004). Many introduced species rapidly die out before they are able to become established, however, some species, finding no local predators or limited competition, spread rapidly, displacing indigenous species. Once established, these invasive alien species are extremely difficult to control or eradicate and can significantly reduce natural biodiversity. The most frequent means of introducing marine alien species is through the ballast water of ships, which is discharged when loading cargo at ports or harbours, along with any surviving organisms. The highly dynamic nature of South Africa's marine environment appears to have prevented many marine alien invasive species from becoming established. Of the ten currently known marine invasive species, only two (Mediterranean mussel, *Mytilus galloprovincialis* and the ascidian, *Ciona intestinalis*) are considered to have major negative ecological or economic impacts, while one (crab, *Carcinus maenas*) has the potential for negative impact (Table 1.2). Invasion of the alien Mediterranean mussel has resulted in the displacement of indigenous intertidal species along much of South Africa's coastline. This species has, however, also formed the basis of a substantial mariculture industry on the West Coast and is being considered for small-scale commercial exploitation, which will result in a positive impact on local communities (Griffiths *et al.* 2004). A more thorough exploration of the entire coast is predicted to reveal several more invasive species, specifically in the eastern part of South Africa, which is currently poorly surveyed for such species (Robinson *et al.* in press). Since 2001, two ascidian species, one anemone, one oyster and one red algae (half the total number of recorded alien invasive species) have been recorded as invasive species in South Africa.

Table 1.2: Invasive marine species recorded in South Africa, 2004

Species name	Common name	First recorded in South Africa
Ciona intestinalis	ascidian	1955
Clavelina lapadiformis	ascidian	2001
Diplosoma listerianum	ascidian	2001
Metridium senile	anemone	1995
Sagartia ornate	anemone	2002
Carcinus maenus	crab	1983
Littorina saxatilis	periwinkle	1974
Mytilus galloprovincialis	mussel	1979
Crassostrea gigas	oyster	2001
Schimmelmannia elegans	red algae	2002

Source: Robinson et al*. in press*.

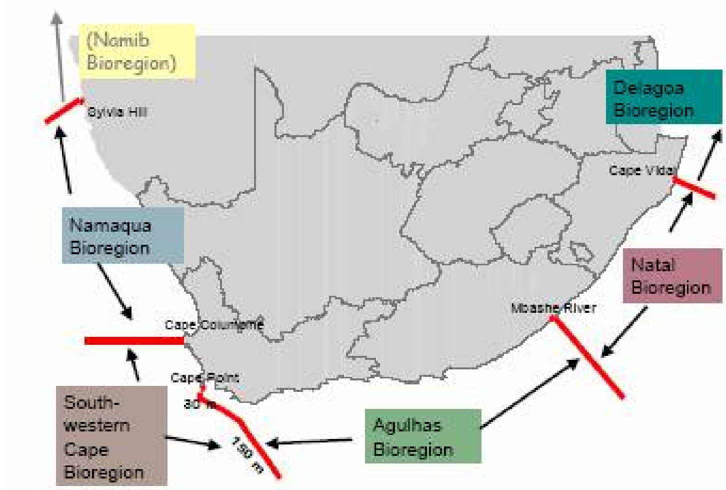
Microscopic algae (phytoplankton) are easily transported around the world in ship ballast water and once discharged, could become invasive. In order to establish whether a phytoplankton species is invasive to a region, a comprehensive historical database must be available for the area in question, historical core samples must be referenced and molecular genetic techniques are often essential for positive identification. These resources are not always readily available and conclusively identifying phytoplankton species as being introduced species thus remains challenging. There is some indication that the species *Aureococcus anophagefferens*, responsible for algal blooms in Saldanha Bay during 1997, 1998 and 1999, may have been introduced from the north-east region of United States of America (pers. comm. L. Botes). This species is thus far only known to occur in these two regions and shipping routes indicate that distribution between these locations was possible during the late 1990s (pers. comm. L. Botes and A. Awad). More recently, the toxic phytoplankton species, *Alexandrium minutum*, was first observed as a red tide bloom in Table Bay Harbour, Cape Town during November 2003 through to February 2004. It is likely that this species was also recently introduced to South Africa and further studies have been initiated to investigate this possibility (pers. comm. G. Pitcher – MCM).

PROTECTION AND MANAGEMENT OF NATURAL MARINE RESOURCES AND THE ENVIRONMENT

Protection of coastal & marine resources

Areas of the ocean closed to fishing activities, particularly ‘no-take’ Marine Protected Areas (MPAs), are generally considered the only effective means of protecting entire marine ecosystems (Branch and Clark in review). MPAs conserve biodiversity by providing refuge for marine fauna and flora and undisturbed sites for research, monitoring, education and tourism (Attwood *et al.* 2000). Since 1999, the role of MPAs in South Africa has come under scrutiny, leading to concerns over the fragmentary approach of declared MPAs and the fact that MPAs did not systematically encompass the country’s marine biodiversity (Branch and Clark in review). Lombard *et al.* (2004) mapped the South African EEZ marine environment into five bioregions, namely, Namaqua, South-western Cape, Agulhas, Natal and Delagoa (Figure 1.13). Since promulgation of the MLRA in 1998, South Africa’s MPA network has undergone substantial expansion and improved management strategies have been implemented (Figure 1.14). In 2004 four new Marine Protected Areas were declared in South Africa, which increased the length of coastline within MPAs in four of the five bioregions. The proportion of the coastline with ‘no-take’ and ‘limited-take’ MPAs increased in three bioregions, whilst the proportion of single-species reserves (considered inappropriate for ecosystem protection) have decreased (Figure 1.14 and 1.15). Most importantly, the increases in MPA areas have taken place in bioregions where they were most urgently required.

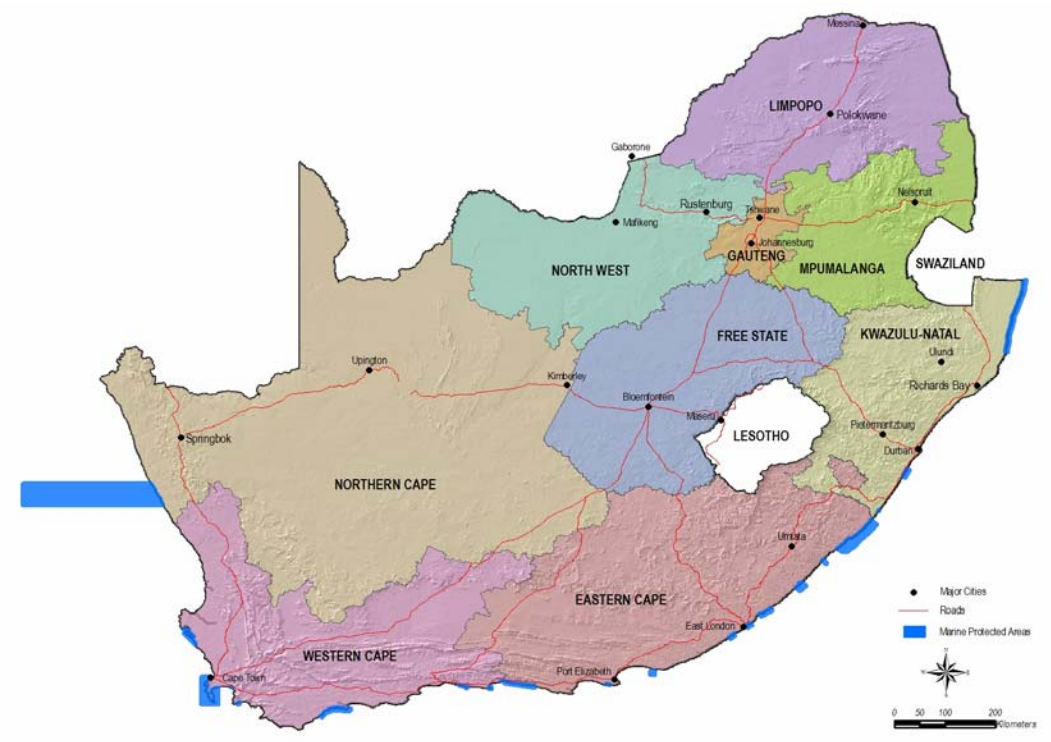
However, in the Namaqua bioregion, increased protection inshore and offshore is still needed (Branch and Clark in review). The total area of the South African EEZ encompassed in some form of MPA has increased from 0.3 percent in 1997 to 1.4 percent in 2004, however, no protected area currently extends greater than 30 km offshore (Branch and Clark in review). A MPA located between the Groen and Spoeg rivers (50 km length), stretching to the edge of the EEZ, in the Namaqua bioregion, has been proposed. Should this be declared, it will greatly improve the protected proportion of this bioregion and that of the overall EEZ (Attwood *et al.* 2000, Branch and Clark in review). Since promulgation of the MLRA in 1998, considerable progress has been made towards achieving the targeted 20 percent protection of South Africa's coastline. There remains an urgent need for protection of offshore habitats, especially considering the impacts offshore fishing and mining activities have on the marine environment (Branch and Clark in review).



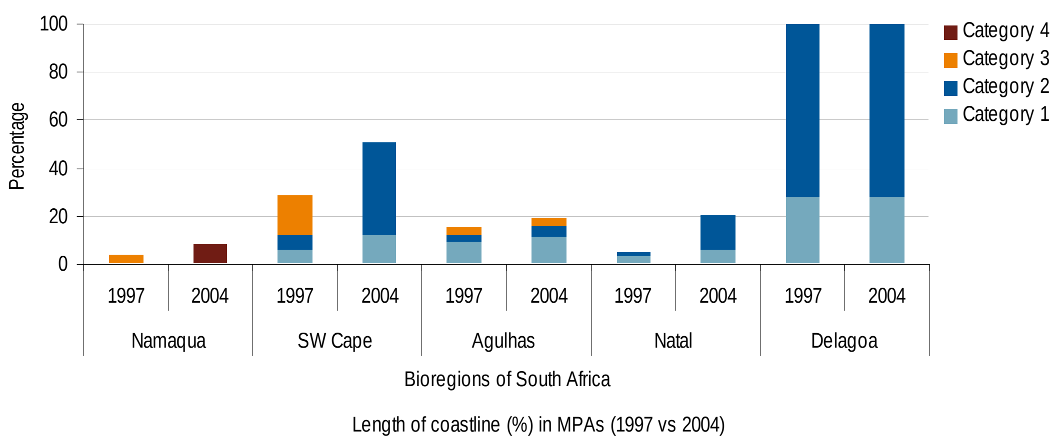
Source: Lombard et al. 2004
Figure 1.13: Five bioregions of the South African EEZ

Law enforcement and compliance within South Africa's marine and coastal environment is the national responsibility of DEAT, Branch: Marine and Coastal Management and is carried out by the Chief Directorate: Monitoring, Control and Surveillance. Fishery Control Officers, Field Rangers and other general administration or support staff are employed to ensure compliance among the 21 fishery sectors and general public in accordance with the MLRA of 1998. In 1999 DEAT officially delegated responsibility for marine and coastal law enforcement in KwaZulu-Natal to Ezemvelo KZN Wildlife (formerly Natal Parks Board), a parastatal conservation body in the province. Prior to this, KwaZulu-Natals' coastline was managed through provincial ordinance only as it was previously excluded from national legislation (pers. comm. K. Morty). In more recent years, national government has further devolved enforcement and compliance responsibility to provincial and local authorities and other conservation agencies e.g. South African National Parks (SAN-Parks), Western Cape Nature Conservation Board (WCNCB) and Overstrand Municipality. Currently 301 staff members are employed for the purpose of addressing compliance in the marine sectors, divided among the coastal provinces as follows; Western Cape = 143, KwaZulu-Natal = 121, Eastern Cape = 35 and Northern Cape = 2. In comparing the number of compliance staff employed in each province, cognisance must be taken of length of coastline, population density and development of fishing industries. Two staff members in the Northern Cape are responsible for 195 km of coastline each (Figure 1.16), however, the population density along this coast is a mere 7 people per km^2 (Figure 1.16) and much of the land is under mining concessions, which do not require patrols. KwaZulu-Natal has the highest population density of 245 people per km^2, followed by the Eastern Cape with 177 people per km^2. The Western

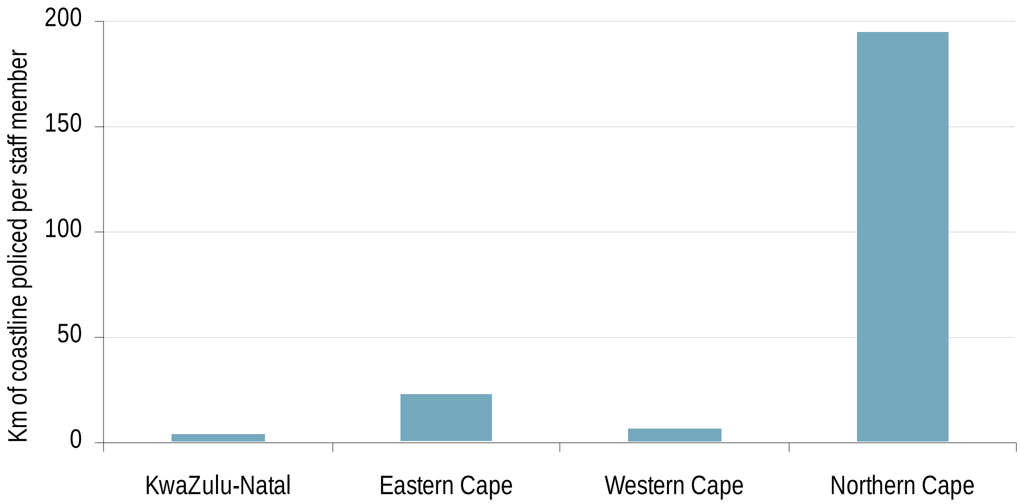
Cape has 66 people per km^2 (Figure 1.16), however, this province also hosts the majority of fishing industries and supports a significant number of recreational fishers.



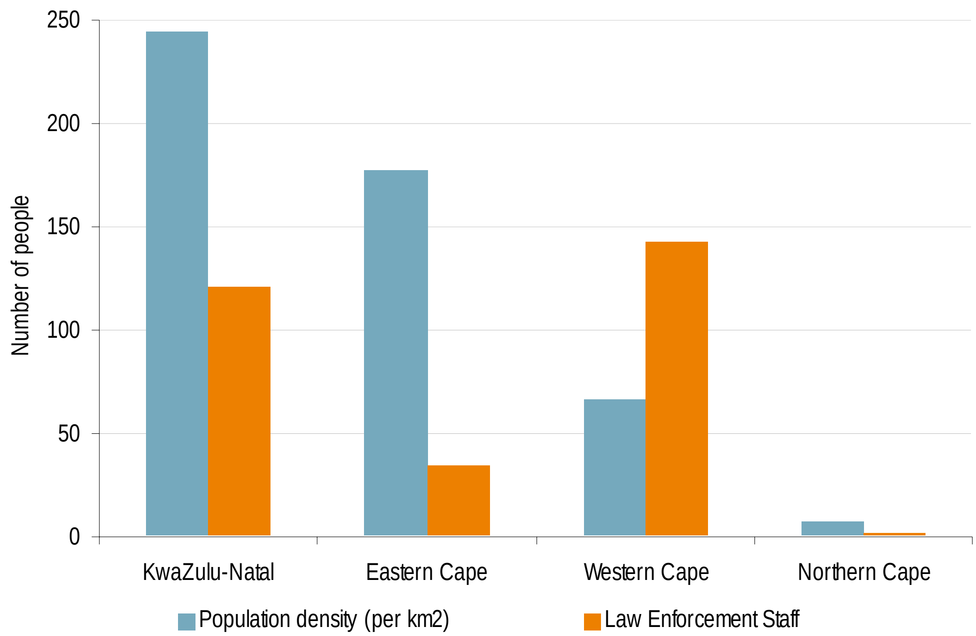
Source: DEAT 2004
Figure 1.14: Existing Marine Protected Areas of South Africa.



Source: Adapted from Lombard et al. (2004) and Branch and Clark (in review).
Figure 1.15: Proportions of the South African coastline within marine bioregions included within various categories of MPA. Category 1 = 'no-take' MPA; Category 2 = some extraction permitted; Category 3 = protection of a single species only; Category 4 = proposed MPA.



Source: DEAT & CSIR (2005)
Figure 1.16: Length of coastline (kms) per law enforcement staff member in each coastal province.



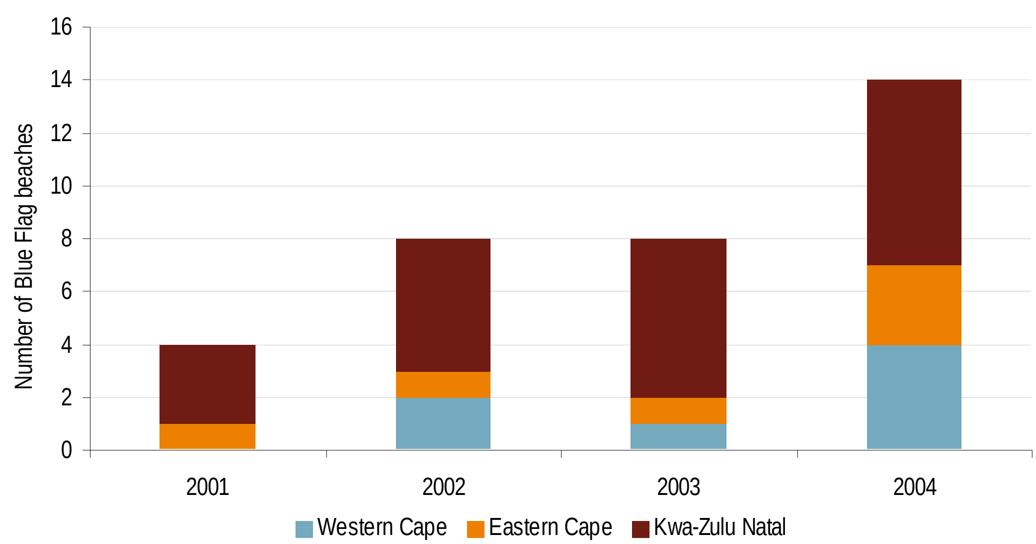
Source: DEAT & CSIR (2005)
Figure 1.17: Law enforcement capacity vs. population density in coastal provinces of South Africa.

To enhance the capacity for monitoring, control and surveillance of South Africa's vast marine environment, DEAT: MCM purchased one offshore and three inshore fisheries and environmental protection vessels, the first of which, *Lillian Ngoyi*, was launched in December 2004. These vessels are capable of remaining at sea for up to 14 days, equipped to implement oil spill counter-measures, search and rescue operations, fire-fighting and limited towing duties. They will spend varying amounts of time at ports around the coast and will monitor all commercial fishing activities. The presence of the four new patrol vessels in the marine environment is expected to considerably improve levels of compliance.

In March 2003 the Department of Environmental Affairs and Tourism opened the first Environmental Court in Hermanus, Western Cape. The court concentrates on addressing environmental offences, specifically the illegal harvesting of abalone from the immediate region. Following the success of the Environmental Court in Hermanus, a second such court was opened in Port Elizabeth in 2004. The specialised courts were initiated to ensure a speedy trial for environmental offenders with suitably qualified prosecutors and magistrates assigned to the cases. Implementation of additional Environmental Courts around the country is currently being considered.

A further, effective means of ensuring that marine resources are sustainably utilised and not overexploited is to develop joint coastal management initiatives. These projects or programmes aim to build partnerships between different government levels (national, provincial, district and local), with civil society and the private sector. Currently there are two such national initiatives, both operating under the CoastCare programme, receiving funding from national government. These are the Working for the Coast (WftC) Programme and the Sustainable Coastal Livelihoods Programme. Joint coastal management initiatives are anticipated to increase and expand as the benefits of such community level management and involvement becomes more apparent with time.

Blue Flag is a voluntary international programme which awards excellence in beach management. The campaign is currently active in 27 countries, mostly European. However, South Africa, after joining this campaign in 2001, is the first country outside Europe to gain Blue Flag status. The Blue Flag status is given to beaches that meet 14 criteria based on aspects of water quality, environmental education and information, safety and services offered. The Blue Flag is awarded for one year only, encouraging continual maintenance of coastal management. The number of beaches awarded Blue Flag status has continued to increase in South Africa since 2001 with KwaZulu-Natal consistently having the highest number of Blue Flag beaches (Figure 1.18).



Source: DEAT & CSIR (2005)

Figure 1.18: Number of Blue Flag status beaches awarded in South Africa 2001 to 2004.

Species Diversity

The categories of IUCN Red Listed species of concern for maintaining species diversity are: Critically Endangered, Endangered and Vulnerable. Monitoring the population trends of IUCN Red Listed species has been used as a conservation tool in South Africa since the 1970s (Barnes 2000), however, in many taxonomic groups there is a lack of base-line information on the species, their populations and distributions. Information on marine species are particularly inadequate, mostly as a result of the difficulties involved in collecting such information with the limitations on time spent underwater. Species that are considered valuable marine resources are mostly assessed in terms of their commercial status, rather than their absolute abundance.

All five species of marine turtles occurring in South African waters are listed on the IUCN Red List as either 'vulnerable' or 'endangered'. Leatherback turtles, *Dermochelys coriacea*, are particularly susceptible to longline fishing and trawling, however, the use of turtle-excluder devices has been made mandatory and has assisted in promoting the status of leatherback turtles from 'critically endangered' in 2001 to 'endangered' in 2004. All turtle nesting sites in South Africa occur within the Greater St Lucia Wetland Park, a world heritage and Ramsar site, thus affording nesting grounds the highest level of protection in South Africa conservation.

The status of the blue whale, *Balaenoptera musculus intermedia* is classified as 'endangered' and although it is now fully protected in South African waters, populations are still struggling to recover from historic exploitation. Four other marine mammal species occurring in South African waters are considered to be 'vulnerable' namely, Indian Ocean bottlenosed dolphin, *Tursiops aduncus*, Indian Ocean humpback dolphin, *Sousa plumbea*, sperm whale, *Physeter macrocephalus* and Bryde's whale, *Balaenoptera brydei*.

Oceanic and coastal bird species are primarily threatened by longline fishing activities, habitat loss and disturbance while nesting. The bittern, *Botaurus stellarus* is considered to be 'critically endangered' due to loss of habitat in the northern KwaZulu-Natal region while three tern species are listed as 'endangered', primarily due to habitat loss and disturbance. The Tristan albatross, *Diomedea dabbenena* and spectacled petrel, *Procellaria* are listed as 'endangered' and four other albatross species as 'vulnerable', mostly due to longline fishing induced mortalities. An additional six oceanic and coastal bird species (as mentioned above) have become listed as 'endangered' or 'vulnerable' within the past decade.

The IUCN lists 53 species of coastal fish found in South African waters on their Red List, however, this is a global assessment and its pertinence to actual fish populations in South Africa has been questioned (van der Elst and Beckley 2002). The most recent evaluation of South Africa's marine fish status has indicated that up to 20 species of commercial and recreational marine fish are considered over exploited and/or collapsed (Mann, 2000, Griffiths and Lamberth 2002). Since the turn of the century, specialised studies on specific fish species (e.g. Scotsman, Englishman, belman, carpenter, red roman), all further confirm the continuing deteriorating status of these species (pers. comm. C. Attwood – MCM).

As a result of habitat degradation and increasing human pressures on estuaries, four South African estuarine fish species are listed on the IUCN Red List. These are doublesash butterfly fish, *Chaetodon marleyi*, Knysna seahorse, *Hippocampus capensis*, St Lucia mullet, *Liza luciae* and estuarine pipefish, *Sygnathus watermeyeri*, all of which are considered 'critically endangered'.

Box 1.3: The African Coelacanth Ecosystem Programme (ACEP)

In 1938 the first known South African coelacanth was caught in nets of a fishing trawler near the Chalumnae River mouth in the eastern Cape. Prior to this, the coelacanth was known only as a fossil fish that was thought to have gone extinct nearly 70 million years ago. It was only 14 years later that another coelacanth specimen was encountered in the Comoros region and further studies of this ancient fossil fish were initiated. In October 2000, recreational Trimix divers encountered three coelacanths at 107 m in Jesser Canyon, Sodwana Bay, KwaZulu-

Natal, the first coelacanths to be located within South Africa since 1938. By May 2001 as many as six individual coelacanths had been sighted in South African waters and the African Coelacanth Ecosystem Programme (ACEP) was initiated. The programme was officially launched in March 2002 with an exploratory expedition aboard the FRS Algoa, making use of the German submersible Jago to explore submarine canyons as deep as 400 m, not only in search of coelacanths but also to gain some degree of understanding of deep water marine ecosystems.

The primary focus of ACEP lies in developing scientific excellence in offshore marine research, being a multidisciplinary project operating within South Africa, Mozambique, Tanzania, Kenya, the Comoros, the Seychelles and Madagascar. Using the coelacanth as an icon symbol unifying these countries, ACEP aims to integrate physical, chemical and biological sciences within Geographic Information Systems (GIS) to gain a holistic understanding of processes sustaining the western Indian Ocean. Some of the aspects being studied through ACEP include;

Geoscience – canyon formation, bottom composition and topography of the sea,

Marine ecology – deep water habitat classification, biodiversity surveys, fish counts, coelacanth studies, and marine reserve sites

Oceanography – primary production, oceanographic variables such as currents, temperatures, salinities, dissolved chemicals (nutrients and oxygen) etc.

Genome resources - generation and preservation of indigenous genomic information and whole genome sequencing,

Phylogenetics – how different species are related and

Larval ecology of deep sea ecosystems.

Additionally, ACEP have strong environmental education sub-programmes and are in the process of developing a socio-economic and indigenous knowledge sub-programme.

ACEP is principally funded by the Department of Science and Technology (DST) and Department of Environmental Affairs and Tourism with many other partners providing additional funding and/or support for select components of the programme e.g. South African Institute of Aquatic Biodiversity (SAIAB), Rhodes University, Max Planck Institute, WWF etc.

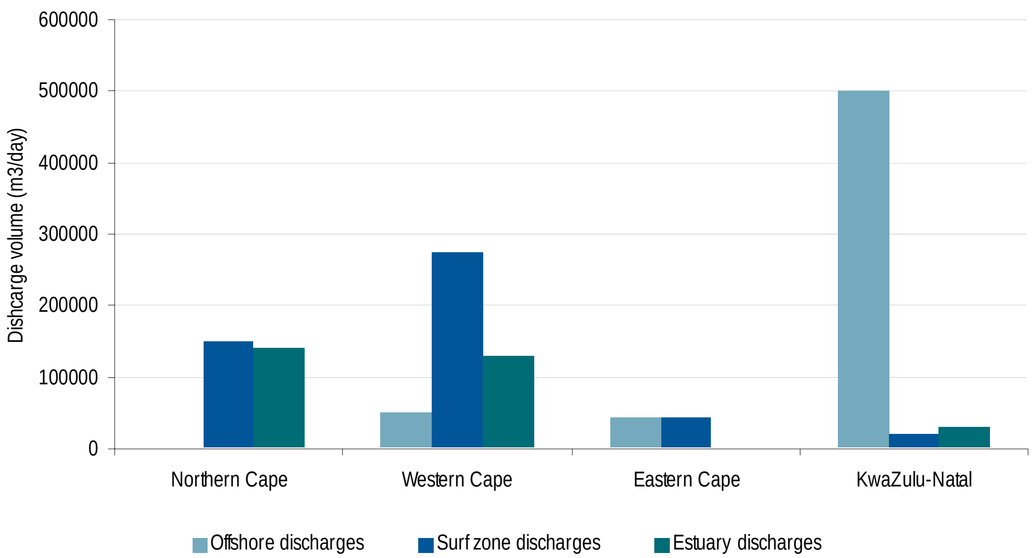
To date, ACEP have conducted three research expeditions into the deep water ecosystems of the Greater St Lucia Westland Park, KwaZulu-Natal, using the German submersible Jago and recently conducted a very successful exploratory Remotely Operated Vehicle (ROV) trial in this environment. Through ACEP, 21 individual coelacanths have thus far been documented in South African waters with several individuals known to be resident over five years. The coelacanths sighted in South Africa occupy a depth range between 54 and 144 m in water temperatures between 16 and 23 ^{o}C, prey on deep water fish species and bear live young. In 2003 one individual coelacanth was fitted with an acoustic tag and its movements tracked over two weeks. This coelacanth remained in the deep water caves during the day and ventured out into shallower water at night, presumably to hunt. Although coelacanth research has revealed much information about this unique fossil fish, many more questions have arisen relating to the broader environment in which it occurs. As many as 58 species of deep water fish (some of which are new species recorded in South Africa), have been documented, several new species of deep water invertebrates are currently being described, 24 canyons (12 previously undiscovered) have been mapped and seven new habitat types have been identified as a result of ecosystem research conducted through ACEP. Further knowledge is urgently required about these mysterious deep sea regions that are increasingly becoming threatened by advancing commercial and recreational fishing pressures.

Through intensive, long-term exploration of the deep water bioregions of the western Indian Ocean, ACEP aims to promote unified management of shared marine resources, sustainability and improved understanding of marine biodiversity. For further information on the African Coelacanth Ecosystem Programme, visit http://www.acep.co.za/

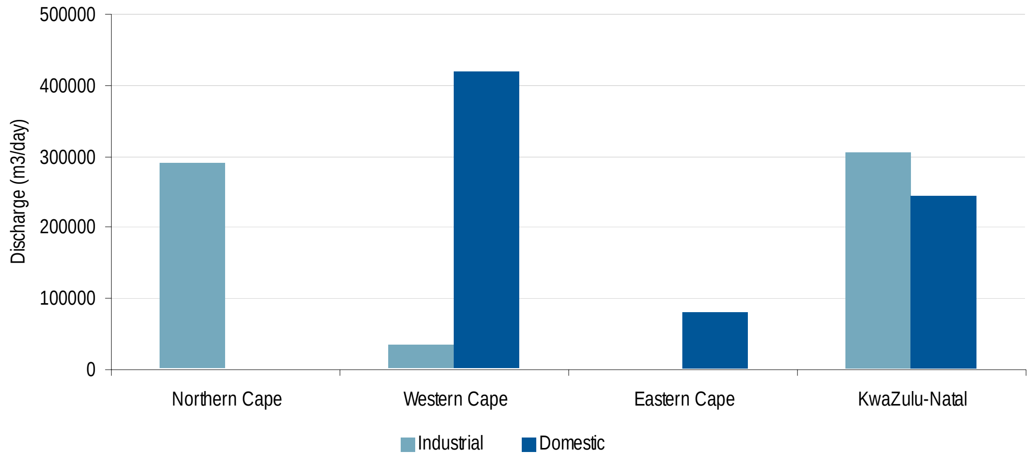
EMISSIONS TO SEA

Water quality (pollution)

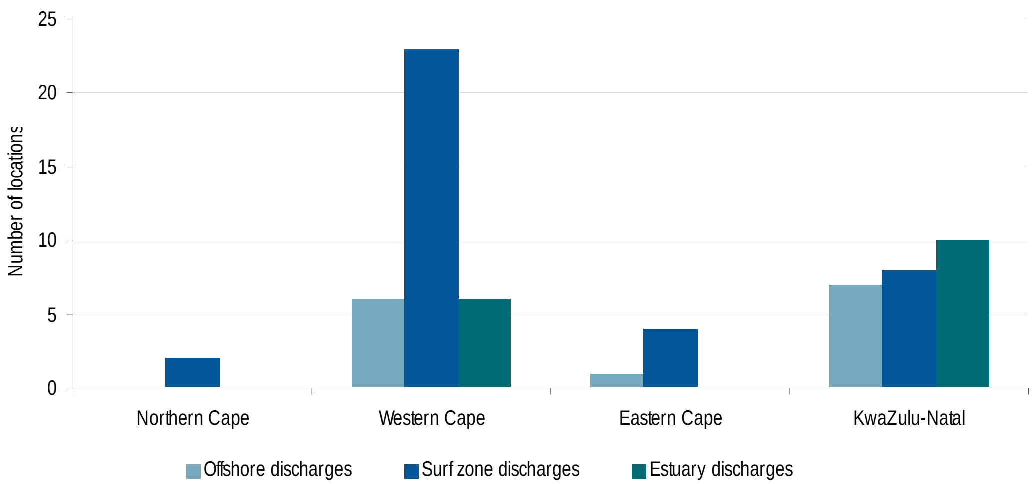
Pollution of coastal waters can originate from land-based sources (industrial, municipal, agricultural run-off), shipping activity (accidental or deliberate discharges, garbage and dumping) and atmospheric gases (Attwood *et al.* 2000). By international standards coastal waters around South Africa are considered to have very low levels of pollution (Brown 1987, Griffiths *et al.* 2004). However, there are as many as 67 discharge points, through which as much as 1.3 million cubic meters of wastewater is discharged into the marine environment on a daily basis (Figure 1.19). The daily amount of wastewater currently being discharged into the marine environment is 62 percent greater than five years ago, although the number of discharge points has only increased by four, indicating a significant increase in wastewater volume. The majority of these discharges are released into the surf zone (37) with considerably fewer points of discharge into estuaries and offshore (16 and 14 respectively). An alarmingly high 23 points discharge into the surf zone in the Western Cape alone, where 275 000 m^3 of wastewater, 90 percent of which is domestic effluent, are discharged per day (Figure 1.19). Offshore discharges along the KwaZulu-Natal coast amount to 500 000 m^3/day, of which 61 percent are industrial, the remaining being domestic effluent (Figure 1.19 and Figure 1.20). The Eastern and Northern Cape have considerably lower amounts of wastewater discharge than either of the other two coastal provinces. The severity of wastewater pollution in the marine environment has continued to deteriorate since reported on in the 1999 National State of the Environment Report.



Source: Department of Water Affairs and Forestry (2004) cited in DEAT & CSIR (2005)
Figure 1.19: Total daily waste-water discharged into the marine environment per coastal province.



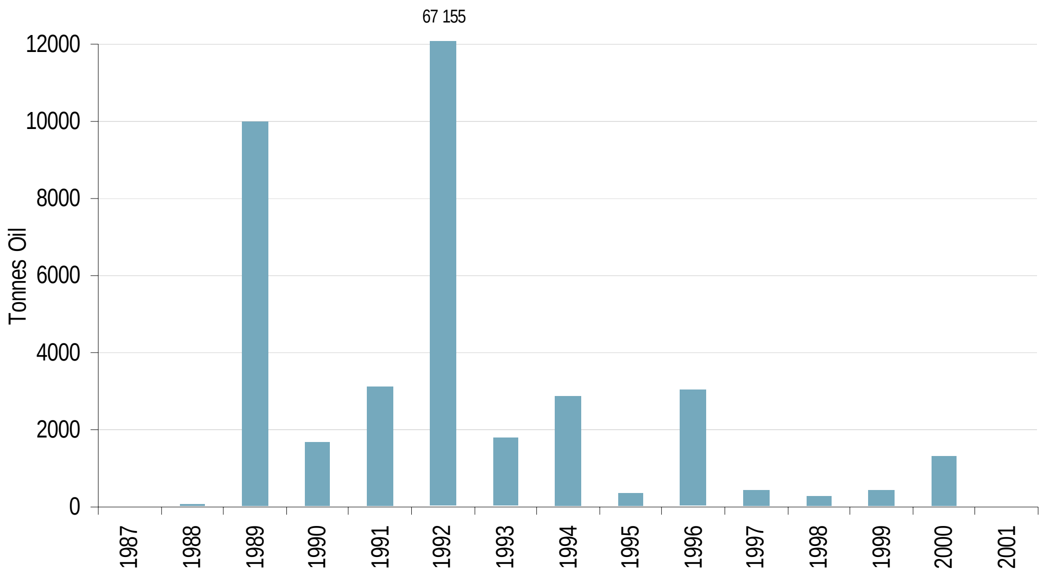
Source: Department of Water Affairs and Forestry (2004) cited in DEAT & CSIR (2005)
Figure 1.20: Total daily breakdown of industrial vs. domestic waste-water discharged into the marine environment per coastal province.



Source: Department of Water Affairs and Forestry (2004) cited in DEAT & CSIR (2005)
Figure 1.21: Location of coastal waste-water discharge points in the South African marine environment per coastal province.

The Mussel Watch Programme, initiated by the DEAT Branch: MCM in 1985, regularly assesses the heavy metal concentrations in the tissues of the Mediterranean mussel, *Mytilus galloprovincialis*, at 42 sites in the Western and Northern Cape. The programme was expanded to Durban and East London in 2004. Mussels are considered good indicators for water quality because they are sessile bio-accumulators. Since 1985 there has been a noticeable decline in levels of lead in the mussel tissue, although areas of False Bay, Western Cape continue to be unsatisfactorily high (Griffiths *et al.* 2004). Levels of zinc and cadmium appear to be increasing, although this is thought to be due to natural causes, as the concentrations remain high, even in non-impacted sample sites (Griffiths *et al.* 2004).

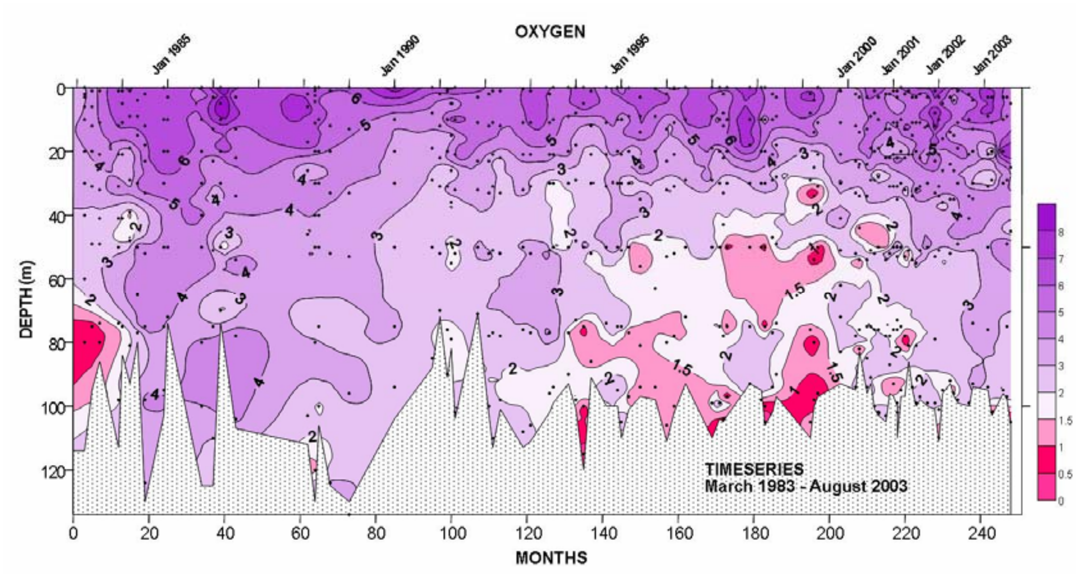
During the last decade, approximately 82 000 tonnes of oil has been accidentally or deliberately discharged into South African coastal waters. The worst oil pollution incident in the last decade occurred in 1992 when the Katina-P oil tanker sank off the coast of Mozambique, releasing over 67 000 tonnes of oil into the ocean. This devastational oil spill is considered by far the worst such incident in several decades. Other oil spill incidents have been known to release between 1500 to 3000 tonnes of oil into the sea (Figure 1.22). Stringent legislation promulgated since 1999 has greatly assisted in preventing any further large scale oil pollution incidents in South African waters.



Source: DEAT & CSIR (2005) and National Ports Authority
Figure 1.22: Incidents and volume of marine oil spills in South African EEZ 1987 – 2001

Phytoplankton form the basis of primary productivity in marine ecosystems and are essential in supporting large fisheries. Blooms of certain phytoplankton species can, however, result in harmful, toxic conditions (Pitcher and Calder 2000). Along the Southern African coastline, the Benguela upwelling region is most frequently subjected to harmful algal blooms (HABs), although isolated incidents have been recorded along the South Coast. Blooms most commonly occur between January and May, during the latter half of the upwelling season (Pitcher and Calder 2000). These blooms are frequently characterised by a sudden abundance of a particular species of microalga that can lead to discolouration of the water, a phenomenon known as red or brown tide (Pitcher 1998). Red tide blooms can become highly toxic, depending on the species of microalgae in abundance, and can lead to mass mortalities of fish and invertebrates (Probyn *et al.* 2000). Once the nutrient supply is depleted, the phytoplankton bloom begins decaying and the organic-rich material uses up oxygen in the inshore waters, leading to oxygen depletion or anoxic conditions. These environmental conditions have resulted in large-scale mortalities of fish and shellfish, often leading to rock-lobster 'walkouts' (Pitcher and Cockcroft 1998, Cockcroft *et al.* 2000).

The earliest accounts of marine mortalities as a result of red tide-induced low oxygen events were recorded in the 1800s, with such events occurring periodically ever since. The incidence of low oxygen events appears to be increasing. This is illustrated in Figure 1.23 with the increasing occurrence of low oxygen conditions (indicated by pink-red colour) occurring in shallow water through time. There appears to be a global increase in the frequency and severity of HABs and in many cases the increases have been related to human activities, such as coastal pollution (Pitcher and Calder 2000). The magnitude of this increase may, however, be related to an increased awareness and improved surveillance techniques (Pitcher and Calder 2000). The Department of Environmental Affairs and Tourism has established a dedicated Red Tide Response Team, tasked with responding to the detection of a red tide event at any of the monitoring stations between Doring Bay and Cape Agulhas. The response team are required to take daily water samples to monitor toxicity levels, educate and inform the public and issue warnings of dangerous toxicity levels. In 1999 a HAB monitoring program was implemented in the southern Benguela to provide a warning and information system to the public, aquaculture and fishing industry (Pitcher and Calder 2000).



Source: DEAT & CSIR (2005)
Figure 1.23: Low oxygen record from Cape Columbine, West Coast 1983-2003.

EMERGING ISSUES

Climate change

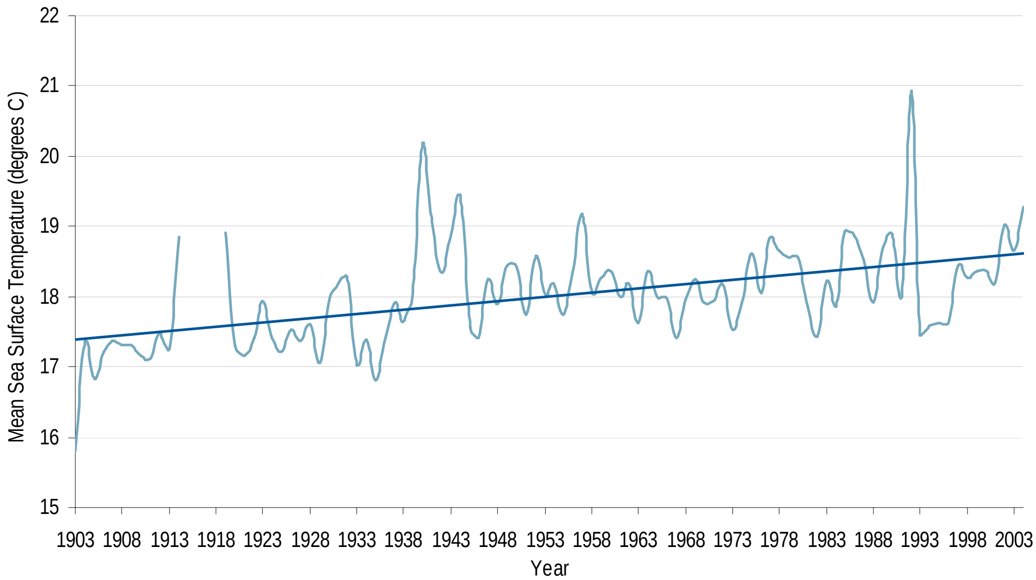
During the past decade, it has become globally accepted that the earth's climate is changing as a result of anthropogenic impacts and the effects thereof are becoming increasingly evident (Clark in review). The International Panel on Climate Change (IPCC) states that global average surface temperatures have increased, global mean sea level is rising, the concentration of ozone in the stratosphere has decreased. Annual average precipitation has also changed and the intensity and frequency of extreme weather events appear to have increased (IPCC 2001). Monitoring of sea surface temperature, mean sea level and rainfall in South Africa suggests that changes in the local environment are similar to those of global patterns and that the impacts thereof are likely to have significant consequences for marine ecosystems and the fisheries they support. Clark (in review) speculates that nearly all sectors of the South African fishing industry will be affected by climatic induced changes, specifically the subsistence and small-scale sectors, where there is limited scope for adapting to changing conditions.

Rainfall fluctuations result in a change in the amount of freshwater runoff. This is of significance to the marine environment in that any reduction in freshwater flow impacts directly on estuaries and the marine biota that utilise these systems such as, estuarine dependent fish species (Clark in review). Migrant birds, fish and prawns extensively utilize South African estuaries, which provide sheltered areas that are used as feeding and nursery grounds. The majority of estuaries in South Africa have already been severely degraded (primarily through reductions in freshwater input and habitat destruction), resulting in negative effects on many estuarine dependent species (Whitfield 1998, Bennett 1993, Griffiths 2000). The anticipated further reductions in the amount of freshwater entering estuaries in South Africa are likely to have further negative consequences for these systems. In comparing the natural (before human activity) Mean Annual Runoff (MAR) with current conditions in the major systems around the coast, it is evident that the most drastic reduction in freshwater flow has occurred in the Orange River (reduced MAR of 39 percent) with similarly severe reductions in other West Coast systems (reduced MAR of 30 percent - DWAF 2004). Other major water-catchment areas along the coast show a reduction in MAR of between 4 and 21 percent (DWAF 2004).

Reduced freshwater flow will also decrease the extent to which wastewater discharges are diluted before reaching estuaries, thereby increasing the concentration of pollutants in the coastal zone and limiting their capacity to support natural biota (Clark in press). Loss or reduction in quality of estuarine habitat is likely to have serious consequences for fisheries targeting estuary-associated species (Clark in press). The total landed catch of estuarine and estuarine-associated fish is approximately 28 000 tonnes per annum, having a value of about R950 million (Lamberth and Turpie 2003). Changes in freshwater flow to estuaries along the east coast will impact on the east coast prawn trawl fishery. Freshwater flow into estuaries is integral in maintaining habitat and food supply for juvenile and adult prawns (Demetriades *et al.* 2000, DWAF 2003). The east coast prawn trawl fishery is small in terms of vessel numbers and total retained catch, but it is both economically and socially important to the region (Fenessey *et al.* 2000, Sauer *et al.* 2002). The total catch of the inshore prawn fishery has averaged 70 tons over the last ten years, and yields a total landed value of R8.5 million per annum (US$ 1.4 million) (DWAF 2003).

Sea surface temperatures off southern Africa appear to have increased by about 0.25°C per decade for the last four decades (Schumann *et al.* 1995). Sea surface temperature data collated from Voluntary Observing Ships (VOS) between Struisbaai and Knysna, from 1903 to 2004, reflect this trend (Figure 1.24). Changes in sea temperature can have severe effects on marine populations e.g. bleaching of coral reefs has been directly attributed to increased temperatures (Wilkinson 2000). With increasing sea surface temperatures, marine species are expected to shift their distribution patterns in response to the changing temperature regimes. This is likely to be most pronounced in those species that are most temperature sensitive. Fish species from the east coast will thus most likely invade waters further south in greater numbers, while the distributional ranges of those in the cooler West coast waters may retreat to greater depths, or become restricted to the immediate vicinity of the stronger upwelling cells (Clark in press).

An increase in sea surface temperature is also correlated with a rise in sea level with measured increases of 10 to 15 mm having taken place over the last century. Tide gauge measurements from South Africa indicate that sea levels have risen by approximately 1.2 mm/y over the last three decades (Brundrit 1995) and this trend is expected to accelerate in the future with recent estimates suggesting 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). 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). The direct impacts of rising sea levels on the ecological functioning of marine biota are less obvious and whilst some regions might be negatively impacted (e.g. salt marshes), others are predicted to undergo a shift in distribution patterns and/or zones (e.g. rocky shores).



Source: Southern African Data Centre for Oceanography (SADCO)

Figure 1.24: 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 the data are years where the data are not available)

CONCLUSIONS

At an international level the marine and coastal environment of South Africa is considered to be in a moderately healthy state, mostly as a result of strong management measures implemented in the past decade. In April 2005, the United Nations Environment Programme (UNEP) awarded South Africa a "Champions of the Earth" award for outstanding environmental achievement and 'commitment to cultural and environmental diversity'. Some important, and occasionally controversial, management measures integral to South Africa's marine conservation include:

- Improvements in many of the regulations used to govern the marine environment
- Allocation of long-term (8 to15 years) fishing rights
- Transformation and re-distribution of fishing rights
- Passing of legislation preventing vehicles from driving in the coastal zone
- Proclamation of four new Marine Protected Areas (MPA) and the proposal for a fifth MPA
- Purchasing of four new marine patrol vessels to better protect the marine environment

Implementation of such management measures has led to many direct and indirect positive impacts within the marine environment, attaining an overall sense of improvement in the state of the marine and coastal environment since the 1999 National State of Environment report. The pelagic resource, particularly sardine, appears to have recovered from a depleted state in the late 1960s, several mariculture ventures have proven to be successful and there has been an increased awareness and demand for access to non-consumptive marine resources (whale and shark viewing). However, certain fisheries, particularly linefish and abalone, continue to show a decline in status. Several other issues of concern for the marine environment have arisen or continue to pose severe threats, namely:

- Increasing coastal development leading to habitat degradation and transformation

- Substantial increases in the amount of waste water discharged into the marine environment
- Reduced fresh water flow having a negative impact on estuaries and the associated species dependant on this sheltered environment.

Exploitation of natural resources (wild stocks) from the ocean and coastal zone is still, by far, the single-most threatening impact on the marine environment. Neither terrestrial nor freshwater ecosystems rely on wild stocks for primary exploitation. Exploitation of marine resources reached a peak in the mid-1960s when over one million tonnes of fish were extracted per year. Catch rates at this level were unsustainable and have declined considerably since. With decreasing catch rates, alternative marine resources have been sought, including squid, octopus and seaweed. Marine 'farming' (mariculture) has also developed more intensively. There is also increasing evidence that the effects of global climate change are beginning to impact on the marine environment of South Africa, however, there remains a large degree of uncertainty surrounding this issue.

The west coast of South Africa supports the majority of large-scale commercial fishing activities, progressively declining towards the east coast, where subsistence and recreational fisheries become more prevalent. The different types of marine resource use around South Africa require different management measures. Commercial fisheries generally have limited access and are historically, tightly controlled, while subsistence and recreational fisheries have widespread access extending over a broad geographic area.

Improved regulations governing the marine and coastal environment now require focussed enforcement effort to assist in rebuilding stocks. Greater scope and encouragement should be focussed on non-consumptive marine resource use, for example, SCUBA diving and marine safaris, to advance the tourism potential of the marine environment, ultimately leading to a greater contribution to the overall well-being of South Africans in the future.

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