AGULHAS NATIONAL PARK STATE OF KNOWLEDGE

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Abbreviations used

ABI	*Agulhas Biodiversity Initiative*, a CAPE pilot project and partnership between SANParks and Fauna & Flora International to conserve biodiversity of lowland fynbos on the Agulhas Plain, through inter-linked conservation, development and socio-economic activities. Other partners are UNDP/GEF, CapeNature, local authorities, Walker Bay Fynbos Conservancy, Grootbos Private Reserve, local farmers, and Flower Valley Conservation Trust (see http://www.flowervalley.org.za/abi.htm).
ANP	*Agulhas National Park*
AP	*Agulhas Plain*, situated on the southwest Cape coast, about 95 km east of Cape Town, stretching from Gansbaai (34º 35' S, 19º 21' E) in the west to Struisbaai (34º 49' S, 20º 03' E) in the east. The area is *ca.* 72 km in length and extends between 7 and 25 km inland, i.e. up to the Bredasdorp mountains.
CDF	*Conservation Development Framework*
CFR	*Cape Floristic Region*
CAPE	*Cape Action for People and the Environment*, a biodiversity strategy and action plan for the Cape Floral Kingdom, funded by GEF.
DEAT	*Department of Environmental Affairs and Tourism*
FFI	*Flora and Fauna International*
GEF	*Global Environment Facility*
GIS	*Geographic Information System*
IBAs	*Important Bird Areas*, defined as places of international significance for the conservation of birds at the global, regional and sub-regional level.
LSA	*Late Stone Age*, i.e. the last 20 000 years of precolonial history in southern Africa
MSA	*Middle Stone Age*, i.e. period between 200 000 and 20 000 years ago
NGO	*Non-Government Organisation*
SANParks	*South African National Parks*
SSU	*Small Stock Unit*
UNDP	*United Nations Development Fund*

1. ACCOUNT OF AREA

1.1 Location

To a large extent this document is not restricted to the current Agulhas National Park (ANP), but accounts for the wider Agulhas Plain (AP). The ANP is still a developing park situated on the AP, the whole of which has been identified as an area of high conservation significance (Willis *et al.* 1996a; Myers *et al.* 2000). The AP is situated on the southwest Cape coast, about 95 km east of Cape Town. It stretches from Gansbaai (34º 35' S, 19º 21' E) in the west to Struisbaai (34º 49' S, 20º 03' E) in the east. The area is *ca.* 72 km in length and extends between 7 and 25 km inland.

1.2 Proclamation & Size

The developing ANP came into existence in 1998/99 when several properties were incorporated, although proclamation only took place on 23 September 1999 (Government Gazette No. 20476) and again on 17 October 2003 (Government Gazette No. 25562). In total, 5 893 ha has been proclaimed as national park (D. Roux, *in litt.* 2003), although the current ANP comprises 16 807 ha if properties are included that have been transferred (but not proclaimed) or where transfer is in process (E. Fourie, *in litt.* 2003).

1.3 Boundaries

1.4 Controlling Authority

The current ANP is managed by South African National Parks (SANParks), but constitutes properties owned by SANParks, WWF-SA, and Transnet Ltd., some of these subject to contractual or lease agreements (E. Fourie, *in litt.* 2003).

1.5 Legislation

ANP was proclaimed a national park in terms of the National Parks Act (Act 57 of 1976). Management by SANParks must comply with national policies, legislation, and international conventions of which the following may be relevant to ANP:

National Legislation:

- Mountain Catchment Areas Act 63 of 1970
- Expropriation Act 63 of 1975
- National Parks Act No 57 of 1976
- Conservation of Agricultural Resources Act 43 of 1983
- Environmental Conservation Act 73 of 1989
- Physical Planning Act 125 of 1991
- Development Facilitation Act 67 of 1995
- Constitution of the Republic of South Africa Act No 108 of 1996
- National Water Act 36 of 1998
- National Forest Act 84 of 1998
- Veld and Forest Fire Act 101 of 1998
- National Environmental Management Act 107 of 1998
- National Heritage Resources Act 25 of 1999
- National Environmental Management: Protected Areas Act 57 of 2003
- Sea Shore Act 21 of 1935
- Marine Living Resources Act 18 of 1998
- Seabirds and Seals Protection Act 46 of 1973
- White Paper on Conservation and Sustainable Use of South Africa’s Biological Diversity, 1997
- White Paper on Coastal Development, 1999

International Conventions & Treaties:

- Ramsar Convention on Wetlands of International Importance, 1971
- Endangered species of Wild Fauna and Flora, 1973
- Convention on the Conservation of Migratory Species of Wild Animals, 1979
- Convention on Biological Diversity, 1992

1.7 Infrastructure

The five major urban settlements which occur on the AP are Struisbaai, Gansbaai, De Kelders, Pearly Beach and Agulhas, with populations of approximately 9 000, 8 000, 6 000, 4 000 and 4 000 persons respectively (MLH 1994). The first two towns support relatively large commercial fishing industries, while De Kelders, Pearly Beach and Agulhas are primarily holiday and retirement villages (MLH 1994). Tourist facilities (in terms of holiday houses and hotels) tend to be concentrated at De Kelders/Gansbaai and Struisbaai/Agulhas. Nevertheless, large caravan and camping resorts are also found at Uilkraalsmond, Struisbaai, Pearly Beach and Die Dam, and the entire area has approximately 1 848 caravan/camping stands, 120 chalets and 3 hotels with 106 beds (MLH 1994). Smaller villages in the area are Baardskeerdersbos, Viljoenshof and Elim mission village. Elim is culturally and socially a close-knit community. Very few informal settlements occur in the rural areas.

The AP is accessed by two tar roads. The first road, the TR28/2 connects Hermanus to Gansbaai, from where it becomes the MR28, which runs along the coast to Die Dam. The second road, the MR261, which links Bredasdorp to Cape Agulhas, extends along the eastern boundary of the AP. In addition to the above, a network of unsurfaced rural roads, varying in condition, services the area. Sections of this road system are susceptible to flooding during heavy rains (MLH 1994).

Harbours are situated at the western and eastern extremities: Gansbaai harbour has facilities for trawlers, while Struisbaai harbour caters for commercial linefishing boats (MLH 1994). Launching facilities for skiboats are available at Gansbaai, Kleinbaai, Franskraal, Buffeljagts, Die Dam, Pietie se Huis and Struisbaai. The closest airports, at Hermanus and Bredasdorp, cater only for light aircraft.

Electricity is supplied by Eskom and distributed by Municipalities and Regional Services Councils. Three 66 kV lines serve the area. The first passes through Standford and ends at Gansbaai. The other two pass through Bredasdorp and continue to Waenhuiskrans. The electricity is then distributed from the 66 kV substation to the surrounding areas by 22 kV and 11 kV lines, and only a few sites, such as Die Dam and south of the Soetanysberg, are not electrified (MLH 1994).

2. ABIOTIC CHARACTERISTICS

2.1 Geology

2.1.1 Geology

The coastal plain, a remnant of an ancient wave-cut platform, is covered primarily by calcareous sands of the Tertiary age. The coastal mountains are Cape Fold Belt sandstone, capped in sections by limestone (Siesser 1970; Raimondo & Barker 1988). Inland of these mountains are the undulating plains, comprised largely of Bokkeveld shale, which together with Cape Fold Belt sandstone are part of the Cape Supergroup System (Raimondo & Barker 1988; MLH 1994). Two fairly broad bands of the Malmesbury formation occur near Viljoenshof and Baardskeerdersbos. The geology of the Die Kelders Cave and environs is desribed by Tankard and Schweitzer (1974).

2.1.2 Soils / Sediments

Virtually the entire coastal plain was inundated by transgressions during the mid-Miocene (15 M yr) and the early-mid Pliocene (4 M yr) (Hendey 1983). Most sediments and soils postdate the regression (Hendey 1983). An outline of the geomorphological history of the AP region is given by Thwaites (1987). A high diversity of geomorphic land units and associated soil types result from the complex geology of the region (Thwaites 1987; Thwaites & Cowling 1988).

The following account of the relationship between the geology and soils of the AP was taken from Cowling and Holmes (1992a). The AP is largely underlain by Palaeozoic sediments of the Cape Supergroup. Sandstones and quartzites of the Table Mountain Group form the low mountains and coastal ridges. Soils derived from these rocks are acidic and highly infertile. Landscapes underlain by Bokkeveld Group Shales comprise the broad vallies and low, rolling surfaces between the mountain ridges. Soils are non-hydromorphic and duplex with acidic topsoil and sodic, clayey B horizon. These are more fertile than the sandstone-derived soils. Numerous siliceous ferricrete outcrops supporting shallow, infertile soils are scattered across this landscape. These are remnants of a ferricrete-veneered surface of late Pliocene age. Mio-Pliocene limestones and associated colluvial deposits of the Bredasdorp Group form distinctive relief features in the coastal zone. Soils on the limestone bedrock are shallow, well-drained, calcareous sands. Colluvial sands which apron the limestone hills are deep, weakly acid and infertile. The Quaternary is represented by an extensive cover of calcrete and dunes comprising calcareous Aeolian quartz and shelly sand. Soils are poorly developed alkaline sands which are moderately fertile, especially under thicket and forest. The valley floodplains, with many vleis and pans, form the youngest identifiable surface. Soils are duplex with alluvial or colluvial acidic topsoils over residual or transported clays. These different soils are juxtaposed in a complex mosaic so that up to five types may be encountered along a transect of 5 km (Cowling 1990a).

Thwaites and Cowling (1988) identified five major land systems on the AP:

- Die Dam system, along the coast with medium to coarse sands.
- Moddervlei system, restricted to the eastern part of the area and having a bisequel, duplex profile with alluvial or colluvial topsoils over residual or transported clays.
- Elim system, primarily in two bands near Viljoenshof and Baardskeedersbos with non-hydromorphic duplex soils.
- Hagelkraal system, near Hagelkraal, Soetanysberg and Heuningrug with shallow, well drained, grey calcareous sands.
- Bredasdorpberge system, mainly in the western half of the area with acidic, highly leached, moderately to excessively drained soils.

According to 1:250 000 land type maps (Land Type Survey Staff 2001, 2002), ANP contains seven land types, four major soil types (i.e. shallow rocky, deep sandy, rocky outcrops, and shallow clayey), and 15 soil units. Two units in need of special conservation attention are the isolated aeolian sand dune west of Soetanysberg with its unique habitat and associated fauna and flora, and a unit on the bottomland coastal plains with very high clay content where impact should be kept to a minimum.

The limestone-derived soils on the AP are shallow alkaline sands with high organic carbon and nitrogen contents (Cowling & Bond 1991). Limestone outcrops (see 2.1.1 & 2.2.1) are surrounded by deep colluvial sands, either derived from limestone and forming an apron at the base of the outcrops, or from adjacent sandstone hills. These sands are acid, leached and extremely low in all nutrients (Cowling & Bond 1991).

Further details on the geology, geomorphology, and soils (including physical and chemical data) of the AP are given in Thwaites (1987) and Thwaites and Cowling (1988). Thwaites and Cowling (1988) drew correlations between soil-based land systems and the vegetation, suggesting that soil nutrient status is more influential to plant diversity than soil moisture. Richards *et al.* (1997) proposed that spatial variation in soil nutrient availability rather than total soil nutrient contents may be important in explaining landscape-level plant species distributions and community composition in nutrient-poor Mediterranean-climate ecosystems.

2.2 Physiography

2.2.1 Topography

The AP comprises a gently rolling, coastal lowland landscape (Cowling & Holmes 1992a). The shoreline of the Agulhas coast has both rocky (60 km) and sandy (45 km) beaches, backed by sand dunes, including rare hummock-blowout and playa-lunette dunes situated between Brandfontein and Cape Agulhas (Heydorn & Tinley 1980; Tinley 1985). North of these dunes is a sandy, flat coastal plain with numerous marshes, vleis and pans. Apart from the extreme eastern sector, this coastal plain is narrow (1.5 – 5 km wide), truncated in places by steep coastal mountains that reach elevations of 150 – 350 masl. Inland of these mountains are fertile undulating plains (Cowling & Witkowski 1994).

The topography of the limestone landscape (see 2.1.1) is complex – the limestone hills rise to a maximum of 500 m above the coastal plain and have both small and large vertical cliff faces and a diversity of slope and aspect combinations (Cowling & Bond 1991). A series of small limestone outcrops (islands) occur for a distance of between 0.5 and 4.5 km east of the main exposure. All the islands are essentially lanceolate in shape with the long axis running north-south. The limestone islands are probably the remnants of a more extensive exposure although there has been no detailed studies on geomorphological processes in the area (Thwaites 1987; Cowling & Bond 1991).

2.2.2 Drainage

The Agulhas region is unique in terms of the wide variety of wetlands that occur within a relatively small area, including freshwater springs, rivers, floodplains, estuaries, lakes, vleis and endorheic (closed drainage) pans (Jones *et al.* 2000). These wetlands vary in kind, origin, hydrology, morphology, and underlying bed rock, so that each is different from its neighbour (Jones *et al.* 2000). Twelve drainage basins, including the entire catchments of six unique wetland systems fall within the AP (Hanekom *et al.* 1995). These are (major wetland types in parentheses):

- Groot Hagelkraal (river, vleis, black water bog)
- Ratel (river, vleis, pans, estuary)
- Melkbospan and Vispan (saline pans, vleis)
- Waskraalvlei (river, vleis)
- Voëlvlei (brackish lake, vleis)
- Soutpan (saline pan and vleis).

Surface water may be present ephemerally, seasonally or permanently in the different wetlands of the AP. Jones *et al.* (2000) identified 37 endorheic wetlands (9 permanent & 28 temporary systems. These endorheic wetlands are particularly diverse and range from fresh to extremely saline. Twenty-nine palustrine wetlands were identified (8 permanent & 21 temporary), generally connected to rivers and including a number of riverine marshes and floodplains. Six permanent lacustrine wetlands were identified (3 brackish & 3 fresh) all of which are coastal lakes, including Soetendalsvlei (the second largest lacustrine wetland in South Africa (GEF undated)) and Voelvlei. De Hoop vlei and the De Mond estuary are both Ramsar sites (GEF undated) and managed by CapeNature. The wetlands of the AP are important conservation features not only in their own right, but also for maintaining the diversity of the surrounding landscapes that they support hydrologically (Jones *et al.* 2000).

The rivers of the AP are all situated on the relatively flat coastal plain and, being lower-reach rivers, they widen out and flow sluggishly. The Hagelkraal River on the western side of the study area supports a number of palustrine wetlands, which are infrequently connected to the sea. The Ratel River, to the east of Hagelkraal River, runs through the coastal plain and feeds two coastal lakes. The Nuwejaars River originates north of Elim and flows into Soetendalsvlei. Within the Nuwejaars River catchment are different types of wetlands including both floodplains, which are hydrologically dependent on the river, and also endorheic wetlands, not hydrologically connected to the river. The Kars River forms a floodplain northeast of Soetendalsvlei and flows into the Heuningnes River. South of the Kars River (southeast of Soetendalsvlei), the Heuningnes River drains Soetendalsvlei and forms an estuary (Jones *et al.* 2000). Several areas along the coast drain directly into the sea, including areas around Gansbaai, Pearly Beach, Quoin Point and Agulhas.

2.2.3 *Bathymetry*

THE SEA OF THE AGULHAS COAST IS SHALLOW, WITH THE 30 M ISOBATH SITUATED BETWEEN 3 AND 8 KM OFFSHORE (RAIMONDO & BARKER 1988).

2.3 Physics

2.3.1 *Climate*

The region has a Mediterranean climate – hot dry summers and cold wet winters. Mean annual rainfall along the coast ranges from 445 mm in the east to 540 mm in the west, and rises to about 650 mm on the low hills that form the region's northern boundary, with 60 – 75 % of the precipitation falling in winter (May to October) (Raimondo & Barker 1988; Cowling *et al.* 1988; Cowling & Holmes 1992a). Potential evaporation exceeds rainfall from November to March at Cape Agulhas. The mean annual temperature at this station is 16.9 ºC. The highest mean monthly temperature is in January (26.6 ºC) and the lowest in August (6.6 ºC) (Cowling & Holmes 1992a). Prevailing winds are westerly in winter, and easterly in summer. Cape Agulhas is the windiest area year-round along the South African coast with the least percent calms (4 %); its lowest average wind speeds between 21h00 and 10h00 are equivalent to Cape Town's highest between 12h00 and 18h00 (RN and SAAF 1941/44 in Tinley 1985). Fog occurs about 20 days per annum (Heydorn & Tinley 1980). Frost is extremely rare and snowfalls have not been recorded (Cowling & Holmes 1992a). Sea temperature averages between 21 ºC in summer and 14 ºC in winter (Bolton & Stegenga 1990). Cold-water upwelling can occur in summer, causing marked declines in surface sea temperatures (MLH 1994).

2.3.2 *Hydrology (flow / flooding / mixing)*

Jones *et al.* (2000) divided the wetlands of the AP into four groups, predominantly based on geographical similarities (see Jones *et al.* 2000 for further details and subdivisions within groups):
Group 1 – Wetlands associated with the Hagelkraal River
Group 2 – Wetlands east of the Hagelkraal wetlands, but not associated with the Nuwejaars River
Group 3 – Different types of wetlands along the length of the Nuwejaars River
Group 4 – Wetlands associated with the floodplains of the Kars and Heuningnes Rivers.

However, Russell and Impson (2006) suggested that hydrological characteristics may be a more informative means of classifying AP wetlands, particularly with respect to the occurrence of fishes. Using physico-chemical variables, they classified the wetlands within ANP into four major groups:
Group i – Palustrine, lacustrine and riverine wetlands
Group ii – Brackish endorheic wetlands
Group iii – Saline endorheic wetlands
Group iv – Highly saline endorheic wetlands.
Fishes occurred predominantly in the first group, and in one instance in a brackish endorheic pan.

Jones *et al.* (2000) drew particular attention to the following:

- Some of the Klein Hagelkraal wetlands (Group 1) having dried out completely due to dense alien plant infestations.
- The Ratel River wetlands (Group 2a) being distinctly different from other groups and being in good condition.
- The uniqueness of the extremely saline wetlands within Group 2b (associated with Ratel River on Rietfontein farm) and Group 3d (endorheic wetlands at lower reaches of Nuwejaars River).
- The wetlands on the plateau above the Ratel River (Group 2c) being the only wetlands on the AP on slopes and hills, the associated vegetation being equally distinct.
- Voëlvlei and Soetendalsvlei (Group 3a) being in good ecological condition and considered as rare wetland types given that so few coastal lakes exist.

- The importance of the wetlands upstream of the Nuwejaars River (Group 3c) for controlling the amount and quality of water flowing into the Nuwejaars River.
- Soutpan (Group 3d) being a large salt flat (177ha).
- Severe modification of the Kars River floodplain (Group 4) threatening the survival of the wetland's unique plant biodiversity.

In a national assessment of estuaries, Turpie and Clark (2007) classified the Ratel Estuary as a small, black-water, sandy estuary with very few birds, with medium scenic/existence value, and considered to be in good health with no need for rehabilitation. Its overall biodiversity importance was not scored very high (32.5 on a scale of 1 to 100), as opposed to that of the Heuningnes Estuary at 83.1 (Turpie & Clark 2007).

2.3.3 Oceanography (wave regime / estuary mouth dynamics)

2.4 Chemistry

2.4.1 Water chemistry

Silberbauer and King (Freshwater Research Unit, Zoology Department, University of Cape Town) studied the chemical features of some AP wetlands in 1989. The data collected and additional field measurements made in 2000 are presented in Jones *et al.* (2000), i.e. chemical and physical characteristics such as pH, salinity, oxygen levels, total P, total N, Na+K:Ca+Mg, conductivity, turbidity, water clarity, water colour, geology, current, and substratum type. Published information is available in Silberbauer and King (1991). Russell and Impson (2006) sampled physical and chemical parameters of the wetlands within ANP in 2003 and compared their findings with those of the abovementioned studies.

<u>Salinity</u>: AP river waters are alkaline and brackish as a result of passage through limestone-bearing Strandvlei sands (Noble & Hemens 1978). Voëlvlei and Soetendalsvlei are moderately saline (2 to 5 g/kg, compared to 35 g/kg for seawater), whereas several of the smaller pans (Soutpan, Melkbospan, Vispan) are strongly saline (16 to 86 g/kg) (Silberbauer & King 1991). Russell and Impson (2006) suggested that the distinction between saline and highly saline wetlands may be an artefact of season-specific sampling rather than reflecting a fundamental difference in physico-chemical characteristics. High salinities render the waters from most pans and lakes unsuitable for domestic consumption or irrigation of all but salinity-tolerant crop species (DWAF 1993). Salinity also limits the type of vegetation and fauna a wetland can support. Although there may be fewer species in wetlands of high salinity, these species may be specific to and therefore characteristic of saline wetlands (Jones *et al.* 2000).

<u>pH</u>: The pH of freshwater systems is determined mainly by lithology and atmospheric influences (Jones *et al.* 2000). Waters in upper mountain streams usually have a low pH (4.5 to 5.0) (Noble & Hemens 1978) while vegetation type may also affect water pH, e.g. water draining from fynbos catchments typically being acidic (Jones *et al.* 2000). However, the passage of rivers through limestone bearing sands, as is the case on the AP, results in increases in pH, with pH in the Heuningnes River system being 7.0 below Elim, and 8.5 in Soetendalsvlei (Noble & Hemens 1978). The pH in most of the lowland wetlands varies between 6 and 8 (Silberbauer & King 1991). One of the wetlands of the Groot Hagelkraal group had relatively acidic water (pH = 5; Jones *et al.* 2000). Aquatic organisms in the south-western Cape are often adapted to acid conditions (Jones *et al.* 2000). Anthropogenic pH changes may take place in the form of acidification (e.g. by industrial effluent or acid precipitation) or alkaline pollution (e.g. by industrial effluents and eutrophication) (Dallas & Day 1993 cited in Jones *et al.* 2000).

<u>Nutrients</u>: The waters of the AP wetlands varied from nutrient rich to nutrient poor, i.e. Soetendalsvlei with the highest concentrations of phosphorus and nitrogen, and Pearly Beach with low nutrient status (Jones *et al.* 2000). These authors list nutrient levels for some AP wetlands. Anthropogenic nutrient enrichment, largely resulting from agricultural activities, presents a significant threat to the biota and functioning of AP wetlands (see 2.4.2).

2.4.2 Pollution

Extensive use is made of fertilizers (superphosphates) on agricultural lands of the AP, and aerial spraying of herbicides and pesticides is common (Bickerton 1984). High nutrient concentrations in wetlands adjacent to agricultural lands would thus not be unexpected. Nutrient enrichment leads to highly productive systems and a change in system processes. Eutrophication frequently results in increased growth of aquatic plants. A change in floral species abundance and distribution has a domino effect with faunal diversity and functions changing in response, and wetland structure and functioning becoming altered. Wetlands could ultimately be converted to permanent dry land if this process is continued (Jones *et al.* 2000).

DAY ET AL. (1971) REPORTED ON THE EFFECT OF OIL POLLUTION FROM A TANKER ON THE MARINE FAUNA OF THE AGULHAS AREA.

2.4.3 General chemistry

Some details on soil chemistry are given by Thwaites (1987) and Thwaites & Cowling (1988) (see 2.1).

3. BIOTIC CHARACTERISTICS

3.1 Flora

3.1.1 Phytoplankton / diatoms

3.1.2 Algae

Based on field surveys of inundated AP wetlands during March and April 2000, Jones *et al.* (2000) identified at least 12 species of algae (Appendix 7.1.1). Dry algal mats were seen at many dry wetlands, suggesting that the diversity of algal species in the AP wetlands may be much greater than the mentioned 12 species (Jones *et al.* 2000).

THE MARINE FLORA INCLUDES AT LEAST NINE SEAWEED SPECIES OF THE COOL TEMPERATE SOUTH-WEST COAST PROVINCE THAT ARE COMMON BETWEEN CAPE POINT AND CAPE AGULHAS, BUT RARE OR ABSENT FROM THE DE HOOP NATURE RESERVE, SOME 60 KM EAST OF STRUISBAAI (BROWN & JARMAN 1978; BOLTON & STEGENGA 1990). *ECKLONIA MAXIMA* IS A HIGHLY PRODUCTIVE SPECIES WITH A DAILY GROWTH RATE OF 1-2 % AND A WET BIOMASS OF 114 000 TONNES BETWEEN CAPE POINT AND CAPE AGULHAS (ANDERSON *ET AL.* 1989). IT IS ESTIMATED THAT KELP BEDS COVER 1 953 HA BETWEEN CAPE AGULHAS AND THE STRAND WITH EACH HECTARE HAVING THE POTENTIAL TO YIELD 0.6 TONNES DRY WEIGHT PER ANNUM (ROTMANN 1999).

3.1.3/4 Aquatic & Semi-aquatic

The plant diversity in the wetlands, especially in the Hagelkraal and Pearly Beach areas, is high relative to other wetlands in the southern Cape, with a total of 21 families and 54 species recorded (J. King 1995 *in litt.*; Jones *et al.* 2000)(Appendix 7.1.2). Of all wetlands studied in the southern Cape (Cederberg to Mossel Bay), those of the Agulhas region are most deserving of protection, and should, due to the extraordinary high diversity of aquatic plants in addition to the invertebrates, amphibians and waterbirds (see below), be considered to be of international importance (De Villiers 1988; Ryan *et al.* 1988; Rebelo 1992; J. King, pers. comm. 1995). Restioid vegetation dominates in most wetlands, but in some reeds are the most abundant species. Some wetlands or parts thereof are not vegetated and have thus been classified as muddy, acid, pan, saltpan, estuarine and riverine (Jones *et al.* 2000). Cole *et al.* (2000) provide a detailed classification of AP wetlands according to wetland vegetation types.

3.1.5 Terrestrial

The terrestrial vegetation is arguably the most significant component of the biota of the AP and its protection is vital for the conservation of fynbos in South Africa (R.M. Cowling, pers. comm. 1995; Willis *et al.* 1996a). More than 1750 plant species have been recorded from the AP (Cowling & Holmes 1992a; Cowling & Mustart 1994). The area has a very high beta diversity and perhaps the most pronounced and remarkable edaphic (soil-controlled) endemism in the world (Cowling 1990a; Cowling & Holmes 1992b; Cowling & Mustart 1994). Gamma diversity is also high and it was concluded that the high regional richness of the AP is a function of high turnover within and between moderately rich communities (Cowling 1990a). The numbers of species in the ten largest families and genera in the flora of the AP are listed in Appendix 7.1.3 (Cowling & Holmes 1992b). Similarities with other phytochorological groups are indicated in Appendix 7.1.4. A massive 112 Red Data Book species occur on the AP (Appendix 7.1.6), whereas 23.6 % of the flora are regional (South Western Centre or Bredasdorp-Riversdale Centre) endemics and 5.7 % local (AP) endemics (Cowling & Holmes 1992a; Cowling *et al.* 1994).

Families which are over-represented in terms of endemics include the Ericaceae, Rutaceae, Proteaceae and Polygalaceae, whereas the Poaceae, Cyperaceae, Scrophulariacae and Orchidaceae are under-represented (Cowling & Holmes 1992a). Endemics are also over-represented among taxa that are particularly speciose in South Africa (e.g. Mesembryanthemaceae) (Cowling *et al.* 1994). Genera with high levels of regional endemism are *Erica, Thesium, Leucadendron, Muraltia, Agathosma* and *Aspalathus* (in decreasing order of percentage endemism). Genera with high levels of local endemism are *Phylica, Muraltia, Leucadendron, Agathosma* and *Erica* (Cowling & Holmes 1992a). More than 90 % of endemics are edaphic specialists (Cowling *et al.* 1994) with endemism being negatively correlated with soil depth and most measures of soil fertility (Cowling & Holmes 1992a). The highest proportion of regional endemics is confined to infertile quartzites and sillicaceous sands, and the lowest proportion confined to relatively fertile shale/ferricrete, whereas most local endemics are confined to limestone and colluvial acid sand (Cowling & Holmes 1992a; Cowling *et al.* 1994). Families which are over-represented in terms of limestone endemics include the Ericaceae, Fabaceae, Polygalaceae, Proteaceae, Rutaceae and Sterculiaceae (Rebelo & Siegfried 1992; Willis *et al.* 1996a). The biological profile of local AP endemics constitutes dwarf to low, non-sprouting shrubs with soil-stored seeds which are ant-dispersed and/or form a symbiotic relationship with microbes (Cowling & Holmes 1992a; Cowling *et al.* 1994).

Nine different broad vegetation types/groups have been identified on the AP (Cowling & Mustart 1994; Cole *et al.* 2000), some of which are highly threatened (Hilton-Taylor & Le Roux 1989; Cowling & Mustart 1994; R.M. Cowling, pers. comm. 1995):

- Acid sand proteoid fynbos
- Lime-/Neutral sand proteoid fynbos
- Limestone proteoid fynbos
- Ericaceous fynbos
- Restioid fynbos
- Dune asteraceous fynbos
- Elim asteraceous fynbos
- Renosterveld
- Forest & Thicket

Species characteristic of these vegetation types/groups are listed in Appendix 7.1.7, and synonyms for these vegetation units as per the 2006 vegetation map of South Africa are indicated (Mucina & Rutherford 2006; fynbos chapter: Rebelo *et al.* 2007). Mucina and Rutherford (2006) also provide assessments (in national context) of conservation status, conservation target, and threats per vegetation type.

Despite heavy infestation by alien plants in places, the indigenous vegetation on the mountains and eastern section of the coastal plain is reasonably intact. On the fertile inland plains, however, only plant communities in the less arable areas have survived (Hanekom *et al.* 1995; Cole *et al.* 2000). The high plant diversity/endemism and the fragmented nature of the AP necessitated extensive conservation planning and prioritization exercises (e.g. Jarman 1986; Willis *et al.* 1996b; Lombard *et al.* 1997; Heydenrych 1994a,b, 1999; Cole *et al.* 2000; Pence *et al.* 2003; Rouget 2003; ABI undated) used in the development of ANP. Hanekom *et al.* (1995) summarized the procedure followed and recommendations (*re* park expansion and reserve configuration) produced by some of these studies. The sites Hagelkraal, Korsika and Heuningrug were found to be irreplaceable for the conservation of Limestone fynbos (Willis *et al.* 1996b; Lombard *et al.* 1997). Hagelkraal has acidic substrata supporting numerous endemic Proteaceae and supports four species restricted to the site. It is furthermore the only site of its size (11.5 x 13.9 km) in the entire Cape Floristic Region, which is regarded as essential for the conservation of both Proteaceae (Rebelo & Siegfried 1992) and Limestone fynbos species (Willis *et al.* 1996b).

Another important botanical site is the Soetanysberg area about 17 km east of Hagelkraal. This site (*ca.* 15 x 6 km) supports seven different fynbos types. Four of these - Limestone proteoid (restricted to limestone substrata), Elim asteraceous fynbos (unique to the AP), (Wet) Restioid fynbos (closely associated with vleis and drainage systems) and Neutral sand proteoid fynbos (confined to colluvial sand derived from limestone) are endangered in the Cape Floristic Region (Cowling & Mustart 1994; R. Cowling 1995, pers. comm.). Although patches of threatened Elim asteraceous fynbos are included in the Soetanysberg area, the most representative populations are found on the farm Vogel Struis Kraal, which is a commonage to the Moravian Missionary village of Elim. The area including Soetanysberg, Heuningrug and Elim (24 x 28 km) has more than 60 Red Data Book plant species, of which at least 15 are Threatened (Rebelo 1992). It was concluded from the above that the four most important nodes for fynbos conservation on the AP are Hagelkraal, Soetanysberg, Elim and Heuningrug (Hanekom 1995; Lombard *et al.* 1997).

Studies of fynbos ecology have largely focused on the Proteaceae. A seed germination study showed that temperature does not affect germination levels of four serotinous Proteaceae species, although germination rates of older seeds are slower than those of younger seeds (Mustart & Cowling 1991). In a subsequent study, Mustart and Cowling (1993b) found that seed germination of the same four Proteaceae species is affected by the water-retention properties of the soils in which they grew. Percentage seedling emergence is lower and more variable on colluvial sands than on limestone soils, the latter having higher clay-, silt- and organic matter contents. Seed characteristics further influence seed germination patterns. Proteas, with thicker pericarps (higher pericarp to embryo ratios), exhibit superior water retention and thus higher germination success following wetting-drying cycles compared to Leucadendrons.

Another study suggested that competitive exclusion, rather than edaphic requirements at the regeneration stage, determines distribution patterns of adult Proteaceae (Mustart & Cowling 1993a). However, Newton *et al.* (1991) found that Proteaceae species normally growing on acid sands (calcifuge spp.) are smaller and show signs of chlorosis and necrosis when grown on limestone soils. Species normally growing on limestone soils (calcicole spp.) are not significantly different when grown on either soil type. It was suggested that soil type plays the major role in the failure of calcifuge species to establish themselves on limestone soils, but that competition is probably more important in the reverse case (Newton *et al.* 1991).

Esler *et al.* (1989) explored the role of soil type as selective factor in the evolution of seed size, number, and nutrient content of non-sprouting serotinous Proteas. The calcifuge *P. compacta* has larger seeds with higher N and P content but lower annual seed production than the calcicole *P. obtusifolia*. The authors proposed that *P. compacta* exhibits a trade-off between seed and crop size since it requires larger, more nutritious seeds to establish in the infertile soils. Mustart and Cowling (1992a) found that seed size and seed nutrient status (N & P) were positively correlated with soil nutrient- and moisture status. This trend was found within, but not across genera (*Protea* and *Leucadendron*), emphasizing the importance of phylogeny in interpreting adaptations.

Mustart *et al.* (1994) examined whether reproductive traits in two closely related Proteaceae species-pairs growing on adjacent soil types are related to differences in soil regime. They found that *Protea obtusifolia* and *Leucadendron meridianum* growing on shallow limestone soils comprise smaller plants, with fewer cones and seeds per plant, than *P. susannae* and *L. coniferum* on deeper colluvial (more acidic, lower clay-content) sands. There are no consistent trends in degree of serotiny or sex allocation across soil types. It was concluded that there are no overall patterns in reproductive traits that can be ascribed to differences in soil regime, other than through size-related effects. Fire regime was thought to have played a more important role in determining reproductive traits. Le Maitre and Midgley (1992) indicated prevalence of different seed bank types (e.g. soil-stored *vs* canopy-stored) on a range of soil types (Appendix 7.1.5)

Kilian and Cowling (1992) showed that the long-term co-existence of two obligate reseeding and morphologically similar dune fynbos shrub species, i.e. *Passerina paleacea* and *Phylica ericoides*, does not result from similar post-fire regeneration success. It may instead be attributed to population instabilities arising from differential regeneration in relation to the fire regime. Hot fires followed by dry summers would favour *Phylica* over *Passerina* as the former has fire-stimulated germination and greater drought tolerance, whereas cool fires followed by moist summers would favour *Passerina* (Kilian & Cowling 1992).

Cowling and Bond (1991) studied the effects of fragmentation on limestone flora by comparing limestone outcrops/'islands' of various sizes with equivalent areas in limestone 'mainland'. For comparable sample areas, islands always have fewer (23-34 % fewer) species than mainland samples, i.e. species-area curve for islands has a steeper slope and lower intercept than mainland curve. There is no difference between mainland and island floras in the frequency of species belonging to different dispersal types, pollination syndromes, growth forms and shrub height categories. Local endemics are significantly under-represented on the islands, and considered to be most vulnerable to extinction as a result of fragmentation. This study suggested that the minimum reserve size needed to avoid species losses is about 4-15 ha, provided a similar disturbance regime.

Comparisons of the AP with a climatically and edaphically matched site in Western Australia indicates strong convergence between Australian and South African shrublands in the frequency of a wide range of traits relating to plant form and function (Cowling & Witkowski 1994) as well as in taxonomic, edaphic and biological aspects of plant endemism (Cowling *et al.* 1994).

3.2 Fauna

3.2.1 Zooplankton

3.2.2 Aquatic invertebrates

The aquatic invertebrate communities, notably those of the Hagelkraal system, are exceptionally diverse. This high diversity in the Hagelkraal system could possibly be attributed to fynbos black waters flowing over alkaline calcareous soils (as opposed to Cape fold belt sandstones as in most other fynbos areas), thus supporting invertebrate species characteristic of both fynbos areas and more alkaline brackish waterbodies (J. King, pers. comm. 1995). The invertebrate communities in the Ratel and Uilkraal estuaries are probably similar to those occurring in the adjacent Heuningnes estuary where 20 species have been recorded (Appendix 7.7; Bickerton 1984).

The invertebrate fauna of the rocky and sandy beaches is fairly rich similar to that of the Warm Temperate South Coast (Brown & Jarman 1978; McLachlan *et al.* 1981), and 26 % and 5 % of these temperate rocky and sandy shores respectively are protected in South Africa (Brown & Jarman 1978; Jackson & Lipschitz 1984; Hockey & Buxton 1989). Unlike De Hoop Nature Reserve, the Agulhas coast has large stocks of commercially exploited abalone (*Haliotis midae*) (Hanekom *et al.* 1995).

3.2.3 Terrestrial invertebrates

Three Red Data Book butterfly species (*Argyrocupha malagrida maryae*, *Poecilmitis brooksi tearsei* and *Thestor rossouwi*) are likely to occur on the AP (Henning 1989; Rebelo 1992).

Two leaf-feeding chrysomelid beetle species (*Chrysolina picturata* and another unnamed species of the same genus) were collected on the AP and tested for host specificity on *Chrysanthemoides monilifera* – a coastal shrub indigenous to the area but a serious invader in Australia (Adair & Scott 1997). Both beetle species were found to be *Chrysanthemoides*-specific and were approved for release as biological control agents in coastal areas of southeastern South Australia.

3.2.4 Fish

The freshwater fish fauna of the aquatic systems in and adjacent to ANP is depauperate with only three indigenous species, one of which with Red Data status, whereas three invasive alien fishes were recorded (Hanekom *et al.* 1995; Russell & Impson 2006; Appendix 7.2). The species composition in Soetendalsvlei howed a strong marine influence with the collection of two estuarine species and three species which, although occasionally found in coastal rivers, occur predominantly in estuaries or inshore coastal waters (Russell & Impson 2006; Appendix 7.2). Limited sampling for fish in the Ratel and Uilenkraal estuaries has yielded six fish species (Harrison *et al.* 1995), but the fish communities are probably similar to that of the more comprehensively sampled Heuningnes estuary (Appendix 7.2). A preliminary survey of the estuarine fish fauna was also done as part of a wider study by Harrison (2001a&b).

Marine fish species caught by line boats in the area are listed in Appendix 7.2, and their contribution to the commercial catches is discussed in the section 5.3.4. Large numbers of sharks, including the Rare Great white shark, frequent the area (Hanekom *et al.* 1995).

3.2.5 Amphibians

Fifteen amphibian species are found in the area (Appendix 7.3), with the endemic and highly Endangered Cape platanna (*Xenopus gilli*) and Micro frog (*Microbatrachella capensis*) having been recorded from seasonal vleis in the Hagelkraal and Ratel River catchments (De Villiers 1988; Picker & De Villiers 1988). The Red Data listed Western Leopard toad (*Bufo pantherinus*) furthermore has a viable population in the area (Baard *et al.* 1999 cited in GEF undated).

3.2.6 Reptiles

Vertebrate species diversity in the fynbos biome is low, approximately half that of the moist and arid savanna biomes of South Africa (Siegfried 1989). Twenty-four reptile species have been recorded, and a further 22 species are likely to occur on the AP (Raimondo & Barker 1988; Appendix 7.4). Amongst these are the Rare Yellow-bellied house snake (*Lamprophis fuscus*) and the Threatened Southern dwarf adder (*Bitis armata)*, which is extinct from similar habitat further west in the Cape Floristic Region (CFR) but occurring on the calcareous and limestone outcrops of the Agulhas coastal plain (Baard *et al.* 1999).

3.2.7 *Birds*

The avifauna is diverse, with 230 bird species recorded from the Agulhas Plain (Underhill & Cooper 1983; Ryan *et al.* 1988; Hockey *et al.* 1989). Of these, 11 are Red Data Book species (Brooke 1984) and 133 are associated with the terrestrial environment (Appendix 7.5). Significant populations of Blue cranes (*Anthropoides paradiseus*) and to a lesser extent the vulnerable Stanley's bustard (*Neotis denhamii*) breed on the inland plains (Brooke 1984; P. Hockey pers. comm. 1995; N. Hanekom, pers. obs.). The Endangered Cape vulture (*Gyps coprotheres*), the Red-listed Striped flufftail (*Sarothrura affinis*), White stork (*Ciconia ciconia*) and Black harrier (*Circus maurus*) have also been recorded on the AP (Barnes 1998 cited in GEF undated). The Agulhas long-billed lark (*Certhilauda brevirostris*, Near Threatened, Ryan & Bloomer 1999 cited in GEF undated) is endemic to the plain (Hockey *et al.* 2005). Nectivores (sunbirds and sugarbirds), important for lowland *Protea*-veld pollination, are abundant.

The wetlands of the area support a diverse assemblage (> 60 species) of waterbirds (Ryan *et al.* 1988; N. Hanekom pers. obs.). Over 21 000 waterbirds (i.e. about 9 % of those in the Western Cape) occur at these wetlands, with the highest numbers at Soetendalsvlei, followed by Uilkraals River estuary and Voëlvlei (Ryan *et al.* 1988). The birds of the AP have been afforded international conservation recognition by the listing of two Important Bird Areas (IBAs), i.e. Overberg wheatbelt (SA 115) and Heuningnes river and estuary system (SA 121) (Barnes 1998; Heydenrych 1999b).

Extensive agricultural transformation (40 % of the AP is cultivated; Lombard *et al.* 1997) and associated habitat destruction has negatively affected many bird species, e.g. sunbirds, nightjars, and mousebirds (Mangnall & Crowe 2003). However, populations of certain bird species, especially granivores and omnivores, such as sparrows, larks and pipits, as well as Egyptian geese and Helmeted guineafowl have proliferated on the AP (Mangnall & Crowe 2003). These authors studied the effects of agricultural development on bird diversity on the AP and recorded the highest avian diversity at sites with a mixture of crops and coastal fynbos. However, all other agricultural activities result in a loss of diversity when compared with fynbos, and a small number of species, e.g. sunbirds, are exclusively reliant on coastal fynbos for survival.

African black oystercatchers (7% of global population) and the Rare Damara tern (<1% of global population) breed along the Agulhas coast (Summers & Cooper 1977; R. Jeffery, pers. comm. 1995). Numbers of oystercatcher breeding pairs showed a significant increase along the coast between Sandy Knoll Point and Brandfontein during 1978 - 2002 (overall mean of 1.3 pairs/km; Jeffery & Scott 2005). Contrastingly, mean numbers of fledglings per pair declined slightly during the same period. The mean number of 0.30 fledglings per pair that bred is slightly below the level required to maintain a stable population (Jeffery & Scott 2005). The closure of the Overberg coast to recreational vehicles (Feb 2002) ought to result in reduced human disturbance of breeding birds.

Dyer Island and Geyser Rock are important breeding sites for seabirds; notably the African penguin, which is classified as Vulnerable and whose populations continue to decline (Brooke 1984). The seabird species present and the size of their populations relative to their global populations are as follows: African penguins (15%), Cape cormorant (13%), Crowned cormorant (9%), Bank cormorants (<2%), Kelp gulls (<2%) and at irregular intervals Whitebreasted cormorant (<4%), Swift terns (<2%) and rare Caspian terns (<2%) (Crawford *et al.* 1982a&b, 1995; Cooper 1981; Brooke *et al.* 1982; Cooper *et al.* 1982, 1990, 1992).

3.2.8 *Mammals*

Of the 81 terrestrial mammals known from the Cape Floral Kingdom, 65 species have been recorded or are likely to occur on the AP (Stuart 1981; Lloyd & Millar 1983; Skinner & Smithers 1990; ABI undated; Appendix 7.6). The majority of these are rodents and small carnivores. Red Data Book species are indicated in Appendix 7.6 and the list includes four Near Threatened bat species (Friedmann & Daly 2004). The AP is one of very few strongholds of the Honey badger (*Mellivora capensis*), widely persecuted for its local destruction of apiaries and fowl runs (GEF undated).

A large breeding colony of South African fur seals on Geyser Rock produces over 8 000 pups a year or 3 % of the seal pup population in southern Africa (David 1984). Significant numbers of Southern right whales use the sheltered bay for breeding and nursery purposes (Raimondo & Barker 1988).

4. HISTORY

4.1 Archaeology

The AP is considered to be an exceptionally rich archaeological region (Raimondo & Barker 1988; Avery 1999) with people having occupied the area for well over a million years(Avery 1999). Large numbers of Later Stone Age (LSA, i.e. the last 20 000 years of precolonial history in southern Africa) sites have been recorded in the area, i.e. at Die Walle, Die Kelders, Hoek se Baai, Gruis se Baai, Oubaai, Bloubaai, Vlei se Bank, Rasperpunt and Cape Agulhas (Hall 1984; Raimondo & Barker 1988; Kaplan 1993; Avery 1999). Middle Stone Age (i.e. the period between 200 000 and 20 000 years ago) tools and occasional Early Stone Age (i.e. the period between 2 million and 200 000 years ago) tools have also been found (Deacon 1988; Wilson 1988; Avery 1999).

Shell middens are densely clustered inshore of the rocky shoreline in the intertidal zone (Raimondo & Barker 1988; Avery 1999). It is here that substantial quantities of shellfish species were exploited, processed and consumed by LSA hunter-gatherers(Avery 1999). Archaeological sites are not only confined to the intertidal zone, however, and large numbers of sites occur further inland on and behind the high limestone cliffs overlooking the sea, and in the inland dunefields (Hall 1984). Well-preserved 'visvywers' (ancient fish traps apparently constructed by Khoi-khoi pastoralists) occur at Cape Agulhas, Rasperpunt and Suiderstrand (Avery 1975; Raimondo & Barker 1988), while rare limestone shelters have been located in the high cliffs overlooking Rasperpunt.

Die Kelders Cave 1 (also called Klipgat) was discovered in the late 1960s and became the focus of a number of excavation projects under the auspices of the South African Museum. Publications that emanated from this work include Rudner (1968), Tankard & Schweitzer (1974), Klein (1975), Schweitzer (1979) , Grine *et al.* (1991, 1998), Wilson (1996), Avery *et al.* (1997), Marean (1998), Bartram & Marean (1999) , Grine (2000), Marean *et al.* (2000) and Feathers & Bush (2000). The LSA cultural material is rich in bone artefacts (awls, points, 'needle' points, link-shafts and spatulas) and ornaments of marine shell, ostrich egg shell and bone (mostly beads and pendants). Stone artefacts are generally simple and based on quartzite cobbles and quartz readily available on the coast (Avery 1999). Formal tools account for a small fraction of the assemblage. Large numbers of grindstones and red and black pigment occur throughout. Marine mussels were chipped to form effective scrapers. The occurrence of ochre staining on many of the ornaments indicates its use in body ornamentation (Avery 1999). The Die Kelders samples provided the earliest occurrence of ceramics in the western Cape, with finely made and decorated spouted pots being present. Bowls made from tortoise carapace, including one of a geometric tortoise that must have been transported many kilometres, are relatively common. Ochre was stored or used in shells of tortoises, mussels, limpets and abalone. A complete ostrich egg flask was recovered (Avery *et al.* 1997). The presence of sheep (see Appendix 7.6.1) raises the issue of the identity of the occupants, which is difficult to resolve given the social and economic flexibility and technological similarity recorded among Khoisan people (Wilson 1996 cited in Avery 1999). It is hoped that evidence from other supposed herder or hunter-gatherer sites in the region will throw further light on whether the Die Kelders LSA people were pastoralists, hunter-gatherers or a mixture of the two (Avery 1999).

Another important archaeological site is the inland cave, Byneskranskop 1 (Schweitzer & Wilson 1982). More general archaeological accounts of the Agulhas area are provided by Avery (1975, 1982, 1990), Volman (1981) and Wilson (1993).

4.2 Palaeontology

The AP has been identified as an ideal site for palaeoenvironmental studies, largely associated with its interesting geomorphological history (Thwaites 1987). The AP is furthermore thought to have been particularly sensitive to changing global Quaternary environments (Carr 2004) due to its position within the winter rainfall zone, between the highly seasonal west coast and the southern winter rainfall zone/all-seasons rainfall zones. The area contains a variety of aeolianite and coastal dune deposits. The diverse aeolian depositional record, including organic/polleniferous sediments, spans at least the last *ca.* 175 000 years, which is unusually old for southern Africa (Carr 2004).

Carr (2004) studied the AP palaeoenvironmental record and produced four vibracores from wetland/pan environments, six radiocarbon age determinations and 35 optically stimulated luminescence ages from pan floor, lunette dune, coastal dune and aeolianite deposits. The aeolianite record and overall record of Cenozoic coastal sediment deposition, combined with absolute age determinations from elsewhere along the winter rainfall zone coastline, demonstrate the linkage of aeolianite formation with relatively high interglacial/interstadial sea levels (Carr 2004).

According to the aeolianite/cordon dune model proposed by Bateman *et al.* (2004) (see 2.1.1) the southern African winter rainfall zone does not show significant Last Glacial Maximum aridity and aeolian activity. The lack of Last Glacial Maximum ages from the aeolianites and cordon dunes on the southern Cape shows they were not active at this time and that regionally conditions were never arid enough to leave enough sediment exposed for aeolian deflation (Bateman *et al.* 2004). It also shows that aeolian deposition in the southern Cape occurred episodically over a much longer time-span than previously postulated, extending beyond interglacials into the early parts of glacials. The impact of this on palaeoenvironments would have been tempered by the seemingly strong primary control on aeolian activity of sea-level (Bateman *et al.* 2004).

Coupled with a better understanding of Late Quaternary sea-level fluctuations and palaeocoastline configuration, the depositional phases appear to have been controlled by interglacial and subsequent interstadial sea-level high stands. The lack of carbonates in more recent dunes is attributed not to leaching but to changes to carbonate production in the sediment source area caused by increased terrigenous material and/or changes in the balance between the warm Agulhas and nutrient-rich Benguela ocean currents (Bateman *et al.* 2004).

Lunette dune optically stimulated luminescence chronology demonstrates the discontinuous occurrence of lunette accretion, considered to be indicative of conditions similar to or drier than the present during the periods 60-45 ka, *ca.* 15 ka, 2.8-2.6 ka, 1.2 ka and *ca.* 800 BP (Carr 2004). The overall lunette record indicates that pan floor hydrological conditions have varied significantly the last 60 ka.

The sporadic preservation of polleniferous material on the AP was found to be consistent with sedimentological evidence from the same cores (Carr 2004). Pollen records obtained reveal the significant presence of fynbos flora on the AP during two periods in the late Pleistocene. However, the relatively short sequences produced do not provide evidence for vegetation change over periods of significant climatic fluctuations (e.g. the Last Glacial Maximum), hampering any assessment of the extent to which the vegetation responded to long-term climatic forcing. The 5000^{+} year record from a core extracted from Voëlvlei suggests limited change during the period *ca.* >38 – 33 ka BP, perhaps reflecting the same relatively stable climatic conditions that resulted in the regular inundation of Voëlvlei (Carr 2004).

The AP, today considered part of the winter rainfall zone proper (i.e. >65 % winter rainfall), at various times during the late Quaternary may have exhibited conditions distinct from the western winter rainfall zone and more akin to the summer rainfall zone (Carr 2004). Evidence from the lunette records further suggests that westerly winds were a significant component of the past climatic regimes of the AP (Carr 2004).

The AP has a large, neoendemic flora (Cowling *et al.* 1992; Cowling & Holmes 1992a). Evidence for neoendemism is that the AP was largely inundated by a marine transgression in the early to mid-Pliocene (4 M yr) (Hendey 1983). Since most local endemics are confined to sediments and soils deposited after this transgression, it is reasonable to assume they are younger than this event (Deacon 1983 cited in Cowling & Holmes 1992a).

Avery (1982) studied micromammals and Avery (1990) the avian fauna of the palaeoenvironment of the late Quaternary in the southern Cape. Avery (1999) lists animal taxa, excluding fish and molluscs (see Appendix 7.6.1), represented at Die Kelders Cave, where extensive excavation work has been done (see 4.1).

4.3 Historical aspects

Numerous national monuments are found in the area. The Cape Agulhas lighthouse, the second oldest lighthouse in South Africa and the oldest government building in the southern Overberg region, is a functional lighthouse and houses the only lighthouse museum in Africa (Lohann 1993). It is sited within 1 km of the southern most tip of Africa. Hotagterklip in Struisbaai has many of the few remaining cottages built in the old South West Cape style. The Moravian mission station at Elim has the largest wooden waterwheel in South Africa, and the clock in the Elim church dates back to 1764 (C. Lohann *op cit.* 1995).

Merino sheep farming in South Africa was pioneered by Michiel van Breda of Zoetendals Vlei. The homestead of this farm is well preserved (C. Lohann *op cit*. 1995), and at least four other homesteads in the area are national monuments (Brandfontein, Aasfontein, Rhenosterkop and Springfield). The novel *Driftwood*, or “*Die Uitgespoeldes*” in Afrikaans, by Matthee (2005) centers around historical characters from the L’Agulhas/Bredasdorp region, and in particular the farms Springfield, Renosterkop and Ratelrivier, at the turn of the 20th century. Matthee was largely informed by the tales of Piet van As, who grew up in the area (Botha 2005).

Eight shipwrecks have provisionally been proclaimed as monuments, i.e. the famous "Birkenhead" (1852), "Clyde" (1874), "Jessie" (1829), "Nicoban" (1783), "Joanna" (1682), "Brederode" (1785), "N. Signora do Los Milagros" (1686), and “Le Centaur" (1750) (Raimondo & Barker 1988).

Mobile dunes along the AP coastline were vegetated by the Department of Forestry primarily with alien *Acacia* species (*A. cyclops* & *A. saligna*) as long ago as 1942 and again in 1962 (Walsh 1968).

5. MANAGEMENT

5.1 Management of vegetation

5.1.1 Burning

Fires have been used on the AP for many years as an agricultural aid and almost half of the AP farmers reported burning the vegetation to improve wildflower production (Heydenrych 1999). However, inappropriate fire regimes (<15 year intervals) are rated as the fourth biggest threat to the indigenous flora of the AP (Cowling & Mustart 1994). Increased frequency of wildfires due to invasive aliens, insufficient firebreaks, a lack of early warning systems, and increased human activities impact on plant diversity, as certain species fail to reach maturity and to develop safe seed store levels between fires.

Late summer/autumn season is an appropriate time to burn, and a coordinated fire management approach (organizing controlled fires in blocks encompassing several farms/properties) would be appropriate for the AP (Cowling & Mustart 1994). The Agulhas Biodiversity Initiative (ABI) is working towards developing and implementing a fire management strategy that will include the conservation management component of the AP, and train a rapid response team to augment conservancy initiatives in priority areas (ABI undated). Recently a National Veld and Forest Fire Act has been promulgated. The Act mandates that veld fire management strategies be developed at the local level and requires landowners to create and maintain firebreaks and install equipment to fight wildfires (GEF undated).

5.1.2 Stocking rates

Heydenrych (1999) found the average reported stocking rates for cattle and sheep on AP farms to be above the agricultural recommended rate of 0.5 small stock units/ha/year. Acid sand fynbos, renosterveld and wetlands are particularly overstocked compared to levels considered sustainable for these vegetation types. Small farm size and poor veld condition exacerbate the problem, resulting in over-trampling, local overgrazing, bank erosion and eutrophication of wetlands. A dominant perennial wetland sedge, Palmiet (*Prionium serratum*), has been reduced over wide areas impairing its ameliorating influence on high flows and channel stability. This, coupled with alien plant invasion in catchments, contributes significantly to wetland deterioration (GEF undated).

Heydenrych (1994b) noted that certain limestone fynbos sites in the southwestern Cape are also subject to and may be threatened by overgrazing. Ostrich ranching may furthermore contribute to land degradation, should the industry expand on the AP and/or be poorly managed (GEF undated). Off-reserve rehabilitation of ecosystems, particularly wetlands, is an initiative of ABI that aims at reducing livestock pressure on sensitive systems and testing appropriate strategies for vegetation recovery (ABI undated).

5.1.3 Alien plant control

Woody alien plants to some extent invade almost the entire AP. Alien species occur in 72 % of the total area and in 96 % of the remaining natural vegetation (cultivated and urbanized areas excluded) (Rouget & Richardson 2003). The three most widespread alien invasive species are (total area indicated in parentheses) *Acacia cyclops* (113 817 ha), *Acacia saligna* (89 162 ha), and *Pinus pinaster* (78 654 ha), occurring mostly at low percentage cover (Rouget & Richardson 2003). Alien (mostly woody) plant infestation is according to Cowling and Mustart (1994) the number one threat to the indigenous flora of the AP and threatens to displace endangered fynbos types, such as Neutral sand proteoid fynbos and Limestone fynbos (Heydenrych 1994b). Vlok (1988) studied the alpha diversity of lowland fynbos herbaceous plants on the AP at various levels of infestation by alien annuals and concluded that they also pose a severe threat to the indigenous flora of lowland fynbos environments, especially to endemic annuals and geophytes.

Invasive alien Acacias, growing in dense thickets, suppress the growth of understorey vegetation, leaving the soil exposed and vulnerable to sheet erosion, which in certain areas causes the filling in of wetlands by sand deposits (GEF undated). The problem is intensified in areas that have suffered from frequent intensive fires, which further reduce ground vegetation.

Large parts of the mobile dunes/driftsands that characterize the coastline of the AP were stabilized with the European dune pioneer species, Marram grass *Ammophila arenaria* (Walsh 1968), which proved highly invasive along the North American west coast (Lubke & Hertling 2001). A chronosequence of stands of Marram grass at De Mond Nature Reserve (eastern AP) showed clear evidence of succession. Four communities could be distinguished, i.e. recent plantings of *A. arenaria*, asteraceous dune fynbos, mature dune thicket and mature dune fynbos. Succession is most rapid in sheltered, moist dune slacks, whilst *A. arenaria* remains vigorous on exposed, steep dune slopes with strong sand movement. *A. arenaria* does not appear to spread unaidedly at De Mond (Lubke & Hertling 2001).

Van Laar and Theron (2004a) developed tree-level models for *Acacia cyclops* and *A. saligna* on *inter alia* the AP to estimate leaf and wood biomass from diameter at knee height. These authors then developed stand-level models for estimating wood biomass for different tree sizes of the same species (Van Laar & Theron 2004b). Theron *et al.* (2004) subsequently assessed the utilizable biomass in invading *Acacia* stands on the AP. By using satellite imagery, they estimated that areas on the AP infested at > 50 % crown cover amount to 11 794 ha for *A. cyclops,* and 3 492 ha for *A. saligna.* They provided estimates of green biomass of woody material and foliage for different tree diameter classes and projected the total green biomass of *A. cyclops, A. saligna* and *A. mearnsii* (collectively) on the AP to be almost 3 million tonnes.

Holmes (1989) evaluated the effects of four different clearing treatments ('fell & pile'; 'fell, pile & burn'; 'burn standing'; 'fell & burn') on the seedbank dynamics of *A. cyclops*. Although all four treatments resulted in significant reductions in seed density one year post-clearing, burning treatments were more effective than the non-burning treatment. The 'burn standing' treatment is recommended where labour costs are prohibitive, but provided that fire intensities aren't likely to destroy indigenous soil-stored seedbanks.

Rouget and Richardson (2003) explored the relative importance of factors driving plant invasions. They showed that by combining propagule pressure (approximated by the distance from invasion foci) and environmental factors (geology, climate, land use, topography), semi-mechanistic models are able to successfully predict more than 70 % of the variation in canopy cover for *A. cyclops*, *A. saligna*, and *Pinus pinaster* on the AP.

Holmes *et al.* (1987) studied the effects of different clearing treatments on seed banks of alien Acacias across the fynbos biome. They found that seed banks of *A. saligna* are longer lived than those of *A. cyclops* as a result of lower germination rates of untreated seeds of the former. *Acacia cyclops* seed densities are higher under brush rows than areas where brush is cleared. Burning reduces both *A. saligna* and *A. cyclops* seed banks more than clearing without burning. Burning is thus recommended in fire-adapted fynbos, though not in the case of *A. cyclops* in coastal fire-sensitive vegetation.

The Plant Protection Research Institute, in collaboration with ABI, is monitoring the long-term combined impact of all three biocontrol agents available against *A. cyclops* (Wood 2006). These agents are the flower-bud gall midge *Dasineura dielsi*, the seed feeding weevil *Melanterius servulus*, and the die-back fungus *Psuedolagarobasidium acaciicola*. Two monitoring sites have been established, one each in the Agulhas National Park, and De Hoop Nature Reserve. When the project was initiated the flower-bud gall midge was already established at both sites. Subsequently the die-back fungus was introduced during February 2006, and the seed feeding weevil during September/October 2006. It is anticipated that not only will this monitoring provide valuable research information, but will also serve as demonstration plots to the ABI stakeholders and therefore act as a catalyst for the adoption of biocontrol in the region (Wood 2006).

Honig *et al.* (1992) investigated the invasive potential of another Australian species, *Banksia ericifolia,* near Cape Agulhas. Compared to the native *Leucadendron laureolum* (both species are serotinous overstorey shrubs), *B. ericifolia* produces a seed bank twice the size of that of *L. laureolum* and the alien species' release of seed after fire is of much longer duration with greater dispersal distances. Seedling growth rates are similar although below-ground biomass of the Australian species exceeded that of the native species after 100 days. It was concluded that *B. ericifolia* has the potential to colonize most fynbos areas in the SW Cape.

Clearing of indigenous vegetation for agriculture and other developments makes the AP increasingly susceptible to alien plant invasion (Cowling & Mustart 1994). Halting this invasion will require prolonged and significant input of finance and labour (Hanekom *et al.* 1995). ABI plans to develop joint alien plant clearing strategies for landscape units on the AP and adapt the existing national park-focused alien monitoring system to meet challenges at a landscape scale (ABI undated).

Heydenrych (1999) did a cost/benefit analysis for the clearing of invasive alien vegetation on the AP. The total cost of invasion on the AP is estimated to be in the order of US$ 3 million per annum, whereas the total cost to clear invasives is approximated to be US$ 5.6 million; thus, clearing should yield economic benefits after two years (Heydenrych 1999; Van Wilgen et al. 2001). Pence *et al*. (2003) calculated standardized clearing costs per hectare per sum alien plant density. Their calculations are based on data obtained from the literature and actual clearing programs on the AP, representing a full range of clearing techniques, and recognising that costs differ mainly in response to variation in densities of alien plants, although plant species and topography may play a role. They present the costs of clearing alien vegetation by density class in terms of initial clearing costs, the factor by which total follow-up costs increase, the total cost of follow-up efforts (0 % discount rate), and the number of years over which the total follow-up costs are spread:

Density class (% cover)	Initial cost/ha	Increase factor for follow-up	Total follow-up cost/ha	Years of follow-up included in total
0 – 1	R113	1.39	R158	4
1 – 5	R294	1.32	R389	6
5 – 25	R730	2.32	R1691	12
25 – 50	R1722	2.51	R4328	16
50 – 75	R3165	2.82	R8922	22
75 - 100	R5067	1.83	R9287	28

5.1.4 Rare Plants

The AP contains numerous rare vegetation communities, including 112 Red Data Book terrestrial plant species (see 3.1.5 and Appendix 7.1.6). This has management implications for burning (see 5.1.1), stocking rates (5.1.2), alien plant control (5.1.3), flower harvesting (5.3.2), and park expansion (5.7).

5.1.5 Vegetation Monitoring

5.2 Management of animals

5.2.1 Introductions / Translocations

Extra-limital medium/large mammal species (see Appendix 7.6.1) need to be removed.

5.2.2 Culling

5.2.3 Alien animal control

5.2.4 Rare / Threatened animals

A population of the Rare fish species, *Pseudobarbus burchelli*, occurring within ANP is divergent from populations elsewhere (Breede system) and could well be accorded full species status, which would further raise its conservation significance ((Swartz 2005; Russell & Impson 2006). Efforts should be made to improve the conservation status of areas where *P. burchelli* still occurs, and to increase land-owner awareness of these fishes (Russell & Impson 2006). Similarly, *Galaxias zebratus* is likely to be taxonomically split into multiple species, which may result in species having very restricted distributions and thus deserving special conservation attention (Russell & Impson 2006).

Based on historical information, the Vulnerable Bontebok (*Damaliscus pygargus. pygargus*) (Friedmann & Daly 2004) is endemic to the renosterveld between Bot River and Mossel Bay (Bigalke 1955), and the original Bontebok National Park was located *ca*. 10 km east of the AP, as defined here. The AP constitutes one of the only extant habitats for viable populations of Bontebok and the Vulnerable (national assessment; Friedmann & Daly 2004) or Endangered (global assessment; IUCN 2004) Cape mountain zebra (*Equus zebra zebra*) (Boshoff & Kerley 2001).

BREEDING COLONIES OF RARE CASPIAN AND DAMARA TERNS OCCUR ON THE AP (P. HOCKEY, PERS. COMM. 1995). DYER ISLAND PROVIDES A SANCTUARY FOR THE THIRD LARGEST BREEDING COLONIES IN THE WORLD OF BOTH THE VULNERABLE AFRICAN PENGUIN AND CAPE CORMORANT (CRAWFORD *ET AL.* 1995; BERRUTI 1989). IN ADDITION, THE EXISTING ABALONE RESERVE AT DYER ISLAND PROHIBITS THE COLLECTION OF ABALONE WITHIN ONE NAUTICAL MILE OF THE ISLAND, AND THEREFORE, PROVIDES AN IMPORTANT BREEDING SANCTUARY FROM WHICH THE SURROUNDING AREAS CAN BE SEEDED (HANEKOM *ET AL.* 1995).

5.3 Resource utilization

5.3.1 Water supply / abstraction

Surface water on the AP varies seasonally and is unreliable (Raimondo & Barker 1994). Underwater aquifers are the main source of domestic water. Ground water from the Bokkeveld shales areas tends to be brackish. Although adequate supplies of freshwater are available for present human demands, these can be exceeded during the summer holiday season. There are concerns about the long-term sustainability of water resources in the Agulhas region, should intensive cultivation of grapes and deciduous fruit expand unchecked (Toens *et al.* 1998 in Heydenrych 1999). Water abstraction, in addition to pollution, alteration of drainage patterns (amongst other by roads), canalization, ploughing, and invasion by alien trees already threatens the ecological integrity of the AP wetland systems (Hanekom *et al.* 1995; Jones *et al.* 2000). Jones *et al.* (2000) advised that it is preferable to conserve wetlands in a specific area rather than single wetlands from different areas since wetlands, together, have cumulative effects, e.g. by maintaining ground-water flows.

5.3.2 Plant harvesting

The fynbos wildflower industry is by far the biggest industry on the AP based on the terrestrial biodiversity of the area (Heydenrych 1999). Heydenrych (1999) lists 71 species that are harvested from the wild from six different fynbos types. He further indicates the average harvest and value per hectare for the different fynbos types, Acid Sand Fynbos being most lucrative. The total net income from wildflower harvesting on the Agulhas Plain for 1997 was estimated at R8.6 million. Being such a major industry, the resource can potentially be destroyed if not properly regulated (Mustart & Cowling 1992b). Native flower cultivation also poses a threat to pristine habitats (see 5.5).

Mustart and Cowling (1992b) found that remaining current year cones of the harvested *Protea* species have greater insect predation levels and unaltered/lower seed set than those of unharvested plants. They recommended (1) that harvesting levels should not exceed 50 % of the current year's Proteaceae cones, (2) with no picking in the year preceding a planned burn, and (3) that stem harvesting only be performed in alternate years. This would allow for some measure of vegetative and subsequent reproductive regeneration.

Low and Lamont (1986) have expressed concern that, due to the high levels of N and P in the seeds of Proteaceae, harvesting from natural populations of inflorescences and cones for the wildflower industry might adversely affect ecosystem nutrient reserves. However, the estimates of Esler *et al.* (1989) of N & P losses resulting from a 50 % harvest of annual inflorescence and cone production, indicate negligible nutrient drain in relation to soil nutrient pools, and that annual losses are less than atmospheric inputs. In contrast, annual N & P losses could exceed atmospheric inputs if infrutescences were harvested (Esler *et al.* 1989). This is because N & P only accumulate in seeds after the inflorescences of Proteas close, i.e. when they are no longer desirable as cut flowers (Cowling 1989).

The cutting of wood older than two years in the Proteaceae results in reduced shoot formation or the death of the branch, whereas incorrect pruning can lead to unproductive shrubs which are more susceptible to disease (Brits *et al.* 1986). Many species in fynbos have long stems unprotected by leaves. If stems are cut in these older sections below the leaves, the whole plant can die (Rebelo 1987). Poor harvesting procedures in the veld can thus lead to serious dieback of sensitive species, e.g. *Brunia albiflora* and *Protea compacta* (Rebelo 1987; Rebelo & Holmes 1988). Harvesting at levels in excess of 75 % of blooms of the non-sprouting shrub *Phylica ericoides* diminishes the subsequent year's flower crop significantly compared to non-harvested controls, whereas a harvesting intensity of 25 % or less has little effect (D.J. Killian & R.M. Cowling unpublished data cited in Van Wilgen *et al.* 1992). Non-sprouting species vary in their seed retention patterns (Van Wilgen & Lamb 1986) – species with short-lived seed banks are more vulnerable and should be lightly harvested (Van Wilgen *et al.* 1992). Sprouting species on the other hand, such as *Protea cynaroides*, are known to be resilient to heavy utilisation (Vogts 1982).

ABI has as one of its four main objectives to "pave the way for sustainable harvesting of wild fynbos as an economically viable land-use on the AP, and develop certification of sustainably and ethically harvested wild fynbos as a market-based tool for improving fynbos management" (ABI undated).

Large kelp beds (mainly *Ecklonia maxima*) occur on the rocky coastline between Cape Agulhas and False Bay (Rotmann 1999). Kelp is used as a feed for abalone, as raw material for the alginate industry, in fish feed, and to stimulate the growth of plants (Rotmann 1999). Commercial contractors collect an average of 2 400 - 3 000 tonnes of kelp per annum from the beaches of the AP, with the largest quantities coming from the Pearly Beach area. Most (*ca.* 80%) of the processed kelp is exported, and although it is a valuable source of foreign exchange (earning an average of R2 million per annum), the removal of kelp wracks may have a major effect on the food web of the beaches (Branch & Branch 1981). According to Stirk and Van Staden (2004) great advances have been made in recent years in mariculture in South Africa, allowing for quality control of the raw material and conservation of natural marine resources. The future for the South African industry, however, lies in developing value-added products rather than supplying low-value raw material to international markets (Stirk & Van Staden 2004). Two possible applications are to utilise the kelp biomass in remediation of heavy metal wastewater and to develop pharmaceutical products.

5.3.3 Invertebrate collecting

Honey production from wildflowers and pollination hives are an important income during winter on the AP, but are raided by Honey badgers if not secured. Apiarists were responsible for dramatic declines in Honey badger populations through gin trapping. A farmer awareness campaign and "badger-friendly" honey certification scheme appear to be successful but need continual reinforcement (GEF undated).

Another major source of employment and income is the abalone industry. During 1992/93 commercial and recreational divers removed approximately 473 tonnes of abalone (or 43 % of the national quota) from the area between Gansbaai and Quoin Point (Sea Fisheries 1993 in MLH 1994). The monetary value of the abalone fishery in 1986 was approximately R3 million to the fisherman and R12 million as export (Tarr 1988), and more recently a figure of R79 million was given for the annual commercial processed catch (CAPE 2000).

5.3.4 Fishing

Over-exploitation is a major threat in the area's marine environment, as the resources are at present being heavily utilized (Hanekom *et al.* 1995). Gansbaai and Struisbaai are the centres of the southwest Cape pelagic- and line-fishing industries respectively. The pelagic industry at Gansbaai processes about 30 000 tonnes of fish (pilchard and anchovy) annually with a turnover of approximately R17 million (MLH 1994). Most of the pelagic seine netting is done west of Quoin Point, but seasonally substantial catches are within 5.5 km of the shore (M. Kirsten, pers. comm. 1995). The major commercial line-fishing grounds are in the western and eastern extremities of the AA, near Cape Agulhas and Danger Point. In 1986, 400 - 600 commercial line-fishing boats operated between Gansbaai and Struisbaai and they landed approximately 1000 tonnes of fish, valued at about R1.3 million (Penny 1988; MLH 1994).

More than two-thirds of the 1986 line-fish catch in the area consist of migratory fish predators, such as Yellowtail, Kob, Geelbek and Snoek (Van Der Elst 1981; Penny 1988), while more stenotopic, bottom feeding species (Carpenter, Hottentot, Roman and Dageraad), which probably reside and breed in the area (Van Der Elst 1981), account for less than a quarter of the catch. Purse-seine trawlers from Gansbaai also catch primarily migratory pelagic species, such as pilchard and anchovy. The coastline of the AP is too small to provide meaningful protection to migratory fish species, and significant populations of the more stenotopic fish species recorded are conserved in the nearby De Hoop Nature Reserve (A.J. Penny, pers comm. 1995). In the marine environment the major threat is over-exploitation, as the resources are at present being heavily utilized.

5.3.5 Vertebrate harvesting

Not applicable.

5.4 Pathogens and diseases

5.4.1 Virology

5.4.2 Bacteriology

5.4.3 Parasitology

5.5 Environmental modification

Agriculture, in the form of cereal cropping and dairy pastures, has transformed more than 90 % of available shale soils on the AP, with significant impacts on Elim asteraceous fynbos and Renoster fynbos, two vegetation types endemic to the AP (GEF undated). Although most transformation for agriculture was completed by the late 1960s, a new trend is the development of novel crops and cultivars, which are able to grow in previously marginal areas (Fairbanks *et al.* 2004). The AP is a recognized area of growth in the wine industry, exploiting the cooling summer sea breezes and poor soils for low volume, high quality wines (Matthews *et al.* undated; GEF undated; Fairbanks *et al.* 2004). Several experimental vineyards have been established, some in sensitive head water catchments of the two main river systems and others requiring in-stream irrigation dams. Increased international demand could greatly expand the area under wine, threatening even small remnants of natural habitat (GEF undated).

Native flower cultivation has emerged in the 1990s as another major threat to habitats previously considered safe. Driven by demand from international consumers demanding perfect flowers on long stalks, many farmers have been forced into planting cultivars and hybrids. These are planted as a monoculture in freshly cleared fynbos areas, as due to phosphate toxicity Proteas will not grow in previously disturbed and fertilized lands. Apart from any threats of genetic exchange with wild relatives, this practice effectively disrupts many natural processes in fynbos, eliminates many native species, and introduces weeds into pristine vegetation (GEF undated).

Alien plant species represent among the greatest threats to the biodiversity of the AP, with at least 15 % of the natural habitat having been converted to dense thickets of invasive alien plants (GEF undated) (see 5.1.3 for further details). A further consequence of invading alien species is greatly altered ground water and river flow regimes. Invasive tree species (e.g. *Acacia cyclops*) can use up to 300 *l* of water per adult tree per day in summer, and reach a density of 3000-4000 trees per hectare (Toens *et al.* 1998 cited in GEF undated). This has significant impacts on the hydrology of the complex wetlands systems, which are sensitive to subtle changes in water level, and on the estuaries requiring flushes for connection to the sea and subsequent fish recruitment.

Land degradation, in the form of hydrological disturbance and soil erosion, appears to be patchy and localized on the AP. There is unfortunately a dearth of quantitative baseline data on the incidence of these phenomena, although the area is considered vulnerable to their effects (GEF undated). Jones *et al.* (2000) identified five direct threats to the wetlands of the AP, i.e. physical structures, alien *Acacia* trees, agricultural activity, water abstraction, and anthropogenic activities. The Kars River, has been canalised and therefore altered from its natural state, while the relatively short Hagelkraal River is infested by alien trees (which are currently being cleared in some areas)(Jones *et al.* 2000). The middle reaches of the Ratel River flows through cultivated lands and then into an ephemeral wetland area. The Nuwejaars river system is made up of a great diversity of standing and flowing waters, crossed by a number of roads and flowing through extensive agricultural areas. Management of the catchment as a whole will affect Soetendalsvlei. The Heuningnes River, which originates in Soetendalsvlei, meanders its way through cultivated land to its estuary at De Mond (Jones *et al.* 2000). The failure to clear invasive alien plants from the Nuwejaars-Heuningnes catchment is expected to result in reduced water flows, which could lead to closure of the Heuningnes estuary mouth (GEF undated).

Inappropriate coastal development and urbanisation destroy and degrade the integrity of coastal habitats and ecosystem processes (Jeffery & Hilton-Taylor 1991). Human disturbance has been shown to detrimentally affect the breeding success of African black oystercatchers (Jeffery & Scott 2005). New developments along the coast thus need to be assessed carefully and the impacts on these birds monitored (Jeffery & Scott 2005). Inappropriate coastal development furthermore exacerbates pollution problems and increases pressure on already over-utilised natural resources, such as water (GEF undated). Many plant species are narrow range endemics, occurring as edaphic specialists particularly on the shale, laterite and limestone soils. These are threatened by inappropriately located developments of several seaside towns and resorts (GEF undated).

5.6 Zonation

The Protected Areas Act requires SANParks to adopt a coherent spatial planning system in all national parks. The overall strategic spatial plan for a national park is what SANParks calls a Conservation Development Framework (CDF), which is based on a standardised SANParks zoning scheme and is informed by a biophysical sensitivity-value analysis. A draft CDF was produced for ANP.

5.7 Park expansion/Conservation planning

Based on conservation planning exercises, Heydenrych and Cowling (2000) recommended that 8 % of the AP (i.e. 1500 km^2) be subject to strict conservation, such as statutory reserves. The best potential for reserve expansion is along the coast (Hanekom *et al.* 1995), and the coastal plain and coastal mountains between Hagelkraal and Soetanysberg have already been acquired as part of ANP. Expansion inland to include the plains contributing to the catchments of Voëlvlei and Soetendalsvlei is in some cases more difficult. Large portions of areas are cultivated, and land prices are accordingly very high, while the inclusion of the Moravian ground at Elim (i.e. Vogel Struis Kraal) will likely have major socio-economical consequences (Hanekom *et al.* 1995).

The South African National Spatial Biodiversity Assessment (Rouget *et al.* 2004) assessed the conservation status, conservation target (percentage of the original extent of a vegetation type that needs be protected in order to capture 75 % of the species occurring in it) and threats facing the vegetation types mapped by Mucina and Rutherford (2006).

Rouget (2003) compared the outputs of conservation planning for the AP based on broad- (1:250 000; nine broad habitat units) and finer- (1:10 000; 36 vegetation types) scale spatial data. He found that a similar amount of land is required to meet all conservation targets at the broad and fine scale, and that there is considerable overlap between the two conservation plans. However, the use of broad-scale biodiversity data underestimates irreplaceability value (a measure of the likelihood of selecting planning units for achieving representation targets) at a fine scale in heterogeneous and fragmented portions of the landscape.

Heydenrych *et al.* (1999) examined the practical challenges of implementing a new protected area in the fragmented landscape of the AP. They emphasized the need for conservation planning to first and foremost consider the threats (particularly spread of alien invasive plants, land transformation for agriculture, and resort development) to biodiversity. In their opinion, conservation efforts will only succeed if institutional and socio-economic considerations are integrated with conservation plans.

Pence *et al.* (2003) investigated the practical and financial implications of combinations of on- and off-reserve conservation strategies for the AP. They showed that a mixed on- and off-reserve approach, and/or a mixed approach in conjunction with financial incentives, will involve leaving 40 % of targeted areas in private hands, saving the state 80 % in acquisition costs. Post-acquisition conservation costs largely constitute those associated with alien clearing. Two types of property-rights agreements (i.e. conservation easements and management agreements) and two types of financial incentives (i.e. land management assistance and tax relief) are deemed appropriate for encouraging off-reserve conservation on priority land.

One of ABI's primary aims is to secure critical habitat under conservation management, employing various approaches (GEF undated). The following have been identified as priorities:

- To consolidate ANP into a viable ecological unit – to this end co-financing has been secured through Fauna & Flora International (FFI) for select land purchases within the core area of ANP. In addition, GEF funding would support the establishment of contractual agreements for other properties as needed to expand ANP.
- To secure high priority freshwater ecosystems west of ANP to Quoin point, lowland Elim fynbos and renosterveld habitats, and the critical northern corridor to Heuningberg – to this end ABI will support the expansion of ANP in the west to include the Ratel River wetland system, and north to the existing district road. This would include contractual agreements (financed by GEF) and outright purchase of key properties (financed by FFI and SANParks).

- To secure high endemism limestone habitats through establishing a satellite contractual park including Groot Hagelkraal, and north towards Elim. Through securing five farms in the Hagelkraal area (including private landowners and Eskom), all limestone vegetation conservation targets will be achieved, and a quaternary catchment entirely protected. This will constitute one of the key demonstration sites looking at novel alien clearing mechanisms, and is a strategic future threat avoidance measure for the ANP's core area.
- To secure highest priority vegetation types around Geelkop (Elim) through contractual agreements – to this end a farm planning pilot project was initiated to set aside priority remnant endemic vegetation types (a joint project between Department of Agriculture, SANParks, CapeNature, and local communities and farmers).
- To secure unconserved vegetation types through consolidating Walker Bay Conservancy – including properties currently excluded from the conservancy and developing joint management arrangements (using GEF funds).
- To secure a habitat corridor between De Mond and De Hoop reserves to facilitate endemic wildlife dispersal and movement (using GEF funds for management agreements and partnerships).
- To secure the Heuningnes estuary from Soetendalsvlei to De Mond Ramsar site through management agreements. GEF funds will support an extension service to develop a participatory management regime and formalise the existence of the Heuningnes Riparian Owners' Association as a conservancy, in addition to determining appropriate water level regulation. Management agreements for remaining natural habitat will create the only inland corridor across fertile soils linking De Mond and ANP, as well as meet several lowland vegetation type targets and protect Soetendalsvlei.

Proclamation of a large marine reserve adjacent to the AP would have to be done in consultation with Marine and Coastal Management and with great circumspection, because of extensive fishing industries in the area (Hanekom *et al.* 1995). The ecological case for protection of a marine area is often based on the protection of an important habitat for commercially or recreationally important species, or protection of a particularly good example of a habitat type and its associated communities. The concepts of critical habitat of endangered marine species or threat of extinction is rarely the basis for protection (Robinson & De Graaff 1994).

5.8 Social ecology (people and tourism aspect)

5.8.1 General / Awareness

ABI would like to generate increased support for biodiversity conservation in the AP through a broad-based conservation awareness program. To this end, the media, two heritage centers (see 6.8.2), and environmental education programmes (i.e. replication of the Early Learning Centre at Flower Valley and a Community Arts Program) will be employed (ABI undated).

5.8.2 Tourism potential

Some of the numerous historical and geographical artifacts found in the Gansbaai – Struisbaai area, such as the Hotagterklip's historical cottages, the old Anglican Church and Elim village, fall outside the current ANP. However, the main holiday attractions are fishing, skin-diving, ski-boating, walking and bathing. These are mostly summer sports, and there is a substantial decline in holidaymakers in winter. The occupancy rate of the Struisbaai Hotel drops from 100 % over Christmas to less than 8 % in June, July and August (MLH 1994). The seasonal nature of the tourist trade and the fact that the local populations are too small to support entertainment facilities throughout the year has discouraged investment in the tourist industry, consequently the recreational resources have not been developed to their full potential (MLH 1994). Nonetheless, Gansbaai has introduced a Fishing Festival (MLH 1944), while Bredasdorp has helped to establish tours, such as the Fynbos Route and Wool Route, as well as area-specific routes (e.g. Agulhas lighthouse, Arniston, Elim, Spanjaardskloof and Boskloof farm) to boost the tourist trade during the off-season. Fynbos-tourism has become popular in the area, with private landowners forming conservancies and offering nature-based activities, education and social-upliftment programmes. A good example is the farm and private reserve, Grootbos (member of the Stanford Conservancy), which is rated by some as the best lodge in South Africa (Getaway 2005).

One of ABI's four main aims is the implementation of nature-based tourism activities in the AP (ABI undated). To this end a local tourism forum was convened and heritage centres will be established on the main tourism nodes at Elim and Cape Agulhas. Tourism trends will be monitored as will the ecological, economic and social effects of tourism activities, and strategies will be adapted accordingly.

5.8.3 *Socio-economic considerations*

The AP is regarded as an area with substantial socio-economic challenges, with *ca.* 60 % of the region's estimated 45 000 inhabitants living in rural areas (mean population density of 6/ha), being unemployed and poorly educated (ABI undated; GEF undated). There has been a tendency towards urbanisation, with urbanisation figures of 50 % for 1980 compared with 64 % for 1997/98, mostly affecting the coastal areas.

Most of the land is in private or communal ownership and is used mainly for commercial agriculture. Four main categories of farm have been identified (Heydenrych 1999), i.e. livestock farms (40 %), fynbos farms (28 %), conservation areas (22 %) and mixed farms (10 %). It is estimated that 74 % of the AP is still covered by natural vegetation and has not yet been transformed by agriculture (GEF undated) (although this figure does not account for other forms of transformation, e.g. alien invasion or urbanisation).

The livestock farms derive a substantial part of their income from cereal cash crops such as wheat and barley. As a result of falling profits from wheat crops, farmers have also begun to cultivate other cash crops such as canola. The net income for livestock farming on cultivated land on the AP is estimated to be R5.7 million/yr. Almost half of the working farms on the AP rely on veld for cattle grazing, a quarter for sheep grazing and 10 % for game. The value of grazing of indigenous veld on the AP amounts to an estimated R2.4 million/yr. Combined with the grazing value from cultivated lands, livestock farming on the AP generates an estimated net income of R8.1 million/yr. Very few farmers on the AP are presently ranching game, and the estimated income from game is small at R54 000/yr. The harvest of fynbos comprises the largest single livelihood opportunity on the AP, yielding an estimated net income of R8.6 million/yr. Cultivated flower orchards yield an estimated net income of R1.1 million/yr from 20 large- and 100 small farms (Heydenrych 1999; GEF undated).

Many of the jobs available to unskilled people in the area are of a seasonal or temporary nature, i.e. fishery work, tourism services, wildflower harvesting and agricultural labour. The establishment of ANP puts a restriction on the activities of ABALONE DIVERS AND PELAGIC AND LINE-FISHERMEN, commercial wildflower pickers and kelp collectors. The major tangible benefit of the park accruing to local communities is the provision of employment opportunities (direct and indirect) through the promotion of tourism, which is a major industry along the coast. Further employment is provided by involving the local people in alien plant eradication through the Working for Water programme, which has socio-economic, hydrological, and ecological spin-offs (Van Wilgen *et al.* 1998).

Privett *et al*. (2002) outline the steady improvement in conservation status of the AP over the last decade as a result of the 'mainstreaming of biodiversity'. Two innovative conservation interventions were made on the AP, i.e. (1) a strategically devised programme of land purchase and of contracting private land into a national park to safeguard much of the region's priority conservation sites (see 5.7); and (2) collaborative conservation projects between the government, private landowners and NGOs using innovative methods to integrate biodiversity into business practices in various sectors, including tourism, agriculture and eduction. Key driving factors in this process of mainstreaming biodiversity were the perceived threats to the region's biodiversity, the role of key individuals and organisations, institutional support, government will, inter-departmental cooperation, and trust between parties (Privett *et al.* 2002).

6. REFERENCES / BIBLIOGRAPHY

Note: All the references in this list are not necessarily cited in the text or summary table.

Legend:
p = Popular literature
u = Unpublished literature
s = Specific to AP
r = Relevant but not specific to AP

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7. APPENDICES

7.1 Species list – Plants

7.1.1 Algae species found on the Agulhas Plain (Jones *et al.* 2000)

Key

1 = Haasvlakte
2 = Soetendalsvlei
3 = Ronde Pan
4 = Springfield
5 = Ratel River
6 = Drie Vleitjies
7 = Rooiwal Pan
8 = Varkvlei
9 = Rietfontein

Species	**Locality**
Calothrix stagnalis	6
Chara globularis var. *strachymorpha*	4
Chara globularis	9
Chara sp.	6
Cladophora spp.	2, 5, 6, 7, 8
Clostericum sp.	2
Cocconeis sp.	8
Gloeotrichia natans	4
Nitella furcata ssp. *mucronata*	2
Nostra linckia	1
Oscillatoria sp.	3

7.1.2 Aquatic plant species found on the Agulhas Plain (Jones *et al.* 2005); Nomenclature follows Germishuizen & Meyer (2003); Old names in parantheses

Species	**Locality**
Aponogeton angustifolius	7
Berula erecta	3
Berzelia lanuginosa	5
Berzelia sp.	5
Calopsis paniculata	5
Carpha glomerata	5
Centella asiatica	2, 3
Chara globularis	1, 3
Chenopodium murale	8
Chondropetalum nudum	3
Chondropetalum tectorum	5, 6, 7, 8
Cladium mariscus	1
Cliffortia strobilifera	3, 5
Cotula coronopifolia	2
Cotula filifolia	3
Delosperma sp.	2
Elegia fenestrata	3
Erica parviflora	5
Fuirena hirsuta	1
Isolepis cf. *cernua*	3
Isolepis prolifera	3
Isolepis rubicunda	2, 5, 7
Juncus kraussii	2, 3, 4, 7, 8
Juncus lomatophyllus	3
Leucadendron xanthoconus	5
Cyperus thunbergii (Mariscus thumbergii)	3
Merxmuellera cincta	5
Neesenbeckia punctoria	5
Nidorella foetida	8
Nymphea nouchali (Nymphea capensis)	1
Nymphoides indica	1
Othonna parviflora	5
Phragmites australis	2, 3, 5
Platycaulos compressus	1, 5
Platycaulos major	5
Prionium serratum	5
Psoralea aphylla	5
Psoralea pinnata	3
Psoralea sp. nov.	5
Sarcocornia natalensis	2, 3, 6, 7, 8
Schoenoplectus scirpoideus (S. littoralis)	2
Schoenoplectus triqueter	3
Ficinia nodosa (Scirpus nodosus)	3, 4, 5
Scirpoides thunbergii (Scirpus thunbergianus)	2
Sebaea ambigua	3
Senecio halimifolius	3, 4
Senecio laevigatus	3
Sporobolus virginicus	2, 3, 7, 8
Triglochin bulbosa	7
Triglochin striata	8
Typha capensis	3, 4
Utricularia sp.	1, 5
Wachendorfia sp.	5

Key:

1 = White water Dam
2 = Soetendalsvlei
3 = Pearly Beach
4 = Donkergat
5 = Groot Hagelkraal
6 = Melkbos Pan
7 = Wiesdrif
8 = Varkensvlei

7.1.3 The number of species in the ten largest families and genera in the flora of the Agulhas Plain (After Cowling & Holmes 1992b)

Family	No. Spp.	Genus	No. Spp.
Asteraceae	204	*Erica*	91
Iridaceae	149	*Aspalathus*	60
Fabaceae	142	*Crassula*	29
Ericaceae	127	*Gladiolus*	26
Restionaceae	88	*Phylica*	26
Poaceae	80	*Senecio*	26
Liliaceae	76	*Ficinia*	23
Cyperaceae	63	*Muraltia*	23
Proteaceae	59	*Thesium*	23
Mesembryanthemaceae	58	*Helichrysum*	21

7.1.4 Phytochorological spectrum of the Agulhas Plain flora. Similarity of AP flora with other phytochoria is indicated as numbers and percentages of co-occuring species (After Cowling & Holmes 1992b)

Phytochoria	No. Spp.	%
Cape endemics	1338	76.4
Cape-Afromontane linking species	63	3.6
Cape-Karoo-Namib linking species	142	8.1
Cape-Tongaland-Pondoland linking species	38	2.2
Afromontane endemics	12	0.7
Afromontane-Tongaland-Pondoland linking species	15	0.9
Phytochorological and ecological transgressor species	132	7.5
Other	11	0.6
Total	1751	100

7.1.5 The percentage of species in 0.1 ha plots with different seed bank types in Agulhas Plain fynbos on a range of soil types (R.M. Cowling unpublished data, after Le Maitre & Midgley 1992)

Seed bank type	Calcareous	Laterite	Quartzite
Soil-stored - myrmecochorous (i.e. ant-dispersed)	13 %	30 %	32 %
Soil-stored - other	40 %	55 %	46 %
Canopy-stored	4 %	13 %	20 %
Neither soil- or canopy-stored	43 %	2 %	2 %
Number of species	30	53	41

7.1.6 Red Data Book plant species recorded from the various veld types on the Agulhas Plain (Cowling & Mustart 1994 after Hall & Veldhuis 1985); Nomenclature follows Germishuizen & Meyer (2003); Old names in parantheses

Red Data Status (Hilton-Taylor 1996):
E = Endangered
V = Vulnerable
R = Rare
I = Indeterminate
K = Insufficiently Known
nt = Not Threatened

Veld Type:
Acid = Acid Sand Proteoid Fynbos
Elim = Elim Asteraceous Fynbos & Renosterbos hrubland
Dune = Dune Asteraceous Fynbos
Lime = Limestone Proteoid Fynbos

Species name	**Status**	**Veld type**
Acrolophia bolusii	V	Acid, Dune
Adenandra odoratissima odoratissima	R	Lime
Adenandra schlechteri	I	Elim
Agathosma abrupta	V	Dune, Elim
Agathosma minuta	E	Elim
Agathosma sp. nov. (P.A. Bean 480)	R	Acid
Amphiglossa callunoides	K	Dune
Anisodontea dissecta	V	Elim
Aristea palustris	V	Acid, Dune, Elim
Aspalathus aciloba	nt	Dune, Elim
Aspalathus burchelliana	V	Elim
Aspalathus excelsa	R	Elim
Aspalathus globulosa	I	Elim
Aspalathus macrantha	I	Elim
Aspalathus prostrata	E	Elim
Athanasia quinquedentata ssp. *quinquedentata (A. mundtii)*	K	Dune
Berkheya angusta	K	Acid
Calopsis impolita	V	Lime
Calopsis rigorata var. *simulans*	V	Dune
Caryotophora skiatophytoides	R	Dune
Chondropetalum rectum	V	Dune, Elim
Cliffortia curvifolia	K	Elim
Cliffortia monophylla	K	Acid
Corycium excisum	nt	Elim
Cyrtanthus carneus	V	Elim
Cyrtanthus guthrieae	V	Acid
Diosma arenicola	K	Dune, Elim
Diosma haelkraalensis	R	Dune, Elim
Diosma parvula	E	Elim
Diosma tenella	R	Dune, Elim, Lime
Dymondia margaretae	R	Elim
Elegia fenestrata	V	Lime
Elegia prominens	V	Dune
Elegia verreauxii	V	Dune
Erica aghillana	V	Lime
Erica berzelioides	K	Elim
Erica oligantha	I	Acid
Erica pauciovulata	R	Acid
Erica regia ssp. *regia (E. casta)*	V	Acid, Elim
Erica riparia	I	Dune
Erica shannonea	R	Acid
Euchaetis diosmoides	K	Dune, Elim
Freesia caryophyllacea (F. elimensis)	R	Elim
Gladiolus acuminatus	R	Acid
Gladiolus debilis var. *variegatus*	R	Acid, Dune
Gladiolus floribundus ssp. *miniatus*	R	Elim
Gladiolus guthriei	nt	Dune, Elim
Gladiolus overbergensis (Homoglossum guthriei)	V	Elim
Gladiolus subcaeruleus	nt	Elim

Harveya euryantha .... K................Acid
Hermannia concinnifolia .... nt ....Elim
Hermannia trifoliata .... nt ....Dune, Elim
Ischyrolepis sabulosa .... E................Dune, Elim
Ixia longituba (I. bellendenii) .... R................Acid
Ixia patens var. *patens*... nt ....Elim
Lampranthus arbuthnotiae .... nt ....Dune
Leucadendron elimense ssp. *elimense* .... V................Acid, Dune, Elim, Lime
Leucadendron platyspermum.. V................Acid, Elim, Lime
Leucadendron stelligerum.. E................Acid, Elim, Lime
Leucadendrum modestum .... nt ....Elim
Limonium kraussianum... R................Elim
Lobelia pinifolia (L. capillipes) .... nt ....Elim
Lobostemon capitatus (L. bolusii)... V................Acid
Lobostemon collinus... R................Elim
Lobostemon regulareflorus (L. grandiflorus) .... R................Acid, Elim
Lobostemon capitatus (L. inconspicuus) .... K................Elim
Lobostemon lucidus.. K................Acid, Elim
Macrostylis cauliflora .... V................Acid, Elim
Moraea barnardii .... V................Dune
Moraea comptonii (Homeria comptonii)..................................... R................Acid
Moraea elegans (Homeria elegans) .... E................Acid
Muraltia calycina.. V................Dune
Muraltia cuspifolia.. I ....Elim
Muraltia gillettiae .... K................Acid, Elim
Muraltia spicata .... K................Acid, Elim
Osteospermum hafstroemii.. R................Dune
Pachites bodkinii .... R................Elim
Paranomus abrotanifolius .... V................Elim
Phylica amoena.. K................Dune
Phylica floribunda .... K................Acid
Phylica incurvata .... K................Elim
Phylica laevifolia... K................Elim
Phylica parvula... V................Elim
Polygala dasyphylla.. I ....Acid, Elim
Protea angustata.. V................Lime
Protea pudens.. E................Elim
Pteronia scabra .... K................Elim
Pteronia tenuifolia.. K................Dune, Elim
Relhania spathulifolia... R................Elim
Restio dodii var. purpureus .... R................Dune
Restio festuciformis .... V................Elim
Restio harveyi... V ....Elim
Rhigiophyllum squarrosum .... K................Acid
Roella compacta (R. cuspidata var. *hispida)* .... K................Elim
Spatalla ericoides .... V................Dune, Elim
Spiloxene curculigoides (S. declinata)....................................... K................Acid, Elim
Staberoha mulitspicula .... I ....Elim, Acid
Stoebe phyllostachya (S. copholepis) .... K................Elim
Stoebe cyathuloides .... K................Dune
Stoebe cyathuloides (S. humilis)... R................Acid
Stoebe schultzii (S. salteri) .... nt ....Dune, Elim
Thamnochortus dumosus .... V................Dune, Elim, Lime
Thamnochortus fraternus... nt ....Lime
Thamnochortus guthrieae .... R................Lime
Thamnochortus pellucidus .... V................Dune, Elim
Thamnochortus pluristachyus .... V................Dune, Elim, Lime
Thesium fallax .... K................Acid
Wahlenbergia bolusiana .... K................Acid
Wahlenbergia levynsiae (Lightfootia squarrosa) .... K................Elim
Watsonia laccata (W. caledonica) .... nt ....Elim
Xiphotheca guthriei (Priestleya guthriei) .... K................Dune
Xiphotheca tecta (Priestleya tecta).. R................Acid, Elim

7.1.7 Agulhas Plain vegetation types/groups and their characteristic species (After Cowling & Mustart 1994; Cole *et al*. 2000); synonymous vegetation units as per Rebelo *et al.* (2006) in Mucina & Rutherford (2006) are indicated in brackets in the first column.

VEGETATION TYPES/GROUPS	PROTEACEAE	ERICACEAE	RESTIONACEAE	POACEAE	CYPERACEAE	ASTERACEAE & ERICOIDS	OTHER
Acid sand proteoid fynbos (Overberg Sandstone Fynbos)	*Lcd. platyspermum* *Lcd. xanthoconus* *Protea compacta* *Aulax umbellata* *Lcd. gandogeri* *Lcd. salignum* *Protea longifolia*	*Erica filipendula* *Erica longiaristata* *Erica longifolia* *Erica melanaeme* *Erica plukenetti* *Erica klotzschii* *Erica globiceps ssp. gracilis* *Erica globiceps ssp. globiceps*	*Restio similis* *Calop. membranaceae* *Elegia filacea* *Staberoha* spp. *Thamno. erectus*		*Tetraria bromoides* *Tetraria cuspidata* *Tetraria fasciata*	*Staavia radiata* *Brunia laevis*	
Lime-/Neutral sand proteoid fynbos (Agulhas Sand Fynbos?)	*Protea repens* *Lcd. stelligerum* *Lcd. modestum* *Lcd. xanthoconus* *Lcs. pedunculatum* *Protea longifolia*	*Erica serrata* *Erica puberuliflora*	*Ischy. capensis* *Rhodocoma fruticosa*			*Metalasia muricata* *Stoebe capitata* *Dicero. rhinocerotis*	
Limestone proteoid fynbos (Agulhas Limestone Fynbos)	*Protea obtusifolia* *Lcd. meridianum* *Protea susannae* *Lcd. coniferum* *Lcd. muirii* *Lcs truncatum* *Lcd. patersonii* *Mimetes saxatilis*	*Erica propinqua*	*Thamno. guthrieae* *Thamno. aniculatus* *Hypod. alboaristatus* *Restio triticeus* *Ischy. Leptoclados*			*Passerina vulgaris* *Metalasia muricata* *Euchaetis burchelli* *Adenandra obtusata* *Stilbe ericoides*	*Chrysa. monilifera* *Myrica quercifolia* *Rhus laevigata*
Ericaceous fynbos	*Lcs. cordifolium*	*Erica coccinea* *Erica serrata*	*Elegia* cf. *persistens* *Chondro. deustum*		*Tetraria thermalis*	*Nebelia paleacea*	
Restioid fynbos	*Lcd. linifolium*		*Chondro. tectorum* *Chondro. rectum* *Thamno. erectus*			*Cliffortia ferruginea* *Dicero. rhinocerotis*	
Dune asteraceous fynbos (Overberg Dune Strandveld)			*Ischyolepis eleocharis* *Calopsis fruticosus*		*Ficinia lateralis*	*Passerina paleacea* *Agathosma collina* *Phylica ericoides* *Metalasia muricata*	*Euclea racemosa* *Myrica quercifolia* *Ptero. tricuspidatus* *Rhus* spp.
Elim asteraceous fynbos) (Elim Ferricrete Fynbos)	*Lcd. elimense* *Lcd. modestum* *Lcd. laxum*	*Erica lasciva* *Erica brunifolia* *Erica nudifolia*		*Pentaschistis colorata*		*Metalasia muricata* *Phylica ericoides* *Passerina galpinii* *Disparago anomala* *Dicero. rhinocerotis*	
Renosterveld (Central Rûens Shale Renosterveld)				*Pentaschistis colorata* *Cynodon dactylon* *Themeda triandra*	*Ficinia tristachya*	*Metalasia muricata* *Stoebe capitata* *Dicero. rhinocerotis*	
Forest & Thicket							*Sideroxylon inerme* *Euclea racemosa*

Abbreviations: *Calop. = Calopsis; Chondro. = Chondropetalum; Dicero. = Dicerothamnus; Hypod. = Hypodiscus; Lcd. = Leucadendron; Lcs. = Leucospermum; Ischy. = Ischyrolepis; Ptero. = Pterocelastrus; Thamno. = Thamnochortus*

7.2 Species list – Fishes

7.2.1 Fish species recorded or likely to occur in the freshwater systems of the Agulhas Plain

Source: B = Bickerton (1984)
D&B = De Moor & Bruton (1988)
K = J. King (1995 *in litt.*)
R&I = Russell & Impson (2006)
S = Skelton (1987)
W = Whitfield (1998)

Species	Common name	Comment	Source
Freshwater fish species previously recorded:			
Galaxias zebratus	Cape galaxias		B; K; R&I
Sandelia capensis	Cape kurper		B; K; R&I
Pseudobarbus burchelli	Burchell's redfin	Rare	R&I
Cyprinus carpio	Carp	Alien	B; R&I
Lepomis macrochirus	Bluegill sunfish	Alien	B; R&I
Micropterus salmoides	Largemouth bass	Alien	B
Micropterus punctulatus	Spotted bass	Alien	R&I
Freshwater fish species that could potentially occur in waterbodies:			
Anguilla mossambica	Longfin eel		B
Micropterus dolomieu	Smallmouth bass	Alien	D&B
Tilapia sparrmanii	Banded tilapia	Translocated	D&B
Oreochromis mossambicus	Mozambique tilapia	Translocated	D&B
Estuarine species recorded in freshwater systems:			
Gilchristella aestuaria	Estuarine round-herring		B; R&I
Mugil cephalus	Flathead mullet		B; R&I
Liza richardsoni	Southern mullet		B; R&I
Monodactylus falciformis	Cape moony		B; R&I
Lithognathus lithognathus	White steenbras		B; R&I
Caffrogobius gilchristii	Prison goby		R&I
Myxus capensis	Freshwater mullet		W

7.2.2 Marine fish species in the Uilkraals, Ratel (Harrison *et al.* 1995) and Heuningnes (Russell & Impson 2006; Bickerton 1984; Day 1981) estuaries.

Species	Common name	Heuningnes	Ratel	Uilkraal
Argyrosomus hololepidotus	Kob	+	-	-
Atherina breviceps	Cape silverside	+	-	+
Caffrogobius gilchristii	Prison goby	+		
Caffrogobius multifasciatus	Prison goby	+	-	-
Coracinus capensis	Galjoen	+	-	-
Diplodus sargus	Blacktail	+	-	-
Gilchristella aestuaria	Estuarine round-herring	+	-	-
Heteromycteris capensis	Cape sole	+	-	-
Lithognathus lithognathus	White steenbras	+	-	-
Liza richardsoni	Southern mullet	+	+	+
Monodactylus falciformis	Cape moony	+	-	-
Mugil cephalus	Flathead mullet	+	+	+
Myxus capensis	Freshwater mullet	+	+	-
Pomadasys capensis	Zebra	+	-	-
Pomatomus saltatrix	Elf	+	-	-
Psammogobius knysnaensis	Knysna sandgoby	+	+	+
Rhabdosargus globiceps	White stumpnose	+	-	-
Rhabdosargus holubi	Cape stumpnose	+	+	-
Sarpa salpa	Strepie	+	-	-
Solea bleekeri	Blackhand sole	+	-	-
Sygnathus acus	Longnose pipefish	+	-	-
Tachysurus feliceps	Sea barbel	+	-	-
Umbrina capensis	Baardman	+	-	-

7.3 Species list – Amphibians

7.3.1 Checklist of amphibians recorded or likely to occur on the Agulhas Plain (De Villiers 1988 in Raimondo & Barker 1988); Nomenclature and Red Data Book status after Minter *et al.* (2004)

Key:
R = Taxa recorded
L = Taxa likely to occur
Endemic = to Cape Floristic Region

Species	Common name	Status
Afrana fuscigula	Cape river frog	Least Concern
Arthroleptella lightfooti	Cape Peninsula moss frog	Near Threatened, Endemic
Breviceps montanus	Cape mountain rain frog	Least Concern, Endemic
Breviceps rosei	Rose's rain frogf	Least Concern, Endemic
Bufo angusticeps	Cape sand toad	Least Concern, Endemic
Bufo pantherinus	Western leopard toad	Endangered, Endemic
Bufo rangeri	Raucous toad	Least Concern
Cacosternum boettgeri	Boettger's caco	Least Concern
Capensibufo rosei	Rose's mountain toad	Vulnerable, Endemic
Hyperolius horstockii	Arum lily frog	Least Concern, Endemic
Microbatrachella capensis	Micro frog	Critically Endangered, Endemic
Semnodactylus wealii	Rattling Frog	Least Concern
Strongylopus bonaespei	Banded stream frog	Least Concern, Endemic
Strongylopus f. fasciatus	Striped stream frog	Least Concern
Strongylopus g. grayii	Clicking stream frog	Least Concern
Tomopterna delalandii	Cape sand frog	Least Concern
Xenopus gilli	Cape platanna	Endangered, Endemic
Xenopus l. laevis	Common platanna	Least Concern

7.4 Species list – Reptiles

7.4.1 Checklist of reptiles recorded or likely to occur on the Agulhas Plain (Branch 1988 in Raimondo & Barker 1988)

Key:

R = Taxa recorded | Endemic = to south-western Cape province

L = Taxa likely to occur | Red Data status after Branch (1988)

Species	Common name	Status
Chenolians		
Chersina angulata	Angulate tortoise	R
Homopus areolatus	Southern padloper	R
Pelomedusa subrufa	Cape terrapin	L
Lizards		
Acontias m. meleagris	Golden sand lizard	R
Agamata a. atra	Common rock agama	R
Brachopodion pumilum	Cape dwarf chameleon	R; Endemic
Chamaesaura anguina	Snake lizard	R
Cordylus cordylus	Common girdled lizard	R
Gerrhosaurus f. flavigularis	Yellow-throated plated lizard	R
Mabuya capensis	Three striped skink	R
Mabuya h. homalocephala	Cape speckled skink	R
Meroles knoxii	Knox's sand lizard	L
Pachydactylus bibronii	Bibron's gecko	R
Pachydactylus geitje	Ocellated gecko	R
Pachydactylus porphyreus	Marble gecko	R
Pedioplanis burchelli	Burchell's sand lizard	R
Pedioplanis lineoocellata pulchella	Ocellated sand lizard	L
Pseudocordylus m. microlepidotus	Cape crag lizard	R
Scelotes b. bipes	Silver sand lizard	L
Tetradactylus s. seps	Short legged plated lizard	L
Tetradactylus t.tetradactylus	Whip lizard	L
Tropidosaura m. montana	Green striped mountain lizard	L; Endemic
Snakes		
Amplorhinus multimaculatus	Cape many-spotted reed snake	L
Aspidelaps l. lubricus	Coral snake	L
Bitis a. arietans	Puff-adder	R
Bitis armata (Baard *et al.* 1999)	Southern dwarf adder	R; Threatened
Bitis atropos	Cape mountain adder	L
Bitis c. cornuta	Many-horned adder	L
Crotaphopeltis hotamboeia	Herald snake	L
Dasypeltis scabra	Common egg-eater	L
Dispholidus t. typus	Boomslang	R
Duberria l. lutrix	Southern slug snake	L
Hemachatus hemachatus	Rinkhals	L
Homoroselaps lacteus	Dwarf garter snake	R
Lamprophis aurora	Aurora house snake	L
Lamprophis fuscus	Yellow-bellied house snake	L; Rare
Lamprophis guttatus	Spotted house snake	L
Lamprophis inornatus	Olive house snake	R
Leptotyphlops n. nigricans	Black worm snake	L
Lycodonomorphus rufus	Common brown water snake	R
Naja nivea	Cape cobra	R
Prosymna s. sundevallii	Southern shovel -snout	R
Psammophis crucifer	Cross-marked sand snake	R
Psammophis notostictus	Whip snake	R
Psammophylax r. rhombeatus	Spotted skaapsteker	L
Pseudapis cana	Mole snake	L
Typhlops lalandei	Delalande's blind snake	L

7.5 Species list – Birds

7.5.1 Bird species recorded in the southern Overberg region after Underhill & Cooper (1983), Ryan *et al*. (1988) and Hockey *et al*. (1989).

Habitat:
T = Terrestrial
M = Marine
W = Wetlands

Red Data Status (Brooke 1984):
E = Endangered
V = Vulnerable
R = Rare
I = Indeterminate

No.	Species	Habitat	Status
1	Ostrich	T	-
3	Jackass Penguin	M	V
5	Macaroni Penguin	M	-
8	Dabchick	W	-
12	Blackbrowed Albatross	M	-
17	Southern Giant Petrel	M	-
21	Pintado Petrel	M	-
23	Greatwinged Petrel	M	-
32	Whitechinned Petrel	M	-
37	Sooty Shearwater	M	-
49	White Pelican	M	R
53	Cape Gannet	M	-
55	Whitebreasted Cormorant	M	-
56	Cape Cormorant	M	-
57	Bank Cormorant	M	-
58	Reed Cormorant	W	-
59	Crowned Cormorant	M	-
60	Darter	W	-
62	Grey Heron	W	-
63	Blackheaded Heron	T	-
65	Purple Heron	W	-
66	Great White Egret	W	-
67	Little Egret	W	-
68	Yellowbilled Egret	W	-
71	Cattle Egret	T	-
72	Squacco Heron	W	-
76	Blackcrowned Night Heron	W	-
81	Hamerkop	W	-
84	Black Stork	T	-
90	Yellowbilled Stork	T	R
91	Sacred Ibis	W	-
93	Glossy Ibis	W	-
94	Hadeda Ibis	T	-
95	African Spoonbill	W	-
96	Greater Flamingo	W	I
97	Lesser Flamingo	W	I
101	Whitebacked Duck	W	-
102	Egyptian Goose	W	-
103	South African Shellduck	W	-
104	Yellowbilled Duck	W	-
106	Cape Teal	W	-
108	Redbilled Teal	W	-
112	Cape Shoveller	W	-
113	Southern Pochard	W	-
116	Spurwinged Goose	W	-
118	Secretarybird	T	-
122	Cape Vulture	T	-
126	Yellowbilled Kite	T	-
127	Blackshouldered Kite	T	-
131	Black Eagle	T	-
140	Martial Eagle	T	-
148	African Fish Eagle	W	-
149	Steppe Buzzard	T	-
152	Jackal Buzzard	T	-
155	Redbreasted Sparrowhawk	T	-
160	African Goshawk	T	-
165	African Marsh Harrier	W	-
168	Black Harrier	T	-
170	Osprey	W	-
171	Peregrine Falcon	T	R
172	Lanner Falcon	T	-
181	Rock Kestrel	T	-
183	Lesser Kestrel	T	-
190	Greywing Francolin	T	-
195	Cape Francolin	T	-
200	Common Quail	T	-
203	Helmeted Guineafowl	T	-
208	Blue Crane	T	-
210	African Rail	W	-
213	Black Crake	W	-
217	Redchested Flufftail	W	-
223	Purple Gallinule	W	-
226	Moorhen	W	-
228	Redknobbed Coot	W	-
231	Stanley's Bustard	T	V
235	Karoo Korhaan	T	-
239	Black Korhaan	T	-
244	Afr. Black Oystercatcher	M	-
245	Ringed Plover	W	-
246	Whitefronted Plover	W	-
247	Chestnutbanded Plover	W	R
248	Kittlitz's Plover	W	-
249	Threebanded Plover	W	-
251	Sand Plover	W	-
254	Grey Plover	W	-
255	Crowned Plover	T	-
258	Blacksmith Plover	W	-
262	Turnstone	W	-
263	Terek Sandpiper	W	-
264	Common Sandpiper	W	-
266	Wood Sandpiper	W	-
269	Marsh Sandpiper	W	-
270	Greenshank	W	-
271	Knot	W	-
272	Curlew Sandpiper	W	-
274	Little Stint	W	-
281	Sanderling	W	-
284	Ruff	W	-
286	Ethiopian Snipe	W	-
288	Bartailed Godwit	W	-
289	Curlew	W	-
290	Whimbrel	W	-

294	Avocet	W	-
295	Blackwinged Stilt	W	-
297	Spotted Dikkop	T	-
298	Water Dikkop	W	-
307	Arctic Skua	M	-
312	Kelp Gull	M	-
315	Greyheaded Gull	W	-
316	Hartlaub's Gull	M	-
322	Caspian Tern	M	R
324	Swift Tern	M	-
326	Sandwich Tern	M	-
327	Common Tern	M	-
328	Arctic Tern	M	-
329	Antarctic Tern	M	-
330	Roseate Tern	M	E
334	Damara Tern	M	R
338	Whiskered Tern	W	-
339	Whitewinged Tern	W	-
344	Namaqua Sandgrouse	T	-
348	Feral Pigeon	T	-
349	Rock Pigeon	T	-
350	Rameron Pigeon	T	-
352	Redeyed Dove	T	-
354	Cape Turtle Dove	T	-
355	Laughing Dove	T	-
356	Namaqua Dove	T	-
377	Redchested Cuckoo	T	-
385	Klaas's Cuckoo	T	-
386	Diederik Cuckoo	T	-
391	Burchell's Coucal	T	-
392	Barn Owl	T	-
400	Cape Eagle Owl	T	-
401	Spotted Eagle Owl	T	-
405	Fierynecked Nightjar	T	-
412	Black Swift	T	-
415	Whiterumped Swift	T	-
417	Little Swift	T	-
418	Alpine Swift	T	-
424	Speckled Mousebird	T	-
425	Whitebacked Mousebird	T	-
426	Redfaced Mousebird	T	-
428	Pied Kingfisher	W	-
429	Giant Kingfisher	W	-
431	Malachite Kingfisher	W	-
435	Brownhooded Kingfisher	W	-
451	Hoopoe	T	-
465	Pied Barbet	T	-
474	Greater Honeyguide	T	-
480	Ground Woodpecker	T	-
484	Knysna Woodpecker	T	-
486	Cardinal Woodpecker	T	-
488	Olive Woodpecker	T	-
495	Clapper Lark	T	-
500	Longbilled Lark	T	-
507	Redcapped Lark	T	-
512	Thickbilled Lark	T	-
518	European Swallow	T	-
520	Whitethroated Swallow	T	-
523	Pearlbreasted Swallow	T	-
526	Greater Striped Swallow	T	-
529	Rock Martin	T	-
533	Brownthroated Martin	T	-
536	Black Sawwing Swallow	T	-
541	Forktailed Drongo	T	-
547	Black Crow	T	-

548	Pied Crow	T	-
550	Whitenecked Raven	T	-
566	Cape Bulbul	T	-
572	Sombre Bulbul	T	-
577	Olive Thrush	T	-
581	Cape Rock Thrush	T	-
587	Capped Wheatear	T	-
589	Familiar Chat	T	-
596	Stonechat	T	-
601	Cape Robin	T	-
614	Karoo Robin	T	-
621	Titbabbler	T	-
631	African Marsh Warbler	W	-
635	Cape Reed Warbler	W	-
638	African Sedge Warbler	W	-
643	Willow Warbler	T	-
645	Barthroated Apalis	T	-
651	Longbilled Crombec	T	-
661	Grassbird	T	-
664	Fantailed Cisticola	T	-
666	Cloud Cisticola	T	-
669	Greybacked Cisticola	W	-
677	Levaillant's Cisticola	W	-
681	Neddicky	T	-
686	Spotted Prinia	T	-
690	Dusky Flycatcher	T	-
698	Fiscal Flycatcher	T	-
700	Cape Batis	T	-
710	Paradise Flycatcher	T	-
713	Cape Wagtail	T	-
716	Richard's Pipit	T	-
717	Longbilled Pipit	T	-
718	Plainbacked Pipit	T	-
727	Orangethroated Longclaw	T	-
732	Fiscal Shrike	T	-
736	Southern Boubou	T	-
742	Southern Tchagra	T	-
746	Bokmakierie	T	-
757	European Starling	T	-
759	Pied Starling	T	-
760	Wattled Starling	T	-
769	Redwinged Starling	T	-
773	Cape Sugarbird	T	-
775	Malachite Sunbird	T	-
777	Orangebreasted Sunbird	T	-
783	Lesser Doublecollared Sunbird	T	-
796	Cape White-eye	T	-
801	House Sparrow	T	-
803	Cape Sparrow	T	-
813	Cape Weaver	T	-
814	Masked Weaver	T	-
824	Red Bishop	T	-
827	Yellowrumped Widow	T	-
846	Common Waxbill	T	-
860	Pintailed Whydah	T	-
872	Cape Canary	T	-
874	Cape Siskin	T	-
877	Bully Canary	T	-
878	Yellow Canary	T	-
879	Whitethroated Canary	T	-
881	Streakyheaded Canary	T	-
885	Cape Bunting	T	-

7.6 Species list – Mammals

7.6.1 Mammals historically recorded or likely to occur on the Agulhas Plain (modified from Siegfried in Raimondo & Barker 1988); Distribution status ***under present climatic conditions according to Skinner & Smithers (1990) and Boshoff & Kerley (2001); Nomenclature, Red Data Book status, and endemism according to Friedman & Daly (2004).

Source:
A = Avery (1999) archaeological evidence from Die Kelders
B = Boshoff & Kerley (2001)
F = Friedmann & Daly (2004)
L = Lloyd & Millar (1983)
S = Skinner & Smithers (1990)
T = Stuart (1981)

Abbreviations:
LSA = Late Stone Age
MSA = Middle Stone Age
CFR = Cape Floristic Region
WC = Western Cape
SA = South Africa
sA = southern Africa

Skinner No.	Common name	Scientific Name	Distribution status*	Archaeological records	Red Data Book status	Endemic to	Source
3	Forest shrew	*Myosorex varius*	Indigenous		Data Deficient	SA	F; S
10	Reddish-grey musk shrew	*Crocidura cyanea*	Indigenous		Data Deficient		F; S
12	Greater musk shrew	*Crocidura flavescens*	Indigenous		Data Deficient		F; S
16	South African hedgehog	*Atelerix frontalis*	Extra-limital	MSA	(Near Threatened)		A
21	Cape golden mole	*Chrysochloris asiatica*	Indigenous		Data Deficient	CFR	F; S
30	Hottentot golden mole	*Amblysomus hottentotus*	Indigenous		Data Deficient	SA	F; S
36	Smith's rock elephant shrew	*Elephantulus rupestris*	Indigenous			sA	F; S
67	Schreibers' long-fingered bat	*Miniopterus schreibersii*	Indigenous		Near Threatened		F; S
71	Temminck's hairy bat	*Myotis tricolor*	Indigenous		Near Threatened		F; S
82	Long-tailed serotine bat	*Eptesicus hottentotus*	Indigenous			sA	F; S
83	Melck's serotine bat	*Eptesicus melckorum*	Indigenous				S
86	Cape serotine bat	*Eptesicus capensis*	Indigenous				S
102	Geoffroy's horseshoe bat	*Rhinolophus clivosus*	Indigenous		Near Threatened		F; S
106	Cape horseshoe bat	*Rhinolophus capensis*	Indigenous		Near Threatened	CFR	F; S
117	Chacma baboon	*Papio usinus*	Indigenous	MSA & LSA			A; B; S; L
122	Cape hare	*Lepus capensis*	Indigenous	MSA & LSA			A; S
123	Scrub hare	*Lepus saxatilis*	Indigenous	MSA & LSA			A; S
124	Smith's red rock rabbit	*Pronolagus rupestris*	Indigenous				S
129	Cape dune molerat	*Bathyergus suillus*	Indigenous	MSA & LSA		WC	A; F; S
132	Common molerat	*Cryptomys hottentotus*	Indigenous			sA	F; S
133	Cape molerat	*Georychus capensis*	Indigenous	MSA & LSA		SA	A; F; S
134	Porcupine	*Hystrix africaeaustralis*	Indigenous	MSA & LSA			A; B; S; L

Skinner No.	Common name	Scientific Name	Distribution status*	Archaeological records	Red Data Book status	Endemic to	Source
138	Woodland dormouse	*Graphiurus murinus*	Indigenous				S
156	Vlei rat	*Otomys irroratus*	Indigenous			sA	F; S
161	Cape spiny mouse	*Acomys subspinosus*	Indigenous			WC	F; S
163	Striped mouse	*Rhabdomys pumilio*	Indigenous				S
165	Water rat	*Dasymys incomtus*	Indigenous		Near Threatened		F; S
168	House mouse	*Mus musculus*	Alien				S
172	Pygmy mouse	*Mus minutoides*	Indigenous			sA	F; S
176	Verreaux's mouse	*Myomyscus verreauxii*	Indigenous				S
179	Namaqua rock mouse	*Aethomys namaquensis*	Indigenous			sA	F; S
183	House rat	*Rattus rattus*	Alien				S
186	Hairy footed gerbil	*Gerbillurus paeba*	Indigenous			sA	F; S
191	Cape gerbil	*Tatera afra*	Indigenous			CFR	F; S
194	White tailed mouse	*Mystromys albicaudatus*	Indigenous		Endangered	SA	F; S
196	Pouched mouse	*Saccostomus campestris*	Indigenous				S
199	Grey climbing mouse	*Dendromus melanotis*	Indigenous				S
200	Brants' climbing mouse	*Dendromus mesomelas*	Indigenous				S
204	Krebs' fat mouse	*Steatomys krebsii*	Indigenous				S
237	cf. Southern right whale	cf. *Balaena glacialis*	Indigenous	LSA			A
244	Aardwolf	*Protelis cristatus*	Indigenous				B; T
248	Leopard	*Panthera pardus*	Indigenous; Ephemeral	MSA & LSA			A; B; T
250	Caracal	*Felis caracal*	Indigenous	MSA & LSA			A; B; T
251	African wild cat	*Felis sylvestris*	Indigenous				A; B; T
255	Bat-eared fox	*Otocyon megalotis*	Indigenous				B; L
257	Cape fox	*Vulpes chama*	Indigenous				B; S
259	Black-backed jackal	*Canis mesomelas*	Indigenous	MSA & LSA			B; A
260	Cape clawless otter	*Aonyx capensis*	Indigenous				S; L
262	Honey badger	*Mellivora capensis*	Indigenous	MSA & LSA	Near Threatened		A; B; F; L; S
264	Striped polecat	*Ictonyx striatus*	Indigenous	MSA & LSA			A; T
267	Small spotted gennet	*Genetta genetta*	Indigenous	MSA & LSA			A; S
268	Large spotted gennet	*Genetta tigrina*	Indigenous				S
272	Yellow mongoose	*Cynictis penicillata*	Indigenous				T
273	Large grey mongoose	*Herpestes ichneumon*	Indigenous				S
275	Small grey mongoose	*Galerella pulverulenta*	Indigenous	MSA & LSA		sA	A; F; T
278	Water mongoose	*Atilax paludinosus*	Indigenous	?? MSA			A; T

Skinner No.	Common name	Scientific Name	Distribution status*	Archaeological records	Red Data Book status	Endemic to	Source
281	Cape fur seal	*Arctocephalus pusillus*	Indigenous	MSA & LSA		sA	A; F
284	Southern elephant seal	*Mirounga leonina*	Vagrant	LSA	Endangered		A; F
288	Antbear / Aardvark	*Orycteropus afer*	Indigenous		Vulnerable		B; F; L
289	African elephant	*Loxodonta africana*	Indigenous; Ephemeral	LSA			A; B
290	Rock dassie	*Procavia capensis*	Indigenous	MSA & LSA			A; L
296	Black rhinoceros	*Diceros bicornis bicornis*	Indigenous	MSA & LSA	Critically Endangered		A; B; F
297	Cape mountain zebra	*Equus zebra zebra*	Indigenous		Vulnerable	SA	B
299	Bushpig	*Potamochoerus porcus*	Extra-limital	LSA			A; B
302	Hippopotamus	*Hippopotamus amphibius*	Indigenous	MSA & LSA			A
305	Black wildebeest	*Connochaetes gnou*	Extra-limital	MSA		SA	A; S
306	Blue wildebeest	*Connochaetes taurinus*	Extra-limital				L; S
308	Red hartebeest	*Alcelaphus buselaphus*	Indigenous	LSA			A; B
309	Bontebok	*Damaliscus pygargus pygargus*	Indigenous	MSA & LSA	Vulnerable	Renosterveld	A; B; F; L
313	Common duiker	*Sylvicapra grimmia*	Indigenous				B; L
314	Springbok	*Antidorcas marsupialis*	Extra-limital	MSA			A; L
315	Klipspringer	*Oreotragus oreotragus*	Indigenous	MSA & LSA			A; B; S
318	Steenbok	*Raphicerus campestris*	Indigenous	LSA			A; B; L
319	Cape grysbok	*Raphicerus melanotis*	Indigenous	MSA & LSA		CFR	A; B; F; L
324	Grey rhebok	*Pelea capreolus*	Indigenous			SA	B; F; L
328	Cape buffalo	*Syncerus caffer*	Indigenous; Ephemeral	MSA & LSA			A; B
332	Bushbuck	*Tragelaphus scriptus*	Indigenous; Ephemeral	LSA			A; B; S
333	Eland	*Taurotragus oryx*	Indigenous	MSA			A; B; L
334	Southern reedbuck	*Redunca arundinum*	Extra-limital	MSA			A; S
	Cape zebra	*Equus capensis*	Species extinct	MSA			A
	Quagga	*Equus quagga*	Species extinct	LSA			A
	Giant buffalo	*Pelorovis antiquus*	Species extinct	MSA			A
	Blue antelope	*Hippotragus leucophaeus*	Species extinct	MSA			A; B
	Dolphin	*Delphinidae*	Indigenous	LSA			A
	Domestic sheep	*Ovis aries*	Alien	LSA			A
	Domestic cattle	*Bos taurus*	Alien	?? LSA			A
	Domestic dog	*Canis familiaris*	Alien	?? LSA			A
	Human	*Homo sapiens sapiens*		MSA & LSA			A

7.7 Species list – Invertebrates

7.7.1 Estuarine invertebrate species recorded in the Heuningnes estuary (after Bickerton 1984)

Species — **Common name**

<u>Polychaeta</u>

Arenicola loveni .... Bloodworm
Ficopomatus enigmatica.............................. Tube worm

<u>Crustacea</u>

Mysidacea
Rhopalaphthalamus terranatalis.................. Mysid

Macrura
Penaeus japonicus .... Ginger prawn
Palaemon pacificus .... Sand shrimp

Anomura
Callianassa kraussi...................................... Sand prawn
Upogebia africana .... Mud prawn
Diogenes brevirostris.................................. Common hermit crab

Brachyura
Cleistostoma edwardsii................................ Crab
Cyclograpsus punctatus .... Common shore crab
Hymenosoma orbiculare.............................. Crown crab
Scylla serrata... Giant mud crab

<u>Mollusca</u>

Notarchus sp. .... Sea hare
Nerita albicilla.. Common nerite
Siphonaria oculus.. False limpet
Natica sp. .... Necklace shell

8. SUMMARY OF AVAILABLE INFORMATION

The summary of available information can be downloaded as an independent file from www.sanparks.org.

9. MAPS

The following maps can be downloaded as independent files from www.sanparks.org:

9.1 Map: Area

9.2 Map: Geology

9.3 Map: Hydrology

9.4 Map: Soils and Landtypes

9.5 Map: Vegetation