



ECOLOGY, VALUE AND MANAGEMENT OF THE KOGELBERG COAST

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EXECUTIVE SUMMARY

Introduction

The Kogelberg Biosphere Reserve (“KBR”), South Africa’s first biosphere reserve, covers a land area of some 103 000 ha and includes a marine portion of 24 500 ha along its 79km of coastline. It is managed by the Kogelberg Biosphere Reserve Company, a Section 21 Company. This report, on the ecology, value and management of the Kogelberg coast, is one of the first steps in the development of an Integrated Management Plan for the coast and is designed to provide detailed background information that can inform improved future management of the area and serve as a resource for the education, awareness and capacity building programmes. The report is based on existing information as well as a study conducted on the use and value of the Kogelberg coast, the technical details of which are contained in an accompanying report.

Geographic and socio-economic context

The KBR is situated to the south-east of Cape Town. It extends along the southern Cape coast from the Steenbras to the Bot Estuary and includes the villages of Rooi Els, Pringle Bay, Betty’s Bay and Kleinmond. Located within the Overberg District, 70% of the KBR falls within the Overstrand Local Municipality, and most of the remainder in the Theewaterskloof Local Municipality. The area has a Mediterranean climate is situated within the Cape Floral Region. The marine life along the coastline, where warm temperate south coast waters interface with cold upwelling, is diverse and productive, and with its mountainous backdrop, the coastal scenery is spectacular.

Based on the wards that fall within the KBR, its population was estimated to be in the region of 9 124 in 2001, of whom 45% were white, 32% coloured and 23% black. Census data suggest that 64% of the population of the Overstrand municipality as a whole, which includes Hermanus and Gansbaai, had incomes lower than R38 400 per annum in 2001, and that unemployment rates were high. However, the proportion of poor inhabitants in the study area is probably lower than for the municipality as a whole.

A large portion of the KBR as a whole is untransformed, particularly in the protected areas of the KBR and the Hottentots-Holland Nature Reserve. The remaining area has been transformed for cultivated agricultural use (mainly apples and vines and also forestry plantations), and there is some industrial development – mainly agro-processing facilities. Vegetation along the KBR coast is mainly untransformed apart from in the village settlement areas, which are not yet fully developed.

Economic growth rates have been high in recent years, but are probably slower at present. The trade and services sectors make up almost half of economic production, which are the main sectors affected by tourism. These and the transport sector have been growing fastest, while job losses have been experienced in the agricultural and manufacturing sectors. Planned projects in the Overstrand Integrated Development Plan include developments of tourism facilities such as paths, craft sector, harbours and campsites as well as developments such as aquaculture, film industry opportunities, and revamping the Kleinmond harbour industrial area.

Coastal marine ecosystems

Ecological context

The coastal portion of the KBR stretches 79km from the Steenbras Estuary eastwards to the Bot Estuary, and extends 3 nautical miles (5.6 km) offshore. The coast is rugged and has a high diversity of habitats and species. However, none of the coastal processes and habitats occurring on the KBR coast are unique to the area.

The study area is influenced by the warm water brought by the strong-flowing Agulhas current that moves down the east coast of South Africa and the cold Benguela upwelling system of the west coast which reaches as far as Cape Agulhas. The Kogelberg coast falls within the upwelling area, and also experiences localised wind-induced coastal upwelling in the Betty's Bay area during summer, which results in low average monthly temperatures of 11.4°C to 15.6°C.

The area experiences semi-diurnal tides and is a high energy coastline which experiences rough seas. Freak or "killer" waves regularly occur between the Steenbras River mouth and Cape Hangklip, making angling dangerous in this area. Although most of the coast is exposed and rugged, rocky headlands protect a series of sheltered bays where beaches have developed. West of Kleinmond, the coast is largely eroding coastline, whereas to the east it tends to be dissipative, i.e. receiving sand. This sand in turn is blown into dune areas. Two of the five estuarine systems along the coast are permanently open to the sea, while three are closed most of the time, opening during high rainfall periods. Being fed by oligotrophic rivers, their outflowing waters are unlikely to bring significant nutrient loads to the marine environment, at least under natural conditions.

Biogeographically, the KBR falls within the Warm Temperate Region for estuaries and the coast, and the area is also considered part of the Agulhas Bioregion, in terms of different bioregional classifications. Both of these areas extend from Cape Point to the Mbashe River. The Kogelberg coast lies on the western edge of this zone, and includes marine fauna and flora characteristic of this region as well as some of those characteristic of areas to the west.

Coastal habitats and their biota

Exposed rocky shores account for the bulk of the habitat of the KBR coast (64%), followed by intermediate sandy beaches (19.2%), with mixed shore (exposed: 7.9%, sheltered: 0.4%), and other rocky shores (very exposed: 4.6%, sheltered: 3.9%) providing smaller contributions. The Kogelberg coast accounts for 5.0% of the Agulhas bioregion, but contains a disproportionately large amount of all types of rocky shore habitat (sheltered: 16.2%, exposed: 7.3%, and very exposed 8.1%) and sheltered mixed shore habitat (5.8%).

A number of sandy beaches are found in the study area. These are unstable by nature and support relatively few, mostly very small, species that are hardy and adapted to this environment. These include aquatic scavengers, aquatic particle feeders, air breathing scavengers, meiofauna (smaller than 0.5 mm in size), that mostly rely on sources of food washed onto beaches, as well as higher predators such as shorebirds and fish. The Betty's Bay beach is one of the few beaches in along the south-west coast onto which paper nautilus shells are washed ashore. Sandy beaches are also

important for the filtering and decomposition of organic matter in sea water, which results in the release of nutrients to the sea.

Rocky shores have a distinct zonation pattern in terms of the amount of exposure to air and the biota they support, ranging from the infratidal zone, through the cochlear zone, the lower balanoid, upper balanoid and littorina zone. Filter feeders such as mussels, red bait and sea cucumbers comprise 70-90% of the faunal community on rocky shores and their principal food source is derived from kelp.

Boulder beaches are relatively uncommon and tend to be dominated by grazers, with the result that the density of seaweed is lower.

Rocky reefs occur subtidally and support diverse assemblages of life. They support kelp forests down to about 10m depth, which in turn shelter dense communities of mussels, sea urchins, rock lobster and abalone and herbivorous gastropods. They also provide habitat for numerous relatively sedentary reef fish species, and higher predators such as sharks.

Subtidal soft sediments have not been studied in detail in the study area, but generally support burrowing gastropods and hermit crabs. Many fish species are characteristically found within the surf zone, such as silverside, mullet, white stumpnose and sand steenbras.

Estuaries in the study area vary significantly in terms of the types of habitat they provide, ranging from small estuarine river mouths to temporarily open/closed systems, and an estuarine lake system. They provide shallow sheltered habitats with soft sediments and with varying salinity. While estuaries are generally known to be productive systems, these systems are fed by oligotrophic rivers, and are thus not particularly productive. The Bot/Kleinmond is an exception, on account of its size and the long residence time of the water that flows into it. This system supports relatively high densities of fish such as harders, and provides an important nursery area for many species including white steenbras. It also supports most of the waterbird fauna of the study area, including migratory waders and wading birds such as herons and flamingos. The Bot/Kleinmond system qualifies for Ramsar status as a wetland of international importance.

Important species

Important species in the study area include kelp *Ecklonia maxima* which is harvested and provides habitat for other valuable species. The abalone *Haliotis midae* is a highly valuable species whose slow growth rates make it vulnerable to exploitation. This species has also been negatively affected by the invasion of west coast rock lobster *Jasus lalandii* into the area, though itself a valuable species. The area is not important for any rare fish species, but several valuable fish species occur in the area. The Kogelberg coast is important for three red-data birds - the African Penguin *Spheniscus demersus*, the Bank Cormorant *Phalacrocorax neglectus* and the African Black Oystercatcher *Haematopus moquini*. Southern right whales *Eubaelana australis* and Bryde's whale *Balaenoptera edeni* are common.

Current state of the coast

Although there are several potential threats to coastal habitats in the area, such as residential development, mining, alien invasive species and pollution, these have been relatively well managed and coastal habitats tend to be in good condition. Three of the

six estuaries (Steenbras and Bot/Kleinmond) have been negatively affected by reductions in freshwater inputs and increased pollution inputs, as well as artificial breaching patterns. Most of the valuable marine species in the study area are overexploited, the stocks of several of these having collapsed.

Use of the coast and its resources

Commercial fisheries

The primary commercial fisheries on the Kogelberg coast include line fish, abalone, west coast rock lobster and kelp. Line fishing has an extremely long history in South Africa but has been largely neglected from a management point of view with the result that most of the target species, aside from snoek and yellowtail, are grossly overexploited. Line fishing effort right around the country was severely reduced in 2005 (from about 3000 active vessels to the current 450) in an effort to rebuild depleted line fish stocks. Compulsory catch returns are the main source of data on the fishery. While these are thought to provide an accurate reflection of major trends in the fishery, it is acknowledged that a great deal of under-reporting and possibly some over-reporting does occur. Recent changes in fishing fleet (towards larger and more mobile vessels) and dramatic increases in operating costs (particularly fuel and bait) also make interpretation of trends in this fishery difficult.

In the period 2000-2007, between 6 and 50 rights holders reported fishing on the Kogelberg coast, expending between 9-11 days each per annum fishing in this area. This reflects partly on the fact that there is no permanent fishing harbour on this stretch of coast but more importantly the nomadic nature of the main target species of the fishery (snoek and geelbek). The majority of the reported fishing effort takes place on the snoek "grounds" offshore of the Kleinmond slipway. A considerable amount of unreported effort, is however, also expended between Cape Hangklip and Betty's Bay where the boats target mostly geelbek. Historically (around the turn of the century) fishing effort off the Kogelberg coast was reported to be much higher than it is at present, as were catch rates, particularly of reef fish species such as red roman, red steenbras and seventy-four. These species are barely represented in the present day commercial line fish catches.

West coast rock lobster recently (in the last 20 years) invaded the Kogelberg coast, having moved around Cape Point from their traditional habitat on the west coast. An experimental commercial fishery for rock lobster was initiated in 1999/2000 and following some good catches, this was consolidated into a full scale commercial fishery in 2003. An annual TAC of 90 tons for the area east of Cape Hangklip has been allocated since 2003, but this has seldom been fulfilled with annual catches mostly in the region of 60-80 tons. The allocation of 90 tons to the area is considered unsustainable by fisheries scientists and the rapidly decline CPUE suggests that they are probably right on this score. Some of the commercial rock lobster boats fishing in False Bay also operate on the Kogelberg coast but this amounts to a landed catch of no more than about 6 tons per annum.

Currently there is no commercial abalone fishery off the Kogelberg coast owing to a country-wide closure of the fishery. The national abalone TAC has been reduced steadily since the mid-1980's owing to concerns over high level of poaching and declines in stock size, and finally dropped to zero in 2006. This is reportedly only a temporary measure, the fishery is scheduled to reopen again sometime in the future when rampant poaching is brought under control. The Kogelberg coast lies within what

was the most productive abalone fishing area (between Cape Hangklip and Quoin Point) and supported a TAC of over 100 tons. This provided an important source of employment to people from the Kogelberg coast and neighbouring areas. When the fishery is reopened again in the future, the TAC is likely to be much lower than this but should will hopefully bring much needed revenue to the area.

The commercial seaweed industry in South Africa is managed by allocating concessions to individuals or companies to harvest or collect seaweed in defined concession areas along the coast. One of these kelp concession areas corresponds with the Kogelberg coast, where an annual TAC of 1 000 tons applies. In the past kelp was mostly collected for alginate extraction but focus has shifted in recent years to the provision of fresh kelp to the abalone farms along the coast. This means that the focus has shifted from beach cast material to divers' harvested live kelp from the sea. While the full kelp TAC for the Kogelberg area has not been collected in recent years owing mainly to a dispute regarding use of a launch site in Betty's Bay, it is expected that this will resume soon given the proliferation of abalone farms and hence demand for fresh kelp in this area.

Subsistence fisheries

Subsistence fishers active on the Kogelberg coast are resident in two coastal towns/villages, one inside the KBR (Kleinmond) and the other on the eastern border (Hawston). Fishing activities and effort by these communities was surveyed in 1999, and has not been studied since or previously. At the time of the 1999 survey, it was estimated that about 100 subsistence fishers were resident in these two communities. They reportedly harvested a range of species including black mussels, redbait, periwinkles, alikreukel, octopus, rock lobster, polychaete worms, sand and mud prawns, abalone, white mussel, and fish. Fishing effort varied for different resources, ranging from 30 to 200 days per year. Black mussels provided the bulk of the catches for the fishers residing in Kleinmond, together with substantial catches of line fish, alikreukel, octopus and rock lobster, and modest catches of abalone and redbait. Fishers based in Hawston reported large catches of sand/mud prawns, net fish (fish caught using gill nets), white mussel, periwinkles, and black mussel, along with smaller catches of polychaete worms, line fish, and abalone among others. How much this has changed since this time is not known.

Recreational fishing

Recreational fishers target a range of different resources, the main ones being line fish, rock lobster and bait. Recreational line fishers include shore anglers, boat anglers and spear fishers. Very little is known about the latter two categories at a national level, let alone that which takes place on the Kogelberg coast. Three "private/club" launch sites (Rooiels, Pringle Bay and Stony Point) and two public launch sites (Maasbaai and Kleinmond) are available to recreational fishers in the Kogelberg area, whilst the area can also be accessed from the Strand, Gordons Bay and Hawston slipways. Catches taken by these fishers are thought to be similar to the commercial line fishery, albeit with a lower overall catch rates and a great focus on reef fish species (such as red roman and hottentot) as opposed to migratory one (geelbek, snoek and yellowtail).

Recreational marine angling from the shore is one of the most popular coastal leisure activities in South Africa, and it is estimated that there are in the region of 460

000-500 000 anglers in South Africa. Average shore angler effort on the Kogelberg coast is estimated to be around $1.42 \text{ angler-days.km}^{-1}$, with anglers catching 11 species at an overall CPUE of $0.32 \text{ fish.angler-day}^{-1}$.

Recreational rock lobster fishing is considered a popular past-time on the Kogelberg coast. It is estimated that the recreational catch from this areas is as high as 58 tons per year over the period 2000-2008, equivalent to about 25% of the total national recreational catch or half of the commercial catch for the area.

When there was still a recreational abalone fishery (i.e. prior to 2004), catches for the Kogelberg coast were high, in the region of 50 tons per annum or 60% of the commercial TAC. This fishery was closed in 2004 and it is uncertain as to whether this resource will ever be opened to recreational fishers again.

Illegal fishing

Illegal fishing takes place whenever living marine resources are harvested in a manner not compliant with the relevant regulations for the species harvested. Abalone poaching is the most infamous illegal fishing activity on the Kogelberg coast, but is by no means the only illegal fishery in the area. Abalone poachers are estimated to remove as much as 30 times the legal catch in South Africa (more than 1 600 tons in 2006). The amount of illegally caught abalone confiscated on the Kogelberg coast peaked in 2001 at just over 18 tons, but has dropped in recent years either due to a real reduction in poaching or (more likely) a reduction in compliance in this area. With the large reductions in abalone density in the area, poaching effort has shifted to rock lobster, the next most accessible and valuable species in the area. Extensive gill net poaching of fish in the Bot River estuary on the eastern border of the Kogelberg zone has been taking place for about the last 10 years with a detrimental impact on the stocks of estuary-dependent species.

Non-consumptive recreational use

Shore-based non-consumptive activities along the coast include walking, sunbathing/relaxing, swimming, exercising on the beach and the appreciation of nature and wildlife, including birdwatching. Most of this activity is concentrated in the six beaches in the area (Koeëlbaai, Rooiels, Pringle Bay, Betty's Bay, Palmiet and Kleinmond), all of which are highly accessible, and all but Koeëlbaai being adjacent to coastal towns. The estuaries associated with Rooiels, Pringle Bay (Buffels) and Kleinmond are heavily utilised. Important shore-based nature attractions include the penguin colony and birdwatching at the Bot/Kleinmond estuary. Water sports are dominated by wave sports, particularly at Koeëlbaai, and kayaking is popular off the beaches. There is not much in the way of boating which is not fishing-related, apart from sailing on the larger estuaries. There are nine popular dive sites along the KBR coast, mostly around Rooiels. An operator in Gordon's Bay takes clients to five of these. While no boat-based whale-watching or shark-diving tours operate out of the study area, the whale-watching boats based in Hermanus obtain about 19% of their sightings within the KBR coast.

Value of the coast

Commercial and subsistence fisheries

Commercial fisheries are currently worth in the order of R20.1 million, of which R16.1 million is the value of the West Coast rock lobster fishery and the balance is the value of the line fishery. If recovered, the abalone fishery could potentially yield about R22.5 million, and the kelp fishery some R0.75 million. Subsistence fisheries around the Hawston/Kleinmond area are worth about R4 million.

Recreation and tourism

In addition to the permanent population of about 13 000, there are an estimated 28 - 34 000 visitors on any one day in December. Visitors spend an estimated total of 4.3 to 5.3 million visitor days per year, of which holiday home owners, other overnight visitors and day visitors account for about 22%, 56% and 21%, respectively.

Coastal activities contribute 71% to all users' enjoyment of the Kogelberg coast, with beach activities (26%) and coastal nature (27%) contributing the bulk of this, and fishing (13%) and water sports (5%) making a smaller contribution. There is little difference between permanent residents, holiday home owners and overnight visitors in this respect, but day visitors give slightly more weight to fishing and coastal nature and relatively little to non-coastal activities. Non-coastal activities such as relaxing at the home base and shopping make up the balance. Visitors spend an average of 70% of their leisure time at the coast. Two-thirds of visitors in summer are beach-oriented visitors and the remainder are fishing and water sport-oriented.

Going to the Kogelberg area is a bigger reason for their trip away for South Africans (average 90%) who tend to be on single destination trips, than for foreign visitors (59%) who tend to be visiting as part of a larger sight-seeing trip.

Coastal cleanliness and bathing safety are the most essential attributes that attract visitors to this part of the coast. The terrestrial environment (geographic features and terrestrial nature) and marine wildlife are the next highest drawcards. While the villages and facilities are not the main attractions, they significantly enhance the recreational attraction of the coast. Sea conditions, which are often rough and dangerous in this area, are not very attractive to visitors, nor are farming landscapes, although this is probably largely due to their relative rarity along this part of the coast rather than their being unattractive. The MPA and its penguin colony are not major influences in attracting visitors to the area.

The recreational expenditure by land-based visitors attributable to the Kogelberg coast was estimated to be in the range of R191 to 235 million per annum. Boat-based whale-watching in the area is worth an additional R1.39 million. Coastal property in the area is estimated to be worth approximately R7.3 billion. Of this, the coastal premium was estimated to be just over R1 billion, translating to an annual value attributed to the coast of R59 million. Thus the recreational value of the coast is estimated to be in the order of R272 million.

Survey data suggested that the value of the coast could be increased most by eradicating crime. Other scenarios that result in a significant increase in value include expanding the MPA system as long as fishing catches in surrounding areas increase, and better enforcement of environmental laws. Litter would have the greatest negative

impact on value, followed by doubling of house numbers and halving of cetacean numbers (Table I).

TABLE I. ESTIMATED CHANGE IN RECREATIONAL UTILITY AND EXPENDITURE UNDER DIFFERENT SCENARIOS

Scenario	Utility score		Change in value (spend) (Rm/y)
	Property owners	Visitors	
Status quo (SQ)	7.8	7.8	
SQ + MPA deproclaimed	4.6	4.6	-59
SQ +Depleted resources	3.3	3.3	-82
SQ +Enviro. laws enforced	10.4	9.0	34
SQ +No crime	17.9	12.6	126
SQ +Development doubled	3.6	3.6	-77
SQ +Whales/dolphins halved	3.5	3.5	-77
SQ +Beaches not free of litter	1.9	1.9	-107
SQ +MPAs expanded (SQ + 2xMPA)	7.4	7.4	-7
SQ + 2xMPA + Fishing 20 % better	9.0	8.3	15
SQ + 2xMPA + Fishing 2x as good	10.8	9.2	37

The contribution of refugia and nursery areas

Since many of the fish caught in commercial, subsistence and recreational inshore marine fisheries are dependent on estuaries for part of their lifecycle, the estuaries in the study area are estimated to *potentially* contribute some R46.7 million annually to the value of these fisheries. It cannot be said for certain, however, how catches in fisheries along different parts of the coast relate to exports from different estuaries along the coast due to the high motility of many of the species involved. Nevertheless, compromise of estuary nursery value will affect fishery value in the study area. Indeed, the nursery value of the Bot estuary, which accounts for nearly the entire estuarine nursery value of the KBR coast, has been severely compromised by poaching in the estuary.

The Betty's Bay MPA is not fully protected, but is closed to boat-based line fishing, and as such provides a refuge for some fish stocks that can replenish surrounding areas. Because of its limited protection, this value is estimated to be in the order of R283 000 per annum. Its contribution to the rock lobster fishery is likely to be more valuable, and in the absence of poaching it could potentially make a very valuable contribution to abalone fisheries. Again these values would be reflected in the use values presented above, but it is important to note that those values are influenced by the presence of such refugia.

Management issues and legislation

Exploitation and disturbance of living marine resources

Overexploitation is the main threat to biodiversity along the KBR coast, affecting not only the future value of abalone and line fish stocks, but the integrity of coastal ecosystems. Human activities threaten oystercatchers and waterbird aggregations on the Bot estuary, and recreational diving can damage reefs.

Exploitation is governed by the Marine Living Resources Act (1998), which regulates which species and size can be caught, by what means and when, and makes provision for the establishment of Marine Protected Areas. The Biodiversity Act (2004) requires identification of priority areas for conservation. Fishing rights are allocated by Marine and Coastal Management (MCM). The Integrated Coastal Management Act (2009) requires the development of coastal management plans, which will provide a means to regulate non-consumptive activities outside of protected areas.

Loss and physical modification of habitat

Development is the main threat to coastal habitats along the KBR coast, and sand mining is a potential issue. There is concern regarding the municipal Spatial Development Frameworks (SDFs) and general awareness of the significance and fragility of the Kogelberg environment, the concept of a biosphere reserve and the notion of sustainable development. Development to date has been reasonably sensitive in respect of coastal ecosystems, and many areas have very adequate coastal buffers. This is not always the case, however, and there are areas where dunes and development conflict. Expansion is planned for Kleinmond, including facilities on the Palmiet and Kleinmond estuaries and industrial extension/renewal for the Kleinmond harbour. These may impact on sensitive environments.

Municipal development plans (including spatial plans and proposed projects) are required by the Municipal Systems Act (2000), with plans having to be updated every 5 years. Developments are subject to environmental impact assessment under the National Environmental Management Act (2003). The Integrated Coastal Management Act (2009) requires the establishment of coastal development set-back lines and facilitation of access to the coast. It also requires coastal municipalities to prepare coastal management programmes for managing the coastal zone within their areas of jurisdiction. Coastal municipalities can pass bylaws in terms of the Act for the purpose of administering and enforcing their coastal management programmes. All estuaries must have estuary management plans. The Minerals and Petroleum Resources Development Act requires that sand mining requires a permit subject to approval of an environmental management plan.

Freshwater inflow and breaching of estuaries

Freshwater inflows have a major impact on estuarine ecosystems, affecting their mouth state, duration of closures, water quality and productivity. Both the Steenbras and Bot/Kleinmond systems have suffered major reductions in flow. This is particularly significant in the latter case. The Bot/Kleinmond system now has to be breached artificially to maintain its functioning, but this does not go very far towards simulating the natural process, since the estuary is no longer properly scoured by floods. The Kleinmond is breached more often (6x per year) than the Bot (every 3 years) with the result that very little seawater enters the Bot and it is turning into a freshwater lake.

This will result in expansion of reedbeds and its gradually turning into an extremely shallow system.

The quantity and quality of freshwater reaching estuaries in South Africa is controlled under the National Water Act (1998). This requires that estuaries are classified according to their future state of health, a decision which involves analysing the tradeoffs between the benefits of water use and estuary protection, taking regional and national conservation and development needs into account. The Classification Process is currently informed by a Resource Directed Measures (RDM) which provides information on the flow requirements of estuaries and the recommended future state of health from an ecological perspective. RDM studies will be carried out for the Bot and Palmiet estuaries during 2009. The issue of artificial breaching is dealt with in the development of estuary management plans, which are required under the Integrated Coastal Management Act (2009)

Alien invasive species

There is no major issue at present in terms of marine alien invasive species along the KBR coast. However, it is important that this issue remains in control. A more pertinent issue is the invasion of coastal dune systems by terrestrial alien invasive plants, mainly *Acacia* species. These plants have stabilised dunefields, affecting the movement of sand in the coastal zone, and ultimately affecting the supply of sand to the popular beaches.

The Biodiversity Act (2004) requires that all spheres of government prepare an invasive species monitoring, control and management plan for land under their control. The Conservation of Agricultural Resources Act (CARA) regulations requires that private landowners keep their land free of invasive alien plants.

Pollution

Hydrocarbons, plastics and nutrients are the most important pollutants affecting the biodiversity and value of the KBR coast. Hydrocarbons are an issue in harbour areas in particular. Plastic pollution poses a litter problem in some areas. Nutrients enter the estuaries and the sea from sewage works and septic tanks. Current systems are inadequate to deal with the amount of waste generated, resulting in water quality degradation and the loss of Kleinmond Beach's Blue Flag Status.

Management of water quality in the marine environment in South Africa is administered severally by the Department of Water Affairs and Forestry (DWAF), the Department of Environmental Affairs & Tourism (DEAT), the Department of Transport (DOT), and the Department of Mineral and Energy (DME), with each responsible for a different area.

Climate change

Climate changes will affect rainfall patterns, river run-off, estuarine functioning, sea surface temperature, mean sea level and fish stocks, as well as the frequency of storm events. Apart from accounting for this under existing legislation, there is no specific legislative provision for these effects. In the KBR, the most pertinent issue will be sea-

level rise. Certain areas of the KBR may be particularly vulnerable, such as low-lying developments around the Bot estuary.

Enhancing coastal integrity and value

Introduction

The coastal ecosystems of the Kogelberg Biosphere Reserve have been identified as being extremely valuable. They make a significant contribution to the local and regional economy, to employment, as well as to people's emotional well being. There are, however, a number of important threats to delivery of these benefits. In particular, the area is beset with problems of overexploitation of living marine resources, and the value of the area is also threatened by pollution, the supply of freshwater to estuaries, terrestrial alien invasive species, and development in the coastal zone. In addition, it will be necessary to plan strategically for the possible impacts of climate change. The legislative framework to deal with these issues has improved dramatically over the past decade, particularly with the very recent promulgation of the Integrated Coastal Management Act (2009), providing the means to significantly improve the outlook for this area.

Recent management initiatives

There is a clear need for an Integrated Management Plan (IMP) for the entire Kogelberg coast, and to identify a clear strategy with which to maximise the ecological and economic value of this stretch of coast. This can build on recent management initiatives. A Strategic Management Framework (SMF) has been prepared for the Kogelberg Biosphere Reserve which outlines management challenges facing the Kogelberg Biosphere Reserve Company. A draft management plan has been prepared for the Betty's Bay MPA (2008). A draft Estuary Management Plan has been produced for the Bot/Kleinmond Estuary (2008) which describes a zonation plan for use of the estuary, including no-take areas and areas of minimal human disturbance. In addition, a proposal was tabled some time ago for the establishment of the Kogelberg Marine Park (2000). While this plan was widely supported by stakeholders, it has not been a high priority for implementation by the Minister who has established several other MPAs around the coast.

Improving ecosystem integrity and environmental quality

The main issues that need to be addressed in the Kogelberg IMP are

- the restoration and conservation of depleted and collapsed marine resource stocks;
- the improvement of estuarine water quality and mouth dynamics;
- the removal of coastal alien vegetation that impacts on biodiversity and impedes sand movement;
- and establishment of coastal buffer zones that preserve the integrity of the coastal zone and that accommodate global climate change impacts such as sea-level rise, increased storm surges and flooding.

This will require an expanded no-take MPA system (ideally to 20% of the coastline); enforcement of regulations controlling use of resources; setting the ecological reserve

for estuaries through the RDM or Classification Process, control of use and development through careful zonation of the whole area, expenditure on restoration, and strategies and incentive systems for achieving compliance.

The Kogelberg coast is valuable: Commercial fisheries along the Kogelberg coast are worth some R20 to 43 million per annum, depending on management; subsistence users earn in the order of R4 million; and recreational use of the coast is worth some R250 – 285 million per annum in the form of tourism and property value.

Conservation management involving expanded MPAs, restrictions on fishing and/or development and utilisation of the coastal zone may have some opportunity costs, for example in terms of the value of commercial fisheries. However, if the spatial configuration of the no-take areas is optimised and regulations enforced in an equitable manner, it is possible that some losses will be offset by gains, for example in the lobster and abalone fisheries. Some of these gains may be felt beyond the study area.

An increase in biodiversity protection would also affect recreational fishers. If increased MPAs do not measurably affect fish catches in the remaining areas, fishing-oriented users have indicated that this would compromise their enjoyment of the coast, a fact that will translate into a decrease in economic value. However, they also indicated that a 20% increase in fishing returns would lead to an overall gain in appreciation of the coast, despite having reduced access to fishing areas. Thus as long as MPAs and other coastal management measures can be shown to have a significant impact on the catches in surrounding areas, they are likely to result in a win-win situation for conservation and recreational fishing. This is highly likely to be the case.

In general, the preferences of the recreational users of the coast are aligned with conservation. Decreased protection, further depletion of marine resources, reduced biodiversity, increased litter and significantly increased development will decrease the recreational value of the coast. The effects of deteriorating water quality are already beginning to take their toll through the closure of beaches. Conversely, increased conservation will increase recreational value. The potential recreational value of the coast will be significantly increased if problems of crime are also addressed, since it is difficult to enjoy any attractions if one does not feel safe or if one's belongings are not secure.

Perhaps the most difficult issue is that of development. There is a continuous pressure for the expansion and densification of development in coastal resort areas, and the Kogelberg coast is no exception. Development is largely supported by municipalities, who benefit from increased rates and taxes generated from properties and businesses in the area. While the current users have indicated that doubling of development will have a serious impact on their utility, behaviour, and ultimately, their expenditure in the area, the reality is that with further densification, the people that are more sensitive to this will gradually be replaced by people that are more attracted by the new conditions. These may be less nature-oriented people than fit the current profile, but the influx of new visitors will likely contribute equally or more to recreational value of the area. In other words, while conservation and value of the area currently go hand in hand, this may not continue to be the case if rampant development is permitted. Thus for conservation to be successful in the area in future, the utility of the current users will need to be maintained or improved, which means that growth of the existing settlements will have to be limited.

ACRONYMS

CAPE	Cape Action for People and the Environment
CARA	Conservation of Agricultural Resources Act
CFR	Cape Floristic Region
CL	Carapace length
CPUE	Catch per unit effort
DDT	Dichloro-Diphenyl-Trichloroethane
DEADP	Department of Environmental Affairs & Development Planning
DEAT	Department of Environmental Affairs & Tourism
DME	Department of Minerals & Energy
DOT	Department of Transport
DWAF	Department of Water Affairs & Forestry
EIA	Environmental Impact Assessment
EMP	Estuary Management Plan
GDPR	Gross Domestic Product per Region
IDP	Integrated Development Plan
IPCC	International Panel on Climate Change
IUCN	International Union for Conservation of Nature
KBR	Kogelberg Biosphere Reserve
KNR	Kogelberg Nature Reserve
LMP	Line fish Management Protocol
LUMS	Land use Management System
MAB	Man and the Biosphere
MAR	Mean Annual Runoff
MCM	Marine and Coastal Management Branch of DEAT
MLRA	Marine Living Resources Act (1998)
MPA	Marine Protected Area
MSY	Maximum sustainable yield
NEMA	National Environmental Management Act (2003)
NGO	Non Government Organisation
NPA	National Ports Authority
NSBA	National Spatial Biodiversity Assessment

NMLS	National Marine Linefish System
NWA	National Water Act (1998)
ORV	Off Road Vehicle
PVC	Polyvinylchloride
ROD	Record of Decision
SDF	Spatial Development Plan
SMF	Strategic Management Framework
SFTG	Subsistence Fisheries Task Group
SW	Shell width
SWOT	Strengths Weaknesses, Opportunities and Threats
TAC	Total Allowable Catch
TAE	Total Allowable Effort
TOC	Temporally-open-closed
VOS	Voluntary Observing Ships
WWF-SA	World Wildlife Fund - South Africa
WWTW	Water treatment works

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1 INTRODUCTION

1.1 THE KOGELBERG BIOSPHERE RESERVE

The Kogelberg Biosphere Reserve (“KBR”) was designated by UNESCO in 1998 under its Man and the Biosphere (MAB) Program, as South Africa’s first biosphere reserve, based on its complex and unique biodiversity. The biosphere concept accommodates conservation and development and seeks to ensure that the sensitive biodiversity areas are adequately protected while benefitting the communities living in and around it.

The KBR covers a land area of some 103 000 ha and includes a marine portion of 24 500 ha. The KBR is managed according to internationally accepted principles of a biosphere reserve with the Kogelberg Nature Reserve (KNR) and Hottentots-Holland Nature Reserves forming the core protected areas of 18 000 ha that remains pristine with a high level of biological diversity. Private and municipal reserves, the Harold Porter Botanical Garden, the Palmiet River Estuary, sections of the coast and the marine area comprise the buffer zone while agriculture, pine plantations, industrial developments and local towns form the transitional zone (CapeNature undated). Deciduous fruit farming and commercial forestry are important industries while there is wild flower harvesting from orchards and the veld. The beauty of the area attracts large numbers of tourists, which is also an important sector (Ashwell *et al.* 2006).

The Kogelberg Biosphere Reserve Company was registered in 2002 as a Section 21 Company to manage the reserve. The board of this company comprises appointed members of the community. A technical committee advises the board and this ensures that statutory management bodies and relevant non-governmental organisations are involved in the management process. A Strategic Management Framework, incorporating a Management Plan and Corporate Plan, for KBR was developed during a consultative process and provides management guidelines for the biosphere reserve. The Marine and Coastal Management Branch of DEAT (MCM), the Western Cape Provincial Department of Environmental Affairs and Development Planning, CapeNature, the Overberg District Municipality, the Overstrand Local Municipality, the Theewaterskloof Local Municipality and the Cape Metro all have an interest or role in the KBR.

1.2 THE PURPOSE OF THIS DOCUMENT

Cape Action for People and the Environment (C.A.P.E.) is a partnership of government and civil society, with support from international donors, to protect and restore the rich biodiversity of the Cape Floristic Region (CFR) for the benefit of all its people. C.A.P.E. has teamed up with the World Wildlife Fund of South Africa (WWF-SA) to build a strong Marine Programme aimed at strengthening conservation and sustainable use of marine biodiversity and resources and sustainable socio-economic benefits to coastal communities in the CFR. The programme is working with other key partners in the region (SANParks, CapeNature and coastal municipalities) to support the effective management of MPAs in two focal areas - the Garden Route and Kogelberg, which have high value biodiversity underpinning thriving tourism industries. In both the Garden

Route and Kogelberg Marine Protected Areas, the programme has the following objectives:

- To develop a multi-use spatial marine plan (building on the approach used by WWF in doing fine-scale planning for the Agulhas Marine Bioregion)
- To develop an integrated marine management plan
- To undertake capacity building training for MPA managers
- To conduct a socio-economic evaluation identifying opportunities for increasing benefits, and
- To promote public awareness of the MPAs.

This report, on the ecology, value and management of the Kogelberg coast, is one of the first steps in this process and is designed to provide detailed background information on the state of the coast, its resources and the management thereof in the Kogelberg area, that can inform improved future management of the area and serve as a resource for the education, awareness and capacity building programmes.

1.3 DATA SOURCES AND SUPPORTING REPORTS

This study is based on existing information as well as a study conducted on the use and value of the Kogelberg Coast, which is reported in more detail in an accompanying report (Turpie & de Wet 2009).

2 GEOGRAPHIC AND SOCIO-ECONOMIC CONTEXT

2.1 LOCATION AND EXTENT OF STUDY AREA

The KBR is situated to the south-east of Cape Town. It extends along the southern Cape coast from the Steenbras to the Bot Estuary and includes the villages of Rooi Els, Pringle Bay, Betty's Bay and Kleinmond. Inland, the KBR includes portions of the Hottentots Holland, Groenland and Houhoek Mountains. It incorporates the Elgin apple region and extends north of the N2 with Grabouw falling within the KBR. Seventy percent of the terrestrial and marine component of the biosphere reserve falls within the Overstrand Local Municipality, with most of the remainder being in the Theewaterskloof Local Municipality – both these local municipalities fall within the Overberg District Municipality. A small section of the KBR near Gordon's Bay falls within the Cape Metropole (Figure 1).

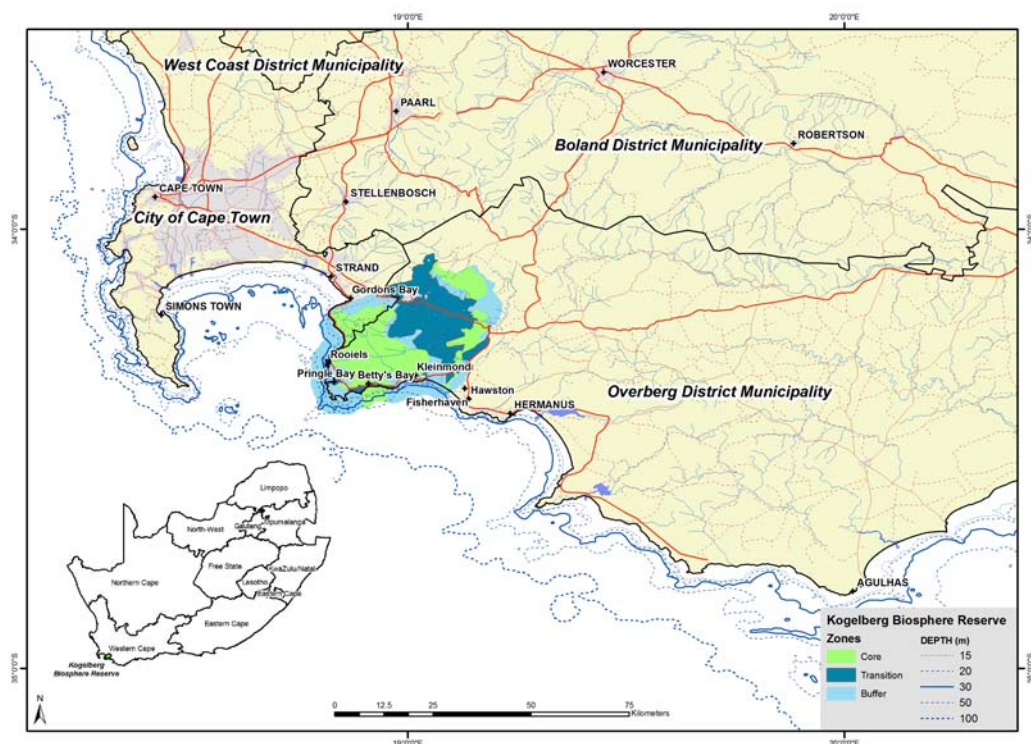


FIGURE 1. LOCATION, ADMINISTRATIVE BOUNDARIES, TOWNS AND ZONES OF KOGELBERG BIOSPHERE RESERVE.

2.2 CLIMATE AND BIODIVERSITY

The climate of the KBR is typical of the Western Cape's Mediterranean climate with cold and wet winters, during which snow may fall on the higher peaks. The summer months are generally hot, dry and windy with the south-easterly the prevailing wind (CapeNature undated). For Kleinmond, the largest town in the KBR, the annual average daily maximum temperature is 22°, with the monthly average maximum temperature ranging from 27° in February to 18° in June, July and August. The annual average daily minimum temperature is 11°, with the monthly average minimum temperature ranging from 7° in July to 16° in January and February. Average annual rainfall is 920 mm with most of the rain falling in the winter months from May to August (South African Rain Atlas 2009) (Figure 2).

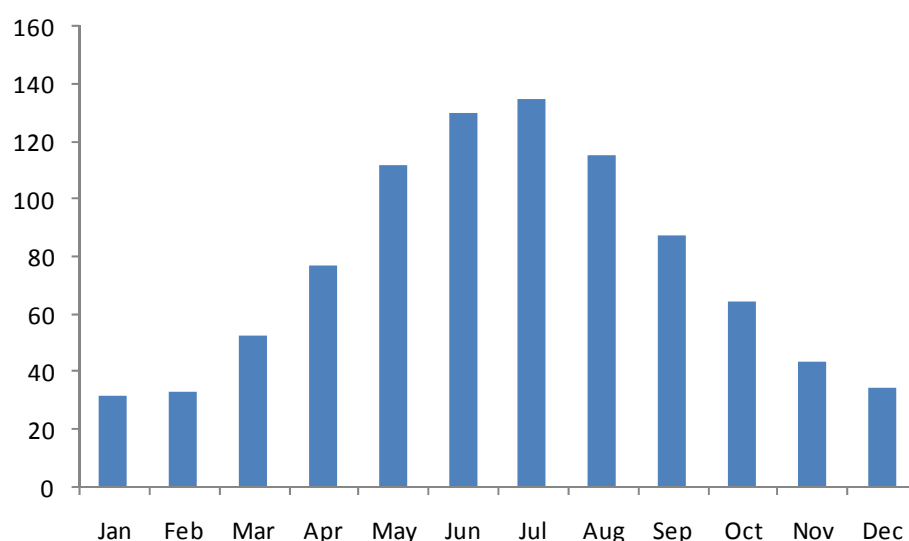


FIGURE 2. MONTHLY RAINFALL IN KLEINMOND (SOUTH AFRICAN RAIN ATLAS 2009)

The KBR, particularly the KNR, contains some of the best-preserved mountain fynbos in the Cape Floral Region. There are some 1 880 different plant species, with 77 of these endemic. Many spectacular members of the protea family occur in the reserve. These include the endangered marsh rose, *Orothamnus zeyheri*, once on the brink of extinction, and now known to occur on a few inaccessible peaks, and the highest concentration of *Mimetes* species in the Cape (CapeNature Undated).

KNR has three patches of relic indigenous forest: Louwsbos, Platbos and Oudebos where yellowwood, stinkwood and boekenhout trees occur. The Palmiet River and its associated riparian vegetation is amongst the most pristine in the south-western Cape with wild almond, rooi-els, yellowwood and Cape beech among the trees occurring in the riverine scrub along the water courses (CapeNature Undated).

There are no large terrestrial animals in the KBR, although leopards have been sighted in the KNR. The Cape clawless otter; smaller antelope such as grey rhebuck, klipspringer and grysbok; baboons; porcupine; mongoose; dassies and hares are

common. Peregrine falcons, black eagles and fish eagles are amongst the bird species that occur in the KNR (CapeNature Undated).

The marine life along the coastline, where warm temperate south coast waters interface with cold upwellings, is also diverse and productive (Ashwell *et al.* 2006). In addition to the biodiversity, the KBR has spectacular scenery.

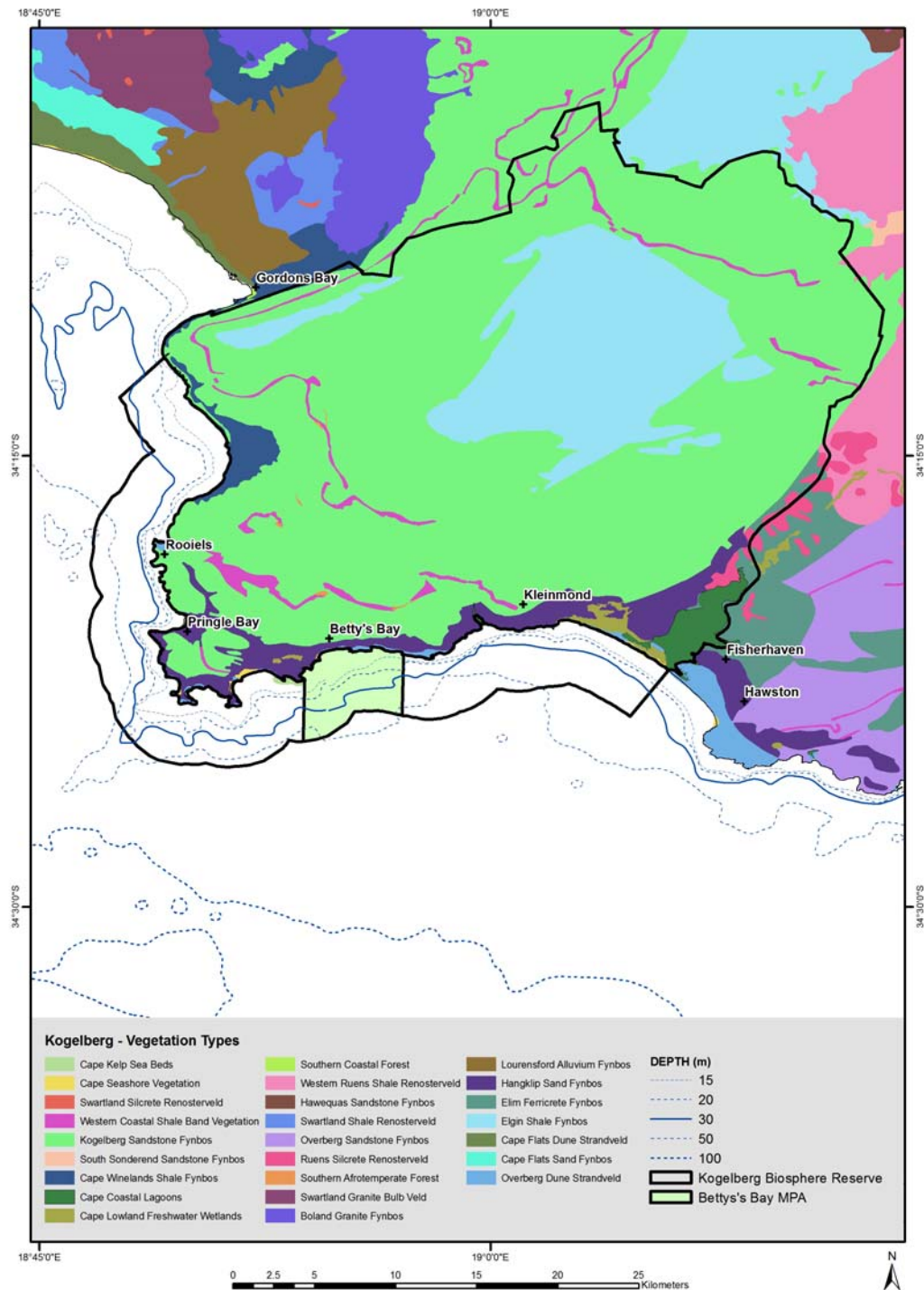


FIGURE 3. VEGETATION WITHIN THE KOGELBERG BIOSPHERE RESERVE

2.3 POPULATION

The KBR coast falls mainly in the Overstrand Local Municipality with a small section being in the Cape Metro. Population data were summarized for the relevant wards that fall within the KBR: Ward 9 (Kleinmond, Proteadorp, Overhills and Honingklip) and Ward 10 (Palmiet, Betty's Bay, Mooisuitsig, Pringle Bay and Rooi Els). Note that the borders of the KBR do not align exactly with the wards. However, this provides a fairly good indication of the demographics of the area (Table 1). The population of the Overstrand Local Municipality as a whole is estimated to have grown by 4.2% per annum between 2001 and 2007, increasing the municipal population from 58 332 to 73 031 (Overberg District 2007). No racial breakdown or ward information for 2007 was available, but assuming the population grew at the same rate for each population group in the relevant wards, the 2007 coastal population is estimated at 11 424. It is also noteworthy that some 91% of the households in the Overstrand Local Municipality are in urban areas with only 9% in rural areas. The Overberg District Municipality (2007) IDP further projects the annual population growth rate for the Overstrand Local Municipality between 2007 and 2015 will be 3.1% per annum, suggesting that the coastal population could exceed 14 000 by 2015. The IDP further projects that up to 2025 the White population will have the highest net migration into the Overstrand municipality, followed by Coloureds and Blacks.

TABLE 1. 2001 POPULATION OF OVERSTRAND MUNICIPAL WARDS THAT FALL WITHIN THE KBR (STATISTICS SA 2003) AND ESTIMATE OF 2007 POPULATION (BASED ON OVERBERG MUNICIPALITY 2007)

	2001 Population	2001 %	Estimated 2007 population
Black African	2 059	23%	2 578
Coloured	2 924	32%	3 661
Indian / Asian	11	0%	14
White	4 130	45%	5 171
Total	9 124		11 424

The unemployment rate for the Overstrand municipality as a whole, which includes Hermanus and Gansbaai, in 2001 was 21.7% while the illiteracy rate of persons over 14 was 19%. Census data suggest that 64% of the population of the municipality had incomes lower than R38 400 per annum in 2001 (Table 2). 89% of Africans and 78% of Coloureds live below the household subsistence level of R1 600 per month, compared to just 10% of Whites. However, the proportion of poor inhabitants in the study area is probably lower than for the municipality as a whole.

TABLE 2. HOUSEHOLD INCOME IN OVERSTRAND LOCAL MUNICIPALITY IN 2001 (STATISTICS SA 2003)

Annual income	Households	%	Cum %
None – R9 600	5 121	26.9	26.9
R9 601 – R19 200	3 240	17.0	43.9
R19 201 – R38 400	3 805	20.0	63.8
R38 401 – R76 800	3 278	17.2	81.0
R76 801 – R153 600	2 325	12.2	93.2
Above R153 601	1 288	6.8	100.0
Total	19 057	100.0	

2.4 LAND-USE, ECONOMY AND DEVELOPMENT

2.4.1 Land use

A LARGE PORTION OF THE KBR IS NATURAL VEGETATION, PARTICULARLY IN THE PROTECTED AREAS OF THE KNR AND THE HOTTENTOTS-HOLLAND NATURE RESERVE. MUCH OF THE REMAINING AREA HAS BEEN TRANSFORMED FOR CULTIVATED AGRICULTURAL USE, WITH FRUIT SUCH AS APPLES AND VINES THE MAIN PRODUCTS, WHILE THERE ARE ALSO FORESTRY PLANTATIONS. THERE IS SOME INDUSTRIAL DEVELOPMENT – MAINLY AGRO-PROCESSING FACILITIES, AND SEVERAL SMALL TOWNS HAVE DEVELOPED (

Figure 4). Vegetation along the coast is mainly untransformed apart from in the village settlements.

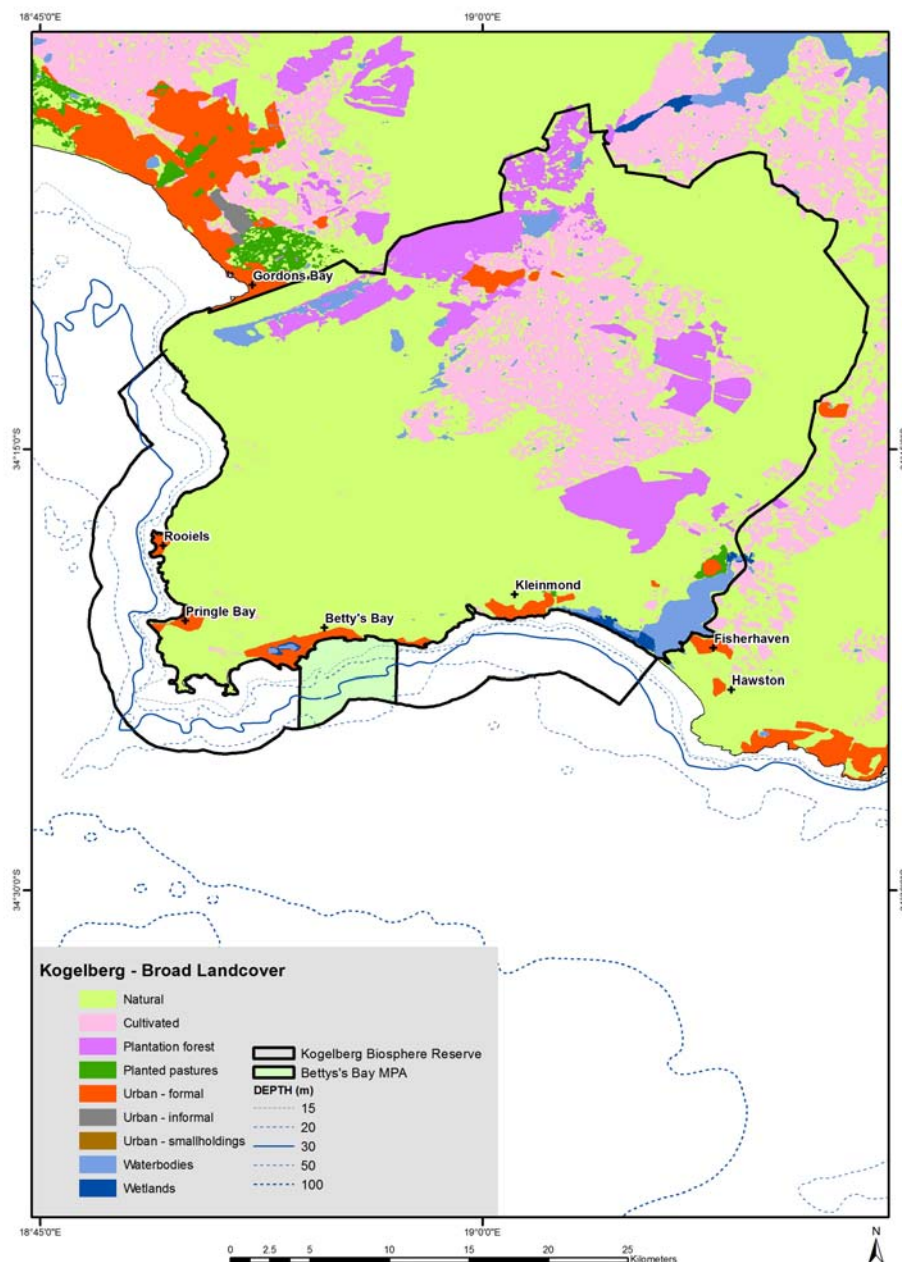


FIGURE 4. LAND USE WITHIN THE KOGELBERG BIOSPHERE RESERVE

2.4.2 Economy

The Overstrand Municipality (2007) IDP Revision provides a summary of the economic conditions within the municipality and highlights the key sectors and economic influences. The summary applies to the whole municipal area and not only the wards within the KBR, but the areas within the KBR are likely to display similar dynamics. An overview of the economic situation in the municipality from the IDP is provided below.

Overstrand's economy is largely linked to that of Cape Town, the wider south coast region and the hinterland of the Overberg District – the economy of the municipality over the years has grown in line with that of the Province. The economy of the Eastern Cape also has an impact on the Overstrand economy, with the bulk of in-migration being low-skilled work-seekers from this province. The local economy was expected to grow by about 6% in 2007/8, which is a decrease from the growth of 8% that it had enjoyed in the prior years. Key sectors contributing to the Gross Geographical Product of the area are (Figure 5):

- Wholesale trade & catering, including tourism (24%),
- finance & business services (23%),
- manufacturing (16%),
- construction (9%),
- transport and communication (9%) and
- government services (8%).

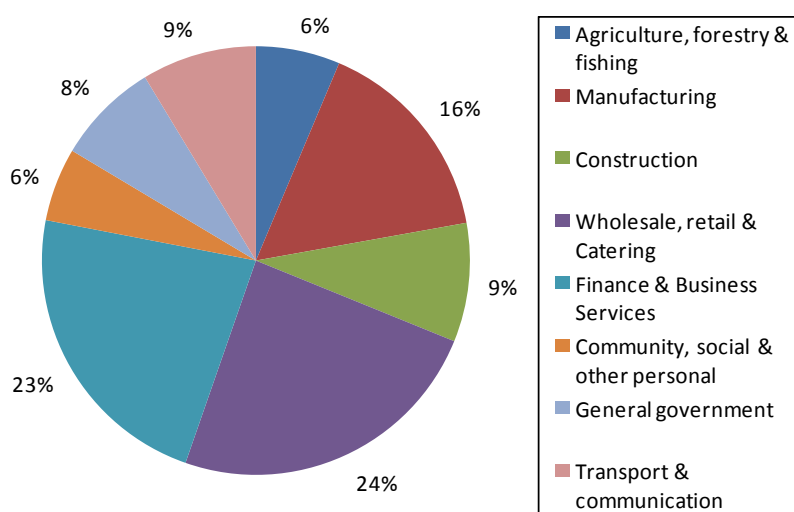


FIGURE 5. SECTORAL CONTRIBUTION TO GDP IN OVERSTRAND MUNICIPALITY IN 2005 (PROVINCIAL GOVERNMENT WESTERN CAPE 2007)

Agriculture, forestry & fishing contributed only 6.3% of the municipal GDP. No sub-sectoral breakdown is provided to indicate the relative contributions and particularly that of the fishing sub-sector, but the high level of urbanised population suggests that fishing rather than agriculture and forestry could be the major contributor. The growth of the overall sector between 2004 and 2005 was 4.9%, which is lower than the municipal GDP growth of 8.1% for the municipality. Indications are that tourism, which forms part of the wholesale, retail and catering sector, is relatively more

important than fishing for the municipality and is also increasing in relative importance as the growth for this sector was 10.6% between 2004 and 2005.

Apart from the trade & catering sector, the transport sector (16.8%) has been the fastest growing, followed by business services and construction while government services and manufacturing have been in decline. The trade & catering, community services, agriculture, government and construction sectors employ the largest number of people although job losses have been experienced in the agricultural and manufacturing sectors (Figure 6).

Once again, no breakdown is provided of the levels of employment in the sub-sectors within the agriculture, forestry & fishing sector, but it is noteworthy that this sector employs relatively more people (17%) within the municipality than its contribution to GRDP (6%). Economic forces such as the decline in fishing and the seasonality of tourism and agriculture impact negatively on the semi-skilled and unskilled workforce of Overstrand. Other than the government grants, the poor depend on informal work such as in construction, or on illegal livelihoods (e.g. abalone poaching).

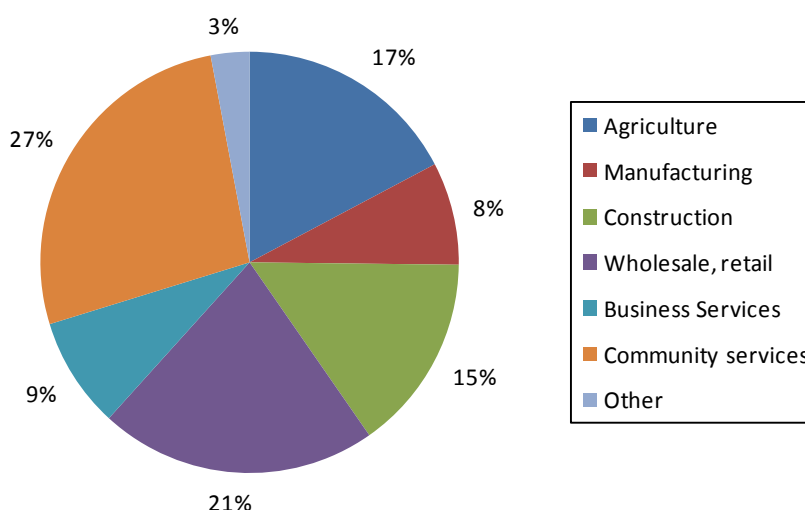


FIGURE 6. EMPLOYMENT BY SECTOR IN OVERSTRAND MUNICIPALITY IN 2001 (STATISTICS SA 2003)

2.4.3 Development Plans

The Overstrand IDP includes the following planned projects.

- Development of additional **trails**, foot paths and bicycle paths to diversify tourism attractions;
- Development of local **craft** sector;
- Development of an **aquaculture** sector strategy to expand the sector;
- Development of **harbours** to increase the productive and recreational capacity of the current infrastructure with the Kleinmond harbour a focus;
- Promote the natural beauty of the area as a destination for the **film industry** through the Cape Film Commission. The Studio City South Africa is already situated in Grabouw;

- Umthimkhulu Village in Kleinmond, earmarked as an ASGISA project to provide **training and small business development** linked to the KBR. It is planned to include a continuing education centre, sustainable ecological systems centre, amphitheatre, cultural activities and small market shops;
- Projects to be facilitated through the Development Agency include a **campsite resort** on the lagoon in Kleinmond, regeneration of the **harbour industrial area** and upgrade of **leisure facilities** at the lagoon with a view to regaining Blue Flag beach status.

Many of the projects are still at a concept or early stage of planning, but the list does provide an overall sense of the likely direction of future local economic development in the KBR and its surrounds. There are several projects listed in the IDPs to enhance local infrastructure and services, such as housing, water and sanitation, but these are not included in the lists below.

The areas of Betty's Bay, Hangklip, Pringle Bay and Rooi Els, are all situated within the transitional zone of the KBR and are regarded as holiday towns with little or no potential for development outside of housing and recreation.

3 COASTAL ECOSYSTEMS

3.1 INTRODUCTION

The coastal portion of the KBR stretches from the Steenbras Estuary eastwards to the Bot Estuary, and extends 3 nautical miles (5.6 km) offshore. The Kogelberg coast is bordered by dramatic mountains that rise sharply from the coastline and contribute greatly to the aesthetic attraction of the area. The rainy season which is associated with sub-antarctic cold fronts occurs during the winter months, with the lower slopes receiving an average rainfall of approximately 800 mm p.a. Rainfall is significantly lower during summer months, with droughts occurring frequently. The annual average maximum temperatures are 11°C and 24°C (du Toit & Attwood 2008).

The coast itself is itself is rugged and has a high diversity of habitats including rocky headlands, wave-cut platforms, sandy beaches, pocket beaches, kelp forests, estuaries, sub-tidal reefs and a pelagic habitat (Clark *et al.* 2004). This high level of habitat diversity is conducive to high biological diversity (Clark *et al.* 2004). Major coastal processes (currents and upwelling, tides and waves, and freshwater flow) and major coastal habitats (sandy beaches, rocky shores, boulder beaches, rocky reefs, and subtidal soft sediment habitats) for the Kogelberg area are described broadly below. However, one must be aware that none of the ecosystem processes and habitats are exclusive to the study area and they are characteristic of the greater south-western cape coast as a whole.

The Betty's Bay Marine Protected Area (MPA) falls within the Kogelberg Reserve, and is situated directly opposite the coastal town of Bettys Bay, 29km south east of Gordon's Bay, and 37km north west of Hermanus. The MPA has a shoreline length of 5.5km with the western boundary at Stony Point and the eastern boundary at Jock's Bay.

3.2 COASTAL PROCESSES

3.2.1 Currents and upwelling

The study area is influenced by both the strong-flowing Agulhas current that moves down the east coast of South Africa and the cold Benguela upwelling system of the west coast which reaches as far as Cape Agulhas (Figure 7). The presence of the two currents is the principal reason for the diverse range of coastal and marine flora and fauna for which South Africa is famous. The Kogelberg coast is influenced by the physico-chemical and biological status of both current systems which are described in more detail below.

The Agulhas current forms part of the huge Indian Ocean Gyre, which brings warm water from the tropics to the east coast of South Africa (Branch 1981) and moves at a speed of approximately 2.6 m per second. The Agulhas current hugs the continental shelf, moving close to the shore edge when the shelf is narrow and being deflected away from the coast as the shelf widens (i.e. from Port Elizabeth westwards). The continental shelf becomes progressively wider from Port St Johns in the eastern Cape

down to the Agulhas bank in the south Cape. The water carried by the Agulhas current cools as it moves southwards, and supports a changing array of species. Cool counter-currents also flow inshore of the Agulhas current in an easterly direction, providing important opportunities for northward and eastward migration of certain species such as the sardine *Sardinops ocellata*. South of the southern African subcontinent, the Agulhas current turns back on itself and begins flowing eastwards and once again joins the Indian Ocean Gyre as the Return Agulhas Current. This is evident in satellite imagery showing sea surface temperatures off southern Africa (Figure 8).

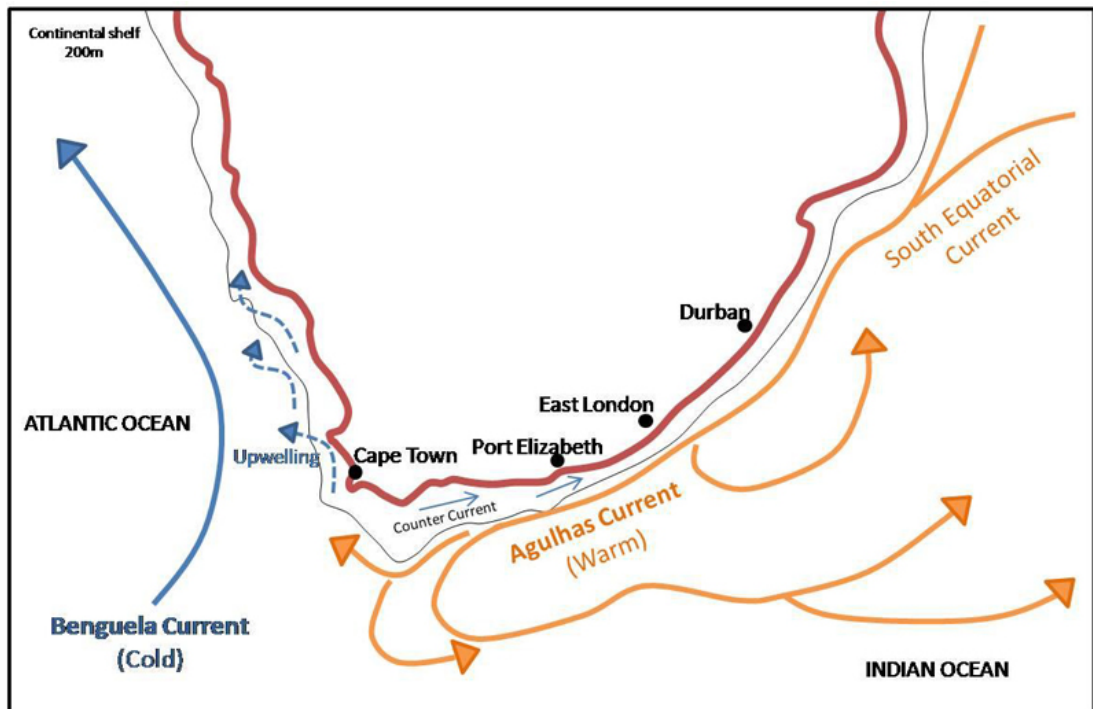


FIGURE 7. MAP OF SOUTHERN AFRICA SHOWING AGULHAS AND BENGUELA CURRENTS

The Benguela Current originates from the South Atlantic Circulation, which circles just north of the Arctic Circumpolar Current. The Benguela is naturally cold (average temperature 10 -14°C), but the cool water is supplemented by the upwelling of nutrient-rich deep water (Branch 1981). As the Benguela moves north it is deflected left from the coast due to the Coriolis forces (rotational force of the earth which causes objects in the southern hemisphere to spin anticlockwise). Strong south-easterly winds driving the Benguela parallel to the coast further enhance this upwelling process. Cold bottom water thus rises up to replace the deflected Benguela water, and this bottom water is the nutrient rich life force of the west coast (Figure 9). Plant life blooms when the nutrients reach the surface waters where plenty of light is available, and the phytoplankton is then preyed upon by zooplankton, which is in turn eaten by filter feeding fish such as anchovy or sardine. This makes the west coast one of the richest fishing grounds in the world and also attracts large colonies of birds and seals (Branch 1981). Figure 9 shows a simplified diagram of this upwelling process.

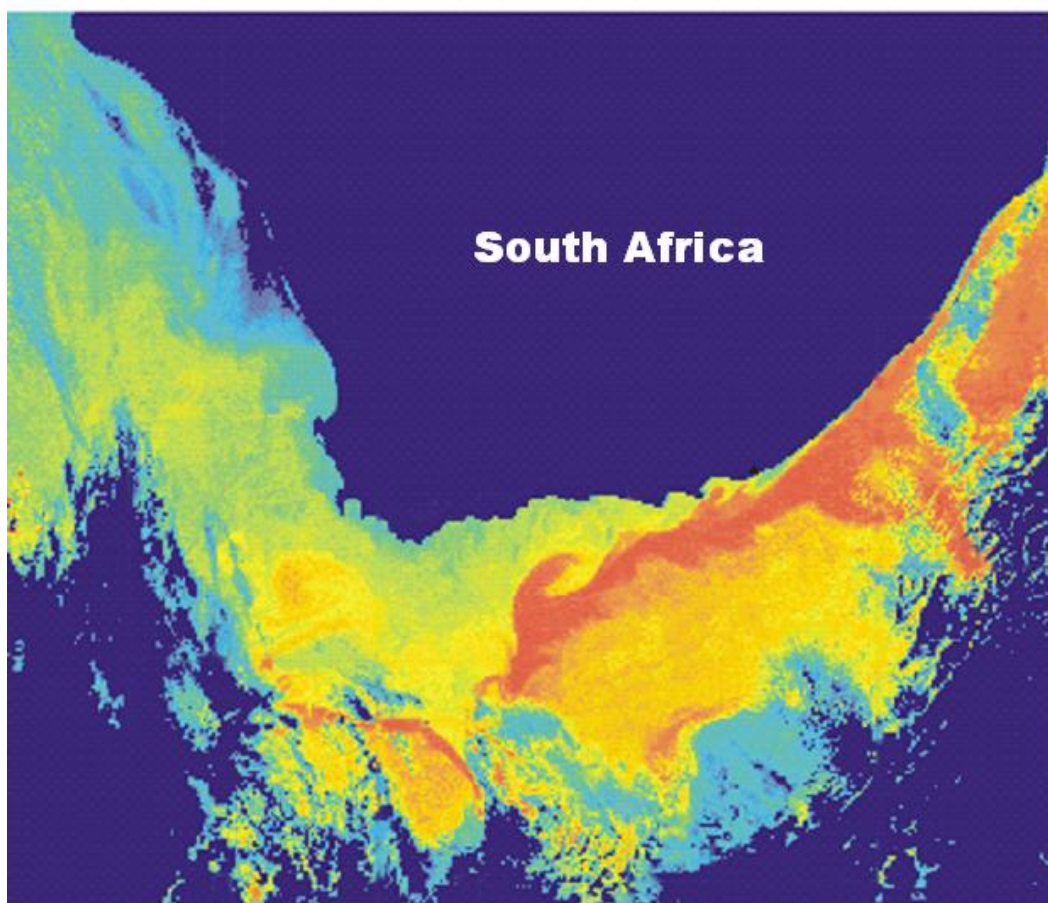


FIGURE 8. SATELLITE IMAGE SHOWING SEA SURFACE TEMPERATURES SURROUNDING SOUTHERN AFRICA. THE WARM AGULHAS CURRENT (ORANGE) FLOWS DOWN THE EAST COAST, AND COLD UPWELLING PLUMES (LIGHT BLUE) CAN BE OBSERVED ALONG THE WEST COAST. FIGURE COURTESY SUE LANE & ROBIN CARTER.

The Agulhas bank, with a depth of less than 200 m, is a broad triangle shaped extension of the continental shelf of southern Africa (Figure 7). It is approximately 8 000 km long and 250 km wide at its apex. The western portion of the bank, from Cape Point to Cape Agulhas, is considered to be an extension of the wind-driven-coastal-upwelling regime of the Benguela Current (Hutchings 1994). Because of its orientation, the south-western Cape coast experiences a net offshore transport of water under south and southeast winds. South easterly winds, which are generated by the South Atlantic high-pressure system, prevail in spring and summer within the Kogelberg region, and are strongest at Cape Hangklip. Upwelling events are thus frequent on the south-western Cape coast in summer, which results in low sea surface temperatures. Localised wind-induced coastal upwelling also occurs in the Betty's Bay area during the summer months, and this results in low average monthly temperatures of 11.4°C to 15.6°C (Jackelman *et al.* 1991). The coldest SW coast upwelling cells are found at Cape Hangklip (11-12°C) and Danger Point (12-13°C). Upwelling at Cape Hangklip generates filamentous coldwater plumes that extend westward to join the larger Cape Peninsula upwelling plumes (Boyd *et al.* 1985; Jury 1988).

3.2.2 Tides, waves and sediment transport

The South African coastline experiences semi-diurnal tides, with each successive high (and low) tide separated by 12 hours. Each high tide occurs approximately 25 minutes later every day, which is due to the 28-day rotational cycle of the moon around the earth. Spring tides occur once a fortnight during full and new moons. Tidal activity greatly influences the biological cycles (feeding, breeding and movement) of intertidal marine organisms, and influences when people visit the coastline to partake in various activities (e.g. relax, bathe, harvest marine resources).

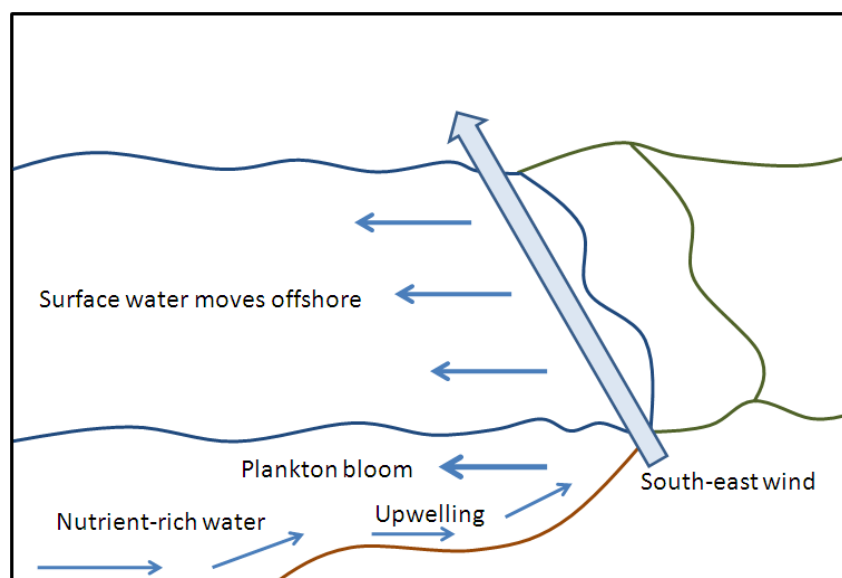


FIGURE 9. DIAGRAM SHOWING WIND-DRIVEN UPWELLING THAT OCCURS ON THE WEST AND SOUTH WEST COASTS OF SOUTH AFRICA.

Another factor that greatly influences marine ecology and human activities along the coastline is wave energy. Wave size is determined by wind strength and fetch (or distance over which it blows) and determines the degree to which breaking waves at the shore will shift sand and erode rock. The KBR coast is an extremely high energy coast, particularly west of Kleinmond. On coastlines with high wave energy, beaches are typically steep and composed of coarse sands. However, hard rock formations (such as the Table Mountain Sandstone) which project from the coast resist erosion and deflect waves and currents (Branch 1981). This results in the formation of ‘half-heart’ bays typical of the western and southern cape coastline (e.g. Walker Bay). As waves enter these sheltered bays they spread out and their energy is dissipated. The ways in which waves spread out in the bay (and thus changes in wave energy) are largely influenced by the shape of the Bay. In False Bay an underwater rocky platform known as the Rocky Bank is situated at the mouth of the bay. South westerly waves entering the bay are retarded by Rocky Bank and converge to form large freak or “killer” waves that impact the coastline between the Steenbras River mouth and Cape Hangklip (Branch 1981). These freak waves have swept many anglers off the rocks to their death and thus shore angling in this part of the Kogelberg is notoriously dangerous.

West of Kleinmond, the coast is largely a reflective, or eroding coastline, while the coast to the east of Kleinmond tends to be a dissipative, or depositing coastline. Sand is

eroded from reflective coasts, deposited on beaches by waves, and is blown by the wind into dune areas and back into the ocean.

3.2.3 Links between freshwater and marine systems

Five estuarine systems occur in the study area – the Steenbras, Rooiels, Buffels, Palmiet and Bot/Kleinmond. While two of these (Steenbras and Palmiet) are permanently open, the rest are closed most of the time. The state of these estuary mouths is influenced by freshwater inflow – they are opened during floods, i.e. usually during the rainy season, and the length of time they remain open depends on the amount of sediment build-up at the mouth, which is in turn influenced by wave action, wind and currents (Allanson & Baird 1999). When estuaries are open, the outflowing water is often an important source of nutrients for the coastal zone. However, in the case of black-water systems that drain fynbos catchments, the river water tends to be oligotrophic (low in nutrients) and thus estuaries along the KBR coast probably do not (at least under natural condition) contribute significantly in this respect.

Many species of fish and invertebrates found in estuaries move between estuaries and freshwater or marine environments to complete their life cycles (Wallace *et al.* 1984). Adults of these species generally live and spawn at sea, and the juveniles enter estuaries shortly after metamorphosing from larvae, and then return to the sea to join adult stocks. The association with estuaries for many species is only facultative, but for a considerable number this has evolved into an obligatory relationship. In South Africa for example, at least 37 species of fish and countless species of invertebrates are entirely dependent on estuaries during the juvenile phase of their life cycles (Whitfield 1994).

TABLE 3 CLASSIFICATION OF SOUTH AFRICAN FISH FAUNA ACCORDING TO THEIR DEPENDENCE ON ESTUARIES (WHITFIELD 1994)

Category	Description
I	Truly estuarine species, which breed in southern African estuaries; subdivided into Ia and Ib:
Ia	Resident species which have not been recorded breeding in the freshwater or marine environment
Ib	Resident species which have marine or freshwater breeding populations
II	Euryhaline marine species which usually breed at sea with the juveniles showing varying degrees of dependence on southern African estuaries; subdivided into IIa, IIb and IIc:
IIa	Juveniles dependant of estuaries as nursery areas
IIb	Juveniles occur mainly in estuaries, but are also found at sea
IIc	Juveniles occur in estuaries but are more abundant at sea
III	Marine species which occur in estuaries in small numbers but are not dependant on these systems
IV	Euryhaline freshwater species that can penetrate estuaries depending on salinity tolerance. Includes some species which may breed in both freshwater and estuarine systems
V	Obligate catadromous species which use estuaries as transit routes between the marine and freshwater environments.

TABLE 4 ESTUARINE ASSOCIATED FISHES FOUND ON THE KOGELEBERG COASTLINE

Cate-gory ¹	Family ²	Species ²	Common Name ²	Utilisation ³
Ia	Clupidae	<i>Gilchristella aestuaria</i>	Estuarine roundherring	Prey
	Clinidae	<i>Clinus spatulatus</i>	Estuary klipfish	Prey
Ib	Gobidae	<i>Caffrogobius gilchristi</i>	Prison goby	Prey
	Gobidae	<i>Caffrogobius nudiceps</i>	Barehead goby	
	Gobidae	<i>Psammogobius knysnaensis</i>	Speckled sandgoby	Prey
	Atherinidae	<i>Atherina breviceps</i>	Cape silverside	Prey
	Clinidae	<i>Clinus superciliosus</i>	Super klipfish	Prey
	Sygnathidae	<i>Sygnathus teminkii</i>	Longsnout pipefish	Prey
IIa	Sparidae	<i>Lithognathus lithognathus</i>	White steenbras	Angling, food
	Sparidae	<i>Rhabdosargus holubi</i>	Cape stumpnose	Angling, food
	Monodactylidae	<i>Monodactylus falciformis</i>	Oval Moony	Food, prey
	Mugilidae	<i>Mugilid cephalus</i>	Flathead mullet	Food, prey
	Mugilidae	<i>Myxus capensis</i>	Freshwater mullet	Food, prey
	Carangidae	<i>Lichia amia</i>	Leervis or Garrick	Angling, food
IIb	Mugilidae	<i>Liza dumerilii</i>	Groovy mullet	Food, prey
	Mugilidae	<i>Liza tricuspidens</i>	Striped mullet	Angling, food, prey
	Soleidae	<i>Heteromycteris capensis</i>	Cape sole	Prey
	Soleidae	<i>Solea bleekeri</i>	Blackhand sole	Prey
	Ariidae	<i>Galeichthys feliceps</i>	White seacatfish	Angling, food
	Sciaenidae	<i>Argyrosomus japonicas</i>	Dusky kob	Angling, food
IIc	Pomatomidae	<i>Pomatomus saltatrix</i>	Elf	Angling, food
	Sparidae	<i>Diplodus sargus capensis</i>	Blacktail	Angling, food
	Sparidae	<i>Rhabdosargus globiceps</i>	White stumpnose	Angling, food
	Sparidae	<i>Sarpa salpa</i>	Strepie	Angling, food
	Mugilidae	<i>Liza richardsonii</i>	Southern mullet	Food, prey
III	Tetraodontidae	<i>Amblyrhynchotes honckenii</i>	Evileye blassop	
IV	Cichlidae	<i>Oreochromis mossambicus</i>	Mozambique tilapia	Food, prey
¹ Whitfield 1994, ² Whitfield 1998, ³ Wallace <i>et al.</i> 1984				

¹Whitfield 1994, ²Whitfield 1998, ³Wallace et al. 1984

Estuarine dependant fish species are described by Whitfield (1994) as those taxa whose populations would be adversely affected by the loss of estuarine habitats. Research has shown that fish inhabiting estuaries can be divided into five categories (I – V) according to their dependence on estuarine environments (Table 3). Categories I and II are subdivided into Ia and Ib, and Ila, I Ib and IIc, respectively. Of the five major categories, only categories Ia and Ila are considered wholly dependant on estuaries. Category Ib, I Ib and IIc is comprised of species which are partially dependant on estuarine systems, and category III comprises species which rarely occur in estuaries. Category IV constitutes euryhaline freshwater species which can penetrate estuaries to some degree according to salinity tolerance (Whitfield 1994).

Estuarine associated fish species from the Kogelberg that fall within the above five categories have been listed in Table 4. Also included is an indication of whether the fish are used for angling, for human food consumption or are preyed upon by larger

predatory fish or birds. A total of 27 estuary-associated fish species are found within the Kogelberg, of which 8 species (30%) are listed as being wholly dependant on estuaries (i.e. belonging to categories Ia and IIa). Three commercially and recreationally important angling species, which either breed in estuaries or depend on estuaries as nursery areas, are found within the Kogelberg systems, namely white steenbras, cape stumpnose and leervis or garrick (category IIa). The majority of fishes (63%) that occur within the Kogelberg estuaries fall into category Ib, IIb and IIc and use estuaries to varying degrees according to their life cycles.

3.3 BIOGEOGRAPHICAL CONTEXT

A number of efforts have been made to understand and map marine biogeographic patterns around the coast of South Africa (e.g. Stephenson and Stephenson 1972; Brown and Jarman 1978; Emanuel *et al.* 1992; Engledow *et al.* 1992; Stegenga and Bolton 1992; Bustamante and Branch 1996; Bolton and Anderson 1997; Turpie *et al.* 2000; Sink 2001; Bolton *et al.* 2004). Most of these studies recognise three coastal regions – a cool temperate west coast, warm temperate and subtropical region, with the main points of argument relating to the position of the boundaries. More recently, Lombard *et al.* (2004) defined a set of regions that include offshore areas under the National Spatial Biodiversity Assessment (NSBA). These included five inshore bioregions which extend out to the continental shelf (Figure 10). The Agulhas Bioregion coincides with the Warm Temperate Region (extending from Cape Point to the Mbashe River), while the two outer regions have been split in this assessment.

The Kogelberg coast lies on the western edge of the Warm Temperate Region / Agulhas Bioregion, and includes marine fauna and flora characteristic of this region as well as some of those characteristic of the Southwestern Cape and even the Namaqua Bioregions. Historical records indicate that many warm water species have been present in the area in the past, but the combination of over fishing and environmental change has resulted in their decline (Attwood & Farquhar 1999).

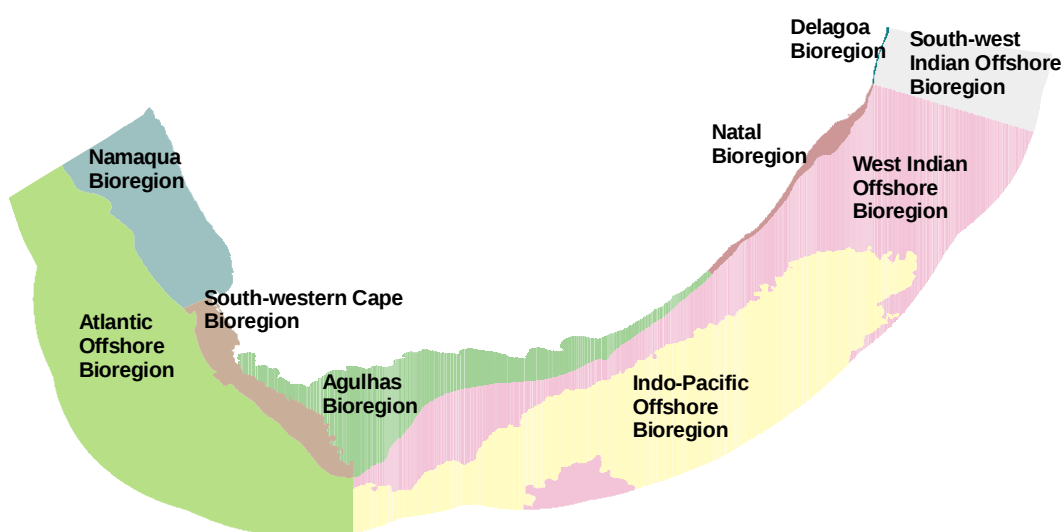


FIGURE 10. INSHORE AND OFFSHORE BIOREGIONS IN SOUTH AFRICA AS DEFINED BY LOMBARD *ET AL.* (2004).

A detailed study of the intertidal and subtidal marine macroalgal (seaweed) species in the Cape Hangklip area was conducted by Jackelman *et al.* (1991), which reported 199 taxa (27 chlorophyta, 25 Phaeophyta and 147 Rhodophyta). The study indicated that within this area, many of the algal species were at the limits of their ranges, and there was no dominance of species with either warm or cold water affinities.

3.4 COASTAL HABITATS AND THEIR BIOTA

3.4.1 Introduction

The South African coastline constitutes a diverse and varied physical environment, which has, over millions of years given rise to different communities of plants and animals. Distinct groups of coastal plants and animals live within different coastal ecosystems, and these include coastal waters, sandy beaches, rocky shores, rocky and coral reefs, rivers and estuaries, and coastal wetlands. Many of these ecosystems do not have distinct boundaries, and tend to merge with one another and are separated by transitional zones called ecotones (Glavovic 2000). The habitats of the study area and biota associated with each of which is described in detail below.

3.4.2 Distribution and extent of shoreline habitat types

A variety of habitats is found along the Kogelberg coast, the distribution of which have been mapped in detail by Clark & Lombard (2007) for the whole of the Agulhas Bioregion. Their distribution on the Kogelberg coast is shown in Figure 11, while their relative contribution of each habitat type to the Kogelberg coast, and the proportion that this represents of this habitat type on the Agulhas Bioregion is listed in Table 5.

According to the convention used by Clark & Lombard (2007), rocky, mixed shoreline and boulder habitats are subdivided into sheltered, exposed and very exposed habitats. In practice though, very exposed shoreline occurs only at the tip of rocky headlands where extreme wave action prevents any mobile material (i.e. sand and boulders) from settling. The latter two categories do not occur in practice therefore, and are thus not included in the table. In the case of rocky shore, sheltered, exposed and very exposed shores are known to harbour distinct communities (Bustamante & Branch 1996, Lombard *et al.* 2004, Blamey & Branch 2009), but whether this is true or not for the mixed shore and boulder shore habitats is not known owing to the dearth of information concerning the biota of mixed and boulder shore habitats, although it is considered likely (Clark & Lombard 2007). Sandy shores are subdivided into dissipative, intermediate and reflective beach types loosely following the classification system of Wright & Short (1984). Dissipative beaches are generally characterised by fine sand, flat intertidal beach gradients, and wide surf zones, while reflective beaches, on the other extreme, are coarse grained (mean particle size >500 µm), and have with steep intertidal beach faces where the waves break directly onto the sand in the intertidal zone. Work of Short (1996) and others (e.g. McLachlan 1983, 1990) has shown that while faunal communities associated with each of these beach types are not distinct from one another, dissipative beaches harbour the richest communities while intermediate and reflective beaches harbour respectively smaller subsets of the species complement found on dissipative shores.

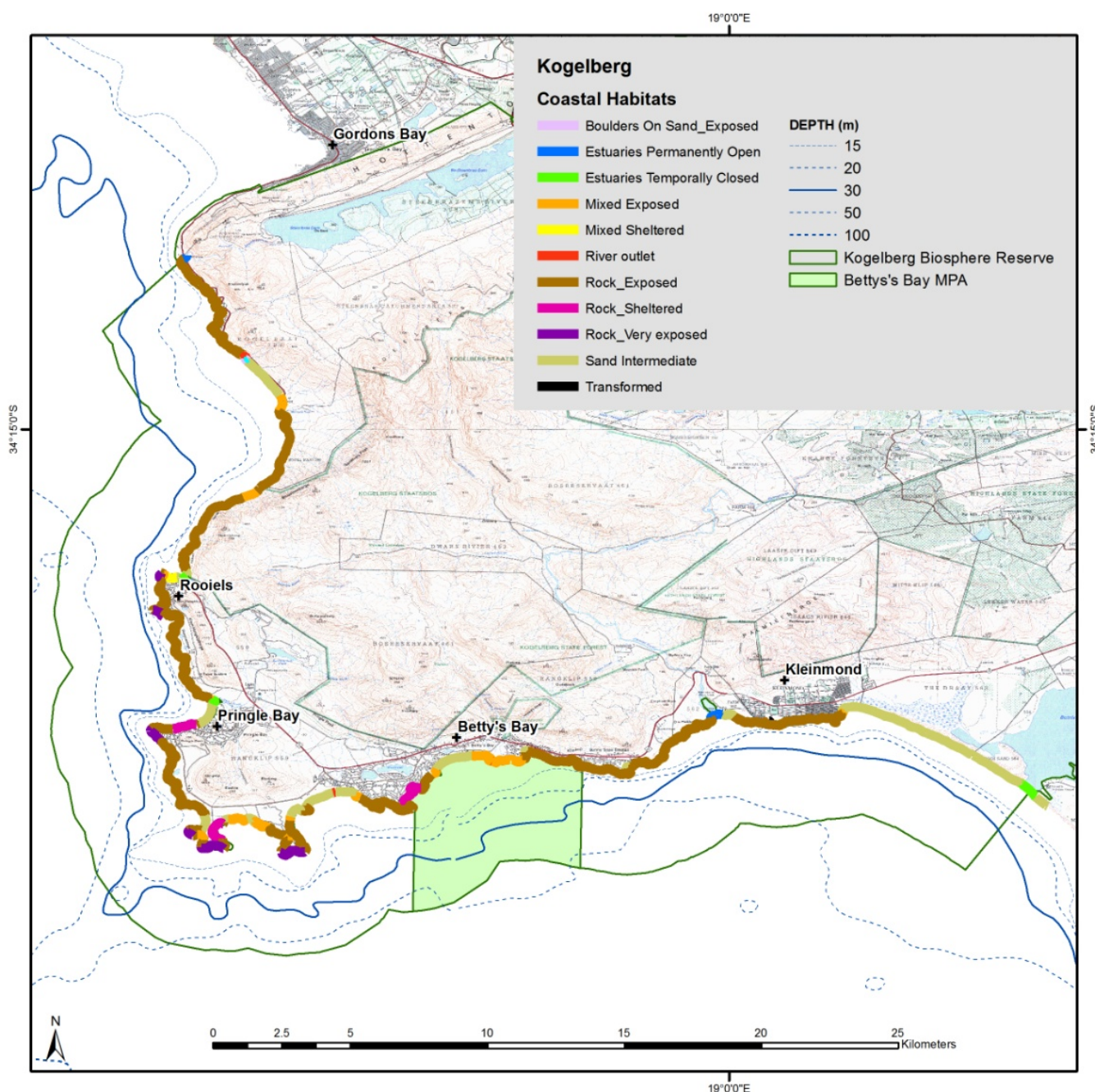


FIGURE 11. DISTRIBUTION OF SHORELINE HABITATS WITHIN THE KOGELBERG BIOSPHERE RESERVE (SOURCE: CLARK & LOMBARD 2007).

Not all the shoreline types listed above are represented in the Kogelberg (e.g. no dissipative sandy beaches, or boulder on sand). Of those that are represented, exposed rocky shores account for the bulk of the habitat (64%), followed by intermediate sandy beaches (19.2%), with mixed shore (exposed: 7.9%, sheltered: 0.4%), and other rocky shores (very exposed: 4.6, sheltered: 3.9) providing smaller contributions. From a bioregional perspective, the Kogelberg coast accounts for 5.0% of the bioregion, but contains a disproportionately large amount of all types of rocky shore habitat (sheltered: 16.2%, exposed: 7.3%, and very exposed 8.1%) and sheltered mixed shore

habitat (5.8%), but disproportionately small amounts of the other habitat types. Rocky shore habitat is scattered throughout the KBR, while the sandy beaches are concentrated between the Bot and Kleinmond estuaries, either side of Betty's Bay, and in Koeëlbaai (Figure 11).

All major habitat types on the Kogelberg coast, aside from very exposed rocky shore, are represented in the Betty's Bay MPA. However, some of these are not represented in proportion with their presence in the KBR, notably exposed rocky shore. Any future increase in the amount of coastline under protection in the Kogelberg should thus focus on these under-represented habitats, viz. exposed and very exposed rocky shore.

TABLE 5. REPRESENTATION OF DIFFERENT TYPES OF SHORELINE HABITAT ON THE KOGELBERG COAST AND IN THE AGULHAS BIOREGION. NOTE THAT ESTUARY MOUTHS MAKE UP A VERY SMALL PROPORTION OF THE COAST AND ARE NOT INCLUDED HERE,

	Kogelberg Coast		Agulhas Bioregion	
	Length (km)	% Contribution	Total length (km)	Kogelberg %
Rocky shore - very exposed	3.5	4.6	43.3	8.1
Rocky shore - exposed	49.5	63.9	679.5	7.3
Rocky shore - sheltered	3.0	3.9	18.7	16.2
Mixed shore – exposed	6.1	7.9	324	1.9
Mixed shore - sheltered	0.3	0.4	4.9	5.8
Sandy beach - Intermediate	14.8	19.2	486.2	3.1
Sandy beach - dissipative	-	-	8.4	-
Boulder on rock - exposed	-	-	3.5	-
Boulder on rock - sheltered	-	-	0.8	-
Boulder on sand - exposed	0.1	0.2	35.7	0.4
Boulder on sand - sheltered	-	-	0.7	-
Total	77.4	100	1562.4	5.0

3.4.3 Sandy beaches

South Africa is famed for its unspoilt and beautiful beaches, a number of which are found within the Kogelberg area, namely; Koeëlbaai, Rooiels, Pringle Bay, Betty's Bay, Palmiet and Kleinmond (Figure 60, Section 5.6.2). These beaches are popular places of recreation for tourists and locals alike and can become a hub of activity over weekends and holidays. Sandy beaches are characteristically unstable habitats, with wave action being the predominant driver of change, which makes these habitats a unique home to a number of hardy and well-adapted species.

Beaches typically comprise three functional zones, namely the surf zone, the beach (intertidal and backshore zones) and the dunes. They are continually changing; strong waves scour and erode beaches while gentle waves deposit sand. Coarse sands and steep gradients characterise beaches that are subject to strong wave action, while fine sands and gentle slopes predominate on calm beaches. Within the Kogelberg area, and generally speaking, sand is typically deposited with offshore winds, and eroded with onshore winds. Sand erosion will also increase during the high seas and stormy weather that is characteristic of south-western Cape winters. The shallow gradients characteristic of the Kogelberg beaches indicate that they are dissipative and so although large quantities of sand may be removed during storms, the gradient of the beach will

not increase dramatically. Relatively few species occur on sandy beaches due to their unstable and harsh nature, but those that do occur are hardy, and well adapted to life in these environments (Branch 1981). Steep, wave beaten beaches are the most unstable, and thus species diversity and abundance tends to be lowest on this type of beach. Animals living here are, however, offered some degree of protection by being able to burrow into the layers of sand to escape desiccation, overheating and strong waves (Branch 1981).

Sandy beaches have no hard substratum onto which animals and plants can attach, and organisms living here rely on seaweeds deposited sporadically on the beach and organic rich froth, or spume, which provides a more steady source of nutrients (Branch 1981). Kelp is regularly deposited on the many KBR beaches, where it provides a food for several scavenging amphipods and isopods such as the Beach hopper, *Talorchestia capensis* and the Giant pill bug, *Tylos granulatus*.

Five groups of organisms are typically found on sandy beaches: aquatic scavengers, aquatic particle feeders, air breathing scavengers, meiofauna (smaller than 0.5 mm in size), and higher predators (Branch 1981). Aquatic scavengers feed on dead or dying animals that wash up on the beach and their activity is largely regulated by tides. This group includes species such as *Bullia* (the plough snail), that emerge from the sand as the tide rises and are deposited in the same area in which the wave drops the debris and decaying matter. Later they follow the tide down the shore as it recedes to avoid be eaten by terrestrial predators. Species of *Bullia* found on the Kogelberg beaches include the Annulated plough shell *bullia annulata*, the Finger plough shell *Bullia digitalis*, the Smooth plough shell *Bullia rhodostoma* and the Pure plough shell *Billia pura*.



FIGURE 12. PRINGLE BAY BEACH.

Aquatic particle feeders, such as the Sand hopper mentioned above, occur mostly on the low-shore and feed on small organic particles. The majority of these species migrate up and down the beach with each tidal cycle, such that they remain in the surf zone and can escape avian and terrestrial predators. Air breathing scavengers live high on the shore and feed on kelp and other seaweeds that have been washed up, as well as dead and decaying animal matter. These species complete their life cycles out of water, emerge from the sand during low tide when there is less risk of being washed

away, and are almost strictly nocturnal to avoid desiccation and predation. These diurnal feeding activities can be observed on the Kogelberg beaches, particularly in the early evening. Sand hoppers are important for the breakdown of kelp, and are also a major food source for sanderlings and other birds. Other examples of air-breathing scavengers found within the Kogelberg include the isopod *Ligia*, the larvae of kelp flies, and the giant isopod *Tylos*.

Meiofauna are by far the most abundant of the animals found on sandy beaches, as their small size enables them to live between sand grains. The two most common groups are nematode worms and harpacticoid copepods. Meiofauna play an important role in breaking down organic matter that is then colonised by bacteria. They are also commonly used to monitor the effects of pollution on sandy beaches owing to their sensitivity to pollution and other forms of disturbance (Branch 1981). Should pollution inputs to the Kogelberg marine environment increase in the near future then benthic and sandy beach meiofauna would be good indicators for change in the health of the marine environment. However since limited data is available on meiofauna species composition within the Kogelberg region it would be difficult to draw comparisons between impacted states and reference (un-impacted) states.

Higher predators that feed on sandy beach organisms include birds such as Black-backed Gulls, African Black Oystercatchers, White fronted Plovers and sanderlings (Branch 1981), all of which can be observed in the KBR. Fish such as galjoen and white steenbras also swim over submerged beaches at high tide and feed on small crabs and the like (Branch 1981). Other fish species occurring within the surf zone in the Kogelberg area include baardman, mullet, elf and sandsharks (du Toit & Attwood, 2008). The Betty's Bay beach is known to be one of the few beaches in along the south-west coast onto which paper nautilus shells are washed ashore (du Toit & Attwood 2008).

Sandy beaches are also important for the filtering and decomposition of organic matter in sea water. As water percolates down through the sand the organic particles are trapped and decomposed by bacteria, which in turn release nitrates and phosphates that are returned to the sea. Continual flow of water through the sand maintains oxygen levels and aids bacterial decomposition, and thus sandy beaches act as water purifiers (Branch 1981).

3.4.4 Rocky Shores

Rocky shores can be divided into distinct bands according to the amount of time each is exposed to the air, which in turn influences the organisms which inhabit each section of the shore. Species that are more tolerant to desiccation (drying out) are found near the high-water mark, while those that cannot stand long periods of water recession are found near the low-water mark. Five distinct zones are typically found on rocky shores South Africa's south coast, all of which are present on the Kogelberg coastline. These zones (moving in a landward direction) are named the Infratidal zone, the Cochlear zone, the Lower Balanoid zone, the Upper Balanoid zone and the Littorina zone (Figure 13).

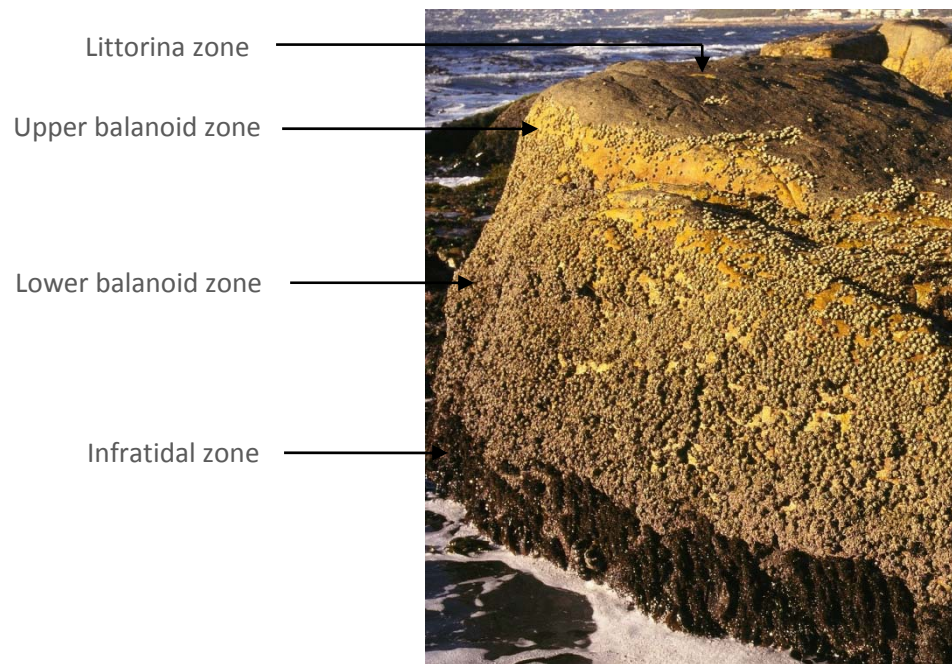


FIGURE 13. TYPICAL PATTERN OF ZONATION EVIDENT ON ROCKY SHORES IN THE KOGELEBERG. NOTE THAT THIS IS A RELATIVELY SHELTERED SECTION OF COASTLINE AND THE COCHLEA ZONE IS THUS ABSENT.

The Infratidal zone is inhabited by species that cannot withstand long periods of exposure and include algal beds, red bait (*Pyura*), corals, coralline algae and sea urchins (*Parechinus*). The Cochlear zone (found only on wave exposed shores) is inhabited by dense bands of the limpet *Patella cochlear*, which occurs almost exclusively in this band, living at such high densities that it is virtually impossible for other species to colonize the area. Above the Cochlear zone is the Lower Balanoid, with thick beds of seaweed *Gigartina radula* and *G.stiriata*, the limpet *Patella longicosta*, winkles *Oxystele sinensis* and welks *Burnupena* species. Mussels *Perna perna* and *Mytilis spp.* also occur within this zone. The upper Balanoid is dominated by animals, in particular limpets and barnacles. Little seaweed occurs within this zone, however some sea lettuce *Ulva* is present. The harshest of all is the *Littorina* zone, which is dominated by the snail *Littorina africana*. The shore crab *Cyclograpsus punctatus* and the flat-bladed algae *Porphyra* also occur in this zone (Branch 1981). Starfish *Marthasterias glacialis*, octopus *Octopus vulgaris*, and various species of fish, termed klipvis in South Africa, live in subtidal rock pools and prey on bivalves.

The diversity of subtidal and intertidal macroalgal species is high in the Kogelberg area, with the dominant subtidal kelp species being *Ecklonia maxima*, which forms large floating canopies. Kelp washed ashore forms an important food source for scavengers and provides shelter for numerous amphipods and isopods (sea lice and sand hoppers), which are in turn are preyed upon by birds. Kelp thus forms an integral part of the rocky shore and sandy beach ecosystems. Kelp that is broken down by the crustaceans is later consumed by filter feeders in the surf zone of sandy beaches (e.g. white mussels) or is broken down by bacteria, and the nutrients are cycled back into the sea (du Toit & Attwood 2008).

Filter feeders such as mussels, red bait and sea cucumbers comprise 70-90% of the faunal community on rocky shores and their principal food source is kelp (du Toit & Attwood 2008). Kelp also produces large quantities of mucus, which encourages bacterial growth upon which protozoa feed. Microorganisms, kelp spores and

phytoplankton and fragments of organic matter form an important food sources for filter feeders (du Toit & Attwood 2008).

3.4.5 Boulder beaches

Boulder beaches are less commonly encountered along the South African coastline than either sandy or rocky shores, and probably make up less than 1% of the coast. None of the boulder beaches on the KBR coast have been subject to detailed study, but Clark *et al.* (1999) provide a detailed description of the fauna and flora of boulder beaches in False Bay which are likely to be very similar.

Zonation on boulder beaches is much less pronounced than it is on shores made up of solid rock, largely because the physical gradients of desiccation and wave exposure so pronounced on a normal rocky shore are largely mitigated by virtue of the fact that the biota are able to shelter beneath and on the sides of the boulders on the shore. The biota inhabiting these areas are also fundamentally different to those inhabiting shores of solid rock. The numbers of grazers tends to be much higher with the result that the density of macroalgae (seaweed) tends to be much lower. On the high shore, the only algal species present in significant quantities is the sea lettuce *Ulva* sp. together with some encrusting coralline algae. On the low shore only the less palatable coralline algae species are present. Dominant grazers on the upper part of the shore include the cushion star, *Patiriella exigua*, periwinkles *Oxystele tigrina*, *O. variegata* and *Gibbula* sp. and the limpets *Helcion pruinosus*, *H. pectunculus* and *Cymbulla granatina*, the chiton *Ischnochiton* sp. and the sea urchin *Parechinus angulosus*. On the low shore a similar suite of grazers are present except that the periwinkle *O. variegata*, and the limpets *H. pectunculus* and *Siphonia capensis* becomes more common, while the others less so. Filter feeding spiral fan worms *Spirorbis* sp. and the cockle *Thecalia concamerata* are present in modest numbers on the high shore, while the latter increases in abundance moving down the shore. Dominant predatory organisms on boulder beaches in False Bay do not differ significantly between the high and low shore, and include the whelk *Burnupena cincta*, the anemones *Anthopleura michaelsoni* and *Anthothoe stimpsoni*, and the key hole limpet *Fissurella mutabilis*.



FIGURE 14. BOULDER BEACH NEAR KOEËL BAY

3.4.6 Rocky reefs

Temperate rocky reefs are found below the low water mark (i.e. are always completely submerged) and are known to support diverse assemblages of life. Stresses from wave action and sedimentation result in a high turnover of competitors in these habitats. Many large predators such as fish and sharks are attracted to rocky reefs, and thus form an important component of these ecosystems (Barros *et al.* 2001). Many of the reef-associated fish and crustaceans not only forage directly on the reef but also on the adjacent sandy bottom areas. Rocky reef community structure is thus also known to influence macrobenthic distribution and abundance in the adjacent soft bottom habitats, and it has been found that more benthic species occur close to rocky reefs (Barros *et al.*, 2001).

Within the south-western Cape and the KBR rocky reefs provide substratum to which kelp (*Ecklonia*) can attach, and these large kelp forests provide food and shelter for many organisms. Light is the limiting factor for plant growth, and thus kelp beds only extend down to approximately 10 m depth. Many other algal species live underneath the floating canopy of kelp, especially inshore where the light is abundant and the water shallow. A sub canopy of *Lamanaria* grows beneath the *Ecklonia* in deeper waters, and dense communities of mussels, sea urchins, rock lobster and abalone live between the *Lamanaria* plants. Herbivores occurring in the kelp forests include abalone *Haliotis midae*, the kelp limpet, alikreukel or giant periwinkle, *Turbo sarmaticus* and *Patella compressa* (lives on the stipes of the kelp plants) (du Toit & Attwood, 2008). Rock Lobster *Jasus lalandii*, which has recently invaded the Kogelberg region from the west coast, is the most important carnivore within kelp forests.



FIGURE 15. KELP COVERED ROCKY REEFS OFF ROOIELS.

3.4.7 Subtidal soft sediments

Biota of sand beaches and subtidal soft sediments in Kogelberg have also not been studied in any detail but those in False Bay which are like to be very similar have been studied and described by Morgans (1962) and Field (1971). Intertidal sandy beach habitats are widely considered to represent an extension of the much larger subtidal soft

sediments habitat into the intertidal zone. The fact that many species are common to these two habitats bears out this conjecture. Common species in soft sediment immediate below the high water mark in the surf zone include the plough whelk *Bulia digitalis*, the sand mussels *Schizodesma spegleri* and *Donax serra*, and the surf mysids *Gastrosaccus psammodytes*, *Mysidopsis similes* and *Acanthomysis indica*, amphipods *Urothoe grimaldii* and *Perioculodes longimanus*, and the clam *Tellini gilchristi*. The composition of the macroinfauna changes beyond the surf zone, at the edge of the study area, species such as the plough whelk *Bullia laevissima*, the hermit crab *Diogenes extricates*, becoming more common in this area.

Fish species common in the surf zone off sandy beaches in False Bay (and presumably the Kogelberg coast as well) include the silverside *Atherina breviceps*, mullet *Liza richardsonii*, white stumpnose *Rhabdosargus globiceps*, blacktail *Diplodus sargus*, the False Bay klipvis *Clinus latipennis*, and sand steenbras *Lithognathus mormyrus*.

3.4.8 Estuaries

Estuaries constitute the region where fresh water from terrestrial drainage meets and mixes with sea water (Allanson & Baird 1999, Kennish 2002). Freshwater inflow into estuaries determines salinity profiles, controls the build up of sediments and supplies nutrients to primary consumers (Turpie *et al.* 2002). Estuaries are highly variable in terms of geology, hydrography, salinity and sedimentation and they may show considerable spatial and temporal variations in their physico-chemical parameters (Allanson & Baird 1999, Kennish 2002). Six estuaries fall within the Kogelberg reserve, namely the Steenbras, Rooiels, Buffels, Palmiet, Kleinmond and Bot (Figure 60), of which the Bot/Kleinmond can be considered as a single estuarine system. The Steenbras and the Palmiet Estuaries are permanently open systems, the Rooiels and the Buffels are temporarily open-closed systems (TOC), while the Bot/Kleinmond Estuary is an estuarine lake system which is usually closed. The characteristics of these classes of estuaries as defined by Whitfield (1992) are summarized below (Table 6).

TABLE 6. PHYSICAL CLASSIFICATION OF PERMANENTLY OPEN, TOC AND ESTUARINE LAKE ESTUARY SYSTEMS

Type	Tidal Prism	Mixing Process	Average Salinity	Examples
Permanently Open	Moderate ($1-10 \times 10^6 \text{ m}^3$)	Tidal/ Riverine	10->35	Steenbras, Palmiet
Estuarine Lake	Negligible ($<0.1 \times 10^6 \text{ m}^3$)	Wind	1->35	Bot/Kleinmond
Temporarily Open/Closed	Absent	Wind	1->35	Buffels Rooiels

Estuaries are typically shallow and sheltered habitats that provide a refuge from the strong waves action that characterises the South African coastline, making them ideal nursery habitats for juvenile fish species, many of which are of commercial importance (Wallace 1984). While estuaries are widely accepted as being among the most biologically productive ecosystems on Earth (Kennish 2002), the estuaries of the study area are fed by oligotrophic (nutrient-poor) rivers, and are thus not particularly productive. The Bot/Kleinmond is an exception, on account of its size and the long residence time of the water that flows into it. The importance of this system is outlined below.

The **Steenbras Estuary** is a small permanently-open system that is situated at the western border of the Kogelberg Reserve. It has a sizeable catchment ($\sim 70 \text{ km}^2$) in which there are two large dams; the Upper and Lower Steenbras dams. The estuary has been described as a 'fjord-like' valley that is incised into a rocky coastal strip (Heineken *et al.* 1982). It has steep cliff-like sides and waves penetrate 350m in from the mouth to the river inlet. The wave energy in the mouth is thus very high; approximately 30% higher than the average for other False Bay estuaries, and it has earned the reputation of a dangerous fishing area. Little information is available on the flora and fauna within this system (Heineken *et al.* 1982).

The **Rooiels Estuary** is a small system and almost the entire catchment area falls within the Hottentots Holland Mountain Catchment Area. The estuary is situated on the northern side of the small coastal village of Rooiels. The broad flat sandbar at the mouth keeps the estuary closed for much of the year. Winter floods scour away this sandbar and fill the estuary with freshwater to the extent that it assumes the character of a river mouth. During summer, the rate of evaporation exceeds that of water inflow and often produces hyper-saline conditions in the estuary (Heineken 1982). The limited connection to the sea and the brown tannin-rich (acidic) water render the Rooiels a relatively unproductive system. The estuary however supports several species of invertebrates (periwinkles, whelks, mussels and sand prawns), and is home to a number of estuary-dependant and estuary-associated fish including steenbras *Lithognathus* sp., gobies *Gobiidae* and mullet *Mugilidae*. The estuary does not have a rich avifauna, but is visited by several species of cormorants, terns and gulls (Heineken 1982).

The **Buffels Estuary** is situated adjacent to Pringle Bay and is a small but healthy system with a catchment area of 23 km^2 and a river length of 8 km. The estuary is a temporarily open/closed system, with a sand bar blocking access to the sea for much of the year. During heavy rains the estuarine lagoon extends parallel to the Pringle Bay beach and opens at its southern end (Heineken *et al.* 1982). Breaching, however, frequently occurs at the northern end of the lagoon when the estuary is inundated with fresh water. During the hot dry summer, the backshore lagoon retreats and both mouths close. The greatest impact to the system has been the construction of the Buffels River Dam, which has reduced freshwater runoff to the estuary and hence mouth dynamics and water chemistry. Other threats to the system include erosion and trampling caused by people walking to and from the lagoon from properties immediately above it. The lagoon is important for the aesthetic appeal of Pringle Bay, and is a popular recreational area for bathers. It is important to conserve its ecological condition, as maintenance of its attributes is essential for recreation use (Heineken *et al.* 1982).

The **Palmiet Estuary** is situated between the coastal towns of Betty's Bay and Kleinmond. The river is 72.5 km long and the estuary itself is small with a narrow channel providing a connection to the sea (Harrison 1999). The position of the mouth is fixed by a rocky bank on the west, and is open for the majority of the year except in the dry summer months when it becomes more constricted. Heavy winter rainfall is important for flushing sediments from the system that have accumulated during the dry months (Harrison 1999). The Palmiet is one of the few estuaries within the south-western Cape region that is predominantly open and receives a large input of freshwater. It is thus considered to provide an essential nursery habitat for both resident estuarine and migratory estuarine-dependant marine species. A total of 19 fish species have been recorded in the Palmiet with *Liza richardsonii* (an estuarine-dependant marine species) being the most dominant (Harrison 1999).

The **Kleinmond Estuary** is a small system situated near the town of Kleinmond. It receives freshwater from two sources - the Lamloch Stream and the Isaacs River. The Isaacs River flows directly into the estuary while the Lamloch stream flows through a marsh dominated by the reed *Phragmites* before it reaches the estuary. The **Bot Estuary** is a large estuarine lake system covering over 1500 ha and has a catchment area of over 800 km² (Heydorn & Grindley 1982). The Bot estuary is closed for the majority of the year and rarely breaches. However, it often spills over into the Kleinmond Estuary, which breaches more often. Water from the Bot flows into a triangular coastal lake (6 x 2 km) which is connected to the Kleinmond Estuary by a shallow arm that runs through Lamloch swamp. The two estuaries can thus be considered together as one estuarine system.

The **Bot/Kleinmond estuarine system** (~1700 ha) is more productive than the other estuaries along the coast and is rich in plant, invertebrate, fish and bird life. Fish are dominated by the estuarine roundherring *Atherina breviceps* and a number of estuary-dependant marine species. The Bot Estuary is recognized as being an extremely important nursery ground for estuarine dependant and associated fish within the south-western Cape, and is vital to 16 recreationally and commercially important species such as white steenbras *Lithognathus lithognathus*, leervis *Lichia amia* and dusky kob *Argyrosomus japonicus* (van Niekerk *et al.* 2005). It is also home to the klipvis, *Clinus spatulatus*, which is endemic to the Bot and Klein estuaries (Whitfield 1998). The Bot/Kleinmond system is also inhabited by high numbers of birds, sometimes supporting up to 50% of the Red-knobbed Coot population of the coastal region between the Olifants River and the Great Brak (Koop 1982). A number of endangered waterbird species such as the White Pelican, Greater and Lesser Flamingos and the Caspian Tern occur on the system, and it is considered one of the ten top birding spots in the south-western Cape for herons, sandpipers and wading birds (Johns & Johns 2001). The Bot has also been ranked in the top ten estuaries in South Africa in terms of its conservation importance for the preservation of estuarine biodiversity (Turpie *et al.* 2002). Due to the dependence of endangered species on this system it qualifies for the inclusion in the Ramsar Convention of Wetlands of International Importance (Johns & Johns 2001).



FIGURE 16. THE STEENBRAS, ROOIELS, BUFFELS (Oos), PALMIET, KLEINMOND AND BOT ESTUARIES ARE ALL LOCATED IN OR ON THE BORDER ON THE KOGELBERG BIOSPHERE RESERVE.

Prolonged mouth closure as a result of anthropogenic interference has resulted in the Bot Estuary shifting towards freshwater conditions enabling freshwater species such as *Oreochromis mossambicus* and *Cyprinus carpio* to encroach into the system. There has been considerable debate in the past as to whether the Bot Estuary is naturally or artificially progressing towards a freshwater state, however recent research indicates that the progression is not natural (van Niekerk *et al.* 2005). The mouth dynamics and freshwater requirements for the Bot Estuary are described in more detail in §7.4.

The Bot Estuary is under considerable pressure from development and reduced freshwater flow. A conservancy has been formed by the landowners in the area with the aim to eradicate alien plants from the catchment and thus increase runoff.

3.5 IMPORTANT SPECIES AND POPULATIONS

Among the large number of seaweed species found on the coast, the most important is *Ecklonia maxima* (sea bamboo) which forms the large kelp beds that occur in some areas. Not only is it important as a utilised species, but it plays an important role in ecosystem functioning within the south-western cape as described in §3.4.4. Data on kelp biomass along the South African coastline is available in several theses and reports, but none of these consider kelp biomass specifically within the boundaries Kogelberg study site. Tarr (1993) estimated biomass of kelp in Concession Area 8, which extends from Macassar Beach in False Bay to the Bot River Estuary. The Kogelberg coastline occupies the majority of this Concession Area, and hence his data can be used to give estimates of the approximate kelp biomass in the Kogelberg. The average kelp biomass values (averaged over all kelp species) within the above mentioned Concession Area is estimated to be 6.35 kg/m² or 28 796 tonnes. A total of 8 316 tonnes of kelp is found within the Betty's Bay Marine Protected Area, which equates to 40.6% of the kelp resources found in Concession Area 8 (Tarr 1993 in Rand 2006). On a larger scale, the kelp resources found within the Concession Area 8 constitute approximately 22.4% of the total kelp biomass (in tonnes) along the South African coastline (Tarr 1993 in Rand 2006). Kelp within the Bettys Bay MPA falls under the Stony Point Exclusion Zone and has been excluded, for conservation reasons, from concession areas and harvesting permits.

There is considerable variability in kelp biomass values reported in the literature, which may be due to the seasonality in kelp bed biomass at different sites (Rand 2006). Kelp biomass can change by up to 50% with season, and density of kelp will vary according to substratum topography, presence of sand, and grazers (Rand 2006). Within the Kogelberg there are kelp beds located off Stony Point, opposite the town of Betty's Bay, near the mouth of the Palmiet estuary, and at the eastern extremity of the town of Kleinmond. Fairly large beds can be found in the vicinity of Cape Hangklip and Holbaai point (Figure 17). Kelp represents the primary habitat for the South African abalone, *Haliotis midae*, and mapping of kelp forests gives an indication of available habitat for abalone (Tarr 1993). For this reason, kelp coverage should be an important aspect when considering the expansion of the Bettys Bay MPA.

The abalone *Haliotis midae* (Figure 18) is a slow growing gastropod that occurs in this region has received the most attention of all invertebrates within the southern African coastline, with its exploitation and conservation being a heated topic. Abalone lives on nearshore rocky substrates, on reefs and between crevices. They are broadcast spawners, releasing their gametes into the water column where they are fertilized. The fertilized eggs hatch into trochophore larvae after approximately 24 hours. These larvae are active swimmers and can be dispersed over large distances (Figure 18). At the end of the larval stage (3-6 days) the larvae settle preferentially on encrusting coralline substrata. Here they feed on benthic diatoms and bacteria, a diet which makes them turn a light pink colour and thus makes them well camouflaged against their coralline background. As they grow their diet changes and they darken in colour, which makes them more visible (Day & Branch 2000). The abalone are at their most vulnerable at this time, as they lack both a protective shell as well as camouflage. This is the point at which the 'recruit' stage is considered to end and the 'juvenile' stage begins (average shell length 3 – 35 mm) (Day & Branch 2000). In order to seek shelter from predators, most abalone species creep between rocks and crevices, however, the South African *Haliotis midae* is unique in that it first seeks shelter beneath the spines of the adult sea

urchins *Parechinus angulosa* before moving into crevices in the rock (Day & Branch 2000). Abalone continue to grow from this time at a rate of 3-5 cm per year, depending on water conditions and food availability (adult abalone typically feed on the kelp *Eklonia maxima* until they reach sexual maturity. Sexual maturity is normally only attained at approximate 8 years and it takes a further four years for the shells to reach a minimum diameter of 115 mm, the size suitable for harvesting (Bürgener 2008). This slow rate of growth makes the abalone population very vulnerable to the overexploitation of sexually mature adults needed to replenish the population.

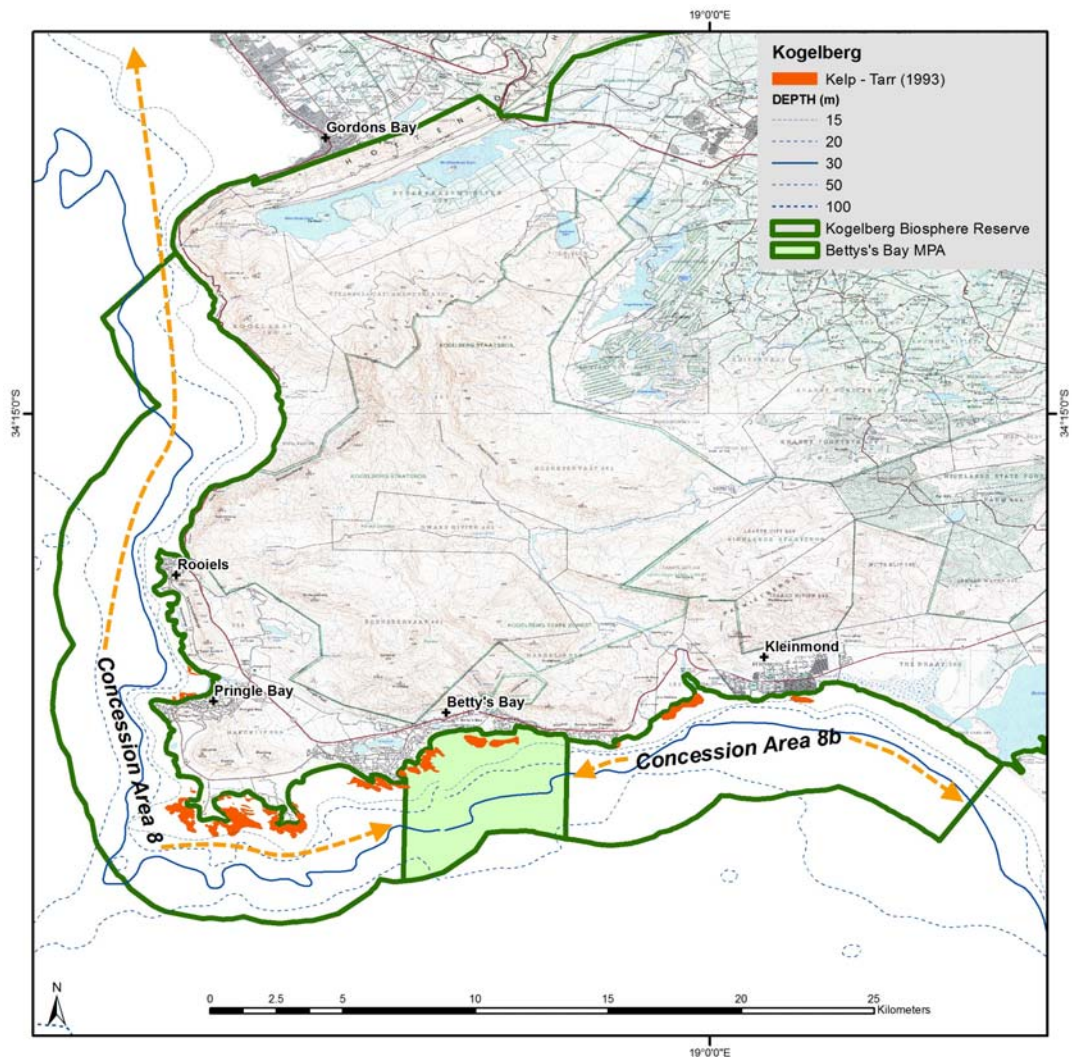


FIGURE 17. LOCATION OF KELP CONCESSION AREAS AND KELP BEDS OFF THE KOGELBERG COAST. (DATA FROM MCM AND TARR (1993))

Apart from humans, abalone stocks in South Africa have also been affected by the recent invasion of the west coast rock lobster *Jasus lalandii* from the west coast. An insatiable predator, the rock lobsters feed upon sea urchins and juvenile abalone which has led to a crash in the urchin population. Since very small abalone are no longer able to seek shelter beneath the prickly urchins, abalone recruitment has declined precipitously. The simultaneous boom in abalone poaching and invasion by rock lobster has decimated abalone numbers on the Kogelberg coast (du Toit & Attwood 2008).

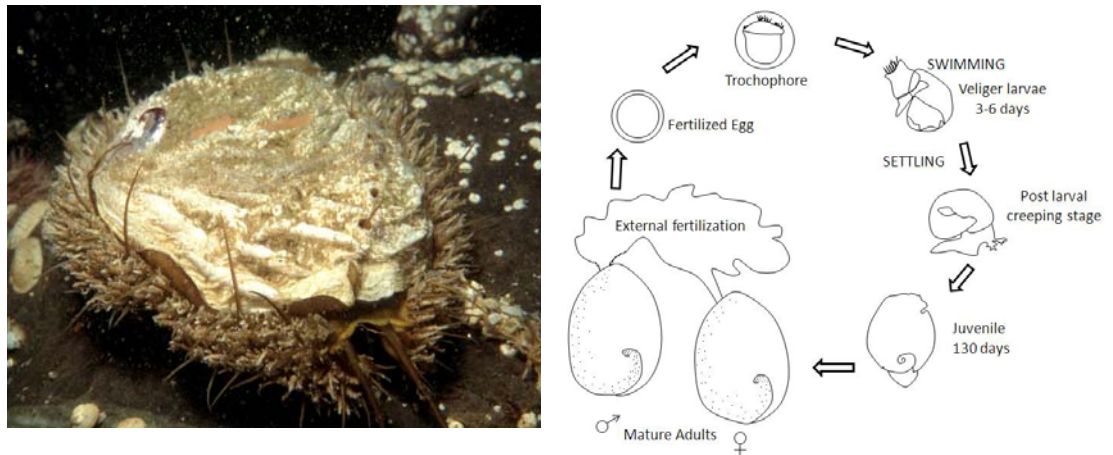


FIGURE 18. ABALONE *HALIOTIS MIDAE* AND ITS LIFE CYCLE

Populations within the sheltered lagoon-like conditions in a large portion of the Betty's Bay MPA are now particularly important, given the status of stocks outside the MPA. This reef has historically been home to some of the least disturbed populations of abalone. Research conducted by DEAT:MCM revealed that larval distribution potential at the seaward edge of the Dawidskraal Kelp Beds is very high, extending as far afield as Quoin Point and Simonstown (du Toit & Attwood 2008). The area is thus important for the distribution of abalone larvae, and probably also for the export of larvae of many other marine species.

A series of diving surveys were conducted by Tarr (1993) in the late 1980s in order to estimate the stock abundance of *Haliotis midae* in the south-western cape. The study area extended from Robben Island to Quoin Point and included eight sampling sites (from west to east): Robben Island, Hangklip, Betty's Bay, Mudge Point, Danger Point, Pearly Beach and Buffelsjags. With the exceptions of Betty's Bay and Robben Island, these sites represented the major fishing grounds at the time. The aims of the study were to assess whether the stock showed any signs of overfishing when compared to protected sites. The study revealed that abalone was more abundant in shallow waters (0-5 m) than in deeper waters (5-10m), and that density was inversely related to depth. Tarr (1993) also found that the majority of the abalone population in Betty's Bay were found in kelp forests, and that depth and kelp coverage are both important factors that influence abalone density and distribution. Betty's Bay was identified as one of the most productive areas of the coast, and had been closed to both commercial and recreational fishing for 14 years prior to the period when the survey was conducted (Tarr 1993). The study found that in 1980 the populations of abalone within Betty's Bay represented a healthy 'natural population', with 85% (0-5m depth) and 97% (5-10m depth) of the population biomass being above the minimum legal size (MLS). A 'top heavy' population structure of this kind is characteristic of the longevity and low mortality of adult abalone, and indicates that they were being afforded adequate protection by the reserve. Poaching within the Bettys Bay Reserve and the surrounding areas has since depleted the natural populations of abalone, as is described in more detail in §5.2.3. It is clear from Table 7 that historically Bettys Bay represents an important refuge for abalone within the south-western-cape coastline (Tar 1993). The reserve itself and adjacent kelp forests provide the necessary shelter, food and topography required for the establishment of healthy abalone populations. However, more recent abundance/biomass data needs to be obtained in order to assess what

percentage of the south-western cape abalone population currently occurs within the Bettys Bay MPA and the greater Kogelberg.

TABLE 7 AVERAGE ABALONE BIOMASS AT 0-5M DEPTH IN KG/600 M² TRANSECT FOR VARIOUS STUDY AREAS IN THE SOUTH-WESTERN CAPE (TAKEN FROM TARR 1993)

Coastal region	Biomass (kg/600 m ² transect)	% Legal Biomass
Robben Island 1985	306	83
Hangklip 1983	59	47
Betty's Bay 1980	268	85
Mudge Point 1985	61	36
Danger point 1982	101	32
Dyer Island 1984	178	51
Pearly Beach 1987	72	58
Buffeljags 1986	61	69

While the area does not support important populations of any Red Data-listed fish, several important fishery species do occur and are harvested in the region. These include snoek *Thyrsites atun* silver kob *Argyrosomus inodorus*, elf *Pomatomus saltatrix*, geelbek *Atractoscion aquidens*, Hottentot *Pachymetopon blochii*, blue hottentot *Pachymetopon aeneum* roman *Chrysoblephus lacticeps*, yellowtail *Seriola lalandi* (rare), sharks, galjoen *Dichistius capensis*, white steenbras *Lithognathus lithognathus* and harder *Liza richardsonii* (du Toit & Attwood, 2008). Although the Kogelberg area is not of particular significance in the life histories of the important migratory (e.g. geelbek, white steenbras) or nomadic (e.g. snoek, yellowtail) linefish species which are widely distributed along South Africa's coastline, aggregations of two these species, (that are targeted by linefishers) do occur in the region. Geelbek spawn in southern KZN in spring and juvenile nursery grounds are predominately in the eastern and southern Cape, whilst both adults and sub adults are found throughout the western and eastern Cape during the summer months (Griffiths and Hecht 1995). The kelp beds in the Cape Hanglip- Betty's Bay area have long been acknowledged as good geelbek fishing grounds and this area does appear to hold concentrations of this species particularly during strong south east winds that cause cold, clear water to upwell along the adjacent coastal stretches. Snoek spawn throughout their distributional range in deeper waters offshore (200-400m), but females frequently move inshore and aggregate to feed in between batch spawning events (Griffiths 2002). The snoek fishing grounds offshore of Kleinmond represent one of these inshore feeding areas for this important commercial linefish species.

Red Data Book coastal birds that occur in the area include the African Penguin *Spheniscus demersus* (listed as vulnerable in 2006), the Bank Cormorant *Phalacrocorax neglectus* and the African Black Oystercatcher *Haematopus moquini* (listed as near threatened in 2006).

Stony Point is one of only two mainland breeding colonies for African Penguins and is important for penguin conservation, as well as for education. African Penguins arrived at the site in 1982 and there were about 40 nests in 1986. The population is thought to have come from Dyer Island and increased at a rate of 10.4 % between 1992 and 2002, almost doubling over this ten year period (du Toit *et al.* 2009). The number of breeding pairs nesting in the Stony Point Reserve has increased dramatically from

1982, when only one nest was recorded, to 2008 when 310 nests were recorded (Figure 19). The percentage breeding pairs of African Penguins in Stony Point Reserve comprises 1.36% of the total population in South Africa. This has increased steadily from 0.29% in 2003, and it is evident that Stony Point is of growing importance to the South African population of African Penguins (Figure 20) (MCM Unpublished data). Threats to these birds at Stony Point include predation by leopards, Water Mongoose and Large spotted Genet. A fence and walkway have been constructed through the colony to reduce the disturbance caused by people, and a small fee is charged for visitor entry. A substantial number of birds do however nest outside the fenced area and are vulnerable to attacks by dogs. Plans are thus being made to extend the protected area (du Toit *et al.* 2009).

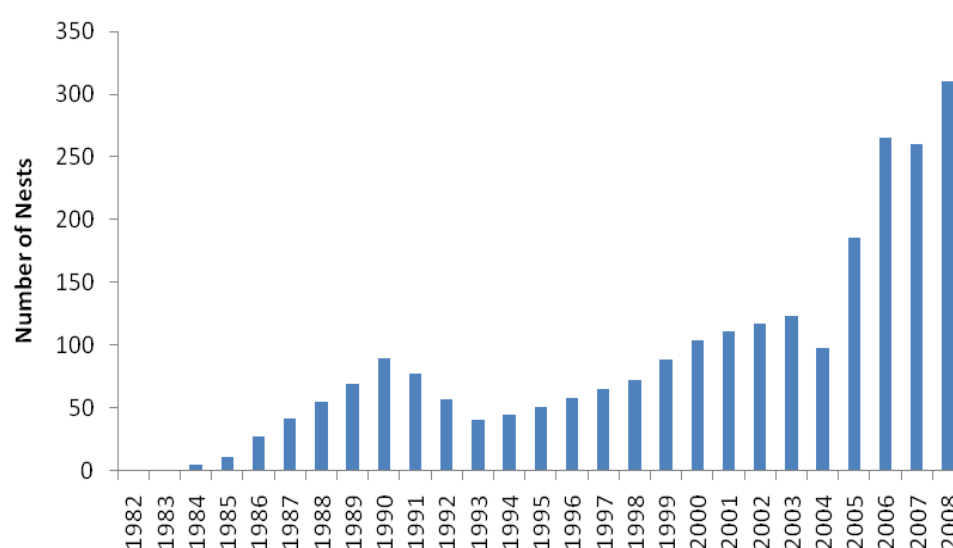


FIGURE 19 NUMBER OF AFRICAN PENGUIN NESTS RECORDED AT STONY POINT PENGUIN COLONY FROM 1983 – 2008 (MCM UNPUBLISHED DATA)

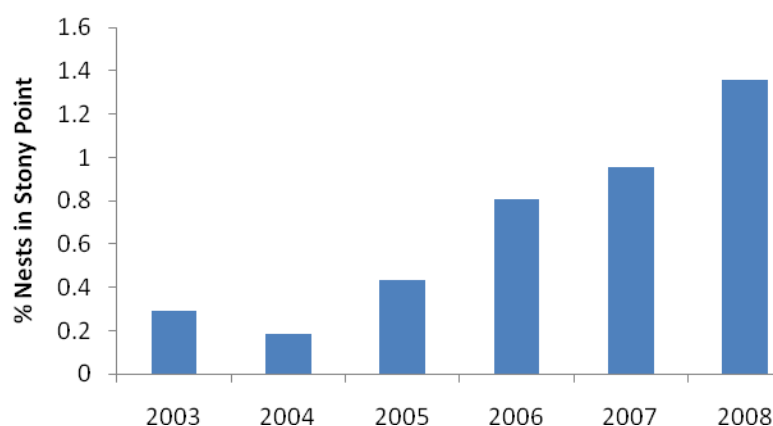


FIGURE 20 PERCENTAGE OF AFRICAN PENGUIN BREEDING PAIRS WITHIN STONY POINT RELATIVE TO ALL BREEDING PAIRS COUNTED IN SOUTH AFRICA, FROM 2003 – 2008 (MCM UNPUBLISHED DATA)



FIGURE 21. THE VULNERABLE AFRICAN PENGUIN, BANK CORMORANT AND NEAR-THREATENED CAPE CORMORANT

The African Black Oystercatcher has a breeding range that extends from Lüderitz, southern Namibia to the Inhlahlani River mouth near Port Edward in Southern KwaZulu Natal. It is an exclusively coastal species with a relatively small population size. The African Black Oystercatcher is highly vulnerable to human disturbances such as destruction of nests by walkers, off road vehicles and predation of birds and chicks by uncontrolled dogs. It is also unfortunate that the breeding season coincides with the summer holidays which means that the eggs and chicks are threatened by beach users (Underhill 2003). Indirect effects of human disturbance include the death of chicks at unattended nests, and drowning or disorientation of chicks during a disturbance (Loewenthal 2007). Breeding success is thus often greater within protected areas than outside protected areas (Loewenthal 2007). Disturbance is likely to increase as the number of people using the coastline grows, and improved protection may be required in sensitive nesting sites (See §7.3.1 for more details on protection of shore birds in the Betty's Bay MPA). Unfortunately no reliable long term bird counts are available for African Oystercatchers on the Kogelberg coast (Les Underhill, ADU, pers. comm.). However, research on a larger scale indicates that Oystercatcher populations within the Western Cape have increased dramatically over the last two decades (Loewenthal 2007). According to Les Underhill (Avian Demography Unit, UCT), Oystercatcher populations have increased notable within the Kogelberg over the last 20 years, to the point where breeding pairs have to compete with each other for available nesting space. Given the small size of the Kogelberg and the large distribution range and mobility of the species, however, it is difficult to estimate what percentage of the population is offered protection by the Bettys Bay MPA.

Recent African Black Oystercatcher counts conducted by Richard Starke, a resident within the Kogelberg, indicated that there are 8 breeding pairs in the Bettys Bay MPA, and 5 juvenile birds at the western end of the marine reserve (adjacent to the Penguin colony). There are estimated to be 10 – 13 breeding pairs of African Black Oystercatchers between Betty's Bay MPA and Rooiels, and 4-5 birds at the Palmiet River mouth. This would total to approximately 52 birds within a 30 km stretch of the

Kogelberg coast. Between 1997 and 2003 the national population of African Black Oystercatchers was estimated to be 6 670 birds, with the Western Cape being the most important region in terms of the global population (representing approximately 37 % of the global population) (Loewenthal 2007). It is interesting to note that although the population of Oystercatchers has increased significantly from 1979 to 2003, the percentage of the population occurring within the Western Cape has remained relatively constant (54% of national population) (Loewenthal 2007). The Bettys Bay MPA is currently home to approximately 0.39% of the national population of African Oystercatchers and 0.57% of the Western Cape population.

TABLE 8. REGIONAL SUMMARY OF NUMBERS OF AFRICAN OYSTERCATCHERS BASED ON HISTORICAL AND RECENT SURVEYS (DATA FROM LOEWENTHAL 2007)

Location	1979/1980	1997/2003
Namibia	116	1297
Northern Cape	126	79
Western Cape	2495	3644
Eastern Cape	778	1607
Former Transkei	23	43
Total	4591	6670

The Bank Cormorant, *Phalacrocorax neglectus*, is endemic to South Africa and Namibia and is classed as 'Vulnerable' largely due to its small population size and the fact that most of the birds are found at a few breeding locations (Underhill 2003). Two surveys of the population size of Bank Cormorants have been made, the first between 1978/1980 and the second between 1995/1997. The total number of active nest sites counted in 1995/1997 was 4 888, which was significantly lower than the 8 672 active nests that were counted in 1978/1980. This population decline of more than 45% over a 17 year period has been attributed to several causes, but is mainly thought to be due to human disturbance and shortage of food. Between the two survey periods a number of nesting sites were deserted. A new colony was, however, noted at Stony Point, Betty's Bay in the early 1980s. The Stony Point colony formed shortly after the African Penguin colony was fenced off, and is thought to have attracted the Bank Cormorants due to the near-elimination of human disturbance (Underhill 2003). Surveys conducted by the African Demography Unit (Underhill and Copper 1984), indicate that in 1984, approximately 10.03 % of the national population of Bank Cormorants were recorded between Bettys Bay and Pringle Bay (Underhill and Copper 1984). The distribution of the Bank Cormorant largely coincides with the distribution of the giant kelp, *Ecklonia maxima*, which is its main feeding habitat.

Other important shore bird habitats within the Kogelberg include the Bot Estuary and adjacent wetland, which has been listed as a Ramsar site and is of great importance to a number of endangered waterbird species (see §3.4.8). The Betty's Bay MPA also includes a short (200 m) section of coastline spanning the mouth of the Dawidskraal River. At the point at which the river enters the sea it spills into a series of small rock pools, which attracts a plethora of bird life. Shore bird populations at this point are currently under threat from walkers and their dogs, fishermen who occupy the small roosting area, poachers who trample the area at night and onlookers who disturb and disorientate chicks (Richard Starke, pers. comm.). It has been proposed that a bird sanctuary be established at this site (tentatively called the Harold Porter Shore Bird

Sanctuary) for the purpose of protecting the large numbers of shore birds that congregate here from human disturbance.

Southern right whales *Eubaelana australis* migrate to the south-western cape coast to escape the Antarctic winter, and the Bryde's whale *Balaenoptera edeni* is a resident. Humpbacks *Megaptera novaeangliae* and bottlenosed dolphins *Tursiopa truncatus* can also be viewed from the coast. Several tour operators run boat-based whale watching trips that extend into the Kogelberg coastal zone. The numbers of whale sightings that are made within the Kogelberg are considerable and are discussed in more detail in §5.7.5.

Although the sandy shores are the sparsest of habitats in terms of species richness and diversity, the extensive dune communities within the Kogelberg support a variety of plant life from the pioneer grasses that stabilize the sands to the climax vegetation of scrub and milkwood groves. Notable flowering plants include the orchid *Bonatea speciosa* which is widespread in the dense dune scrub (Johns & Johns 2001), and the striking bright pink *Gladiolus carmineus* which grows within the low mat of vegetation just above the high water mark.

3.6 CURRENT STATE OF THE COAST

This section provides a brief overview of the status of marine resource stocks and coastal habitats. The main threats to different habitats are summarised in Table 9. The issues/threats highlighted in this section are explored in more detail in the following sections.

3.6.1 Coastal habitat integrity

Uncontrolled development in the coastal zone and below the high water mark in the country as a whole has resulted in loss of important habitat and supporting ecosystems (e.g. nursery or feeding grounds for marine species), which threatens the livelihoods of many species. These impacts are relatively rare in the Kogelberg area, and have been mainly confined to the village areas. On the whole, there is generally a sizeable buffer of natural vegetation between the village developments and the coast, but dunes have been encroached upon in certain areas, and have been artificially stabilised. Human disturbance of important breeding areas has been contained through management. There has been some sand mining in the Kogelberg, but not on a significant scale. Localised contamination occurs around the slipways and harbours. In general, coastal habitats in the study area are in good shape. The most important problem appears to be the prevalence of alien invasive species in some areas, particularly dune areas.

3.6.2 Estuarine health

Although there are methods to assess the state of estuaries on an indexed scale, none have been properly assessed in the study area. Nevertheless broadscale assessments made in the past, coupled with research findings on some of the systems, have provided a fair idea of their condition. The Rooiels, Buffels and Palmiet are considered to be in good to excellent condition, while the Steenbras and Bot/Kleinmond are in a fair condition. Both of the latter have suffered from reduction in freshwater inflows due to dams, direct abstraction and the invasion of catchment areas by alien

vegetation. In the case of the Bot/Kleinmond, this has had an impact on mouth condition. The system now closes more frequently and for longer periods than it ever did in the past, and some believe that the pattern of artificial breaching that takes place to compensate for loss of natural breaching is exacerbating the problems. In addition, water quality in the Kleinmond estuary has deteriorated markedly as a result of urban pollution inputs, and this has also led to the loss of water quality for recreation in the adjacent marine area.

TABLE 9. THREATS TO THE COASTAL HABITATS ON THE KOGELEBERG COAST AND THEIR BIOTA

Habitat	Threat
Sandy beaches	Artificial stabilization of foredunes or removal of foredunes to prevent sand inundation in houses. Alien invasive plants Sand mining Pollution inputs from nearby towns and coastal developments
Rocky shores	Over exploitation of resources Damage to intertidal and subtidal life by bait collection and trampling Litter (e.g. fishing tackle, bait, plastic, glass, cans), posing a direct threat to marine life Pollution inputs from nearby towns and coastal developments
Sub-tidal Reefs	Overexploitation of resources Entanglement of organisms in discarded fishing gear Pollution inputs from nearby towns and coastal developments
Estuaries	Freshwater abstraction Inappropriate breaching Siltation from catchment erosion Erosion of banks due to trampling, destabilization of dunes Pollution inputs from rivers, nearby towns and coastal developments Overexploitation Habitat destruction associated with urban development

3.6.3 Marine living resources

Many species have been over exploited within the Kogelberg area, perhaps the most famous being the abalone *Haliotis midae*. The Betty's Bay marine reserve, which forms the core of the Kogelberg Marine Park, has provided some protection to the abalone, and was home to the least disturbed population in recent years. However, as stocks crashed elsewhere, poachers started to target Betty's Bay MPA, and this together with the encroachment of the predatory rock lobster has led to substantial declines of abalone within this MPA and much of the Kogelberg (Figure 22). Prior to invasion by poachers, the Betty's Bay MPA would have played an important role in sustaining abalone stocks in other areas, through the export of eggs, large and juvenile abalone, especially given that abundance of adults in this area was much higher than the adjacent exploited areas (Figure 22). However, once abalone stocks in the MPA had been decimated along with the surrounding areas, the support role played by the MPA would also have been lost.

Despite this, the loss of its abalone stocks, Bettys Bay MPA is still considered to play an important role in the conservation of the species as well as provide a platform for scientific research (du Toit & Attwood 2008). Increased conservation efforts in the region could play a role reducing ongoing poaching of abalone provided that these

efforts included an increase in conservation staff working in the region. Greater presence of conservation and enforcement personnel would act as a real and perceived deterrent to poachers, whilst increased awareness of conservation amongst Kogelberg residents and visitors would increase the degree of community policing. Enlarging the Betty's Bay MPA, if effectively staffed and policed, would facilitate recovery of

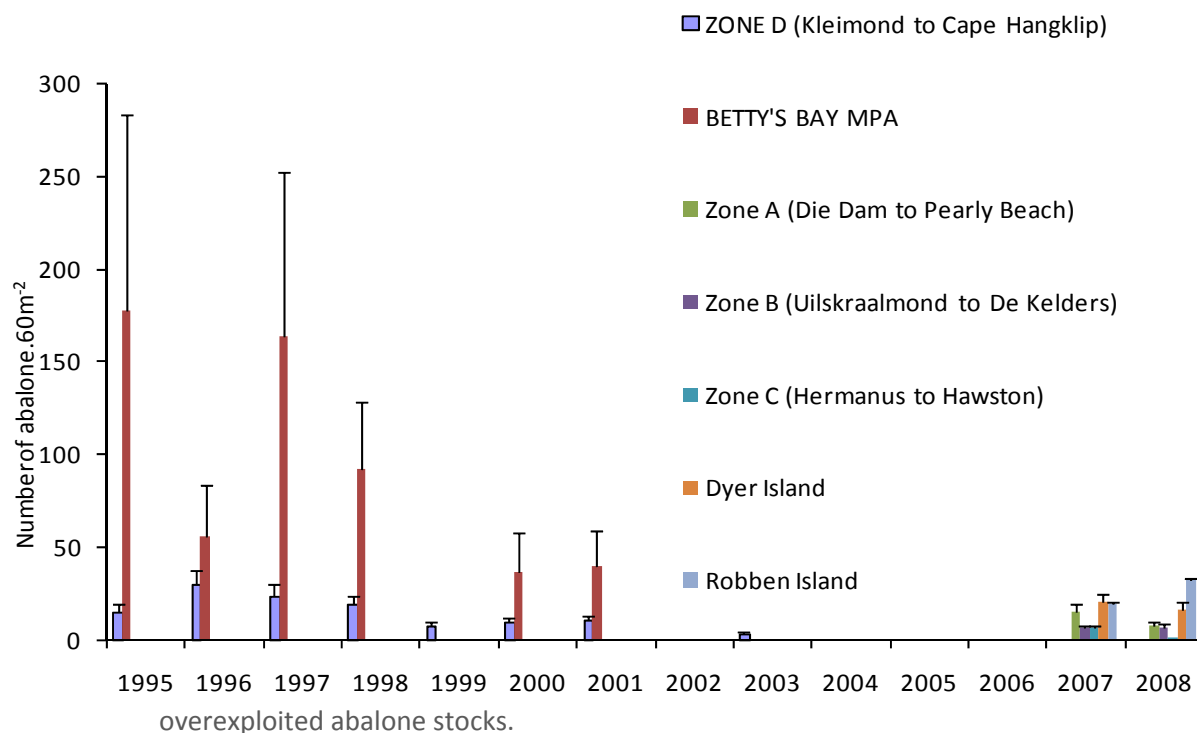


FIGURE 22. ABALONE DENSITY WITHIN THE KOGELBERG FISHING AREA (ZONE D, 1995-2008), THE BETTYS BAY MPA (1995-2003) AND IN THE OTHER ABALONE FISHING ZONES (2007-2008). DATA FROM MCM.



FIGURE 23. ANTI-POACHING SIGN AND ABALONE CONFISCATED FROM POACHERS OPERATING IN THE KOGELBERG BIOSPHERE RESERVE.

Long before the poaching of abalone became so common in the area, a number of predatory fish populations were already feeling the effects of overfishing (du Toit & Attwood, 2008). For more than a century, uncontrolled linefishing has taken place off the South African coast, and has led to the collapse of a number of important coastal and offshore fish populations. Geelbek and red steenbras are currently estimated to be at less 10% of their original pre-exploited biomass, with have little hope of recovery (Attwood & Farquhar 1999). Silver kob populations have collapsed with spawner-biomass-per-recruit being reduced to between 4.4 and 10.4 % of the original unfished population. Other linefish species that were once common in the Kogelberg area but have shown catch reductions of 70 to 100% in the latter part of the 20th century include the carpenter, chub mackerel, dageraad, roman and white steenbras (Attwood & Farquhar 1999, du Toit & Attwood 2008). Species such as white steenbras have been particularly hard hit by overfishing owing to their dependence on estuaries as nursery areas which have also been severely degraded in recent years. The decline in these predators has and will continue to bring about important changes in coastal and offshore ecosystems. Regrettably though, our poor state of knowledge regarding historic population sizes or the status of exploited species populations within MPAs in the country (likely to be similar to historic population densities) means that we do not fully understand the nature or implications of these changes.

Shore anglers still target many of the species mentioned above, and have recently expanded their focus to include sharks and rays mostly owing to the poor catches of the former species. Shark and ray species commonly targeted in the Kogelberg area include sevengill cowshark, smoothhound and spotted gully sharks. In general sharks are returned to the sea after capture, but mortalities are common even within these catch-and-release fisheries (du Toit & Attwood 2008).

Top predators such as penguins and cormorants have also been affected by overfishing within the Kogelberg as this results in food shortages for these species (du Toit & Attwood 2008). Oystercatchers feed on inter-tidal molluscs and nest in the costal zone, where human disturbance (trampling, crushing, movement, pets) is an important source of disturbance.

4 MARINE PROTECTED AREAS

It has been demonstrated conclusively over the last decade that traditional fishery management measures (e.g. size limits, bag limits, closed seasons) used in isolation have failed dismally in their efforts to limit the effects of exploitation, and appear powerless to halt further declines (see for example Plan Development Team 1990, Roberts and Polunin 1991, Ballantine 1995, Bohnsack and Ault 1996, Attwood *et al.* 1997). MPAs, however, used in conjunction with traditional management measures, offer some hope of being able to halt this trend and even help rebuild some depleted stocks. Reasons for this are numerous, and mostly relate to the benefits provided by MPAs. Some of these benefits are articulated here. Adults of exploited species within MPAs are able to reach full size and hence full reproductive potential. Production of offspring is thus greatly enhanced within an MPA and is often sufficient to restock nearby fishing grounds. Substantial numbers of fish are known to move out of MPAs into adjacent exploited areas, where they can be caught by fishermen. The spawn of protected fish and shellfish also drift out of MPAs and seed exploited areas where adults are scarce. MPAs also make enforcement easier. It is far easier to spot a transgressor fishing in an MPA than it is to enforce regulations such as size and bag limits across an entire fishing ground. There are no problems associated with the discarding of unwanted or illegal bycatch or the survival of fish that must be returned to the water. Complete information about complex ecosystem interactions is not necessary for MPA management as it is with bag limits or size limits – the assumption being that recruitment, growth and survival is maximized under natural conditions. All fisheries management has some degree of uncertainty and risk; it can fail because of inadequate scientific models, errors in the data, inadequate compliance, or ineffective management actions. MPAs also provide insurance against stock collapse – if other management measures fail, at least some populations are protected in reserves. MPAs also allow for the maintenance of genetic diversity of exploited stocks. They allow natural (non-fishery induced) selection forces to apply, so preventing a stock from losing productivity or increasing its susceptibility to fishing. This is in direct contrast with measures such as minimum size limits that actively select for smaller individuals and slower growth. Marine protected areas are also fair and equitable in that they prevent exploitation by all fishery sectors. No group is favoured at the expense of others, as is often the case with traditional management measures.

The World Conservation Union (IUCN) have proposed a goal of conserving 20% of the world's coastline by the turn of the century (IUCN 1992). This value is based on the result of fishery modeling studies which show that the risk of a fishery collapsing increases dramatically if spawner biomass (the mass of adult fish above the age of sexual maturity) falls below 25% of its unexploited value. It has been suggested however, that MPA coverage should be extended to 30% where fishery management in exploited areas is poor (Plan Development Team 1990). A single MPA on its own cannot hope to sustain marine communities in the face of natural and anthropogenic disturbances. However, a network of well managed MPAs can provide the basis for self-sustaining resilience in protected communities, with the capacity to seed exploited areas, provided that the principals of representivity, replication and size (combination of large and small protected areas) are observed.

There is only one MPA within the KBR, this being the Betty's Bay MPA. A brief description of its history and salient features is provided below. Proposed expansion of MPAs in the area is discussed under §8.2.4.

The MPA was originally proclaimed under its previous title as the H.F. Verwoerd Marine Reserve, under the Sea Fisheries Act (1973) in order to address the progressively declining trends in the availability of line-caught fish and to protect abalone *Haliotis Midiae* from over exploitation. The MPA was re-proclaimed in terms of the Marine Living Resources Act (1998) and in the process the name was changed to the Betty's Bay Marine Protected Area, in line with the new practice of naming MPAs after geographical features.

The MPA covers 5.5 km of coastline and encompasses the inshore marine environment between two beacons, the western one of which is situated on a rocky promontory at Stony Point and the eastern one, just to the east of Jock's Bay.

Marine habitats in the MPA comprise predominantly rocky shores with one stretch of sandy beach. The subtidal habitat comprises predominantly of reef, and kelp beds can be seen extending in patches far out to sea. The area was once very rich in abalone *Haliotis midae*, and the Bettys Bay MPA protected healthy stocks of this species until approximately 1996, when poaching operations thinned these populations. The area still holds abalone, but it is questionable whether these stocks are now self-sustaining.

Goals and Objectives of the Betty's Bay MPA as articulated in the Betty's Bay Management Plan (du Toit & Attwood) correspond with the over-arching goals associated with management of all Marine Protected Areas under jurisdiction of CapeNature, and include Biophysical, Socioeconomic, Governance Goals and Regulatory Objectives:

Biophysical Goals

1. To protect the marine and estuarine ecosystems that are representative of the south coast zone and to maintain biodiversity and ecological functioning in these ecosystems;
2. To protect depleted, endangered and endemic species and populations and to protect habitats which are important for the survival and revival of these species and populations;
3. To contribute towards the long-term viability of marine fisheries

Socioeconomic Goals

1. To promote non-consumptive, ecotourism opportunities;
2. To provide opportunities for marine ecological research and monitoring of environmental effects of human activities on marine ecosystems;
3. To facilitate the interpretation of marine ecosystems for the promotion of conservation among scholars and tourists;

Governance Goals

4. To reduce conflicts between competing users in the MPA and surrounding areas;
5. To ensure that appropriate and effective legal structures are developed for protecting the biodiversity of the MPA and the activities that benefit from it;
6. To fulfil South Africa's international commitment to marine protection in terms of international protocols and conventions;

Regulatory Objectives

1. Protection of fauna and flora or a particular species of fauna or flora and the physical features on which they depend;
2. To facilitate fishery management by protecting spawning stock, allowing stock recovery, enhancing stock abundance in adjacent areas, and providing pristine communities for research; or
3. To diminish any conflict that may arise from competing uses in that area.

5 USE OF THE COAST AND ITS RESOURCES

5.1 INTRODUCTION

Human utilization of coastal and marine resources can be broadly grouped under consumptive and non-consumptive activities. Consumptive utilization, including commercial, recreational, subsistence and illegal fishing activities, if poorly managed, is generally accepted to pose the greatest threats to marine biodiversity and ecosystem functioning. This chapter provides a descriptive account of each of these fishing sectors along the Kogelberg and Garden Route coasts, and includes information on temporal variation in catch, effort and catch-per-unit (CPUE) at the highest spatial resolution available. As far as possible data for the period 2000-2008 are provided and long-term trends where known, are mentioned. Spatial and temporal patterns in non-consumptive human use of the coastal zone, comprising a variety of aquatic and terrestrial recreational activities within the two study areas, are also described based on aerial surveys and interviews with key informants. A descriptive account of the status and trends of other threats to the coastal zone in the study areas, such as development, pollution, alien invasive organisms, mariculture and climate change is also provided.

5.2 COMMERCIAL FISHERIES

5.2.1 Traditional Line fishery

The origins of the South African line fishery can be traced back to the fishing activities of indigenous Khoi and European seafarers in the 1500s (Thompson 1913). After an initial slow start due to limited markets and strong restrictions on fishing by the Dutch colonists, the line fishery expanded rapidly with the removal of restrictions by the British in 1795 and by the mid-1800s the line fishery had become a thriving industry (Thompson 1913). Both fishing effort and line fish catches increased substantially after the Second World War as a result of the introduction of technological advances such as reliable combustion engines, nylon line and echo sounders as well as the construction of small boat harbours along the coast (DEAT 2005aa)

By the end of the 20th century approximately 3 000 fishing boats ranging from 3m dinghies to 15m deck boats carrying a total of around 3 000 crew were involved in the commercial line fishery (Griffiths 2000, Mann 2000). This multispecies fishery landed about 250 species, although only approximately 40 teleosts are actively targeted, of which 20 may be regarded as commercially important (Lamberth and Joubert 1999).

Despite the long history of the line fishery, both basic biological information on target species and a lack of a long-term catch and effort data series has severely hindered the management of the fishery (Griffiths 2000). Minimum size limits for selected species were introduced in 1940. At this time, the absence of life-history information about line fish species, however, meant that these regulations were determined on a fairly arbitrary basis and proved largely ineffective. Biological studies on a few important sparid species (hottentot *Pachymetepon blochii*, seventy-four *Polysteganus undulosus* and carpenter *Argyrozona argyrozona*) were undertaken in the 1960's (DEAT 2005aa). It was only in the 1980's and 1990's that life history studies and basic stock assessments were conducted for some of the more important line fish stocks, and these studies are still required for numerous line fish species (Mann 2000).



FIGURE 24. TRADITIONAL LINE-FISH CATCH.

A management framework that included a comprehensive suite of line fish regulations was introduced in 1985, including revised minimum size limits equal to sizes at maturity (when known), daily bag limits, closed seasons, commercial fishing bans for certain species and the capping of the commercial effort at the 1984 level. These regulations were updated in 1992, but due to the continued lack of life history and quantitative stock assessment data, were still largely based on perceived vulnerability to exploitation (e.g. some sparid species that exhibit life history characteristics such as slow growth, residency, late age at maturity, sex change were afforded higher levels of protection) (Mann 2000). Griffiths (2000) investigated long-term trends in the commercial linefishery in the Cape Province and analysed commercial catch and effort data for three periods during the 20th century: 1897-1906, 1927-1931 and 1986-1998. In spite of technological advances over this period, declines in catch rate indicative of severe overexploitation (i.e. 75-99%) were observed for many important line fish species during the 20th century. Scientific angler surveys and stock assessments carried out on several (supposedly resilient species) during the 1990's also revealed that the current line fish management framework was failing to provide adequate protection for linefish stocks (Attwood and Bennett 1995, Brouwer *et al.* 1997, Griffiths 1997a, b, Griffiths 2000, Griffiths *et al.* 1999, Mann *et al.* 1997, Sauer *et al.* 1997).

This led to the development of a new Line fish Management Protocol (LMP) that uses biological reference points for species for which quantitative stock assessment data exist, or trends in catch composition and catch rate for species where stock assessment data are lacking, to determine management actions (Griffiths *et al.* 1999). According to the LMP any stock estimated to have a spawner biomass to recruit ratio of less than 40% of the pristine ratio, or demonstrating a historical reduction in CPUE of more than 75% is to be regarded as overexploited (Griffiths *et al.* 1999). In these cases, the LMP requires that management action be implemented to reduce fishing mortality and to facilitate stock recovery towards target levels (40-50% of pristine).

CPUE data and stock assessments conducted since the mid 1980's have revealed that with the exception of fast growing species, such as snoek and yellowtail, most

commercially exploited traditional line fishes have been depleted to dangerously low levels (DEAT 2005aa). Apart from reduced productivity associated with stock depletion, other setbacks, such as ecosystem alteration, loss of genetic diversity and short term commercial extinction, were also anticipated (Griffiths 2000). In order to rebuild depleted line fish stocks (as required by the LMP) the Minister of Environmental affairs and Tourism declared an environmental emergency in the traditional line fishery in December 2000. In terms of the emergency, the Minister determined that a Total Allowable Effort (TAE) of no more than 450 vessels and 3 450 persons may fish commercially for line fish (DEAT 2005aa). Revised bag and size limits for commercial and recreational line fishers were implemented in 2005 (Government Gazette No. 27453, 6 April 2005). The commercial line fishery was split into three regional management zones (Zone A = Port Nolloth to Cape Infanta, Zone B = Cape Infanta- Port St Johns and Zone C =KwaZulu Natal), restricting the movement of vessels from one region to the next with the 2006-2013 long-term rights allocation. The TAE remained at 450 vessels and 3 450 crew with the majority (65 %) of permits issued in Zone A, 23.5 % issued in Zone B and 11.5 % issued for Zone C (KZN) (MCM 2006).

Since 1985, the compulsory catch returns of all commercial line fish permit holders have been stored on a database, the National Marine Linefish System (NMLS) developed by MCM (then known as the Sea Fisheries Research Institute). Several studies have found the data captured within the NMLS to be inaccurate, specifically a large degree of under-reporting (although over-reporting also occurs) has been identified (Attwood and Farquhar 1999, Brouwer *et al.* 1997, Griffiths 2000, Mann *et al.* 1997, Sauer *et al.* 1997). In response to criticisms concerning its accuracy, attempts have been made to validate the NMLS data. From these comparisons, the data on the NMLS appear to correctly reflect major trends in the fishery (Penney 1997). Furthermore, most of the inaccuracy within the NMLS appears to be the result of failure to submit returns which would result in underestimates of total catch and effort but not CPUE or catch composition (Griffiths 2000, Attwood & Farquhar 1999). The NMLS remains the only comprehensive database on commercial line fish catches and data extracted from the NMLS are used in this report to describe trends in reported catch, effort and CPUE of the commercial line fishery in the two study areas.

The trends in the commercial line fishery catch, effort and CPUE for the Kogelberg coast described below need to be interpreted taking cognisance of the recent management actions and economic forces that have altered the nature of the South African line fishery. By the late 1980's, economic forces had caused the majority of vessels in the modern line fishery to be highly mobile, trailable ski-boats that can follow aggregations of shoaling species such as yellowtail, snoek, geelbek and kob. Prior to 2003 the commercial fleet was large (~3 000 vessels nationally) with a large number of part-time participants or participants who had other fishing interests or alternative sources of income. The mobility of the fleet was also not restricted. Post-2003 the commercial fleet has consisted of fewer vessels; ski boats in the fishery are on average larger, have longer travel ranges, can fish for longer in rougher weather and are mostly operated and crewed by full time professional line fishers. The large freezer deck boats with long range and long trip capability (up to several months) have mostly been excluded from the commercial line fishery, but smaller deck boats ("Chukkies") are still active at some ports particularly along the south-western Cape coast. Effort in the commercial line fishery has most likely also responded to dramatically increased operating costs (particularly fuel and bait) that have occurred over the period 2003-2008.

Attwood & Farquhar (1999) compared historical commercial line fish catches landed at the Hermanus harbour over the period 1897-1906 with commercial line fish catches made in the area between Cape Hanglip and Walker Bay (incorporating the most intensively fished stretch of the Kogelberg coast) over the decade 1987-1997. The earlier records were published in the reports of the Government Biologist and listed the number of vessels and quantity of fish landed each month at each fishing harbour (Gilchrist 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1906a, b, 1907 in Attwood & Farquhar 1999). Although adjacent to our current study area, Hermanus harbour was the closest safe anchorage for the sail or oar driven fishing vessels used at the time. These vessels did confine their fishing activities nearly exclusively to Walker Bay in the summer months and just to the west of the Hermanus harbour in the winter months (Attwood & Farquhar 1999). The 1987-1997 data were extracted from the NMLS. This paper provided dramatic evidence of a collapse of line fish stocks in the vicinity of the Kogelberg coast.

Over the period 1897-1906, 10-15 vessels were reported as active from the Hermanus harbour. These boats carrying between 59 and 87 crew, in total fished an average of 2 268 boat-days.year⁻¹ and landed an annual average of 1 231 tons of fish from 17 species (Figure 25). The average overall catch rate during this decade was 99 kg.angler-day⁻¹ (Attwood & Farquhar 1999). During the decade 1986-1997 an average of 1 782 boat-days.year⁻¹ were reported, with only three small deck boats still operating from Hermanus harbour - the majority of the effort now reported by ski boats. During the two years of a roving creel survey (1995-1997), the maximum number of vessels active at any one time occurred during those periods when snoek *Thyrsites atun* were caught in abundance. During the "snoek run" that occurred in August of 1995 and 1996, the number of skiboats that launched from the Hermanus, Hawston and Kleinmond slipways reached maxima of 42, 11 and 30 respectively (Attwood & Farquhar 1999). In the latter period the catch was more diverse, with 36 species reported in catch returns. The average annual reported catch was only 255 tons for the entire area Cape Hanglip to Walker bay, (only 68 tons was reported for Walker Bay), the catch composition had changed dramatically and average CPUE was only 23 kg.angler-day⁻¹ (Figure 25), (Attwood & Farquhar 1999).

This represents an overall (for all species combined), decrease of 75% in CPUE indicative of a substantial decrease in line fish abundance in the region. Catch rates for most species (geelbek *Atractoscion aequidens*, carpenter, silver kob *Argyrosomus inodorus*, white stumpnose *Rhabdosargus globiceps* and chub mackerel *Scomber japonicus*) had dropped dramatically, whilst two sparids red steenbras *Petrus rupestris* and seventyfour had disappeared completely from reported catches during the latter period. The authors of this study note that although no comparative early data exist for the area Cape Hanglip to Walker Bay, the contemporary data for the entire area show very similar catch rates to those from Walker Bay alone, and suggest that the changes that occurred in Walker Bay have been widespread along the entire region. Attwood & Farquhar (1999) attributed this observed decline in CPUE in the region, (not withstanding indications of environmental change), to a collapse in the linefish stocks due to overexploitation poor management and lack of enforcement.

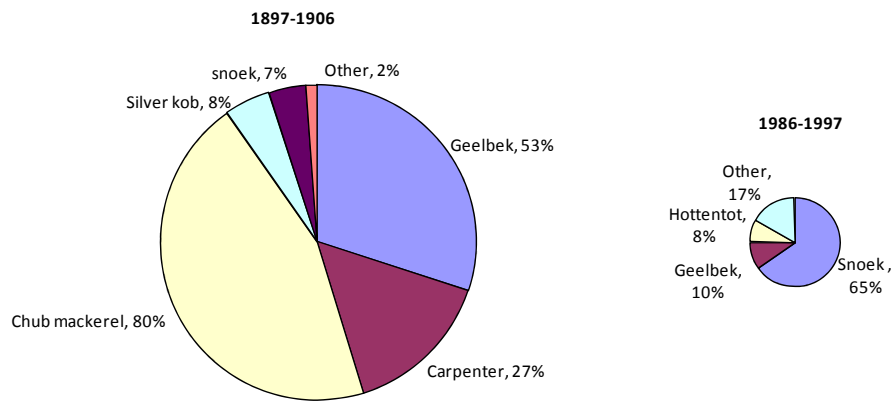


FIGURE 25. SPECIES COMPOSITION OF COMMERCIAL LINE FISH CATCHES IN WALKER BAY FOR THE YEARS 1897-1906 (GILCHRIST DATA) AND 1987-1997 (NMLS DATA). THE AREA OF THE PIE IS PROPORTIONAL TO THE AVERAGE ANNUAL CATCH (BY MASS) (SOURCE: ATTWOOD & FARQUHAR 1999)

Since 2003, the slipway at Kleinmond has been the only legal designated landing site on the Kogelberg coast for commercial line fish permit holders. Smaller commercial line fishing vessels (dinghies and skiboats) have historically used the Cape Hangklip (Massbaai) slipway and continue to do so particularly for night fishing targeting geelbek (pers. obs.). Gordons Bay, Strand and Hermanus harbour slipways are other designated landing sites that may be used by commercial line fishers to land fish caught along the Kogelberg coast.

Recent data from the NMLS over the period 2000-2007 reflect the changes in the number of commercial line fish permit holders. Approximately 50 different permit holders submitted returns for catches made along the Kogelberg coast in 2000, this decreased drastically over the next two years to a low of only eight different rights holders submitting returns in 2001 (Figure 26). This was presumably due to the uncertainty in the fishery at the time. Fishers had applied for medium term rights and were operating under exemptions on the old “A” and “B” linefish permits during this period. Many also did not automatically receive catch return books from MCM at this time and were unsure of what to do. The level of reporting increased rapidly again over the medium term rights allocation (2003-2005), and then decreased to only 16 different permit holders submitting returns in 2006 and 2007 (Figure 26). It is not clear whether the recent decrease in reporting levels is due to fewer rights holders being active in the Kogelberg region, or due to a level of complacency developing amongst rights holder who had secured long term rights in the line fishery. Only minor changes in the proportion of the TAE allocated occurred between the medium and long term rights periods, but the spatial distribution of rights holders and/or line fishing activity within zone A may have changed. The high levels of reporting over the period 2003-2005 could have been a true reflection of the number of permit holders active in the Kogelberg region (in response to good availability of snoek- see below), but were also undoubtedly influenced by management processes as fishers knew that performance would be used as a criterion for the allocation of long term rights in the fishery.

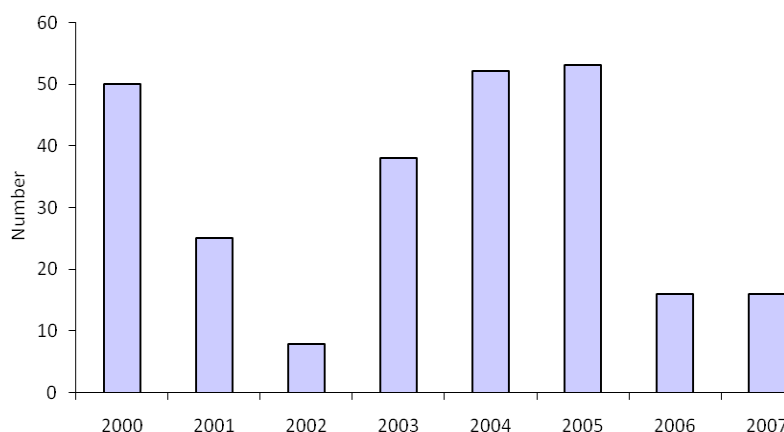


FIGURE 26. ANNUAL NUMBER OF LINE FISH PERMIT HOLDERS SUBMITTING CATCH RETURNS FROM THE KOGELBERG REGION OVER THE PERIOD 2000-2007 (SOURCE: NMLS, MCM).

Total annual reported effort (boat-days.year⁻¹) mirrored the trend in the number of permit holders submitting catch returns, peaking at around 300-500 boat-days.year⁻¹ during 2000, 2003-2005 and at only ~150-170 boat days.year⁻¹ for 2006-2007 (Figure 27). On average, returns indicate that permit holders fished only 9-11 days per year along the Kogelberg coast, although some (presumably resident in the area) were much more active. The eight permit holders who submitted returns in 2002, however, reported 129 sea-days between them (average 16 trips/permit holder). The inter-annual variation in the data reflects both the lack of a permanent fishing harbour within the Kogelberg study area and the influx of boats for short periods to target “runs” of shoaling species such as snoek and Geelbek that are not consistent every year; as well as the variation in reporting compliance that has been influenced by management actions. Interestingly, the national reported effort in the commercial line fishery over the same period follows a similar trend to that reported for the Kogelberg coast, although the drop over the 2000-2002 period was not as severe (Figure 28). This suggests relatively decreased activity (or reporting) compared to other areas, along the Kogelberg coast during this period and possibly relatively increased line fishing activity over the period 2003-2005.

The spatial distribution of commercial line fishing effort around the Kogelberg coast shows highest effort levels offshore of the Kleinmond slipway, particularly on the snoek “grounds” between the 50m and 100m depth contours (Figure 29). The other “hotspot” appears to be the coast between Koeël Bay and Pringle Bay, an area that is easily accessible by commercial line fishers launching at both the Gordons Bay and the Strand slipways, and that yields both snoek and geelbek (Figure 29). The complete lack of commercial effort reported for the inshore block extending from Cape Hangklip (Maasbaai) – Betty’s Bay area appears erroneous, as this is a known geelbek hotspot and commercial linefish permit holders do fish this area frequently during the summer months (pers. obs.). A possible explanation for the lack of catch returns from this block is that the Cape Hangklip and Betty’s Bay slipways are not designated landing sites for commercially caught linefish, and as the geelbek are mostly caught in this area on nights with strong south-easterly winds which precludes the use of other “legal” slipways, fishers simply do not submit catch returns.

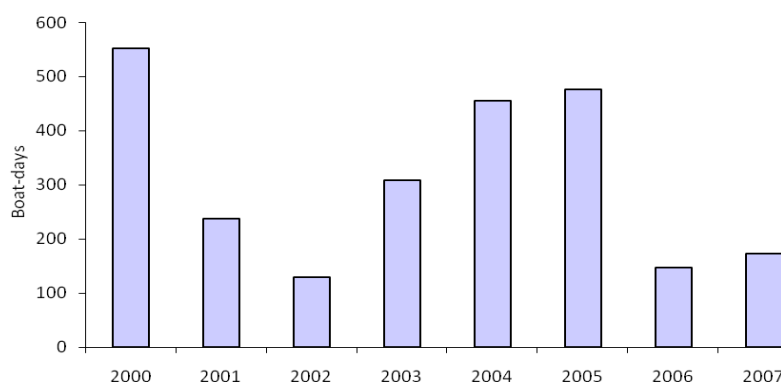


FIGURE 27. ANNUAL REPORTED EFFORT BY COMMERCIAL LINEFISH PERMIT HOLDERS FISHING IN THE KOGELBERG AREA, 2000-2007 (SOURCE: NMLS, MCM).

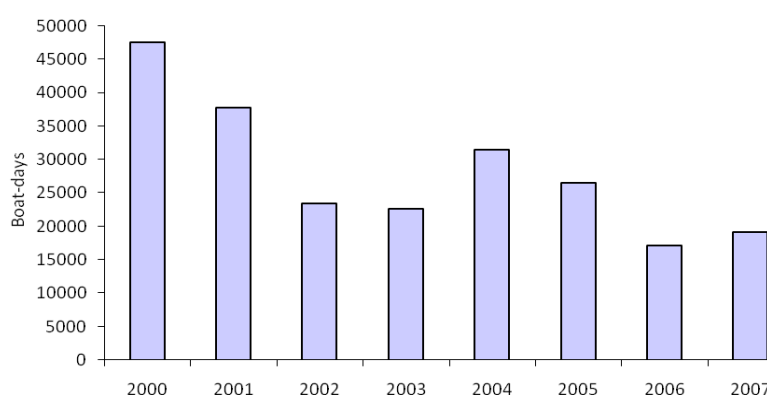


FIGURE 28. NATIONAL TOTAL ANNUAL REPORTED EFFORT BY COMMERCIAL LINEFISH PERMIT HOLDERS, 2000-2007 (SOURCE: NMLS, MCM).

Catch composition reported by line fish permit holders over the period 2000-2007 was similar to that for the period 1986-1997 covered by Attwood & Farquhar (1999), with 27 different species reported as being caught (Figure 25, Figure 30). Snoek remained the dominant species, but the proportion of geelbek in the catch doubled between the two periods, with this species showing coast wide evidence of increased abundance since ~2000, despite being scarce in catches for much of the preceding 30 years. The most recent assessment of this species in the late 1990's classed the stock as collapsed, and, as no recent assessment has been conducted, it is not possible to conclude if the increased catches are due to a stock recovery (Griffiths & Fennessy 2000 in Mann 2000). The ranking of hake (probably shallow water hake, *Merluccius capensis*) as the third most common species in the catch over the 2000-2007 period is a bit anomalous, as this species has not been a traditional target species of line fishing boats in the Kogelberg region (Figure 30). These hake catches were made almost exclusively during 2005 by a few boats targeting this species at "Diep bank", eight kilometres off the Bot River mouth. It is not known what made this species temporally available to line fishers in the region, but probably had to do with low bottom water temperatures that allowed the hake to move inshore. For all the other years in the period 2000-2007, Snoek, Geelbek and Hottentot were the dominant species contributing ~90% of the reported catch and occurring in most of the catches made in the region (Figure 30).

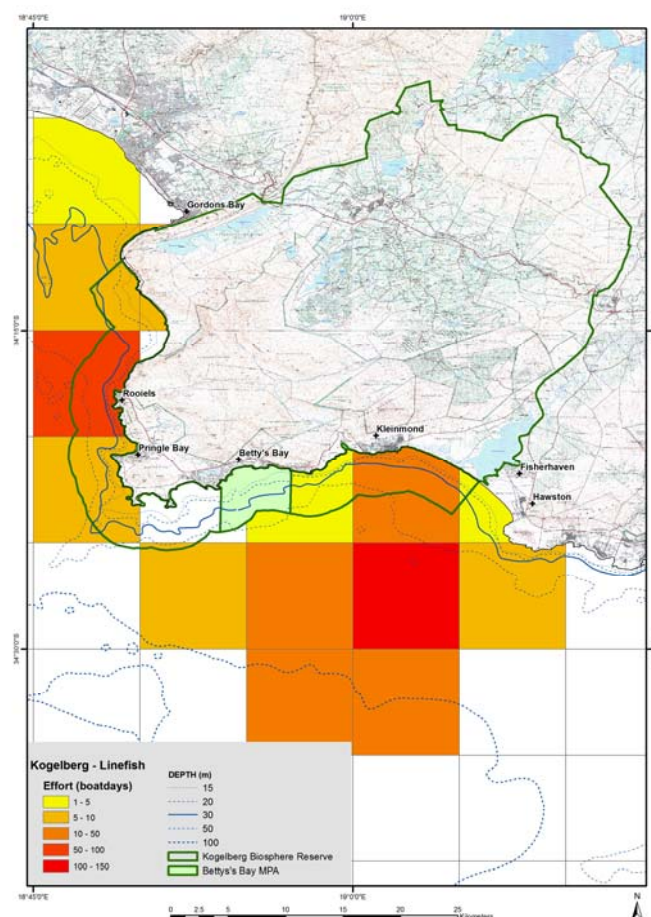


FIGURE 29. SPATIAL DISTRIBUTION OF AVERAGE ANNUAL EFFORT REPORTED BY COMMERCIAL LINE FISH PERMIT HOLDERS FISHING THE KOGELBERG COAST 2000-2007 (SOURCE: NMLS, MCM).

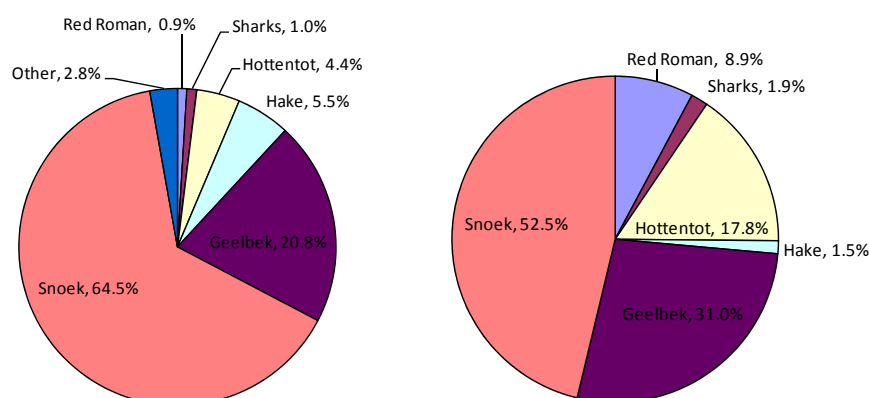


FIGURE 30. CATCH COMPOSITION LEFT AND PERCENTAGE OCCURRENCE IN CATCH REPORTED BY COMMERCIAL LINE FISH PERMIT HOLDERS FISHING IN THE KOGELBERG OVER THE PERIOD 2000-2007 (SOURCE: NMLS, MCM).

The annual reported catch of line fish (all species) over the period 2000-2007 averaged $\sim 44 \text{ tons} \cdot \text{year}^{-1}$, only 0.5% of the total national average reported line fish catch over this period. The total reported national catch over the period 2000-2007 has shown a

sustained decline from an early high of around 14 000 tons in 2000 to a low of ~5000 tons in 2007 (Figure 31). A stabilization and recovery of catches was evident during 2003-2005, but catches declined again thereafter (Figure 31). Most of this decline in total reported catch can be attributed to inter-annual variability in the availability of snoek (the dominant species) to linefishers. Reported annual catch from the Kogelberg showed substantial variation, with the total reported catch following a similar trend to the reported effort, and peaked during 2003-2005 (Figure 31). Total catch also followed the trend of the catch of the dominant species, with good snoek catches being taken between 2003-2005 (Figure 31). The annual geelbek catch reported from the Kogelberg coast initially declined from 11-12 tons reported during 2000-2001 to a low of ~4 tons in 2002, but then showed a steady increase back to 11-12 tons during 2006-2007 (Figure 31). It must be remembered that very few permit holders were reporting catches during 2002 and the actual catch of all species was probably much higher than the reported figures. Reported hottentot catch was initially high in 2000 and showed a similar, yet less exaggerated pattern than snoek catches, with a decline (2001-2003), followed by moderate recovery (2004-2005), and a decline again (2006-2007). Spatially the distribution of reported catch along the Kogelberg coast followed the pattern for effort, with most fish reported caught in the area off Kleinmond and the cliffs between Koeël bay and Pringle Bay (Figure 32).

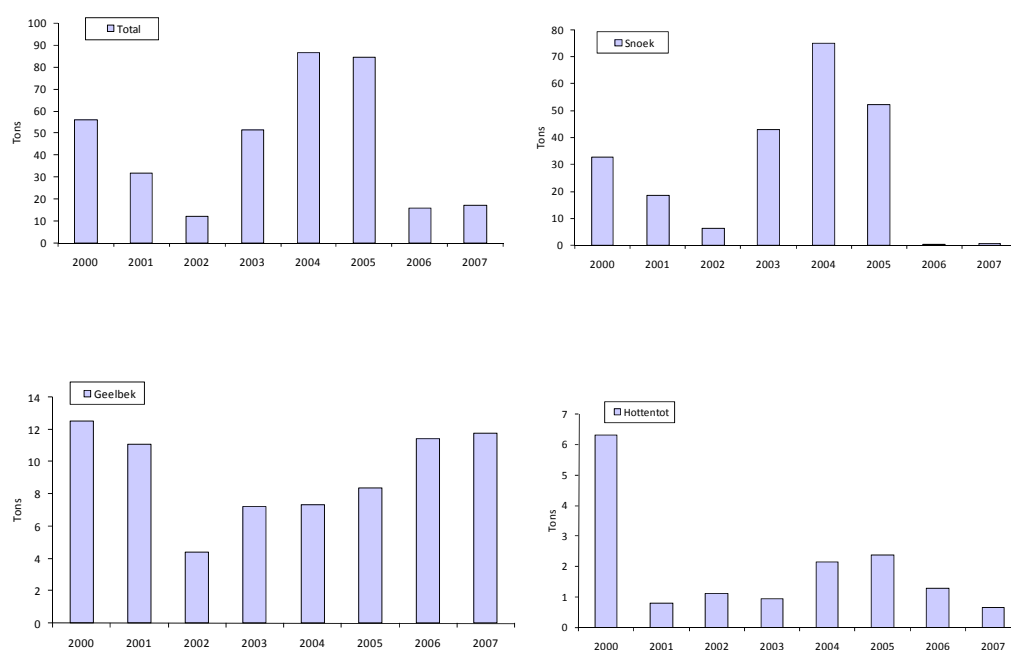


FIGURE 31. REPORTED ANNUAL TOTAL CATCH (ALL SPECIES COMBINED), OF SNOEK, GEELBEK AND HOTTENTOT MADE BY COMMERCIAL LINEFISHERS ACTIVE OFF THE KOGELBERG COASTLINE OVER THE PERIOD 2000-2007 (SOURCE: NMLS, MCM).

Given that the inaccuracies in total catch and effort returns are mostly due to failure to submit catch returns, CPUE trends probably give a better indication of the status of stocks or the availability of fish to the line fishery. CPUE trends for the total catch and the three most common species (snoek, geelbek and hottentot) for the Kogelberg coast and the national average are shown in (Figure 34).

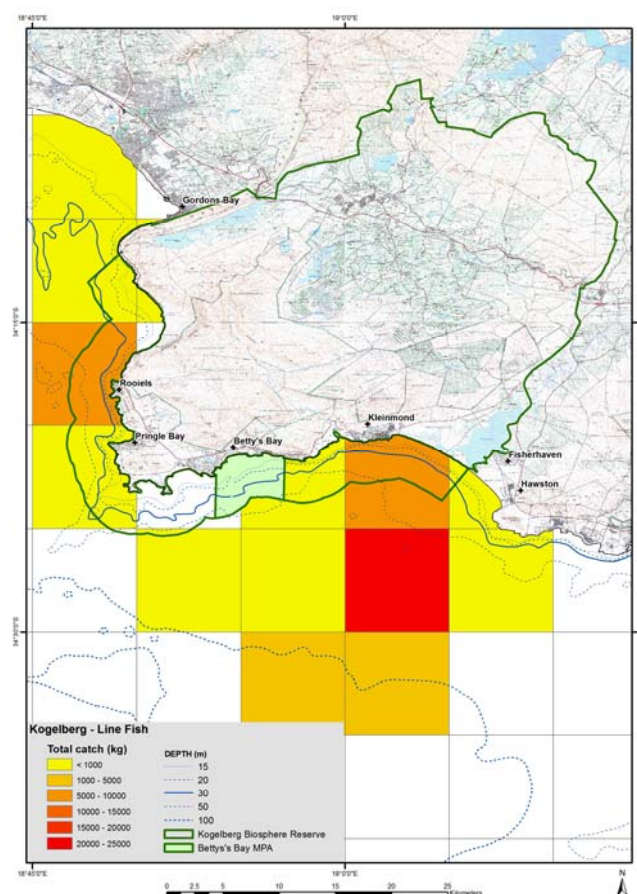


FIGURE 32. SPATIAL DISTRIBUTION OF AVERAGE ANNUAL CATCH REPORTED BY COMMERCIAL LINE FISH PERMIT HOLDERS ALONG THE KOGELBERG COAST 2000-2007 (SOURCE: NMLS, MCM).

The national total catch rate has stayed relatively constant at between 250-300 kg.boat-day⁻¹ over the last eight years (Figure 33). The overall reported catch rate for the Kogelberg coast is much lower at between 100-200 kg.boat-day⁻¹ and was more variable with the 2003-2005 increase in CPUE reflecting increased snoek catches in the region (Figure 33). The spatial distribution of CPUE for the total catch and the three most common species is shown in (Figure 34). The catch rate of Geelbek in the Kogelberg exceeded the national average on four out of the eight years considered, revealing the importance of this area for line fishers targeting geelbek (particularly in the vicinity of Cape Hangklip and Bettys Bay) (Figure 34, Figure 35). The catch rate of hottentot was similar to or exceeded the national reported CPUE for this species, indicating that it is also relatively common in and around the kelp beds along the Kogelberg coast (Figure 34, Figure 35). The decline in snoek CPUE along the Kogelberg coast simply reflects reduced availability of this nomadic species in the area rather than stock decline as the national catch rate did not decline substantially. Geelbek (a coastal migrant) and hottentot (a resident) CPUE trends show no indication of decline in the availability of these species in the last eight years. In fact, an increase in the geelbek CPUE is evident during 2006-2007. The average crew size on vessels used for the 763 records where geelbek was landed in the Kogelberg area over the last eight years was three (mostly small dinghies and skiboats are used). This means that the recent 2006-2007 geelbek catch rates, although good compared to the last ~30+years, translate into

23-26 kg.angler-day⁻¹, only about half the reported observed catch rate (54 kg.angler-day⁻¹) during the period 1897-1906 (Attwood & Farquhar 1999). Other species such as silver kob, seventyfour, and carpenter that were important species in the catch at the beginning of the 20th century are either absent in the current data, or caught at much lower catch rates than reported in both the 1897-1906 and 1987-1997 data. This suggests that although a moderate recovery may have occurred for geelbek, many other linefish species that occur off the Kogelberg coast remain overexploited.

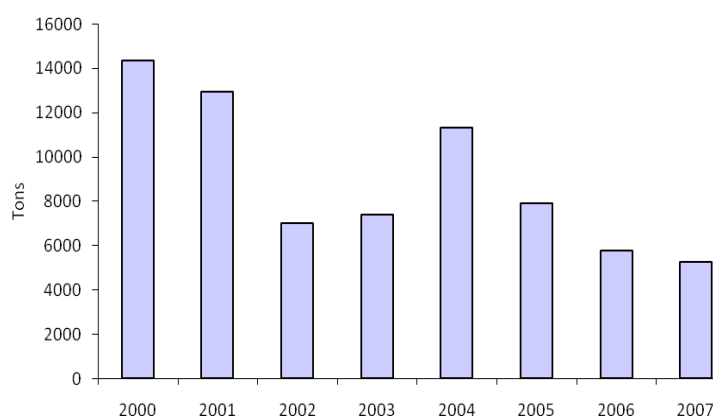


FIGURE 33. REPORTED NATIONAL TOTAL (ALL SPECIES) LINEFISH CATCH BY PERMIT HOLDERS OVER THE PERIOD 2000-2007 (SOURCE: NMLS, MCM).

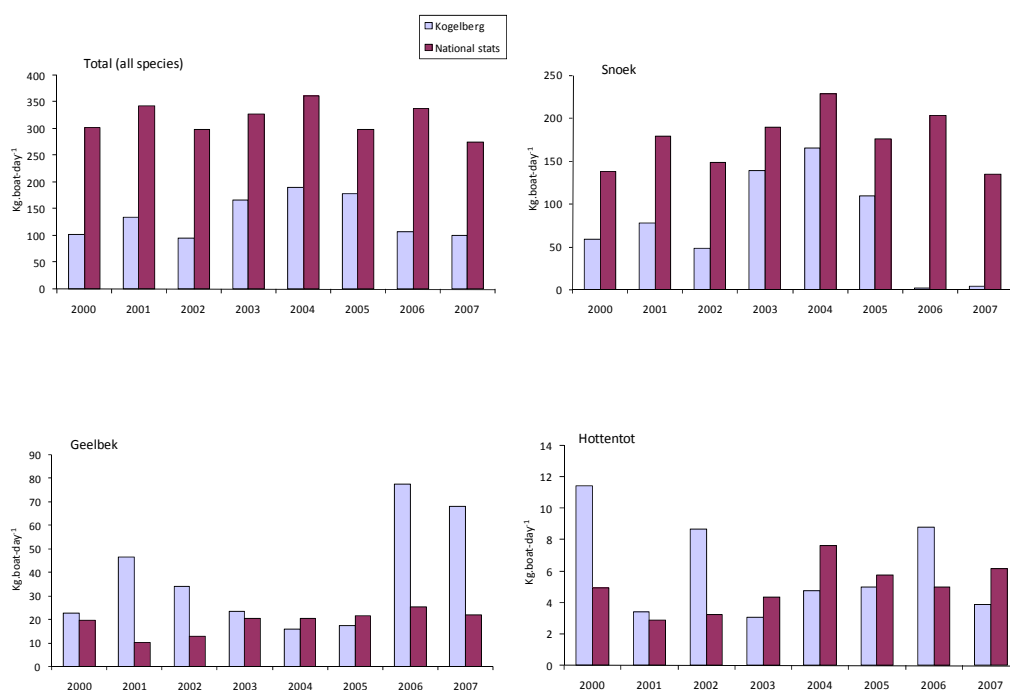


FIGURE 34. REPORTED ANNUAL CATCH RATE FOR ALL SPECIES COMBINED (TOTAL), SNOEK, GEELBEK AND HOTTENTOT OFF THE KOGELBERG COASTLINE AND THE NATIONAL AVERAGE FOR THE PERIOD 2000-2007 (SOURCE: NMLS, MCM).

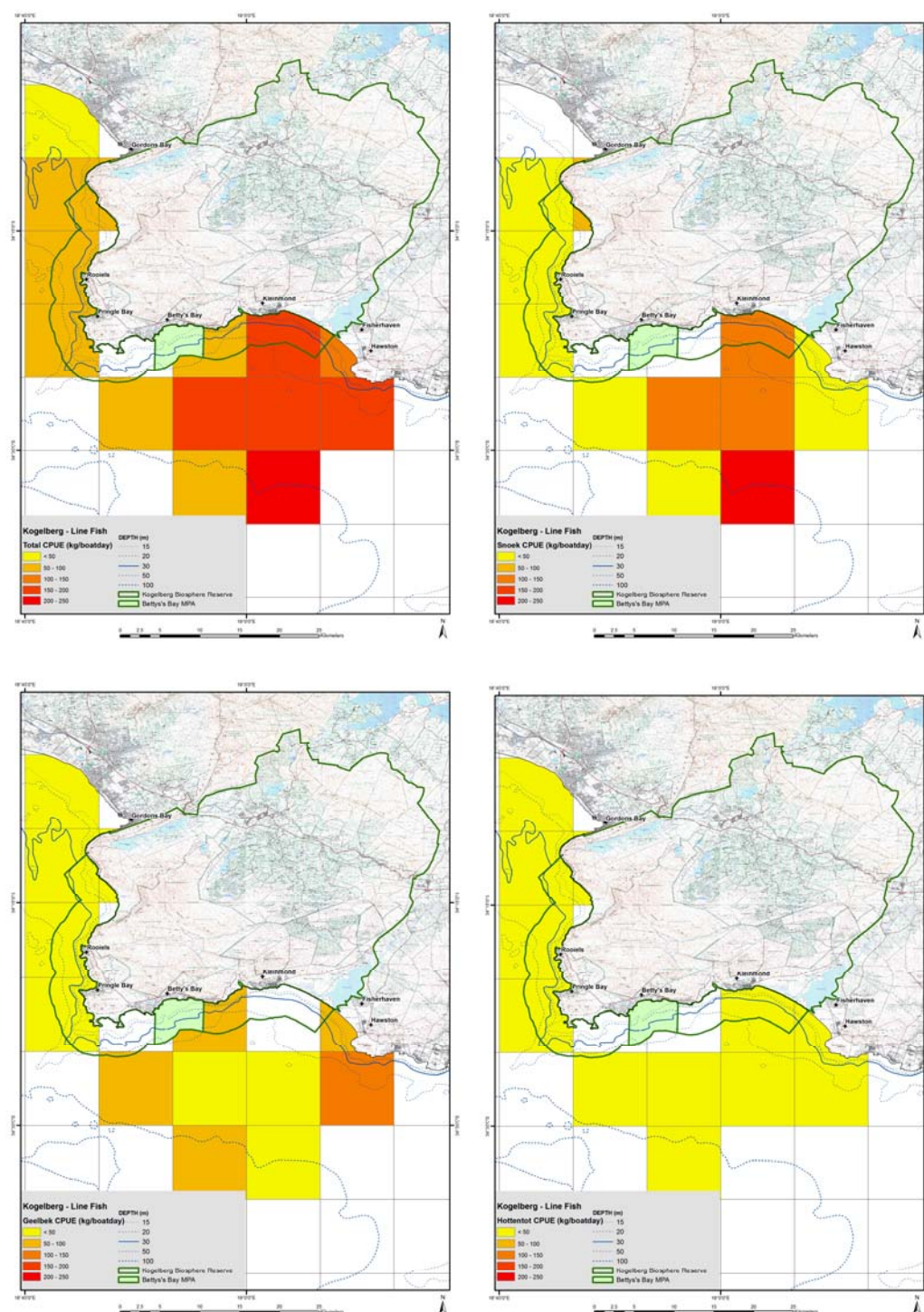


FIGURE 35. SPATIAL DISTRIBUTION OF THE AVERAGE ANNUAL REPORTED TOTAL CATCH RATE (ALL SPECIES COMBINED), SNOEK, GEELBEK AND HOTTENTOT OFF THE KOGELBERG COASTLINE FOR THE PERIOD 2000-2007. (SOURCE: NMLS, MCM).

The sale of commercially caught linefish is largely conducted as cash transactions at the point of landing or at fish dealer's premises and is poorly recorded and reported on, and

thus the markets of linefish caught along the Kogelberg are not well known. The dominant species in the catch, snoek (and frequently hottentot), are typically purchased by “langaanes” – mobile fish buyers who follow the commercial skiboat fleet and purchase catches at slipways. Langaanes market the fresh snoek purchased from fishers extensively throughout the Western Cape, depending on the supply some of the fish may be frozen, salted and dried or smoked. A substantial proportion of fresh snoek purchased is destined for the large Cape Town market, but rural towns further inland are also significant markets. During snoek runs in the Kogelberg area, some of the catch will be sold and consumed locally (often “fries” taken home by crew or sold “out of hand” in their communities), but given the large volumes of snoek frequently landed by the commercial fleet (often in excess of 500 fish per boat) the local market is likely to be quickly saturated. More valuable linefish species (e.g. geelbek, yellowtail, red roman), if caught in small quantities, may be sold locally to individuals or businesses (restaurants and fish shops), but larger catches (>50kg) are most likely to be sold to commercial fish buyers based in other areas (e.g. Gordon’s Bay, Strand, Cape Town).

5.2.2 West Coast Rock lobster

Commercial west coast rock lobster *Jasus lalandi* (hereafter referred to as rock lobster) fishing was historically concentrated along the South African West coast from the Namibian border to just east of Cape Point (Cockcroft & Payne 1999, Cockcroft *et al.* 2008). Although the earliest evidence of rock lobster exploitation dates back to the early Holocene, established from remains found in Khoi-San caves and middens, commercial fishing by Europeans only began in the 1880’s (Cockcroft & Payne 1999). Catch records prior to 1940 are sparse, but catches appear to have peaked in the period 1950 to 1965, when between 13 000 and 16 000 tons were landed annually (Cockcroft & Payne 1999).



FIGURE 36. THE WEST COAST ROCK LOBSTER *JASUS LALANDI*.

Prior to 1946, the commercial fishery was unregulated. In that year, a tail-mass production quota was imposed to control exports. This formed the basis of the

“output-controlled” management philosophy that is still employed in the management of the west coast rock lobster resource today (DEAT 2005ab). These quotas appeared to control catches until the mid-1960’s, but in the late 1960’s catch rates began to decline, probably due to over fishing, and quotas could not be filled (Cockcroft & Payne 1999). Decreases in the Total Allowable Catch (TAC) to between 4 000 and 6 000 tons and the universal implementation of an 89mm carapace length minimum size limit restored some balance in the period 1970/71 to 1989/90 (Cockcroft & Payne 1999).

Area or zonal allocations were introduced in the early 1980’s. Other management measures that were enforced early on were size limits and a closed season. Catches of berried or soft-shelled lobsters were banned. The 1990/91 season again saw catch rates dropping sharply as result of a dramatic reduction in lobster somatic growth rates at the end of the 1980s/early 1990s, which resulted in decreased recruitment to the lobster population above the minimum size limit (Cockcroft & Goosen 1995, Cockcroft 1997). To maintain fishery stability and address concerns regarding increased discard mortality due to increased handling of undersized lobsters, the minimum size limit was reduced from 89 mm to 75 mm carapace length (CL) between the 1991/1992 and 1993/1994 fishing seasons, and has remained unchanged since then (Cockcroft *et al.* 2008). The commercial TAC was also gradually reduced, reaching 1 500 tons in the 1995/96 season. Since then, there has been a slow recovery, with the commercial TAC being set at 3 527 tons for the 2004/2005 season (DEAT 2005ab).

Commercial rock lobster fishing is now split into two sectors: a nearshore component that uses hoopnets deployed from small vessels (ski boats and dinghies) with rights allocations of less than 1.5 tons, and an offshore component that uses traps deployed from larger deck boats with greater than 1.5 ton allocations. The offshore sector is not restricted to a particular fishing zone or area but is allowed to fish according to an agreed inter-area schedule. In the nearshore sector, right-holders may only use hoopnets and may not move between areas. (Cockcroft *et al.* 2008). Approximately 20 percent of the TAC is allocated to 812 rights holders in the nearshore fishery and 80 percent of the TAC to 245 rights holders in the offshore fishery. The reason for this split is that approximately 20 percent of the resource is located in the inshore region, while 80 percent is located offshore in deeper waters (DEAT 2005ab).

A geographic shift in the distribution of rock lobster, with decreased abundance along much of the west coast north of Saldanha Bay and increased abundance in the area east of Cape Hangklip, has been documented and confirmed by changes in both commercial and recreational catch distributions and by fishery independent field surveys (Cockcroft *et al.* 2008, more detail on this in §5.6). The increased lobster abundance in the area east of Cape Hangklip prompted an investigation into the feasibility of a commercial fishery in that area (Cockcroft *et al.* 2008), and the introduction of an experimental nearshore fishery for lobster, using hoopnets from small boats, in 1999/2000 on three fishing grounds: Kleinmond, Hermanus and Gansbaai (10 tons in each area). This was consolidated as a full commercial fishery in 2003 with 230 t allocated to rights holders during the medium-term rights allocation process in 2001/2002 and 215 t during the 2005/2006 long-term rights allocation process (Cockcroft *et al.* 2008). An annual quota of between 30 and 70.5 tons has also been allocated in False Bay (referred to as area 11 in MCM management documents) since 1987. This is equivalent to 3-4% of the total (all areas) rock lobster TAC. MCM researchers estimate that approximately 25 % of the inshore (bakkie) catch within False Bay is made along the eastern shore (between Gordons Bay and Cape Hangklip i.e. on the Kogelberg coast as defined for this report). The Kleinmond fishing ground stretches from the eastern border of the Betty’s Bay MPA to the Bot River Mouth near Hawston

(referred to as area 12 in MCM management documents) and lies wholly within the Kogelberg coast as defined for this report. An annual TAC of 90 tons has been allocated to this area since 2003, despite research recommendations that 50 tons is a sustainable TAC for this area. This is equivalent to a further 3-4% of the total rock lobster TAC. Along the Kogelberg coast therefore, commercial rock lobster fishing only takes place along rocky shore and reefs between Gordons Bay and Cape Hangklip (Area 11) and in the area east of the Bettys Bay MPA (Area 12). In reality, the later fishing area stops at the Kleinmond estuary, as Sandown Bay is mostly sandy substratum) and no commercial exploitation is permitted between Cape Hangklip and the Bettys Bay MPA.

The commercial rock lobster season extends from 15 November each year to 31 August the following year, however, for the purposes of this report catches are presented as being taken in the year in which the bigger part of the season falls (e.g. 2000 represents the 1999-2000 fishing season). Annual reported effort in the Kleinmond area was low during the experimental fishery phase (2000-2002) when an annual TAC of 10 tons was allocated, but increased to between 300-400 boat-days.year⁻¹ during 2004-2006 and increased further to between 560-660 boat-days.year⁻¹ during 2007-2008 (Figure 37). Although a TAC of 40 tons was set for the area in 2003, no allocation was made in this year. After the experimental fishery phase, the actual catch only met the TAC in 2007 although catch almost equalled the allocated mass in 2008 (Figure 38). Catch rates were high during the experimental phase (2000-2002), lower but fairly constant during 2004-2006 and have declined sharply in 2007-2008 to about half the earlier rates. This suggests that catches are exceeding recruitment (into the fishery) and the abundance of rock lobster is being reduced in this area. The current TAC for this area does not appear sustainable and justifies the research recommendations that a TAC of 50 tons be set. The larger 90 ton TAC allocated was undoubtedly influenced by socio-political considerations (government policy to increase access to living marine resources), but it appears likely that this will be detrimental to the resource and the fishery in the long term.

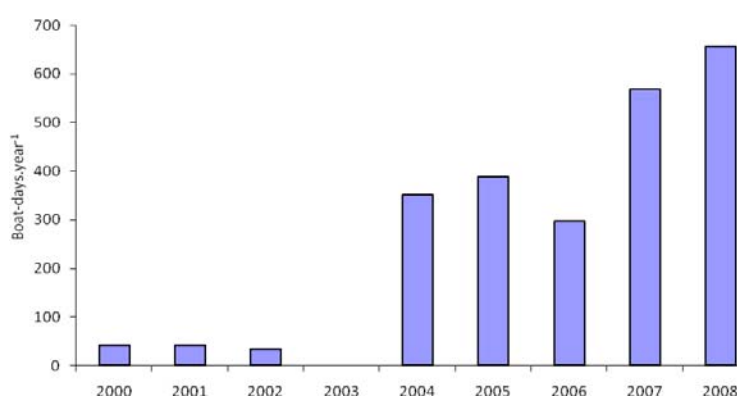


FIGURE 37. REPORTED ANNUAL EFFORT BY NEARSHORE ROCK LOBSTER PERMIT HOLDERS IN THE KLEINMOND FISHING GROUND 2000-2008. NOTE THAT THE YEAR 2000 REFERS TO THE 1999-2000 FISHING SEASON AND SO ON. (SOURCE: MCM).

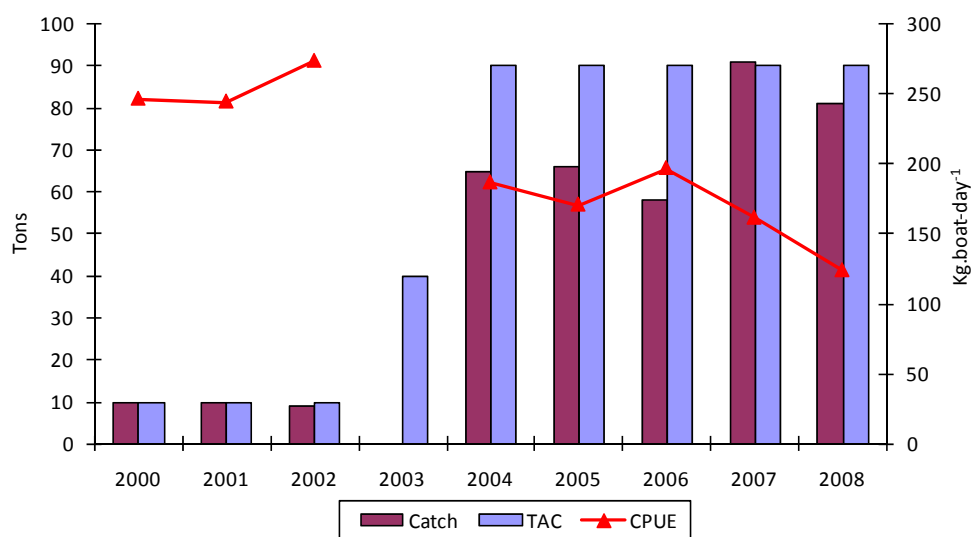


FIGURE 38. ALLOCATED TOTAL ALLOWABLE CATCH (TAC), CATCH AND CATCH PER UNIT EFFORT (CPUE) OF ROCK LOBSTER IN THE KLEINMOND FISHING GROUND 2000-2008 NOTE THAT THE YEAR 2000 REFERS TO THE 1999-2000 FISHING SEASON AND SO ON. (SOURCE: MCM).

Very little rock lobster fishing effort within False Bay took place along the eastern shore prior to 2002 as most of the TAC was allocated to larger trap boats (offshore sector) that fished the western shore. However, after 2002 between 37-80% of the TAC for area 11 has been allocated to “bakkies” fishing the in the inshore sector. The 25% estimate of this effort distributed along the eastern shore of False Bay has remained fairly consistent for most years at between 50-75 boat-days.year⁻¹ with about half that effort reported in 2006 and 2008 (Figure 39).

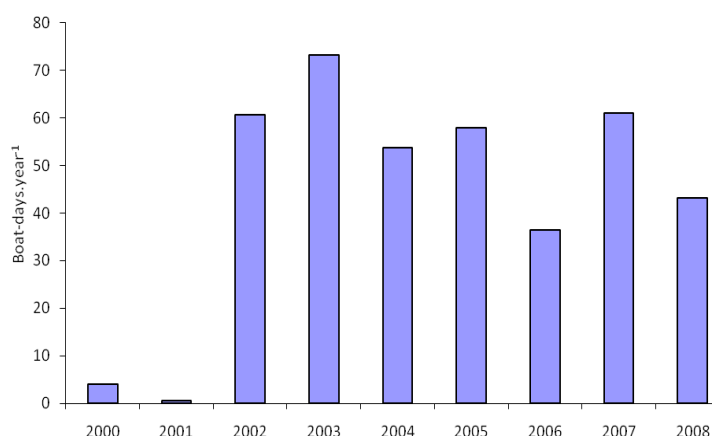


FIGURE 39. REPORTED ANNUAL EFFORT BY NEARSHORE ROCK LOBSTER PERMIT HOLDERS ALONG THE EASTERN SHORE OF FALSE BAY (SUBSET OF MCM AREA 11) 2000-2008 NOTE THAT THE YEAR 2000 REFERS TO THE 1999-2000 FISHING SEASON AND SO ON. (SOURCE: MCM).

The portion of the area 11 inshore catch attributed to the eastern shore of False Bay since 2002 varied between 6.25-10.75 tons and has mirrored the effort in the area (Figure 40). The catch rate has remained almost constant at between 150-200 kg.boat-day⁻¹ suggesting that lobster abundance in this area has not shown much inter annual variability (Figure 40). Since the medium term rights allocation (2003-2004 season) until the 2007-2008 fishing season, the average annual rock lobster catch from the entire Kogelberg coast has varied between 80.5-113.5 tons (average of 94.7 tons), on average this represents 3.5 % of the total commercial TAC.

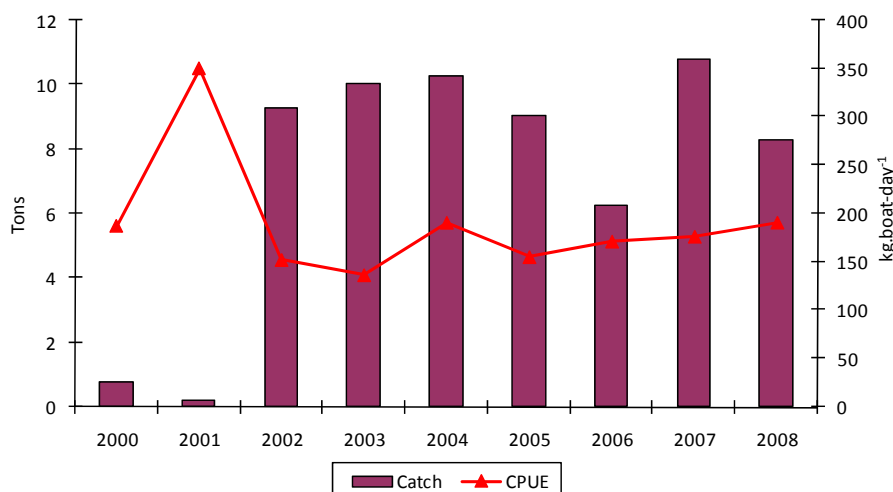


FIGURE 40. ESTIMATED ANNUAL CATCH AND CATCH PER UNIT EFFORT (CPUE) OF ROCK LOBSTER ALONG THE EASTERN SHORES OF FALSE BAY 2000-2008. NOTE THAT THE YEAR 2000 REFERS TO THE 1999-2000 FISHING SEASON AND SO ON. (SOURCE: MCM).

5.2.3 Abalone

Shells found in middle Stone Age cave deposits that date back about 125 000 years, record human exploitation of abalone, making it one of the oldest fisheries in the region (Tarr 1989). The commercial South African abalone fishery started in 1949 at Gansbaai and rapidly expanded to the area from Saldanha on the west coast to Cape Agulhas on the south coast (Tarr 1989). The most productive abalone populations occurred in the area between Cape Hanglip and Quoin Point (east of Gansbaai) (Tarr 1989). This area historically contributed more than 85 % of the total annual catch and includes much of the Kogelberg coastline (Tarr 1989).

Commercial divers harvested abalone from small motorized dinghies or skiboats using a “hookah” system (compressed air pumped to diver via a reinforced hose). Abalone were collected by divers using a flat lever to remove them from the reef. Abalone are then placed in bags and either lifted to the surface using lifting bags or hauled to the boat keeping station above the diver (Tarr 1989). Crew aboard the vessel tended the compressor and checked the catch for undersize abalone (a minimum size limit of 114 mm shell diameter was enforced) (Tarr 1989).

Early abalone harvests (1953-1959) were constrained by lack of demand in the Oriental market, the destination of most South African abalone (Tarr 1989). Thereafter, the catch increased considerably averaging 1 800 tons annually for the 1960s, with a peak of 2 800 tons in 1963 (Tarr 1989). Concern over the stock status resulted in progressively smaller production quotas (processed product mass) being implemented

between 1968 (385 tons) and 1970 (227 tons) (Tarr 1989). The production quota was further reduced to 181 tons (1971-1978) and 163 tons (1979-1982) in response to falling catch rates (Tarr 1989). The production quota was converted to an equivalent total landed mass quota of 660 tons in 1983, which was gradually reduced to 640 tons in 1986 (a result of area closures to the commercial fishery), and remained at a fairly constant level around 600 tons per year until the mid 1990's (Figure 41). Post 1996 the TAC has been progressively reduced in response to dwindling catch rates and evidence from fishery independent surveys that indicated stocks were collapsing. In 2003 the recreational abalone fishery was closed. By 2008 the commercial TAC was effectively set at zero and the commercial abalone fishery closed (Figure 41).

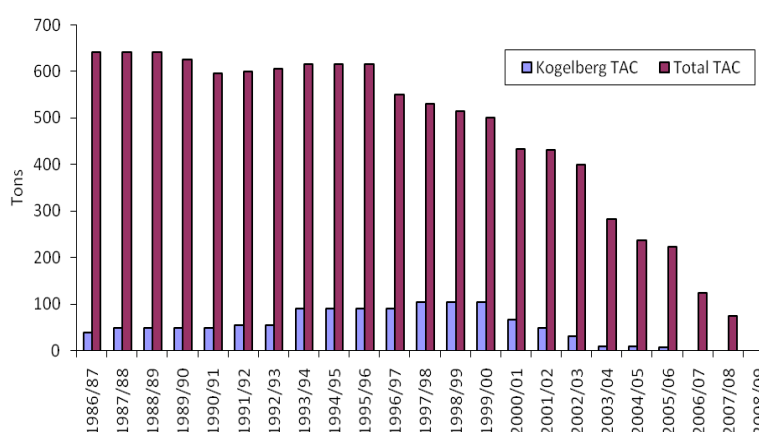


FIGURE 41. TOTAL ALLOWABLE CATCH (TAC) FOR THE SOUTH AFRICAN ABALONE FISHERY AND FOR THE KOGELBERG COSAT 1986-2008 (SOURCE: MCM).

The collapse of abalone stocks was brought about by two main forces: the decrease in abalone recruitment in the traditional area of resource abundance (Hangklip-Quoin Point) due to the ecological shift in rock lobster abundance discussed above, together with rampant illegal harvesting (Plagányi 2007 in Cockcroft *et al.* 2008). This has had a particularly severe impact along the Kogelberg coast a formally productive abalone harvesting zone. Initially between 1990 and 2000 the TAC for the Kogelberg coast (Zone D) was actually doubled from 50 tons to just over 100 tons as stocks in this area appeared healthy (no doubt partially sustained by the presence of the Betty's Bay MPA) (Figure 41). Annual effort required to harvest the TAC, however, steadily increased out of proportion to the increased regional TAC (Figure 42). Although the TAC was set at 90 tons over the period 1993-1997 and increased to only 105 tons for the next three years, divers had to spent nearly twice as long underwater to harvest this increased TAC (Figure 42, Figure 43).

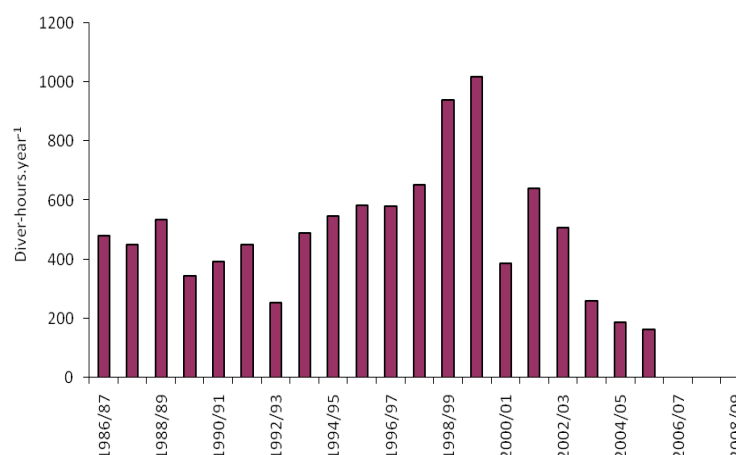


FIGURE 42. ANNUAL EFFORT IN THE COMMERCIAL ABALONE FISHERY OFF THE KOGELBERG COAST (SOURCE: MCM).

In reality abalone abundance in this zone was decreasing sharply, as evidenced by the catch rate that peaked in 1992, decreased moderately till 1995, stabilized until 1998 and dropped sharply thereafter (Figure 44). Reductions in the area TAC implemented after 2000 did little to check this decline (probably as brazen poaching, even within the MPA, was escalating – see below) and this zone was closed to commercial abalone harvesting in 2006.

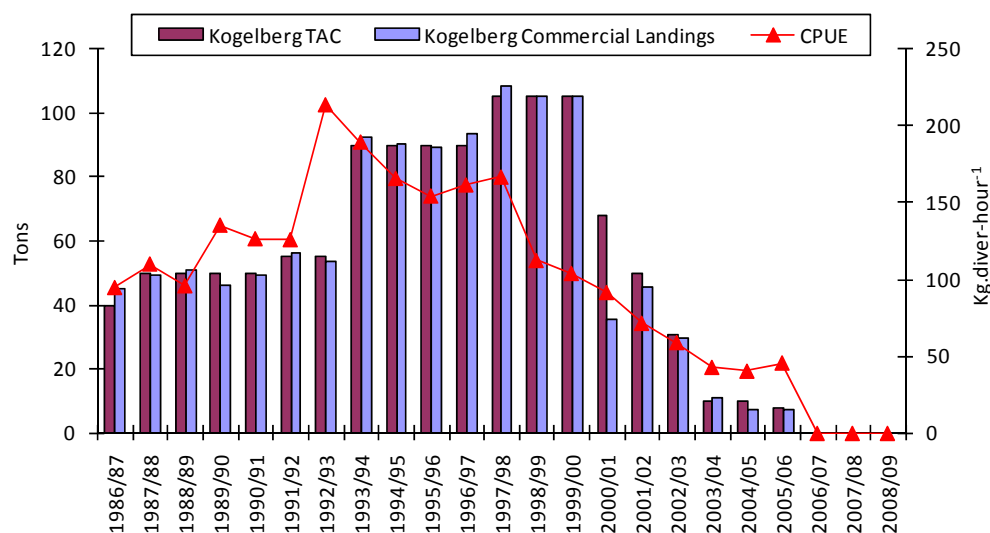


FIGURE 43. TOTAL ALLOWABLE CATCH (TAC), CATCH AND CATCH PER UNIT EFFORT (CPUE) IN THE COMMERCIAL ABALONE FISHERY OFF THE KOGELBERG COAST (SOURCE: MCM)

Fishery independent dive surveys conducted by MCM confirmed the decline in abalone abundance inferred from declining catch rates in the commercial fishery along the Kogelberg coast (Figure 44). Mean abalone abundance along 30m dive transects dropped by two thirds over the period 1996-1999 (Figure 44). It is interesting to note that these dive surveys took place between Cape Hangklip and Stony Point, an area

closed to the commercial fishery. As abalone lives for well over 10 years, and the decline in abundance took place in less than five years, it is evident that poaching, rather than reduced recruitment due to rock lobster predation, was the major contributor.

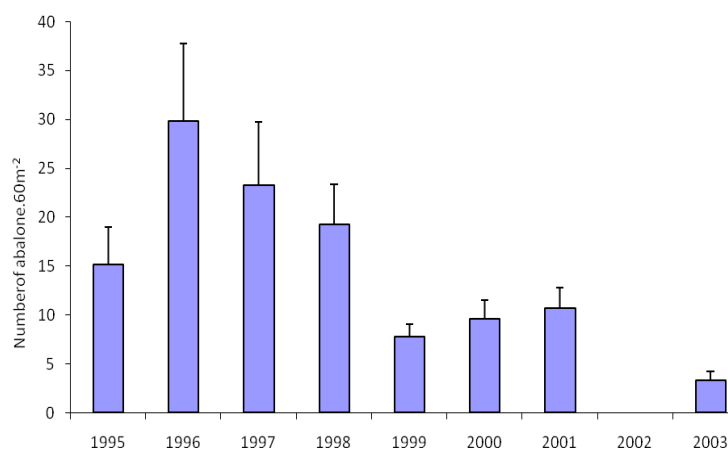


FIGURE 44. ANNUAL ABALONE DENSITY IN THE AREA BETWEEN CAPE HANGKLIP AND STONY POINT AS ESTIMATED BY MCM'S FISHERY INDEPENDENT DIVE SURVEYS. ERROR BARS SHOW 1 STANDARD ERROR OF THE MEAN (SOURCE:MCM).

5.2.4 Kelp

Two species of kelp, *Eclonia maxima* and *Laminaria pallida*, three species of *Gellidium* and *Gracilaria/Gracilariops* spp. are commercially utilized by the South African seaweed industry (Anderson *et al.* 2003). Within the Kogelberg study area, only one species of kelp *E. maxima* is commercially harvested. The collection of beach-cast kelp, which is dried, milled and exported for alginate extraction began as early as 1953 (Anderson *et al.* 2003). The annual yield of dried beach cast kelp has fluctuated with market demand, reached a maximum of 5 000 tons dry weight in 1977, with the total annual harvest over the period 2000-2008 of 805 tons (Anderson *et al.* 2003). The harvesting of fresh kelp around the Cape Peninsula, for the production of a liquid plant growth stimulant (Kelpak) began in 1979 (Anderson *et al.* 2003).

The commercial seaweed industry is managed by allocating concessions to individuals or companies to harvest or collect seaweed in 23 areas along the South African coast. Kelp occurs from Cape Agulhas to the Namibian border but is only harvested in some areas (concession areas 5-9, 11-16 and 18-19) (Anderson *et al.* 2003). Currently there are 10 kelp concession holders, but three are inactive due to legal cases over rights allocation or inability to access restricted areas (Northern Cape Diamond mines) (personal communication., R. Anderson MCM). Since 2003, MCM has set a concession area specific Maximum Sustainable Yield (MSY) that is applicable to harvested kelp only (live kelp cut from beds), and concession holders are permitted to collect as much beach cast as they can (personal communication, R. Anderson MCM). The MSY for each area is set at about 6-10 % of the estimated standing biomass and a further ~10 % of each area is set aside as a "non-harvest zone" (if no suitable MPA's exist in the area) for the protection of old plants and kelp epiphytes that are important in kelp bed food webs (Troell *et al.* 2006). The total (country wide) MSY for kelp has

been set at about 10 400 tons wet weight for the last eight years, but with the exception of 2003 actual total yield (including driftcast wet kelp) was only about 40-60% of the MSY (Figure 46). Anderson *et al.* (2007) estimate that the total kelp harvest mortality represents only about 2 % of the total estimated West Coast biomass.



FIGURE 45. DENSE KELP BEDS OFF BETTY'S BAY.

The cultured abalone industry in South Africa developed rapidly since the early 1990's (now ~22 farms in existence) and the demand for fresh kelp as abalone feed has increased substantially reaching over 6 000 tons wet weight in 2003 (Troell *et al.* 2006). Many of these farms are located in or adjacent to the Kogelberg coast and the harvesting (cutting of live fronds) and collection of fresh beach cast for abalone feed has become an important industry (Anderson *et al.* 2003, Troell *et al.* 2006). In some of these areas, including the Kogelberg coast, concession holders no longer consider it worthwhile collecting dry beach cast kelp for alginate production and focus on the more lucrative harvesting or collection of fresh kelp for abalone feed (Troell *et al.* 2006). In these concession areas the amount of kelp harvested has approached the area specific MSY and concern has been expressed that the availability of kelp may constrain the future development of abalone farming (Troell *et al.* 2003).

Specifically in the concession area that includes the KBR, harvests were equivalent to the MSY in 2003 and 2004 but have since decreased and no kelp was harvested in 2007 (in this year all fresh kelp was reported as wet beach cast) and 2008 (Figure 46). The national fresh kelp harvest for abalone feed also dropped off over the 2004-2006 period, but has since increased to nearly 6 000 tons during 2007-2008 (Figure 46). Anderson *et al.* (2007) speculate that the decline in kelp harvest over the 2004-2006 period was a result of abalone farmers starting to cultivate their own seaweed (mainly *Ulva*) and a greater reliance on artificial feeds. However, these authors did also note that kelp remains the preferred abalone feed, either alone or in combination with other seaweeds or artificial feed (Naidoo *et al.* 2006 in Anderson *et al.* 2007). Anderson *et al.* (2007) predicted an increased demand for kelp as the abalone farming industry continues to expand and other kelp dependent industries (e.g. plant growth stimulant) develop. The continued drop off and cessation of kelp harvesting in the Kogelberg area (Figure 46), is unrelated to demand for fresh kelp, but rather is a result of the

concession holder been unable to utilize a suitable launch site (currently a “private boat club” facility in Betty’s Bay) in the vicinity of the kelp beds (R. Anderson pers.com). The most dense kelp beds around the Kogelberg coast that are in sheltered waters and most economically viable for seaweed concession holder to harvest are concentrated between Cape Hangklip and Bettys Bay (Figure 17). The current concession holder is of the opinion that the Cape Hangklip (Masbaai) slipway is shallow and not suitable for launching the size vessel required for harvesting kelp, whilst the Kleinmond slipway is too far from the resource. The permit holder feels it is currently not viable to continue harvesting kelp without access to the Bettys Bay launch site. When this issue is resolved, it is anticipated that kelp harvests in this region will resume at a level close to the area specific MSY. Expansion of this industry is therefore not possible without likely negative ecosystem level impacts.

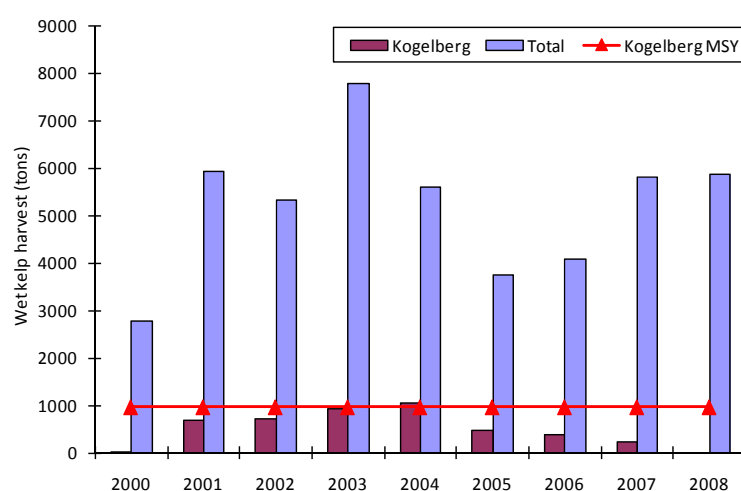


FIGURE 46. TOTAL ANNUAL WET KELP *ECKLONIA MAXIMA* COLLECTED FROM THE KOGELBERG COAST AND NATIONALLY (TOTAL). THE MAXIMUM SUSTAINABLE YIELD (MSY) FOR THE KOGELBERG COAST CONCESSION AREA IS SHOWN.

5.3 SUBSISTENCE FISHERIES

Little information is available on subsistence fishing activities in South Africa. Indeed, subsistence fishers were not even recognized as a legitimate sector until the promulgation of the Marine Living Resources Act (MLRA) in 1998. Since this time Marine & Coastal Management (the agency responsible for administration of fisheries rights in South Africa) has still not been able to finalize their subsistence and small scale fisheries policies and to this day continue to issue annual exemptions to allow participants in this sector to fish legally.

The Subsistence Fisheries Task Group (SFTG) was appointed in 1998 in an effort to give effect to the provisions of the MLRA relating to subsistence fishing (Harris *et al.* 2002). One of the first actions of the SFTG was to initiate research into subsistence fishing activities in South Africa which took the form a brief survey of the numbers of subsistence fishers in the country, their distribution around the coast, and to collect information on the types and quantities of resources being harvested by this group (Clark *et al.* 2002). Regrettably the data is not very reliable as it was collected over a very short period of time, mostly through anecdotal sources, at a time when subsistence fishing was still illegal in practice and fishers were being prosecuted on a

daily basis. However, these data remain the only available data on subsistence fishing for most coastal areas in this country, and form the basis of the information included in this report.

Subsistence fishers active on the Kogelberg coast are resident in two coastal towns/villages, one inside the Kogelberg Biosphere Reserve (KBR) – Kleinmond – and the other on the eastern border of the KBR – Hawston. At the time of the SFTG survey in 1999, an estimated 50 subsistence fishers were resident in Kleinmond and a further 33-60 were resident in Hawston. Note that while Clark *et al.* (2002) report that every effort was made to distinguish bone-fide subsistence fishers from other informal (and/or illegal) fishers during the survey, they do acknowledge that the level of success here was not known or necessary good. Subsistence fishers in these communities reportedly harvest resources from the shore (in estuaries, off sandy beaches and off rocky shores) and from boats, using a range of gears (line, trap, net, and by hand). Resources harvested included black mussels, redbait, periwinkles, alikreukel, octopus, rock lobster, polychaete worms, sand and mud prawns, abalone, white mussel, and fish. Fishing effort varied for different resources, and ranged from 30 to 200 days per year. Estimates of the total amount of each kind of resource harvested by these fishers on the Kogelberg coast is provided in Table 10. In calculating these estimates, it was assumed that fishers in Kleinmond harvested 100% of their reported catch from the Kogelberg coast, while those in Hawston harvested only 33% of their catch on this section of coast.

Black mussels provided the bulk of the catches for the fishers residing in Kleinmond, together with substantial catches of linefish, alikreukel, octopus and rock lobster, and modest catches of abalone and redbait. Fishers based in Hawston reported large catches of sand/mud prawns, netfish (fish caught using gill nets), white mussel, periwinkles, and black mussel, along with smaller catches of polychaete worms, linefish, and abalone among others. The absence of white mussels, polychaete worms, sand/mud prawns and netfish from the Kleinmond catches is indicative of the fact that fishers residing at this site did not report fishing in any of the estuaries or on the beaches in the area.

TABLE 10. ESTIMATED ANNUAL CATCH BY SUBSISTENCE FISHERS OFF THE KOGELBERG COAST. (SOURCE: CLARK ET AL. 2002). DATA IS IN NUMBERS FOR ALL RESOURCES EXCEPT RED BAIT WHICH WAS REPORTED IN KG.

	Kleinmond	Hawston
Black mussel	200 000	480 000
Redbait	1 250	28 500
Periwinkle	-	528 000
Alikreukel	33 333	96 000
Octopus	33 333	90 000
Rock lobster	17 733	90 000
Polychaete worms	-	186 000
Sand/mud prawns	-	1 425 000
Abalone	2 133	132 000
White mussel	-	564 000
Linefish	39 333	156 000
Netfish	-	765 000

Additional data on informal fishing patterns in the Kogelberg Biosphere Reserve are currently being collected as part of a companion project - Community Co-management for the Kogelberg - led by the Environmental Evaluation Unit (EEU) at the University of Cape Town. These data should provide further insights into subsistence fishing activities in the KBR.

5.4 RECREATIONAL FISHERIES

5.4.1 Recreational line fishing

Recreational line fishers operate either from the shore or boats and these two components tend to target different species in different habitats with limited overlap in catch. Recreational spear fishers do operate in habitats where both shore and boat-based line fishers are active and tend to have greater overlap in catch composition with both sectors (Mann *et al.* 1997). All the recreational fisheries have some degree of overlap in catch and hence interaction, with the commercial line fishers discussed above. Boat-based recreational anglers often operate in the exact same habitats and catch the same species as commercial line fishers, whilst shore anglers are less likely to share catch areas, although the same species may be targeted (e.g. kob, elf, geelbek). Unlike the commercial line fishery wherein participation is strictly limited by a total allowable effort, the recreational fisheries are open access. Any South African (or visitor) over 12 years of age is allowed to purchase the relevant recreational fishing permit from the post office. Recreational fishers are subject to the same size limits and closed seasons as the commercial line fishers, but a total bag limit and species specific bags are also applicable.

Recreational fishers are, however, not required to submit catch returns, and as such data on these fisheries are relatively scarce. Much of what is known about the recreational fisheries results from a roving creel and access point “National Linefish Survey” conducted between 1994-1997 that covered shore angling (Brouwer *et al.* 1997), spear fishing (Mann *et al.* 1997) and boat-based line fishing (Sauer *et al.* 1997). It was the intention of MCM and other Line fish researchers that the “National Survey” would be conducted every five years. Lack of funds and expertise have unfortunately precluded this and more recent data on the recreational line fishery are only available for a few spatially limited areas e.g. Plettenberg Bay - Natures valley (King 2006, Smith 2006). Aerial surveys conducted during this project do give a very limited snapshot of current effort levels within the study areas, but without ground truthing (catch inspections, interviews with skipper etc), it was not always possible to ascribe boat or fisher counts to the correct recreational fishing activity.

5.4.1.1 Boat-based angling

The only data available for recreational boat-based line fishing around the Kogelberg coast is that provided by Sauer *et al.* (1997). This survey was conducted 15 years ago and much has changed in the fishery. The substantial (~80%) reduction in commercial line fishing rights undoubtedly resulted in a more or less equivalent increase in the number of recreational line fishing boats. Furthermore, the recreational fishing permits were introduced and new more stringent line fish regulations were gazetted in the interim. Sauer *et al.* (1997) reported on the recreational line fishery over fairly large

spatial scales and the Kogelberg fell within the Southern Cape zone (Cape Hangklip-Bree River). A total of 248 boat inspections were conducted in this zone during 1994-1996, although only 15 of these were recreational line fish boats (remember that at this time some ~2 400 commercial line fish boats were licensed). Overall CPUE for boat-based recreational line fishers in the Southern Cape zone was the lowest for the whole country at a mere 8.6 kg.boat-day⁻¹ but this low catch rate is considered unreliable due to the very small sample size (Sauer *et al.* 1997).



FIGURE 47. RECREATIONAL SHORE ANGLING.

Three “private/club” launch sites (Rooiels, Pringle Bay and Stony Point) and two public launch sites (Maasbaai and Kleinmond) are available to recreational fishers in the Kogelberg area, whilst the area can also be accessed from the Strand, Gordons Bay and Hawston slipways. It is likely that boat based recreational line fishers along the Kogelberg coast have a similar catch composition as the commercial line fishers shown above (Figure 25), although snoek is probably of lesser importance to recreational fishers, whilst geelbek, silver kob, yellowtail *Seriola lalandi* and red roman *Chrysoblephus laticeps*, amongst others, are more desired species. The three aerial surveys conducted during the peak holiday period recorded an average instantaneous count of 33 (min=19, max = 54) vessels at sea throughout the Kogelberg coast. This instantaneous count is not the total number of boat outings on a day, as at the time of the flyover some would have already returned to shore and others yet to launch. Quantitative data on the timing and duration of boat trips are needed in order to accurately convert the instantaneous count to a total daily effort count. These data are not available for this survey, but a rough turnover rate of 1.5 boats.24 hours⁻¹ is a good approximation (Pradervand *et al.* 2003). This means that on average about 50 boats are fishing along the Kogelberg coast on any given day during peak summer holiday period. At this time, recreational boat effort was concentrated from Rooiels around to Maasbaai and off the Kleinmond slipway (Figure 48).

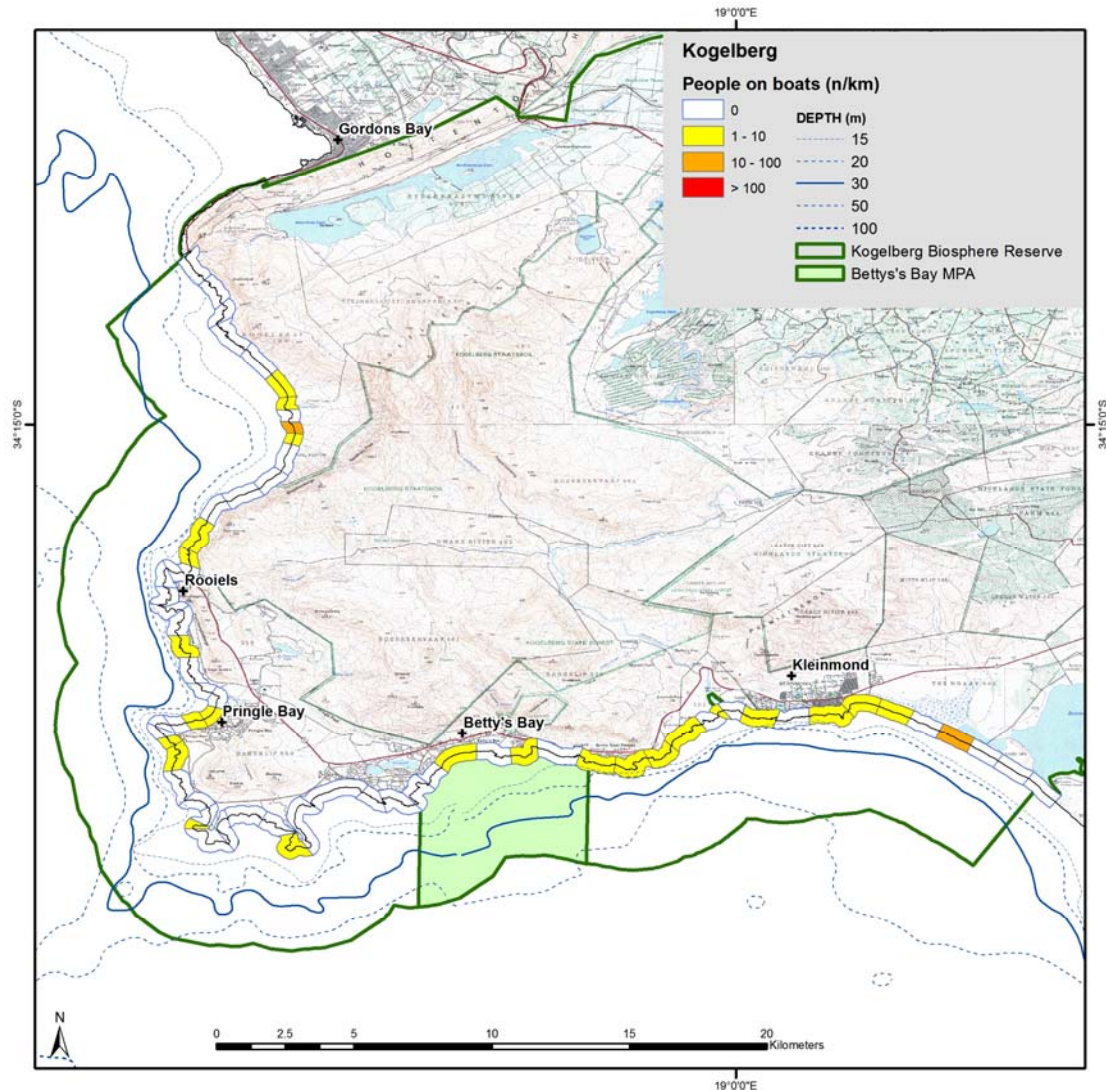


FIGURE 48. SPATIAL DISTRIBUTION OF BOATING AROUND THE KOGELBERG COAST SHOWING INSTANTANEOUS COUNTS MADE DURING THREE FLIGHTS CONDUCTED DURING DECEMBER 2008 AND JANUARY 2009

These are not all recreational line fishing vessels. A small number may be commercial line fishers and the vast majority would be targeting rock lobster. It is clear that recreational rock lobster fishing is a major draw card in the Kogelberg region (see below) and many recreational fishers targeting lobster from vessels (ski boats, rigid inflatable boats, dinghies, canoes, fishing skis etc) do participate in recreational line fishing at the same time (pers. obs). Quasi-recreational boat-based line fishing for geelbek, silver kob and other species at night in Maasbaai and the Betty's Bay area is also popular during the summer months, with many participants probably often exceeding the two fish per person bag limit and selling surplus catch (pers. obs). Recreational boat fishing is undoubtedly less popular during the winter months with regular bad weather, the closure of the recreational rock lobster season at Easter and many of the target line fish species becoming unavailable when waters cool. The exception would be during snoek "runs" that usually occur in late winter.

5.4.1.2 Shore-based angling

Recreational marine angling from the shore is one of the most popular coastal leisure activities in South Africa with an estimated excess of 400 000 participants in 1996 (McGrath *et al.* 1997). The number of shore anglers is expected to have increased at a rate at least equivalent to the general South Africa population growth rate (1.2% per year – Statistics South Africa 2006) since then and there were probably about 460 – 500 000 recreational shore anglers in 2008. Attwood & Farquhar (1999) reported the results of a roving creel survey conducted along the coast between Cape Hangklip and Walker Bay during March 1995-January 1997. A total of 2 448 inspections conducted during this survey revealed an average shore angler effort of 1.42 angler-days.km⁻¹, with anglers catching 11 species at an overall CPUE of 0.32 fish.angler-day⁻¹ (Attwood & Farquhar 1999). This was well below the average CPUE of 1.55 fish.angler-day⁻¹ estimated for the South West Cape as a whole during the National Line fish Survey (Brouwer *et al.* 1997). Galjoen *Dichistius capensis* dominated the recreational shore angler catch at this time, followed by silver kob, white steenbras *Lithognathus lithognathus* and blacktail *Diplodus sargus* (Figure 49).

Additional data on shore angling effort along the coast from Cape Hangklip to the Steenbras estuary are available from seven aerial surveys conducted on weekends between March and October 1996 as part of the National Linefish Survey (Lamberth 1997). No catch data is available for shore anglers along this stretch. Instantaneous counts of shore angler made during the current study were converted to angler effort estimates (angler-days.km⁻¹) by dividing the average (of three flights) counts by the length of the survey block and multiplying by an estimated turnover rate of 2.5 (Brouwer *et al.* 1997, Attwood & Farquhar 1999). Counts from individual aerial survey zones were combined to the same survey beats as used by Attwood & Farquhar (1999) and Lamberth (1997) to allow comparisons with these earlier surveys (Figure 50).

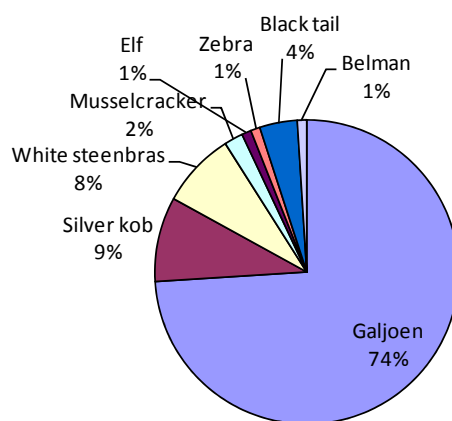


FIGURE 49. CATCH COMPOSITION OF RECREATIONAL SHORE ANGLERS ALONG THE COASTS BETWEEN CAPE HANGKLIP AND WALKER BAY (1995-1997). (SOURCE: ATTWOOD & FARQUHAR 1999).

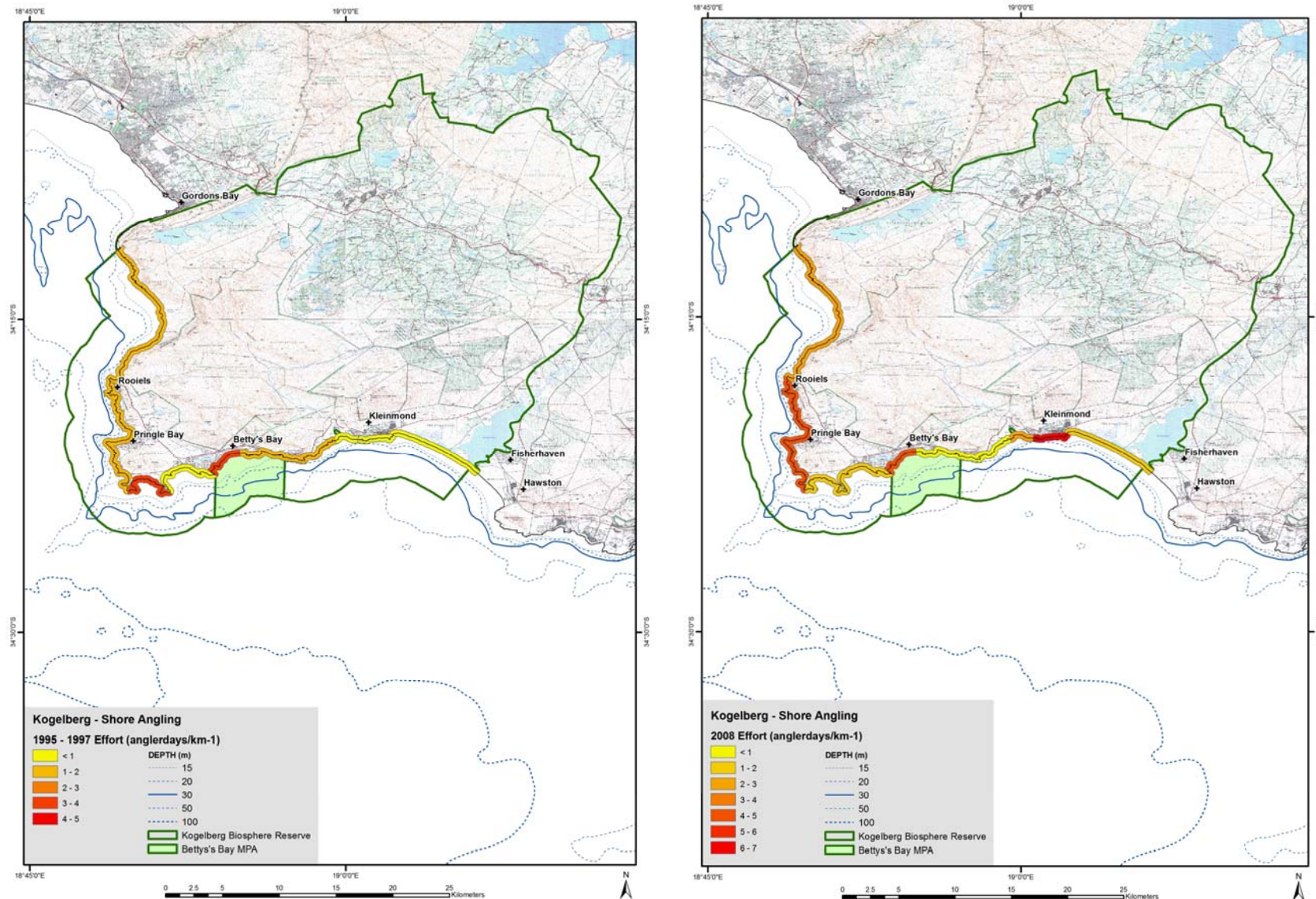


FIGURE 50. DISTRIBUTION OF SHORE ANGLING EFFORT ALONG THE KOGELBERG COAST BASED ON HISTORICAL (1995-1997) AND RECENT (2008) DATA.



FIGURE 51. BOAT LAUNCHING SITE AT MAASBAAI IN THE KOGELBERG BIOSPHERE RESERVE.

Higher shore angler effort has been recorded in the past towards the western side of the Kogelberg coast (From Betty's Bay to Heuningkloof=Steenbras River mouth) (Figure 52). Current shore angler effort levels are somewhat higher than historical estimates at Kleinmond, Sunny Seas and Rooiels, but lower at Palmiet and Maasbaai (Figure 52). The current survey was conducted during the peak summer holiday period, whilst the earlier surveys covered all seasons (Attwood & Farquhar 1999) and are more representative of the year round pattern, or predominately conducted during the winter months (Lambert 1997). High angler counts during the recent survey at family-friendly, easily-accessible sites such as Kleinmond and Rooiels are to be expected during peak holiday periods. The season for galjoen, the dominant species in the shore angler catches and presumably the primary target species, is in winter. Thus the distribution of anglers in the recent survey may not be entirely representative of average distribution of effort through the year.

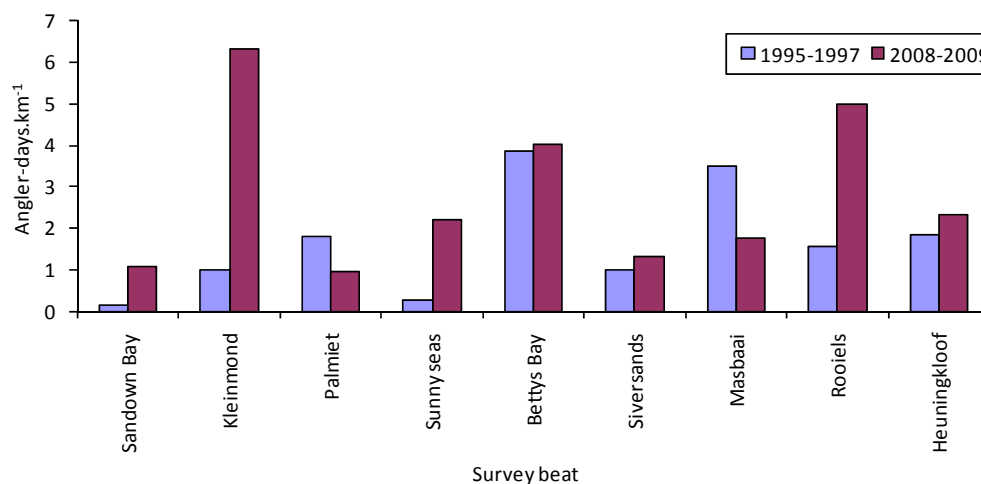


FIGURE 52. HISTORICAL AND CURRENT SPATIAL DISTRIBUTION OF SHORE ANGLING EFFORT ALONG THE KOGELBERG COAST. SOURCES: 1995-1997 DATA FROM ATTWOOD & FARQUHAR (1999) AND LAMBERT (1997).

5.4.2 Recreational spear fishing

There is generally less data available on recreational spear fishing along the South African coast than for any other fishing activity. As a result of the high physical and mental fitness requirements to partake in the sport there are relatively few participants - estimated at only ~7 000 in 1996 (Mann *et al.* 1997). Furthermore, spear fishers are often not available for catch inspections or interviews during roving creel or access point surveys (mostly in the water and dispersed along the coastline). As a consequence, much of the available data comes from club or spear fishing association records of competitions or from inspections in frequently patrolled, managed areas (e.g. Greater St Lucia Wetland Park). These do not necessarily reflect the “usual” recreational spear fishing catch composition or catch rates (Mann *et al.* 1997). The 1994-1996 national line fish survey only recorded 74 spear fishing outings in the Western and Eastern Cape provinces. These spear fishers had an average CPUE of 0.45 fish.spearfisher-hour⁻¹. Only two spear fishers were interviewed along the Kogelberg coast during the 1994-1996 survey and these spear fishers had not landed any fish, but were targeting yellowtail, hottentot, galjoen, blacktail and red roman. Mann *et al.* (1997) provides a catch composition of spear fishers in the Western Cape based on competition data that includes at 14 species contributing ~90% of the catch, all of these are found along the Kogelberg coast and are undoubtedly occasionally landed by spear fishers active in the area. Between two and thirteen free divers were counted during the aerial surveys conducted during this study, but it was not possible to discriminate between consumptive (spear fishers, rock lobster divers, often do both) and non-consumptive divers from the air.

5.4.3 Recreational rock lobster harvesting

The recreational rock lobster fishery is open access, but total effort in the fishery is limited by controlling fishing season length and the length of the fishing day. The recreational fishery size limit (79 mm carapace length) is slightly larger than the commercial size limit (75 mm), and a bag limit of four crayfish per permit holder per day is enforced. Over the period 1987-1996 the recreational season varied between 5 and 6 months (150-180 days) long and fishing was permitted between sunrise and sunset (Cockcroft & Mackenzie 1997). Since 2000 fishing after 31 January has been restricted to weekends & public holidays (2000/2001-2007-2008 seasons) and more recently after 31 December (2008-2009 season) (Figure 53). Recreational fishing effort was further reduced since 2004 by restricting permit holders to only land rock lobster between 8 am and 4 pm. The reduction in recreational fishing effort was needed in order to meet general MCM policy of maximizing the commercial TAC and broadening access to the resource, particularly for previously disadvantaged individuals. (This is one of the primary stated objectives of South Africa’s Marine Living Resources Act of 1998).

Although variable, there has been a slight reduction in the number of recreational rock lobster permits sold in recent years (post-2004) with an annual average of 38 000 permits sold during 2005-2008 and an annual average of 52 000 sold over the period 2000-2004 (Figure 53). Numbers of permits sold appears to increase when the season length is decreased while fewer are sold when the season is lengthened. This is probably a result of the natural human inclination to try and take advantage of a resource that is available for a limited time period only, but may also be driven by unknown socio-economic factors (petrol price, inflation etc).

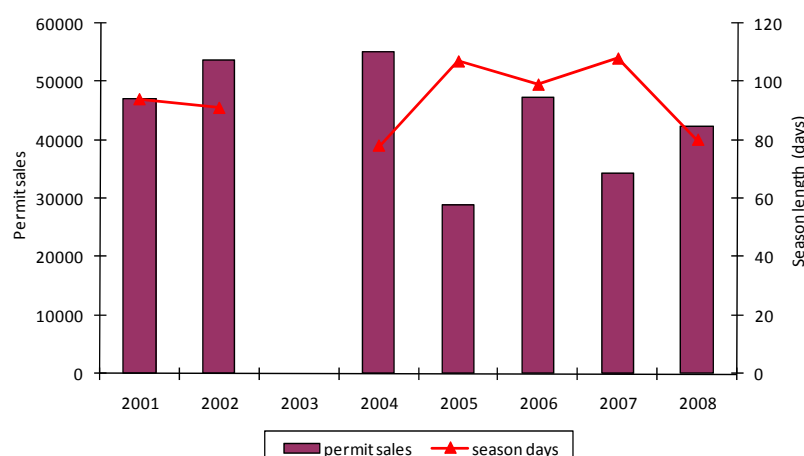


FIGURE 53. ANNUAL NUMBER OF PERMIT SALES AND THE LENGTH OF THE ROCK LOBSTER FISHING SEASON 2000/01-2007/08 FISHING SEASONS (SOURCE: MCM TELEPHONE SURVEY REPORTS).

MCM annually contracts service providers to estimate recreational rock lobster catch and effort by means of a telephone survey. The recreational permit has a form on the reverse side on which permit holders are required to complete daily catch returns. MCM law enforcement inspectors regularly check recreational rock lobster fishers to ensure that the catch size and bag limits are obeyed and that the catch return forms are completed. As a result, compliance with this requirement is reasonably good which facilitates data collection via the telephone survey. No data were available for the 2002/2003 fishing season. Recreational fishers are not spatially limited to where they collect their lobsters, but respondents in the survey are asked where they fished and the data is analysed by recreational fishing zones. The Kogelberg coast falls within a broader assessment area 9, this includes the coastline east of Cape Hangklip (as far as Gansbaai). MCM staff estimate that 50% of the recreational catch in this area is made along the Kogelberg coast (D. van Zyl, pers. comm.). Within the Kogelberg region, boat based recreational rock lobster fishing is concentrated in the vicinity launch sites (Rooiels, Pringle Bay, Maasbaai and Kleinmond) although some recreational fishers launch at Gordons Bay or Strand slipways to catch rock lobster within the Kogelberg (Figure 48). Shore based (using poles, hoopnets & diving) takes place throughout the Kogelberg coast wherever rocky shores and reefs occur but would be concentrated where access to the shore is available.

Since the 2000/2001 season the estimated recreational rock lobster catch from the Kogelberg coast has averaged 58 tons per year over the period 2000-2008, this is equivalent to about 25% of the total national recreational catch (Figure 54). With the exception of 2006, both the total and the Kogelberg recreational catch post 2004 was about half that estimated for 2001 and 2002 (Figure 54). As a result the Kogelberg catch as a percentage of the commercial TAC dropped from around 5 % to between 1-2% (Figure 54). Considering the Kogelberg region alone, the average annual estimated recreational catch since 2004 equates to nearly half (46 %) of the estimated commercial catch for the area (Commercial catch area 11 & 12, average = 95 tons, Figure 38, Figure 54). Nonetheless, the management objective of reducing the recreational catch as a proportion of the commercial TAC has been achieved with the total recreational off take now averaging only 7 % of the TAC over the last five seasons compared to around 20% of the TAC for much of the preceding decade. This reduction appears to have been achieved largely through restriction of effort by reducing the length the fisher day, with

permit holders on average catching fewer lobster per season post 2004 compared to the 2000-2002 seasons (Figure 55).

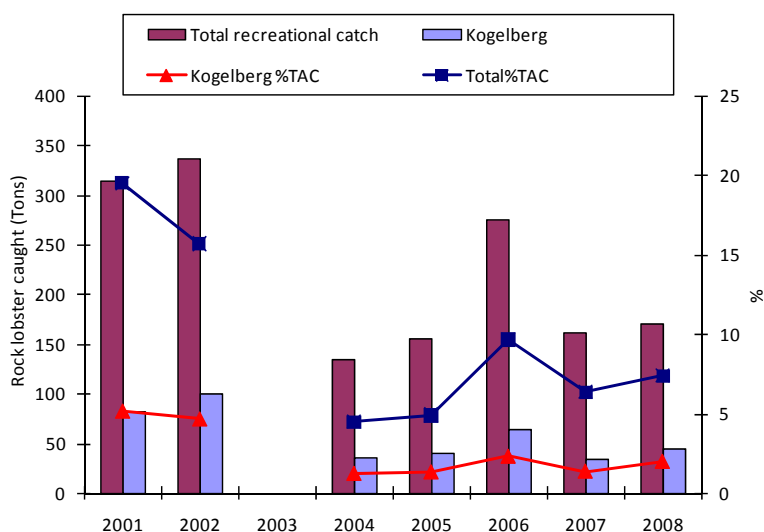


FIGURE 54. TOTAL NATIONAL AND KOGELBERG RECREATIONAL ROCK LOBSTER CATCH SHOWING THE PERCENTAGE RECREATIONAL CATCH IS OF THE GLOBAL COMMERCIAL TAC (SOURCE: MCM TELEPHONE SURVEY REPORTS).

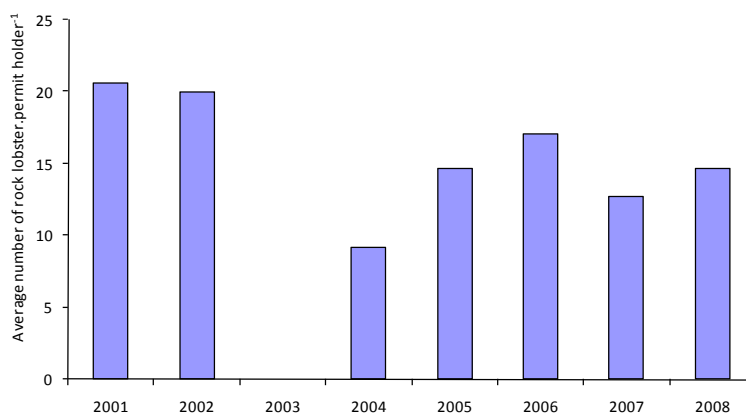


FIGURE 55. AVERAGE NUMBER OF ROCK LOBSTER CAUGHT PER PERMIT HOLDER PER SEASON (CORRECTED FOR SEASON LENGTH) (SOURCE: MCM TELEPHONE SURVEY REPORTS)

5.4.4 Recreational abalone harvesting

Prior to 2003, the recreational abalone fishery was controlled by a permit system, minimum size limit (114mm shell diameter), closed season and daily bag limit. These restrictions became more severe as poaching levels escalated and managers struggled to maintain a sustainable commercial fishery. The recreational season was drastically shortened for the 2000/2001 season from four months to only 11 days and the recreational abalone fishery was closed prior to the 2003/2004 season. Whilst the recreational abalone fishery existed, MCM conducted annual telephone surveys in much the same manner as for the recreational rock lobster fishery in order to estimate the recreational off-take. Over the last six recreational abalone seasons, the estimated

recreational catch in the Kogelberg region averaged 50 tons per season. Prior to 2000, the recreational catch was between 40-90 tons (1997-2000) before the fishing season was shortened, about 60 % of the annual commercial catch for the region and between 8-17% of the total commercial TAC (Figure 56). Post 2000, both commercial and recreational catches dropped – the former due to reduction in the area-specific TAC and the latter due to a reduction in season length, but over this period the recreational catch equalled or exceeded the commercial catch (Figure 56). The recreational fishery was suspended nationally prior to the 2003/2004 season, and the commercial fishery in the Kogelberg (MCM zone D) was close two years later prior to the 2006/2007 season.

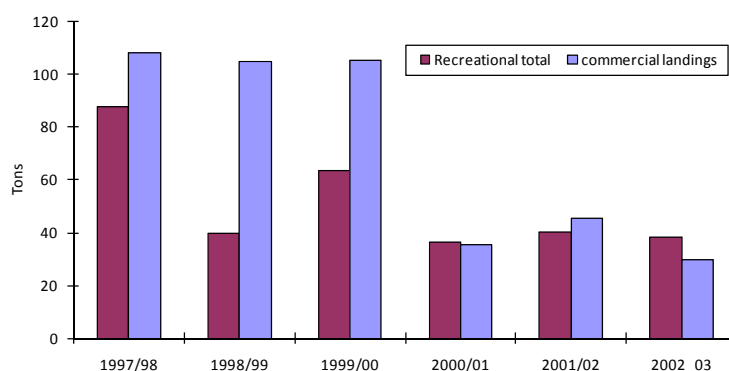


FIGURE 56. ESTIMATED RECREATIONAL AND REPORTED COMMERCIAL ABALONE LANDINGS FOR THE KOGELBERG COAST 1997-2003 (SOURCE: MCM).

5.5 MARICULTURE

Currently there are no active mariculture operations along the Kogelberg coast, several shore-based abalone farms have however, been proposed, or have operated along the Kogelberg coast in the past. The Department of Environmental Affairs and Tourism, Branch: Marine and Coastal Management list of successful applicants to engage in mariculture for the year 2005 as at 07/09/2005 listed two companies based at the same premises in Kleinmond (Avuca Abalone & Fish Bay Mariculture) and a company, Pringle Cove Abalone based at Pringle Bay. The former two companies were in a joint venture with a third company Global Ocean and operated an abalone hatchery and grow out facility at premises on Harbour road Kleimond up until February 2008 (Personal communication, Kriek Bekker, Global Ocean). The reasons for the closure of this facility (the aquaculture farming licence has been officially cancelled with MCM) include the limited area available for expansion of the farm, (precluding the economies of scale necessary for a viable land based aquaculture farm); an outbreak of a fungal organism within the farm's stock, and the high real estate value of the land (personal communication, Kriek Bekker, Global Ocean). Although the water use rights for this property are still valid, Mr. Bekker is of the opinion that another abalone farm is unlikely to develop on this land for the above mentioned reasons. He did think that a purging/holding facility for rock lobster prior to live export is a feasible alternative use of these water rights, but he did not know of any plans for this. The aquaculture rights of third successful applicant "Pringle Cove Abalone" were withdrawn after a court action by local residents opposed to the development of the facility and it was never built (Neville Green, Overstrand Municipality, personal communication). Mr Bekker of Global Ocean feels that future mariculture development along the Kogelberg coast is unlikely due to the high levels of environmental consciousness amongst local residents.

The area is also not an identified mariculture development node according to the Draft Marine Aquaculture Sector Development Plan (DEAT MCM 2006).

5.6 ILLEGAL FISHING

Illegal fishing takes place whenever living marine resources are harvested in a manner not compliant with the relevant regulations for the species harvested. This may include fishing without the correct permit or in contravention of permit conditions, catching of undersize individuals, landing in excess of the daily bag limit, fishing in closed areas or during closed seasons etc. The degree of compliance with South African fishery regulations varies around the coast and is largely related to the degree of enforcement in any given area. The national line fish survey revealed a very poor knowledge of the fishery regulations pertaining to line fishing, amongst commercial and particularly amongst boat and shore based recreational line fishers in the Cape Provinces, with knowledge of the regulations being only slightly better in KZN (Sauer et al 1997, Brouwer et al 1997). This obviously translates into poor levels of compliance amongst line fishers. There is no evidence indicating that the situation amongst recreational anglers has improved at all since then. Compliance amongst commercial line fishers is likely to have improved post 2003 with the ~80% reduction in the number of permit holders, but there is no recent data available to test this. Typically in the Western Cape (and Kogelberg) enforcement activities are focused on the high value commercial species such as rock lobster and abalone. As discussed above, compliance with rock lobster regulations by commercial and recreational fishers along the Kogelberg coast is probably fairly good. With the large reductions in abalone density in the area however, a shift in large scale poaching effort to rock lobster, the next most accessible and valuable species is anticipated (if not already occurring). Extensive gill net poaching of fish in the Bot River estuary on the eastern border of the Kogelberg zone has been taking place for about the last 10 years and is having with a detrimental impact on the stocks of estuarine dependent species (S. Lamberth MCM, pers. comm.)



FIGURE 57. ABALONE POACHERS IN THE BETTY'S BAY MPA.

Abalone poaching is the illegal fishing activity within the Kogelberg coast that has received the most official and public attention. The Kogelberg coast falls within the historically most productive abalone fishing area (Tarr 1989), and uncontrolled poaching has resulted in the closure of both the recreational and commercial abalone fisheries. Several state and public-state initiatives (Operation Neptune, The Marines, Seawatch) have failed to bring an end to abalone poaching in the Kogelberg area, or nationally. A combination of a highly valuable species that is easily accessible from the shore, unlimited demand for the product on eastern markets, high levels of unemployment and poverty amongst coastal communities and the involvement of organized criminal gangs are contributing factors that appear to make this illegal fishery apparently impossible to control. The annual number of abalone confiscated annually, converted into a mass of abalone confiscated over the period 1994-2006 is shown in Figure 58. This was done using a conversion ratio of 0.7kg per abalone (which probably becomes increasingly inaccurate over time as poachers land progressively smaller abalone).

The volume of confiscated abalone both from the Kogelberg area and nationally increased rapidly from the late 1990's (Figure 58). Confiscations from the Kogelberg peaked at around 14-20 tons during 2000-2003 and then dropped off sharply to 3-6 tons per year with the closure of the recreational fishery in 2003 which apparently facilitated enforcement efforts (Figure 58). The alternative, more worrying explanation is that stocks are simply so overexploited that poachers have moved their attentions to other areas of coast. The number of abalone confiscated nationally however, was only temporarily checked with the recreational fishery closure in 2003 and climbed again to record levels of nearly 1 700 tons in 2006 (Figure 58). It must be noted that MCM estimates that on average only ~14 % of abalone poached are confiscated and hence the total poached mass is approximately seven times the values shown in Figure 58. Since the total commercial TAC was only 223 tons for the 2005/2006 season, the mass of poached abalone nationally in that year (about 7000 tons) was approximately 30 fold the commercial catch. Data on the number of abalone confiscated during 2007 and 2008 have not yet been finalized.

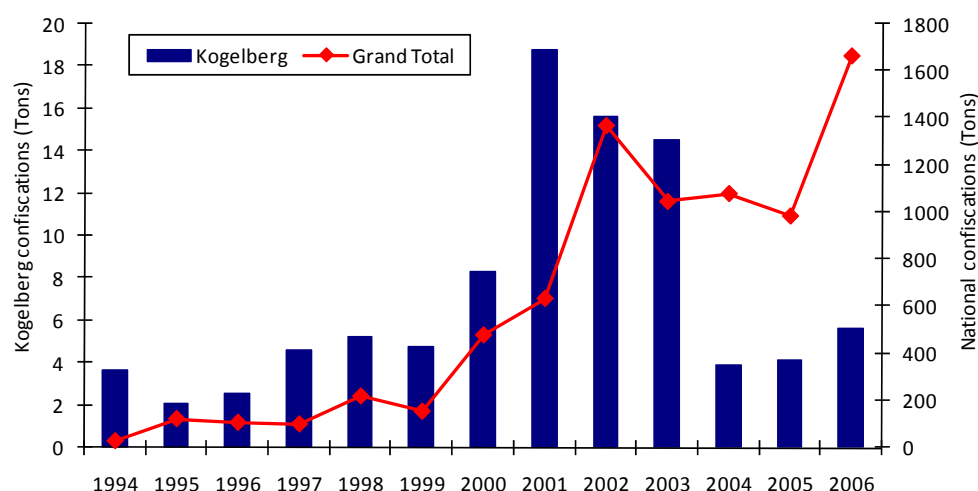


FIGURE 58. MASS OF ABALONE CONFISCATED ALONG THE KOGELEBERG COAST AND NATIONALLY 1994-2006 (SOURCE: MCM).

Additional information on abalone poaching along the Kogelberg coast (Rooiels-Kleinmond) was obtained from Seawatch, a volunteer group of concerned citizens based in Bettys Bay. Seawatch relied on a network of local informants who observed, recorded and reported abalone poaching activities in the area. Seawatch assisted various law enforcement bodies and initiatives, including the MCM inspectors, Operation Neptune (SAP and MCM task force) and the Marines (Overstrand municipality anti poaching unit) by communicating the occurrences of poaching events as they were happening. Seawatch also kept accurate records of the number of poaching events reported to them, and the number of successful preventions resulting from them informing enforcement agencies (which took the form of arrests, confiscations, fines, warnings etc). These data mirror the trends shown for the confiscations of poached abalone shown above (Figure 58, Figure 59). The number of poaching events escalated rapidly between 2000 and 2003 and then dropped to lower, but nonetheless still a significant level (average 26 per month) from July 2003 (Figure 59). Poaching intensity appeared to be seasonal, peaking over the summer months; this is related to both more favourable diving conditions and the greater market demand. The relationship between enforcement success and poaching intensity is clear in many cases, a high success rate is followed by a drop in the number of poaching incidents and the converse also occurs (Figure 59). Seawatch attributes the low success rate between December 2001 and March 2003 due to the moving of Operation Neptune to Hermanus, a lack of MCM inspectors in the area, alleged corruption within enforcement bodies and intimidation of Seawatch members. Seawatch is also of the opinion that the quality of the leadership of various antipoaching groups and the quality of communication between Seawatch and these groups was a strong factor influencing the success rate. The good success rate post mid-2003 is attributed to the presence of Operation Neptune SAP members in the vicinity and the establishment of the Marines. A concerning gap between poaching incidents and the success rate was again starting to occur after May 2006, partly due to the closure of the Marines group by the Overstrand Municipality (Figure 59).

5.7 NON-CONSUMPTIVE USE OF MARINE AND COASTAL RESOURCES

5.7.1 Introduction

Non consumptive use of marine and coastal resources involves the use of a resource such that the supply of that resource is not depleted, and it typically includes many forms of coastal recreation and ecotourism. Non-consumptive resources have the potential to produce a substantial income for the tourism industry, and offer major opportunities for development. Marine ecotourism, if managed properly, can provide a platform for environmental education and conservation, as well as provide employment opportunities and socio-economic empowerment for coastal communities (DEAT, 2006).

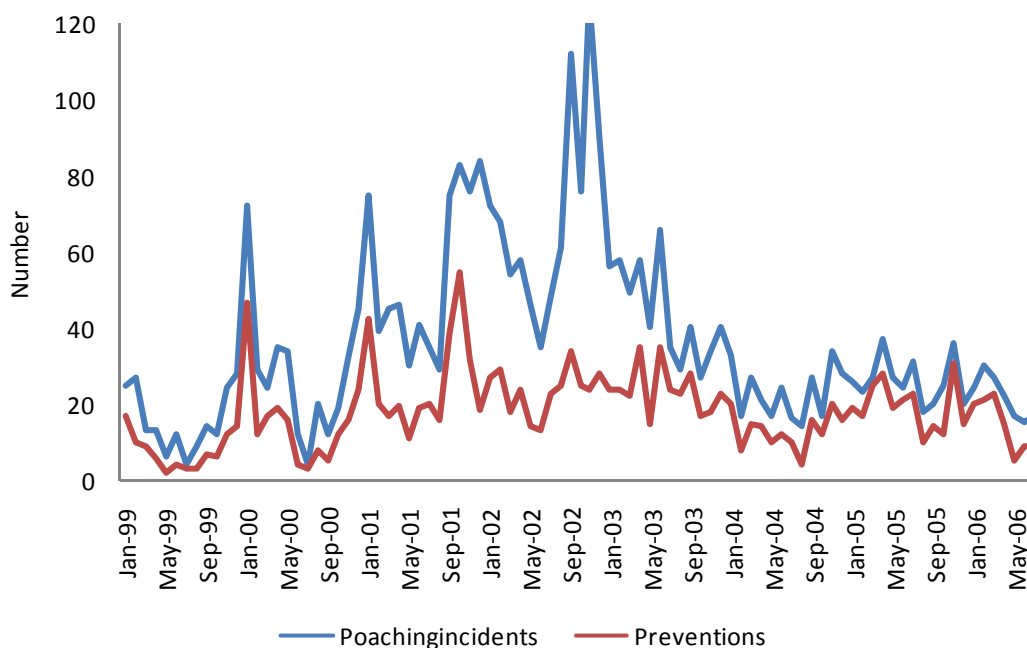


FIGURE 59. NUMBER OF POACHING INCIDENTS AND THE NUMBER OF SUCCESSFUL PREVENTIONS OF POACHING EVENTS ALONG THE KOGELBERG COAST BASED ON DATA FROM THE SEWATCH PROGRAMME (MIKE TANNETT AND RICHARD STARKE).

Non-consumptive uses are often considered to have minimal impact on the environment in as much as they do not consume or remove reove resources from the environment. However, disturbance associated with non-consumptive use can have a very severe impact on the environment and other peoples' enjoyment thereof. Offroad vehicles, speedboats and jetskis disturb sensitive species such as birds and mammals as well as posing a risk to human health, and can also pollute the environment through exhaust fumes and other discharges. People themselves can also have an impact on the environment through trampling, which impacts on rocky shore fauna and flora and dune vegetation. Dogs and other pets are also an important source of disturbnace for nesting, feeding and roosting birds and other fauna. These activities need to be carefully managed to ensure that damage to the environment and risks to human health are minimised

Three aerial surveys of the Kogelberg were conducted in peak summer holiday season in order to enumerate the number of people partaking in various non-consumptive activities such as watersports, boating, relaxing on the coastline, swimming and exercising, the results of which are described below. Data on boat-based whale watching effort within the Kogelberg and adjacent areas were obtained from Marine and Coastal Management (MCM) to provide an indication of the contribution of whale watching to marine eco-tourism in the Kogelberg region. Other sectors of marine ecotourism that have been described include birding and scuba diving, both of which enhance the tourism value of the Kogelberg Biosphere Reserve.



FIGURE 60. LOCATION OF POPULAR SANDY BEACHES WITHIN THE KOGELBERG BIOSPHERE RESERVE. SOURCE: GOOGLE EARTH INC.

5.7.2 Shore-based non-consumptive activities

Shore-based non-consumptive activities along the coast include walking, sunbathing/relaxing, swimming, exercising on the beach and the appreciation of nature and wildlife. The latter includes spotting and watching birds and cetaceans. Apart from the latter, these activities are mainly concentrated around the sandy beaches. There are six major sandy beaches within the KBR area, at Koeëlbaai, Rooiels, Pringle Bay, Betty's Bay, Palmiet and Kleinmond. With the exception of Koeëlbaai, all of these beaches are adjacent to small coastal towns, which receive swathes of visitors during weekends and holidays. The Rooiels, Pringle Bay and Kleinmond beaches are also associated with estuary mouths, which are characteristically sheltered environments and good for bathing and certain watersports. All of the main beaches are accessible by road and have parking facilities. There are also several seaside walking trails in Kleinmond and Betty's Bay, and these are well described in the "Where to Walk in Kleinmond" guide, which is available from the Kleinmond Tourism Bureau.



FIGURE 61. VISITORS AND RESIDENTS ENJOYING THE BEACH AT BETTY'S BAY

Three aerial surveys were conducted during December 2008 and January 2009 in order to determine the number and density of people partaking in various activities along the coastline. The density of people swimming, relaxing and exercising was greatest on sandy beaches and near estuaries, which are typically associated with coastal towns and residential areas (Figure 62). The rocky shore along the Kogelberg is exposed and subject to strong wave action and is thus unsafe for bathing and not conducive to relaxing. Several people were, however, counted exercising on paths adjacent to the rocky shore.

The penguin colony at Stony Point is a popular tourist destination and attracts many visitors who are interested in observing penguins in their natural environment. A total of 6 770 people visited the colony in December 2008, and 1 752 in January 2009, which correspond to the peak summer holiday period. No other data were available with which to describe the temporal variation in visitor numbers, and it was thus not possible to estimate either the annual visitors or the economic value of the colony, which would be done by calculating the expenditure of visitors to the colony on the R20 entrance fee and other expenditure associated with it, such as on refreshments. The general public survey undertaken in December 2008 highlighted that the presence of the penguin colony was not a major influence in attracting visitors to the Kogelberg coast, with 77% of visitors interviewed stating that it was not an influence at all, 13% stating this it was somewhat of an influence and 10% that it was a strong influence. The bistro that has been opened next to the colony and the plans to expand the activity centre could potentially increase the popularity of the penguin colony amongst visitors and increase its economic value and contribution to the Kogelberg coast.

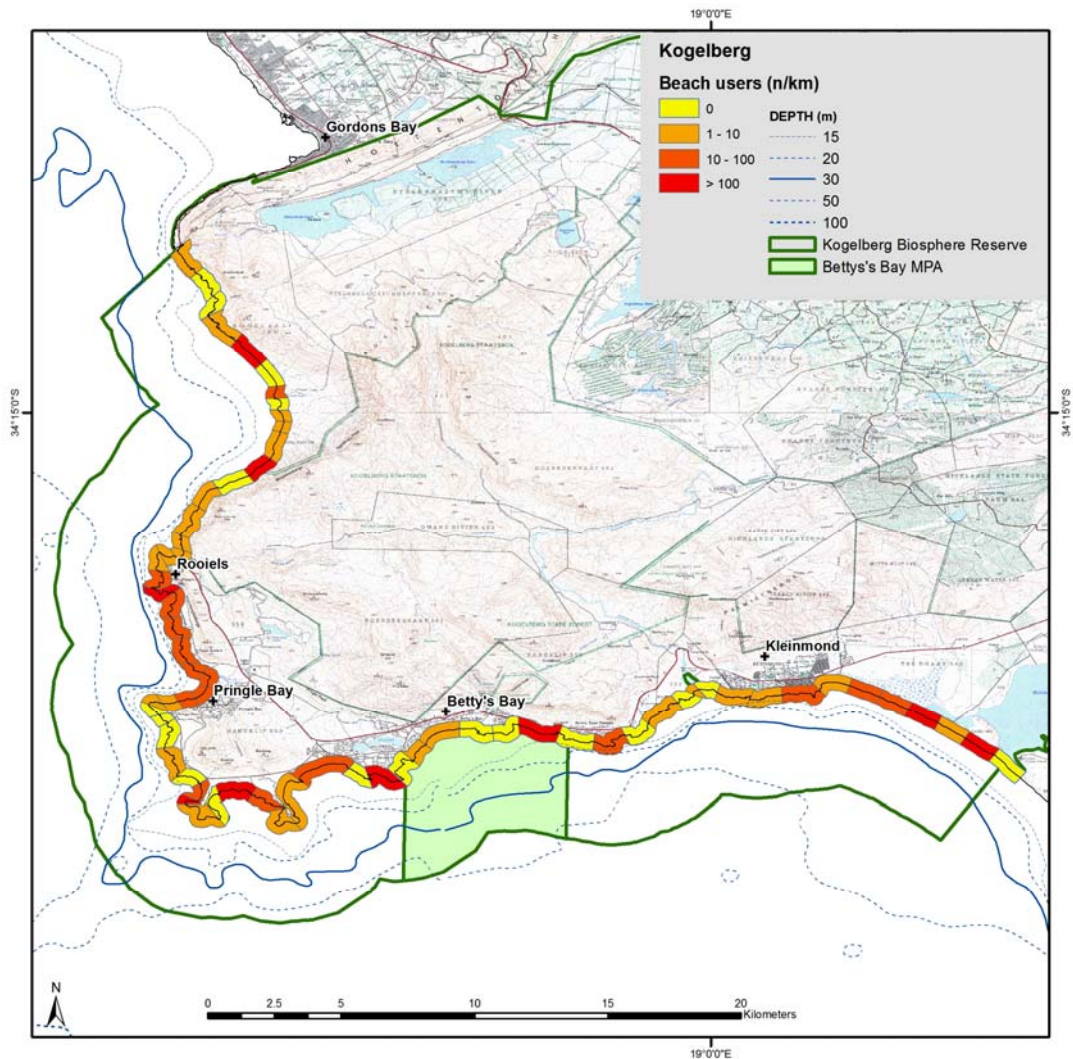


FIGURE 62. DENSITIES OF BEACH USERS ON THE KOGELBERG COAST, EXCLUDING SHORE-ANGLERS.

The other major birding site within the Kogelberg area is the Bot/Kleinmond Estuary, which supports over 163 species of birds, 62 of which are waterbirds. The estuary can support between 25 000 and 40 000 birds and is an important summer refuge for waterfowl (Barnes 1998). It also holds the greatest number of coots in South Africa, with the Redknobbed Coot being the dominant waterbird (Barnes, 1998).

5.7.3 Water sports and boating

Surfing, paddle-skiing and boogie-boarding accounted for 82% of the number of people engaged in water-sports in mid-summer (Figure 63). Kayaking was particularly popular on the Kleinmond Estuary, Betty's Bay beach and at Pringle beach. The distribution of people engaged in water sports (other than angling) is shown in Figure 64.

Approximately 60 % of the people on board motorized boats were either angling or catching crayfish, and nearly all boats had at least one person angling. There is little boating in the study area (apart from sailing on the Bot estuary) that is not fishing-associated.

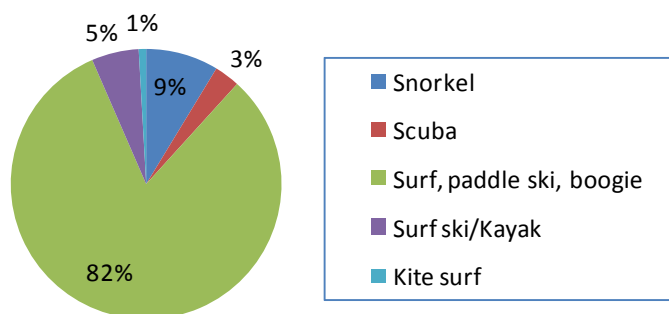


FIGURE 63. PROPORTION OF DIFFERENT WATERSPORTS TAKING PLACE ALONG THE KOGELBERG COAST DURING PEAK SUMMER HOLIDAY SEASON. DATA REFLECT MAXIMUM COUNTS FROM THREE AERIAL SURVEYS.

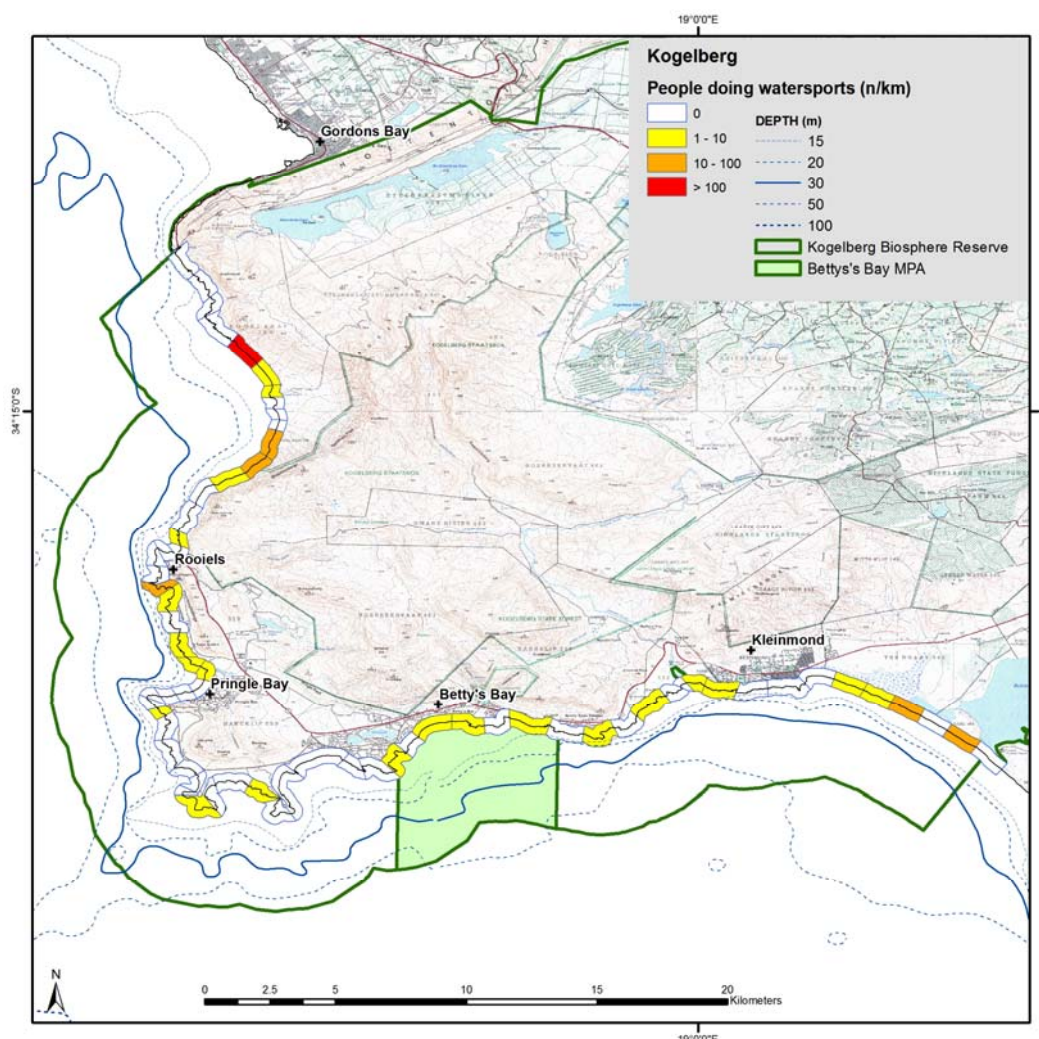


FIGURE 64. NUMBERS OF PEOPLE PARTICIPATING IN WATERSPORTS ON THE KOGELBERG COASTLINE.

5.7.4 Scuba diving and snorkelling

The KBR area is known for its brightly coloured fan corals and orange sponges. Kelp forests, which are also frequently dived, have clear visibility and house a number of larger predators such as pajama sharks, leopard catsharks and pufadder sharks. The steep coastline makes access difficult for snorkelling and shore-entry scuba. There are

nine popular dive sites between Gordon's Bay and Cape Hangklip that have been published in 'the Dive Sites of South Africa' (Koornhof, 1991): Koei en Kalf, Lorrey Bay, Steenbras Deep, Percy's, Crosses, Coral Gardens, Balcony, Anchors, and the Meridian (Koornhof, 1991). Most of these are in the vicinity of Rooiels. Diving in this area is best in summer when the strong south easterlies have cleaned and flattened the sea, although if the south easterly is too strong then conditions are not suitable for diving. Diving conditions are poor in winter due to the north westerly which turns the water rough and green. A Gordon's Bay dive operator (Alpha Dive Centre) runs dives to five of these sites, all of which are shore entries. Alpha Dive Centre typically takes 20 to 30 trips in summer constituting six divers per trip plus one dive master. Dives are charged at R 300/pax. The dive company located in Hermanus (Scuba Africa), does not operate on the Kogelberg reefs. The turnover to the dive operator at Gordon's Bay is estimated to be in the range of R24 000 (assuming the minimum trips of 20 per annum with four divers per trip) to R54 000 (assuming the maximum of 30 trips per annum with 6 divers per trip). Diving is relatively less popular than many other activities along the Kogelberg coast with 75% of respondents (n = 536) in the general public survey conducted in December 2008, stating that they never participated in diving or snorkelling, while 20% (n = 137) participated "sometimes" and 5 (n = 39) a lot. The potential to increase scuba diving along the Kogelberg Coast is constrained by weather conditions that limit the activity to the summer months, and even then a strong south-easter can prevent diving.

5.7.5 Boat-based tours

The south-western cape coast, also known as the Whale Coast, provides some of the best land-based whale watching in the world. Hermanus is possibly the most famous of the whale watching towns in the Western Cape, however many of the boat-based operators enter the Kogelberg to view whales. According the Marine and Coastal Management (MCM) there are two permitted whale watching operators that enter the Kogelberg area, and both are based in Hermanus. The Western Cape province contains 56 % of the gazetted boat-based whale watching areas in the country and boasts the highest subscription to whale watching permits (Turpie *et al.*, 2005). Since the industry of boat-based whale watching was legalized in 1998, whale watching has grown rapidly as a sector of eco-tourism within South Africa (DEAT, 2006).

A number of different cetaceans occur on the southern African coastline, but whale watching focuses on the southern right whales *Eubaleana australis*, humpback whales *Megaptera novaeangliae* and Bryde's whales *Balaenoptera edeni*. Southern right whales migrate to the South African coastline each year to mate and calf in the many sheltered bays. Due to the seasonal migrations of some whale species as well as sea and weather conditions, boat based whale-watching peaks between July and December. Within South Africa whale populations are reportedly greatest between Kleinmond and Mossel Bay, and they generally occur within one nautical mile of the shore (DEAT, 2006). The great diversity of other marine species such as seals, dolphins and seabirds also contribute to the biological attractions of boat-based tours. In order to protect whale populations from human disturbances inflicted by whale watching, the industry in South Africa is strictly regulated (DEAT, 2006). Marine and Coastal Management issue permits to boat operators, and boats are restricted to stop 50 m from the whales for a maximum of 20 minutes. Boats that do not have a permit cannot approach whales closer than 300m, and it is illegal to approach cow-calf pairs. Several popular mating and calving grounds have thus been declared as sanctuaries to protect the whales from excessive disturbance (DEAT, 2006). Marine and Coastal Management are responsible



FIGURE 65 BOAT-BASED WHALE WATCHING IN THE KOGELBERG

for policing the whale watching industry in the Western Cape and for ensuring that permit holders obey the strict code of conduct. It is also however the responsibility of tourists to know the regulations pertaining to whale watching and to ensure that operators do not break the laws simply for the tourists pleasure.

The boat based whale watching industry is proving to be an economically successful form of ecotourism, generating approximately

R45 million in tourism expenditures and contributing approximately R37 million to South Africa's gross domestic product per year (DEAT 2006), with potential for further growth. It has been predicted that the number of permits issued could increase between 20 – 40% in the near future based on existing demand. Management of the industry however needs to address sustainable development in terms of protecting the resource if the industry is to continue growing (DEAT 2006).

There are no permit-holding boat-based whale-watching operators based in the study area. However two Hermanus-based permit holders operate within the Kogelberg area. Both operators have boats with a passenger capacity of 70 people that and conduct between three to four trips a day in season (weather depending), at a charge of R 550/pax. Data obtained from Marine and Coastal Management (MCM) show that the number of passengers on whale-watching tours conducted by these two operators has increased steadily from 2000-2007, with a boom in the industry occurring in 2004 and 2006 (Figure 66). The number of passengers on boat-based tours increase 10-fold from 749 to 7 765 individuals, between 2000-2004, and then almost double to 13 268 passengers in 2007. International tourists are the highest subscribers to boat-based whale tours, constituting on average 93 % of passengers (Figure 66). Data from the two Hermanus based operators indicate that whale sightings (which are correlated to number of trips) have increased exponentially from 2000 to 2007 (Figure 66). On average, 19% of whale sightings on boat-based tours are made within the Kogelberg coast (Figure 66), indicating that the occurrence of whales within the Kogelberg contribute significantly to the value of boat-based whale watching industry with the estimated contribution of boat-based whale tours within the Kogelberg area being R1.39 million. The locations of each boat-based whale sighting between 2000 and 2008 have been transposed onto a map of the south-western cape coast and are shown in Figure 67. It is clear from this image that the majority of sightings within the Kogelberg biosphere reserve are adjacent to the Bot River Estuary and Kleinmond beach. Unfortunately at the time of writing this report no data was available on the boat-based whale watching effort between Gordons Bay and Cape Hangklip (i.e. the eastern border of False Bay).

Shark cage diving occurs further east, with several tour operators based in Hermanus (Sharklady Adventures) and Gansbaai (White Shark Eco Adventures, White Shark Adventure, White Shark Diving Company, Great White Shark Tours, Marine Dynamics, Shark Diving Unlimited and White Shark Projects). There are none in the Kogelberg area, which is further away from Dyer island where shark density is high and also lacks a suitable harbour.

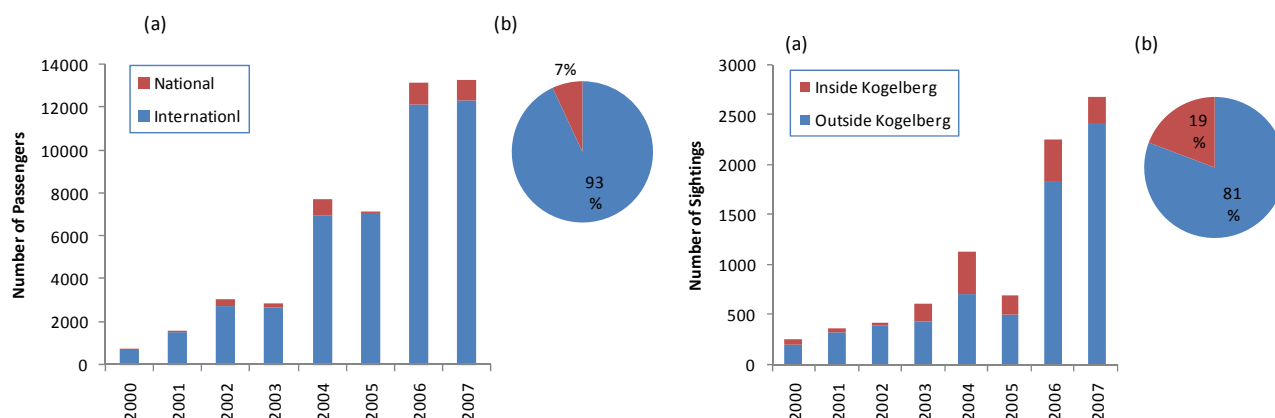


FIGURE 66. LEFT: (A) NUMBER OF PASSENGERS ON PERMITTED BOATS (HERMANUS OPERATORS) FROM 2000-2007 (B) AVERAGE PERCENTAGE OF NATIONAL AND INTERNATIONAL PASSANGERS ON BOAT-BASED TOURS (HERMANUS OPERATORS) FROM 2000-2007. RIGHT: (A) TOTAL NUMBER OF WHALE SIGHTINGS INSIDE AND OUTSIDE THE KOGELBERG ON BOAT-BASED TOURS CONDUCTED BY HERMANUS OPERATORS (B) AVERAGE PERCENTAGE OF BOAT-BASED WHALE SIGHTNGS INSIDE AND OUTSIDE THE KOGELBERG ON BOAT-BASED TOURS.

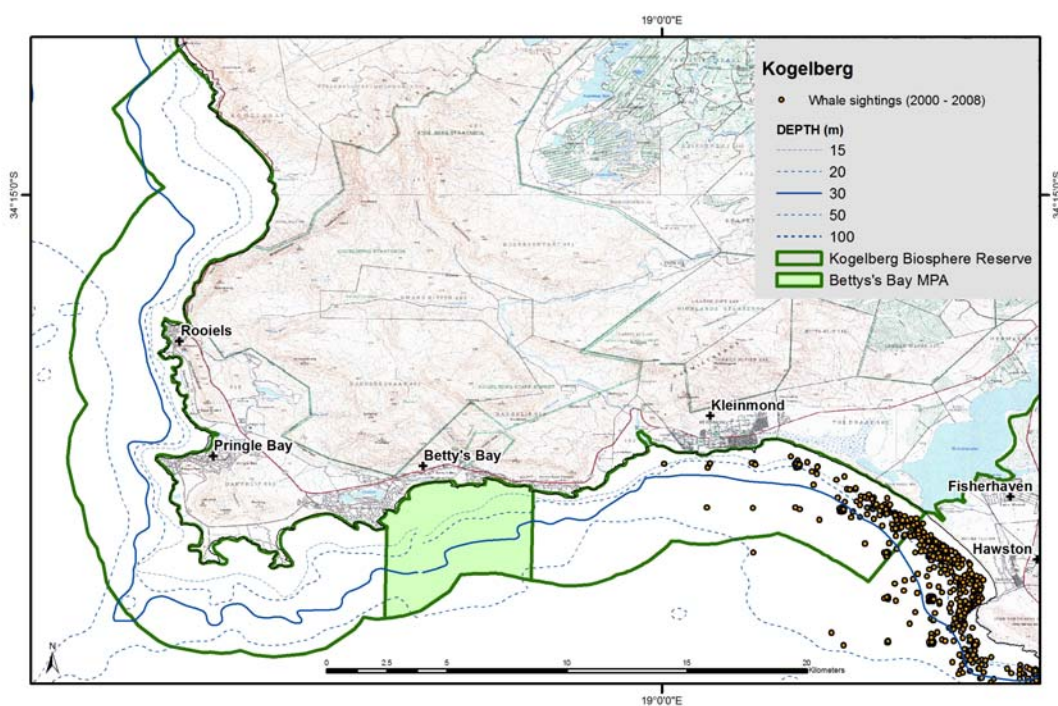


FIGURE 67. MAP SHOWING WHALE SIGHTINGS MADE BY HERMANUS BOAT-BASED WHALE WATCHING OPERATORS FROM 2000-2008

6 VALUE OF THE COAST

6.1 INTRODUCTION

The value of the Kogelberg coast includes the value of natural resource use, recreational value, indirect value associated with ecosystem functioning such as nursery and refuge value, and non-use or existence value. In this study we have concentrated on the more tangible values, but it should be recognised that existence value is an important value inasmuch as it is a reflection on the welfare gains or losses that would be associated with changes in the coast.

6.2 COMMERCIAL & SUBSISTENCE FISHERIES

Commercial fisheries on the coast are currently worth in the order of R20 million per annum, with three-quarters of this value coming from West Coast Rock Lobster (Table 11). The kelp fishery can potentially add a relatively small amount to this if it becomes operational again. Should the abalone resource recover sufficiently to reinstate that fishery, with a conservative estimate of TAC of 50 tons, this would double the commercial fishery value of the area.

TABLE 11. ESTIMATED VALUE OF RESOURCES HARVESTED IN COMMERCIAL FISHERIES ALONG THE KOGELBERG COAST AND ESTUARIES PER ANNUM. VALUES IN PARENTHESES ARE POTENTIAL VALUE IF THE FISHERIES WERE REINSTATED

Fishery	Landed price/kg	Approximate Landed Value
West Coast Rock Lobster	R160-180	R16.1 million
Abalone	R450	(R22.5 million)
Linefish	R25	R4.0 million*
Kelp	R0.75	(R0.75 million)
Total		R20.1 million (R42.9 million)

*Taking into account that catches are calculated to be under-reported by 3.5-3.8 times.

Based on the MSY of 1000 tons, fishery not fully operational at present

Estimated value of resources harvested by subsistence fishers in resident in Kleinmond and Hawston from the Kogelberg coast and estuaries (mainly the Bot) per annum is provided in Table 12. Estimates of value are based on data collected during the Subsistence Fisheries Task Group research programme (Clark *et al.* 2002, Table 10). Total value of resources harvested is estimated at ~R4 million per annum, with fishers from Hawston and Kleinmond extracting roughly equal value (~R2 million each) from the area. These estimates should be treated with caution, given the constraints mention in §5.3.

TABLE 12. ESTIMATED VALUE OF RESOURCES HARVESTED BY SUBSISTENCE FISHERS IN RESIDENT IN KLEINMOND AND HAWSTON FROM THE KOGELBERG COAST AND ESTUARIES PER ANNUM.

Location	Value
Hawston	R2 132 000
Kleinmond	R2 019 000
Total	R4 152 000

6.3 RECREATION AND TOURISM

The recreational value of any stretch of coast can be assessed in terms of both tourism value and property value (Figure 68). Visitors generate expenditure on travel to the area, accommodation, in restaurants and the retail sector. The value that residents hold for the coast is reflected in the premium paid for properties with access to, or views of, the coast. Holiday-home owners spend money both on property and travelling to the area. In all cases it is necessary to isolate that part of the investment and expenditure that is attributable to the area of interest, in this case the coast.

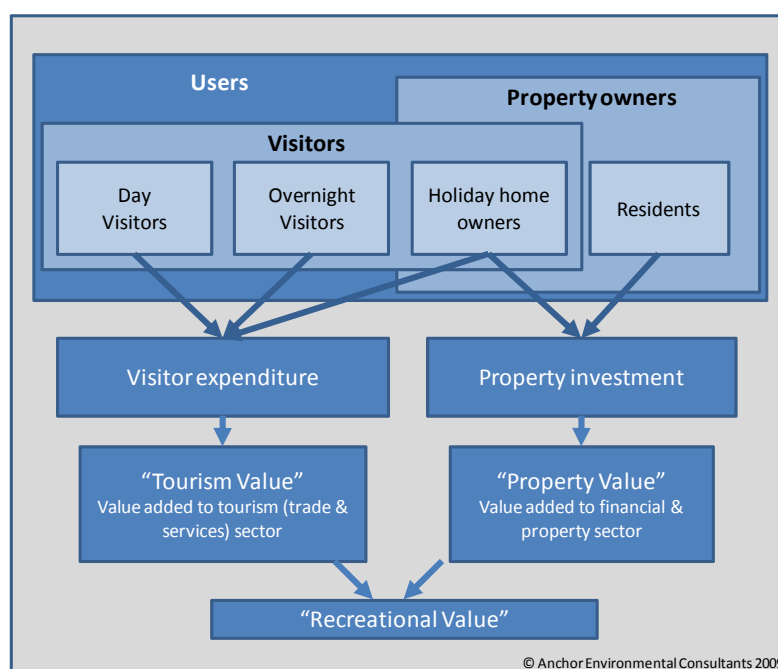


FIGURE 68. SCHEMATIC DIAGRAM TO EXPLAIN THE TERMINOLOGY USED IN THE REPORT

The recreational use value of the study area was estimated using an interview survey of coastal users and property owners, spatial data on visitor numbers collected in aerial surveys, and available data on coastal property, population, recreational activities and visitor numbers. A questionnaire survey was conducted during December 2008, in which 715 respondents were interviewed by a team of seven trained enumerators. The study aimed to estimate the recreational value in terms of the contribution made by users to tourism and property value that could be attributed to the coast. Details of the

methodology are provided in an accompanying report (Turpie & de Wet 2009) and the results are summarised and discussed below.

6.3.1 Estimated total resident and visitor numbers

Information supplied by the Hangklip / Kleinmond Tourism Bureau (HKTNB) indicates that during the December peak holiday season the number of residents in the coastal towns (Kleinmond, Betty's Bay, Pringle Bay, Rooiels and Hangklip) increases from 13 000 permanent residents to 40 000, implying that during the peak season there are 27 000 holiday makers, which includes both holiday home owners and other overnight visitors.

In the survey, it was found that holiday home owners on average spend considerably more time in Kogelberg than do overnight visitors – average of 10.9 (± 2.9 S.D.) days and 2.5 (± 3.1 S.D.) days respectively, and foreigners spend more time in the area than South Africans (Figure 69).

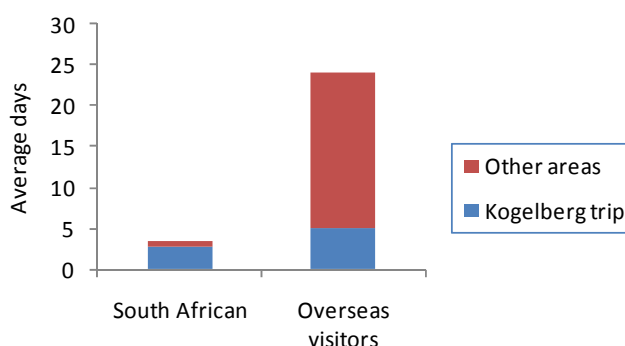


FIGURE 69 AVERAGE NUMBER OF DAYS SPENT IN THE KOGELBERG AREA FOR SOUTH AFRICAN AND OVERSEAS HOLIDAY HOME OWNERS (N = 105), OVERNIGHT VISITORS (N = 250) AND DAY VISITORS (N = 92)

The total number of visitors on any one day during December was estimated based on the known number of permanent residents in the area, the proportion of permanent residents, holiday home owners, overnight visitors and day visitors in the survey, the relative probability of encountering them (based on time spent at the coast) (Table 13.) Assuming that the same proportion of visitors to the Kogelberg area visit the HPNBG throughout the year, the estimated number of visitor days for December were extrapolated to provide an estimate of total annual visitor days to the Kogelberg area of between 4.2 million and 5.3 million (Table 13., Figure 70).

6.3.2 Activities and user groups

Relaxing on the beach and relaxing at home are the most common activities, followed by coastal nature-based hikes, walks and drives. Relatively little time is devoted to collecting bait, non-motorised and motorised boating, wave sports, diving / snorkelling and boat tours (Figure 71). Forty eight responses were received for "other" activities, with the most popular of these being cycling (n = 11), while none of the other described activities, which ranged from bird watching to the fynbos festival, horse riding and work, received more than five responses.

TABLE 13. HIGH AND LOW RANGE ESTIMATES OF INSTANTANEOUS VISITORS, TOTAL VISITORS AND VISITOR DAYS FOR DECEMBER AND ESTIMATED ANNUAL VISITOR DAYS FOR THE KOGELEBERG

Visitor type	Instantaneous visitors in December	Total visitors in December	Average length of stay	Visitor days in December	Annual visitor days
High range					
Holiday home owners	7 703	21 911	10.9	238 798	1 184 713
Overnight visitors	19 297	236 686	2.5	598 202	2 967 765
Day visitors	7 259	225 023	1.0	225 023	1 116 371
Total (upper)	34 259	483 620		1 062 023	5 268 848
Low range					
Holiday home owners	5 789	16 468	10.9	179 470	890 374
Overnight visitors	16 077	197 190	2.5	498 379	2 472 530
Day visitors	5 888	182 520	1.0	182 520	905 508
Total (lower)	27 754	396 177		860 369	4 268 412

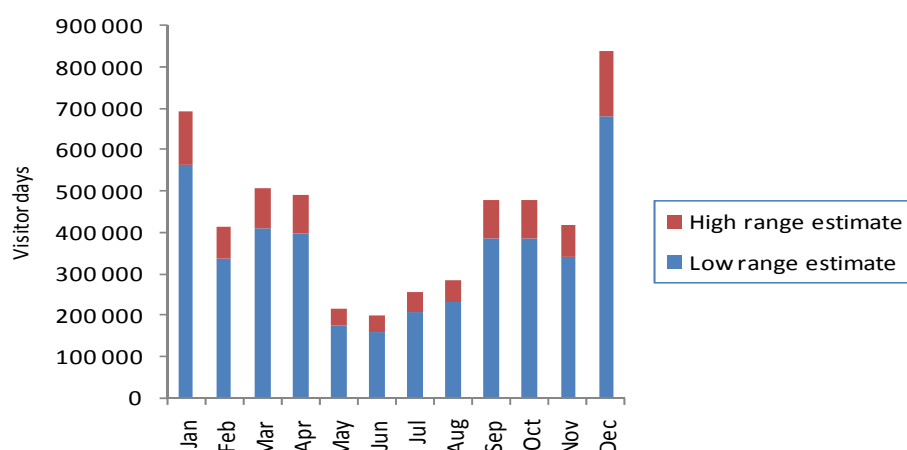


FIGURE 70. LOW AND HIGH RANGE ESTIMATE OF MONTHLY VISITOR DAYS TO THE KOGELEBERG AREA

Coastal activities contribute 71% to all users' enjoyment of the Kogelberg coast, with beach activities and coastal nature contributing the bulk of this, and fishing and water sports making a relatively smaller contribution. Non-coastal activities such as relaxing at the home-base, and indoor activities such as shopping and restaurants account for the balance (Figure 72). Fishing and coastal nature contributes relatively more and non-coastal activities relatively less to the enjoyment of the area by day visitors in relation to the other respondent groups (Figure 72).

Visitors spend an average of $69.7\% \pm 27.8\%$ S.D. of their leisure time at the coast (on the shore, in the water or in sight of the coast), with day visitors spending relatively slightly more time than overnight visitors ($71.7\% \pm 29.8\%$ S.D vs $69.1\% \pm 27.2\%$ S.D) and considerably more time than permanent residents ($54.4\% \pm 27.3\%$ S.D.).

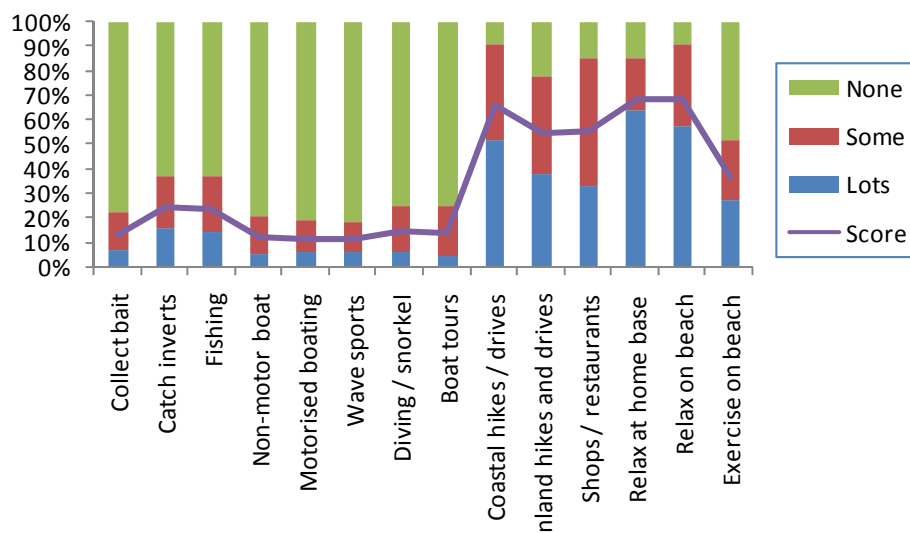


FIGURE 71. PERCENTAGE OF RESPONDENTS WHO PARTICIPATED “LOTS”, “SOME” OR NOT AT ALL IN DIFFERENT ACTIVITIES, AND WEIGHTED SCORE FOR ACTIVITIES (N = 713)

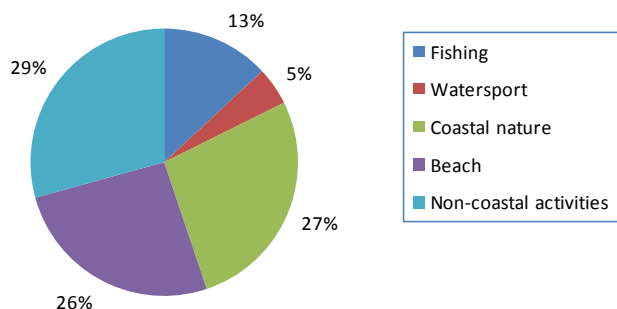


FIGURE 72. STATED CONTRIBUTION OF DIFFERENT ACTIVITY GROUPS TO OVERALL ENJOYMENT OF AREA (N = 615)

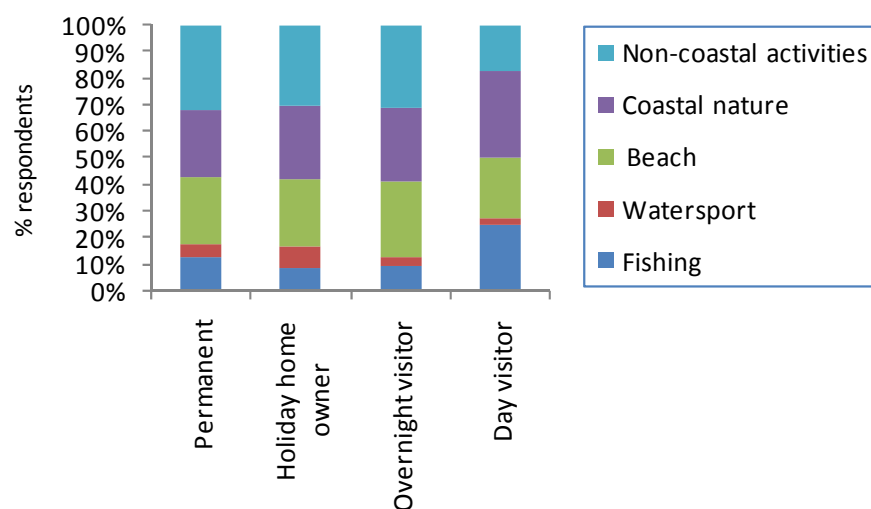


FIGURE 73 STATED CONTRIBUTION OF DIFFERENT ACTIVITY GROUPS TO OVERALL ENJOYMENT OF THE AREA FOR PERMANENT RESIDENTS (N = 250), HOLIDAY HOME OWNERS (N = 96), OVERNIGHT (N = 186) AND DAY VISITORS (N = 83)

It was necessary to distinguish different types of users in order to estimate recreational value and its spatial distribution more accurately. Cluster analysis revealed two distinct groups of users in terms of the contribution of different groups of activities to their enjoyment of the area. The first group comprised those respondents who had indicated higher relative enjoyment from fishing and water sports, while the second group comprised the respondents for whom coastal nature, the beach (including swimming) and non-coastal activities were more important.

A total of 67% of visitors fall into the beach-oriented group and 33% into the fishing and watersports-oriented group. This split of the groups corresponded closely with the observed participation in activities from the aerial count where 65% of coastal users were involved in beach or swimming activities, and the other 35% in fishing (15%) and water sports (20%). Overnight visitors (77%) were relatively more likely to be shore-based than holiday home owners (50%) and day visitors (58%) (Figure 74).

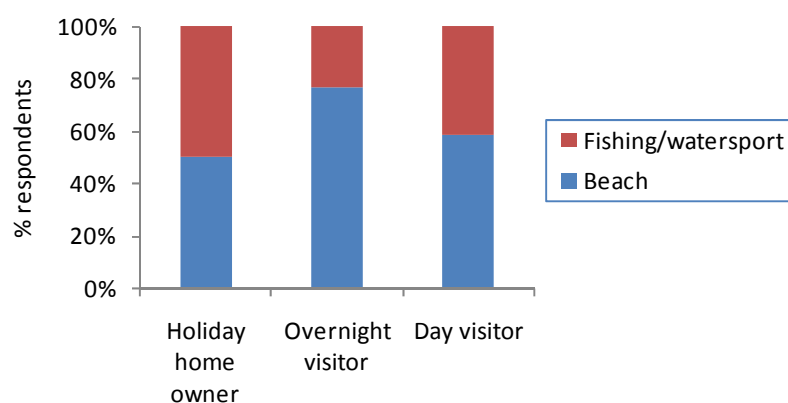


FIGURE 74 A) PERCENTAGE OF VISITORS ASSIGNED TO EACH GROUP BASED ON CLUSTER ANALYSIS OF CONTRIBUTION OF ACTIVITY TO ENJOYMENT OF THE AREA (N = 444) AND B) PERCENTAGE OF HOLIDAY HOME OWNERS (N = 104), OVERNIGHT VISITORS (N = 249) AND DAY VISITORS (N = 91) IN EACH GROUP

6.3.3 Attraction of the coast and its attributes

Users rate the recreational value of the Kogelberg coast compared with other South African coastal areas highly (average rating of 7.8 where 10 indicates total satisfaction). As expected, with permanent residents (8.0) rate it higher than holiday home owners (7.8), overnight visitors (7.7) and day visitors (7.3, Figure 75).

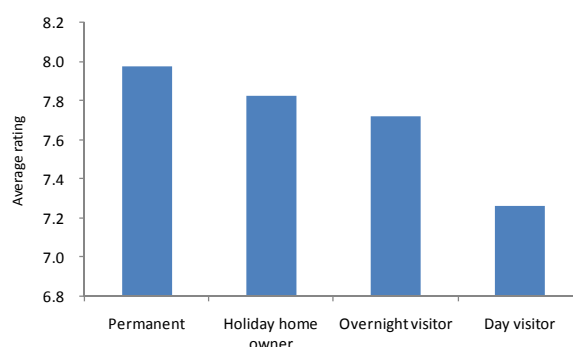


FIGURE 75 AVERAGE RATING OF RECREATIONAL VALUE OF KOGELBERG COAST RELATIVE TO OTHER COASTAL AREAS (N = 705)

In the recreational study, it was found that holiday home owners spend most of their trip (93%) in the Kogelberg area, and overnight visitors and day visitors spent an average of 68% and 49% of their trip in the Kogelberg area respectively (Figure 76). Most South African visitors (87.4%) have visited the Kogelberg area previously, but only 28.3% of foreign visitors have been to the area before.

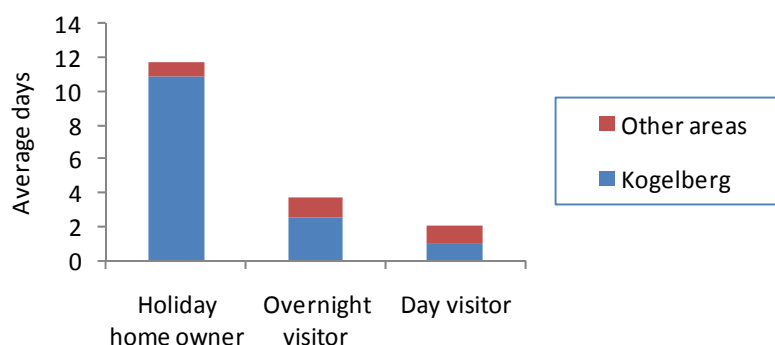


FIGURE 76 AVERAGE NUMBER OF DAYS FOR KOGELBERG AND ENTIRE TRIP FOR HOLIDAY HOME OWNERS (N = 105), OVERNIGHT VISITORS (N = 250) AND DAY VISITORS (N = 92)

As expected, going to the Kogelberg area is a bigger reason for their trip away for South Africans (average 89.9%) who tend to be on single destination trips, than for foreign visitors (59.4%) who tend to be visiting as part of a larger sight-seeing tour.

Only 26% of holiday home owners surveyed were not already aware of the existence of the Betty's Bay MPA. Among the remaining visitors, some 48% of South Africans and 29% of foreigners already knew about the Betty's Bay MPA before their visit. Of those that had visited the MPA, 88% did so to walk and/or view the penguins and 11% did so for diving or snorkeling. Neither the presence of the penguin colony nor the Betty's Bay MPA is a major influence on property owners to invest in the area or for visitors to come to it (Figure 77).

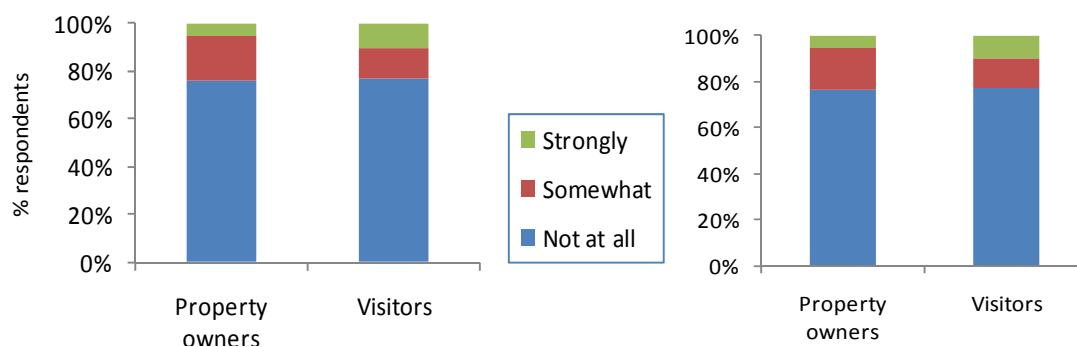


FIGURE 77 INFLUENCE OF A) BETTY'S BAY MPA AND B) PRESENCE OF PENGUIN COLONY ON PROPERTY OWNERS (N = 367) TO INVEST IN THE AREA AND VISITORS (N = 322) TO VISIT IT

Coastal cleanliness was the most important attribute contributing to respondents' enjoyment of the Kogelberg coast, followed by its geographical features, bathing safety and natural terrestrial backdrop. Sea conditions and farming landscapes were the least important characteristics (Figure 78). Apart from the listed characteristics, forty two responses were received for the "other" category, of which two indicated that crime or litter detracted from the area, while the other responses were seen as either enhancing or being essential to the experience. A wide range of characteristics was recorded, with the tranquility of the area ($n = 8$) and the friendliness of the people ($n = 5$) being the most common responses.

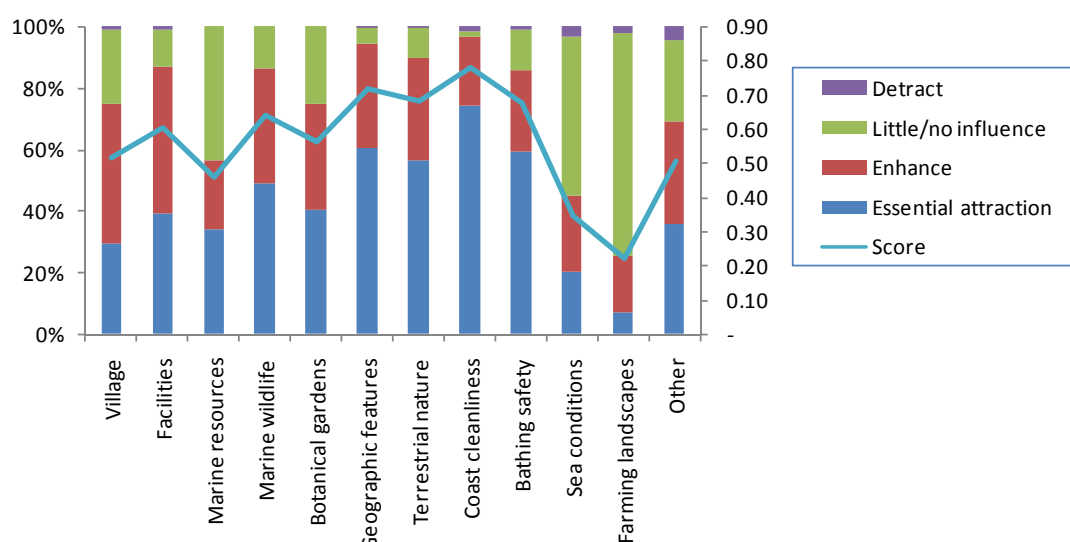


FIGURE 78 EXTENT TO WHICH CHARACTERISTICS CONTRIBUTE TO ENJOYMENT OF AREA AND WEIGHTED SCORE FOR CHARACTERISTIC ($n = 711$)

6.3.4 Tourism value

The expenditure of land-based tourism (involving visitors that arrived by land) includes the value of shore-based and boat-based activities. The stated average daily expenditure per person per day (pppd) for both the entire trip and for the expenditure in the Kogelberg area is higher for overseas visitors than for South Africans, while overnight visitors spend more in the Kogelberg area (R77 pppd) than holiday home owners (R59 pppd) and day visitors (R50 pppd) (Figure 79). The higher expenditure by overnight visitors is to be expected as these visitors have to pay for accommodation.

Based on the expenditure of visitors, the contribution of KBR to the trip and the time spent on the coast for the two main user groups, the recreational expenditure attributable to the Kogelberg coast was estimated per visitor day (Table 14). This worked out to a total value of the coast of between R191 and 235 million (Table 15).

The spread of tourism value along the coast was estimated on the basis of the observed peak-season spread of users in the two main user groups. Value is centered around major beaches and settlements (Figure 80). Value for the beach-based visitors is more concentrated around these points. The value for fishing and water sports is more evenly spread along the coast, but clearly influenced by access points.

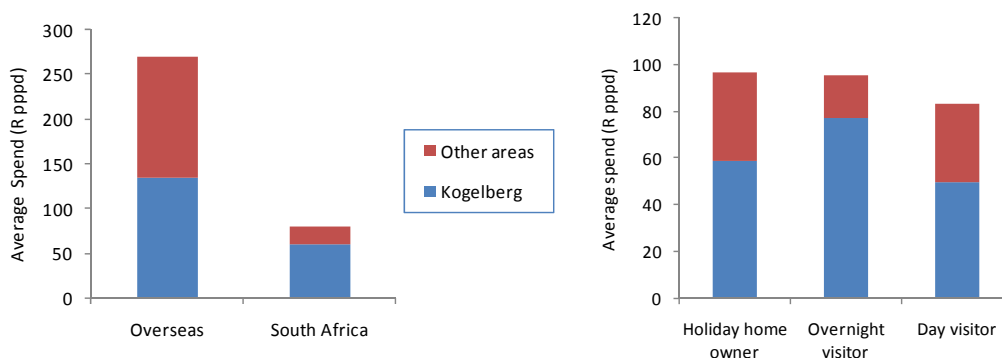


FIGURE 79. AVERAGE EXPENDITURE PPPD FOR THE ENTIRE TRIP AND SPENT IN KOGELBERG AREA FOR A) OVERSEAS AND SOUTH AFRICANS (N = 447) AND B) HOLIDAY HOME OWNERS AND VISITORS (N = 447)

TABLE 14. AVERAGE LENGTH OF TOTAL TRIP AND TO THE KOGELBERG BIOSPHERE RESERVE (KBR) AREA, AVERAGE EXPENDITURE PPPD FOR THE TOTAL TRIP AND IN THE KOGELBERG AREA, PERCENTAGE REASON FOR WHOLE TRIP TO COME TO THE KOGELBERG AREA AND PERCENTAGE OF LEISURE TIME SPENT ON THE COAST FOR USER GROUPS (N = 444)

User group	Trip length (days)		KBR as % reason for trip	% leisure time spent on coast	Average spend (R/ppd)			
	Total	in KBR			Total trip	Spent in KBR area	Spent on KBR area	Spent on KBR coast
Beach	4.2	2.7	86%	69%	R97	R77	R 83	R 58
Fish/sport	4.2	3.5	87%	72%	R85	R52	R 74	R 53
Combined	4.2	2.9	86%	70%	R93	R67	R 80	R 56

TABLE 15. LOW AND HIGH RANGE ESTIMATE OF RECREATIONAL VALUE ATTRIBUTABLE TO KOGELBERG COAST FOR USER GROUPS AND VISITOR TYPES

	Holiday home owner R000	Overnight visitor R000	Day visitor R000	Total R000
Low range estimate				
Beach	18 955	82 420	20 308	121 683
Fish/watersport	23 038	30 024	15 906	68 968
Total	41 993	112 444	36 214	190 651
High range estimate				
Beach	25 221	98 929	25 037	149 187
Fish/watersport	30 654	36 037	19 610	86 301
Total	55 875	134 966	44 647	235 488



Tourism value (R millions/y)

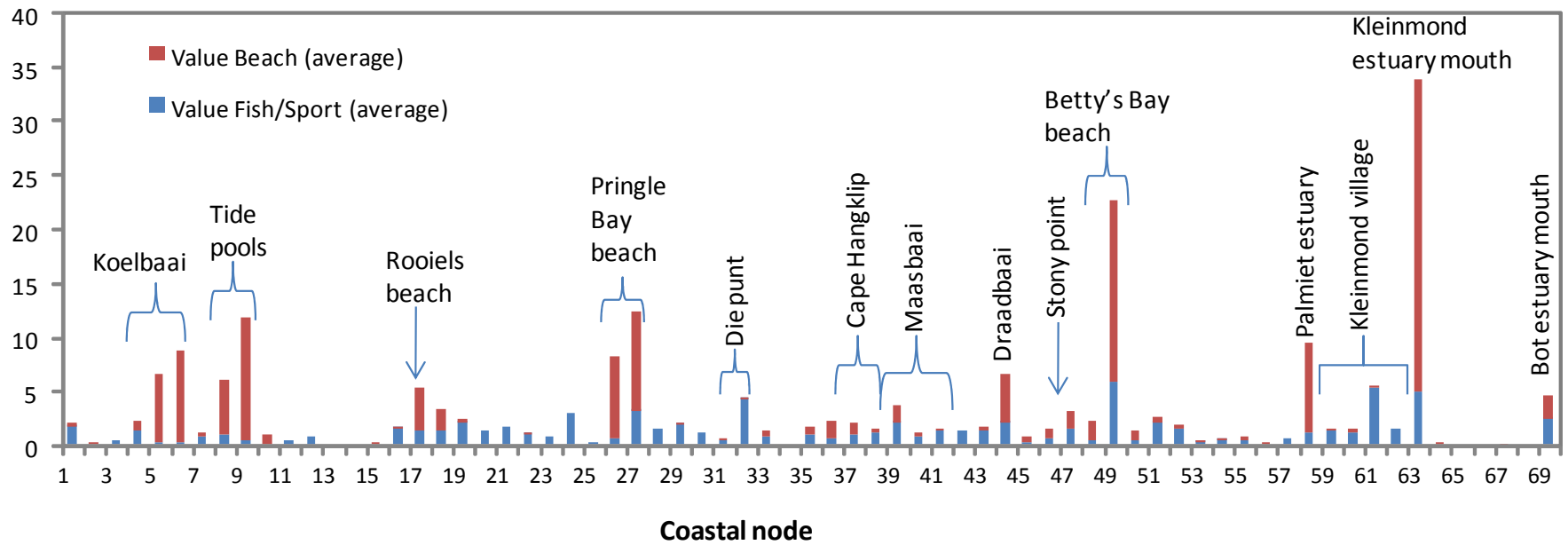


FIGURE 80. ESTIMATED DISTRIBUTION OF THE ANNUAL VALUE OF TOURISM ALONG THE KOGELBERG COAST

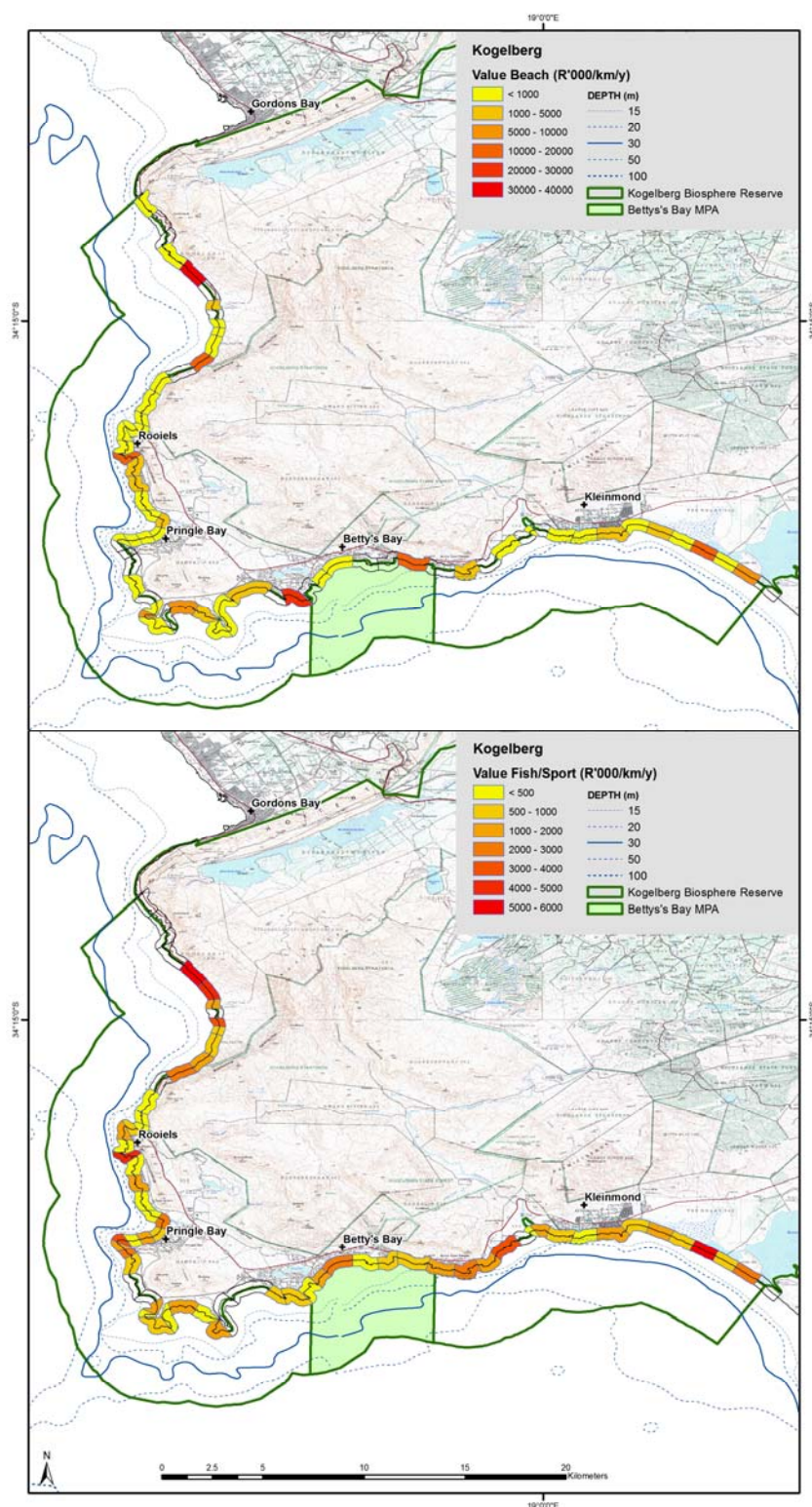


FIGURE 81. ESTIMATED DISTRIBUTION OF TOURISM VALUE OF THE COAST FOR (A) BEACH-ORIENTED VISITORS (TOP) AND (B) FISHING AND WATERSPORT-ORIENTED VISITORS (BOTTOM)

In addition to the above, some of the tourism value associated with boat-based whale watching is attributed to the KBR coast. Assuming that there was no change in the number of boat-based whale watchers between 2007 and 2009, the total annual

turnover of the boat-based whale watching industry in Hermanus is currently in the order of R7.29 million. Based on the finding that some 19% of whale sightings on boat-based tours are made within the Kogelberg coast (Figure 67), it was estimated that whales within the Kogelberg contribute at least R1.39 million to the total value of the boat-based whale watching industry.

6.3.5 Property value

According to the municipal property register, there are 5 811 houses in the study area, made up as follows: Kleinmond (50%), Betty's Bay (27%), Pringle Bay (18%), Rooiels (4%) and Hangklip (1%). The property value estimate was based on interviews with 220 property owners. In general, properties with sea or estuary frontage had a higher average value than other properties except for properties with six bedrooms or more, where the average value was similar irrespective of the distance from the coast. There was not a noticeable difference in property values between those with and without sea or estuary views (Figure 82).

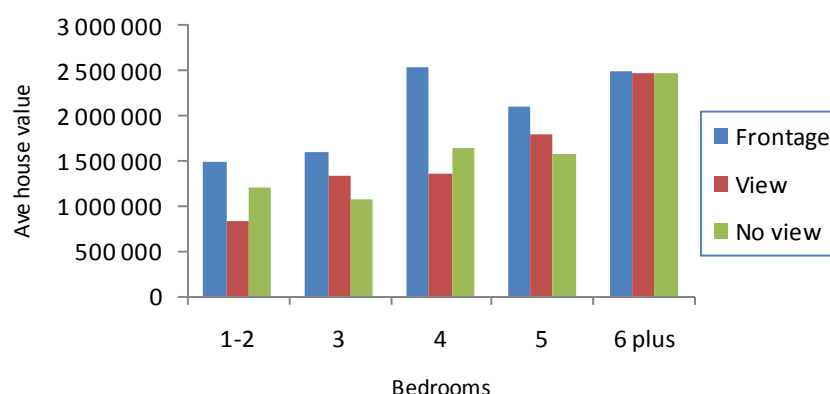


FIGURE 82. COMPARISON FOR AVERAGE PROPERTY VALUES AS A FUNCTION OF PROPERTY SIZE, MEASURED BY NUMBER OF BEDROOMS, AND DISTANCE FROM COAST (N = 220)

Property value was modeled as follows ($n = 220$, $R^2 = 0.29$, $P < 0.0001$):

$$\ln \text{Value} = 13.397 + 0.187*B + 0.300*F - 0.0257*D,$$

where B = number of bedrooms, F = frontage (1 or 0) and D = distance from the coast in Km. Based on this model, property in the KGR area was estimated to have a total capital value in the order of R7.3 billion, and the total premium associated with coastal proximity was estimated to be about 14% of this, or just over R1 billion. This translates to an annual turnover of about R59 million in the financial and property sectors (Table 16). The estimated distribution of this value is shown in Figure 83.

TABLE 16. ESTIMATED CONTRIBUTION OF THE COAST TO ECONOMIC OUTPUT IN THE FINANCIAL AND PROPERTY SECTORS

	Total property value (R millions)	Premium (R millions)	Cost of capital (R millions)	Annual inc to property sector (R millions)	Total turnover (R millions)	Value attributed to adjacent coast (R/km/y)
Rooiels	263	37	11.6	1.6	13.2	819 887
Pringle Bay	1 441	248	25.4	3.6	28.9	5 040 893
Hangklip area	71	10	0.5	0.1	0.6	117 410
Bettys Bay	1 986	231	12.4	1.7	14.2	4 294 621
Kleinmond	3 536	507	1.9	0.3	2.1	560 421
Total	7 297	1 035	51.8	7.2	59.0	

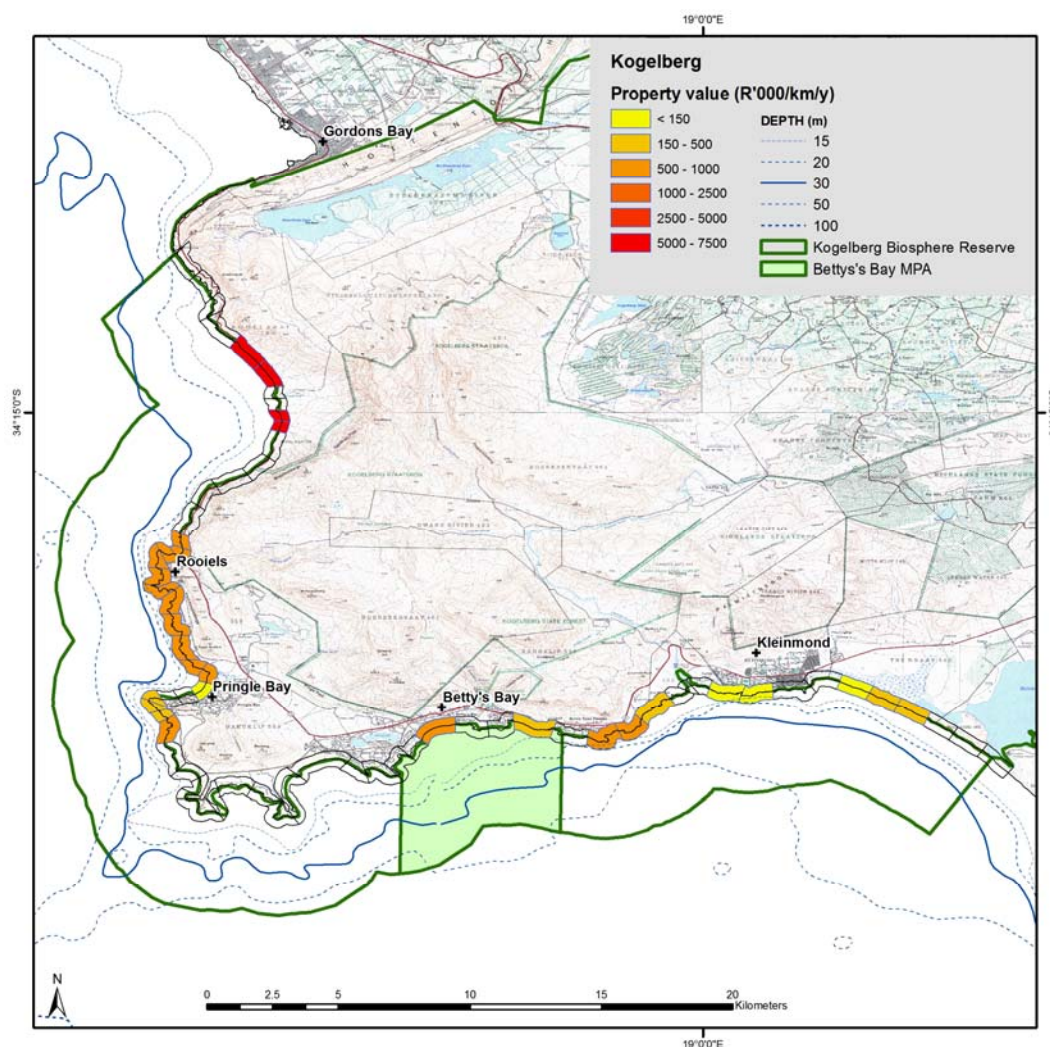


FIGURE 83. ESTIMATED PROPERTY VALUE OF THE COAST

6.3.6 Impacts of management on recreational value

The survey of coastal users included an investigation into how respondents' utility or satisfaction with the coast would be affected under different management scenarios, and how these scenarios would affect the recreational value of the coast.

Ten different scenarios were presented to interviewees and they rated the recreational value of the coast on a scale of 0 – 10 for each of these scenarios. The average score for the current status quo was 7.8. Most respondents (87%) gave the no-crime scenario the highest score of all the scenarios, with an rating of 9.4. Other scenarios whose average rating represented an improvement over the current rating were having fishing twice as good (8.3), ensuring that laws for vehicles, boats and fishing were enforced (8.2) and having fishing improved by 20% (Figure 84).

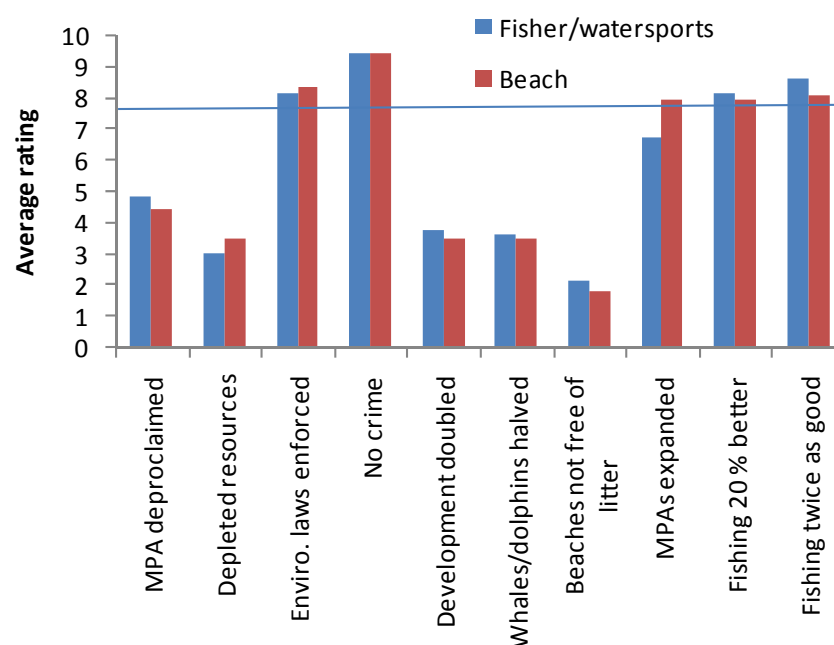


FIGURE 84 AVERAGE RATING OF DIFFERENT SCENARIOS RELATIVE TO CURRENT SCORE (SHOWN AS LINE) FOR THE COAST ON RECREATIONAL VALUE (N = 708).

There was no significant difference between the scores given by fishing and watersport-oriented and beach-oriented users of the coast (Figure 84). Nevertheless, as might be predicted, the beach-oriented group gave the three MPA scenarios similar scores irrespective of their impact on fishing, whereas the fishing and watersport-oriented group scored the MPA without mention of benefits lower, but responded favourably when given the same scenario with a positive effect on fishing in the remaining areas.

When asked about their most-preferred scenario, the majority of respondents indicated that if it was implemented it would have a positive impact on either their property value, in the case of home owners, or the amount of time spent in the area, in the case of visitors, with 73% of permanent residents, 83% of holiday home owners, and

74% of overnight and day visitors indicating a positive impact (as opposed to no change). Property owners estimated an average increase in property value of 25.8% and visitors an average of 29.9% increase in time spent in the area per unit increase in utility (Table 17).

Ten percent of both permanent residents and holiday home owners indicated that they would sell their properties if their worst scenario came about, while 35% of overnight visitors and 25% of day visitors would stop coming to the area under such a scenario. A substantial percentage (54% of permanent residents, 66% of holiday home owners, 43% of overnight visitors and 60% of day visitors) indicated that if their least preferred scenario came about it would decrease their property value, in the case of property owners, or decrease the amount of time spent in the area, in the case of visitors. Property owners estimated an average decrease in property value of 5.3% and visitors an average of 7.1% decrease in time spent in the area per unit decrease in utility (Table 17).

Respondents were asked to express their willingness to pay to bring about their best scenario and to prevent their worst scenario. The average willingness to pay by all property owners (permanent residents and holiday home owners) for their preferred scenario was R78 per month while overnight and day visitors were willing to pay R33 and R20 per day respectively. The average willingness of property owners to pay to prevent their least preferred scenario was R60 per month, while visitors were willing to pay R28 per day.

As predicted, average willingness to pay per unit change in utility (as indicated by the score given to the scenario) was higher for the improved scenarios, suggesting that true utility was proportionally greater in the scores above the average score for the status quo. Willingness to pay was 6 times and 3 times higher per unit increase in utility than per unit decrease for property owners and visitors, respectively (Table 17). This difference arises because property owners scored the status quo higher, and therefore had a smaller range of possible increase in scores, as well as being potentially influenced by their stronger views.

TABLE 17. RESPONDENTS' ESTIMATED IMPACTS ON PROPERTY VALUE, TIME SPENT IN THE AREA AND WTP PER UNIT CHANGE IN UTILITY

	Property owners			Visitors		
	Per unit increased utility	Per unit decreased utility	Ratio incr:decr	Per unit increased utility	Per unit decreased utility	Ratio incr:decr
% change in property value / time spent visiting	25.8	-5.3	4.9	29.9	-7.1	4.2
WTP (R) to achieve/prevent	11.83 pppm	1.87 pppm	6.3	4.90 pppd	1.65 pppd	3.0
Aggregate WTP (R million) per year/unit utility	0.835	0.132		23.379	7.860	
Aggregate WTP(R million) /y for ave change	1.473	0.863		49.417	52.300	

Of the respondents who were not willing to pay to prevent their least preferred scenario (n = 152), 30% did not advance a reason for not being willing to pay. The most

common reasons for not being willing to pay were that it is government or the municipality's responsibility (28%), not having money (13%), being visitors to the area (11%) and already paying taxes (9%). Several other responses were not statistically important but are nonetheless interesting and included that there is no guarantee that the money will be used for the purposes provided, that time rather than money could be contributed and that money would be provided to a new manager but not to the existing authorities.

The total current recreation of value of the coast was estimated to be in the order of R272 million per annum, based on the average of the upper and lower bounds of tourism and property value. The respondents' stated willingness to pay suggest that the aggregate willingness to pay to achieve maximum utility (~10) is in the order of R51 million, and to prevent the worst case scenario (utility of ~1) is R53 million (Table 17). This reveals the aggregate strength of their preference (e.g. people would be willing to pay in the order of R53 million per year to eradicate crime), but not necessarily how value of the coast might change. What is potentially more revealing is the respondents' estimates of how property value and visitation time will change (Table 18). Alternatively, if the scores presented by the respondents for the different management scenarios represent their relative potential utility (level of satisfaction gained), then this would also suggest that the above scenarios can be valued in terms of the proportional change in value. However, since the respondents were constrained to score improved scenarios out of 10, they could not reflect whether a scenario actually increased its score beyond 10 relative to the current score. This effect can be corrected by scaling utility to current value using the relative value of utility (ratio of WTP per unit increase vs decrease) suggested in Table 17. The results of this method yield similar results to those based on predicted behaviour, but reveal that the change in behaviour is not as great as the change in utility associated with a worse scenario. For example, if fishery resources are decreased, people's utility will be substantially affected as suggested by their WTP to prevent such an occurrence, but their behaviour in terms of the amount they visit the area, will not be as greatly affected.

TABLE 18. ESTIMATED CHANGE IN TOURISM VALUE FROM THE STATUS QUO (R272 MILLION PER ANNUM) IN TERMS OF UTILITY AND EXPENDITURE, UNDER DIFFERENT SCENARIOS

Scenario	Ave Utility Score	Rescaled utility based on relative WTP per unit		Change in value (utility) (Rm/y)	Change in value (spend) (Rm/y)
		Property	Tourism		
Status quo (SQ)	7.8	7.8	7.8		
SQ + MPA deproclaimed	4.6	4.6	4.6	-112	-59
SQ +Depleted resources	3.3	3.3	3.3	-157	-82
SQ +Enviro. laws enforced	8.2	10.4	9.0	58	34
SQ +No crime	9.4	17.9	12.6	211	126
SQ +Development doubled	3.6	3.6	3.6	-147	-77
SQ +Whales/dolphins halved	3.6	3.5	3.5	-147	-77
SQ +Beaches not free of litter	1.9	1.9	1.9	-205	-107
SQ +MPAs expanded (SQ + 2xMPA)	7.4	7.4	7.4	-12	-7
SQ + 2xMPA + Fishing 20 % better	8.0	9.0	8.3	27	15
SQ + 2xMPA + Fishing 2x as good	8.3	10.8	9.2	64	37

Results of the above methods suggests that depleting the fishery resources to very low levels could reduce overall economic value of the area by more than half to R82 million, and doubling available resources could lead to an increase in value by some R37 million (Table 18). Eradication of crime could potentially increase tourism value by as much as R126 million per year, while a littered environment would reduce value by as much as R107 million.

6.4 NURSERY VALUE OF THE ESTUARIES

Because they are relatively sheltered and productive, estuaries are used as nursery areas for a number of marine fish species that spawn at sea, recruit to estuaries in their early stages, and return to the sea after having grown to a suitable size. Many of these species are then caught in inshore marine commercial, recreational and subsistence fisheries.

Lamberth & Turpie (2003) estimated the role and value of estuaries as a nursery area for inshore marine fisheries. Some 80 estuarine fish are utilised, these species varying in their degree of association with estuaries. Based on the types of association of different species with estuaries, about 21% of the value of inshore marine catches was attributed to estuaries. Estuaries in the study area were estimated to contribute some R46.725 million per annum to fishery values. However, Turpie & de Wet (2008) noted that the nursery value of the Bot/Kleinmond estuary, whose potential value is orders of magnitude greater than the other systems, has probably been seriously compromised by gill-net poaching in the estuary. The estimation of recreational and commercial linefish values provided above includes the value of estuary-dependent fish. However, understanding to contribution made by estuaries is important in estimating the economic implications of changes in management of these systems. Nevertheless, it should also be noted that the estuaries in the study area probably also contribute to fisheries on either side of the study area, and estuaries from beyond the study area contribute to fisheries in the study area as well.

TABLE 19. ESTIMATED NURSERY VALUE OF ESTUARIES ALONG THE KOGELBERG COAST (LAMBERTH & TURPIE 2003)

Estuary	Nursery value R per year
Steenbras	50 000
Rooiels	300 000
Buffels (Oos)	475 000
Palmiet	900 000
Bot/Kleinmond	45 000 000
Total	46 725 000

6.5 FISH EXPORTS FROM THE BETTY'S BAY MPA

6.5.1 Introduction

Theory suggests that MPAs improve the fishing yields in adjacent areas by the export of larvae, pre-recruits and adults (Attwood & Bennett 1995, Mosqueira *et al.* 2000, Gotz 2005, King 2005) and ideally the increase in fishing should be sufficient to off-set the loss of fishing in the MPA (Roberts *et al.* 2000). Thus an MPA can cause economic impact by the loss of a fishing area but also by enhancing catches in exploited areas. The main objective of this component of the study was to put an economic value on export of fish from the Betty's Bay MPA to the adjacent exploited Kogelberg coast.

Other MPAs in the country, e.g. Tsitsikamma, Goukama and De Hoop) have been shown to have a higher catch-per-unit-effort (CPUE) within them than in adjacent areas (see for example Brouwer 1997, Sauer *et al.* 1997, Gotz 2005, King 2005, Smith *et al.* in prep) with the CPUE decreasing with decreasing proximity to the MPA. An effect of this nature is not expected in the case of the shore angling species in the Betty's Bay MPA given that shore angling is permitted in this MPA (and indeed is not evident in shore angling catches in and adjacent to the MPA as assessed by Attwood & Farquhar 1999), but is expected for the linefishery which tends to focus on a different suite of species, most of which are not caught from the shore (see §5.4.1). It is important to note also that this assessment focuses only on fish and does not extend to abalone, rock lobster or any of the other exploited species in the area and thus is a minimal estimate of the value of the MPA.

For the Betty's Bay MPA, the export and contribution to recruitment was estimated for one fish species representative of the boat based linefishery (red roman *Crysoblephus laticeps*). This assessment was modelled on the approach developed for valuation of fish exports from MPAs on the Garden Route, developed by Turpie *et al.* (2006)

6.5.2 Estimation of fish exports and their value

Nomadic and migratory fish species that are wide ranging are unlikely to derive much more than temporary benefit from MPAs (unless the sites of spawning aggregations are protected). The values estimated in this study were therefore based only on resident reef dwelling species (mostly sparids). Estimation of the annual emigration rates of adult, resident fish from the Betty's Bay MPA was done by estimating the total population size within the MPA (calculated from density estimates) and the proportion thereof estimated to disperse beyond the MPA borders based on information on movement patterns.

There is limited data available from mark-recapture studies on the movement patterns of South African reef fish species. Quantitative data on the actual density of reef fish species within MPAs, however, is scarcer. For the calculations made in this study, one fish species considered representative of the boat based line fishery (red roman *Crysoblephus laticeps*) for which information on their movement patterns and density within MPAs was available, was selected.

Red roman are an important component of both the recreational and commercial boat fishing sectors along the Cape coast (Brouwer 1997). Mark-recapture data indicate that this species is highly resident, with 74 % of recaptures being made within 1 km of

the release site, 95 % of recaptures occurring within a radius of 13 km and maximum displacement of 39 km (Griffiths & Wilke 2002). More recent telemetry studies also suggest that although some red roman move up to 4 km, most red roman inhabit small home ranges of about 50m² (Kerwath 2006). Given the limited movement of most tagged red roman, an export rate of 0.5% of the total populations was assumed.

No data are available on density of red roman in the Betty's Bay MPA. However, data are available on the densities of red roman in nearby, comparable sized MPAs in False Bay (Lechanteur 1998, Lechanteur & Griffiths 2002) based on underwater visual census (UVC) data. The reef area considered as suitable habitat for red roman within the Betty's Bay MPA was conservatively estimated at 30% (based on similar estimates for the Goukamma and Tsitsikamma MPAs – Turpie *et al.* 2006).

There is also a dearth of information on fecundity for nearly all South African surf zone and reef fish, whilst information the survival and dispersal rates of eggs and larvae (which are certain to be highly variable depending on prevailing environmental conditions) is also non existent. What is known is that MPAs protect dense populations of large individuals and that fecundity is exponentially related to body size for nearly all fish species. It follows that the populations within the Betty's Bay MPA must contribute a substantial proportion of the pre-recruits to exploited areas where spawner biomass of nearly all line fish species has been drastically reduced. This proportion for red roman was estimated based on the difference between the estimated spawner-biomass-per-recruit ratio as a percentage of the pristine ($SBPR\%SBPR_{F=0}$) for the exploited area (extracted from Mann 2000) and the SBPR ratio for the MPAs (assumed to be 1, i.e. pristine).

Values of fish were taken from Turpie *et al.* (2006) as R76 for recreational boat anglers(based on recreational expenditure), and R11 for commercial linefishers (based on income derived). The data for these estimates were derived from the work of McGragh *et al.* (1997) and Brouwer (1997).

The value of larvae, pre-recruits and adult red roman and galjoen exported from the three MPAs was calculated by multiplying estimates of the number of individuals exported by the value per fish for each fishing sector. For the boat based recreational and commercial sectors, the value of red roman export from MPAs was calculated as the relative proportion of the total red roman catch made by each sector from data presented in Brouwer (1997). The total value of linefish exports for all resident surf zone and reef species was crudely estimated by extrapolation of the values obtained for galjoen and red roman based on their proportions in the catch composition (data extracted from Brouwer 1997). This method assumed that movement patterns and stock status of all species in exploited areas are identical (or at least similar), and as such estimates should be considered preliminary.

6.5.3 Value of fish exports

An estimated 3 904 adult red roman are exported annually from the Betty's Bay MPA, worth about R28 771 to the commercial linefishery and substantially more to the recreational boat fishery (R98 897) (Table 20). Including the likely contribution by spawner biomass within the MPAs with the exploited area $SBPR\%SBPR_{F=0}$ of 20 %, elevates the value to almost R248 000 per annum (two sectors combined). Given the relative contribution of red roman to the commercial and recreational resident reef fish

catch (17%) and the commercial catch (5%) the total value contributed by the MPA's is estimated to be approximately R283 000 per annum (Table 20).

TABLE 20. ESTIMATES OF LINEFISH EXPORT FROM THE BETTY'S BAY MPA TO BOAT BASED LINE FISHERIES ALONG THE KOGELEBERG COAST. DATA ON ROMAN DENSITY IN THE MPA WAS TAKEN AS BEING THE SAME AS FOR CASTLE ROCKS MPA IN FALSE BAY (DATA FROM LECHANTEUR & GRIFFITHS 2002)

Parameter	
Roman density (No. m ⁻²)	0.124
Total population in the Betty's Bay MPA (number)	780,764
Export (0.5% per year)	3,904
Value to the commercial linefishery (R)	R28,771
Value to the commercial linefishery (R)	R98,897
Reserve spawner contribution	3,672
Value to the commercial linefishery (R)	R26,927
Value to the recreational linefishery (R)	R93,021
Total Roman value (R)	R247,617
Total value to the commercial linefishery (R)	R58,483
Total value to the recreational linefishery (R)	R224,544
TOTAL (R)	283,028

Although crude, the estimates of economic value presented here are based on the best available information. The estimates of emigration from the MPAs used were conservative and the contribution of spawning products, although unproven, is extremely probable. The total estimated annual contribution of R283 000 from the Betty's Bay MPAs to the line fisheries in the region is certainly inaccurate, but is probably within an order of magnitude of the real value. The contribution to the West Coast Rock Lobster Fishery and to the potential Abalone fishery, though primarily through export of larvae, are likely to be far more valuable. The true monetary value of fishery enhancements by MPAs could be best quantified by long-term monitoring of CPUE both within and in areas adjacent to, before and after, the proclamation of a new MPA.

7 MANAGEMENT ISSUES AND LEGISLATION

7.1 INTRODUCTION

While tremendous economic and cultural benefits are obtained from coastal resources, these resources are under increasing pressure from anthropogenic causes, and many are dwindling. The major threats to marine and coastal resources are exploitation of living marine resources, physical loss and modification of habitat, pollution from land and marine based sources, disturbance through human activity in the coastal zone, abstraction of freshwater from rivers and aquifers, invasion by alien species, exploitation of non-living resources (mining), and climate change (Attwood 2000). Each of these issues is explored in more detail below, focusing on the main pressures on the Kogelberg coast, and the current legislation pertaining to these issues is explained.

In South Africa the Constitution is the supreme law of the land, and provides the legal framework for legislation regulating environmental management in general. Section 24 of the Constitution states that:

"Everyone has the right:

- *to an environment that is not harmful to their health or well-being; and*
- *to have the environment protected, for the benefit of present and future generations through reasonable legislative and other measures that –*
- *prevent pollution and ecological degradation;*
- *promote conservation; and*
- *secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development."*

All other legislation is required to be consistent with the constitution. Where this is not the case, the constitution prevails.

7.2 EXPLOITATION AND DISTURBANCE OF LIVING MARINE RESOURCES

7.2.1 Issues

Exploitation of living marine resources is one of the most serious threats to marine biodiversity in South Africa and is the main threat to biodiversity along the KBR. Abalone and line-fish stocks are severely overexploited. In addition to threatening the exploited populations themselves and the future value of these stocks, overexploitation is threatening the integrity of ecosystems in the KBR through changes in community structure (loss of grazers (abalone), loss of top predators and keystone species, alteration of benthic environments, and changes in the gene pool (through selection against traits such as large size and fast growth).

Non-consumptive recreational activities may also have direct impacts on biodiversity. Human presence on the shore can cause trampling and damage to dune plants and rocky shore biota and may disrupt the breeding success of coastal birds such

as the African Black Oystercatcher *Haematopus moquini*. These birds have experienced some recovery since the ban of the use of off-road vehicles in the coastal zone but are still vulnerable in high use areas. Large aggregations of waterbirds such as on the Bot estuary are vulnerable to disturbance from people moving around on the estuary, and from overhead disturbance such as microlites. This can have a profound influence on the numbers of migratory birds whose food intake is curtailed by disturbance. Excess numbers of recreational divers can also damage reefs.

7.2.2 Legislation and responsible parties

The exploitation of marine living resources in South Africa is governed by the **Marine Fisheries Policy for South Africa** (1997) and the **Marine Living Resources Act** (1998). Objectives of the policy are as follows:

- to achieve optimum utilisation and ecologically sustainable development of marine living resources;
- to conserve marine living resources for present and future generations, to use marine living resources;
- to achieve economic growth, human resource development, capacity building within fisheries and mariculture branches, employment creation and a sound ecological balance consistent with the development objectives of national governments;
- to protect the ecosystem as a whole, including species which are not targeted for exploitation; and
- to preserve marine biodiversity.

The Marine Living Resources Act (MLRA) seeks to ensure the sustainable utilisation of marine living resources, through scientifically based and publicly acceptable operational management procedures. Fish and marine organisms are protected by means of prohibition against their catching, disturbance or possession except for those in possession of a commercial, recreational or subsistence fishing right. Commercial fishing operations are managed in through the General policy on the allocation and management of long term commercial fishing rights: 2005 (DEAT 2005a) and individual policy documents published for each resource or group of resources (e.g. abalone, west coast rock lobster, squid, traditional linefish, seaweed, etc.). Regulations published in terms of the MLRA provide for restrictions on the kinds of gear that may be used by participants in the recreational and commercial fishing sectors (i.e. gear restrictions), as well as for closed periods when no fish may be caught (closed seasons), and minimum size limits for certain species. Similar conditions may be attached to permits or fishing rights issued to rights holders in specific fisheries. The MLRA also makes provision for the establishment of Marine Protected Areas, where all forms of fishing are banned. This is discussed in more detail under §7.2.

Conservation and protection of biodiversity with the coastal zone is provided for under the **National Environmental Management: Biodiversity Act** (2004) and through the proclamation of various types of protected areas under the Marine Living Resources Act (1998) and the National Environmental Management: Protected Areas Act (2003)

The Biodiversity Act (2004) provides for the conservation of biological diversity. It requires identification of important landscapes, ecosystems, ecological process and species for biodiversity conservation, and promotes monitoring of these. It also

provides for the proclamation of protected areas, recognising South Africa's obligations to international conventions. The Act has the following stated objectives:

- to provide, within the framework of the National Environmental Management Act for the management and conservation of biological diversity within the country;
- to provide for the use of indigenous biological resources in a sustainable manner;
- to provide for the fair and equitable sharing of benefits arising from the commercialisation through bioprospecting of traditional uses and knowledge of genetic resources;
- to give effect to international agreements relating to biodiversity which are binding on South Africa;
- to provide for co-operative governance in biodiversity management and conservation; and
- to provide for a National Biodiversity Institute to assist in achieving the above objectives.

The Act, furthermore, provides for the implementation of a National Biodiversity Framework and for the preparation and delimitation of Bioregions, Bioregional Plans and Biodiversity Management Plans. The latter plans must be aimed ensuring the long-term survival in nature of the species or ecosystem to which the plan relates.

Marine reserves were previously proclaimed under the Sea Fishery Act 12 of 1988 or under the National Parks Act 57 of 1976. Now all marine reserves have been re-proclaimed under the Marine Living Resources Act (1998). This Act provides for the declaration of marine protected areas for the protection of fauna, flora and the physical features on which they depend; for fisheries management by protecting spawning stock, allowing stock recovery, enhancing stock abundance in adjacent areas and providing pristine communities for research. Save a few exceptions, the act bans any person from carrying out an activity that may impact on ecosystems or the fauna and flora within a marine protected area including banning on fishing, discharge or deposit of waste and the erection of any buildings or structures below the high water mark.

The **Protected Areas Act** (2003) provides for the declaration and management of protected areas, and can also provide for co-operative governance, the sustainable utilisation of protected areas that preserves their ecological character, and the participation of local communities in the management of protected areas, where appropriate. A consultation and public participation process is outlined in the Act. It also contains the requirement that marine and terrestrial protected areas with common boundaries must be managed as an integrated protected area by a single management authority. It is also important to note that under this Act, commercial prospecting or mining is prohibited in any nature reserve. The Act makes provision for the declaration of four types of protected areas.

- **Special Nature Reserves:** declared to protect highly sensitive, outstanding ecosystems, species, geological or physiological features.
- **National Parks:** declared to protect areas of national or international biodiversity significance; a viable, representative sample of South Africa's natural systems and scenic areas and to provide the foundation for spiritual, scientific, educational, recreational and tourism opportunities which are environmentally compatible.

- **Nature Reserves:** declared to protect areas with significant natural features, species, habitats or biotic communities; protect a particular site of scientific, cultural, historical or archaeological interest; provide for its long-term protection and maintenance of its biodiversity; provide for a sustainable flow of natural products and services to meet community needs.
- **Protected environment:** declared to provide a buffer zone from undesirable development adjacent to national parks or nature reserves; to protect ecosystems needing protection outside of national parks and nature reserves; to protect areas which are sensitive to development due to either their natural characteristics or aesthetic reasons.

South Africa has international commitments under the Convention on Biological Diversity, the World Summit for Sustainable Development and the World Parks Congress to protect marine biodiversity and ensure the ecological integrity and sustainable use of marine systems and resources. These commitments include the establishment of a representative Marine Protected Area (MPA) network by 2012, with global targets recommending that between 10 and 30% of each marine habitat should be incorporated into effectively managed MPAs by this date.

Although some 22% of South Africa's coastline falls within MPAs, only 9% of the coastline is fully protected in 'no-take' Category 1 zones, with limited extraction allowed in the remaining MPAs. The existing MPA network falls short in that it is not representative of the marine environment and falls below the targets for protection. These targets were set in the National Protected Area Expansion Strategy (NPAES), which was developed for both terrestrial and marine areas with the overall goal of achieving cost effective protected area expansion, supporting ecological sustainability and increasing resilience to climate change (DEAT & SANBI 2008). The NPAES sets a 20-year target of 25% of the coast being protected, with 15% as a 'no take' zone (Table 7-1), with an interim five-year target also specified. Expanding the MPA along the Kogelberg coast will contribute towards achievement of the NPAES targets.

There is no legislation at present that specifically controls non-consumptive recreational use of the coast outside of MPAs. There are a range of indirect means by which this can and has been achieved, section 10 of the Seashore Act (1935) having been the most common means used to control recreational activities on the coast, with powers delegated to Provincial Authorities (in this case the Western Cape Provincial Government). This Act will, however, be repealed in the near future, when the **National Environment Management: Integrated Coastal Management Act** (2009) comes into force. The latter Act will regulate non-consumptive use of the coastal zone through the development of national, provincial and local coastal management programmes which require local authorities in particular to develop coastal and estuary management plans and to pass bylaws to ensure adequate protection of the coastal zone in their areas of jurisdiction. Exactly how this will be achieved remains to be seen.

TABLE 7-1: SUMMARY OF MARINE PROTECTED AREA TARGETS AND AREAS REQUIRED TO MEET TARGETS (DEAT & SANBI 2008)

	20-year target	Current protection level*	Addition needed to meet 20-year target	Addition needed in next 5 years
Marine inshore**	No-take: 15%	No-take: 9.1% (334km) ***	No-take: 6% (234km)	No-take: 1.5% (56km)
	Total: 25%	Total: 21.5% (785km)	Total: 9.6% (353km)	Total: 2.4% (88km)
Marine offshore: mainland EEZ	No-take: 15%	No-take: 0.16% (1 671 km ²)	No-take: 14.8% (159 111 km ²)	No-take: 3.7% (39 887 km ²)
	Total: 20%	Total: 0.4% (4 172 km ²)	Total: 19.6% (210 205 km ²)	Total: 4.9% (52 551 km ²)
Marine offshore: Prince Edward Islands EEZ ****	No-take: 15%	No-take: 0%	No-take: 15% (70 032 km ²)	No-take: 3.8% (17 508 km ²)
	Total: 20%	Total: 0%	Total: 20% (93 376 km ²)	Total: 5% (23 344 km ²)

Notes:

- * An area is considered protected if it falls within a protected area recognised in the Protected Areas Act.
- ** Inshore marine targets are measured in kilometres of coastline because of the varying distances which inshore MPAs extend from the coastline. Inshore is considered to mean from the high water mark to the 30m depth contour. All inshore MPAs extend at least this far. In future a more accurate area-based measure for inshore MPA targets will be used, but this is not possible with current data.
- *** The protection levels reflected in this table exclude the Stilbaai MPA that was declared in 2008 after the release of the NPAES, with more than 50% of this MPA being “no-take”
- **** A proposal to create an MPA around the Prince Edward Islands was gazetted in May 2009

In addition to this, Section 24(4) of the **National Environment Management Act** (2003) (NEMA), through the Off Road Vehicle Regulations (2001, amended 2004) regulates the licensing and control of recreational boat launching sites as well as the use of recreational vehicles in the coastal zone. These regulations imposed a general ban on the use of ORVs on the coast, with exemption for certain “permissible uses”:

- on a public road, private land with the permission of the owner or lawful occupier or on a road within a coastal protected area with the permission of the manager of that area;
- for mining or associated purposes within a mining area (defined in the Minerals Act 50 of 1991);
- in an emergency situation (to safeguard human life or health);
- within any part of a proclaimed harbour that has already been physically modified to the extent that it is no longer in a natural or semi-natural state;
- by an employee of the state for the purposes of performing public duties;
- the use of electrically propelled vehicles operated by physically disabled persons; and

- within a boat launching site, provided the site has been issued with a valid boat launching site license (to be applied for in terms of these regulations).

The regulations also allow for an application to be made for a permit to allow vehicle access to the coastal zone for the following purposes:

- Scientific research
- Commercial fishing activities (defined in the Marine Living Resources Act 18 of 1998)
- Recreational use within a demarcated Recreational Use Area (RUA)
- Tourism business conducted by registered tour operators
- To access private property where no reasonable road access exists

All applicants for a license (boat launching site) or permit are required to follow environmental impact assessment procedures, unless granted an exemption from this requirement by the Minister.

The Minister of Environmental Affairs and Tourism also has the right to exempt an applicant from certain requirements of the regulations if he is satisfied that the proposed activity;

- Will not result in significant harm to the environment,
- Will not seriously affect any rights of the general public to enjoy the coastal zone and,
- Is in the public interest, in the interest of providing equitable access by any physically disabled person to any part of the coastal zone, or in the interests of protecting the environment.

7.3 LOSS AND PHYSICAL MODIFICATION OF HABITAT

7.3.1 Issues

Direct disturbance to habitat in marine and coastal environments is mostly associated with mineral exploitation (i.e. mining), infrastructure development (e.g. slipways, harbours, etc.) and dredging. The latter does not apply to the study area. Sand mining occurs in the study area on a minor scale and does not appear to be a significant issue. The main potential issue is development.

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). Some 40% of South Africa's population lives within 100 km of the coast, resulting in substantial development pressure. Access to the coast and the sea for fishing, recreation, and other purposes requires construction of roads, harbours and slipways, all of which consume natural habitat that would otherwise be available for marine and coastal species. Similarly, human desire to live as close as possible to the water drives demand for the erection of infrastructure in the coastal zone both above (e.g. houses, roads, ablutions) and below the high water mark (e.g. marinas).

The dunes of the KBR coast are highly mobile, and the landward transport of sand has resulted in inappropriately-positioned coastal properties being regularly inundated with sand, a fact that has resulted in huge development costs within the area. This has led to the demand for artificially stabilizing the dunes with vegetation or removing the foredunes. Such actions threaten the sandy beaches of the area by removing the reservoir of sand available to the beaches and impairing their function as a refuge used by many sandy beach species during storms or when food supplies on the beach are low (McLachlan & Brown 2006, du Toit & Attwood, 2008).

There is some concern that the Spatial Development Frameworks (SDFs) pertaining to the study area do not incorporate sustainability principles of biosphere reserves (despite implementation of a bioregional planning model - Figure 85), and that the local municipalities and communities are not sufficiently aware of the significance and fragility of the Kogelberg environment, the concept of a biosphere reserve and the notion of sustainable development (iKAPA ENVIROPLAN 2006). In theory, bioregional planning takes into account the relationship between environmental integrity, human well being and economic efficiency, which are managed in order to promote sustainable development, by making use of its five spatial planning categories (Figure 85).

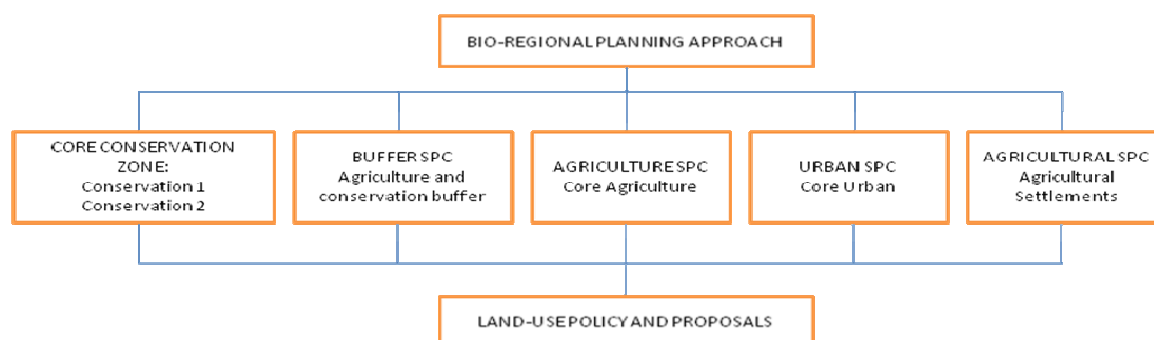


FIGURE 85. BIOREGIONAL PLANNING MODEL

All four villages in the KBR are surrounded by conservation-agriculture buffers of varying width, and the shore edge of Kleinmond is bordered by a thin band of core conservation zone. The conservation-agriculture buffer zone that exists between the core urban area and the coast at Rooiels is clearly evident in aerial photos of this section of coastline (Figure 86). This buffer is 100 – 250 m wide between the western boundary of the town and the rocky shore, but is alarmingly narrow between the town and the estuary. There is virtually no buffer zone along the edge of the Rooiels beach and the lower reaches of the estuary and the urban core has been allowed to extend up to estuary edge (Figure 87). According to the Overstrand spatial development framework there is no further urban expansion proposed for Rooiels.



FIGURE 86 BROAD CONSERVATION BUFFER ZONE EVIDENT BETWEEN SHORE AND RESIDENTIAL DEVELOPMENTS AT ROOIELS



FIGURE 87. NARROW BUFFER ZONE BETWEEN RESIDENTIAL DEVELOPMENTS AND THE ROOIELS ESTUARY.

There is a very small buffer zone (~100 m) around Pringle Bay between the rocky shore and the urban core, and there is virtually no buffer zone between the sandy beach and the urban core (Figure 88). Residential developments extend right up to the edge of the Pringle Bay beach and the Buffels Estuary. There appears to be a landward migration of sand from the Pringle Bay dune system, which typically results in the inundation of houses by sand.



FIGURE 88. COASTAL DEVELOPMENT AT PRINGLE BAY WITH POOR OR NO CONSERVATION BUFFER ZONE

The Bettys Bay Urban core extends approximately 10 km along the coastline and the buffer zone between the residential area and the town varies from 50 – 300 m (Figure 89). As with Pringle Bay, residential development has been allowed to encroach onto the mobile dune systems. It is also apparent from satellite imagery that residential housing on Betty's Bay beach lies directly in the path of the sand migration corridor behind the Betty's Bay beach (Figure 90). Limited urban development is proposed for the Betty's Bay area, none of which is in the proximity of the shore or estuary.



FIGURE 89. COASTAL DEVELOPMENT IN BETTY'S BAY WITH COASTAL BUFFER ZONES OF VARYING MAGNITUDE



FIGURE 90. BETTY'S BAY IS DIRECTLY IN THE PATH OF A MOBILE DUNE CORRIDOR ORIGINATING ON THE BEACH. (SOURCE: GOOGLE EARTH 2009)

Kleinmond has the most development planned of all four villages in the Kogelberg area. Two urban extension zones have been identified, both of which lie on the landward side of current residential developments. An industrial extension/renewal has also been proposed adjacent to the Kleinmond harbour. Development of a resort/campsite has been proposed adjacent to the Palmiet estuary. This is a well defined conservation buffer zone situated between the town of Kleinmond and the rocky shore. There is also limited development permitted on the banks of the estuary (Figure 91).



FIGURE 91 KLEINMOND ESTUARY AND TOWN. NOTE THE ABSENCE OF A BUFFER ZONE ALONG BETWEEN THE TOWN AND THE LOWER REACHES OF THE ESTUARY

Three main coastal development projects have been identified by the Overstrand Municipality for the Kogelberg area and have been incorporated into the Integrated Development Plan (IDP) for 2008/09. These include development of a resort/campsite on the Palmiet estuary, regeneration of the industrial area adjacent to the Kleinmond harbour and development/improvement of leisure facilities at the Kleinmond lagoon with the aims of re-applying for Blue Flag status (Figure 92). Detailed development plans were not available for each of these projects at the time of writing this report. It is not clear what impact these developments will have on the marine systems as detailed plans and objectives for each development were not available at the time of writing this report. Development of the Palmiet estuary/campsite may result in habitat destruction and trampling of indigenous vegetation surrounding the estuary. In order for the Kleinmond lagoon to qualify for blue flag status it will have to satisfy water quality requirements, and thus developments such as improved ablution facilities and improved waste/litter management will have positive repercussions for the health of the marine environment. Activities relating to the development of the Kleinmond harbour may impact the marine environment via the runoff of materials and chemicals associated with building and construction. If industrial activities are established at the Kleinmond harbour the responsible authorities (Overstrand Municipality) will have to ensure that no harmful discharges are released into the marine environment. Another concern with regards to developing along the margins of water bodies and coastlines, is that an increase in hard/sealed surface area will result in increased volumes of storm water runoff entering the coastal and estuarine environments. Storm water runoff can lead to degradation of water quality and can negatively impact the health of coastal environments. However, given the small surface area of the proposed developments it is unlikely that the volumes of storm water runoff at these sites will result in long term deterioration of water and sediment quality.



FIGURE 92 KEY DEVELOPMENT AREAS SITUATED ON THE KOGELBERG COASTLINE. (SOURCE OVERSTRAND MUNICIPALITY IDP 2008/09).

7.3.2 Legislation and responsible parties

Land use management and control of development in the coastal zone is mostly the responsibility of the provincial government and local authorities (municipalities), and is administered through the **Local Government: Municipal Systems Act** (2000), the Seashore Act of 1935, and the National Environmental Management Act (2003) (NEMA) and associated EIA regulations.

Development planning has been rather *ad hoc* in the past, but has now been formalised under the Municipal Systems Act, which requires that all municipalities (i.e.

Metros, District Municipalities and Local Municipalities) have to produce **Integrated Development Plans** (IDPs). As the IDP is a legislative requirement it has a legal status and supercedes all other plans that guide development at local government level. The IDP process is one of the key tools for local governments to cope with their developmental roles and responsibilities. It is the principal strategic planning instrument which guides and informs all planning, budgeting, management and decision-making in a municipality for a five-year period. IDPs are also supposed to guide the activities of other spheres of government, corporate service providers, NGOs and the private sector within the municipal area. Because of the participatory process it takes approximately 6 – 9 months to complete an IDP. The IDP is updated every five years.

Every municipality is required to produce an indicative plan, called a **Spatial Development Framework** (SDF), showing desired patterns of land use, directions of growth, urban edges, special development areas and conservation-worthy areas. It must also produce a scheme, called a **Land use Management System** (LUMS) recording the land use and development rights and restrictions applicable to each erf in the municipality. The plan should be flexible enough to accommodate changing priorities, and the scheme has to conform to the plan. The plan (SDF) is a *guide* to development, and the scheme (LUMS) is *binding*.

The Spatial Development Framework for the Western Cape Province is pitched at a very broad level, encapsulated in the vision “a home for all in the Western Cape”. It offers very little material guidance of specific relevance to the management of the Kogelberg coast, except to acknowledge the existence of the Kogelberg Biosphere Reserve as one of two such areas in the Western Cape. The IDP and SDF documents for the Overberg District Municipality and the Overstrand Local Municipality contain much more of direct relevance to management of the Kogelberg coastline, but are far too detailed to be summarized in a meaningful way in this document. These documents downloaded from their respective websites (Overberg District Municipality: www.odm.org.za, Overstrand Local Municipality: www.overstrand.gov.za) and the reader is encouraged to do so.

Development within the coastal zone is also to some extent controlled through National Environmental Management Act (2003) (NEMA) and associated EIA regulations. A range of listed activities are included in the annexures to the regulations for which either a Basic or full EIA are required. In the event that a developer wishes to undertake project involving any of the listed activities, the developer is required to appoint an independent EIA practitioner to conduct a Basic Environmental Assessment (in the case of the former) or initiate a scoping exercise in the case of the latter). Following completion of such an assessment, an application must then be made to the relevant authority (Western Cape Department of Environmental Affairs & Development Planning or DEAT in the case of the Kogelberg area) for approval of the project. The application will be considered by the MEC/Minister and his/her staff and a Record of Decision issued indicating that the development may either proceed under certain conditions, must be subject to a more detailed assessment (i.e. full EIA), or may not proceed at all. The Record of Decision (ROD) issued by the authority (DEADP) may be appealed by the applicant (or anyone opposed to the development) which could result in the ROD being upheld, additional conditions being imposed on the development, or the ROD being overturned. Such an appeal must be lodged within 30 days of the ROD being published, using the appropriate forms. Further details on the EIA process, application and appeal forms are available on the Cape Gateway website (www.capegateway.gov.za/eng/directories/services/11537/10199).

In addition to the above, for development on any land below the high water mark, land required for the purpose must be leased from the state under the **Seashore Act** of 1935. Responsibility for administration of this Act, and hence the lease of any land below the high water mark in the Western Cape Province, has been devolved to the Provincial Government in the Western Cape Province, the relevant authority being Cape Nature. This is set to change in the near future, however, following the recent proclamation of the National Environmental Management: Integrated Coastal Management Act (2009).

The **National Environmental Management: Integrated Coastal Management Act** (2009) is projected to come into force later this year, and seeks to:

- promote the conservation of the coastal environment, and maintain the natural attributes of coastal landscapes and seascapes, and to ensure that development and the use of natural resources within the coastal zone is socially and economically justifiable and ecologically sustainable;
- define rights and duties in relation to coastal areas;
- determine the responsibilities of organs of state in relation to coastal areas;
- prohibit incineration at sea;
- control dumping at sea, pollution in the coastal zone, inappropriate development of the coastal environment and other adverse effects on the coastal environment; and
- give effect to South Africa's international obligations in relation to coastal matters

The Act designates all land below the high water mark as coastal public property that is held in trust by the state on behalf of the citizens of the country, and requires that the state take "whatever reasonable legislative and other measures it considers necessary to conserve and protect coastal public property for the benefit of present and future generations". In terms of the Act, all land within one kilometre of the high water mark zoned for agricultural or undetermined use and not part of a lawfully established township at the time at which the Act came into force, and all other land within 100 metres of the high-water mark will be incorporated within a "coastal protection zone". The purpose of coastal protection zone is to protect ecological integrity, natural character and the economic, social and aesthetic value of the land and sea below the high water mark and to maintain the natural functioning of the littoral active zone. Authorisation for construction of any structures within this zone may only be issued in terms of the NEMA EIA regulations provided the structure in question is inconsistent with the purpose for which the coastal protection zone was established, is likely to cause irreversible or long-lasting adverse effects to any aspect of the coastal environment that cannot satisfactorily be mitigated nor is likely to be significantly damaged or prejudiced by dynamic coastal processes. Provincial MEC's are required to establish or coastal set-back lines in which the erection of any structures shall be prohibited. All municipalities in the country are required to facilitate public access to the seashore through the designation of coastal access land.

The national government (DEAT), all coastal provinces and coastal municipalities are also all required to prepare coastal management programmes for managing the coastal zone within their areas of jurisdiction. These coastal management programmes are required to set out a vision, objectives, priorities and strategies for achieving objectives, norms and standard for management of the coastal zone, and a framework for co-operative governance that identifies the responsibilities of different organs of state in

respect of the management of the coast. Coastal management programmes are required to be consistent with other planning documents (e.g. IDP and SDF documents) and vice versa. Coastal municipalities are also empowered to pass bylaws in terms of the Act for the purpose of administrating and enforcing their coastal management programmes.

Certain sections of the coast may be designated as “special management areas” in terms of the Act for the purpose of conserving, protecting or enhancing coastal ecosystems and biodiversity in the area and for facilitating the management of coastal resources by a local community. The Act requires that all estuaries in the country be managed in a co-ordinated and efficient manner and in accordance with a national estuarine management protocol.

Minister and provincial MECs are also empowered to remove any structure on or within the coastal zone deemed to be having an adverse effect on the coastal environment by virtue of its existence or because it has been erected, constructed or upgraded in contravention of this Act or any other law.

The **Minerals and Petroleum Resources Development Act** (2002) makes provision for equitable access to and sustainable development of the nation’s mineral and petroleum resources. The Act affirms the State’s obligation to protect the environment for the benefit of present and future generations, to ensure ecologically sustainable development of mineral and petroleum resources and to promote economic and social development. Chapter 4 of the Act deals with Environmental Management principles as set out in section 2 of the National Environmental Management Act (1998). The holder of a prospecting or mining right or permit must abide by the general objectives of integrated environmental management as stipulated in Chapter 5 of NEMA and is required to conduct an environmental impact assessment and thereby manage all environmental impacts in accordance with the environmental management plan. The Act also stipulates that the holder of such a right or permit is responsible for any environmental damage, pollution or ecological degradation resulting within or outside the boundaries from the mining activity. On application for a mining right, an environmental management programme is required to be submitted to the Minister and on application for a prospecting right or mining permit, an environmental management plan (as prescribed) is required to be submitted. Only on approval of the environmental management programme or plan by the Minister, can such a mining or prospecting right or licence be granted.

7.4 FRESHWATER INFLOW AND BREACHING OF ESTUARIES

7.4.1 Issues

Water is a scarce resource in South Africa (Davies & Day 1998), and increasing demands for water caused by industrialisation, agriculture and urbanisation have led to increased impoundments, abstraction and inter-basin transfers. This has caused drastic changes to the flow and flood regimes of rivers, which affects estuarine ecosystems and the adjacent inshore marine environment.

A reduction in flow, particularly in the frequency or intensity of flooding, has several major consequences for an estuary, including sedimentary processes, depth profiles, mouth configuration, duration of the open phases and the tidal prism within an estuary.

Sand banks situated in the mouths and lower reaches of estuaries will grow larger, constricting the channel and reducing tidal exchange with the sea. Ultimately this will have the effect of increasing the frequency and length of time for which the mouths will close or remain closed.

Changes in mouth state affect the degree to which estuary-dependent species from the marine environment can move between these habitats, affecting the nursery value of the estuary.

A change in flow may also be accompanied by changes in nutrient levels, suspended particulate matter, temperature, conductivity, dissolved oxygen and turbidity (Drinkwater & Frank 1994), all of which play a role in structuring biological communities in estuaries.

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 (Kennish 2002).

The greater part of the catchments of the river systems supplying water to estuaries on the Kogelberg coast lies within the Kogelberg Biosphere Reserve where there is very little agriculture or development, aside possibly for the Bot estuary. Most of these systems are too small to support any significant levels of abstraction for urban or industrial uses with the result that level of abstraction is low except in the case of the Steenbras estuary where water is captured to supply the City of Cape Town and the Bot estuary where water is diverted for agricultural and domestic use. The rocky mouth of the Steenbras estuary ensures that this system remains open. The reduction in freshwater runoff to this system is thus not as important, given also its small size and steep gradient which implies that it probably did not ever support significant populations of any marine or estuarine species.

Impacts of reductions in freshwater flow have been far more significant for the Bot/Kleinmond system, whose freshwater inputs have been reduced to 64% of those under natural conditions (van Niekerk et al. 2005). Up to 44% of the catchment has been ploughed under for cereal production, and a further 4.5% is infested with alien vegetation (mostly pines and *Acacia* sp.) which uses more water than the indigenous species. A mere 43% of the catchment is undisturbed by human activities (van Niekerk et al. 2005). Freshwater abstraction from irrigation dams upstream, as well as evaporation from these dams, rivers and the estuary contributes directly to freshwater loss. Remaining runoff is insufficient to produce a natural breaching event of the Bot River Estuary (van Niekerk et al. 2005). In fact, the estuary has breached naturally only three times in the period from 1940 to 1986 (Bally & Branch 1986), and must now be breached artificially approximately every three years to maintain the system in a semi-natural state. The situation is less than ideal, as artificial breaching does not go very far towards simulating the natural process. Normally a breaching event would be triggered by a large flood that would scour out the estuary basin, facilitating a period when seawater is able to flow naturally in and out of the estuary basin, and also facilitate another natural breach in the future. The current breaching policy for the estuary is a hotly debated topic and will be reviewed in early 2009 (iRap Consulting 2009).

The Kleinmond estuary is also breached artificially, roughly six times a year, and this can drain up to 1m of water from the Bot, which also inhibits natural breaching of the Bot Estuary (van Niekerk et al. 2005). Seawater thus rarely enters the Bot estuary, and it is consequently shifting towards a freshwater lake. It is predicted that more frequent

opening would stabilize the ecosystem and would reduce the effects of gill-netting on marine fish stocks by allowing an escape route for fish (iRap Consulting 2009). Frequent breaching would also increase biodiversity within the system and would increase the nursery value of the estuary, which in turn would help sustain marine fish stocks and would benefit commercial and recreational fishers (van Niekerk et al. 2005).

Allowing the Bot estuary mouth to continue on its current trajectory will also result in expansion of the reed *Phragmites australis* in the upper reaches, which in turn will trigger further habitat changes. *Phragmites* beds trap sediments and would most likely cause the estuary to become shallower, and would facilitate further reed expansion and sediment trapping. More frequent breaching, on the other hand, would facilitate re-suspension and flushing of the sediments out to sea (van Niekerk et al. 2005). Freshwater alien fish species such as carp *Cyprinus carpio* and Mozambique tilapia *Oreochromis mossambicus* also invade under freshwater conditions and compete with indigenous species.

7.4.2 Legislation and responsible parties

The quantity and quality of freshwater reaching estuaries in South Africa is controlled under the **National Water Act** 36 of 1998, administered by the Department of Water Affairs and Forestry which gives effect to the White Paper on National Water Policy for SA (1997). This policy document promotes efficiency, equity and sustainability in the use of water resources under the slogan “some, for all, for ever”. The policy explicitly recognises the environment as a legitimate user of water and makes provision to protect the environment from overexploitation of water resources. The National Water Act 36 of 1998 (NWA) makes provision for a freshwater “Reserve” which provides the quantity and quality of flows required in aquatic ecosystems required to meet basic human needs and to protect the natural functioning of a water resource. The latter portion of the reserve is known as the environmental Reserve, and its extent is negotiable.

The extent to which an estuary’s functioning is catered for is determined by the designated “class” (= future state of health) of that estuary, with some estuaries being assigned a low class to allow maximal water provision and others being assigned a high class in order to meet conservation needs. The decision as to the designated class of the estuary is thus a critical one and is set to take place using a **Classification Process** that has recently been gazetted. This process has yet to be implemented in any of the river systems in South Africa, but will entail consideration of the trade-offs in value generated by allocating water (or pollution rights) to off-stream users (e.g. irrigation agriculture), flow-reducing activities (e.g. plantation forestry) and polluters (e.g. municipalities, farmers) versus allocating water to the environment for the provision of ecosystem services (e.g. fishing, tourism) and meeting biodiversity conservation targets. The Catchment Management Agencies will in future probably play the key role in this decision –making process, but until these agencies are operational, decisions are being made with the aid of water situation assessments known as Internal Strategic Perspectives (ISPs) that were developed as an interim aid.

Pending the implementation of the Classification Process, the environmental Reserve is currently determined on the basis of recommendations emanating from a reserve determination study using the **Resource Directed Measures** methodology (DWAF 2004b) in conjunction with considerations of the demand for water in the catchment (the classification process described above will effectively standardise the

way this is done). The environmental reserve has not yet been assessed for any of the estuaries in the Kogelberg area, although this process is currently underway for the Palmiet estuary and a rapid assessment will take place for the Bot estuary during late 2009.

The issue of artificial breaching is dealt with in the development of estuary management plans, which are required under the **Integrated Coastal Management Act** (2009).

7.5 ALIEN INVASIVE SPECIES

7.5.1 Issues

Species that are introduced to new areas, either intentionally or accidentally, may become established and can become invasive under certain conditions (Griffiths *et al.* 2004). Without local predators or limited competition, these species can spread rapidly, displacing indigenous species. Once established, invasive alien species are extremely difficult to control or eradicate and can significantly reduce natural biodiversity. To date, a total of 23 marine species have been recorded as introduced to South African waters mostly through shipping activities or mariculture (Griffiths *et al.* 2008, Table 2). Three of these are considered invasive: the Mediterranean mussel *Mytilus galloprovincialis*, the European green crab *Carcinus maenas* (Griffiths *et al.* 1992; Robinson *et al.* 2005) and the recently-detected barnacle *Balanus glandula* (Laird & Griffiths 2008). An additional five species are currently regarded as cryptogenic (i.e. of uncertain origin) but very likely introduced. Only a few of these species are known to occur in the Kogelberg area, but this probably has more to do with low sampling intensity in this area than anything else.

Numbers of introduced species in South Africa are very low compared to other countries in the world where the tallies in excess of 100 species have been recorded (e.g. USA, Australia). Gibbons (1999) and Griffiths (1999) caution, however, that the South African tally may be an underestimate given that large areas of the South African coast that are unexplored, and the taxonomy of many marine groups is still poorly developed in South Africa. Most of the introduced species in this country have been found in sheltered areas such as harbours, and are believed to have been introduced through shipping activities. Because ship ballast water tends to be loaded in sheltered harbours, the species that are transported originate from these habitats and have a difficult time adapting to South Africa's exposed coast. This might explain the low number of introduced species that have become invasive along the coast (Griffiths *et al.* 2008).

There is no major issue at present in terms of marine alien invasive species along the KBR coast. However, it is important that this issue remains in control. A more pertinent issue is the invasion of coastal dune systems by terrestrial alien invasive plants, mainly *Acacia* species. These plants have stabilised dunefields, affecting the movement of sand in the coastal zone, and ultimately affecting the supply of sand to the popular beaches.

TABLE 2. INTRODUCED AND CRYPTOGENIC MARINE SPECIES IN SOUTH AFRICA WITH THEIR KNOWN DISTRIBUTION RANGES, STATUS AND THE MOST LIKELY VECTOR OF INTRODUCTION. DATA ARE EXTRACTED FROM ROBINSON ET AL. (2005) AND GRIFFITHS ET AL. (2008).

Group	Species	Range of distribution	Status	Introduced by
Rhodophyta	<i>Antithamnionella spirographidis</i>	West coast	Cryptogenic*	Unknown
	<i>Antithamnionella ternifolia</i>	West coast	Cryptogenic*	Unknown
	<i>Chimmelmanntia elegans</i>	Table Bay harbour	Established	Shipping
Bryozoa	<i>Membranipora membranacea</i>	Found on kelp along South African coast	Established	Unknown
Cnidaria	<i>Metridium senile</i>	Table Bay harbour	Established	Unknown
	<i>Sagartia ornate</i>	Langebaan Lagoon	Established	Unknown
Polychaeta	<i>Boccardia proboscidea</i>	Saldanha Bay and Hermanus	Established	Unknown
Cirripedia	<i>Balanus glandula</i>	Cape Point and Lamberts Bay	Invasive	Recent introduction
Isopoda	<i>Paracerceis sculpta</i>	Port Elizabeth Harbour	Established	Shipping
	<i>Limnoria quadripunctata</i>	Table Bay – Port Elizabeth	Cryptogenic*	Unknown
Amphipoda	<i>Jassa marmorata</i>	Harbour areas in South Africa	Established	Shipping
	<i>Jassa morinói</i>	Harbour areas in South Africa	Established	Shipping
	<i>Jassa slatteryi</i>	Harbour areas in South Africa	Established	Shipping
	<i>Corophium acherusicam</i>	Harbour areas in South Africa	Established	Shipping
Decapoda	<i>Carcinus maenas</i>	Saldanha Bay, Table Bay harbour and Hout Bay	Invasive	Shipping
Bivalvia	<i>Mytilus galloprovincialis</i>	Saldanha Bay to Port Elizabeth	Invasive	Mariculture
	<i>Crassostrea gigas</i>	Knysna Estuary - other estuaries along the south coast	Established	Mariculture
	<i>Ostrea eduli</i>	Knysna Estuary - Alexander Bay	Established	Mariculture
	<i>Bankia carinata</i>	East coast	Cryptogenic*	Unknown
Gastropoda	<i>Littorina saxatilis</i>	Langebaan Lagoon and Knysna Estuary	Established	Shipping
Echinoidea	<i>Tetrapyrgus niger</i>	Alexander Bay	Established	Unknown
	<i>Marthasterias glacialis</i>	Western and Eastern Cape	Cryptogenic*	Unknown
Ascidacea	<i>Botryllus schlosseri</i>	Durban harbour, Alexander Bay, Saldanha Bay and Hout Bay	Established	Shipping
	<i>Ciona intestinalis</i>	Harbour areas in South Africa	Established	Shipping
	<i>Clavelina lapadiformis</i>	Knysna estuary and Port Elizabeth Harbour	Established	Mariculture
	<i>Cnemidocarpa humilis</i>	Table Bay and Hout Bay harbours	Established	Shipping
	<i>Diplosoma listerianum</i>	Harbours between Saldanha Bay and Port Elizabeth	Established	Shipping
	<i>Microcosmus squamiger</i>	Alexander Bay, Table Bay and Knysna Estuary	Established	Shipping

7.5.2 Legislation and responsible parties

Policy and legislation dealing with the accidental or deliberate import of alien species into this country is dealt with under the National Environmental Management: Biodiversity Act (2004) and International Maritime Organisation (IMO) ballast water management guidelines under IMO resolution A868 (20) of 1997 to which South Africa is a signatory.

The International Maritime Organisation (IMO) ballast water management guidelines under IMO resolution A868(20) of 1997 require that ships exchange their ballast water far out to sea, or carry detailed records of how it has been treated. Ballast water discharged in South African waters has to conform to certain standards.

The **National Environment Management: Biodiversity Act** (2004) deals with the prevention of the unauthorised introduction and spread of alien species and invasive species into ecosystems where they do not naturally through a permit system. Permits for the introduction of alien species may be issued only after the prescribed assessment of risk to and potential impacts on biodiversity has been carried out. The Act specifies that an individual can be held liable should an alien species establish itself in nature as an invasive species as the result of the actions of that individual. All organs of state in all spheres of government are required to prepare an invasive species monitoring, control and management plan for land under their control. Most importantly, these organs of state are also required to ensure that the appropriate environmental assessments are conducted in terms of issuing permits under the Genetically Modified Organisms Act (1997).

The Conservation of Agricultural Resources Act (CARA) regulations require that landowners keep their land free of listed invasive alien species, including those that affect the study area.

7.6 POLLUTION

7.6.1 Issues

Pollution is defined by the United Nations Convention on the Law of the Sea as *‘the introduction by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, which results in such deleterious effects as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of the sea water and reduction of amenities’*. Pollutants or contaminants can broadly be grouped into five different types: trace metals, hydrocarbons, organochlorines, radionuclides, and nutrients.

Certain **metals** (e.g. mercury, cadmium, arsenic, lead, chromium, zinc and copper), normally found in very low concentrations in the environment (hence referred to as trace metals) are highly toxic to aquatic organisms. Many of these metals are mined, used in industrial processes and discharged to the environment together with industrial effluent and waste water. This is not a significant issue in the KBR.

Hydrocarbons discharged to the marine environment include mostly oil (crude and bunker oil) and fuel (diesel and petrol). Sources include spills from vessels, refineries, storage tanks, and various industrial and domestic sources. Hydrocarbons are lethal to

most marine organisms due to their toxicity, but particularly to marine mammals and birds due to their propensity to float on the surface of the water where they come into contact with seabirds and marine mammals. This is an important issue in the vicinity of harbours in the KBR.

Organochlorines are manufactured entirely by man. The most commonly known are plastics (e.g. polyvinylchloride or PVC), solvents and insecticides (e.g. DDT). Most organochlorines are toxic to marine life and have a propensity to accumulate up the food chain. Solid plastic waste is a problem that is pertinent to the KBR coast. It is unsightly, affecting the recreational value of the coast, and entangles and chokes seabirds and seals.

Nutrients are derived from a number of sources, the major one being sewage, industrial effluent, and agricultural runoff. They cause eutrophication of coastal and inland waters. Eutrophication results in proliferation of algae, phytoplankton (red tide) blooms, and deoxygenation of the water (black tides). This is an issue of major importance in the KBR.

There is only one waste water treatment works (WWTW) in the Kogelberg, which is situated in Kleinmond. There are no sewage works or pump stations in Rooiels, Pringle Bay or Betty's Bay. Sewage from these areas is either treated in septic tanks or is collected from conservancy tanks and transported by truck to Kleinmond WWTW for treatment (C. Harding, Engineering Department, Overstrand Municipality *pers. comm.*). The location of sewage pump stations are shown Figure 93. Only 20 % of households are served by the water-borne sewage system in Kleinmond and the remainder have septic tanks that are serviced by vacuum tankers (IDP 2009). The treated sewage effluent runs from the treatment works into the natural reed bed (Kleinmond wetland area) and then into the sea. The water quality of the effluent typically meets water quality requirements, however there have been isolated incidents where effluent has been discharge with unsafe concentrations of ammonia and faecal coliforms. For example, in November 2008, faecal coliform counts were 45 000 per 100 ml, which far exceeds the permissible limit of 1000 per 100 ml (Table 6). The high faecal coliform count was attributed to the lack of chlorine for proper treatment (AL Abbot & Associates 2008).

The Kleinmond beach was awarded Blue Flag status in 2004, and 2006-2007. The Blue Flag eco-label is given to beaches that meet 14 criteria spanning three aspects of coastal management: water quality, environmental education and information, and safety and services, which include excellent life-saving standards, top-rate parking and sparkling ablution facilities. Blue Flag status is awarded yearly and can be removed if beaches do not meet certain quality criteria. The Kleinmond beach was not re-awarded blue flag status in 2008/09 due to water quality and safety issues. In terms of water quality *E. coli* and faecal coliform counts are presently very high in the Kleinmond Estuary and the public have been warned not to bathe in the water. The Overstrand Municipality is currently trying to identify why the *E. coli* and faecal coliform counts are elevated and have suggested that it may be linked to leaking French drains and conservancy tanks. Poor water quality in the Kleinmond Estuary has been exacerbated by extended mouth closure inflicted by the dry season (L Geldenhuys, Environmental Officer, Overstrand Municipality *pers comm*). High nutrient input from sewage contamination would also lead to eutrophication, which results in algal blooms, which are followed by anoxia and widespread death of estuarine fauna.

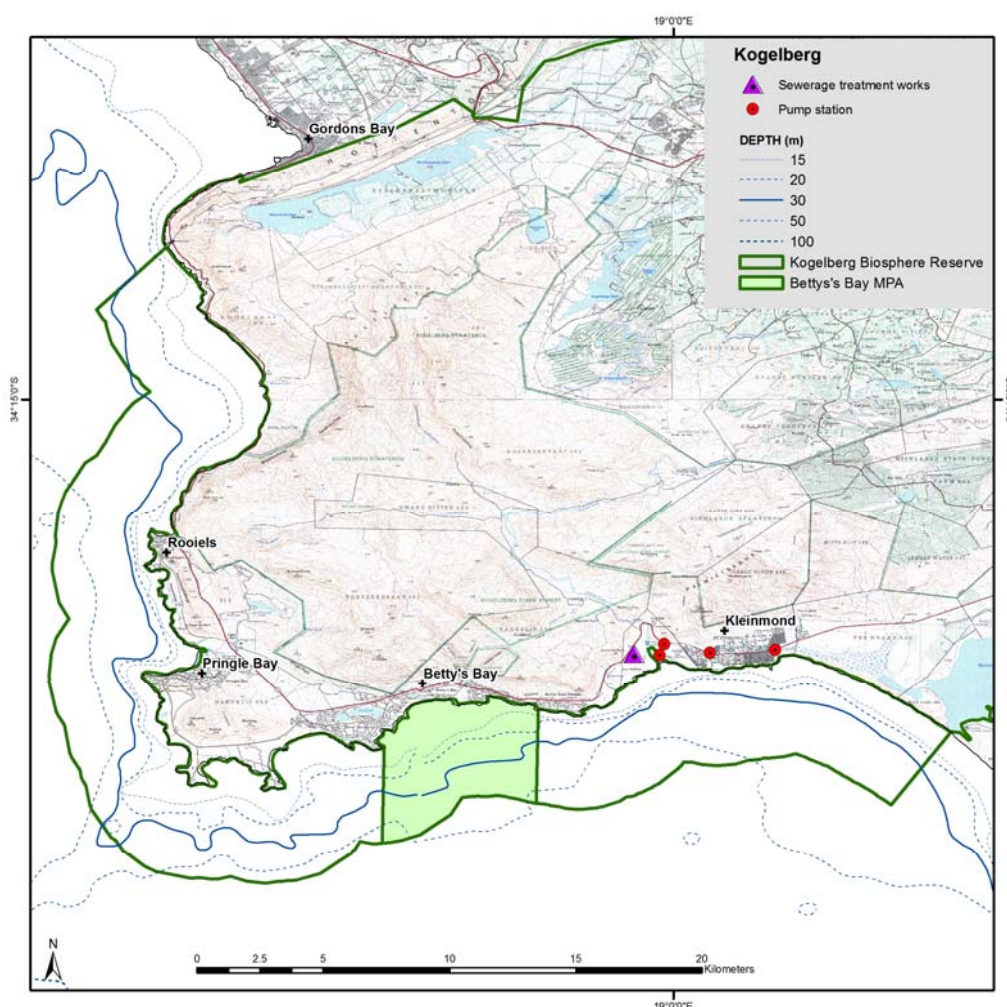


FIGURE 93 LOCATION OF SEWAGE PUMP STATIONS IN THE KOGELBERG BIOSPHERE RESERVE

In terms of stormwater runoff, there are approximately 80 km of groundwater channels spread throughout Kleinmond to carry storm water; however there are currently no formal storm water drains in Rooiels, Pringle Bay and Betty's Bay, resulting in many houses being flooded during heavy storms (IDP 2009). There is no data available on the impacts of stormwater runoff on water quality in the Kogelberg area.

7.6.2 Legislation and responsible parties

Management of water quality in the marine environment in South Africa is administered severally by the Department of Water Affairs and Forestry (DWAF), the Department of Environmental Affairs & Tourism (DEAT), the Department of Transport (DOT), and the Department of Mineral and Energy (DME), with each responsible for a different area (Table 23).

The legislation for marine pollution control is consequently extensive but fragmented and often hampers the proper integrative management and control thereof. It should be noted though that the newly proclaimed **National Environmental Management: Coastal Management Act** (2009) provides for the transfer of all responsibility for marine pollution management to the Department of Environmental Affairs and Tourism. Again, how this will be administered remains to be seen.

TABLE 23. GOVERNMENT DEPARTMENTS INVOLVED WITH MARINE POLLUTION MANAGEMENT IN SOUTH AFRICA AND THEIR RESPECTIVE AREAS OF RESPONSIBILITY.

Sub-category	Responsible authority
Land-based Sources	Department of Water Affairs and Forestry
Dumping at sea	Department of Environmental Affairs & Tourism
Maritime Transportation	Department of Environmental Affairs & Tourism (prevention) Department of Transport (clean-up)
Offshore Exploration & Production	Department of Minerals and Energy

DWAF exercises its mandate through the **National Water Act** (1998) and its Operational Policy for the Disposal of Land-derived Water containing Waste to the Marine Environment of South Africa in 2004 (DWAF 2004a) and Water Quality Guideline Documents (DWAF 2004b-e). In essence, anyone wishing to discharge effluent from a land-based source to the sea is required to obtain a water use licence from DWAF that will stipulate water quality requirements for that effluent based on designated beneficial uses of the receiving environment (i.e. the sea). DWAF recognizes the following beneficial uses for marine waters in South Africa:

- natural environment (marine ecosystems)
- recreation
- industrial uses (e.g. taking in cooling water and water for fish processing) and,
- mariculture (including collection of seafood).

Corresponding target water quality values have been published for each beneficial use category (DWAF 1995a-d) and are used to set minimum water quality criteria in respect of water use licences for a particular area. Water quality guideline values for each of the four beneficial use types are included in APPENDIX 1: , Table 25-Table 28. As a rule of thumb, water quality requirements of the natural environment need to be adhered to throughout, except in the 'sacrificial zones' that, at times, may be allocated to particular pollution sources.

Water quality requirements can also be set by external factors such as those required by the EU to allow the export of farmed shellfish products (see for example APPENDIX 1: , Table 29). These requirements include actual water quality standards as well as audited monitoring plans, and can serve as a guideline in setting water quality criteria for water use licences where this is required. Mariculture permits issued by DEAT in terms of the **Marine Living Resources Act** (Act 18 of 1998) also sometimes include specific conditions pertaining to water quality in which shellfish are grown, some of which are more stringent than those included in the South African Water Quality Guidelines, and can influence water quality criteria included in water use licences.

There are a number of contaminants potentially discharged to the marine environment that are not covered by the South African Water Quality Guidelines for Coastal Marine Waters (DWAF 1995a-d). For example, these guidelines do not provide target values for compounds that are known to cause tainting of seafood. DWAF do however, provide a list of organic compounds that could potentially cause tainting of seafood along with concentrations of these substances in seawater at which tainting

can occur (Table 30) and can thus serve as a guideline in setting water quality criteria for water use licences in these instances. There is also a precedent where site specific water quality criteria have been developed to safeguard the environment from a specific threat (e.g. in the case of Saldanha Bay where the Saldanha Water Quality Forum Trust commissioned the development of for maximum specified levels inorganic nitrogen designed to minimise risks of disrupting the balance between the macroalgae species *Gracilaria* and *Ulva* as well as recommendations for excluding exotic microalgae species that may disrupt food chain or mariculture production (CSIR 2002). A similar approach could be followed in the Kogelberg Biosphere Reserve if this is deemed necessary.

DEAT exercises its mandate through the **Dumping at Sea Control Act** (1980), the Prevention and Combating of Pollution of the Sea by Oil (1981), and the Marine Living Resources Act (1998). The first Act provides for the control of dumping of substances in the sea, the second for dealing with oil spills at sea, and the last for management of pollution arising from mariculture activities.

DOT exercises its mandate through the **International Convention for Prevention of Pollution from Ships Act** (1986), which gives legal effect to the International Convention for the Prevention of Pollution from Ships 1973/78 (MARPOL) in South Africa, as well as Annex I (regulations on oil), Annex II (regulations on noxious liquid substances in bulk), Annex V (regulations for the Prevention of Pollution by Garbage from Ships) of the MARPOL Convention prohibits any form of disposal of garbage, which it defines as '*all kinds of victual, domestic and operational waste, excluding fresh fish and parts thereof, generated during a normal operation of the ship and liable to be disposed of continuously or periodically except those substances which are defined or listed in other annexes to this present Convention*'. South Africa is in the process of drawing up the necessary regulations to implement these regulations (CSIR 2006).

7.7 CLIMATE CHANGE

7.7.1 Issues

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 *et al.* 2000). 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 2007). 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 (2005) 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 *et al.* 2000). 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%) with similarly severe reductions in other West Coast systems (reduced MAR of 30%- Clark *et al.* 2000). Other major water-catchment areas along the coast show a reduction in MAR of between 4 and 21% (Clark *et al.* 2000). The consequences of this are discussed above.

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 (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 (Kennish (2002)).

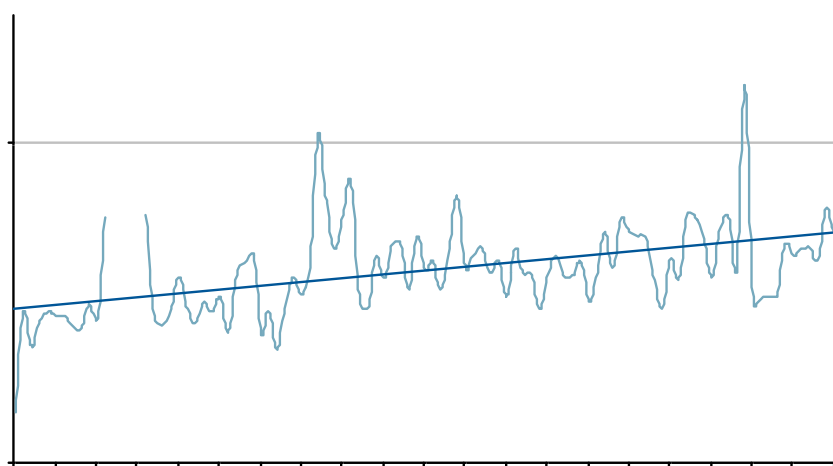


FIGURE 94. MEAN ANNUAL SEA SURFACE TEMPERATURE COLLECTED FROM VOLUNTARY OBSERVING SHIPS (VOS) BETWEEN STRUISBAAI TO KNYSNA UP TO 60 NAUTICAL MILES OFFSHORE, 1903 TO 2004. (GAPS IN THE DATA ARE YEARS WHERE THE DATA ARE NOT AVAILABLE) (SOURCE: SOUTHERN AFRICAN DATA CENTRE FOR OCEANOGRAPHY)

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 & 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). Certain areas of the KBR may be particularly vulnerable, such as low-lying developments around the Bot estuary.

7.7.2 Legislation and responsible parties

There is no specific legislation that focuses specifically on mitigation of or adaption to impacts of climate change. The new Coastal Management Act (2009) does, however, “Setback Lines” recognises explicitly that issues related to climate change (such as sea level rise and increased storm intensity and frequency) must be addressed through coastal management processes. Establishment of a Coastal Protection Zone and Coastal set back lines, discussed in some detail in §**Error! Reference source not found.**, have been incorporated into the Act to address these issues. DEAT have prepared and released an initial national communication under the United Nations Framework Convention on Climate Change (DEAT 2003) and a National Climate Change Strategy (DEAT 2004), while the Western Cape Government also commissioned a study on the likely physical and socio-economic effects of climate change in the Western Cape (Midgley *et al.* 2005).

8 ENHANCING COASTAL INTEGRITY AND VALUE

8.1 INTRODUCTION

The coastal ecosystems of the Kogelberg Biosphere Reserve have been identified as being extremely valuable. They make a significant contribution to the local and regional economy, to employment, as well as to people's emotional well being. There are, however, a number of important threats to delivery of these benefits. In particular, the area is beset with problems of overexploitation of living marine resources, and the value of the area is also threatened by pollution, the supply of freshwater to estuaries, terrestrial alien invasive species, and development in the coastal zone. In addition, it will be necessary to plan strategically for the possible impacts of climate change.

The legislative framework to deal with these issues has improved dramatically over the past decade, particularly with the very recent promulgation of the Integrated Coastal Management Act (2009), providing the means to significantly improve the outlook for this area. There is also a coordinated national programme aimed at increasing the amount of coastal and marine habitat under protection in terms of the National Protected Area Expansion Strategy (NPAES). It is now generally recognized that Marine Protected Areas (MPAs), used in conjunction with other more conventional management measures, offer one of the only means of properly conserving marine and coastal biodiversity as well as stocks of exploited species.

Levels of protection applied to the Betty's Bay MPA needs to be increased such that it can offer protection to the full range of species and resources within its boundaries (i.e. including linefish species targeted by shore anglers). The overall amount of coastline under protection within the Kogelberg coast also needs to be increased either through the expansion of the Betty's Bay MPA or through the proclamation of an additional MPA in the area. Any efforts to expand the amount of coastal habitat under protection should seek to minimise impacts to existing users (particularly scale commercial and subsistence fishers) but must also address the resource and habitat conservation requirements for the area (i.e. must provide enhanced protection for abalone, linefish and other exploited resources and their supporting habitats). While an expanded MPA network may have some negative short-term socio-economic impacts on the fisheries in the region, these will be more than adequately offset by socio-economic benefits derived from reduced risk of stock collapse and by catches that will be sustained in the long-term, and associated ancillary benefits (e.g. growing ecotourism, enhanced property value etc.).

There is also a clear need for an overarching management plan for the entire Kogelberg coast, and to identify a clear strategy with which to maximise the ecological and economic value of this stretch of coast. The WWF-CAPE Marine programme, coupled with the existence of the Kogelberg Biosphere Reserve, and the demonstrated willingness and desire of the residents and visitors to the Kogelberg to improve management of the area, presents a unique opportunity to address these threats within the framework of an Integrated Management Plan (IMP). Existing management plans that have been developed for the Bot/Kleinmond Estuary and the Betty's Bay MPA, and other recent management initiatives, provide an important set of resources that can be used in the development of the IMP for the KBR coast.

This report was designed as a situation assessment which describes the ecosystems of the area and their status, and highlights their current and potential value. This final chapter presents an overview of recent management issues, and a discussion on some of the main issues that need to be considered in the IMP with a view to achieving optimal use of the area.

8.2 RECENT MANAGEMENT INITIATIVES

8.2.1 Kogelberg Biosphere Reserve planning documents

A Strategic Management Framework (SMF) has been prepared for the Kogelberg Biosphere Reserve and was designed to accomplish the following goals:

- Galvanising diverse Kogelberg stakeholders around a common vision for the biosphere reserve and the setting of clear objectives to achieve this vision.
- Providing strategic direction on Kogelberg Biosphere Reserve Company's core business activities, and how it should go about consolidating and operationalising the biosphere reserve.
- Establishing a framework for decision making and addressing how to establish and maintain effective co-ordination between the KBRC and the various statutory authorities active in the KBR, with particular attention to clarifying jurisdictions and responsibilities of the different spheres of government, parastatals (e.g. SAFCOL), and other statutory bodies (e.g. CapeNature) active in the KBR.
- Facilitating the involvement of private landowners as voluntary participants in the biosphere reserve initiative.
- Rationalising biodiversity management activities in the KBR's core, buffer and transition areas.
- Ensuring that the KBR delivers tangible socio economic benefits to local communities.
- Introducing research programs, benchmarks for monitoring the performance of the KBRC and the state of the environment, and the exchange of information.
- Securing sufficient funding for the company to operate.

The SMF document outlines management challenges facing the KBRC, external threats and opportunities the company needs to be aware of and respond to, local strengths and weaknesses that it has influence over (i.e. SWOT analysis), and sets out a vision for the KBR with guiding principles to underpin the management activities and management goals. Other products produced through the strategic management planning process include a "Conceptual Framework & Situational Analysis" report and an "Initial Stakeholder Consultation: Implications for the Strategic Management Framework". Other products to be produced in this process include a Strategic Management Plan, a Corporate Plan and performance measurement system to monitor and review progress of the KBRC. The Strategic Management plan list three overarching goals and associated management objectives to be addressed by the KBR managing authority:

Goal 1: To raise general awareness of the KBR, build a broad based understanding of the Man and the Biosphere program, and establish an identity for the managers of the biosphere reserve.

- Objective 1.1 Develop and maintain a KBR communication strategy
- Objective 1.2 Develop and maintain an education and outreach strategy for the KBR
- Objective 1.3 Develop the KBR into a recognized 'brand' of sustainable development and provide opportunity for business certification
- Objective 1.4 Develop a Memorandum of Understanding between KBR partner institutions and organizations
- Objective 1.5 Erect Signage (and establish a KBR Gateway)

Goal 2: To support environmentally sustainable (organizationally, financially and/or logistically) socio-economic and conservation initiatives in the biosphere that offer scope for wider replication.

- Objective 2.1 Promote environmentally sustainable household technologies (e.g. dwelling design & construction, water supply & use, energy supply & use, sanitation, and solid waste).
- Objective 2.2 Promote appropriate 'greening' of home gardens & neighbourhoods in KBR
- Objective 2.3 Facilitate a KBR biodiversity conservation program
- Objective 2.4 Support projects demonstrating environmental sustainability in the farming, fishing and forestry sectors
- Objective 2.5 Record the KBR's heritage resources and promote the conservation and showcasing of these assets
- Objective 2.6 Facilitate implementation of the strategies proposed in the KBR Tourism Plan (currently being prepared for KBRC)
- Objective 2.7 Support the development & implementation of the KBR LED Strategy (currently being prepared by Overberg District Municipality)

Goal 3: To facilitate and co-ordinate biosphere level research and forward planning, and share the results with partners.

- Objective 3.1 Develop and maintain a Spatial Development Plan (SDP) for KBR
- Objective 3.2 Establish and maintain knowledge management partnerships with institutions hosting and maintaining data on the KBR
- Objective 3.3 Host and maintain a 'one-stop' database of available information on the KBR
- Objective 3.4 Facilitate the establishment of a Kogelberg Marine park
- Objective 3.5 Develop Fire Management Plan for KBR and establish KBR Fire Protection Agency

- Objective 3.6 Design and maintain sustainability indicators for the KBR
- Objective 3.7 Implement and maintain the monitoring and evaluation framework for the KBR
- Objective 3.8 Integrate KBR into the national, regional and international network of biosphere reserves

Objectives of the KBR Corporate Plan are as follows:

- a) To specify appropriate governance structures that will allow the entity managing the KBR to effectively implement the programs defined in Part 3, to be representative of the Kogelberg's interest groups, and to remain accountable to its members.
- b) To outline how the entity managing the biosphere reserve will interact with its partners in implementing the KBR's management programs.
- c) To explore the source and application of funds to the entity managing the KBR, and outline its financial control & reporting systems.
- d) To present a logical program of action for implementing the Corporate Plan's recommendations.

8.2.2 Betty's Bay MPA management plan

A draft management plan has been prepared for the Betty's Bay MPA by du Toit & Attwood (2008). The management plan identified Cape Nature as being the management agency for the Betty's Bay MPA and sets the over-arching goals biophysical, socio-economic and governance goals associated all MPAs under their control as follows:

Biophysical Goals

1. To protect the marine and estuarine ecosystems that are representative of the south coast zone and to maintain biodiversity and ecological functioning in these ecosystems;
2. To protect depleted, endangered and endemic species and populations and to protect habitats which are important for the survival and revival of these species and populations;
3. To contribute towards the long-term viability of marine fisheries

Socioeconomic Goals

1. To promote non-consumptive, ecotourism opportunities;
2. To provide opportunities for marine ecological research and monitoring of environmental effects of human activities on marine ecosystems;
3. To facilitate the interpretation of marine ecosystems for the promotion of conservation among scholars and tourists;

Governance Goals

1. To reduce conflicts between competing users in the MPA and surrounding areas;
2. To ensure that appropriate and effective legal structures are developed for protecting the biodiversity of the MPA and the activities that benefit from it;

3. To fulfil South Africa's international commitment to marine protection in terms of international protocols and conventions;

The management plan also provides a summary of the main habitats and fauna within the MPA and threats to these habitats, and legislation applicable within this MPA. The plan also identifies a number of "Key Performance Areas" where management interventions are required to ensure that the Betty's Bay MPA meets its objectives. These include:

- Improved management of key species within the Betty's Bay MPA
- Demarcation of boundaries and signage of the Betty's Bay MPA
- Management of fishing activities
- Management of scuba diving/snorkelling
- Boat launch site management
- Anchoring within the Betty's Bay MPA
- Private moorings
- User and vessel safety requirements
- Tourist programmes
- Emergency events such as flooding
- Appropriate boating and sailing organisations and clubs

The plan provides a comprehensive list of staff, infrastructure and equipment required of the effective management of the MPA, recommendations for improving compliance within the MPA specifically on combating poaching, and recommendation for improving awareness specifically on the importance of healthy ocean ecosystems, the importance of MPAs, and the role that the community may play in their care. The plan also elaborates on the importance of and need for scientific research and monitoring in the MPA. The plan concludes with recommendations on approaches to secure sustainable financing for the management of the MPA.

8.2.3 Bot/Kleinmond estuary management plan

Estuary management plans will eventually be drawn up for all the estuaries in the KBR. This process was initiated in 2007 under the C.A.P.E. Estuaries Management Programme. Of the estuaries in the study area, a draft EMP has been developed for the Bot/Kleinmond estuary. The essential elements of this EMP are outline below.

The Bot estuary EMP provides a vision statement for the estuary:

"The Bot and Kleinmond estuaries and associated wetlands, form a unique biologically diverse and productive ecosystem. It is one of South Africa's most important nursery areas for the marine fish that sustain our fisheries. The tranquil quality of this natural environment makes it a popular recreation place for local families, fishers and nature lovers and a sought-after destination for eco-tourists. Management of the estuaries takes place in partnership with the local community and all spheres of government."

The management plan is centred around four "strategy sets" that produce 15 co-ordinated outputs, each with a set of deliverables that are to be achieved within a five year time horizon (Table 24).

TABLE 24. MANAGEMENT STRATEGY SETS, ASSOCIATED OUTPUTS AND DELIVERABLE AS LAID OUT IN THE DRAFT BOT-KLEINMOND ESTUARY MANAGEMENT PLAN (IRAP 2008).

Management “strategy sets” and associated outputs	Deliverables
1 Social institutional and governance • Organisational arrangements • Funding and capacity • Monitoring and evaluation programme • Improved compliance	• The establishment of an Estuarine Management Office in the Overstrand Municipality tasked with co-ordinating implementation of estuary management plans across the whole municipality, • Funding secured for the management of the Bot/Kleinmond estuary, and • A monitoring and evaluation framework in place, and compliance on the estuary up by 50%.
2 Water flow and quality • Resource directed measures • Water quality programme • Riparian reserve	• Deliverables from the second strategy set (Water flow and quality) include: • Water quality and use on the Bot and Kleinmond rivers being managed in accordance with Resource Directed Measure (RDM) in accordance with the National Water Act (1998), • A measurable improvement in the water quality in the Bot and Kleinmond estuaries, and • A riparian reserve established on all estuarine frontage on the Bot and Kleinmond estuaries, with plans in place to extend this up into the catchments of both systems.
3 Fish resource priority area • Estuary protected area • Mouth management policy • Co-operative management and sustainable use of marine living resources	• No harvesting or disturbance of living marine resources within defined sanctuary zones on the Bot estuary, • Policy adopted for the management of the Bot estuary mouth that prioritises the nursery function of the system, and • Five local fishers actively involved in community-based resource management of the Bot estuary’s marine living resources, and the unlicensed subsistence fishery on the estuary is permanently closed.
4 Estuary + landuse, conservation + development • Spatial framework for conservation and development • Coastal planning scheme • Conservation plans • Public recreation areas development	• IAPS have agreed on a Spatial Conservation Development Framework (SCDF) for the Bot-Kleinmond catchment which prioritises biodiversity conservation in 50% of the estuary margin and is incorporated into the Overstrand Municipality SDF, • A coastal planning scheme has been drafted for integration into the Overstrand Municipality SDF, • A plan for assembling the terrestrial component of the SCDF has been adopted and is being auctioned • A plan for developing the Public Recreation Areas in the SCDF has been adopted and is being auctioned, and
5 Eco-tourism development	• The Overstrand Municipality has awarded five concessions for development of ecotourism ventures and that these are established and operating

The Bot-Kleinmond EMP also includes a zonation plan (Figure 95) which includes the following zones:

1. Estuarine Sanctuary Zone where no disturbance or harvesting of living marine resources will be permitted
2. Estuarine Recreation zone 1 for low impact recreation including recreational fishing
3. Estuarine Recreation zone 2 for low impact recreation, recreational and subsistence fishing
4. Estuarine Recreation zone 3 for high intensity recreation, recreational and subsistence fishing
5. Terrestrial Conservation1 that incorporates all statutory protected areas
6. Conservation2 that incorporates municipal and private land with high biodiversity value but no statutory protection
7. Core agriculture for agricultural areas
8. Public access ways for facilitating public access to the water,
9. Terrestrial recreation areas for public recreation facilities,

10. Regional nodes which includes the local towns,
11. Sub-regional nodes which includes the smaller urban settlements,
12. Resort/tourism areas which incorporates existing resort and residential development outside of the core urban areas, and
13. Riparian reserve where no cultivation or development is permitted and alien vegetation is to be prohibited or cleared

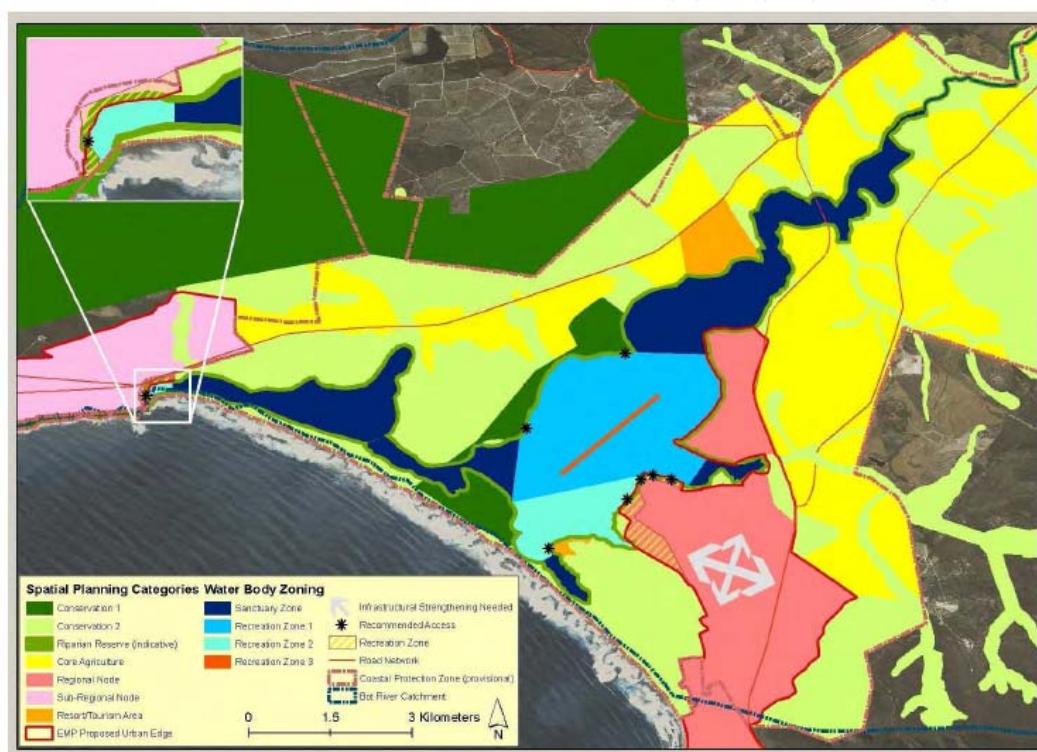


FIGURE 95. ZONATION PLAN FOR THE BOT-KLEINMOND ESTUARY (IRAP CONSULTING 2008)

8.2.4 The Proposed Kogelberg Marine Park

Marine and Coastal Management (DEA&T) were signatories to the proclamation of the Kogelberg Biosphere Reserve, and pledged to incorporate the marine area referred to above, into the Biosphere Reserve. This was debated by the Kogelberg Biosphere Reserve Sub-committee (largely government representation), and the Hangklip Kleinmond Coastal Management Forum (largely non-government representation), in 1999 with Marine and Coastal Management (MCM) acting as the lead agency in this process. A proposal emerged from this process, prepared by Dr Colin Attwood of MCM, which outlined a vision, management objectives and principles, and boundaries for the coastal component of the Kogelberg Biosphere Reserve, thereafter referred to as the Kogelberg Marine Park (Attwood 2000). The proposal was designed to take account of submissions from the Hangklip-Kleinmond Coastal Management Forum but also had to comply with defined guidelines for the establishment of any new MPA. The agreed vision for the Kogelberg Marine Park was:

“The Kogelberg Marine Park is an area in which coastal resources are protected to provide an optimistic future for fisheries, recreation and tourism-related activities. While

specifically providing for opportunities for local economic development, all South Africans may expect fair and equitable access to its resources. The Park will also serve as an attraction to visitors who can expect to find a well-managed area with outstanding natural beauty and biological diversity.”

Management objectives for the Kogelberg Marine Park were defined as:

1. To prevent lawlessness from threatening the future of fisheries and degrading the natural environment
2. To allow depleted living marine resources to recover to a state from which they can produce optimal yields.
3. To protect the capacity of living marine resources to regenerate in reserves.
4. To provide South Africans with fair and equitable access to the marine and coastal resources of the Kogelberg area.
5. To provide opportunity for the development of tourism and related industries.
6. To provide facilities for field-based environmental education.

A zonation plan for the park was also developed, which included the following zones (Figure 96):

1. The Pringle Bay Marine Protected Area – two no-take zones on either side of Pringle Bay in which no fishing or disturbance of marine life of any kind is allowed.
2. The Betty’s Bay Restricted Area - a partial MPA that extends from Stony Point to the mouth of the Palmiet River where no fishing or disturbance of marine life of any kind is allowed, with the following exceptions:
 - a. Commercial and recreational fishing for invertebrates (including abalone and rock lobster) to be permitted between eastern edge of Jock’s Bay and the mouth of the Palmiet River;
 - b. Commercial and recreational linefishing to be permitted in the area between Stony Point and the mouth of the Dawidskraal River, and between De Wets Bay and the mouth of the Palmiet River (Fig 3);
 - c. Shore-angling to be permitted between Stony Point and the eastern edge of Jock’s Bay (Fig. 4);
 - d. Spear fishing to be permitted between De Wets Bay and the mouth of the Palmiet River.
3. Stony Point Penguin Colony – to be enclosed and developed into a tourist attraction.

While this plan was approved by stakeholders, and earmarked along with others by MCM for implementation, it has not been a high priority for implementation by the Minister, who has had to establish several high priority MPAs over the past couple of years, including the Pondoland MPA (Attwood, pers. comm.).

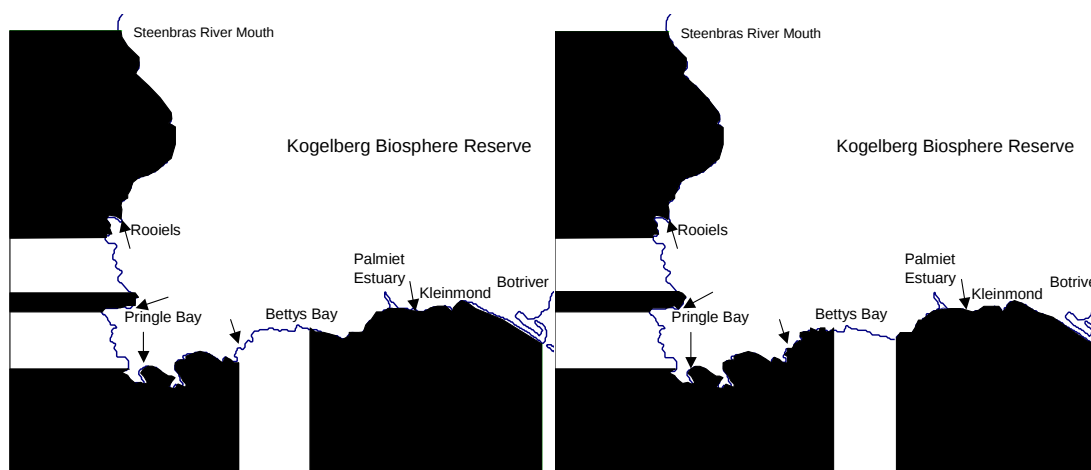


FIGURE 96. THE KOGELBERG MARINE PARK SHOWING (A) ABALONE, ROCK LOBSTER AND INVERTEBRATE AREAS AND (B) LINEFISHING AREAS. SLIPWAYS ARE INDICATED WITH ARROWS.

8.3 IMPROVING ECOSYSTEM INTEGRITY AND ENVIRONMENTAL QUALITY

In developing an overarching management plan for the Kogelberg coast, the main priorities that need to be addressed from a biodiversity conservation and environmental management perspective are:

- the restoration and conservation of depleted and collapsed marine resource stocks;
- protection of marine and coastal biodiversity;
- the improvement of estuarine water quality and mouth dynamics;
- the removal of coastal alien vegetation that impacts on biodiversity and impedes sand movement; and
- establishment of coastal buffer zones that preserve the integrity of the coastal zone and accommodate global climate change impacts such as sea-level rise, increased storm surges and flooding.

This will require an expanded no-take MPA system, enforcement of regulations controlling use of resources, setting the ecological reserve for estuaries through the RDM or Classification Process, control of use and development through careful zonation of the whole area, expenditure on restoration such as alien clearing, and strategies and incentive systems for achieving compliance.

Existing management approaches and interventions have largely failed to protect living marine resources in the KBR from overexploitation. This is largely because a holistic ecosystem system based approach that provides protection for large sections of habitat and their attendant fauna and flora has not been effectively applied. While conventional management measures such as minimum size limits, bag limits, and gear restriction have their place, these have been shown to be largely ineffective in the face of increasing human population and limited budgets and resources for enforcement of conservation agencies. Currently only 6.9% of the Kogelberg coast is included within an MPA (the Betty's Bay MPA) and protection provided by this MPA does not even extend

to one of the most severely overexploited groups in the area, namely line fish. Abalone poaching in the MPA is also rife, and together with the exemption which allows shore angling in this MPA, effectively negates much of the potential benefit that could be realized from this MPA.

With an ecosystem-based approach to management, conventional management measures are complimented by the establishment of Marine Protected Areas (MPAs). MPAs provide exploited species with habitats that have not been modified by human actions, which are able to restock adjacent exploited areas thereby ensuring continued opportunities for livelihoods, employment and recreation amongst human populations. Success stories from areas where MPA networks have been established and benefits to exploited species, communities, and human population have been demonstrated, are now beginning to emerge. This has prompted international agencies such as IUCN and WWF, governments (including the South African government) and other role players to recommend and adopt a strategy whereby at least 20% of the coastline is set aside in no-take MPAs. A similar approach needs to be embraced and adopted in the Kogelberg, where at least 20% of the coastline is incorporated with no-take MPAs and must be accompanied by increased enforcement and compliance both within and outside of these protected areas.

Studies on genetic diversity of marine species around the South African coast have also highlighted the importance of the Kogelberg coastline as an area with particularly high genetic diversity, at least for those groups that have been studied to date (west coast rock lobster: Matthee *et al.* 2007, and fish: Neethling *et al.* 2008, Von Der Heyden *et al.* 2008). Authors of these studies have all called for enhanced conservation measures to be implemented on this section of coast, specifically including expansion of the amount of coastline in no-take MPAs.

An opportunity exists to establish a larger zoned MPA system that encompasses a large part or even the whole of the Kogelberg coastline and adjacent inshore marine environment, in a manner analogous to that which has been accomplished on the Cape Peninsula and has been previously been advocated by for the region (Attwood 2000). Under this system, parts of the coast will be set aside as no-take areas, and the remainder of the coast will benefit from improved management.

Ecosystem integrity would be strengthened by better links between marine and terrestrial protected areas, particularly in the immediate coastal environment. The Protected Areas Act (2003) strongly promotes the concept that terrestrial and marine protected area be management in an integrated and holistic manner and provides a further opportunity for the improving levels of protection along the entire Kogelberg coastline and adjacent inshore marine environment over and above that that provided under the MLRA. While the boundaries of the KBR have always extended 3 NM seawards of the high water mark this fact has never been used effectively to enhance management or protection of species or habitats below the high water mark.

Increased focus is also required to ensure development, non-consumptive utilization, and discharge of waste water and other contaminants to the coastal and inshore marine environment of the Kogelberg, such that these threats do not obviate any successes that can be achieved through improvements in the management of exploitation of living marine resources. The new Integrated Coastal Management Act (2009) offers excellent prospects in this respect, consolidating management of coastal development, utilization of coastal resources and pollution of the marine environment (including estuaries) under a single agency (DEAT) and providing clear guidelines for

development of responsibility to provincial and local government. While this new Act has yet to come into force and it will most likely be many years before the provisions contained in the Act translate to improved management on the ground, it does provide an opportunity for stakeholders in the KBR to work proactively with established government authorities and conservation agencies to establish new and improved structures that will ultimately enhance the value and delivery of goods and services to themselves and the region through improved management of marine and coastal resources. These agencies can be encouraged to proactively adopt new management protocols proscribed in the Act such as coastal protection zones, development setback lines, special management areas and estuary management plans at an early stage rather than waiting until the last minute to do so, and can be encouraged to utilize newly established powers to for example demolish and remove existing infrastructure in the coastal zone that have been erected illegally or poses a threat to the integrity of the coastal zone.

The National Environmental Management Act (2003) (NEMA) itself and its attendant regulations governing requirements for Environmental Impact Assessment (EIAs) and use of vehicles in the coastal zone all provide excellent scope for improving protection of coastal resources and habitats from the damaging effects of exploitation, use and development in the Kogelberg. Responsibility for enforcement in the Kogelberg lies with nominally with the provincial government (in the case of EIAs) and MCM (in the case of ORV use and boat launching in the coastal zone) but local government, residents and visitors can play a very effective role as a lobby group and by assisting with compliance monitoring and enforcement.

While the National Water Act (1998) makes provision to set the water quantity and quality requirements for estuaries, resource constraints mean that it will take a long time for this process to roll out to all the country's estuaries. In some cases, the studies have been speeded up by interest groups sourcing own funds to implement the process. Once accomplished, there are clear guidelines for meeting water quality and other objectives through management of the immediate surrounds as well as the catchment. Benefits that would accrue to and from the estuaries in the Kogelberg region would more than adequate compensate for the costs involved in setting the environmental reserve and meeting the requirements therein (such as improving the quality of urban runoff and outflows from treatment plants).

8.4 ENHANCING THE VALUE OF THE KOGELBERG COAST

The Kogelberg coast is valuable: Commercial fisheries along the Kogelberg coast are worth some R20 to 43 million per annum, depending on management; subsistence users earn in the order of R4 million; and recreational use of the coast is worth some R250 – 285 million per annum in the form of tourism and property value.

Conservation management involving expanded MPAs, restrictions on fishing and/or development and utilisation of the coastal zone may have some opportunity costs, for example in terms of the value of commercial fisheries. However, if the spatial configuration of the no-take areas is optimised and regulations enforced in an equitable manner, it is possible that some losses will be offset by gains, for example in the lobster and abalone fisheries. Some of these gains may be felt beyond the study area.

An increase in biodiversity protection would also affect the substantial proportion of recreational users who enjoy fishing along the coast. If increased MPAs do not measurably affect fish catches in the remaining areas, fishing-oriented users have indicated that this would compromise their enjoyment of the coast, a fact that will translate into a decrease in economic value. However, they also indicated that a 20% increase in fishing returns would lead to an overall gain in appreciation of the coast, despite having reduced access to fishing areas. Thus as long as MPAs and other coastal management measures can be shown to have a significant impact on the catches in surrounding areas, they are likely to result in a win-win situation for conservation and recreational fishing. This is highly likely to be the case. Analysis of creel survey data have shown that the catch per unit area among recreational shore-based anglers is significantly elevated in the 50km stretch of coast to the west of the De Hoop MPA (Turpie 1996).

In general, the preferences of the recreational users of the coast are aligned with conservation. Decreased protection, further depletion of marine resources, reduced biodiversity, increased litter and significantly increased development will decrease the recreational value of the coast. The effects of deteriorating water quality are already beginning to take their toll through the closure of beaches. Conversely, increased conservation will increase recreational value. The potential recreational value of the coast will be significantly increased if problems of crime are also addressed, since it is difficult to enjoy any attractions if one does not feel safe or if one's belongings are not secure.

Perhaps the most difficult issue is one of development. There is a continuous pressure for the expansion and densification of development in coastal resort areas, and the Kogelberg coast is no exception. Development is largely supported by municipalities, who benefit from increased rates and taxes generated from properties and businesses in the area. While the current users have indicated that doubling of development will have a serious impact on their utility, behaviour, and ultimately, their expenditure in the area, the reality is that with further densification, the people that are more sensitive to this will gradually be replaced by people that are more attracted by the new conditions. These may be less nature-oriented people than fit the current profile, but the influx of new visitors will likely contribute equally or more to recreational value of the area. In other words, while conservation and value of the area currently go hand in hand, this may not continue to be the case if rampant development is permitted. Thus for conservation to be successful in the area in future, the utility of the current users will need to be maintained or improved, which means that growth of the existing settlements will have to be limited.

9 ACKNOWLEDGEMENTS

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11 APPENDIX 1: Water Quality Guidelines

TABLE 25. RECOMMENDED CONCENTRATIONS OF KEY WATER QUALITY CONSTITUENTS FOR THE NATURAL ENVIRONMENT (AFTER DWAF 1995b)

PARAMETER/CONSTITUENT	RECOMMENDED CONCENTRATION
Physicochemical properties:	
Temperature	The maximum acceptable variation in ambient temperature is + or - 1 °C
pH	Salinity 33-36 ppt 7.3-8.2
Floating matter, including oil and grease	Water should not contain floating particulate matter, debris, oil, grease, wax, scum, foam or any similar floating materials and residues from land-based sources in concentrations that may cause nuisance. Water should not contain materials from non-natural land-based sources which will settle to form putrescence. Water should not contain submerged objects and other subsurface hazards which arise from non-natural origins and which would be a danger, cause nuisance or interfere with any designated/recognized use
Colour/turbidity/clarity	Should not be more than 35 <i>Hazen units</i> above ambient concentrations (colour) Should not reduce the depth of the euphotic zone by more than 10 % of ambient levels measured at a suitable control site (turbidity)
Suspended solids	Should not be increased by more than 10 % of ambient concentrations
Dissolved oxygen	Dissolved oxygen should not fall below 10 % of the established observed variation at a comparable site.
Toxic substances	
Ammonia-N	20 µg N per litre (as NH ₃) 600 µg N per litre (as NH ₃ plus NH ₄ ⁺)
Cyanide	12 µg/L
Fluoride	5 000 µg/L
Arsenic (As)	12 µg/L
Cadmium (Cd)	4 µg/L
Chromium (Cr)	8 µg/L
Copper (Cu)	5 µg/L
Lead (Pb)	12 µg/L
Mercury (Hg)	0.3 µg/L
Nickel (Ni)	25 µg/L
Silver (Ag)	5 µg/L
Zinc (Zn)	25 µg/L

TABLE 6. RECOMMENDED CONCENTRATIONS OF KEY WATER QUALITY CONSTITUENTS FOR FULL- AND INTERMEDIATE CONTACT AND NON-CONTACT RECREATION AREAS (AFTER DWAF 2004c)

PARAMETER/CONSTITUENT	RECOMMENDED CONCENTRATION
<i>Aesthetics and safety:</i>	
Floating matter, including oil and grease	Water should not contain floating particulate matter, debris, oil, grease, wax, scum, foam or any similar floating materials and residues from land-based sources in concentrations that may cause nuisance. Water should not contain materials from non-natural land-based sources which will settle to form putrescence. Water should not contain submerged objects and other subsurface hazards which arise from non-natural origins and which would be a danger, cause nuisance or interfere with any designated/recognized use
Colour/turbidity/clarity	Should not be more than 35 <i>Hazen units</i> above ambient concentrations (colour) Should not reduce the depth of the euphotic zone by more than 10 % of ambient levels measured at a suitable control site (turbidity)
Suspended solids	Should not be increased by more than 10 % of ambient concentrations
Faecal coliforms	
Faecal coliform (or <i>E. coli</i>)	Maximum acceptable count per 100 ml: 100 in 80 per cent of the samples 2 000 in 95 per cent of the samples

TABLE 27. RECOMMENDED CONCENTRATIONS OF KEY WATER QUALITY CONSTITUENTS TO SUSTAIN ORGANISM HEALTH AND ELIMINATE RISK TO HUMAN HEALTH FOR MARICULTURE (DWAF 1995d).

PARAMETER/CONSTITUENT	RECOMMENDED CONCENTRATION
Physicochemical properties:	
Temperature	The maximum acceptable variation in ambient temperature is + or - 1 oC Salinity 33-36 ppt
pH	7,3-8,2
Floating matter, including oil and grease	Water should not contain floating particulate matter, debris, oil, grease, wax, scum, foam or any similar floating materials and residues from land-based sources in concentrations that may cause nuisance. Water should not contain materials from non-natural land-based sources which will settle to form putrescence. Water should not contain submerged objects and other subsurface hazards which arise from non-natural origins and which would be a danger, cause nuisance or interfere with any designated/recognized use
Colour/turbidity/clarity	Should not be more than 35 <i>Hazen units</i> above ambient concentrations (colour) Should not reduce the depth of the euphotic zone by more than 10 % of ambient levels measured at a suitable control site (turbidity)
Suspended solids	Should not be increased by more than 10 % of ambient concentrations
Dissolved oxygen	Dissolved oxygen should not fall below 10 % of the established observed variation at a comparable site.
Toxic substances	
Ammonia	20 µ g N per litre (as NH ₃) 600 µ g N per litre (as NH ₃ plus NH ₄ ⁺)
Cyanide	12 µ g/L
Fluoride	5 000 µ g/L
Arsenic (As)	12 µ g/L
Cadmium (Cd)	4 µ g/L
Chromium (Cr)	8 µ g/L
Copper (Cu)	5 µ g/L
Lead (Pb)	12 µ g/L
Mercury (Hg)	0.3 µ g/L
Nickel (Ni)	25 µ g/L
Silver (Ag)	5 µ g/L
Zinc (Zn)	25 µ g/L
Faecal coliforms	
Faecal coliform (or <i>E. coli</i>)	Maximum acceptable count per 100 ml: 20 in 80 per cent of the samples 60 in 95 per cent of the samples

TABLE 28. RECOMMENDED CONCENTRATIONS OF KEY WATER QUALITY CONSTITUENTS FOR INDUSTRIAL RELATED USES

PARAMETER/CONSTITUENT	RECOMMENDED CONCENTRATION
<i>Aesthetics and safety:</i>	
Floating matter, including oil and grease	Water should not contain floating particulate matter, debris, oil, grease, wax, scum, foam or any similar floating materials and residues from land-based sources in concentrations that may cause nuisance. Water should not contain materials from non-natural land-based sources which will settle to form putrescence. Water should not contain submerged objects and other subsurface hazards which arise from non-natural origins and which would be a danger, cause nuisance or interfere with any designated/recognized use
Colour/turbidity/clarity	Should not be more than 35 <i>Hazen units</i> above ambient concentrations (colour) Should not reduce the depth of the euphotic zone by more than 10 % of ambient levels measured at a suitable control site (turbidity)
Suspended solids	Should not be increased by more than 10 % of ambient concentrations

TABLE 29. EEC DIRECTIVES ON THE QUALITY OF WATER USED IN THE CULTIVATION OF SHELLFISH AS PROVIDED IN COUNCIL DIRECTIVE OF 30 OCTOBER 1979 ON THE QUALITY REQUIRED OF SHELLFISH WATERS. (SOURCE: TALJAARD & MONTEIRO 2002).

PARAMETER/CONSTITUENT	GUIDELINE/MANDATORY VALUE	MEASURING FREQUENCY
Temperature	A discharge affecting shellfish waters must not cause the temperature of the waters to exceed by more than 2°C the temperature of the waters not so affected (<i>guideline</i>)	Quarterly
Salinity	12 to 38 (<i>guideline</i>) < 40 (<i>standard</i>) A discharge affecting shellfish waters must not cause salinity to be exceeded by more than 10 % the salinity of water not so affected (<i>mandatory</i>)	Monthly
pH	7 – 9 (<i>standard</i>)	Quarterly
Suspended solids	A discharge affecting shellfish waters must not cause must not cause SS to exceed by more than 30 % that of waters not so affected (<i>standard</i>)	Quarterly
Colour (dissolved substances)	A discharge affecting shellfish waters must not cause the colour (after filtration) to deviate by more than 10 mg Pt/l from waters not so affected (<i>standard</i>)	Quarterly
Dissolved oxygen	> 80 % saturation (<i>guideline</i>) > 70 % saturation (<i>standard</i>)	Monthly

TABLE 30. ORGANIC COMPOUNDS KNOWN TO CAUSE TAINING OF SEAFOOD, AND CONCENTRATIONS IN SEAWATER AT WHICH THIS IS LIKELY TO OCCUR (DWAf 1996b)

CONSTITUENT	CONCENTRATION (µg/L)	CONSTITUENT	CONCENTRATION (µg/L)
Acetophenone	500	ethylacrylate	600
Acrylonitrile	18 000	formaldehyde	95 000
m-cresol	200	petrol	5
o-cresol	400	kerosene	100
p-cresol	120	kerosene plus kaolin	1 000
cresylic acid (meta, para)	200	isopropylbenzene	250
n-butylmercaptan	60	naphtha	100
O-sec. butylphenol	300	naphthalene	1 000
p-terry. butylphenol	30	naphthol	500
O-chlorophenol	1	2-naphthol	300
p-chlorophenol	10	dimethylamine	7 000
2,3,-dichlorophenol	84	a-methylstyrene	250
2,4-dichlorophenol	1	oil, emulsifiable	15 000
2,5-dichlorophenol	23	pyridine	5 000
2,6-dichlorophenol	35	pyroatechol	800
2-methyl, 4-chlorophenol	75	pyrogallol	500
2-methyl, 6-chlorophenol	3	quinoiine	500
o-phenylphenol	1 000	p-quinone	500
diphenyloxide	50	styrene	250
B,B-dichlorodiethyl ether	90	toluene	250
p-dichlorobenzene	250	outboard motor fuel, as exhaust	500
ethylbenzene	250	guaiaicol	82
ethanethiol	240		

TABLE 31. ADDITIONAL WATER QUALITY GUIDELINE PARAMETERS TO BE ADOPTED FOR SALDANHA BAY AS RECOMMENDED BY TALJAARD & MONTEIRO 2002.

Inorganic nutrients	<i>Saldanha Bay</i> : Inorganic dissolved nitrogen concentrations in shallow waters (less than 5 m) particularly during spring/summer) to prevent <i>Ulva</i> from outcompeting <i>Gracilaria</i> (Dr P M S Monteiro, CSIR, environmentek, pers. comm.)
Microalgae	Marine water should be free from of foreign or invader microalgal species, that can, for example be introduced through ballast water discharges.