An investigation of land-use practices on the Agulhas Plain (South Africa), with emphasis on socio-economic and conservation issues

By Barry John Heydenrych

Submitted in fulfilment of the requirements for the degree of Master of Science at the University of Cape Town.

Main supervisor: Prof. R.M. Cowling, *Institute for Plant Conservation, University of Cape Town*

Co-supervisor: Dr. J.K. Turpie, *Percy FitzPatrick Institute, University of Cape Town*

Institute for Plant Conservation
Botany Department
University of Cape Town
Private Bag
Rondebosch
7701
South Africa

December 1999

The following sponsors contributed to this study and are gratefully acknowledged:

The Pew Charitable Trusts via the Institute for Plant Conservation, University of Cape Town; The Green Trust, a subsidiary trust of WWF - South Africa, founded in 1990 in association with Nedbank; the Mazda Wildlife Fund; the Flora Conservation Committee of the Botanical Society of South Africa and South African National Parks.

Abstract

An investigation of land-use practices was undertaken on the Agulhas Plain, a species-rich area at the southern tip of Africa. Data were collected from landowners and visitors using questionnaire surveys. Further information was obtained by means of a literature search and interviews with key informants.

A historical background of land use in the area is given. Although the area has been utilized since the Earlier Stone Age (>200 000 years BP), the most dramatic changes to the landscape have occurred post 1850, with the large transformation of indigenous veld into cultivated lands.

Four categories of farms were identified: livestock farms, fynbos farms, mixed farms and conservation farms. Livestock farms covered the largest surface area. Cereal crops cultivated on these farms provided a net income of R 918 000/y. Grazing provided a net income of R 7.3 million/y on cultivated land and R 2.3 million/y was attributed to indigenous veld. This latter figure highlights the importance of natural veld for grazing, but for certain vegetation types, stocking rates were above the recommended norms.

Fynbos flower farms had the second largest surface area of the four categories of farms. Fynbos wildflowers were found to be the largest single agricultural sector on the Agulhas Plain, yielding an estimated net income of R 8.55 million/y. Most harvesting from the wild takes place from Acid Sand Fynbos, which is relatively common, and there appears to be potential for wildflower harvesting to be compatible with biodiversity conservation, if managed correctly.

Cultivated fynbos flowers yielded a net income of R 1.5 million/y. Cultivation of land for fynbos flowers is on the increase, and pristine fynbos is primarily being targeted for this practice, thereby threatening the biodiversity of these areas.

Many landowners are involved with mixed farming practices and there are a small number of conservation farms, generally situated at the coast, which rely on outside funding for their management.

There is a small amount of game farming which relies to a large extent on the natural vegetation (net income of about R 54 000/y) and there is an illegal trade in sour figs, which yields a net income of approximately R 86 000/y.

The products of the beekeeping industry, honey and pollination services, yield a net income of R 1.68 million/y which can be directly attributed to indigenous vegetation. The potential of indigenous fynbos to accommodate an increase in the number of commercial colonies, has not been determined, and is an important area requiring more research.

Invasive alien plants negatively affect grazing, wildflower harvesting and products from the beekeeping industry. However, the largest negative effect that invasive alien plants have on the Agulhas Plain appears to be on water resources, where underground water resources are being compromised by invasive alien trees.

The cost to clear invasive alien trees on the Agulhas Plain is estimated to be R 39 million, just for the initial clearing. During 1997 private landowners on the Agulhas Plain collectively spent approximately R 377 000 and South African National Parks spent approximately R 800 000 on clearing invasive alien plants. There remains a massive shortfall in the amount of money required to clear these plants.

There are also benefits to be obtained from invasive alien plants, for example R 804 000 is the estimated net income per year for products of the beekeeping industry obtained form *Eucalyptus* spp. The firewood industry (based primarily on *Acacia cyclops*) yielded a net income of R 361 000/y and has a massive potential to expand, but is in need of stricter management.

An expanding tourism and recreation industry exists on the Agulhas Plain. Visitors suggested that almost 70% of their reason for visiting the Agulhas Plain is the natural environment, is based largely on activities along the coast. Visitors to the Agulhas Plain were found to spend a substantial amount of money in the area, more than the amount spent on getting there in the first place. The Western Cape is the zone contributing to the largest aggregate spending on the Agulhas Plain, followed by Europe and then Gauteng. Patterns of use and values of income generated by international and domestic visitors are described.

The travel-cost method was applied to survey data to estimate the economic value of the natural environment of the Agulhas Plain for the region's recreational and tourism industry. The overall value that can be allocated to the natural environment of the Agulhas Plain is estimated to be R22.4 million/year.

The implementation of the Agulhas National Park needs to be sensitive to the landowners and local communities of the area: 97% of the area is privately owned, and many previously disadvantaged people would like more access to certain natural resources such as fish, alien firewood and sour figs. Attitudes differ from sector to sector with conservation landowners being in favour of the park (82%), visitors showing the same trend (93%) but owners of working farms being less in favour of the park (38%). The process of park implementation, including decision making, land prices, tenure issues and access to resources, is discussed.

The establishment and management of new protected area networks is expensive and relies on creative strategies to implement these systems. What is needed to be conveyed to decision makers, including potential funders, are the financial requirements and economic benefits of strategic conservation incentives. At the same time ongoing conservation planning and decision making should be based on a rigorous, but flexible conservation plan. Strategies for conservation implementation and resource utilisation for the long-term conservation of the rich biodiversity of the Agulhas Plain, are explored.

Acknowledgements

I thank my supervisor, Richard Cowling for his enthusiasm and guidance, and my co-supervisor Jane Turpie for her ongoing input and ideas.
The Agulhas Plain landowners, who willingly shared information on their land-use practices, which was sometimes of a sensitive nature, are warmly thanked.
Owners of accommodation establishments, 1997 MSc Conservation Biology students at UCT, and visitors to the area are thanked for their assistance with the visitor survey.
All key informants from which information, particularly on values associated with fynbos, was obtained, are gratefully acknowledged.
My colleagues at South African National Parks and at my previous place of employment, the Botanical Society of South Africa, are warmly thanked for their support and sharing of ideas concerning this project.
The financial support of the Pew Charitable Trusts via the Institute for Plant Conservation, University of Cape Town; the Green Trust, a subsidiary trust of WWF - South Africa, founded in 1990 in association with Nedbank; the Mazda Wildlife Fund; the Flora Conservation Committee of the Botanical Society of South Africa and South African National Parks is gratefully acknowledged.
Finally, I thank my wife Helen and sons Matthew and Tim for their patience and support.

Contents

Chapter 1 Introduction[1]

Most regions of the world have biased systems of conservation areas (Pressey *et al.*, 1996). The reasons for this are straightforward: it is much easier, both financially and politically to establish conservation areas where the scenery is rugged and beautiful, where the land use potential is low, and where few people live. Thus, remote, sparsely-populated, mountainous country, with little potential for conventional economic activity, is often over-represented in the conservation system, whereas productive, lowland landscapes, especially along the coast, are usually inadequately conserved (Rebelo, 1997).

This bias is certainly true of South Africa's Cape Floristic Region (CFR) (Goldblatt, 1978). This region, which includes the Cape Floral Kingdom, has long been recognised as an area of outstanding floristic diversity and endemism (Takhtajan, 1986). With approximately 8 600 plant species in only 90 000 km^2, levels of regional-scale diversity (1-100 000 km^2) are comparable with the richest tropical rainforest areas (Cowling *et al.*, 1992). Patterns of local and regional plant endemism are probably unparalleled in the world (Gentry, 1986; Cowling & Hilton Taylor, 1994): some 5 850 species, 195 genera and seven families are endemic to the CFR (Goldblatt 1978).

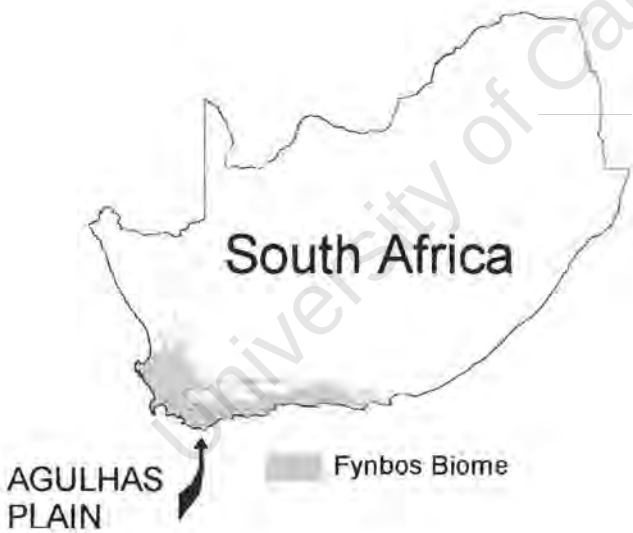


Figure 1.1 Extent of the fynbos biome and position of the Agulhas Plain relative to the rest of South Africa.

[1] This chapter is largely based on a paper published as:
Heydenrych, B.J., Cowling, R.M. and. Lombard, A.T. (1999) Strategic conservation interventions in a region of high biodiversity and high vulnerability: a case study from the Agulhas Plain at the southern tip of Africa. *Oryx* 33: 256-269.

The predominant vegetation type in the CFR, and the one that includes most of the endemic component, is fynbos, a fire-prone shrubland that grows on the infertile, sandy soils of the region (Figure 1.1) (Cowling, 1992; Cowling & Richardson, 1995). Fynbos is also home to the vast majority of the CFR's approximately 1 500 Red Data Book species (Cowling & Hilton Taylor, 1994), one of the highest known concentrations of such species in the world. The high numbers of both endemic and Red Data Book taxa combine to afford the CFR status as one of the world's hot-spots of biodiversity (Myers, 1990; Cowling & Pierce, 1999).

Most conservation interventions in the CFR have occurred in the mountainous landscapes of the Cape Folded Belt. These mountains, which comprise about 45% of the CFR, are extremely rugged, have infertile soils and are almost entirely fynbos-clad (Cowling *et al.*, 1997a). Their major economic value lies in the production of water for the fast-developing lowlands (Van Wilgen *et al.*, 1996; Higgins *et al.*, 1997a). Approximately 55% of the mountains are formally conserved. Based on data from the Proteaceae, Rebelo and Siegfried (1990) estimated that 93% of mountain fynbos plant species are included in the existing conservation system. The major threat to the biodiversity of the mountains is the invasion by alien trees and shrubs (Richardson *et al*, 1992); about 24% of mountain fynbos is invaded by alien pines, hakeas and wattles. However, the Working for Water Programme of the Department of Water Affairs and Forestry – an ambitious restoration and job creation project aimed at eliminating alien plants that negatively impact on water production – has cleared more than 330 000 ha of alien plants from mountain catchments in South Africa between October 1995 and March 1999 (Working for Water Programme, 1998; Working for Water Programme, 1999). Therefore, while not perfect, the conservation status of the CFR's mountain landscapes is at least not deteriorating rapidly.

The same cannot be said of the lowlands. Here, centuries of intensive agriculture have reduced coastal Renosterveld – a fire-prone and species-rich shrubland associated with moderately fertile and arable soils – to between 5% (in the west) and 35% (in the east) of its former extent (Heijnis *et al.*, 1999; Kemper *et al.*, 1999), and only 1.5% of the original area is conserved (Rebelo, 1992). Some 40% of lowland fynbos has been transformed by agriculture (Rebelo, 1992), and of the remaining habitat, about 90% (or 7 600 km^2) is invaded to some degree by Australian wattles (Richardson *et al.*, 1992). Moreover, only 4.5% of the original extent of lowland fynbos is conserved (Rebelo, 1992). Other threats facing lowland ecosystems, all of which are rapidly escalating, include urbanization (especially resort

development), flooding of valley bottoms for dams, drainage of wetlands, inappropriate fire regimes and unsustainable flower harvesting.

Clearly, on the basis of their high conservation value (or irreplaceability) and high vulnerability, the CFR's lowland ecosystems areas are the major priority for conservation interventions in the region. The concepts of irreplaceability (Pressey *et al.*, 1994) and vulnerability (Pressey *et al.*, 1996) were developed to make operational the otherwise elusive concept of conservation priority. In its simplest form, irreplaceability is a measure of the likelihood that an area will be needed to achieve a conservation goal; vulnerability is a measure of the imminence or likelihood of the biodiversity in an area being lost to current or impending threatening processes. Thus, irreplaceability is a measure of conservation value whereas conservation priority is the value of an area, combined with some assessment of the urgency with which it should be conserved (Pressey, 1997). Areas of high irreplaceability and high vulnerability – such as remnant patches of coastal Renosterveld and lowland fynbos - are the highest priorities for conservation action in South Africa and, indeed, globally (Pressey *et al.*, 1996; Lombard *et al.*, 1999).

One such priority region is the Agulhas Plain, a lowland region of the CFR at the southern tip of Africa (Figure 1.1). This is an exceptionally species-rich area of coastal lowland that was once covered by many different forms of fynbos and coastal Renosterveld (Cowling *et al.*, 1988). Today, agriculture, alien plants and coastal resorts have transformed much of the landscape, and remnant areas of natural habitat are being lost at an ever-increasing pace. Moreover, most of the land is in private ownership and is used mainly for profitable commercial agricultural; hence, land is very expensive by CFR standards. However, the effective conservation of the CFR's endemic biodiversity requires that these problematic, but high priority areas, are not ignored (Richardson *et al.*, 1996).

The biodiversity of the Agulhas Plain is not restricted to terrestrial ecosystems. Indeed, the marine, estuarine, coastal and island biodiversity has been identified as extremely conservation-worthy by South African National Parks (Hanekom *et al.*, 1995). Priorities for conservation action include certain threatened bird species at the coast (e.g. the African Black Oystercatcher, *Hermatopus moquini* and the Damara Tern, *Sterna balaenarum*), and dwindling marine resources, a phenomenon which is due to over-exploitation (Griffiths and Branch, 1997), rather than habitat destruction (Prof. C. Griffiths, Zoology Dept., University of Cape Town, pers. comm.). One of the three largest marine reserves in South Africa is located adjacent to the De Hoop Nature Reserve, approximately 60 km east of Cape

Agulhas. While the need for additional marine reserves in South Africa is important, the proximity of the De Hoop Marine Reserve to the Agulhas Plain means that it may not be necessary to establish a full marine reserve in this region (C. Attwood, Marine and Coastal Management, pers. comm.). Preliminary results from an investigation into the need for large no-take marine reserves adjacent to the CFR indicate that the marine components of De Hoop Nature Reserve, the Tsitsikamma and West Coast National Parks and the proposed marine components of the Cape Peninsula National Park adequately perform the function of retention of biodiversity of most species (C. Griffiths, pers. comm.). However, certain critical species (e.g. abalone & certain fish) need special management interventions to ensure survival of populations (C. Griffiths, pers. comm.). In addition, management of the coastal region to protect sensitive environments and species from human abuse, for example by off-road vehicles (Avis, 1998), is an important off-reserve management tool. Furthermore certain off-reserve management interventions, for example closure of a beach to vehicles, would result in a *de facto* marine protected area (C. Attwood, Marine and Coastal Management, *in litt.*) without having to establish a formal protected area.

In addition to the biodiversity issues, cultural-historical features (e.g. archeological middens, stone age fish traps) and as well as landscapes are important factors to be considered for broad conservation planning with respect to national parks (Hanekom *et al.*, 1995). Owing to the fact that many of the Agulhas Plain's cultural/historical features are situated in the coastal zone (MLH, 1994; Du Toit & Rehder, 1998), appropriate access management in this zone, is imperative for the preservation of these assets.

Although the marine biodiversity and cultural-historical features of the region are important for conservation planning, this study focuses primarily on terrestrial biodiversity with respect to use, value and conservation planning. However, the coastal environment features prominently with respect to recreational use and value on areas adjacent to the Agulhas Plain.

In this chapter, a background to the study area, the patterns of biodiversity, a framework for strategic conservation interventions and the importance of measuring the economic values of biodiversity, are addressed.

Study area

Biodiversity

Terrestrial features

The study area for the conservation interventions described here is the western portion of the Agulhas Plain (Figure 1.2). This area of 1 540 km^2 comprises an ancient weathered landscape broken by low (less than 800m), isolated, quartzitic hills (Thwaites & Cowling, 1988). The geology of the area is complex and gives rise to a mosaic of largely infertile major soil types, each supporting a different vegetation type (Cowling *et al.*, 1988). The region has eleven distinct vegetation units (Figure 1.2) (Lombard *et al.*, 1997), one of which is endemic, and 1 751 plant species, including 99 endemics (Cowling & Holmes, 1992) and 112 Red Data Book species (Cowling & Mustart, 1994). Compositional turnover – or beta diversity - along edaphic gradients is very high (Cowling, 1990) and almost all of the local endemics are edaphic specialists, often occurring in small and scattered populations (Cowling & Holmes, 1992). The region is also a site of relatively recent (Pleistocene) ecological (edaphic) diversification; it includes several clusters of closely related species that are specialised to grow on different edaphic surfaces (Cowling & Holmes, 1992).

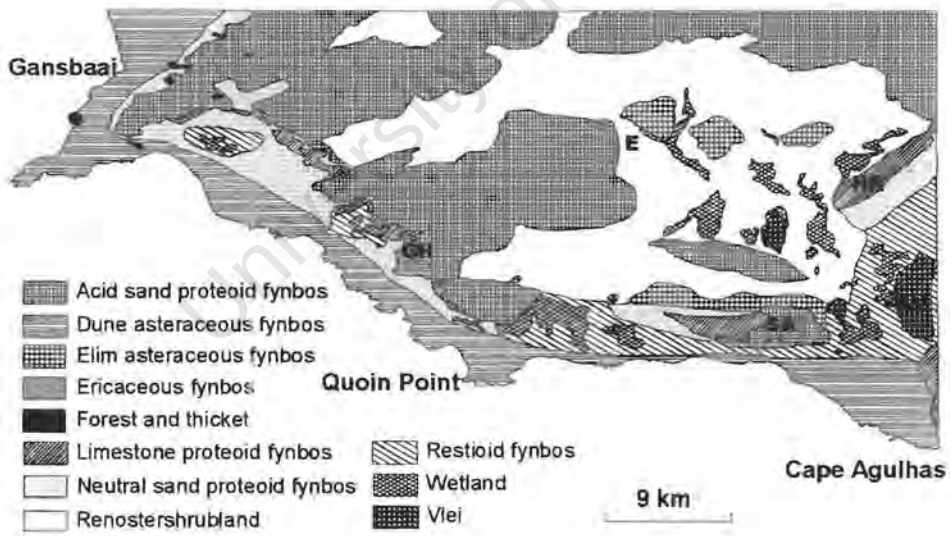


Figure 1.2 Indigenous vegetation types, including wetlands and vleis (lakes and pans) on the Agulhas Plain. (SV = Soetendalsvlei, SA = Soetanysberg, HR = Heuningrug, E = Elim, GH = Groot Hagelkraal) (After Lombard *et al.*, 1997)

The extraordinary terrestrial biodiversity of the region is complemented by a series of extremely species- and endemic-rich wetlands that are internationally recognised as habitats for unique amphibian and bird assemblages (Barnes, 1998; Lombard *et al.*, 1997). The wetlands to the west of the Soetendalsvlei (SV - Figure 1.2) – a low-lying area of clayey, impermeable soils that are covered in short grassland, chenopod marsh and rush (Restionaceae) communities, supported the largest concentration of large herbivores in the CFR in historical times (Skead, 1980), and deserves to be known as the "Serengeti of the Cape". The extent to which this grazing system and its associated processes can be re-established within the conservation system, is not currently known.

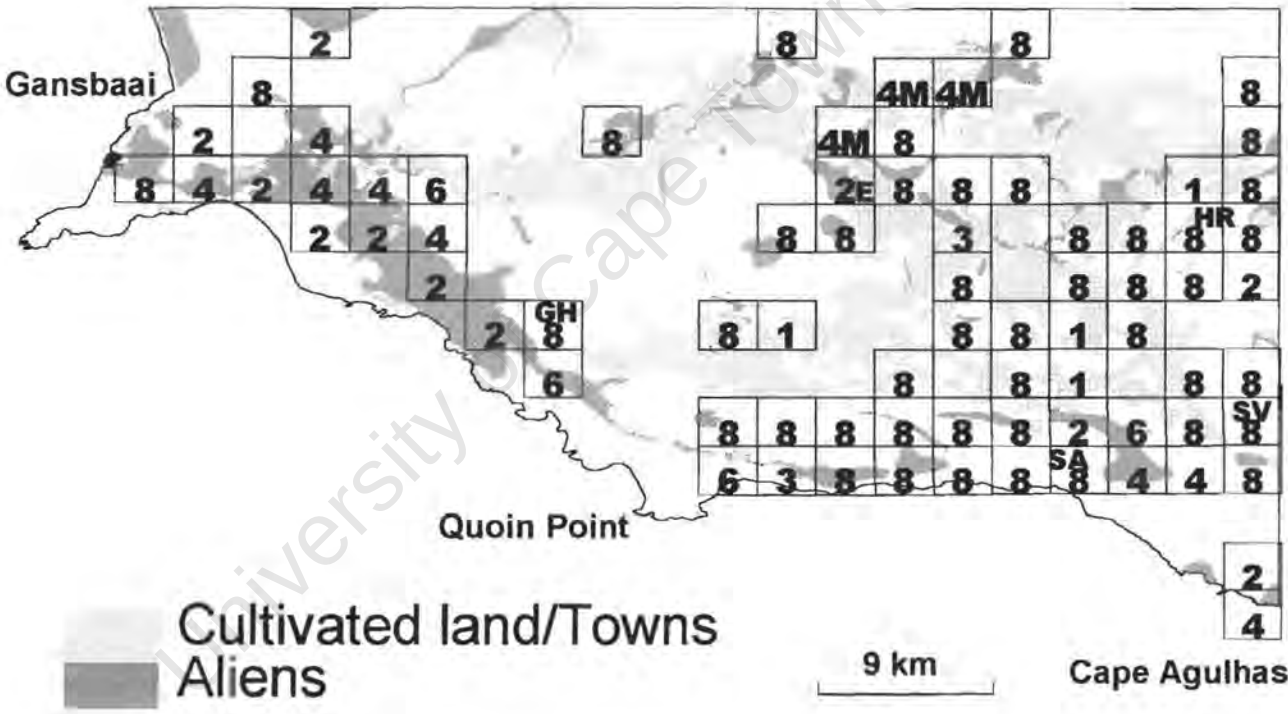


Figure 1.3 Cultivated land (& towns) and alien vegetation (dense thickets) on the Agulhas Plain. Blocks represent 3 X 3 km cells selected by eight reserve selection algorithm variations, with the number of different variations selected indicated in each cell. Three mandatory cells selected to conserve coastal Renosterveld are indicated with an M. (SV = Soetendalsvlei, SA = Soetanysberg, HR = Heuningrug, E = Elim, GH = Groot Hagelkraal) (After Lombard *et al.*, 1997)

Two major forces of transformation have changed the face of the Agulhas Plain over the past two hundred years. Cultivation of the more fertile shale-derived soils (previously supporting coastal Renosterveld and Elim Fynbos), for cereals and pastures has resulted in a loss of 34 693 ha (22.5%) of the area (Lombard *et al.*, 1997) (Figure 1.3). Furthermore, invasive alien plants, mainly wattles from Australia, have invaded almost all of the Agulhas Plain to some extent. Approximately 17 470 ha (14.7%) of the remnant natural habitat of the Agulhas Plain has been transformed by dense thickets of invasive alien plants (Lombard *et al.*, 1997) (Figure 1.3). These thickets reduce indigenous biodiversity, increase fuel loads (and, hence, wildfire hazards), and exhaust subterranean water supplies as a result of increased evapotranspiration (Richardson *et al.*, 1992). In contrast to areas which have been transformed over centuries by agricultural cultivation, however, some form of indigenous plant cover can be readily restored in most areas which have become densely invaded by alien plants (Holmes & Cowling, 1997).

Other threats to the biodiversity of the region include coastal resort development, the introduction of novel forms of land use (e.g. cultivation of wildflowers, viticulture, sand mining) that encroach on otherwise intact habitats, unsustainable harvesting of wild populations of horticulturally-valuable species, and the drainage or damming of wetlands.

Marine features

The South African coastline and adjacent marine environment is characterised by three distinctive biogeographical provinces:

- the warm subtropical East Coast province; dominated by the Agulhas current;
- the South Coast province; a transitional zone between east and west and the
- the cold water West Coast province, doimanted by the cold Benguela upwelling system (Robinson, 1989; Lubke, 1998).

The Agulhas Plain coastline is the southern most region of the South Coast province, and predominantly displays features of the cool temperate south-west coast, but is also transitional between the warm temperate south coast and cool temperate south-west coast regions of the South Coast province. Owing to the fact that both warm and cold water events occur along the Agulhas coastline, the coastal flora and fauna include species of both the west and east coast regions, including species endemic to the South Coast province (Robinson, 1989).

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 (Brown & Jarman, 1978; Bolton & Stegenga, 1990).

The marine invertebrate fauna (Day *et al.*, 1971) is fairly rich and similar to that from De Hoop Nature Reserve (Coetzee & Zoutendyk, 1993), which has fauna typical of the warm temperate south coast province (Brown & Jarman, 1978; Emanuel *et al.*, 1992). Unlike De Hoop Nature Reserve, the area has large stocks of commercially exploited abalone (*Haliotis midae*). The sandy beach fauna of Struisbaai is typical of the warm temperate south coast (McLachlan, 1981).

The invertebrate communities in the Ratel and Uilkraal estuaries, are probably similar to those occurring in the adjacent Heuningnes estuary where 16 species have been recorded (Bickerton, 1984).

Over 30 fish species are caught by line boats in the area, providing an important contribution to the economy of the area (MLH, 1994). Large numbers of sharks, including the "rare" Great white shark, frequent the area, and a fairly recent phenomena is the establishment of a relatively lucrative shark cage-diving industry at Gansbaai (personal observation).

Limited sampling for fish in the Ratel and Uilenkraal estuaries has yielded six species (Harrison *et al.*, 1995), but the fish communities are probably similar to those of the more comprehensively sampled Heuningnes estuary.

Dyer Island and Geyser Rock are important breeding sites for seabirds; notably the African penguin (*Sphenicus demersus)*, 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%) (Cooper, 1981, Cooper *et al.*, 1982; Crawford *et al.*, 1982a; Crawford *et al.*, 1982b; Brooke *et al.*, 1982; Cooper *et al.*, 1990; Cooper *et al.*, 1992). African black oystercatchers (7%) and the "rare" Damara tern (<1%) breed along the coast (Summers & Cooper, 1977; Jeffrey 1987).

A large breeding colony of South African fur seals (*Arctocephalus pusillus*) on Geyser Rock produces over 8 000 pups a year or 3 percent of the seal pup population in southern Africa (David, 1987). Significant numbers of Southern right whales frequent the Agulhas coast for breeding and nursery purposes (Best, 1998).

Abalone, kelp, pelagic and line fish stocks are extensively exploited along the coast of the Agulhas Plain. The existing abalone reserve at Dyer Island prohibits the collection of abalone within 1 nautical mile of the island, and therefore, provides an important breeding sanctuary from which the surrounding areas can be seeded.

Cultural/Historical Features

The Agulhas Plain area is steeped in history. High concentrations of Later Stone Age shell middens, as well as fish traps, apparently constructed by Khoikhoi pastoralists, are found along the coast (Avery, 1975; Avery, 1997; Du Toit & Rehder, 1998). Early and Middle Stone Age sites occur on the farm Springfield (Wilson 1988).

Numerous national monuments are found in the area. The Cape Agulhas lighthouse, the second oldest lighthouse in South Africa, recently celebrated 150 years of existence. The lighthouse is fully functional and houses the only lighthouse museum in Africa (C. Lohann 1997, pers. comm.). 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 (A. Joorst, Elim Tourism Officer, pers. comm.).

Merino sheep farming in South Africa was pioneered by Michiel van Breda of Zoetendals Vlei. The homestead of this farm is well preserved and at least four other homesteads in the area are national monuments (Brandfontein, Aasfontein, Rhenosterkop and Springfield).

Eight shipwrecks have provisionally been proclaimed as monuments, while salvage operations are in progress. They are 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).

Given the exceptional biodiversity of the Agulhas Plain, and the threats that it faces, it is no surprise that the region has long been identified as a top conservation priority in the CFR. Based on a scoring system, Jarman (1986) identified the Soetanysberg region (figures 1.2 & 1.3) - an area of finely juxtaposed fynbos vegetation, high diversity and high endemism in the south of the Agulhas Plain, as a major conservation priority in the CFR lowlands. This area was later mooted as the Soetanysberg Nature Area, a Protected Natural Environment (see Table 1.1) (Burgers *et al.*, 1987). However, in over 80% of the CFR lowland sites that were identified as priorities by Jarman (1986), no progress had been made in improving their conservation status almost one decade later (Burgers, 1994). This fact underscores the inertia associated with tackling the complex conservation problems in the CFR lowlands.

More recently the "minimum set" approach to conservation planning – the identification of whole systems of complementary areas which collectively achieve some overall conservation goal – have been used to identify systems of conservation areas in the CFR (Lombard *et al*, 1997). Based on the occurrence of species of Proteaceae (Rebelo & Siegfried, 1992) and limestone endemics (Willis *et al.*, 1996), several such areas were identified on the Agulhas Plain. Cowling and Mustart (1994) used these results as well as distributions of endemic species to identify a representative system of conservation areas for the Agulhas Plain, as part of a Structure Plan for the region (MLH, 1994). However, the approach used was subjective and lacked the efficiency and goal-defined complementarity aspects of the minimum set approach.

In 1996, the Board of South African National Parks (SANP) approved the establishment of a national park on the Agulhas Plain, following an assessment of the area's conservation potential (Hanekom *et al.*, 1995). Simultaneously, Lombard *et al.* (1997) were completing a reserve-selection study for the same area. A flexible algorithm for selecting representative areas of the Agulhas Plain for incorporation into a conservation system was developed. The goal of the algorithm was to simultaneously select different target areas of the 11 vegetation types on the Plain (Figure 1.2), as well as one population of each of the 99 endemic plant species, in the smallest area possible. Targets for vegetation types were based on the following factors: the amount of remaining, untransformed vegetation in the study area; conservation status of the vegetation type on the Agulhas Plain (amount already protected as a percentage of remaining amount); number of endemic plant species; and presence outside the study area.

The selection units of the algorithm were 3 x 3 km cells, and eight variations of the algorithm were run to provide flexibility in results. Owing to the fragmented nature of remaining vegetation and the high levels of infestation by alien plants, three constraints were built into the algorithm variations. Some variations forced adjacency i.e. cells were selected for incorporation into final results based on their proximity to one another, resulting in a less fragmented reserve configuration. Other variations forced the exclusion of cells infested by more than 50% with aliens (owing to the high cost of clearing and loss of biodiversity), and other variations forced the inclusion of three mandatory cells (cells with the biggest contiguous area of Renosterveld remaining on the Agulhas Plain).

Between 55 and 61 cells (out of a total of 193) were selected by the algorithm variations, for incorporation into a reserve system. Forty-five of these cells were common to all eight variations (Figure 1.3), and it was suggested that these 45 cells form the core of the system. Four important nodes were identified, and coincided with areas previously identified as conservation priorities: (i) the Heuningrug (HR) limestone complex in the northeast (Willis *et al.* 1996); (ii) the Elim (E) area in the centre (Jarman, 1986; Rebelo 1992); (iii) Groot Hagelkraal (GH) in the southwest (Cowling, 1990); and (iv) the Soetanysberg (SA) hills and environs in the southeast (Jarman, 1986) (see figures 1.2 & 1.3). Because the final boundaries of the conservation system will differ from the selection units, the algorithm variations can be rerun to account for changes in the reserved areas of vegetation targets, thereby providing a flexible tool for developing the boundaries of the protected area.

Owing to the difficulty of incorporating ecological and evolutionary processes (e.g. pollination, dispersal, responses to global climate change, speciation) into reserve design, the provision for some of these factors in the suggested reserve design were examined *a priori*. For example, the representation of contiguous vegetation types would facilitate ongoing edaphic speciation and would allow for the monitoring of vegetation responses to global climate change. Two thirds of the most diverse cells (i.e. with five or six vegetation types) were captured by four of the algorithm variations. The representation of gamma diversity (i.e. the representation of the same vegetation type along the predominant east-west geographical gradient) in the study area was also well catered for in the variations of the algorithm (see Lombard *et al.* 1997). Altitudinal gradients (for species migration in the event of climate change) and seasonal migration routes of pollinators (nectarivorous birds) were also selected in the various options for reserve design.

A major shortcoming of the minimum-set approach, such as that used by Lombard *et al.* (1997), is that it assumes the whole reserve system can be implemented with the stroke of a pen, and that ongoing loss or degradation of habitat will not compromise the achievement of the representation goal. A much more common planning situation, and certainly the case for the Agulhas Plain, is for the implementation of a notional reserve system to take years or decades, during which time the agents of biodiversity loss continue to operate. In such situations, strategies for maximizing representation on paper must be complemented or replaced by those that maximize "retention" in the face of ongoing loss or degradation of habitat. Maximizing the retention of the natural features of interest is defined as minimizing the extent to which the original representation goals are compromised by habitat loss while the system of conservation areas is developing (Pressey *et al.*, 1996). In this respect, it is crucial to incorporate retention goals by setting priorities on the basis of both conservation value and vulnerability to threats.

The ultimate goal of conservation planning is to enable biodiversity to persist not only despite such direct threats but also in the face of less obvious human-induced disturbances (e.g. climate change, altered fire regimes) as well as longer-term ecological and evolutionary processes (Cowling *et al.*, 1999). This is not to deny the importance of habitat loss for the immediate persistence of biodiversity, but long-term persistence goals also need to be considered in designing and implementing reserve systems. Cowling *et al.* (1999) define design as the size, shape, connectivity, orientation and juxtaposition of conservation areas intended to address issues such as viable populations, minimization of edge effects, maintenance of disturbance regimes and movement patterns, continuation of evolutionary processes, and resilience to climate change. Lombard *et al.* (1997) attempted to accommodate some of these longer term processes in their study but much more attention is required if persistence goals are to be taken seriously.

A conservation planning approach which is guided by an explicit protocol for designing a system of conservation areas that will achieve, as far as is possible, the goals of representation, retention and persistence, is being used in the Cape Action Plan for the Environment (CAPE) Project (Cowling *et al.*, 1998). The CAPE Project, which is funded by the Global Environmental Facility (GEF), aims to provide a systematic and strategic plan for the biodiversity of the CFR, as well as a five-year investment programme focused on the first priorities within the strategy to be presented to financial agencies, private and public, national and international, including the GEF (WWF-SA, 1999). Conservation planning within the CAPE Project is being considered at two spatial scales: at 1:250 000 for the entire CFR in

order to identify broadly-defined priorities; and a "real-world" analysis on the Agulhas Plain at the 1:10 000 scale, where the selection units for conservation areas will be cadastral units (principally farm boundaries) (Cowling *et al.*, 1998).

The launch of the Agulhas National Park was officially announced by the Minister of Environmental Affairs and Tourism on 1 March 1999 and the first portions were proclaimed in September 1999 in terms of the National Parks Act (Anonymous,1999). Using Lombard *et al*'s (1997) study, SANP have identified an area of approximately 20 000 ha for the Agulhas National Park, approximately half the area identified by the study but nonetheless incorporating the four core areas of Soetanysberg, Heuningrug, Elim and Hagelkraal. Nevertheless, off-reserve conservation will be required to ensure that effective conservation of much of the biodiversity pattern and processes on the Agulhas Plain is achieved. What makes the conservation intervention by SANP on the Agulhas Plain unique, however, is that this is the first example in South Africa where a flexible, strategic and systematic conservation planning approach has been used to plan a system of conservation areas.

Institutional, legal and policy framework

There is an increasing acceptance that successful implementation of conservation projects depends on the development of successful partnerships between state institutions, the private sector and non-governmental organizations (NGOs) (McNeely, 1995). Furthermore, an appropriate legal and policy framework must be in place for interventions to succeed (e.g. Brandon, 1997). In this the institutional, legal and policy framework for the implementation of a system of terrestrial conservation areas for the Agulhas Plain is discussed.

The role of the state

South Africa has three tiers of government: national, provincial and local (Anonymous, 1996) and nature conservation responsibilities span all three of these levels. The major organisations responsible for terrestrial biodiversity conservation on the Agulhas Plain are South African National Parks (SANP) (formerly called National Parks Board), a national statutory board; the Western Cape Nature Conservation Board (WCNCB) (usually referred to as Cape Nature Conservation, or CNC), a recently-formed provincial (Western Cape) statutory board; Overberg District Council, a regional authority; local town councils; and in the case of the Moravian Church-owned land at Elim, the *Opsienersraad* (Overseers

Council). However, regional and local authorities typically do not have sufficient funds to carry out nature conservation functions in their areas of jurisdiction. Furthermore, the allocation of funds to provincial- and national-tier conservation institutions by the South African govemment has shrunk steadily over the past five years and this pattem is likely to continue in the future (Kumleben *et al.*, 1998)

Table 1.1 Summary of major terrestrial conservation categories which are currently relevant to the Agulhas Plain, in the Western Cape Province. Much of the legislation pertinent to the Western Cape Nature Conservation Board is currently under review (* denotes assistance from the state with respect to privately-owned land; ** a new Forests Act is in the process of replacing the current act)

Type of Protected Area	Legislation	Administration	Ownership	Finances for manage-ment *	Manage-ment advice *	Deproclamation process
Schedule 1 National Park	National Parks Act (Act 57 of 1976)	South African National Parks (SANP)	State/ SANP	N/A	N/A	South African Parliament
Contractual National Park	National Parks Act (Act 57 of 1976)	South African National Parks and private/ parastatal party	State + private	Yes	Yes	(National) Minister of Environmental Affairs and Tourism (DEAT), on recommendation from SANP
State Forest	Forest Act (Act 122 of 1984) **	Department of Water Affairs and Forestry (DWAF) but assigned to the Western Cape Nature Conservation Board (WCNCB)	State	N/A	N/A	South African Parliament
Protected Natural Environment	Environmental Conservation Act (Act 73 of 1989)	Department of Environmental Affairs and Tourism – delegated to competent authorities such as WCNCB	State + private	No	Yes	The authority which enacted the declaration in the first place, may also withdraw this, following extensive consultation
Nature reserves						
(a) Provincial nature reserves within the Western Cape Province	Nature and Environmental Conservation Ordinance (Ord. 19 of 1974)	Western Cape Nature Conservation Board	State	N/A	N/A	Premier of the Western Cape Province at any time
(b) Local Authority nature reserves within the Western Cape Province	Nature and Environmental Conservation Ordinance (Ord. 19 of 1974)	Local Authorities such as Regional Services Councils & Municipalities	Private (legally, third tier government is considered private)	No	Yes	Premier of the Western Cape Province at any time
(c) Private nature reserves within the Western Cape Province	Nature and Environmental Conservation Ordinance (Ord. 19 of 1974)	Private Landowners	Private	No	Yes	Premier of the Western Cape Province at any time
Conservancies	No legal status but registered with WCNCB	Landowners/ farmers in co-operation with WCNCB	State + private	No	Yes	N/A
Natural Heritage Sites	No legal status but registered with DEAT	Landowners – sites are listed on a National Register	Private	No	Yes	N/A
Ramsar Site	No legal status in South Africa, but under the auspices of the International Ramsar Convention	Department of Environmental Affairs and Tourism and other delegated (nature conservation) agencies, including DWAF	State + private	No	Yes	N/A
Biosphere Reserves	No legal status in South Africa, but registered internationally with UNESCO.	Department of Environmental Affairs and Tourism and other delegated (nature conservation) agencies and landowners	State + private	No	Yes	N/A

The categories of protected areas that are of relevance to the Agulhas Plain's terrestrial biodiversity are summarised in Table 1.1. There are three important implications for conservation interventions regarding these categories. Firstly, although national legislation is applicable to many types of protected areas, most of the responsibility for implementation rests with the provincial authority, the Western Cape Nature Conservation Board (WCNCB). Secondly, public-private partnerships are applicable to many conservation categories. Thirdly, in most cases involving private land, although there may be assistance from authorities in terms of management advice, there is not usually any direct financial assistance for management.

SANP's role on the Agulhas Plain is strictly speaking limited to activities relating to the establishment and management of a national park for the area. However, in practice the institution does play a role in off-reserve issues. Clearly, much is to be gained by developing strategic partnerships between the two institutions, SANP and CNC. One possible strategic initiative would be the recognition, as part of the Agulhas National Park, of CNC holdings that have IUCN Category II status (Kumleben *et al.*, 1998), and the development of equitable co-management relationships between CNC and SANP. Such arrangements would also ensure some central government responsibility for these areas in terms of important international conventions.

Other state initiatives of relevance to the implementation of conservation actions on the Agulhas Plain are the Department of Water Affairs and Forestry's Working for Water Programme, and the Department of Agriculture's Landcare Project. Both projects aim to provide employment for the economically and socially-marginalized sectors through ecological restoration works that will provide national economic benefits (Marais, 1998). While the Landcare initiative is still in its infancy, the Working for Water Programme has been in operation since 1995, and has created 42 000 jobs nation-wide in two and a half years (Working for Water Programme, 1998). Although the bulk of this activity has focused on mountain catchments, where the water production benefits of alien plant removal are perceived to be greatest (Van Wilgen *et al.*, 1996), there is a growing awareness that alien trees impact severely on groundwater resources in lowland fynbos ecosystems (Visser *et al.*, 1999). Since all Agulhas Plain towns derive their water supplies from groundwater sources, and unemployment and social deprivation is widespread in the region, SANP has been able to secure funds from the Working for Water Programme. Two such projects are currently underway on the Agulhas Plain, with an overall expenditure since early

1998 of more than R4 million that has created almost 300 jobs and cleared approximately 4000 ha of invasive alien plants.

State-private sector partnerships

Although the post-apartheid South Africa has stronger environmental legislation than it ever had before – the "promotion of conservation" is enshrined in section 24 (b) of the Constitution (Anonymous, 1996) - owing to pressing socio-economic upliftment requirements, state funding for biodiversity conservation is likely to continue to shrink well into the future. Clearly, it is not realistic to depend on the state for the provision of all of the requirements for the establishment of new protected areas. For example, since most of the planning domain of the Agulhas National Park is in private ownership, a great deal of money is required for land purchases.

Thus, approximately R27 million is required for purchasing 12 000 ha that would consolidate the major priorities for the effective conservation of the national park's biodiversity. (The remaining 8000 hectares would be included into the park on a contractual basis). Although SANP have established an internal development fund for land purchase (Hall-Martin, 1997), the funds generated by this scheme will not be sufficient for consolidating all important conservation areas. Other sources of funding, including those administered by WWF-South Africa and Fauna & Flora International, are likely to be used to supplement SANP's internal land purchase funds.

The prospect of SANP incorporating sufficient land to effectively consolidate the Agulhas National Park without the co-operation of the private sector and other conservation agencies, is unrealistic. Indeed, the co-operation with CNC is a prerequisite for the effective consolidation of conservation-worthy areas on the Agulhas Plain.

There are three ways in which the private sector can invest in the establishment of a formal conservation system for the region: i) by donating land for the system, with or without commercial opportunities; ii) under an agreement or contract whereby land is included in the long term interests of conservation, in exchange for various benefits (which are not necessarily financial) and iii) by landowners undertaking conservation and sustainable farming practices of their own free will. It is vitally important, however, that the first two relationships described above ensure equitable benefits to both parties. The experience thus far in South Africa is that accrual

of benefits often favours the private sector (AJ Hall-Martin, Director: Conservation, South African National Parks, pers. comm.).

Two models of state-private sector partnerships for conservation are pertinent to the Agulhas Plain. These are contractual national parks, implemented by SANP, and conservancies, implemented by WCNCB (Table 1.1). The former, which have a relatively long history of application in South Africa, are bound by a formal contract between the landowner and SANP. It is important that the contractual national park provides mutual benefits to both parties and strives to fulfil explicit conservation goals over the long term. The arrangement should not be perceived by landowners solely as an incentive for a land improvement service (e.g. alien plant control) or for economic opportunities (e.g. eco-tourism).

Conservancies, implemented by CNC in this region, encourage off-reserve conservation through co-operative management, whereby the authorities advise a committee of interested and affected landowners. Although they are based on a voluntary agreement, legislation is being investigated to strengthen the protection status of conservancies (Cape Nature Conservation, pers. comm.). Ultimately, conservancies could play an important role as a buffer zone for the Agulhas National Park and provincial nature reserves, as well as enabling the continuation of ecological and evolutionary processes that require tracts of natural habitat that extend beyond the boundaries of these protected areas (Cowling *et al.*, 1998). The Walker Bay Conservancy is operative in the western section of the Agulhas Plain, and there are plans for others in the eastern sector (Cape Nature Conservation, pers. comm.).

Tourism in the CFR, which is essentially based on the region's natural assets, provides incentives for both state and private conservation. There are many opportunities on the Agulhas Plain for state-private sector relationships in the tourism industry. For example, SANP-private sector partnerships can be developed to provide tourism facilities within the national park. Tourism opportunities on private nature reserves can potentially generate funds for conservation activities, as is the case for the Grootbos Private Nature Reserve on the western Agulhas Plain (Pithers, 1997). Many of these opportunities are being co-ordinated on the Agulhas Plain by the Fynbos Eco-tourism Forum, which aims to promote sustainable, fynbos-based tourism on private and communally-owned land (Overberg Conservation Services, 1997).

There is provision in the Water Act (Act 36 of 1998) which calls for the establishment of Catchment Management Agencies with smaller supporting committees, enabling greater state-private sector partnerships in the management of water resources (Anonymous, 1998a). The importance of such committees is highlighted by a group of landowners to the north of the Agulhas Plain, who managed to successfully motivate for state funding (from the Department of Water Affairs and Forestry) for an alien plant clearing project (K. Brooke-Sumner, Sandies Glen Farm, pers. comm.).

Biosphere reserves could be used as a basis for co-ordinating all conservation-based state-private sector relationships within an overall strategic framework. Although biosphere reserves do not have any legal status in South Africa (Table 1.1), they are an internationally-recognised initiative of the United Nations Educational, Scientific, and Cultural Organisation (UNESCO) which serve to integrate humans and the biosphere through a zoning system of land-uses (Batisse, 1982). The use of biosphere reserves as a planning tool is formally recognised by the Provincial Government of the Western Cape (Provincial Administration Western Cape, 1998). The first biosphere in South Africa was recently registered by CNC for the Kogelberg area to the west of the Agulhas Plain (Cape Nature Conservation, pers. comm.) and another one is being planned for the threatened lowland ecosystems adjoining the West Coast National Park, north of Cape Town (Heijnis *et al.*, 1999). The biosphere reserve concept has great potential for integrating conservation activities on the Agulhas Plain.

Non-governmental organizations

There are a number of active NGOs on the Agulhas Plain, which have traditionally focused on social, agricultural and marine resource issues. In this area, there are relatively few conservation-related NGOs in comparison with the nearby Cape Town metropole, where an activity such as the infilling of a wetland would cause a huge outcry from many organisations. In the relative isolation of the Agulhas Plain, such activities may even go unnoticed. However, following improved environmental awareness and legislation in recent years, Agulhas Plain NGOs have begun to tackle activities such as environmental education (Bredasdorp/ Napier Branch of the Botanical Society of SA; Pearly Beach Conservation Society), community conservation (Elim Tourism Committee), improving the nature reserve system (Franskraal Conservation Association) and "watchdogging" unscrupulous developments (Suidpunt

Conservation Society) Many NGOs are currently playing an important role in the implementation of the Agulhas National Park.

Financial, economic and social factors

The financial and socio-economic issues that are relevant to conservation implementation on the Agulhas Plain are social deprivation, dwindling funds for conservation and effective valuation of the costs and benefits of biodiversity conservation. These topics are briefly dealt with below.

Social deprivation

The Agulhas Plain has many social problems and issues which are currently being addressed by a regional development plan (Prins, 1999). While the per capita income is reasonable by South African standards, unemployment is over 50% in certain regions (MLH, 1994). About 60% of the region's estimated 45 000 inhabitants live in rural areas where health and educational services are rudimentary. Although primary health care services have improved since the first democratic elections of 1994, infant mortality is still unacceptably high and curable diseases such as tuberculosis are on the increase (MLH, 1994).

Owing to the peculiar history of South Africa, deprivation is overwhelmingly and disproportionately concentrated amongst the region's previously neglected community (i.e. coloured and African population groups). This poverty is juxtaposed with considerable affluence, especially in coastal resort settlements. In recent years, components of the predominantly white commercial farming sector have faced economic hardships associated with the withdrawal of state subsidies for the production of certain commodities. Low economic growth has also resulted in a contraction of economic activity in resort towns, although this is offset to a certain degree by increases in foreign tourism. These trends, in conjunction with the relatively recent migration into the area of many rural people from the Eastern Cape, have exacerbated unemployment, poverty and social problems (Prins, 1999).

Access to land and natural resources on the Agulhas Plain is not equitably distributed throughout the various sectors of the population (Prins, 1999). In particular, access to marine resources and dwellings at the coast are important issues for certain previously disadvantaged

communities (e.g. Elim, Struisbaai Noord) and a few land claims from local people have been submitted in this regard (R. Stevens, African National Congress: Bredasdorp Branch, pers. comm.).

The consequences of a large, poverty-stricken population on the Agulhas Plain is detrimental to many of the area's natural resources, where for example, sour figs (*Carpobrotus* spp.) and abalone (*Haliotis midae)* are being illegally harvested from within protected areas (D. Geldenhuys, Cape Nature Conservation, pers. comm.) and there is an increased incidence of hunting of wildlife for meat (A Adams, Alien Plant Clearing Contractor, pers. comm.).

Dwindling funds for conservation

The contribution by the South African state to conservation activities is decreasing every year. In 1996, only 0.28% of the national fiscus was allocated to biodiversity conservation (Kumleben *et al.*, 1998). The assumption is that nature conservation should ultimately become self-supporting. However, in South Africa only under exceptional circumstances does income derived from protected areas exceed expenditure through activities such as recreation, accommodation, game sales and other adjuncts to conservation (Kumleben *et al.*, 1998). In the interim, many conservation institutions and areas are facing serious decline.

Kumleben *et al.*, (1998) suggest a number of measures to increase funds for conservation activities, including: obtaining a sufficient share of the national lottery; tax relief in respect of donations for nature conservation causes; and the introduction of user fees in the form of a small excise tax for the purchase of hunting and fishing equipment. Owing to the fact that the above suggestions are likely to take a long time to be implemented, creative thinking and planning is required to ensure that the continued management and expansion of the conservation system occurs in the short term (Working for Water Programme, 1999; Hall-Martin, 1997).

The costs of managing fynbos ecosystems are very high and are certainly not covered by the tourism income derived by conservation authorities (Higgins *et al.*, 1997a). For example, it is estimated that the costs of the initial clearing of alien plants from the Agulhas National Park will be far in excess of what the national park is likely to generate from tourism within a 10 year period. These costs can be covered to a certain extent by the Working for Water Programme, as well as through funding by the international community. Alien plant removal qualifies as an

incremental cost in terms of GEF requirements, and GEF funds are being used to remove alien plants from the Cape Peninsula National Park to the west of the Agulhas Plain (World Bank, 1998).

In addition to the high costs of management, the costs of purchasing land for an Agulhas Plain conservation system are extremely high; clearly, alternative sources of funding will be required. In this respect, Fauna and Flora International have provided funds for the purchase of land on the Agulhas Plain that was imminently destined for vineyards. The transformation of the holding would have compromised severely the attainment of goals for the conservation of both biodiversity patterns and processes on the Agulhas Plain. This timely intervention – impossible without assistance from the international sector – ensured the retention of irreplaceable biodiversity (Cowling *et al.*, 1998).

As conservation is an expensive business, conservation management needs to be as efficient as possible, providing incentives to the private sector, who need to understand the costs and benefits of conservation facing different types of landowners and institutions. At the same time there is a need to demonstrate the socio-economic benefits of conservation (e.g. increased revenue and jobs) and the state needs to play an active role in promoting this awareness.

Effective valuation of the costs and benefits of biodiversity conservation

The rapid, world-wide natural habitat destruction which has taken place in the last fifty years is primarily attributable to unsustainable human economic activity Munasinghe (1994). That author believes that a more accurate valuation of natural resources would lead to a greater realization of the often irreversible environmental damage taking place. Ecological economics, a relatively new field (Costanza and Daly, 1992; Jansson *et al.*, 1994) plays a key role in identifying efficient natural resource management options for sustainable development (Munasinghe, 1994; McNeely, 1995; Peine, 1999).

Recent South African studies have attempted to value aspects of fynbos systems (Van Wilgen *et al.*, 1996; Higgins *et al.*, 1997a), biologically important regions (Turpie, 1996) and the entire fynbos biome in the Western Cape (Turpie *et al.*, in press). An ambitious attempt has also been

made to quantify the world's ecosystem services and natural capital in monetary terms (Costanza *et al.*, 1997).

Ecological economics is seen as a new tool which can be used to quantify the costs and benefits of protected areas and can thereby allow comparison between competing land uses. In most cases this involves the expression of ecosystem values in monetary terms which, though offensive to some, may actually strengthen the case for protection of key natural resources (Turpie & Siegfried, 1996).

Traditional market-related valuation techniques are well known and are readily accepted. However, natural systems often provide services which are not easy to value in conventional markets (Munasinghe & McNeely, 1994). Such values have to be estimated using non-market valuation techniques which are controversial as they are open to biases and subjectivity. However, various methods for measuring non-market values exist, many of which have been used in real-world cost-benefit analyses (Munasinghe & McNeely, 1994).

It is important also to capture non-market values associated with protected areas and biodiversity (Costanza *et al.*, 1997). Although certain non-market valuation techniques are controversial, they are nevertheless important in establishing society's willingness to protect natural resources.

Overview of different measurements of the value of ecosystems

The types of value attributable to the biodiversity of the Agulhas Plain can be classified following the conventional breakdown of total economic value of natural resources (Munasinghe 1994; Figure 1.4). These comprise use and non-use value, the former being further subdivided into direct, indirect and future use (or option) values.

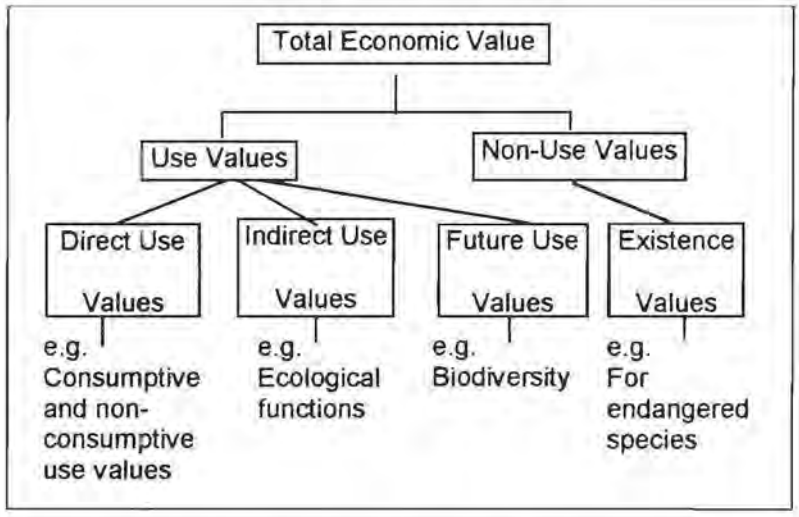


Figure 1.4 Categories of economic value associated with natural systems (after Munasinghe, 1994).

All of these categories of value may be attributable to ecosystem goods and services and some of the less tangible ones, e.g. existence value, may be very important for levering funds for endangered species conservation. However, non-use values and indirect and future use values are very difficult to measure. The easiest values to measure are direct use values, and where there are no existing markets, various techniques exist to enable the development of surrogate markets from which values can be measured (Munasinghe, 1994). For this study, direct and indirect use values are primarily dealt with.

Why is it important to value natural systems?

The importance of valuing natural systems cannot be over emphasized. The entire multi-million rand Working for Water Programme of the Department of Water Affairs and Forestry, which involves clearing invasive alien plants from mountain catchment areas (Department of Water Affairs & Forestry, 1997), was sold to decision makers (e.g. the Minister of Water Affairs and Forestry) using ecological economics. The argument presented showed that in terms of water production, it was far more cost-effective to clear catchments invaded with alien plants, than it was to build more dams (Van Wilgen *et al.,* 1996). Social and biodiversity benefits of the programme were positive spin-offs of what was essentially a cost-benefit analysis based on water production costs.

Little attention has focused on the benefits of biodiversity conservation on the Agulhas Plain and elsewhere in the CFR. Tourism is the CFR's fastest growing industry and in 1998 it comprised

about 11% of the Western Cape's gross regional product (WESGRO, 1998). Although tourists are attracted by the region's natural features, very little is done to protect those attributes that underpin the industry. For example, in 1996 the provincial budget for nature conservation was less than 1% of the aggregate spending of R 7.7 billion by tourists. Properly managed eco-tourism holds great potential as an economic incentive for conservation in the CFR (Cowling, 1993), especially with regard to job creation (MLH, 1994). A recent survey of businesses on the Agulhas Plain, indicated that, owing to the economic opportunities, the majority favoured the establishment of the Agulhas National Park (BJ Heydenrych & JK Turpie, unpublished data). Indeed, the economic impacts of protected areas extend well beyond their boundaries (McNeely, 1993). In South Africa, the Kruger National Park is estimated to have a value of between R 3 billion and R 5 billion after the economic multipliers have been taken into account (Kumleben *et al.*, 1998). Similarly, the Addo Elephant National Park generates some R 360 million annually (Geach, 1995). The value of these protected areas, which exceeds the individual park budget by orders of magnitude, provides evidence to decision-makers of their true contribution to the economy.

In a recent study undertaken by the University of Cape Town, the total willingness to pay for the conservation of terrestrial biodiversity on the Agulhas Plain was R 33.5 million (BJ Heydenrych & JK Turpie, unpublished data). Despite obvious shortcomings, this exercise nevertheless emphasises the willingness by a random sector of society (from both the Agulhas Plain and adjacent metropolitan Cape Town) to protect the biodiversity of the Agulhas Plain.

Clearly, there is much creative strategizing required to create the financial, economic and social basis for the Agulhas National Park. While the national park does have the potential to create funds, the costs of development will far exceed direct income derived from the project over the next 10 years. In this respect, the South African institutions must engage with the international community to provide for the incremental costs of park development. Only once the national park enjoys a measure of economic sustainability, will its biodiversity be effectively safeguarded. In the interim, and as the national park develops, commercial opportunities are being exploited by SANP. Thus, a decision was made to establish a gateway to the national park at Cape Agulhas, the southern tip of Africa but a relatively biologically depauperate area, in order to capitalize on the area's substantial tourist population. To the extent that it is practical, it is important not to sacrifice biodiversity conservation principles in the pursuit of economic sustainability (Burnie, 1994).

The overall aim of this study is to scientifically evaluate key parameters of the sustainable use, conservation and economics of a species-rich landscape, the Agulhas Plain, with a view to maximising the implementation of a protected area network.

Key questions which this study addresses are as follows:

1. **What are the current patterns of land-use on the Agulhas Plain - how has this changed over time and what are the predicted trends for the future?**
   Patterns of current land use are addressed in chapters 4, 5 and 6 with an indication of how these are changing in time being addressed in chapters 3 (past) and 5 (future).

2. **To what extent do landowners rely on the natural veld for their agricultural activities?**
   The above question is dealt with in chapter 4, where patterns of income source and land use are described, and in chapter 5 where estimates of the monetary value of natural veld is addressed.

3. **What is the use and value of the terrestrial biodiversity of the Agulhas Plain in terms of direct and indirect use value – fynbos products, grazing, bees etc.**
   The use and value of the vegetation of the Agulhas Plain is addressed primarily in chapter 5 where the use and value of activities such as veld-based grazing and wildflower harvesting are addressed.

4. **What is a typical Agulhas Plain visitor? – origins, accommodation used, time of year and length of stay.**
5. **What are their main reasons for visiting the area, and how important is the natural environment?**
6. **How do visitors currently use the natural environment?**
7. **What do visitors spend and what is the current recreational use value of the area?**
   The above questions (4 – 7) are all dealt with in the chapter 6 which deals with the use and value of tourism.

8. **How sustainable is the use of indigenous vegetation and what are some of the key the management implications?**
   The issue of sustainable use and management of fynbos is addressed in chapter 7.

9. **What are the costs and benefits of clearing invasive alien plants, ecologically, economically and socially?**
   This question is dealt with in chapter 8

10. **How will the establishment of a national park on the Agulhas Plain influence the existing land use of the area**
11. **What are the practical considerations which need to be to be taken into account when conservation interventions on the Agulhas Plain are implemented?**
    The issue of how the implementation of the Agulhas National Park will influence the current land use of the area is dealt with primarily in chapter 9.

12. **Which factors, economic or other, are determining land-use patterns and practices on the Agulhas Plain and are these compatible with the conservation of the area's rich biodiversity?**
    This question represents a theme which runs through the entire study.

Chapter 2 Methods

The methodology for this study comprises a landowner and visitor survey, a review of the scientific literature and interviews with key informants.

Landowner questionnaire survey

The data for this study were collected using a questionnaire which was designed to elicit as much information as possible about the use and importance of natural vegetation on the Agulhas Plain (Appendix 1). Owing to the fact that 97% of the land on the Agulhas Plain is privately owned (Lombard *et al.*, 1997), questionnaires were directed towards private landowners rather than the state or local authorities.

Appendix 1 outlines the information collected which can be grouped as follows;

- personal details of landowners;
- sources of income for management (this information was then used to determine land use categories);
- perceptions towards the proposed Agulhas National Park;
- future plans for the farm;
- farm size and tenure arrangements with respect to hiring out or leasing land;
- flower farming activities, including information on management of land and cultivation techniques;
- invasive alien plant information, including an estimation of areas infested, species found and management practices;
- grazing practices in areas of indigenous vegetation; and
- beekeeping activities.

In addition to the above, landowners involved with wildflower harvesting were asked to estimate average annual harvests, separately for the fresh and dried flower industry for all species used, using whichever units were appropriate (kg, stems or bunches; see Appendix 1). Thatching products used on the Agulhas Plain industry were included with fynbos flower data.

Fynbos is a fire-driven system (Van Wilgen *et al.*, 1992) and biomass, and also the number of harvestable stems, increases with post-fire age of the vegetation. This production increases up until the next fire occurs, at which time the plant material is eliminated and the cycle starts again.

There is a concomitant change in many fynbos wildflower products with this increase in biomass, until the next fire regenerates the growth cycle. As fires occur throughout the Agulhas Plain and data were collected from a wide variety of fynbos and allied vegetation types, it is assumed that the figures given integrate the dynamic fluctuations of fynbos ecosystems owing to fire. Actual harvest rates will, of course, differ from area to area, depending on age, as well as other factors, including degree of invasion by alien plants and species composition as a result of post-fire successional processes. The area of different vegetation type on each farm was ascertained with the aid of a Geographic Information System (GIS) coverage of the area at a 1:50 000 scale (Lombard *et al.*, 1997).

Prices and labour costs were obtained from a representative selection of landowners and buyers and the farm gate value was estimated separately for each species. Unit prices differ from species to species and depending on specific forms of marketing - fresh stems, dried stems, kg leaf matter and kg loose cones.

Most greens are sold by producers for R 0.80 – R 1.20 / kg, yielding an average net income to farmers of approximately R 0.75 / kg after accounting for picking (R 0.22- R 0.24 / kg) and transport costs. Prices for flowers and cones vary greatly between species (see Appendix 4), as do labour costs (about R0.03 - R0.05 per flower).

Owing to the large amount of information required to be captured for this survey, questionnaire interviews were conducted on a one- to- one basis with landowners or their appointed land managers. During the interviews, farm boundaries were determined on 1:50 000 maps and in most cases a field visit was undertaken with the landowner / manager.

Most questionnaire data were collected during 1997, and this is the year subsequently used for the calculations of economic values.

In many instances, average values and ranges are presented in the form $x \pm y$. Where this occurs, x is the mean of a sum of values and y is the standard deviation from the mean.

After the landowner interviews had been completed, the data were entered into a computer database (Microsoft® Excel 97) and Geographic Information System (ArcView® 2.1), and the results corroborated and augmented with interviews with key experts and a literature survey.

Visitor survey

For the purposes of the visitor survey, the area considered as the Agulhas Plain was slightly broader than that used for the landowner survey (Appendix 2). For example, visitor survey included the popular resort town of Arniston (Appendix 2). However, although the map in Appendix 2 suggests that Hermanus is part of the Agulhas Plain, this town was in fact, excluded from this study, as it was considered an end-destination in itself, in terms of tourism, i.e. many visitors to Hermanus do not visit the Agulhas Plain to the east (JK Turpie, Percy Fitzpatrick Institute, University of Cape Town, unpublished data). Furthermore, Hermanus attracts an enormous number of visitors due to its fame as a prime shore-based whale watching site (JK Turpie, unpublished data). This feature provides a large amount of revenue to the town (Findlay, 1997) which is likely to result in disproportionate spending patterns when compared with nearby towns on the Agulhas Plain.

Data were collected from organised tourism structures; publicity bureaux, Cape Overberg Tourism Association (COTA), Western Cape Investment and Trade Promotion Agency (WESGRO), accommodation establishments and questionnaire surveys of visitors. Two sets of visitor questionnaire surveys were used, as described below.

1. Self fill-in survey (Appendix 2). This survey was conducted jointly by BJ Heydenrych and Dr JK Turpie between September 1996 and early 1998, incorporating the peak visitor seasons in spring and summer. Self-fill-in questionnaires, in English, Afrikaans and German, were distributed to hotels, guesthouses, bed & breakfast establishments, self-catering accommodation and caravan parks throughout the Agulhas Plain. A total of 165 questionnaire responses (out of 679) were collected, representing a total of 403 visitors.

2. Interview survey (Appendix 3). The above data were supplemented by a similar questionnaire survey administered to visitors through interviews during the long weekend of 15th - 17th June 1997. The aim of the interview survey was to sample a greater proportion of local Agulhas Plain visitors, as initial analysis showed that the self fill-in survey was mainly being filled in by international visitors. In order to get a representative local visitor sample, based on the results of Turpie (1996), the high tourist season peaks were avoided. Instead, a long weekend period was chosen. Sampling intensively during this period does have certain drawbacks, which are

discussed in Chapter 6. M.Sc. students in Conservation Biology at the Fitzpatrick Institute, University of Cape Town assisted with the administration of the interview survey

The interview survey was altered and simplified from the self fill-in survey to make it more suitable (Appendix 3). The interview survey was carried out at a wide variety of locations (beaches, monuments, harbours, hotels etc.) and in all Agulhas Plain towns. A total of 97groups of visitors were interviewed representing 501individual visitors within the Agulhas Plain..

The terms "visitor" and "tourist" are used interchangeably throughout this study, although a small percentage of the visitors were involved with non-tourist activities (Chapter 4). The self fill-in questionnaire was administered by accommodation establishments which cater primarily for tourists and during the interview survey only people who considered themselves visitors to the area, were interviewed (Appendix 3).

Owing to the fact that the self-fill-in survey was biased in favour of international visitors and the interview survey was over-representative with respect to domestic visitors, the data from the two surveys were pooled for the analyses, with the expected 75:25 - domestic:international visitor ratio, described above, being achieved as a representative sample of Agulhas Plain visitors.

In the pooling of data from the two different tourism survey questionnaires, the accommodation categories "self-catering" and "rented house" were combined. In addition, certain activities, "hiking/mountain biking" and "museums/culture" were grouped together.

The travel-cost method

The total expenditure by tourists to the Agulhas Plain was estimated from the survey data. In addition, the full recreational use value of the Agulhas Plain, including consumer surplus, was estimated using the zonal travel cost method (OECD, 1995; Turpie, 1996). The travel cost method is used for estimating the recreational demand for a site in the absence of market prices (Freeman, 1993; OECD, 1995;). Concentric zones are drawn around the site and the number of visitors from each zone is elicited through surveys, with travel distances finally being converted to expenditures (De Lacy & Lockwood, 1994). The travel expenditures are then used to draw up a demand curve for the site or resource in question and the area under the curve is interpreted as the total benefit of the site or resource (OECD, 1995). Opportunity cost in terms of time taken

away from the workplace to travel to a recreational site was not considered in this study, as this should not necessarily be regarded as a cost to the user (OECD, 1995).

In this study the frequency of visitors from zones of different distances from the Agulhas Plain is compared with the travel expenditures from each zone to estimate the visitors demand curve and consumer surplus. The 11 origin zones were as follows: Asia, Europe, North America, Australasia, Gauteng, Northern Province, Kwazulu-Natal, Eastern Cape, the Western Cape excluding Cape Town and the Overberg, which were treated as separate areas. Population estimates were obtained from Arc View 2.1 ® data sets (international), 1995 population estimates by the Central Statistical Services and KPMG (1998).

Travel expenditures include on-site costs as well as the costs of getting to the Agulhas Plain. For international visitors the latter was calculated by the time spent at the Agulhas Plain as a proportion of the total trip multiplied by the total transport costs (flight, hired car etc.). For domestic visitors this figure again factored in the time spent at the Agulhas Plain as a percentage of the entire trip away form home. Here the cost of getting to the area was obtained by multiplying the distance travelled from the place of origin and back by the average car running cost per kilometre in 1997, supplied by the Automobile Association of South Africa (R0.413/km – average running cost for cars with 1.1 to 3.0 litre engines).

Foreign exchange rates

The self fill-in questionnaire allowed visitors to state their spending patterns in whatever currency they chose. Although the questionnaires were collected over a period in which there were vast fluctuations in exchange rates (1997), standard rates were used in order to facilitate computation of the results in South African rands. The following average exchange rates for the 1997 period were therefore used for this study:

1 British pound = 8.7 South African rands
1 United States dollar = 5.3 South African rands
1 Deutsche mark = 2.9 South African rands
1 Swiss franc = 3.3 South African rands
1 Austrian shilling = 0.4 South African rands

For the self fill-in survey, certain international visitors failed to fill in their flight costs to and from South Africa, or filled in amounts which were clearly the costs of their entire trip. In such cases, where the information with regard to spending within South Africa was otherwise well filled in, an average flight cost per person, to and from South Africa of R5 000 and R7 000 was estimated for Europe and North America respectively.

Some respondents to the questionnaire surveys failed to provide information on their on-site spending. To take this into account, these respondents were excluded when average on-site spending was calculated for different zones.

After the visitor interviews had been completed, the data were entered into a computer database (Microsoft® Excel 97) and the interpretation of the results was enhanced from interviews with certain key experts and results from similar studies published in the scientific literature.

In certain instances, average values and ranges are presented in the form $x \pm y$. Where this occurs, x is the mean of a sum of values and y is the standard deviation from the mean.

Chapter 3 Historical background of land use on the Agulhas Plain

Land use by humans at a landscape level provides an ever-changing picture, which is at best experienced as a snap shot of the current pattern at any given time. What is described as land use for a particular area may in reality reflect a short term pattern, which could change dramatically in a period as little as a few years. In order to understand current land use on the Agulhas Plain, it is pertinent to look briefly to the past history of this region.

This chapter addresses part of key question 1 in that it examines how land use on the Agulhas Plain is changing over time.

Pre-colonial land-use

The earliest records of early human habitation on the Agulhas Plain include Earlier Stone Age (more than 200 000 years ago) artefacts from the Springfield farm (Wilson, 1988).

Extensive evidence of modern human habitation on the Agulhas Plain has been unearthed from the Die Kelders Cave on the western shores, near the fishing town of Gansbaai. Here, excavations from the Die Kelders Cave 1 have dated findings of modern humans to the Middle Stone Age (MSA), 60 – 80 000 years ago, at the same time that Neanderthals inhabited Europe (Avery *et al.*, 1997). Faunal remains found at the cave for the MSA, which include grazers such as the quagga (*Equus quagga*), the Cape mountain zebra (*E. zebra)* , the black wildebeest (*Connochaetes gnou)* and the southern reedbuck (*Redunca arundinum)*, provide evidence for a grassy vegetation and cooler, moister conditions than at present (Avery *et al.*, 1997).

It is suggested that during this period, MSA people were using fire as a tool to "farm" fynbos, by stimulating the yield of edible geophytes such as *Watsonia* spp., plants which are most prominent in early post-fire succession (Deacon, 1992).
Hunter gatherers of the Later Stone Age (LSA) began occupying the fynbos biome in larger numbers from approximately 21 000 years ago, after the cooler glacial conditions that preceded this time abated. These people hunted zebra, wildebeest and eland on the coastal lowlands and, using fire to burn the veld, played a part in the extinction of large grazing herbivores such as the hartebeest and the giant buffalo, which were components of this LSA fauna (Deacon,

1992). Faunal evidence from the Agulhas Plain suggests that there has been little climatic variation over the past 13 000 years (Avery *et al.*, 1997).

It is suggested that approximately 2000 years ago, following an increase in population numbers due to successful hunting and "fire-stick farming" techniques, the LSA population was close to its carrying capacity for the region (Deacon, 1992).
A significant event which allowed the expansion of the human population in the Western Cape and was to change the patterns of land use enormously, occurred at this time with the introduction of first domestic sheep, and later cattle, by the Khoikhoi herders (Deacon, 1992; Boonzaier *et al.*, 1996). In Africa, domestic cattle and sheep, which originated in the Middle East, were first domesticated in the extreme north of the continent 8000 years ago, but it took approximately 6000 years before they were introduced to southern Africa (Boonzaier *et al.*, 1996). There are various theories on the southward migration routes which were followed by the Khoikhoi herders (Boonzaier *et al.*, 1996) but it is agreed that the fat-tailed sheep were ideally suited to cross the dry interior of the country to reach the more dependable winter rainfall region of the south western Cape (Boonzaier *et al.*, 1996).

The spread of nomadic herding by the Khoikhoi developed as these people moved to find new grazing and water for their stock, entering the territory previously inhabited by the hunter-gatherers, the San (or Sonqua), thereby putting pressure on the latter's resources, in particular grazing areas for wild game. Conflict arose between the herders and the hunters with the San firstly hunting and later "stealing" the Khoikhoi's livestock. Later, many of the San were employed by the Khoikhoi and thereby began to lose their identity and culture as they adopted the herding lifestyle (Boonzaier *et al.*, 1996).

The effect that the herders had on the south-western Cape's landscapes and ecology is not quantifiable, but given the estimated numbers of humans (50 000), cattle (250 – 500 000) and sheep (up to 1 million) by the mid-seventeenth century (Deacon, 1992), this must have been significant. Soil erosion from diminished vegetation cover and increased fire cycles would have been important disturbance factors (Deacon, 1992).

However, it is unlikely that either 100 000 years of "fire-stick farming", regarded as a minor modification of the natural fire regime (Downing, 1978) or 2000 years of subsistence stock

farming would have nearly as much effect on the ecology of the area as the next 350 years of European-style farming which began after the Cape was colonised by the Dutch in 1652.

Early colonial land-use

Just as the Khoikhoi before them had impacted on the way of life of the San, so too did the European colonists dramatically alter the lifestyle of the Khoikhoi. As early as 1679 permits for loan farms were issued and by 1760 farming extended throughout the entire fynbos biome (Deacon,1992). The permits involved grazing rights for six months or a year and the nomadic pastoralist farmer (*trekboer* in Afrikaans), could leave one area when the grazing deteriorated and apply for a license for another area to which he travelled (Le Roux, 1988). Although this land-use by the early colonists was arguably similar to that of the Khoikhoi herders, other factors, in particular the introduction of guns and disease, led to the extermination of many large game species and indigenous people respectively. The majority of larger mammal species (more than 50 kg) and numerous bird species were exterminated during the 1800s (Skead, 1980). In 1713, the entire Khoikhoi people were practically exterminated by a smallpox epidemic (Boonzaier *et al.*, 1996).

Two agricultural developments introduced by the colonists significantly influenced the natural process shaping the Cape's landscapes at the time:
Firstly, the awarding of more permanent holdings to encourage farmers to settle away from the Cape Colony (at Cape Town), resulted in individual ownership of areas with the concomitant potential for overstocking and overgrazing. To the Khoikhoi, who farmed these areas previously, grazing and water were considered communal resources which were allocated by various clans, and private possession existed only with respect to domestic stock (Boonzaier *et al.*, 1996). When European settlers entered Khoikhoi areas, the herders would sometimes defend their territories, but in the end they responded by moving out of the way, either by taking over other herder's areas or by becoming employed (often as slaves) by the colonists.
Secondly, the introduction of the plough in the 17th century, which was already in existence at the time in central but not in southern Africa, dramatically changed the landscape of the south western Cape. The European immigrants started cultivating wheat, rye, barley and grapes for making wine, initially targeting the richer Renosterveld soils, and later initiating ploughing of the marginally fertile fynbos soils of the Cape lowlands. By the late 1980s, Renosterveld on the

coastal plain had been severely reduced (Chapter 1), and 40% of lowland fynbos has been replaced by agricultural cultivation (Rebelo, 1992). Whereas low-level grazing may be considered a sustainable form of agriculture, agronomy normally causes irreversible change and destruction of natural ecosystems (Harris, 1978, cited by McDowell, 1998).

Grazing rights on the Agulhas Plain were first granted in 1739 and the oldest farms include Nacht Wacht (1739) and Zeekoeivlei (1740) (Scott, 1995), although living relatives of original setters claim that their forefathers have been farming in the region since the late 1600s (Petrus Swart, Bosheuwel Farm, pers. comm.). Initially meat production was the main source of income with native breeds of livestock being better suited to unimproved pastures than European ones.

However, the introduction of Merino sheep from Spain which were crossed with indigenous breeds at the farm Soetendalsvlei near Cape Agulhas (Scott, 1995), saw the beginning of the wool industry that not only saved the Cape Colony from bankruptcy in the middle of the 1800s, but also financed the opening up of South Africa's interior to European settlement (Deacon, 1992). By 1875, 19 300 tons of wool were being exported from the Cape Colony annually (Downing, 1978). However, there are often negative consequences associated with economic growth. With the large scale transformation of the landscape already having taken place by the time the early naturalists explored the region in the late 18th century, it has been suggested that many plant species may have become extinct before the region was explored botanically (Hall & Veldhuis, 1985).

In the Western Cape, a dramatic expansion of the agricultural sector took place between 1826 and 1909 and between 1850 and the 1950s the majority of land transformation which is evident today had already taken place (Downing, 1978; Hoffman, 1997). Major environmental changes as a result of agricultural activities are likely to become noticeable from 1850 onwards. It is interesting to note that, partly as a result of the Cape Colony having trade with other colonies (notably Australia) at the same time, new horticultural varieties (*Acacia* spp., *Hakea* spp, *Leptospermum laevigatum*, *Paraserianthus lophantha*) which were introduced during the period 1830 - 1860 also became major agents of land transformation through their uncontrolled spread (Richardson *et al.*, 1992; Hoffman, 1997).

After slavery was abolished 1834, and after serving an "apprenticeship" of four years (1834-38) on their master's properties, some indigenous people were fortunate enough to acquire their

own land, although many of the indigenous people stayed on the farms where they had originally worked as slaves, (Boonzaier *et al.*, 1996). For example, the town of Elim which was founded by German Moravian missionaries in 1824, became a major refuge for freed slaves, following their emancipation in 1838. A communal system of land ownership and tenure was introduced to the 7000 ha property which remains in place today. The fynbos wildflower industry has its roots in Elim where as early as 1877 everlastings (*Syncarpha* spp.) were harvested on a large scale and sent to Cape Town for export to Europe (Kruger, 1967, in Killian, 1995).
Other indigenous peoples remained in situations similar to their original slavery through a series of pass laws and similar restrictive legislation which began in the early 1800s. Five years after South Africa's first democratic elections, descendants of these people remain in a worse socio-economical predicament today than the descendants of the European immigrants (Prins, 1999). This is not surprising, as the process of redressing injustices of the past, building capacity and empowering previously disadvantaged people of the rural lowlands of the Cape, is likely to be a lengthy process.

Modern land-use and tourism trends

Although much agricultural transformation had already occurred in the 18th and 19th centuries, the 20th century saw ongoing increases in this trend. Dramatic changes in agricultural use of the Agulhas Plain were introduced after the 1940s with the introduction of mechanised agriculture, which saw an increasing shift from veld-based grazing to the cultivation of soil for artificial pastures and cereal crops (Mustart *et al.*, 1997). This shift is likely to have been enhanced further by incentives to clear land for cultivation, which were made possible by legislation promulgated in 1930 which served to protect South African producers (Talbot 1971, in Hoffman, 1997).

Conventional agriculture still dominates the region today (MLH, 1994), although new forms of agriculture are now starting to make their appearance. Recently, the development of modern irrigation equipment has meant an increase in the cultivation of intensively-grown crop plants (personal observation). Patterns of modern terrestrial land-use are examined in detail in Chapter 5.

The tradition of spending a certain time period each year at the coast, which dates back to the 1800s for some long-standing Agulhas Plain families (J. Albertyn, Brandfontein Farm; L. October, Elim, pers. comm.) has increased to a much wider group of domestic visitors who make an annual pilgrimage to their holiday homes, rented accommodation, friends, family or caravan park each summer in mid-December (personal observation). This practice, which has seen a dramatic increase in the numbers of visitors and value of domestic tourism over the past 30 years or so, started in earnest in the mid 1960s and has escalated since then, slowing somewhat only recently with emigration, higher real tax rates and opportunities to invest off-shore.

Notwithstanding this, following the first democratic elections in 1994, South Africa has experienced an influx of international visitors, and the Agulhas Plain has also benefited socio-economically over the past few years from this trend. Tourism and recreational value of the Agulhas Plain's natural and cultural environment is examined in detail in Chapter 6.

Introduction

This section provides an overview of land-owner profiles and pattern of terrestrial land-use on the Agulhas Plain. The information presented here is based on questionnaire surveys and interviews with key informants. A Geographic Information System (GIS) is used to illustrate patterns of land use.

When establishing a new protected area network in an area it is important to have a clear idea of the patterns of land use which currently exist in the region. This chapter addresses the issue of current land use patterns (key question 1) as well as the importance of the natural environment for landowner's agricultural activities (key question 2).

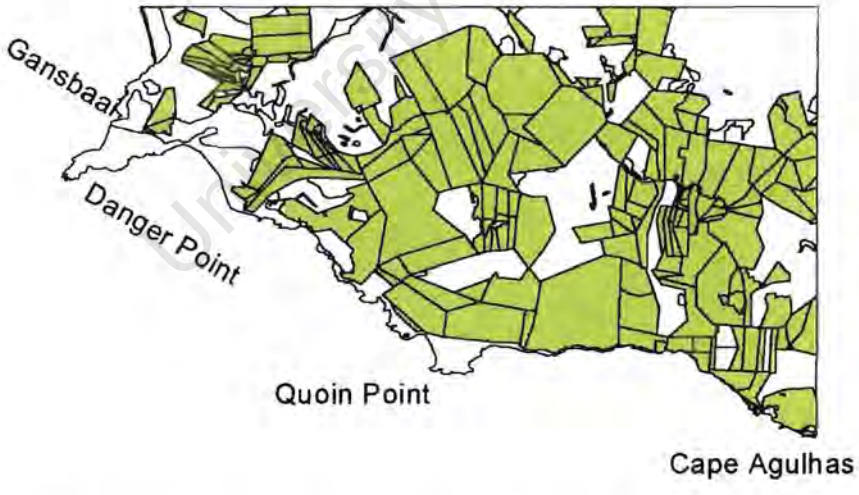


Figure 4.1. Area surveyed during interviews during the questionnaire survey, depicted by shaded polygons (n=60).

General land-owner profile

A total of 60 land-owner questionnaire surveys (see Appendix 1) were completed, representing an area of approximately 87 404 ha (57%) of the Agulhas Plain (Figure 4.1). This represents 201 individual land parcels, with each landowner owning on average between three and four parcels with an average farm size of 1457 ha.

The majority of landowners (70%) reported that they derived their income from agricultural activities while the remainder supported their properties' management costs using external sources of income. Most landowners (77%) resided on the properties or had permanent managers residing there, with relatively few farms having absentee landlords. 58% of landowners sampled belonged to one of the local farmers associations (Haasvlakte - 27%; Strandveld - 19%; and for Bredasdorp, Stanford and Elim combined - 10%). The main reason that the remaining landowners did not belong to farmers' associations was that they were not actively engaged in farming.

The relative stability of this farming region is reflected by the fact that the majority (70%) of landowners have owned their farms for more than 10 years with some families owning them for more than 100 years (18%).

Income sources for private landowners

According to MLH (1994) the most important agricultural products on the Agulhas Plain are milk products, fynbos flowers, grains and wool. Figure 4.2 indicates the average ratio of different income sectors for all the Agulhas Plain landowners sampled. These different income sectors were determined *a priori* (Appendix 1) and, for completeness, the results include sectors for which zero values were obtained.

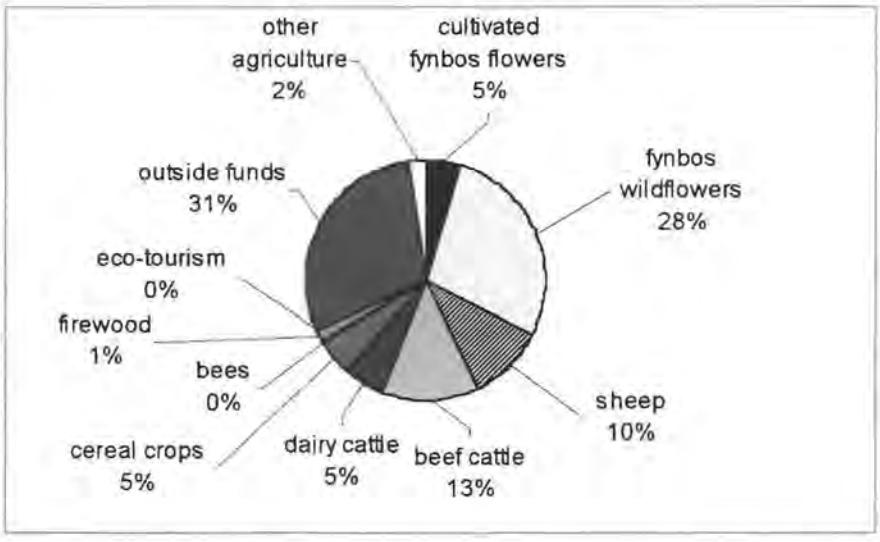


Figure 4.2. Average ratio of reported landowner income for different sectors (n=54).

Clearly, as would be expected, agriculture dominates the region's income. A surprisingly high 31% of the landowners' income was reported to come from outside funds (Figure 4.2), which could indicate that there is possibly a sampling bias towards "conservation landowners" who are not reliant on the land for their income. To correct for this possibility it is therefore important to distinguish between "working farms" and "conservation farms". As "conservation landowners" were found to be, on average, 90% reliant on outside funds, it is more pertinent to examine *bona fide* farmers alone with respect to income sector analysis.

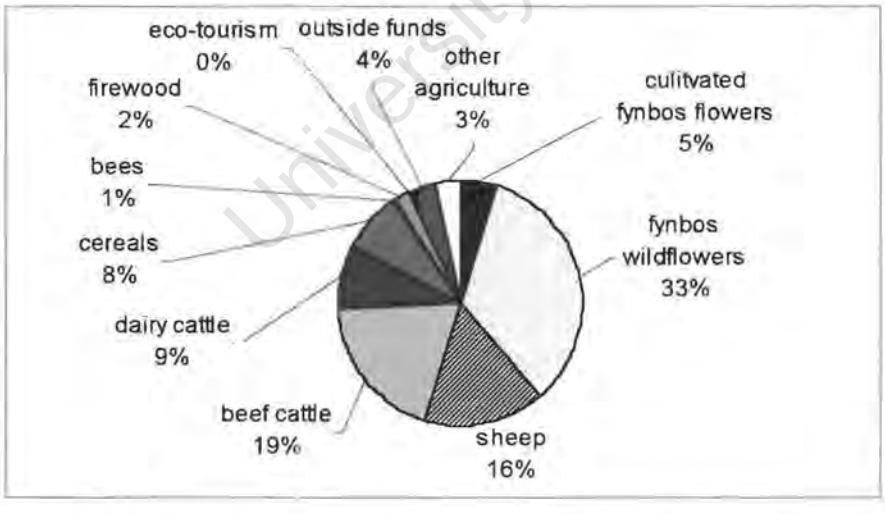


Figure 4.3. Average ratio of reported landowner income ("working farms" only) for different sectors. (n=42)

Figure 4.3 illustrates that on average for "working farms", the most important agricultural economic sectors reported was fynbos wildflowers, followed by various forms of conventional agriculture, with outside funds, other agriculture, firewood and beekeeping having the lowest values.

The estimated income ratios for farms in the relatively nutrient-rich Strandveld agricultural zone (Figure 4.4) are as follows:

30% cash crops (wheat, barley, canola etc.)
50% sown pastures for livestock (oats, clover, medics etc.)
20% veld and vlei derived products (wildflowers, thatch, grazing)
(K. Robertson, agricultural consultant, pers. comm.).

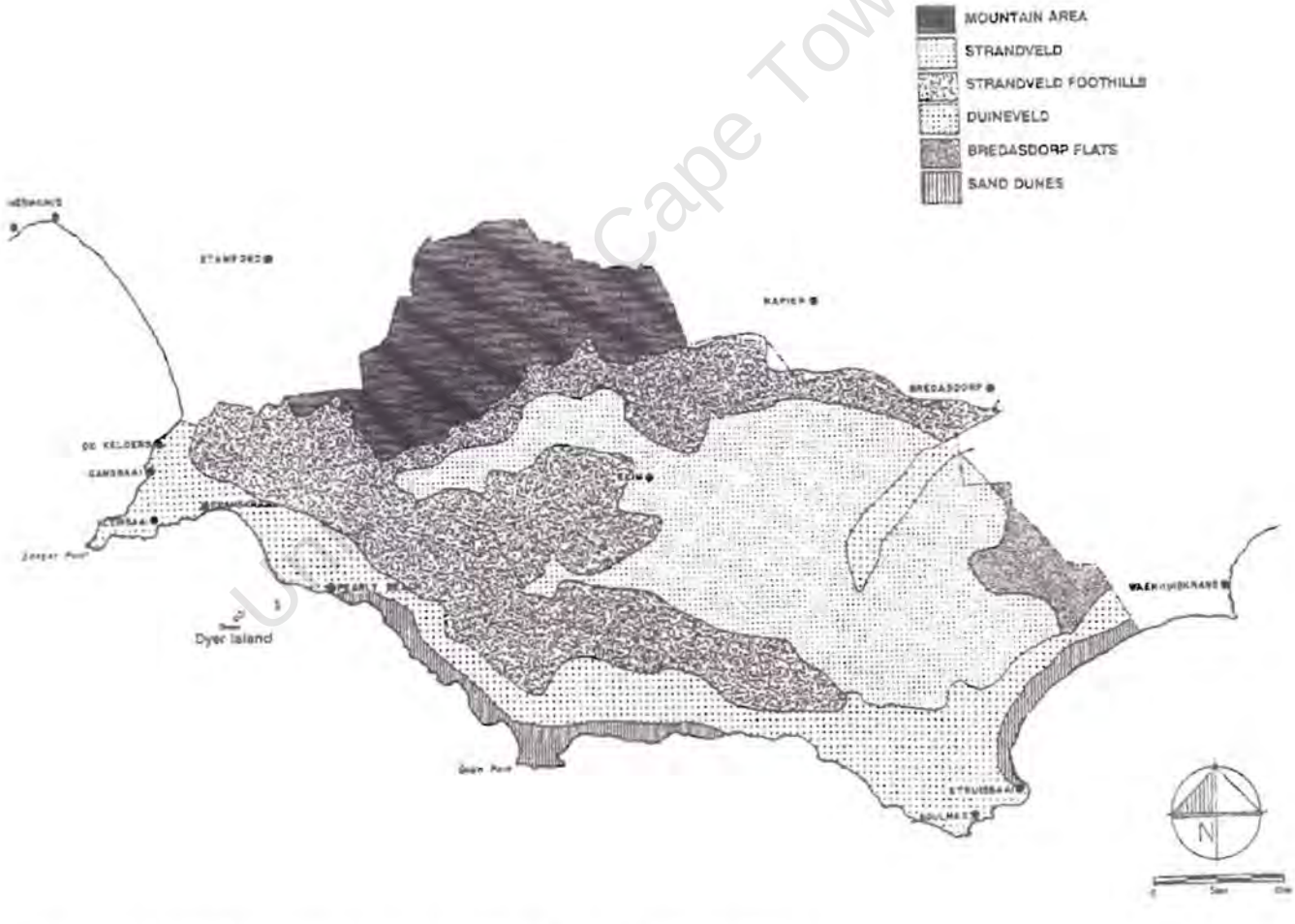


Figure 4.4 Agricultural zones on the Agulhas Plain (after MLH, 1994).

However, the importance of fynbos flowers increases in the less fertile Mountain and Strandveld Foothills agricultural zones (Figure 4.4) where a number of farmers rely entirely on fynbos flowers as a source of income.

Current land-use patterns

Conventional agricultural zones

The Overberg region, of which the Agulhas Plain forms a substantial part, is primarily an agricultural area, with 37% of the Gross Regional Product (GRP) allocated to this sector, followed by trade at 12% GRP (WESGRO, 1997).

Farming zones

There are four main farming zones applicable to the Agulhas Plain: Duineveld (= duneveld), Strandveld foothills, Strandveld and Mountains (Figure 4.4).

The Duineveld zone occurs on the coastal plain where sandy, calcareous soils which are highly wind-erodible, are found. This zone includes the state-owned driftsand reclamation areas controlled by the Cape Nature Conservation (state forests), and most of the Agulhas Plain's towns, villages and resorts. Very little of the privately-owned Duineveld has been ploughed, although some cultivation for wheat, pastures and vegetables has been attempted. However, the area has been severely invaded by Australian acacias, in particular *Acacia cyclops* and *A. saligna* (Figure 1.3) (MLH 1994).

The Strandveld foothills which dominate the western Agulhas Plain (Figure 4.4), incorporating the Viljoenshof, Baardskeerdersbos and Uilkraal settlements, have soils which are marginally fertile for agriculture. Although much of the indigenous fynbos in this area is available for commercial wildflower picking, substantial areas have been cleared for pastures for dairy and meat production (MLH, 1994) and more recently for the cultivation of fynbos species.

The Strandveld zone on the inland plains has the highest agricultural potential on the Agulhas Plain, and prior to cultivation would have primarily supported Renosterveld and allied vegetation

(Figure 1.2). About 70 percent of this zone is cultivated with wheat, oats, barley, rye and vegetables (MLH, 1994). The area further supports a range of agricultural activities including wildflower cultivation and wool/mutton sheep and dairy/beef grazing, but remaining fynbos patches are mostly infested with alien acacias (D. Cronjé, Department of Agriculture, *in litt.*; MLH, 1994).

Mountain areas are characterised by highly infertile soils, here irrigation of pastures takes place in the lower slopes where water resources are good, and agricultural activities are otherwise dominated by wildflower harvesting, and more recently cultivation of fynbos flowers (MLH, 1994).

Although not a major use to the landowner, grazing of fynbos and other indigenous vegetation types does supplement the diet of cattle, sheep, and in a few cases, game.

Small holdings

There are a number of small holdings on the Agulhas Plain which are used for various activities. Many of these are poorly sited, often on sensitive vegetation (e.g. Limestone Fynbos and Neutral Sand Fynbos) or in places where they impact negatively on the aesthetic character of the area . It is believed that in time, as each owner of a small holding "develops" the piece of land through bush clearing, grazing or by excluding fire, the indigenous biodiversity of these areas will decline markedly . In addition, small holdings attract many people from the cities who do not have the necessary farming skills and local knowledge manage these areas, and are often responsible for starting veld fires on the Agulhas Plain (P. Cilliers, pers. comm.).

The lower limit of self-sufficient agricultural holdings is estimated to be 30 hectares (F. Van Eeden, Department of Agriculture, pers. comm.), although others may contend that smaller areas (e.g. 5-10 ha), particularly under irrigation (C. Swart, Blomerus Farm, pers. comm.) would be viable (P. Swart, Elim Opsienersraad, pers. comm.). Of the 667 land parcels on the Agulhas Plain (which excludes plots in municipal areas), 219 are smaller than 30 hectares, but combined, account for only 1949 hectares (1.3% of the surface area of the Agulhas Plain). Although some of these properties are part of larger farming units, and are a result of odd subdivisions of agricultural land in the past, many represent independent small holdings.

Urban development

Urban and holiday resort development, important economic activities for the Agulhas region, are regulated by local authorities, and are primarily sited along the coastal strip. Although certain local authorities have instituted good conservation practices, this is not consistent throughout the Agulhas Plain. Boardwalks to protect coastal vegetation and the establishment of local authority nature reserves represent good conservation practices, but certain authorities have sold off public open space for development and insist on clearing vast tracts of coastal fynbos and thicket as a method for reducing the fire hazard (personal observation). In actual fact most of the fire hazard comes form the alien Rooikrans trees (*Acacia cyclops*) which the local authorities have failed to clear.

Conservation

Conservation as a formal land-use on the Agulhas Plain began in 1941 with the proclamation of the De Mond State Forest, followed by the Walker Bay State Forest in 1960 (Figures 4.5 & 4.6; Cape Nature Conservation, *in litt.*). These areas do not contain elements that could be described as "forest" (although there are thickets) worthy of protection, but were proclaimed for two completely different reasons.

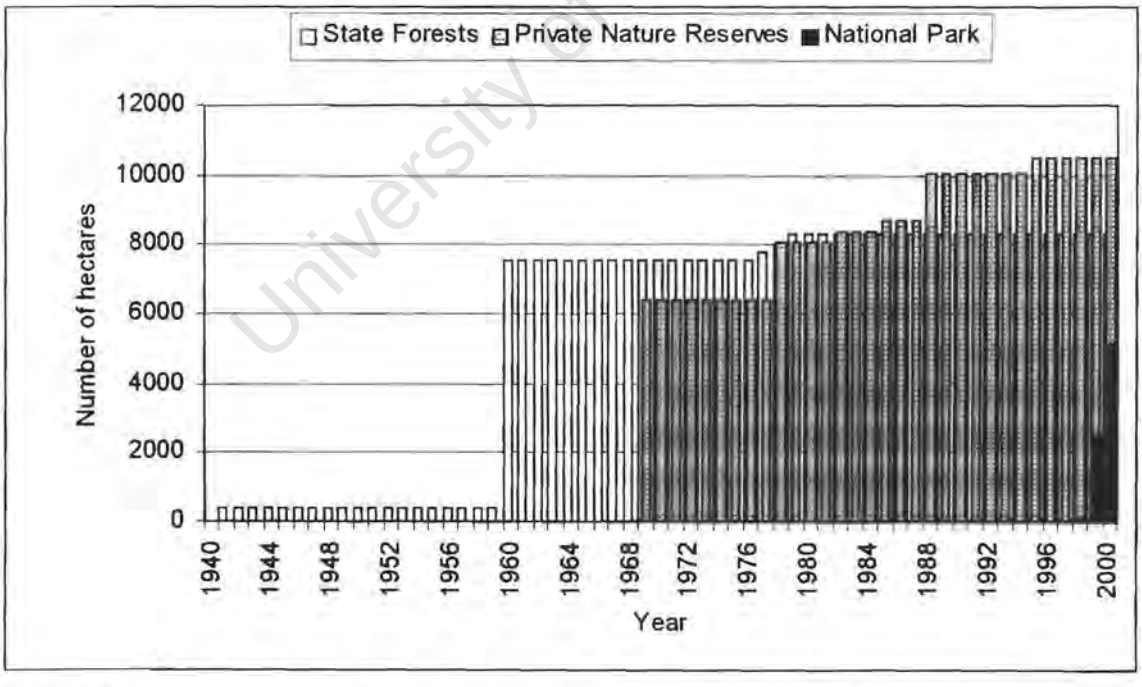


Figure 4.5. Sixty years of formal conservation on the broader Agulhas Plain, represented by cumulative hectares under three protected area categories.

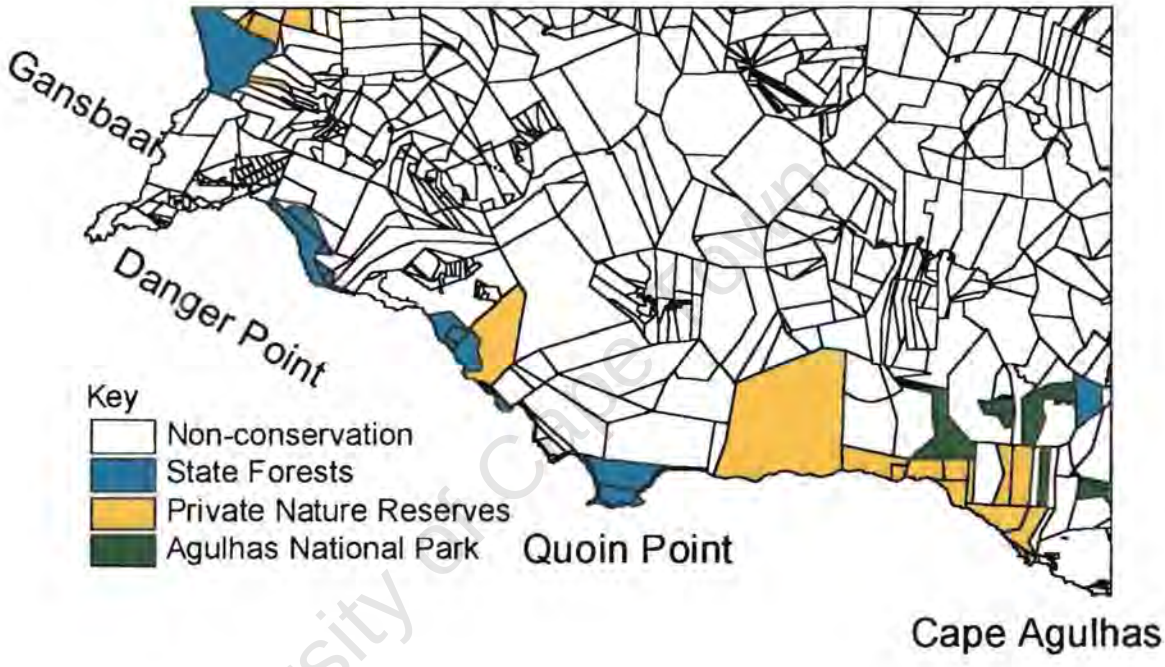


Figure 4.6. Protected area network on the Agulhas Plain showing existing protected areas and the first portions of the Agulhas National Park.

The first portion of the De Mond State Forest to be proclaimed is situated in the middle of the Soetendalsvlei, a permanent freshwater lake! This area later became recognised for its important role in the conservation of wetland birds (Barnes, 1998). However, the original reason for proclaiming the lake a state forest was for state security, as this area was apparently made available for sea planes to land during the 2nd World War (Agulhas Plain landowners, pers. comm.).

Later, more state forests were proclaimed to stabilise coastal sand dunes. The shifting sand in these coastal areas was considered a threat to agricultural land, and it was believed they should be stabilised. An intensive planting programme was initiated which included both indigenous and alien plant species (Walsh, 1968) The programme continued as late as the 1960s until it became apparent that some of the alien species had become invasive, and it was subsequently reversed. Today, the biggest management cost in these state forests is the manual removal of invasive alien trees (primarily *Acacia cyclops*) which were actively planted there a few decades previously.

There are a number of state forests on the Agulhas Plain, representing a relatively large area (Figure 4.6). There are currently no facilities for tourism at these sites and they are used primarily for conservation purposes. When the management of these state assets was devolved from national government to the provincial government in the mid-1980s, cross subsidisation from forestry permits which had previously financed their management fell away (Rebelo, 1992). There is consequently insufficient funding to adequately manage these areas (Cape Nature Conservation, pers. comm.).

Private conservation on the Agulhas Plain was initiated by the Albertyn family with the establishment of the Brandfontein Private Nature Reserve in 1969 (Figures 4.5 & 4.6; Cape Nature Conservation, *in litt.*). Other landowners followed suit and today there are a number of private nature reserves and Natural Heritage Sites in existence on the Agulhas Plain. These areas are conserved for private use, and some landowners have initiated income-generating eco-tourism activities.

Nuclear power site

During a ten year siting programme, South Africa's electricity supply utility (Eskom), used a process of elimination to identify four sites suitable for the generation of nuclear power, including one on the Agulhas Plain, Bantamsklip, on the farm Groot Hagelkraal near Quoin Point (MLH, 1994). The Groot Hagelkraal site has been recognised as an irreplaceable hotspot of botanical diversity (Lombard et a., 1997) and has been described as the botanical jewel of the Southern Overberg (Mustart *et al.*, 1997). Although Eskom have established the framework for siting a nuclear power generator at Groot Hagelkraal within a structure plan for the area (MLH, 1994), it is not certain when (if at all) the site would need to be developed. In the meantime the area continues to be managed as a private nature reserve and Natural Heritage Site, where

sustainable harvesting of wildflowers, firewood collection and invasive alien plant clearing takes place in accordance with an approved management plan (CSIR, 1996). Therefore, although the site remains irreplaceable, it is currently not vulnerable in terms of major threats to its botanical biodiversity.

Spatial patterns reflecting landowner's income source

When examining the different categories of landowners spatially, interesting patterns emerge. Figure 4.7 indicates the geographical location of "working farms" and "conservation farms", based on income source (internal versus external), sampled in this study. Spatially, the conservation farms cover a much smaller area than the working farms and tend to lie close to the coast (Figure 4.7), ideally situated as either getaway locations for the enjoyment of nature and/or for eco-tourism development. The "working farms" are spread throughout the region, covering a broad range of vegetation types (Figure 1.2) and agricultural zones (Figure 4.4). The use and value of both "working" and "conservation" farms are examined in Chapter 5.

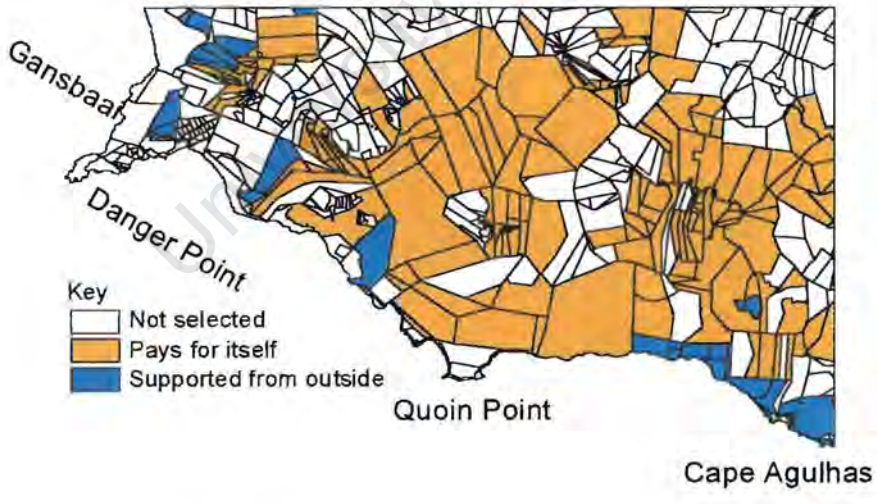


Figure 4.7. Geographic location of "working farms" (pays for itself) and "conservation farms" (supported from outside) on the Agulhas Plain (n=60).

Chapter 5 Agriculture and utilization of natural resources – use and value

This chapter addresses the use and value of land and natural resources on the Agulhas Plain and deals with some of the issues raised in key questions 1 – 3:

- What are the current patterns of land-use on the Agulhas Plain - how has this changed over time and what are the predicted trends for the future?
- To what extent do landowners rely on the natural veld for their agricultural activities?
- What is the use and value of the terrestrial biodiversity of the Agulhas Plain in terms of direct and indirect use value?

Land-use activities primarily undertaken by private landowners

A spatial representation of four categories of land-use by private landowners on the Agulhas Plain (fynbos flowers, livestock farming, mixed farming, conservation) is shown in Figure 5.1. Properties were assigned categories based on the dominant (more than 50%) income sector reported by the landowner. Livestock properties include both sheep (wool and mutton) and cattle (beef and dairy) farming. The distribution pattern of conservation farms (Figure 5.1) mirrors properties which depend on outside funds (Figure 4.7).

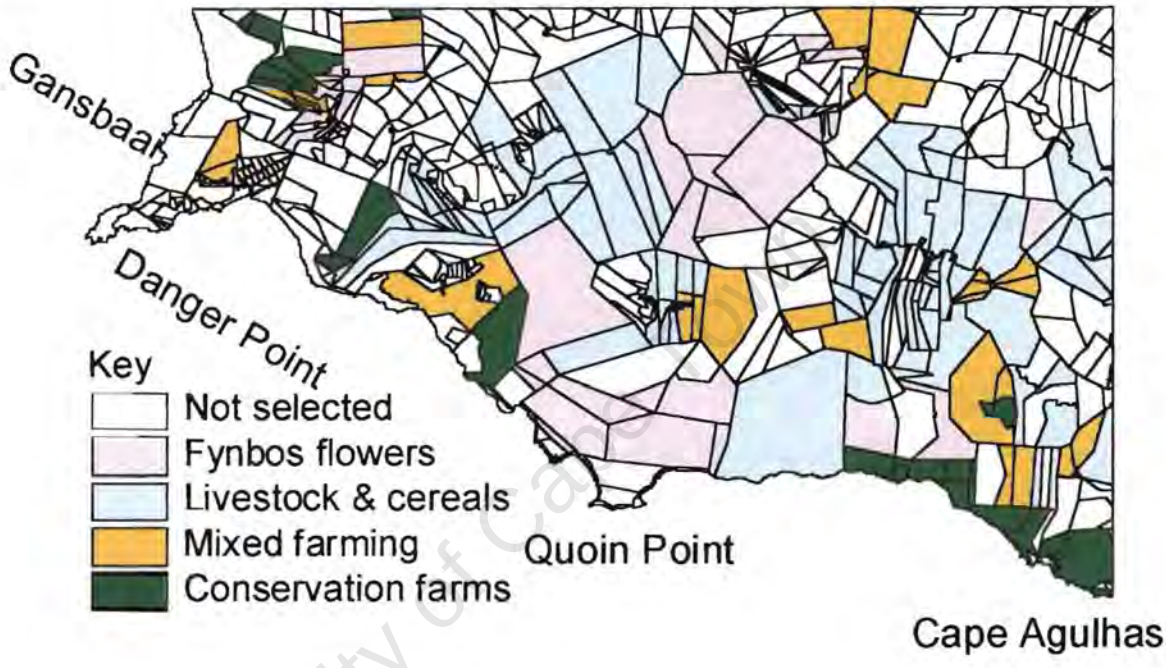


Figure 5.1. Land use categories (based on dominant income sectors) for 60 private landowners selected in a questionnaire survey on the Agulhas Plain. The categories were selected on the basis that more than half the income for farm management is derived from each activity.

Livestock farming covers the largest area of the farms sampled (48%), followed by fynbos flowers (28%), mixed farming (15%) and conservation (9%) (Figure 5.1).

Livestock & cereal farming

The majority of the Agulhas Plain's land surface is today still utilised for livestock farming, a tradition which began approximately 2000 years ago (Boonzaier *et al.*, 1996). However, techniques have changed enormously since the introduction of the plough, and practically all the Agulhas Plain Renosterveld of agricultural value has already been cultivated (Lombard *et al.*, 1997). Certain Agulhas Plain endemics which used to occur in this vegetation and are now in the Red Data List for southern African plants (*Lobostemon collinus* (rare); *Leucadendron stelligerum* (endangered) (Hilton -Taylor, 1996) are today restricted to a few metres of remnant vegetation on road verges.

Many of the farms categorised in the livestock category (Figure 5.1) derive a substantial part of their income from cereal cash crops such as wheat and barley. Although historically grain crops have been the mainstay of growth and development in the development of the Overberg region (WESGRO, undated), no landowners reported cereal cropping as their dominant income source. The large capital and input costs required for cash cropping, together with a total reliance on favourable weather for the sowing, growing and harvesting periods, make cereals cultivation a high risk business (K. Robertson, pers. comm.). In recent years, cereal cultivation has come under pressure from international competition following the liberalisation and deregulation of the grain markets in South Africa (WESGRO, undated), resulting in the abolishment of state subsidies for cereal production.

Wheat is under more pressure than barley, which has a promising future (particularly within the rest of Africa) for malt production for the rapidly growing beer industry (WESGRO, undated). As a result of falling profits for wheat crops, Agulhas Plain farmers have also begun to cultivate other agricultural cash crops such as canola (Brasé, 1995).

Table 5.1 gives an estimation of the ratios of different agricultural land use in five farming zones (Figure 4.4) on the Agulhas Plain. The importance of areas used for livestock production in the Strandveld and Strandveld foothills is clear, whereas cereal cultivation is restricted to the more fertile soils of the Strandveld alone.

Table 5.1.. Estimated percentages of areas used for different practices on the Agulhas Plain per agricultural zone, with activities on the increase and decrease indicated by + and – signs respectively (Modified from D. Cronjé, 1993, Department of Agriculture, *in litt.*).

	Strandveld	Strandveld Foothills	Mountain Area	Duineveld	Sand Dunes
Use	%	%	%	%	%
Veld-based farming	30	70	95	100	100
Wheat	5	0	0	-	-
Barley	15	0	0	-	-
Oats & other fodder crops	5(+)	8	1	-	-
Fallow & old lands	4	5	1	-	-
Dryland pastures	35	5	2	-	-
Irrigated pasture	2	2(+)	1	-	-
Vegetables	1	2	0	-	-
Long term crops	1(-)	1(-)	0	-	-
Cultivated flowers	2	7(+)	0(+)	-	-
	100	100	100	100	100

The current expected net incomes from livestock farms are in the order of R155/small animal unit (SAU)/y for dairy cattle, R 75/SAU/y for beef cattle, R100/SAU/y for sheep, and R 300/ha for cereal crops (A. Fourie & K. Robertson, Agricultural Consultants, pers. comm.). (Large animal units were converted to small animal units (SAU) units for ease of reporting)

Taking the following into account:

- a ratio of 90:10 (Strandveld:Standveld foothills) for the area of agriculturally-transformed vegetation in the Strandveld and Strandveld foothills (D.Cronjé, *in litt.*);
- an area of agriculturally-transformed land on the Agulhas Plain of 34 000 ha (Lombard *et al.*, 1997);
- recommended stocking rates for these areas (A. Fourie & K. Robertson,, pers. comm.); and
- an average net income of R110/SAU/y for all livestock on non-irrigated pastures and R155/SAU/y for irrigated pastures; the net income for livestock farming on transformed land on the Agulhas Plain is estimated to be R7.3 million/year (Table 5.2).

Table 5.2. Weighted ratios of transformed areas in Strandveld and Strandveld foothills (modified from Table 5.1), extrapolated transformed areas (based on Lombard *et al.*, 1997), recommended stocking rates & net incomes per SAU ((K. Robertson and A. Fourie, agricultural consultants, pers. comm.) and total net income for Agulhas Plain livestock on four types of transformed land.

Agricultural Use	Weighted ratio of agriculturally-transformed area	Area (ha)	Recommended stocking rate (SAU/ha/y)	Estimated number of SAUs	Unit income (R/SAU/y)	Total net income (R/y)
Fodder crops (oats etc)	5.3	1802	3.3	5947	110	654,126
Fallow fields	4.1	1394	2	2788	110	306,680
Dryland pastures	32	10880	4	43520	110	4,787,200
Irrigated pastures	2	680	15	10200	155	1,581,000
TOTAL						7,329,006

Grazing of indigenous vegetation

Sixty two percent of "working farms" sampled reported using their indigenous veld (vegetation and/or vleis) for grazing at some time of the year and in total 32 864 hectares of the Agulhas Plain were estimated to be used for veld grazing. Almost half of the working farms relied on veld for cattle grazing, a quarter for sheep grazing and 10% for game.

Table 5.3. Results of veld grazing reported by Agulhas Plain farmers (n=26) for sheep and cattle showing estimated numbers of SAUs, unit net income and total net income.

Kind of livestock	SAU sampled	SAU for entire Agulhas Plain	Net unit income (R/SAU/y)	Total net income (R/y)
Cattle	14,802	25,834	91*	1,346,982
Sheep	10,100	17,627	100**	1,010,000
TOTAL				2,356,982

- based on weighted ratio of 80:20 for beef: dairy cattle reported

The value of grazing of indigenous veld on the Agulhas Plain was found to be fairly substantial. Table 5.3 indicates that the total net income allocated to cattle and sheep grazing amounted to an estimated R2.36 million/y. Combined with the grazing value from cultivated lands, livestock farming on the Agulhas Plain has a net income of R9.68 million/y with veld-based grazing contributing 24% of the value.

Game

Very few Agulhas Plain farmers (4 in the sample) were farming with game. Species used include bontebok, eland, springbok, black wildebeest, ostrich and the exotic fallow deer. Assuming an average net income of R 87.5/SAU/y (range: R 75 – R 100/SAU/y; A. Fourie, pers. comm.), and extrapolating numbers for the entire Agulhas Plain, the total net income for game is estimated to be R 53 988/y.

Cereals

Assuming that an area of approximately 3060 hectares is cultivated for cereals on the Agulhas Plain (K. Robertson, pers. comm.), the total net income is R 918 000/year.

The cultivation of cereals, in particular barley, is extremely input-intensive, and profit margins are very small (K. Robertson, pers. comm.).

Mixed agriculture

A substantial area of the Agulhas Plain comprises farmers whose income is derived from mixed agricultural practices (Figure 5.1). These practices include combinations such as flowers/sheep, flowers/beef cattle and flowers/cattle/firewood. Most of the properties undertaking mixed agricultural practices (Figure 5.1) were found in the Strandveld Foothills and Duineveld zones (Figure 4.4), where soils are less fertile than the Strandveld, where large tracts of natural vegetation remain, and where diversification is the key to survival. Table 5.1 shows an fairly even spread in the ratio of different areas of agricultural sectors for the Strandveld Foothills zone.

New agricultural trends

Owing to a number of factors, including market forces, reduction in state subsidies and recent unfavourable weather conditions on the Agulhas Plain, the agricultural industry is, in general, not doing particularly well at present (Agulhas Plain farmers, pers. comm.). As a result, farmers are tending to diversify, and increased cultivation for new forms of crops, dryland and irrigated, is occurring. Table 5.1 indicates which agricultural activities were on the increase or the decline, as based on information from 1993. Cultivation for fodder crops, irrigated pastures and cultivated fynbos flowers was then reported to be increasing, while it was suggested that long term crops (e.g. deciduous fruit and grapes) were on the decrease (D. Cronjé, Department of Agriculture, *in litt.*)

Subsequent to the 1994 democratic elections, however, world markets opened up to South Africa, and long term crops which have export potential, in particular deciduous fruit and grapes, have become increasingly popular products for cultivation. A group of entrepreneurial farmers have registered the broader Agulhas area as a wine producing region and to date have cultivated approximately 5 ha of grapes, with plans to increase this to 150 ha in the next few years (Toens *et al.*, 1998). While these first few hectares of Agulhas Plain vineyards have been established on previously-cultivated land, more vineyards are planned for land on which indigenous vegetation occurs (personal observation). Technological advances in agriculture mean that crops such as grapes and apples, which would previously have been viable only on relatively fertile soils, can now be cultivated almost hydroponically on infertile, acidic sands.

There are concerns about the long term sustainability of water resources in the region, should intensive cultivation agriculture for grapes and deciduous fruit expand unchecked (Toens *et al.*, 1998). Recently a 5 X 10^6 m^3 capacity dam was approved and constructed on the Uilkraal River in the western Agulhas Plain. This dam was a joint initiative between a private landowner for the intensive cultivation of fynbos flowers, grapes and apples, and a local authority for bulk water supply for domestic use. Although strict environmental controls (Gale, 1998) were conditions of the approval for the dam, concerns remain about the policing of regulations pertaining to water use from the system, and the concomitant potential detrimental effects on the Uilkraal River Estuary. Similar proposals for large dams in the upper reaches of the Nuwejaars River, which bisects the Agulhas Plain (EnviroAfrica, Environmental Consultants, *in litt.*) contributed to the decision by a technical working committee examining water resources in the region, to motivate for funds from the Department of Water Affairs and Forestry for a full catchment management study.

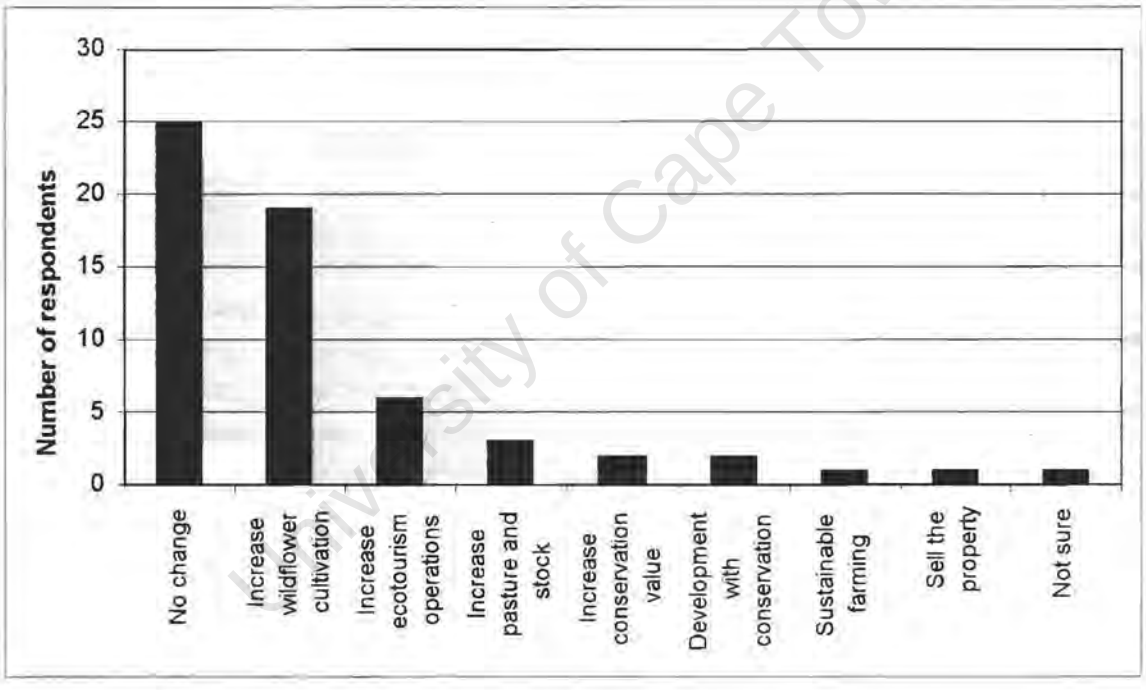


Figure 5.2. Future land use plans of Agulhas Plain landowners with respect to their properties (n=60).

Figure 5.2 illustrates reported future plans for farms on the Agulhas Plain. The majority of landowners (42%), reported no intention to change land use on their properties. Only 5% indicated that they intended to increase the pasture and stock sector of their agricultural practices. This suggests that this form of agriculture is not the major threat to the Agulhas

Plain's indigenous vegetation (in particular those found on richer soils such as Renosterveld) at present. However, fynbos flower cultivation is set to become a big threat to the indigenous vegetation of the Agulhas Plain, as over 30% of landowners reported plans to increase fynbos flower cultivation operations (Figure 5.2).

The fynbos flower industry

The wildflower industry

Up until 1938 there were no restrictions on picking fynbos flowers from the wild and the main outlet for the industry was local, via the flower sellers of Cape Town (Davis, 1990). The international flower trade began with a small group of entrepreneurial farmers in the 1960s and by 1979 there were 20 exporters of wildflower products in the Western Cape (Davis, 1990). By 1989 the industry was worth R 30 million with an estimated 10 – 15 000 people being dependent on income from this sector (Middelmann *et al.*, 1989), and the most recent estimates suggest that the industry is worth R 149.3 million and employs 25 000 people (SAPPEX, 1999).

Substantial growth in demand in the past 20 years has led to increased flower cultivation, mostly for the export trade. Quality control of Proteaceae in terms of stem length, shape and colour as well as stringent phyto-sanitary requirements (especially for insects and fungi) are the two main factors which have pressurised the industry into increased cultivation of fynbos products (Davis, 1990).

Fynbos flowers are cultivated using a variety of techniques, ranging from low input, broadcast sowing (seeds scattered on the ground for enhancing products for the dried flower industry), to ploughed rows (sown or planted) between strips of natural vegetation, to intensive drip-irrigated orchards for the fresh flower industry, which is largely based on genetically-improved cultivars. In 1989 it was estimated that the ratio of veld-derived to cultivated material was 65:35 for the fresh flower trade and 90:10 for the dried-flower industry (Middelmann *et al.*, 1989). Today the trend has shifted more in the direction of cultivated products with the ratio of veld-derived to cultivated, probably in the region of 80:20 for the dried flower industry (Mr R. Middelmann, pers. comm.).

There has also been a large increase in the cultivation of flowers for the fresh flower industry (Malan, 1996). Cultivation of improved cultivars for the fresh flower industry can be far more

lucrative than harvesting from the veld. One hectare of cultivated proteas generates the equivalent income of about 50 to 100 ha of natural veld. (A.I. Gerber, Dept. Horticulture, University of Stellenbosch, pers. comm.). It has been estimated that an average turnover of R20 000/ha/y can be obtained from intensive cultivation of members of the Protea family (e.g. *Leucospermum cordifolium*) for the fresh flower export market (Leiman, 1996). By comparison, estimates of R169/ha/y have been suggested as upper limits for the veld-based wildflower industry (Leiman, 1996).

Fresh vs. dried flower industry

There is a very clear distinction between the fresh and dried flower industries (Malan, 1996), with packing houses usually specialising in either one or the other. For the fresh flower industry, value is sometimes added at packing houses where bouquets are made. However, most fresh flower products are packed into boxes and, following cleaning and spraying with pesticides, are delivered directly to airports, primarily Cape Town International, which accounts for 93% of the volume (SAPPEX, 1997). Here, export agents process the pre-packed boxes and send them overseas, where they are distributed further to various retail outlets (including florists) in the destination country. An enormous amount of value is added to fynbos products from the time they are harvested to when they are sold. A single protea flower which incurs a labour cost to the farmer 5 cents, could sell for as much as R45 in Germany (Brasé, 1995), a 900 fold mark-up on the product! This is clearly a gross oversimplification, as it does not take into account the landowner's investment in producing the flower, but it nevertheless shows the enormous amount of value added from farm to final point of sale.

Material for the fresh industry primarily comprises showy inflorescences of the Proteaceae and decorative "filler" material (so-called "Cape greens"), including *Erica* spp., *Brunia* spp., *Berzelia* spp., *Leucadendron* spp. and *Phylica* spp.

The fresh flower industry is very seasonal with an annual peak between September and December, which reflects the European pre-Christmas and New Year holiday season (Davis, 1990). However, as most members of the Proteaceae flower in the period June to October, manipulation (in cultivated stands) to delay and lengthen flowering periods has been necessary to meet the demand (Davis, 1990).

For the dried flower industry a large amount of value is added at the packing shed where products are treated in various ways before being sent to export agents. Malan (1996) notes that species may be sold as a variety of products, for example *Protea repens* is sold as 20 distinct items. Malan (1996) defines a dried floral item as; "a shoot with or without one or more flowers, seed heads or seed pods, or only a flower, seed head or seed pod with or without an artificial stem". Furthermore, the product may be broken into sections, cut into different shapes (rosettes or stars) and treated in one of eight different ways incorporating combinations of the following treatments: drying, sulphuring, bleaching, dyeing, application of glycerine and painting (Malan, 1996).

The dried flower industry is clearly highly complex and makes use of a variety of material which, apart from the conventional Proteaceae inflorescences, includes many other fynbos taxa, alien species (e.g. *Hakea* spp. and *Eucalyptus* seedpods) and even products of marine origin such as abalone shells (Malan, 1996).

Although the dried flower industry is less seasonal than the fresh flower industry, it nevertheless relies on specific occasions (e.g. remembrance days in central Europe) in order to help boost export sales (R. Middelmann Dried Flower Exporter, pers. comm.).

The land-use category covering the second largest surface area (Figure 5.1) and having the reported highest income per sector on the Agulhas Plain (Figures 4.2 & 4.3) is the fynbos wildflower industry. As the reported ratio of income for veld-derived:cultivated fynbos was 85:15 for the Agulhas Plain flower farmers sampled for the survey, it is not surprising that large tracts of land are utilised for this industry.

Direct use values (consumptive use)

The remaining natural vegetation (not transformed by agriculture) on the Agulhas Plain makes up approximately 75% of the land surface area (Lombard *et al.*, 1997), and a similar amount of natural veld per farm (70%) was reported by the landowners sampled in this study. It therefore seems logical to suspect that the indigenous vegetation will be afforded a high use value when its sub-components are analysed and aggregated.

Fynbos wildflower harvesting

The fynbos wildflower industry is by far the biggest industry on the Agulhas Plain based on the terrestrial biodiversity of the area.

Appendix 4 lists all species harvested from the wild (n=71) by flower farmers (n=35) for the fresh and dried industry, for six different fynbos types, indicating the average harvest and value (expressed as net income) per hectare.

Table 5.4 is a summary of this information and indicates that the total net income per annum from wildflower harvesting on the Agulhas Plain is estimated to be R 8.55 million.

This amount, however is likely to be an underestimate, as the picking effort represented by landless contract pickers was small in the flower farmers sampled. Many small-scale pickers dispatch teams to farms to harvest flowers on a "piecework" system, where the more they pick the more they get paid. There is also a certain amount of illegal picking (picking without the permission of the landowner) which takes place on the Agulhas Plain (Agulhas Plain flower farmers, pers. comm.). However, as the species harvested in this study were controlled by the landowner, and picking primarily took place on the landowner's own land, it may be safe to assume that the levels reported here are by and large sustainable, although more rigorous research is needed to verify this.

An important point to note is that the Agulhas Plain is likely to have higher flower harvesting levels and incomes than other fynbos areas in the Cape Floristic Region, as this Agulhas region is considered to be one of the richest wildflower areas in the Western Cape (R. Middelmann, Dried Flower Exporter, pers. comm.).

Table 5.4. Average annual net income per hectare and total net income to landowners (averaged across harvested and unharvested land) on six different fynbos vegetation types on the Agulhas Plain (1997 prices). n = 35

Vegetation Type	Area on Agulhas Plain (ha)	Type of product	Number of species used	Average net income/ha/y (n=35)*	Total net income (R/y)
Acid Sand Fynbos	48,646	Proteaceae flowers/cones	13	93.79	
		Other fynbos products	42	47.76	
				141.55	6,885,826 (81%)
Elim Fynbos	3,781	Proteaceae flowers/cones	3	6.78	
		Other fynbos products	7	27.97	
				34.76	131,415 (2%)
Restioid Fynbos	9,172	Other fynbos products	4	50.43	462,500 (5%)
Limestone Fynbos	3,642	Proteaceae flowers/cones	3	66.40	
		Other fynbos products	5	8.96	
				75.35	274,435 (3%)
Neutral Sand Fynbos	9,951	Proteaceae flowers/cones	2	44.99	
		Other fynbos products	13	18.17	
				63.16	628,496 (7%)
Dune Fynbos	14,757	Other fynbos products	5	11.39	168,103 (2%)
TOTAL	89,767		71**		8,550,775

* Values are based on mean yields per hectare and net income at farm gate for each species harvested.
** Some species are used as both flowers/cones and as other products such as leaf material as "greens"

Net income from flower harvesting was found to vary considerably between vegetation types. Acid Sand Fynbos is by far the most important vegetation type for wildflowers, contributing the highest net income of all vegetation types at R 142/ha/y. This is followed by Limestone Fynbos, Neutral Sand Fynbos and Restioid Fynbos. The Restioid Fynbos value includes a value for the thatching reed *Thamnochortus insignis*, which was found to have a net income of R 22/ha/y (Appendix 4; Turpie *et al.*, in press). Elim Fynbos had the next highest flower harvesting income, and Dune Fynbos was the least most important vegetation type with respect to wildflower harvesting (Table 5.4).

When taking the relative areas of fynbos remaining on the Agulhas Plain into account the pattern for the total net income across different vegetation types differs somewhat from the per hectare values. Here, Acid Sand Fynbos, with its large area, and large number of species harvested (Appendix 4), was found to make up a massive 81% of the total net income for the Agulhas Plain, with Neutral Sand Fynbos contributing a much smaller second highest value at 7% of the total income. The other vegetation types provided 5% or less of the share (Table 5.4).

Figure 5.3 clearly shows that the majority of species harvested from the wild on the Agulhas Plain belong to the Proteaceae, followed by the Ericaceae, Asteraceae, and Bruniaceae. The genus with the most number of species was *Erica*, with 18 species, followed by *Leucadendron* with 13 species and *Protea* with 8 (Appendix 4).

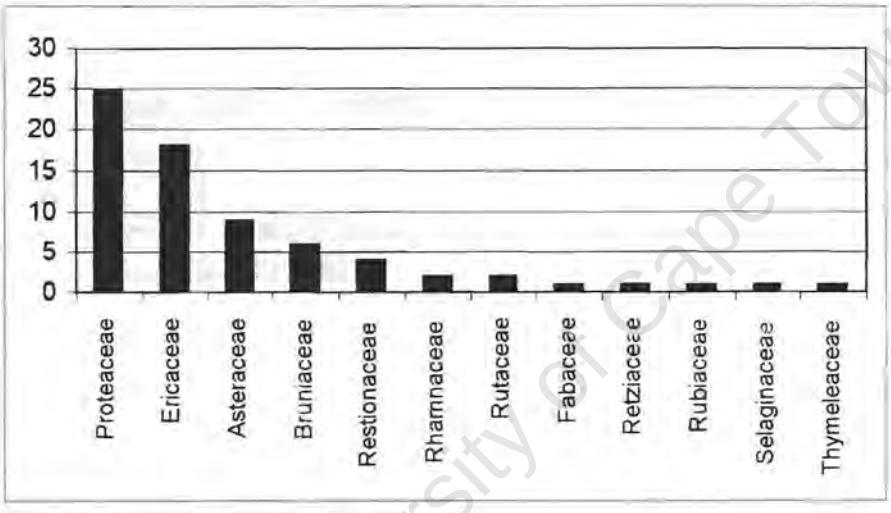


Figure 5.3. Number of species used from different families from wildflower harvests on the Agulhas Plain.

The great diversity of fynbos vegetation types, and consequently species and products for the wildflower industry, help to buffer the region's industry in terms of changing market demands (R. Middelmann, pers. comm.) or a sudden shortage of a species due to unplanned wildfires destroying floral resources (Malan, 1996).

Fynbos cultivation – general trends

Although historically most habitat transformation within the Cape Floristic Region (CFR) involved the removal of Renosterveld vegetation for pasture and cereals (McDowell & Moll, 1992; Kemper *et al*, 1999), a recent trend (past 20 years) has seen the cultivation of a number of indigenous crops including Rooibos tea (*Aspalathus linearis*), honeybush tea (*Cyclopia* spp.), buchu

(*Agathosma* spp.), thatching reed (*Thamnochortus* spp.) and various fynbos floral products. In the western part of the CFR, many of these indigenous fynbos products are increasingly being cultivated; half the buchu harvest is from cultivated stands (L. Graven, pers. comm.) and Rooibos tea cultivation has completely replaced the harvesting of this product from the wild (D. Brand, Rooibos Tea Board, pers. comm.). The commercial development of wild plants follows a world-wide trend, and in southern Africa a number of species have potential for commercial development as foodstuffs, seed oils and teas, sources of essential oils, and horticultural and medicinal plants (Cunningham and Davis, 1997).

From the perspective of maintaining low vegetation biomass and thereby enhancing water supplies (Van Wilgen *et al.*, 1996), the cultivation of indigenous plants may be preferable to dense stands of invasive alien trees. However, the net result of cultivation is habitat transformation and a loss of biodiversity, although there are different cultivation techniques which have varying effects on biodiversity conservation.

Fifty nine percent of the flower farmers on the Agulhas Plain reported growing fynbos species, with a median area of 95 ha (range 2 – 450 ha) under cultivation. It has been suggested that if all flower farmers on the Agulhas Plain were to cultivate 10% of their land surface area, this would provide enough high quality material for the fynbos flower industry, and the remaining area could be used for harvesting wildflowers, conservation or other agricultural practices (P. Cilliers, Waterford Farm, pers. comm.). The average area under fynbos flower cultivation on flower farms sampled was 7.8% of the farm.

The total area under cultivation for fynbos flowers was reported by landowners sampled to be 2698 ha, which would extrapolate to approximately 4600 ha for the entire Agulhas Plain, taking all veld except for state forests, into account.

This figure is almost double the estimated area cultivated for the entire fynbos region, as reported by landowners in an extensive survey of the industry (Malan, 1996). The 4600 hectares of fynbos under cultivation represents almost 10 times the amount of virgin land for which approval to cultivate had been granted (471 ha) on the Agulhas Plain for the period 1992 – 1997 (Directorate of Resource Conservation, Department of Agriculture, 1999, *in litt.*), during which most of this fynbos cultivation was reported to have taken place.

Although landowners' attitudes may account for part of the reason for not seeking permits to plough virgin land, ("baas op die plaas" attitude – McDowell, 1988) it seems as if the agricultural extension service was in fact to blame for the lack of permits issued for ploughing virgin land. Apparently, certain extension officers in the past believed that the replacement of fynbos (natural) with fynbos (cultivated) did not constitute a change in land use and therefore did not require an agricultural permit (W. Alheit, Department of Agriculture, pers. comm.).

Similar problems with the interpretation of the definition of "virgin land" in terms of the Conservation of Agricultural Resources Act 43 of 1983 have been reported by McDowell (1988). The definition of virgin soils: "land which in the opinion of the executive officer, has at no time during the preceding ten years been cultivated", places a huge responsibility for an important part of the act, on the opinion of a single individual, which could be problematic (McDowell, 1988).

In addition, veld which is to be used for cultivation is usually burnt (often without permission), and then no longer considered to be virgin veld, and is consequently ploughed (personal observation).

It is not surprising that farmers are showing an increasing trend towards fynbos cultivation. Species of *Leucadendron* and *Erica* have been shown to increase their biomass more than five fold, in tilled as opposed to adjacent untilled areas in Acid Sand Fynbos, after three years of growth (Davis, 1990; personal observation). However, there are a number of ecological and biodiversity issues which need to be addressed when examining the cultivation of fynbos products.

The Honeybush tea industry

Honeybush tea is made from at least nine of the 23 species of the fynbos-endemic genus *Cyclopia*, with approximately 30 tonnes of dried and processed material being produced annually (Schutte-Vlok, 1998). The most important species used are *C. intermedia, C. subternata,* and *C. sessiliflora* all of which are collected primarily from the mountains of the Kouga - Langkloof region. (H. de Lange, National Botanical Institute, pers. comm.). However, different species of *Cyclopia* occur in a variety of vegetation types and have been collected in various parts of the fynbos biome in the past, including Genadendal,

Swellendam, Albertinia, Riversdale, Tsitsikamma and Yzerfontein (H. de Lange, pers. comm.), and in some cases there is evidence of past over-harvesting practices.

Owing to market demands for the product (e.g. Malaysia recently ordered 50 tonnes, Schutte-Vlok, 1998), a steadily increasing area of *Cyclopia* cultivars is being planted.

A few Agulhas Plain farmers who are involved with cultivating fynbos flowers, have begun to experiment with the cultivation of various *Cyclopia* species (personal observation). These farmers cultivate honeybush tea using the strip ploughing method (section 4.4). There is only one species of honeybush, *Cyclopia genistoides*, which occurs naturally on the Agulhas Plain. It is interesting to note that cultivars of this species outperformed cultivars derived from other species in initial trials in this region (F. Joubert, Koksrivier Farm, pers. comm.). The cultivation of honeybush is set to become an important industry in the future, although it is still in an experimental stage. At present there is still a very strong reliance on genetic material from the wild for the cultivation of *Cyclopia* spp. (H. de Lange, pers. comm.).

In a similar trend to the Rooibos tea and the fynbos flower industry, the honeybush tea industry could, in time, pose a substantial threat to the very resource from which it was derived, due to demands for increased cultivation of the product (Schutte-Vlok,1998).

The thatching industry

The most important thatching reed obtained from fynbos is *Thamnochortus insignis* (mannetjiesriet), which occurs on deep, sandy, limestone-derived soils between Cape Agulhas and Albertinia. This species makes up about 98% of the total thatch harvest (Ball, 1995.). *T. insignis* is harvested from areas in which it occurs at high densities of up to 11 700 plants per ha (Ball, 1995). Other species harvested in small quantities are *T. erectus* (wyfie-riet), along the southern Cape coast, and *T. spicigerus*, along the West Coast from Table Bay to Langebaan (Cowling & Richardson, 1995). In addition, *Chondropetalum tectorum* (pannetjiesriet) is harvested in small quantities throughout the fynbos region, and is currently popular for the wildflower industry. In the mid 1990s, the entire thatching industry was reported to be worth approximately R 10 million (Cowling & Richardson, 1995).

Conservation farms

Although conservation farms comprise the smallest area of the four land-use categories assigned to private land sampled (Figure 5.1), this category is nevertheless very important from a biodiversity conservation point of view. Conservation farms as a category have more land than the state forest reserves (Figure 4.6) and protect more plant species than state forests, which mainly occur in Dune Fynbos (Lombard *et al.*, 1997).

Conservation farms comprise areas which have primarily natural veld and have been purchased by conservation-minded landowners within the past 30 years. These properties are most commonly used as weekend and holiday retreats with either no agriculture or minor activities such as sustainable flower harvesting or firewood sales, which contribute to covering management costs. However, these management costs are usually relatively low, and are invariably covered by outside funds. Conservation farms are almost exclusively either declared private nature reserves or listed Natural Heritage Sites (Table 1.1), and in some cases both.

Private conservation farms represent a land use which is on the increase for two reasons: firstly more and more people are seeking areas away from urban centres where they can enjoy nature, and secondly, business people are purchasing farms in rural areas with a view to making some money through eco-tourism or developing part of their land and rezoning the remainder for conservation purposes. A new spatial planning policy to regulate all activities of this nature along the coastline (Western Cape Provincial Administration, 1998) is currently underway.

Land use primarily undertaken by non-landowners

Land-use is not restricted to the owners of the land themselves. There are certain direct and indirect land-uses which are not undertaken by the land owner. Some examples include the harvesting of sour figs and products of the beekeeping industry, which are discussed below.

Harvesting of sour figs (Carpobrotus spp.)

Sour figs, *Carpobrotus acinaciformis, C. deliciosus* and *C. edulis,* are harvested throughout Dune Fynbos areas, especially from the area between Gansbaai and Mosselbay (Cowling &

Richardson, 1995). The fruits are harvested in summer, dried and sold in markets as far afield as Durban, and are used in traditional cooking and jam making (Du Preez & Esler, 1997).

A substantial illegal industry exists on the Agulhas Plain, where pickers (mainly from greater Cape Town) harvest sour figs, primarily in state forests (without the consent of the authorities), where the resource is most abundant. Therefore, while not an activity to be promoted without changes in current legislation and with extremely strict regulation, this land-use provides an important source of indigenous produce and income to a sector of the population.

No landowners reported being involved with this activity and there are few data concerning on the economic importance of this activity.

In the broader Agulhas Plain area, harvest levels of 1.95 kg / ha have been reported from De Mond State Forest for the summer season of 1991/2 (2 300 kg from a 1180 ha reserve, of which sour figs occurred densely on approximately 4.5 ha; M. & P. Swart, Cape Nature Conservation, pers. comm.). At least 19 000 kg of sour figs were harvested illegally from the Walker Bay State Forest reserve in the 1996/7 season and this is likely to be an underestimate. (D. Geldenhuys, Cape Nature Conservation, pers. comm.). Sour figs were sold wholesale for approximately R7 per kg in 1997, with retail prices fetching up to R16/kg (P Deverson, Fairhill Farm, pers. comm.). Using estimated reported input costs for harvesting sour figs of 42% (R Metcalf, Walshacres Farm, pers. comm.), the estimated net income of sour figs is R 3.75/kg.

The total net income for the above known harvests (21 300 kg) is thus R 86 250, which is approximately R 10.49/ha for the source area (8298 ha).

Carpobrotus spp., being members of the Mesembryanthemaceae, are protected species in terms of the Nature and Environmental Conservation Ordinance for the Western Cape (Glavovic, 1993). However, members of this genus are not listed as Red Data species (Hilton-Taylor, 1996). *Carpobrotus* spp. are pioneer species which colonise open sandy areas and are therefore ideally suited for rehabilitation purposes (e.g. in areas where dense thickets of invasive alien trees have been removed).

Although it is important to have "no-take" benchmark protected areas, and proposals to harvest fynbos wildflowers from Cape Nature Conservation reserves areas have been severely criticised (Cape Nature Conservation, 1995), it may be appropriate to investigate legalising the picking of *Carpobrotus* spp. from protected areas in the future. According to members of certain previously disadvantaged communities on the Agulhas Plain, many people feel it is their right to have access to these resources, which they claim were taken away from them under the apartheid government (M. Dennis, Struisbaai Noord Community; L. October; Elim Community, pers. comm.).

Production of honey and "overwintering" in fynbos of bees that pollinate orchards

The Cape Honeybee (*Apis mellifera capensis)* is endemic to the fynbos region, where it is naturally limited in population size by available nesting sites (Rebelo, 1987). Hives are kept throughout the fynbos region and are used both for the production of honey and for providing a pollination service to fruit farmers. There are no conclusive records of the number of hives kept in the fynbos region of the Western Cape. It has been estimated, however, that there are a minimum of 58 000 hives in this region, although this may be a conservative estimate (M. Allsopp, Plant Protection Research Institute, pers. comm.).

In the fynbos biome, bees forage on the flowers of fynbos and other indigenous vegetation for most of the year, although they spend part of their time foraging on *Eucalyptus* spp. trees and some crop plants. It is estimated that approximately 50% of the honey production in the fynbos region is attributable to bees foraging on fynbos vegetation (M. Allsopp, pers. comm.). *Eucalyptus* spp. flowers serve to boost honey production substantially, while the diversity of fynbos plants with differing flowering times ensures that honeybees can forage throughout the year. Honeybees thus "overwinter" in the natural vegetation where they build up their reserves and strengthen their colonies.

Indirect use values of the beekeeping industry

Very little income from the bee industry accrues to the landowners of the Agulhas Plain (Figure 4.3). Although 56% of landowners reported having hives on their properties, only 27% had their own hives and of these only one quarter had more than 50 hives (the cut-off number below which is considered to be small-scale bee farming; Van der Merwe & Eloff, 1995). The majority

of landowners who allowed outside beekeepers to keep hives on their properties were happy with payment of a few jars of honey each year.

Beekeeping is a large and important industry and a substantial amount of income can be ascribed to the indigenous fynbos vegetation on which honeybees depend. Pollinators world-wide have an extremely important ecological service role, with more than 200 000 plant species being pollinated by animals, and in particular, by a large number of insect species (Nabhan and Buchanan, 1997). Honeybees are further responsible for the pollination of 72% of the world's agricultural crops (Nabhan and Buchanan, 1997).

Based on the reported number of hives per hectare sampled in this study, it is estimated that there are 10 345 hives on the Agulhas Plain. This represents 18% of the 58 000 hives estimated to occur in the Western Cape (M. Allsopp, pers. comm.) and confirms that the Agulhas Plain is an important beekeeping area.

Honey production

On average, landowner's hives were reported to yield 23.8 ± 19.1 kg of honey per year, whereas a large-scale Agulhas Plain beekeeper who is not a landowner estimates an average of 15 kg/hive/y (N Esterhuizen, Beekeper, pers. comm.). A mean of the above values, 19.4 kg/hive/y, was used in this study as the expected honey production for the region. Honey fetched a wholesale price of R10/kg and a retail price of approximately R25/kg in 1997. Thus, based on the estimated total number of hives for areas housing indigenous vegetation, the total wholesale value of honey from Agulhas Plain hives is estimated to be ± R2 million, with a retail value of ± R5 million per annum in 1997. Part of this value must be attributed to *Eucalyptus* spp. plantations, however, and the farm gate values attributable to fynbos are thus estimated as 50% of the wholesale value, i.e. ± R1 million, based on the proportion of honey manufactured from fynbos nectar (M. Allsopp, pers. comm.).

Assuming input costs of 35% for the honey industry, the 1997 net income for honey production on the Agulhas Plain was R 0.65 million or R 63.05/hive or R 5.58/ ha for areas containing indigenous vegetation.

Pollination services by bees for the fruit industry

In total, approximately 15 000 hives are used for the pollination of fruit orchards In the Western Cape (M. Allsopp. Plant Protection Research Institute, pers. comm.) and the entire fruit-producing region depends to a large degree on this service (Van der Merwe & Eloff, 1995). Hives are used for two pollination cycles per year, for which beekeepers were paid approximately R147 per hive per cycle by fruit farmers in 1997 (M Allsopp, pers. comm.). Assuming that 60% of all Agulhas Plain hives are used for pollination services (6207 hives; N. Esterhuizen, pers. comm.), the total income which accrued to beekeepers for this service from this region was thus R1.82 million in 1997. Eighty seven percent of this value (R1.59 million) can be attributed to fynbos, based on the average reported time that bees spend foraging in this vegetation type on the Agulhas Plain. Assuming 35% input costs for pollination services, a total net income of R 1.03 million, or R 163.88/hive/y or R 8.82/ha/y is attributable to the fynbos of the Agulhas Plain.

Examining the value of bee pollination services to the fruit industry another way, Turpie *et al.* (in press) estimated a total net income of R627 million for all fynbos areas in the Western Cape. This was based on a "bee factor", i.e. the percentage dependence of various fruit crops on bees for their pollination, and the annual turnover of these crops (Plant Protection Research Institute, 1992). If the Agulhas Plain provides 42% of the 15 000 pollination units for the fruit industry, R 263 million could indirectly be attributed to the Agulhas Plain in terms of this industry with R 229 million being allocated to the indigenous vegetation of the region, based on the amount of time (87%) that bees spending foraging here.

It has been estimated that the demand for pollination units in the fynbos region is still greater than the supply (Van der Merwe & Eloff, 1995; N. Esterhuizen, pers. comm.). Potentially, fynbos can therefore still provide more income for the beekeeping industry and has the ecological capacity to do so (M. Allsopp. pers. comm.). However, there has been some caution voiced that too many honeybees in the fynbos could negatively affect the pollination of certain fynbos plants (Rebelo, 1987). From a production point of view, certain natural areas, e.g. the West Coast region, are considered to be saturated with hives and could not withstand more honeybees being brought into the area (F. Kotze, Langrietvlei Farm, pers. comm.). The extent to which natural fynbos systems can accommodate more beehives is therefore a very important and urgent area for future research. Studies from Australia, where honeybees are not indigenous but were introduced in 1821, suggest conflicting results of the effect that honeybees have on

indigenous plant-insect pollination relationships. Hoskins and Turner (1999) reported that although honeybees may disrupt pollination and inhibit seed-set in certain plant species, niché partitioning between honeybees and indigenous insects has resulted in a relatively harmonious co-existence during foraging.

Both pollination services and the fruit industry turnover are important ways of measuring the value of bees and the natural vegetation on which they depend. However, they differ with respect to who gets the benefit. In the case of the export fruit industry, the benefit is spread wider and is measurable nationally, whereas with pollination services, the benefits are less widely spread and accrue locally to beekeepers.

A new threat to the beekeeping industry in the Western Cape is the infection of the Cape honeybee by the varroa mite (*Varroa jacobsoni*) which is placing severe threats on colonies world-wide (Tew, 1999), and is already extremely widespread in the Western Cape (Allsopp, 1999.). This mite has the potential to wipe out entire colonies of bees as it has already done in Europe and the USA (Tew, 1999), and could in future not only threaten commercial honeybee colonies and products of the industry, but the pollination of many indigenous plant species as well (Allsopp, 1998). While recommendations have been made to try and strop the spread of the mite in South Africa – first detected in 1997 – only commercial colonies can be treated for the infection, and wild colonies, as well as the flowers which depend on them for pollination, remain at risk.

The firewood industry

Unlike most indigenous species which provides poor quality firewood, certain invasive alien species within the fynbos biome have become a valuable fuelwood resource, especially where they occur in dense stands (Azorin, 1992). The most important species used for firewood is Rooikrans (*Acacia cyclops)*. Other species such as Port Jackson Willow (*A. saligna)* are used to a small extent in areas where Rooikrans is scarce, but have not become as important for commercial exploitation because of their inferior quality as firewood.

Medium to dense infestations of *A. cyclops* are viable for commercial exploitation for firewood. Although this species invades various vegetation types on the Agulhas Plain it is

primarily restricted to Neutral Sand Fynbos and Dune Fynbos where it is the dominant invader plant.
The value of the firewood industry should not be under estimated. For example, in 1992 the firewood industry was valued at more than R28 million for the greater Cape Peninsula area alone (Azorin, 1992).

A mature dense stand (75 – 100% cover) of *A. cyclops* produces between 30 000 and 93 000 pieces of wood/ha (C. Martens, Cape Nature Conservation, pers. comm.; J. Ricketts, professional woodcutter, pers. comm.). Other estimates suggest that for mature stands of *Acacia* spp. this figure may be as high as 150 - 200 000 pieces per hectare (B. Duminy, Wortelgat Farm, pers. comm.). Trees may be clear-felled, thinned, or pruned for wood harvesting.

For the purposes of this study it was assumed that trees are cut when they reach a suitable size, after an average of 20 years, and that at this age, a stand of 1 ha can yield on average 61 500 pieces. Wood cutter contractors on the Agulhas Plain, approximately 200 km south-east of the main market centre at Cape Town, harvest Rooikrans and market it as individual pieces R 140/1000 pieces. With a reported input cost of R 75/1000 pieces (54%) the net income is R 65 per 1000 pieces. Assuming that woodcutters have access to trees or stands of all ages at any time and that there are no unutilised trees over 20 years old, the average net income from firewood that can be harvested from areas of fynbos that are densely infested with *A. cyclops* is (61 500 x R0.065) / 20 = $\pm$ R 200/ha/y.

The area infested with dense stands of *Acacia cyclops* is not known, but it is conceivable that 50% (8735 ha) of the dense stands mapped by Lombard *et al.*, (1997) comprise thickets of this species (personal observation). Based on this assumption, the potential net income to Agulhas Plain wood contractors is R 1.75 million / year or 26.9 million pieces/year (average throughout the area infested with dense alien plants of 3075 pieces/ha/y).

Almost half of the landowners with invasive alien trees on their properties reported to be involved with the production of firewood. Of these, 60% made use of outside contractors and the remainder used their own staff.

The actual amount of wood harvested is difficult to gauge, but the following estimates have been made. Actual numbers of pieces harvested are estimated to be 3.18 million / y, based on mean number of pieces harvested per annum reported by landowners (56 750) and contractors (278 650), multiplied by the ratio of landowners to contractors sampled in this study. This represents 5.56 million pieces of firewood, 636 pieces/ha/y or R41/ha/y when extrapolated to the entire Agulhas Plain area. This comprises only about 21% of the potential annual harvest and provides a net income of R 361 177/y to woodcutters and landowners who cut wood. It would appear therefore, that there is scope for this industry to expand enormously. Some problems, however, exist in the management of the resource, as woodcutting is not compatible with clearing invasive alien vegetation (Agulhas Plain landowners, pers. comm.) unless it is done in a well-controlled manner by reliable contractors (G. Greef, Eskom Environmental Services, pers. comm.). Indeed, many Agulhas Plain landowners reported attempts to get invasive alien trees cleared by woodcutters but stopped this activity as it was *ad hoc* and undertaken with poor environmental controls.

Packaged in 10 kg bags (containing approximately 18 pieces), firewood from the Agulhas Plain was sold in 1997 at a retail price of approximately R220/1000 pieces locally, and up to R 400/1000 pieces in Cape Town. Assuming a 50:50 ratio of local to Cape Town sales, with an average price for sales for the latter area of R 310/1000 pieces, the estimated turnover for 1997 for Agulhas Plain firewood, based on the above assumptions, is R 1.47 million.

It is likely that conflicts regarding the use of veld-based resources as opposed to invasive alien firewood will develop as the firewood industry expands, and it is important to weigh up the costs and benefits of these potentially conflicting land uses. Using a dynamic model, Higgins *et al.*, (1997b) found that fuelwood harvesting is sustainable and that the sustainability is guaranteed when the fuelwood stand is left until it is eight years old before harvesting. The costs and benefits of clearing and use of invasive alien plants are addressed in Chapter 8.

Summary of chapter 5

In this chapter the following were the key outcomes:

- cereal production on the Agulhas Plain is of relatively low importance in terms of the area cultivated and the net income to the landowner
- grazing of livestock is the largest source of income to Agulhas Plain landowners with approximately 24% of the estimated R 9.68 million annual net income being attributed to veld-based grazing
- there is a clear trend towards the cultivation of new areas for fynbos flowers, which could have negative consequences for plant biodiversity
- the veld-based fynbos wildflower industry is the single biggest agricultural industry on the Agulhas Plain with an estimated annual net income of R 8.55 million
- seventy one plant species are used for the wildflower industry and Acid Sand Fynbos is the most important vegetation type for wildflowers, both in terms of number of species and values
- indigenous veld is extremely important for the bee keeping industry with an estimated net incomes of R1.68 million for honey and commercial pollination services combined, and R 229 million of the total value of the fruit industry being allocated to this sector
- small scale tourism and conservation activities, which have been initiated by private landowners, are on the increase.
- overall, indigenous vegetation, and in particular, fynbos, is the major primary resource for the region's agricultural economy.

This chapter provides an assessment of the extent, nature and value of tourism and recreation on and adjacent to the Agulhas Plain, particularly with respect to the importance of the natural environment for these sectors. The following key questions are addressed:

- What is a typical Agulhas Plain visitor? – origins, accommodation used, time of year and length of stay?
- What are the main reasons for visiting the area, and how important is the natural environment?
- How do visitors currently use the natural environment?
- What do visitors spend and what is the current recreational use value of the area?

Background

Global tourism (domestic and international) has become the world's largest and fastest growing industry with estimates of its annual worth ranging from 0.5 - 1 trillion US$ (Filion *et al.*, 1994). In South Africa, which was recently ranked 26th amongst the world's tourist destinations, tourism accounts for 8.2% of GDP, comprising 55 million tourists (domestic and international) in 1997 (KPMG/WESGRO, 1998).

The Western Cape is a very important tourism destination, attracting more than 50% of the international visitors to South Africa and boasting a substantial share of the South African tourism market, represented by approximately 7 million tourists (domestic and international) whose aggregate spending in 1996 was over R7.7 billion (KPMG/WESGRO, 1998). The figures quoted here represent tourism in the broadest sense of the word, including inter and intra-provincial tourism, and business and holiday tourism. The words tourist and visitor are used interchangeably throughout this study.

Popular tourist destinations are not evenly distributed throughout South Africa. Indeed, of the 10 top destinations visited by international tourists in South Africa, seven are in the Western Cape and four of these in and around Cape Town (Anonymous, 1998b; Table 6.1).

Table 6.1. Results of survey by South African Tourism (Satour) of South Africa's most popular international tourism destinations (modified from Anonymous, 1998b).

Rank	Destination	Nearest metropolitan centre	Province
1	V&A Waterfront	Cape Town	Western Cape
2	Cape Point (Cape Peninsula National Park)	Cape Town	Western Cape
3	Cape Wine Routes	Various	Western Cape
4	Garden Route	Various	Western Cape
5	Kruger National Park	Various	Mpumalanga & Northern Province
6	Table Mountain (Cape Peninsula National Park)	Cape Town	Western Cape
7	Durban Beachfront	Durban	Kwazulu-Natal
8	Kirstenbosch National Botanical Garden	Cape Town	Western Cape
9	Ostrich farms	Various	Western Cape
10	Gold Reef City	Johannesburg	Gauteng

Table 6.1 indicates that international tourists choose many "eco-tourism" destinations as their favourite sites. The distinction between tourism and eco-tourism is not always that clear and these terms are used interchangeably in this study. Eco-tourism was originally coined by Hector Ceballos-Lascurain as "travelling to relatively undisturbed or uncontaminated natural areas with the specific objective of studying, admiring, and enjoying the scenery and its wild plants and animals, as well as any cultural manifestations" (Butler 1991, in Filion *et al.*, 1994). Some definitions have expanded the concept to include the environmental and socio-cultural consequences of this kind of tourism (Peine, 1999).

The southern Overberg, incorporating the Agulhas Plain, is well situated to eco-tourism (MLH, 1994) and a recent eco-tourist guide (Scott, 1995), a local wildflower guide (Mustart *et al.*, 1997), together with active marketing campaigns (Cape Overberg Tourism Association, pers. comm.) have increased the region's profile as an eco-tourism destination.

An evaluation of tourist behaviour can be used for different purposes including: identifying investment opportunities (Bloom, 1998; KPMG/WESGRO, 1998); guiding structure planning processes (MLH, 1994; Provincial Administration Western Cape, 1998) and for providing input

into policy decisions with respect to protected areas (Munasinghe and McNeely, 1994; OECD, 1995). The latter is particularly important today where non-market valuation techniques are being used to guide decision-making with respect to protected areas (De Lacy and Lockwood, 1994).

Perhaps the most important use for eliciting information on tourism behaviour is to ensure that sustainable tourism development takes place. Although there is no such thing as "zero impact" tourism, minimum levels of negative impacts and carrying capacity need to be incorporated into tourism planning (Peine, 1999). Aggregate tourist arrivals of approximately 7 million in the Western Cape in 1997 are expect to increase to almost 10 million by the year 2002 (KPMG/WESGRO, 1998).

Few studies have been conducted to investigate tourism numbers, behaviour and spending for the different regions of the Western Cape, and there are no conclusive data for the Agulhas Plain as a geographical region. However, existing records show that the Agulhas Plain is a relatively poorly frequented by tourists, even though it is only two hours drive from the major centre of Cape Town.

The official figure for visitors to the Cape Agulhas Lighthouse in 1997 was 26 000 (Suidpunt Tourism Bureau, *in litt.*), although it is estimated that 40 000 people visit the southern most point of Africa at Cape Agulhas (L'Agulhas Residents, pers. comm.). To some this figure may sound high in terms of tourism numbers, but represents only 5% of the 800 000 visitors who visited Cape Point in 1997 (KPMG/WESGRO, 1998).

Although many people are drawn to the Agulhas Plain to visit the southern tip of Africa, many visit the region for other reasons. Little information exists on visitor origins or the main reasons that people visit the area. With the implementation of the Agulhas National Park, the biological reasons for the park's existence (Hanekom *et al.*, 1995; Lombard *et al.*, 1997) need to be married with the commercial developments required to fund the park in the long run. The analysis of current tourist behaviour patterns will greatly enhance this process. This information can also provide insights regarding the current recreational use values of the natural resources in the area.

Estimation of the total annual number of tourists visiting the Agulhas Plain.

Although the Agulhas Plain technically falls within the Overberg region (Appendix 2), the area of Agulhas/Struisbaai is also considered to be part of the South Coast region (Bloom, 1998). Together with Bredasdorp, it is estimated that 60 000 domestic tourists visit Agulhas/Struisbaai region each year (Bloom, 1998). Other data sources from the Agulhas Plain and De Hoop Nature Reserve indicate a mean domestic: international tourist percentage ratio of approximately 75:25 (COTA, *in litt*; Suidpunt Tourism Bureau, *in litt*; Turpie, 1996). Taking this into account, the total annual tourist population for the Agulhas Plain would be about 80 000.

Since mid-1997 the Cape Overberg Tourism Association (COTA) has been collecting visitor statistics from tourism bureaux throughout the Overberg region. Records from June 1997 to May 1998 suggest total tourist numbers for the Agulhas Plain of 60 000, adjusting figures to account for the assumption that only 25% of tourists sign visitors' books (J Britz, COTA, pers. comm.).

A conservative estimate of visitor numbers to the Agulhas Plain is therefore taken as a mean of the estimates of 80 000 and 60 000 calculated above, i.e. 70 000 tourists per year.

Accommodation profile and sample bias

Of the 904 visitors interviewed in this survey, 668 (74%) were local and 236 (26%) were international. Although pooling the two questionnaire surveys resulted in a representative local:international visitor ratio, the sample is problematic for the following reasons:
Firstly, over-representation for certain kinds of accommodation establishments (e.g. bed and breakfast establishments [B&Bs]) exists for the sampled population, while others (particularly caravan parks) are severely underrepresented (Table 6.2) in the sample. This sample bias was statistically tested with a Chi squared analysis, which showed a significant difference between the frequency of visitors sampled at different establishments and the number of beds available at various types of accommodation establishments on the Agulhas Plain
($X^2 = 5633$, df = 4, $p < 0.05$; categories "own house" and "other" where no data for expected frequencies could be computed were excluded in the analysis).

A large number of local visitors, most of whom would stay in caravan parks, visit the coastal areas of the Agulhas Plain during the December/January holiday period. This visitor group (particularly from the upcountry provinces) would not have been captured in any large numbers during this survey (Chapter 2).

Secondly, the sample is biased towards the month of June, an obvious result of the large number of samples taken during the long weekend survey. However, it is believed that local visitors who took the long weekend break during this month, comprise a representative sample of local visitors to the region, and would be attracted by a variety of reasons other than the Christmas/New Year holidays. The fact that weather was particularly good on the long weekend sampled in June 1997, together with the fact that a large percentage of the respondents (77%) stayed in either their own holiday houses, rented houses or caravan parks (typical behaviour of regular visitors as opposed to less frequent visitors who would be expected to stay in hotels or B&Bs), is perhaps further justification for proceeding with the analysis of results from a sample which differs from the expected pattern based on the available beds in various accommodation establishments. Nevertheless, it is important to bear in mind that the results presented below are constrained by the above biases.

On the Agulhas Plain, the summer holiday season attracts anglers, abalone divers hikers, beach goers, ski boaters and bathers to the main tourist resorts in the area (MLH, 1994). However, the tourist trade is very seasonal, and the occupancy rate at Struisbaai Hotel is less than 20 percent for the five winter months of the year (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, discouraged investment in the tourist industry in the early 1990s. Recent studies however, indicate an increase in the number of tourists in the Overberg (Kellas, 1999) and more specifically in the Agulhas/Struisbaai region (Bloom, 1998).

Table 6.2. Number of beds at different accommodation establishments in the Agulhas Plain (COTA accommodation data base, *in litt.*) and number of people who responded to questions in the surveys with regards accommodation.

Accommodation establishment	No. of beds in the Agulhas Plain establishments	Beds as% of total	No. of people sampled at different establishments	People sampled as a% of total
Hotels	397	7.0	92	10.7
Self catering/ rented	230	4.1	164	19
B&B + Guest houses	146	2.6	280	32.4
Caravan Parks	4818	85.4	59	6.8
Own house	No data	No data	193	22.3
Other	No data	No data	76	8.8
Nature Reserves	52	0.9	0	0
TOTAL	5643	100	864	100

What is a typical Agulhas Plain visitor? – origins, accommodation used, time of year and length of stay and group size and composition

The majority of visitors surveyed on the Agulhas Plain were domestic (74%), mainly from within the Western Cape, and only a small percentage from the rest of South Africa (Figure 6.1). Although it is expected that the Western Cape would provide the largest number of domestic visitors to the Agulhas Plain, other studies have shown that the rest of South Africa, particularly Gauteng, provide more visitors to the southern Overberg than found in this study (Turpie, 1996; Bloom, 1998). The international tourists were primarily from Europe (Germany 58%, United Kingdom 19%), with North America being the second largest representative continent (Figure 6.2).

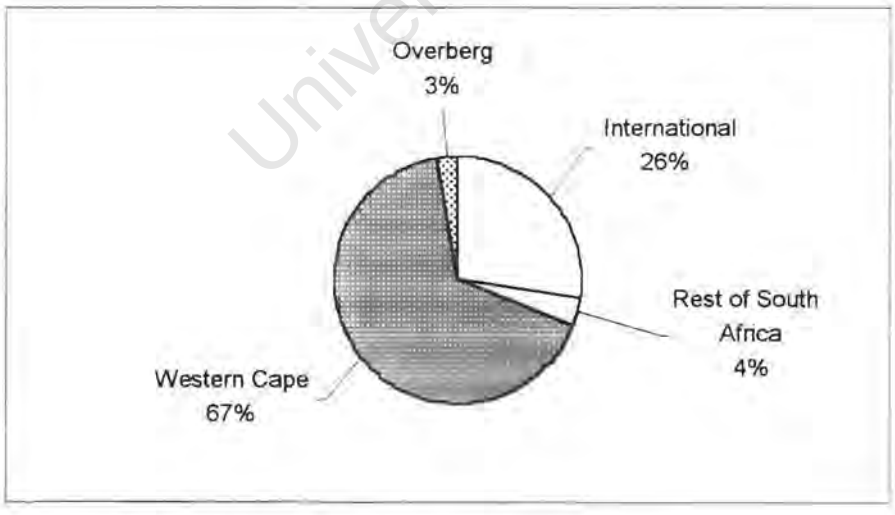


Figure 6.1. Origins of visitors to the Agulhas Plain (n=904).

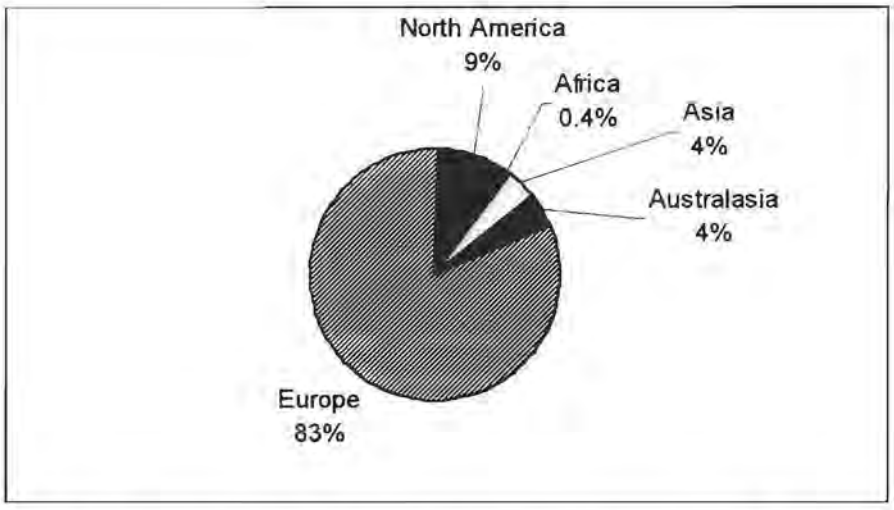


Figure 6.2. Origins of international visitors to the Agulhas Plain per continent (n=245).

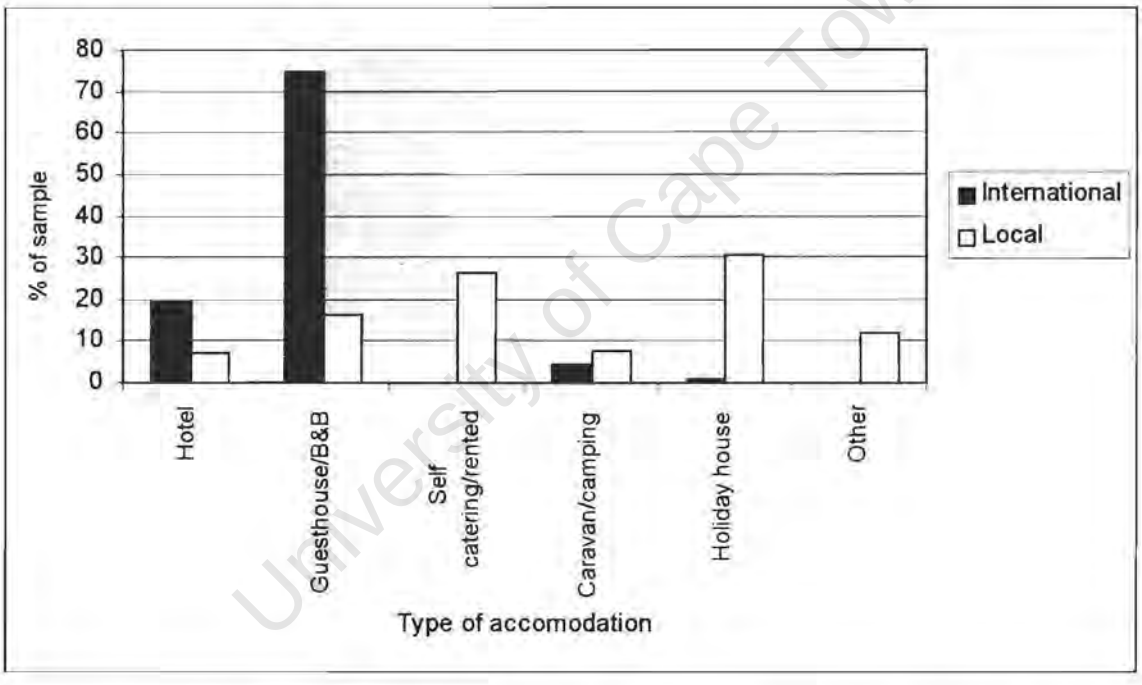


Figure 6.3. Breakdown of accommodation used by local and international tourists to the Agulhas Plain.

When examining accommodation establishments, overseas visitors clearly use hotels and guesthouses/B&Bs almost exclusively, whereas domestic visitors use a wider variety of accommodation, focussed primarily on their own holiday houses and self catering/ rented accommodation (Figure 6.3). It is likely that the number of domestic visitors staying in

accommodation classified "other" were staying with friends and family, as this was the largest type of accommodation reported in a recent survey for the Overberg (Kellas, 1999).

With the interview questionnaire being undertaken in June, visitation rates to the Agulhas Plain were biased towards this month. When June's results were excluded, the pattern showed peaks (all visitors combined) in late spring and summer, with a marked drop in winter. Turpie (1996) found that international visitors to the De Hoop Nature Reserve to the east of the Agulhas Plain peaked during spring and early summer, whereas the peaks for domestic visitors were in spring, summer and autumn. Other than a clear peak in December, visits to the Overberg by domestic tourists were evenly spread over the remaining months of the year (Kellas, 1999).

Length of stay

For the Western Cape as a whole, the average length of stay is approximately 10 nights for domestic visitors, with an increasing trend towards shorter trips, and 11 nights (out of a total of 18 in South Africa) for international visitors (KPMG/WESGRO, 1998).
In this study, domestic visitors to the Agulhas Plain stayed on average 2.9 (± 3.3) nights and international visitors 1.7 (± 1.3) nights.

Although this length of stay for international visitors is consistent with existing information (KPMG/WESGRO, 1998), it would be expected that domestic visitors would stay for a longer period. However, when examining the reported total length of the trip, international visitors reported an average length of 25 (± 14) days and domestic visitors 9 (± 31) days, which are respectively higher and the same as the norms for the Western Cape (KPMG/WESGRO, 1998).

It would be expected nevertheless that the average length of time spent in the Agulhas Plain would be far greater than the 2.9 days reported for domestic visitors, had the sampling of visitors been spread out over a longer period, including the popular December and early January period when the majority of domestic visitors take their annual leave (Bloom, 1998).

Group size and composition

International visitors to the Agulhas Plain were found to typically comprise two adults (mean = 2.14) and were generally without children (mean = 0.1). In contrast, domestic visitors were found to travel in slightly larger groups (mean = 3.26) with at least one child (mean = 1.1).

What are the main reasons for visiting the area, and how important is the natural environment?

When visitors were asked to estimate how much of their visit could be ascribed to the natural environment on a percentage scale from 0 - 100, the average was 68% (± 27). This figure highlights the importance of the natural environment (including biodiversity) for tourism and recreation on the Agulhas Plain.

Other important reasons for coming to the Agulhas Plain included a visit to the southern most tip of Africa, enjoyment of rural landscapes (mainly international visitors) and relaxation and friends/ family (mainly local visitors) (Figure 6.4). There was a significant difference between international and domestic visitors with respect to their reasons for coming to the Agulhas Plain (Chi squared test, $X^2 = 407$, df = 8, $p < 0.05$).

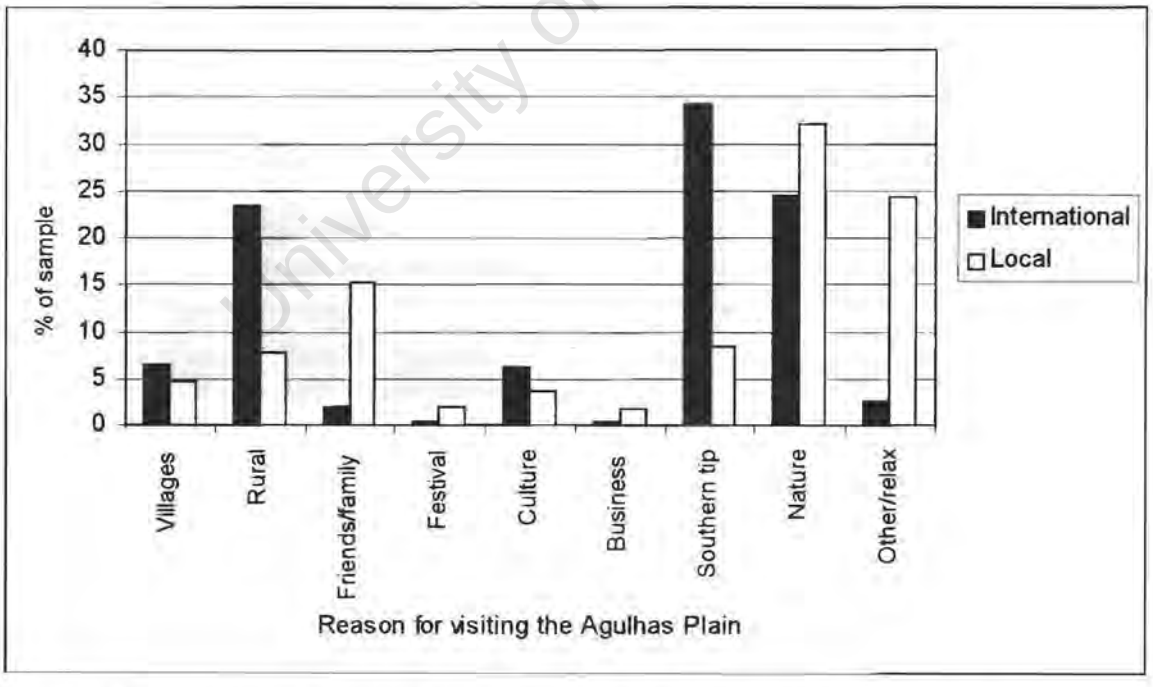


Figure 6.4. Breakdown of reasons for coming to the Agulhas Plain for international and domestic tourists.

International tourists are primarily attracted by the geographical aspect of being at the southernmost tip of Africa, the rural landscapes and the natural environment. National tourists and visitors appear to be visiting the region primarily for nature experiences, relaxation (angling) and friends and family. The strong attraction of the Agulhas Plain for relaxation, nature enjoyment and the southern tip of Africa bodes well for the establishment of the Agulhas National Park, as national parks enhance and promote such attractions.

The results in Figure 6.4 need to be examined in relation to the activities which visitors view as important with respect to the natural environment. Unfortunately, little comparative data are available from surveys for other areas. The survey responses also indicated a lack of clarity as to what was meant by the "natural environment". For example, some respondents did not regard the natural environment as an important reason for visiting, yet participated in several activities related to the natural environment. Alternatively, visitors do not consciously perceive these activities as being dependent on a healthy natural environment.

How do visitors currently use the natural environment?

Overall, visiting the beach was the most popular activity for visitors to the Agulhas Plain (Figure 6.5). The coast proved to be a very popular destination, with the majority of activities that visitors participated in having a strong focus on this area (Figure 6.5). When examining the use of the coastal and the terrestrial environment for nature-based activities, where international and domestic visitors are combined, the percentage ratio of use between "coastal" and "terrestrial" activities is 66:34.

When compared separately, the activities undertaken by international and domestic tourists were significantly different (Chi squared test, $X^2 = 192$, $df = 8$, $p < 0.05$), with the most notable differences being the almost exclusive participation in angling by locals, and the greater emphasis on cultural features by international visitors (Figure 6.5).

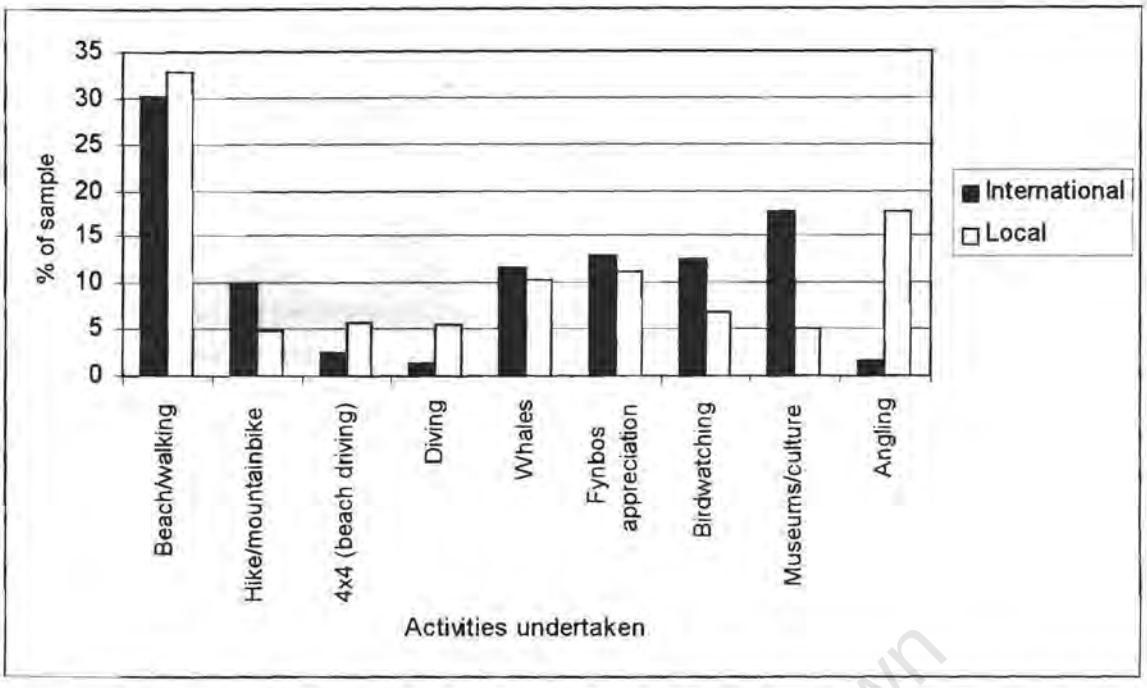


Figure 6.5. Breakdown of activities undertaken on the Agulhas Plain by international and local tourists.

Neither international nor local visitors showed a large interest in fynbos (one of the major reasons for the establishment of the Agulhas National Park), suggesting that this is not a priority for visitors (Figure 6.5). This may be a consequence of inadequate information and education facilities in the area and highlights a need for specialist education and marketing of fynbos vegetation (Overberg Conservation Services, 1997).

Apart from beach-based activities, significantly more international visitors participated in non-extractive activities, which focus on nature appreciation, than locals ((Chi squared test, $X^2 = 174$, $df = 7$, $p < 0.05$). Local visitors were significantly overrepresented in terms of preference for extractive activities (diving, angling) and off-road vehicle driving than international visitors (6.5). This is probably because locals have their own off-road vehicles, diving and fishing equipment. Off road vehicle driving is known to be potentially destructive to certain biota (Jeffery, 1987), and is an issue which needs to be carefully monitored and managed (Avis, 1998).

Recreational use and value of the Agulhas Plain

What do visitors spend and what is the current recreational use value of the area?

Assuming that spending patterns by visitors in the Western Cape as a whole (KPMG/WESGRO, 1998) hold true for the Agulhas Plain, an aggregate spending of R67.9 million would be predicted, based on a 70 000 visitor population. This section aims to test this prediction.

Aggregate spending for the entire Western Cape showed a percentage ratio of 60:40 for international:domestic tourists, despite there being fewer international tourists (WESGRO, 1998). This trend, as well as spending patterns on the Agulhas Plain are investigated further here.

Expenditure by visitors in the Agulhas region.

On-site spending (expenditure within the study area) comprises all spending apart from transport costs to the area and includes transport at the site, accommodation, restaurants, bars, groceries and gifts etc. On the Agulhas Plain, the average on-site spending per person per day was R 203 (± 157) for international visitors and R 70 (± 87) for domestic visitors. This is thought to be an underestimate as some of the pertinent questionnaire details were not provided in the survey. These figures are well below the R 600/day spent by international visitors and R 189/day spent by domestic visitors to the Western Cape, as reported by KPMG/WESGRO (1998).

Aggregate spending can be calculated using the simple formula:

Number of arrivals x average spending per day x average no. of days

WESGRO (1998)

Using this formula, with arrivals of visitors being calculated proportionally per sample population per area of origin for the estimated 70 000 Agulhas Plain visitor population, the total aggregate on-site spending for the region in 1997 was R19.6 million. If the average on-site spending reported for the Western Cape (international visitors - R600/day and R 189/day for domestic visitors) were used in this calculation, the aggregate on-site spending by Agulhas Plain visitors would be R56.8 million. Even using these more realistic on-site spending values, this total is

substantially lower than the R67.9 million predicted above. The main reason for this discrepancy is the fact that visitors reported spending less time on the Agulhas Plain than the average for the Western Cape.

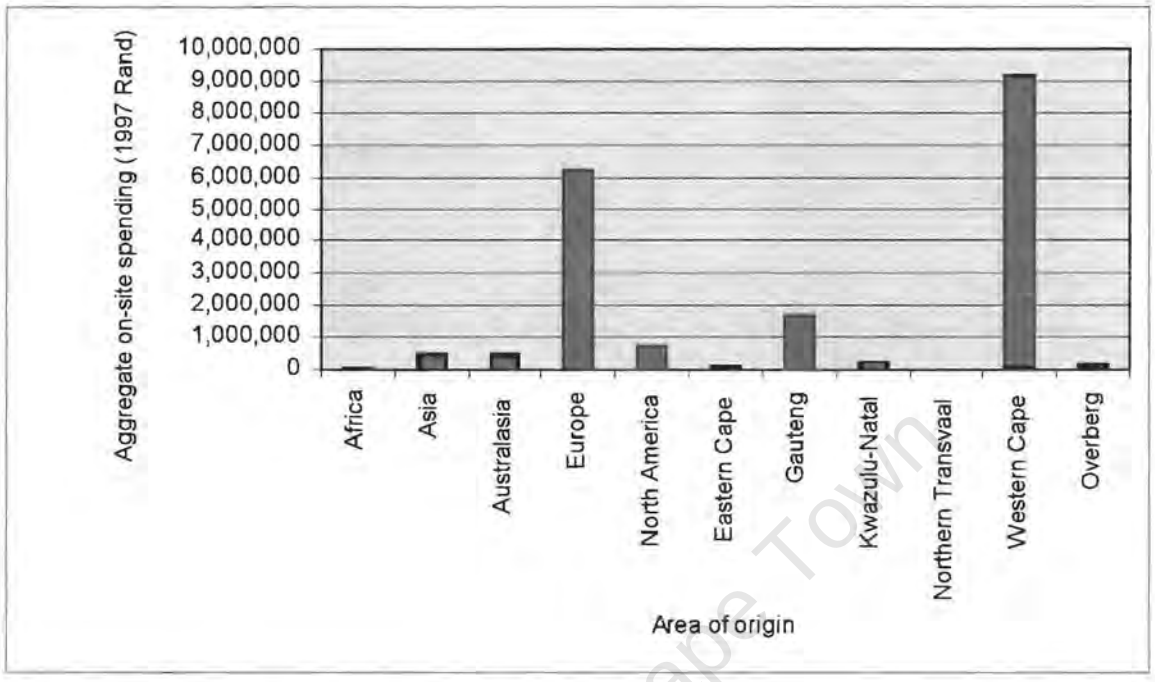


Figure 6.6. Aggregate spending on the Agulhas Plain, per visitor area of origin, in 1997.

It can be seen that visitors from the Western Cape spend the most in the Agulhas Plain, followed by visitors from Europe and then Gauteng (Figure 6.6). These established market sectors are the obvious starting points for the development of new tourism ventures in the region.

The aggregate on-site spending by international visitors was 41% of the total, although these visitors only made up 26% of the total number of people. However, the domestic tourist market clearly dominates on-site spending on the Agulhas Plain.

Recreational use value – a travel cost method.

Average travel expenditure per visitor for each zone are summarised in Table 6.3. These results included adjustments to account for the relative importance of the Agulhas Plain to the visitor's entire trip away from home. The average total travel expenditure per person included the on-site costs, calculated on a per day basis.

Table 6.3. Visitor origins (zones); average total travel expenditure (includes on-site costs) per person; populations per visitor origin sampled and extrapolated as visits to the Agulhas Plain; population of zone, visits per zone population and total travel expenditure per visitor origin zone (* reflects only the countries from which visitors were sampled).

Visitor origin (zone)	Average total travel expenditure per person [R]	Sample population surveyed	Visits to the Agulhas Plain	Total population of zone	Visits per million inhabitants	Total Travel Expenditure [R]
Asia	1143	9	697	*131,050,000	0.07	796,966
Australasia	750	11	852	*16,765,000	0.66	639,334
Europe	858	201	15564	*299,345,306	0.67	13,361,658
North America	535	23	1781	*274,545,000	0.08	953,507
Eastern Cape	113	7	542	6,481,300	1.08	61,250
Gauteng	190	18	1394	7,048,300	2.55	265,153
Kwazulu-Natal	338	9	697	8,713,100	1.03	235,587
Northern Province	114	2	155	5,397,200	0.37	17,808
Cape Town	162	377	29192	1,292,000	291.80	4,753,581
Western Cape	105	213	16493	2,970,000	71.72	1,733,719
Overberg	105	31	2400	181,000	171.24	254,310
						23,072,873

In 1997 the total travel expenditure to the Agulhas Plain was estimated to be R23 million, when extrapolated to the total population of the Agulhas Plain for the different visitor origin zones (Table 5.3). The total on-site spending of R19.6 million therefore represents 85% of the total travel costs and suggests that firstly, for international tourists, the Agulhas Plain comprised only a small part of their travel costs (*en route* stopover) and secondly, for domestic tourists, most came from relatively nearby (mainly Cape Town) and spent more in the Agulhas region than on actually getting there.

The results in Table 6.3 were used to create a demand curve from which consumer's surplus could be estimated (Figure 6.7).

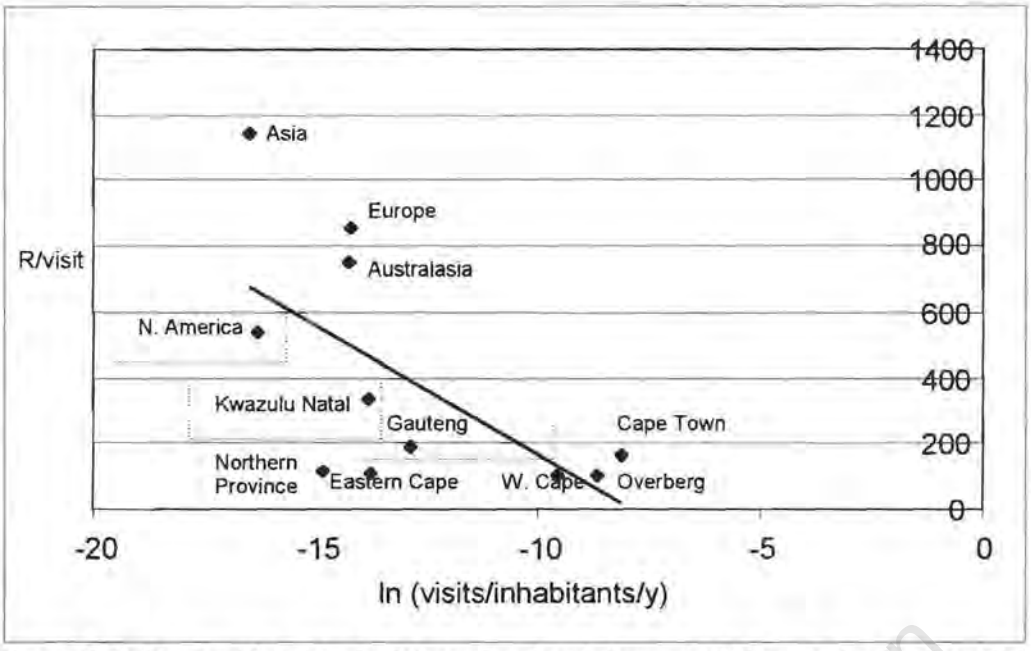


Figure 6.7. Demand for visits by international and domestic visitors to the Agulhas Plain as revealed by the travel cost method under the assumption of single purpose visits for domestic tourists.

The demand curve for visits to the Agulhas Plain is as follows:

$$\ln(\text{visitation rate}) = -10.97 - 0.005(\text{travel cost});\ (n = 11,\ r = 0.63,\ p < 0.05).$$

Consumer surplus for each zone was calculated by taking the integral under the demand function with respect to Price (TC):

For the semi-log function:

$$\ln(Q) = a + b(TC),$$

the consumer surplus for each zone is calculated as:

$$CS = -e^{a+b(TC)}/b \qquad \text{(Hof \& King, 1992)}$$

After calculating the consumer surplus for each zone, the results were summed to yield an annual consumer surplus for the sample populations, which was then extrapolated to the total zone population (Table 6.4).

Table 6.4. Visitor origins (zones); average total travel expenditure (includes on-site costs) per person; visit rate, zonal average consumer surplus and total consumer surplus for visitors to the Agulhas Plain.

Visitor origin (zone)	Average total travel expenditure per person [R]	Visit rate to the Agulhas Plain [visitors per annum]	Zonal average consumer surplus per visit [R]	Total consumer surplus [R]
Asia	1143	697	164	114,429
Australasia	750	852	123	104,440
Europe	858	15564	70	1,087,294
North America	535	1781	2,817	5,016,474
Eastern Cape	113	542	1,806	978,688
Gauteng	190	1394	519	723,351
Kwazulu-Natal	338	697	613	427,042
Northern Province	114	155	5,210	806,920
Cape Town	162	29192	5	152,065
Western Cape	105	16493	28	466,503
Overberg	105	2400	12	28,310
				9,905,515

The demand curve for visits to the Agulhas Plain produced an annual consumer surplus of R 9,9 million (Table 6.4). This is equivalent to approximately 43% of the total travel expenditure by visitors and represents an additional value which can be allocated to the Agulhas Plain.

The recreational use value of the Agulhas Plain to visitors in 1997 is therefore estimated to be approximately R33 million.

Allocation of value to biodiversity sectors.

It is extremely difficult to allocate the recreational use value of the Agulhas Plain to the biodiversity sectors found there. This is due to two factors: firstly, it is difficult to measure which aspect of a recreational site or landscape is attracting visitors to it (Freeman, 1993). For example, agricultural fields could be attracting people as much as the fynbos patches occurring in between them. Secondly, there were no questions in the interview survey designed to elicit responses as to how important the terrestrial environment was in comparison to the coastal environment.

However, taking the following into account:

- 68% of the reason for coming to the Agulhas Plain being attributed to the natural environment; and
- the ratio of terrestrial:coastal activities undertaken in the area examined, is 34:66,

it is estimated that the terrestrial area accounts for 23% and the coastal area for 45% of the value (i.e. enjoyment) of the Agulhas Plain by visitors. The terrestrial natural environment therefore has an estimated recreational use value of R7.58 million per annum, whereas the coastal environment of the Agulhas Plain is estimated to have a recreational use value of R14.84 million per annum. Thus the total recreational use value that can be allocated to the natural environment using the travel-cost method is of the order of R 22.4 million per annum.

Although the travel cost method is a useful way of measuring the recreational use value of an area in the absence of markets, it is based on a series of assumptions and has come under some criticism recently. Areas of criticism relate to multipurpose visits (Turpie, 1996), differences between international and domestic tourism (Geach, 1995) and sampling biases and extrapolation to zone populations (OECD, 1995). Nevertheless, the travel cost method has been used widely (OECD, 1995; De Lacy and Lockwood, 1994) and remains an important tool for quantifying the economic importance of the natural environment. Ecological economics is an integral aspect in the determination of policies and strategies relating to the protection and sustainability of biodiversity (Costanza and Daly 1992, Jansson *et al.*, 1994).

Summary of Chapter 6

This chapter concluded the following key outcomes:

- there is a significant difference between international and local visitors to the Agulhas Plain with respect to their reason for going there, their choice of accommodation and the activities in which they take part
- international visitors are primarily attracted by the southern tip of Africa, rural landscapes and the natural environment, whereas the natural environment, relaxation, and friends and family are the primary attractants for local visitors
- international visitors typically stay in B&Bs and hotels, whereas local visitors use a variety of accommodation establishments
- the natural environment was reported as being on average 68% of the reason for attracting visitors to the Agulhas Plain, with the coastal environment being the most important factor
- average expenditure per person is higher for international than local visitors
- aggregate spending on the Agulhas Plain per zone of origin was highest for the Western Cape, followed by Europe and Gauteng
- the total travel expenditure on the Agulhas Plain was estimated to be R 23 million per annum, of which 85% was direct on-site expenditure
- the travel cost survey produced an annual consumer surplus of R 9.9 million
- the total value that can be allocated to the natural environment of the Agulhas Plain is estimated to be R 22.4 million/year.

Chapter 7 Cultivation, harvesting and grazing of indigenous vegetation - how sustainable is this what are some of the key management implications?

In this section the effect of fynbos cultivation and harvesting on the natural environment is examined. In addition the effect of grazing of indigenous vegetation is briefly addressed. This chapter addresses the issue raised in key question 8. i.e. how sustainable is the use of indigenous vegetation and what are some of the key management implications?

Fynbos cultivation method and loss of biodiversity

Ploughing method

It has been suggested that after two successive ploughings of an area of fynbos, most of the biodiversity will be permanently lost (D.G. Malan, Fynbos Horticultural Consultant, pers. comm.). Davis (1990) found a significant decrease in plant species richness in tilled as opposed to untilled mountain fynbos. Figure 7.1 indicates that over 50% of the cultivated fynbos areas sampled is ploughed twice, thereby effectively reducing chances of fynbos recovery. A fairly substantial area was reported being ploughed once, and only a small amount of veld was burnt and/or scarified (worked lightly with a shallow toothed implement) only (Figure 7.1), a practice thought not to influence species diversity to a great extent (Malan, 1996).

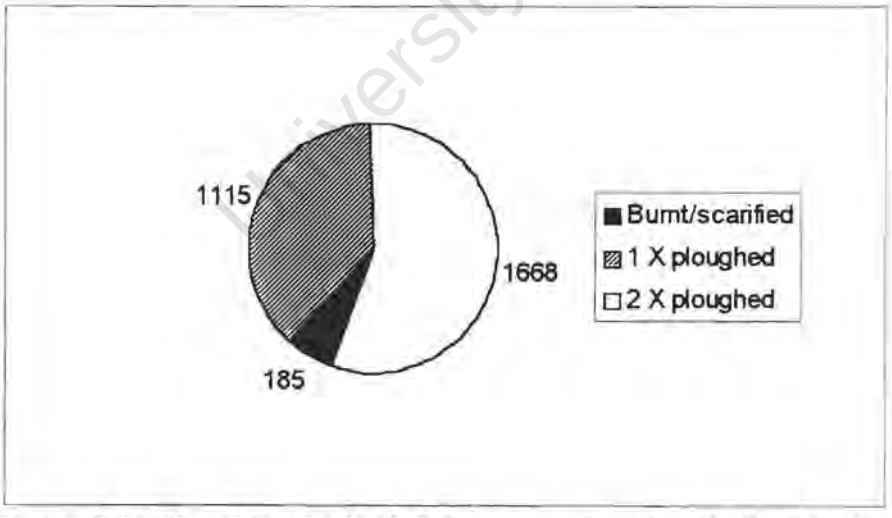
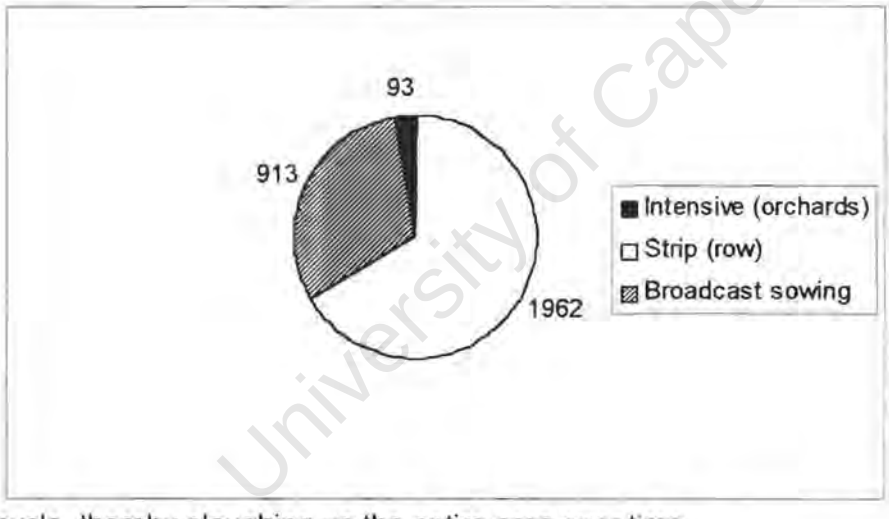


Figure 7.1. Ploughing method of flower growers sampled on the Agulhas Plain, expressed as hectares for each method used (n = 27).

Cultivation method

The breakdown of cultivated fynbos areas for different methods used on the Agulhas Plain is given in Figure 7.2. The majority of fynbos cultivated areas are under strip cultivation, followed by broadcast sowing, with a relatively small area under intensive orchard cultivation. It could be argued that strip cultivation (mean width of strip cultivated = 2.8 m (± 2.3), mean natural fynbos strip = 3.1 m (± 0.9) effectively conserves ± 50% of the area's biodiversity as only half of the area is ploughed. This is very difficult to ascertain without experimental evidence, although it is suggested that less than half the species would be impacted, considering species-area relationships in small areas of fynbos, where most species are captured in relatively small areas (Cowling, 1990; Cowling *et al.*, 1992) However, it is likely that ecological processes such as insect movements (important for pollination) could be affected negatively when vegetation structure is artificially altered. Furthermore, sites which have been ploughed once will inevitably be ploughed up again at some time in the future. Some farmers reported that in the case of strip cultivation, they intended to cultivate the remaining fynbos strips during the following cultivation



cycle, thereby ploughing up the entire area over time.

Figure 7.2. Fynbos flower cultivation practices of flower growers sampled on the Agulhas Plain, expressed as hectares for each method used (n = 27).

With broadcast sowing the soil is usually only ploughed once or sometimes simply scarified or seeds scattered onto it following a fire. Many landowners argue that broadcast sowing is therefore simply "helping nature" by increasing the proportion of desirable species which grow on the property. While this may be true in some cases, broadcast sowing usually results in near

mono-cultures (e.g. *Leucadendron platyspermum*) where diversity of non-target species is severely compromised. In addition, some species are cultivated in areas of natural veld in which they would not naturally occur, although they do occur in the broader Agulhas area (personal observation).

Intensive cultivation of fynbos products comprises a relatively small fraction of the surface area under cultivation on the Agulhas Plain (Figure 7.2). However, there is little difference between fynbos orchards and conventional fruit orchards with regard to the consequences of intensive cultivation. The removal of indigenous biodiversity, maintenance of weeding programmes (with flower farming often removing indigenous species as weeds), increased demands on water quantity and quality (possible leaching effects of irrigation water into natural river systems), and the maintenance of chemical spraying programmes, are all factors which need to be considered.

Application of pesticides and fertilisers

Rebelo (1987) has reported extreme examples of "pest" control where sunbirds and sugarbirds (important fynbos pollinators) had been poisoned for damaging Proteaceae inflorescences. This practice was not reported on the Agulhas Plain, although pesticides (mainly fungicides) and fertilisers are used to an extent. While only 9% of fynbos flower growers reported using fertilisers on their crops, 23% said that they used pesticides. This activity was not restricted to intensive orchards, but some strip-cultivated and broadcast-sown fields of fynbos flower products were also treated with fungicides.

Condition of veld used for fynbos cultivation

In the mid 1990s, the South African Protea Producers and Exporters Association (SAPPEX), following a request from the Department of Agriculture, developed a set of guiding principles for the fynbos industry (Appendix 5). Included in these guidelines are following recommendations for the environment:

- previously cultivated land should preferably be used for orchard-type plantations
- farmers applying to plough virgin soil should consult closely with and by guided by the recommendations of the Department of Agriculture as well as the relevant nature conservation authorities.

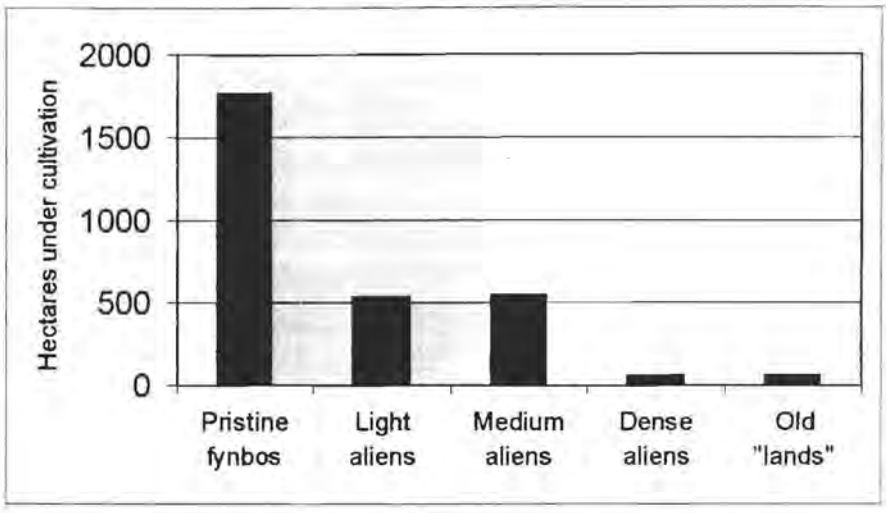


Figure 7.3. Number of hectares of different quality of veld cultivated by Agulhas Plain flower growers in the sample (n = 27).

Figure 7.3 clearly indicates that pristine fynbos comprises the largest areas used for fynbos cultivation, with old lands and densely infested areas comprising the smallest areas. Although this makes agricultural and economic sense for the farmer, it is a cause for concern from a conservation point of view.

Origin of plant genetic material

Of the flower growers interviewed, approximately 50% used local plant material (own or nearby plant populations), 50% used a combination of local and foreign material (outside of the Agulhas Plain), and no farmers used exclusively foreign material.

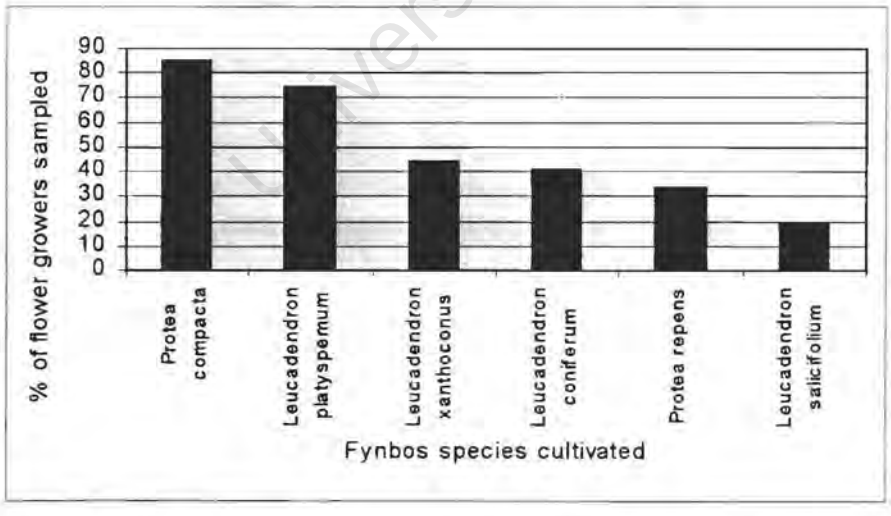


Figure 7.4. The six most important fynbos species cultivated on the Agulhas Plain, depicted as the percentage of flower growers sampled (n = 27) who grow these crops.

Agulhas Plain flower farmers mainly grow six plant species of which *Protea compacta* was most frequently grown (Figure 7.4), followed closely by *Leucadendron platyspermum*. *P. compacta*, the mainstay of the Agulhas Plain's wildflower industry and *L. platyspermum*, a listed Red Data species (Vulnerable; Hilton-Taylor, 1996) but widely cultivated, are both used extensively in the fresh and dried flower industries. All of the species listed in Figure 7.4, occur naturally on the Agulhas Plain. Of the foreign plant material reported used, certain varieties of species, e.g. *Protea repens* from Riversdale, when cultivated on the Agulhas Plain, shows improved pest resistance and more favourable flowering times than its local conspecific (Agulhas Plain flower farmers, pers. comm.). Many species which do not occur naturally on the Agulhas Plain (e.g. *Brunia albiflora,)*, do very well in cultivation here (personal observation).

Questions regarding the possible hybridisation of cultivated species with naturally occurring plants frequently arise, (e.g. Rebelo, 1992) and it has been requested that cases of genetic contamination get reported to SAPPEX (Appendix 5). Although genetic contamination seems to be a rare occurrence, it has been observed in the Langeberg (D. McDonald, National Botanical Institute, pers. comm.) and in natural fynbos, hybridisation between species within genera does occasionally occur (personal observation). A number of farmers cultivating intensive orchards made use of hybrid and other culitvar material from the Agricultural Research Council's Fynbos Unit.

Vegetation types being cultivated for fynbos cultivation

Figure 7.5 and Table 7.1 illustrate that by far the most important vegetation type for the cultivation of fynbos flowers on the Agulhas plain is Acid Sand Fynbos. Although the cultivation of this vegetation type is associated with potential physical problems such as erosion, Acid Sand Fynbos, due to its relative abundance on the Agulhas Plain (Figure 1.2) was given a relatively low target (10%) for inclusion into a protected area network (Lombard *et al.*, 1997).

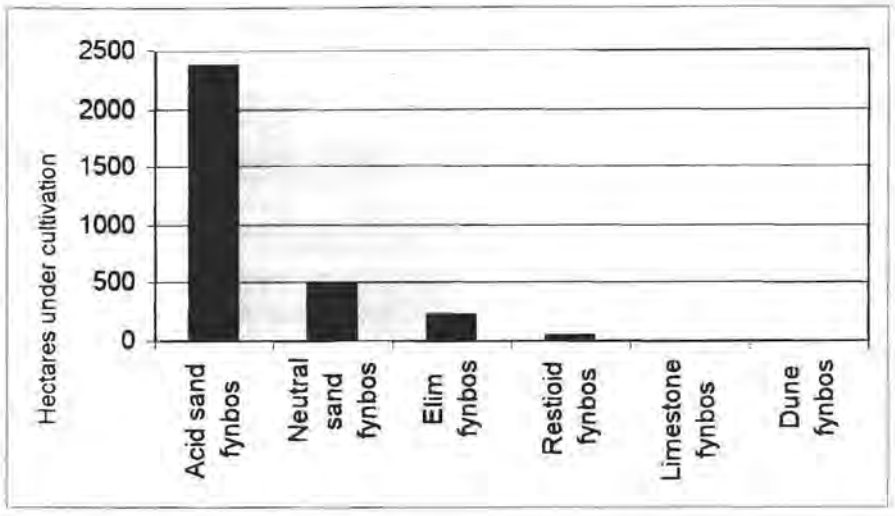


Figure 7.5. Number of hectares of different types of fynbos cultivated by sampled Agulhas Plain flower growers (n = 27).

Table 7.1. Percentage of total area cultivated for different vegetation types in sample of flower growers from the Agulhas Plain (n = 27), percentage of regional and local endemics for the Agulhas Plain flora (Cowling and Holmes, 1992).

Fynbos vegetation type	% of sample area cultivated	% regional endemics	% local endemics
Acid Sand Fynbos	75.2	30.7	12
Neutral Sand Fynbos	15.6	13.3	14
Elim Fynbos	7.1	3.4	13
Restioid Fynbos	1.8	no data	no data
Limestone Fynbos	0	13.3	37
Dune Fynbos	0	8	9

A cause for concern, however, is the cultivation of ± 500 ha of Neutral Sand Fynbos for flowers (Figure 7.5). This vegetation type, occurring on relatively recently-formed soils derived from the colluvial processes of parent rock (primarily limestone), is home to a number of endemic species (Cowling and Holmes, 1992; Cowling & Mustart, 1994). Neutral Sand Fynbos was given a target area of 50% for inclusion into a protected area network for the Agulhas Plain (Lombard *et al.*, 1997).

Elim Fynbos, a vegetation type endemic to the Agulhas Plain (Cowing *et al.*, 1988), housing a number of endemics (Killian, 1995; Rebelo, 1995) and with a target value for reservation of 75% (Lombard *et al.*, 1997) is also being cultivated for fynbos flowers, but to a lesser extent. If this practice continues unchecked, severe threats could be placed on this unique vegetation type. Restioid Fynbos was also reported to be cultivated to a small extent (Figure 7.5), but Dune

Fynbos and Limestone Fynbos were not reported cultivated at all. The calcareous soils supporting Dune Fynbos are not suitable for growing the predominantly calcifuge species (Esler *et al*, 1989) used in the cut-flower industry (Appendix 4), but excessive drainage, salt exposure and generally poor soil moisture probably also play a role. Part of the reason for no cultivation being reported in Dune Fynbos is likely to be as a result of this vegetation type being primarily under conservation ownership (state and private; Figures 1.2 & 4.6). Limestone Fynbos, a unique vegetation type housing numerous endemics (Willis *et al.*, 1996), has an in-built measure of protection – it is simply too hard to plough (*harde duine* in Afrikaans). Limestone Fynbos generally occurs in shallow soils on top of a hard, rocky, limestone pavement (Thwaites & Cowling, 1988; Heydenrych, 1994). However, if the soils closely associated with this vegetation type (neutral sands) are significantly disturbed, the knock-on effect is likely to influence the adjacent limestone flora in time.

The threat of cultivation for fynbos flowers on the endemic plants on the Agulhas Plain is illustrated in Table 7.1. The greatest threat on regional endemics is for Acid Sand Fynbos, followed by Neutral Sand Fynbos. Local endemics on acid sand and Neutral Sand Fynbos as well as Elim Fynbos are potentially being threatened by fynbos cultivation (Table 7.1). Limestone Fynbos and Dune Fynbos, with the highest and lowest numbers of locally endemic species respectively are not directly affected by fynbos cultivation (Table 7.1).

Each of the major vegetation types of the Agulhas Plain include a range of wetland sub-types, all of which have extremely high conservation value (Cowling and Mustart, 1994; Lombard *et al.*, 1997). Although there is strict legislation preventing the cultivation of wetlands (Conservation of Agricultural Resources Act 43, of 1983), some of these habitats are being cultivated by certain Agulhas Plain flower farmers. It should be noted, for example, that *Leucadendron salicifolium* (trade name "strictum"), one of the six most popular species cultivated (Figure 7.4), is a wetland species.

The fynbos wildflower industry, how sustainable is it?

Harvesting rates

One of the most difficult aspects of measuring the sustainability of harvests from fynbos vegetation is the lack of baseline data regarding standing stocks (Turpie *et al.*, in press). Being a fire-driven system, fynbos stocks vary with post-fire age and are also variable as a result abiotic factors such as slope, aspect, moisture gradients and soil nutrient status, as well as inherent genetic, and inter- and intra-specific biological factors. For example, Le Maitre (1998) found a stand density for *Protea neriifolia* of 2114 plants per hectare in 8 year old fynbos and only 76 plants per hectare in 12 year old fynbos, where slope, aspect and soil parent material varied between the sites.

Another difficulty relates to extrapolation of data from sampled sites to larger vegetation categories. For example, fynbos vegetation types are classified at levels ranging from very broad for the Cape Floristic Region (e.g. Low and Rebelo, 1996) to more detailed within a sub-region (Cowling *et al.*, 1988), to land-holding size for management planning purposes (Jeffery and Heydenrych, 1996). In addition, fynbos stocks differ with respect to their quality in terms of invasion by alien plants and past utilisation of the veld. Therefore, unlike in the commercial forestry industry for example, it is not possible to refer to "typical" stocks of fynbos species and communities.

Information on the rates of harvests and sustainability of the industry, remain restricted to broad questionnaire-based surveys (Malan, 1996; this study) and biological studies based on a handful of species (e.g. Rebelo & Holmes, 1988; Mustart and Cowling, 1992, Maze & Bond, 1996).

Although it may be assumed for this study that the rates of wildflower harvests reported (Appendix 4) are more or less sustainable, as landowners were primarily picking from their own land, certain flower farmers admitted how they had decimated populations of re-seeding shrubs such as *Erica* spp. and *Syncarpha* spp. through over-harvesting. It has been shown in the case of *Brunia albiflora* near Kleinmond, that where land was leased from a local authority nature reserve, extreme harvesting intensity led to a high mortality of plants, whereas where harvesting was undertaken on privately-owned land by the landowner, mortality rates were significantly

lower (Rebelo and Holmes, 1988). Nevertheless mortality rates of plants on the landowner's land were higher than natural mortality (Rebelo and Holmes 1988).

Harvesting rates - stems per hectare (primarily Proteaceae)

The number of stems per hectare for various Agulhas Plain fynbos species varies considerably, from less than one to over 200 (Appendix 4). Only six species, *Leucospermum patersonii, Leucadendron coniferum, Protea susannae, Protea compacta, Protea obtusifolia* and *Syncarpha vesita* had reported harvesting levels of over 100 stems per hectare.
The average number of stems per hectare reported harvested was 39 ± 63 for all species, with an average of 46 ± 68 for *Protea* spp. alone (data from Appendix 4, represented by mean values and standard deviations from the mean).

These values may seem low, but in actual fact include areas within each vegetation type in which species were not being harvested, only low levels of picking were occurring, or no stocks were available due to a recent fire. Malan (1996), reported higher rates of harvesting for 21 *Protea* spp. (89 ± 97 stems / ha) in a sample of the entire fynbos biome. Here it was reported that on average, 55% of the available *Protea* spp. material was harvested, ranging from 10% for *Protea nitida* to 75% for *P. susannae* and 80% for *P. speciosa (*Malan, 1996). Using the reported percentage of material harvested for each *Protea* sp. by Malan (1996), the average standing stock (harvestable blooms) for *Protea* spp. is estimated to be 188 ± 204 stems per hectare, from approximately 600 626 hectares available to flower farmers in the fynbos biome.

Fynbos plants are not distributed evenly across the landscape. Based on the results of three studies on the population biology of five *Protea* spp. (Esler *et al.*, 1989, Mustart and Cowling, 1992; Le Maitre, 1998) a mean of 25 432 ± 23 634 inflorescences/ha is obtained. This represents sampling in dense proteoid fynbos, and cannot be considered to be the norm in terms of numbers of flowers per hectare throughout areas of fynbos veld. Indeed, this average is even greater than the average number of flowers per hectare reported for cultivated stands of proteas (Malan, 1996). However, where fynbos wildflowers are accessible and plentiful, there will perhaps always be an incentive to harvest them. In mountain fynbos in the Barrydale district, a landowner recently discovered illegal picking of flowers of an incredibly high intensity, 37 100 stems/ha/y for *Protea neriifolia* and 25 400 stems/ha/y for *P. repens* (J. Blignaut, *in litt.*). This represents harvesting levels above the mean number of stems per hectare reported

occurring elsewhere in mountain fynbos for *Protea neriifolia* (27 046 stems/ha) and 69% of the number for *P. repens* (36 628) (Le Maitre, 1998).

Mustart and Cowling (1992) recommended that no more than 50% of the current year inflorescences should be harvested, for Agulhas Plain serotinous Proteaceae, whereas Maze and Bond (1996) suggested that for *Protea neriifolia* this level could be higher, and still provide enough seed for recruitment of the species following a fire.

Although there have been a number of recommendations concerning safe wildflower harvesting practices (e.g. Mustart and Cowling, undated [Appendix 6]; Greyling & Davis, 1989; Davis, 1990; Mustart & Cowling, 1992), over exploitation of species is still occurring in certain areas of the Agulhas Plain, largely as a result of pickers being paid per number of stems harvested, rather than a fixed wage. Very few cases where only 50% of the inflorescences are left on the plant were reported by Agulhas Plain flower farmers, and even very conservation-minded farm managers reported difficulties in controlling the amount of fynbos material their pickers were removing from the veld.

Harvesting rates - kilograms per hectare (primarily Cape "greens")

The average reported yield of fynbos material measured in kilograms on the Agulhas Plain was:

3.2 ± 11.1 kg/ha/y.

Reported yields were as follows for the major plant families harvested:

- Proteaceae; 9.6 ± 22.7 kg/ha/y;
- Ericaceae; 0.8 ± 1.1 kg/ha/y;
- Bruniaceae; 1.8 ± 1.9 kg/ha/y.

These values are probably underestimates, nevertheless, they represent the major component of the plant material harvested as a filler material on the Agulhas Plain (Appendix 4).

Stock and Allsopp (1992) removed a maximum average biomass of $10\,005 \pm 4\,442$ kg / ha of fynbos from an experimental plot, which, although outside the study area of this study, had a similar productivity. The average reported mass of fynbos material harvested in this study therefore represents a fraction of the average veld "standing stock" and is unlikely to have a dramatic effect on these fynbos ecosystems from a functional perspective. However, the high diversity of fynbos species means that different harvesting practices will need to be applied to

different species to safeguard against over harvesting of certain species which are at risk. Rebelo (1987) suggests that the use of "greens" probably results in more plant mortality than the picking of cut flowers, particularly in plant species with monopodial growth forms and short-lived leaves which cannot regenerate from epicormic buds. It has been shown that harvesting levels of more than 75% in *Phylica ericoides*, resulted in a significant loss of the subsequent year's flower crop, whereas levels of 25% had little effect (Killian, 1991).

Another factor which has not been taken into account is the question of wastage of material which has been harvested but is discarded, either through cleaning of plant material, the material being of inferior quality or simply not needed once it arrives at the packing shed. It is estimated that at some packing houses up to 30% of the material harvested is discarded (L. Kabot, Flower Valley Farm, pers. comm.). Other factors which need to be considered regarding sustainability of harvesting practices include the cutting techniques used for each species, so that plants are not unduly stressed or die as a result of pruning, and the effect on the ecosystem that the large-scale removal of nutrients in fynbos plant material (particularly seeds) for different species harvested, might have (Van Wilgen *et al.*, 1992).

The above indicates the complexities of determining levels of wildflower harvests from fynbos systems. Clearly more research is needed before sustainable levels of harvesting can be determined with any degree of accuracy. At the same time education of both the owners and pickers of fynbos areas is a prerequisite to achieving this end.

Fires

Fire frequency

Fires have been used for a very long time on the Agulhas Plain as a management tool (Chapter 3), and almost half of the Agulhas Plain farmers reported burning their veld to improve wildflower production (Figure 7.6). However, although many landowners planned to burn their veld, a large proportion were reluctant to do so (in case the fire spread to neighbouring farms), or planned not to burn their veld (Figure 7.6). Records from the Department of Agriculture, (Directorate of Resource Conservation, *in litt.*) indicate a relatively large number of permits being issued to Agulhas Plain landowners for burning their veld during the past eight years. However, it would appear that more fires are being purposefully lit on the Agulhas Plain in recent years, than those for which permission has been obtained (personal observation).

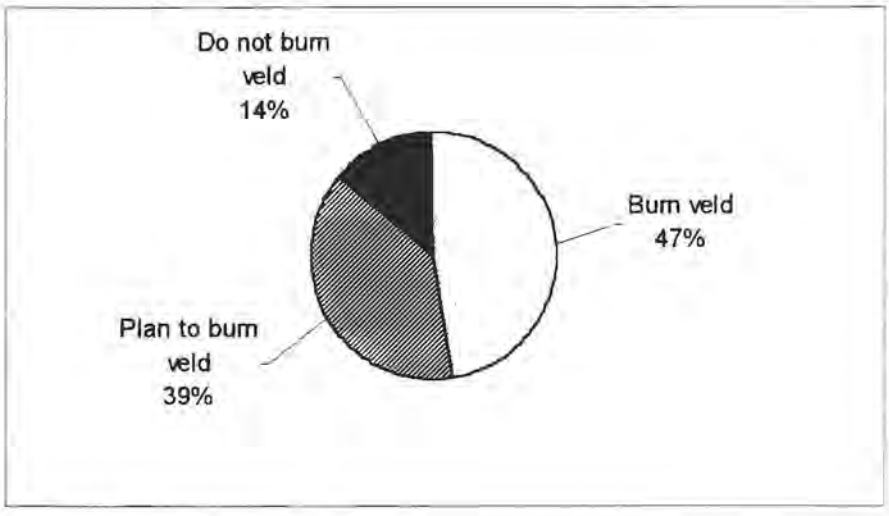


Figure 7.6. Burning practices of Agulhas Plain landowners sampled in the questionnaire survey (n = 44).

Twenty five per cent of Agulhas Plain farmers who burned their veld did so with a fire frequency of between 6 – 10 years, whereas 75% indicate that they burned their veld on a cycle more than 10 years (average 14.2 years). The official fire frequency recommended for "flower veld" in the Agulhas Plain is 14 years on northern slopes and 12 years on southern slopes (Department of Agriculture, *in litt.*).

Fire frequencies at intervals of 6 – 10 years are not recommended for the regeneration of serotinous fynbos species, as many fynbos Proteaceae only begin to flower at six years (Rebelo, 1995). Such species could be at risk from local extinction if the adult plant had not formed sufficient seed reserves by the time of a fire (Van Wilgen *et al.*, 1992).

The only "rule of thumb" for determining minimum fire frequencies is as follows:
a fire should only take place once 50% of the population of the slowest maturing species in an area has flowered for at least three successive years (Kruger and Lamb, 1978, in Van Wilgen *et al.*, 1992).

More recently, research has found that fire frequencies of longer than those currently used in many fynbos ecosystems (12 – 15 years) may be optimal for promoting diversity under a Proteaceae canopy in mountain fynbos (Vlok, 1996). The fact that stands of fynbos older than

14 years are undesirable in terms of floral products (Agulhas Plain flower farmers, pers. comm.) highlights the need for bench-mark protected areas from which no harvesting takes place (Cape Nature Conservation, 1995).

Fire season

All Agulhas Plain farmers involved with burning indicated that late summer and autumn was the preferred time to burn. This period is considered the optimum from a regeneration perspective (Van Wilgen *et al.*, 1992) as fynbos species can begin to germinate from seed or resprout from underground storage organs at the onset of the first winter rains. As a result of the low fire risk, the Department of Agriculture (*in litt.*) recommends fires in mountainous regions should take place between May and August. However it has been shown that late winter/early spring fires are detrimental to the regeneration of serotinous Proteaceae (Van Wilgen and Viviers, 1985; Midgley, 1989l Van Wilgen *et al.*, 1992)).

More recently there has been a spate of early summer fires on the Agulhas Plain, which, exacerbated by extensive thickets of invasive alien plants, have burnt large tracts of veld (personal observation). It is alleged that these fires are the results of arsonists, who burn fires in order to create a distraction for authorities, and then smuggle illegally-harvested abalone out of the area (Agulhas Plain residents, pers. comm.). The frequency of man-made veld fires is evident at Elim where less than 150 ha of 2 700 ha of fynbos was found to be greater than 12 years old (Jeffery & Heydenrych, 1996).

In addition to the lack of an adequate agricultural extension service on the Agulhas Plain a number of landowners do not adhere to the basic rules and regulations with respect to fires, and many do not have firebreaks anywhere on their property (personal observation). Recently, however, a National Veld and Forest Fire Act was promulgated (Anonymous, 1998c). Under this act, a veldfire management strategy must be prepared and landowners must create and maintain firebreaks and ensure they have the correct equipment and suitably-trained personnel. Although certain sections of the new legislation, in particular those dealing with negligence, are objectionable to some landowners (Opperman, 1998), there is a general acknowledgement that landowners must work together to manage runaway veld fires (Claassen, 1999). It is imperative that a co-ordinated fire management strategy is formulated for the Agulhas Plain, not only to fight uncontrolled wildfires but also to assist with controlled burning of veld. The establishment of a "crack" fire – fighting team from a previously disadvantaged community such as Elim, could

be an excellent way of assisting all landowners in the region and at the same time providing jobs as a secondary industry to the existing Working for Water Project (Working for Water Programme, 1999).

Red data and endemic plant species

Of the 71 species reported harvested for the wildflower industry on the Agulhas Plain, only two, *Leucadendron laxum* (endangered), *L. platyspermum* (vulnerable), are listed in the Red Data List for southern African plants (Hilton-Taylor, 1996). Furthermore, only five of the 99 plant species endemic to the Agulhas Plain are reported being used for the wildflower industry. On the Agulhas Plain there is a correlation between rarity and endemism, with 55% of the 99 local endemics being classified as rare. While there may well be other red data and endemic species which are misclassified taxanomically by flower harvesters (e.g. certain *Erica* spp.) or were not sampled as being harvested, there does not appear to be a significant conflict of interest between species harvested for the wildflower industry and rarity and endemic status.

Indeed, certain biological characteristics of Agulhas Plain endemics, dwarf to low shrubs occurring in small populations (Cowling & Holmes, 1992; Willis *et al.*, 1996) may offer some in-built protection against these species being used in the wildflower trade (see also Malan, 1996). Therefore, although the Proteaceae - the most important family used in the flower trade - is over-represented in the Agulhas Plain flora in terms of endemics (Cowling & Holmes, 1992), few endemic members of this family are considered sufficiently attractive (i.e. tall and showy) or common to be harvested for the wildflower trade.

Of the two rare and endemic members of the Proteaceae harvested for the wildflower trade, *Leucadendron platyspermum* is today harvested almost exclusively from plantations which have been broadcast sown, but *L. laxum* is harvested exclusively from the wild. The harvesting of this species is cause for concern. The amounts harvested amount to 15 200 stems per year, which must certainly place an enormous strain on populations of this species, which have an extremely limited natural distribution (Rebelo, 1995). No populations of this species are as yet included in any formally protected area.

Another important reason explaining the low numbers of rare and endemic species utilised for the wildflower trade relates to the fact that Agulhas Plain endemics are largely edaphic

specialists, being restricted to specific habitats such as laterite and limestone (Cowling & Holmes, 1992). These habitats are smaller in area than the more common Acid Sand Fynbos, and therefore simply do not provide sufficient material for the profitable harvesting of many species. However, should the market demand a particular species, and should the returns be favourable, there is no reason why these rare endemics will not be harvested. For example, *Protea holosericea*, an endemic to the mountains near Worcester in the south western Cape, which is listed as "rare" (Hilton-Taylor, 1996), was brought to the brink of extinction in the early 1980s after a farmer illegally exported more than 20 000 of the showy inflorescences of this species (Van der Walt, 1996).

Grazing of indigenous vegetation

Owing to their extremely low nitrogen levels, most fynbos plants provide very poor grazing for both domestic livestock (Le Roux, 1988) and indigenous game species (Rebelo, 1992). In contrast, Renosterveld, which occurs on relatively nutrient-rich soils and contains a grassy component, is more palatable to grazers. However, relatively large areas of this vegetation type may be needed to sustain certain large game species (Rebelo, 1992). Where tracts of fynbos and Renosterveld are limited in size, they may need to be artificially manipulated in order to support domestic stock and game. A variety of techniques, including the provision of salt licks, frequent burning and rotation with artificial pasture enable indigenous veld to increase its carrying capacity, although some of these techniques may be detrimental to biodiversity conservation (Rebelo, 1992). The primary use of indigenous vegetation on the Agulhas Plain for grazing comprises stocking of certain vegetation types for part of the year, alternating with artificial pastures for the remainder of the annual cycle.

The average stocking rates recorded were similar for cattle and sheep, namely 0.93 ± 1.16 SAU/ha/y and 0.81 ± 2.21 SAU/ha/y respectively. This is approximately 20 – 25% of the stocking rate recommended for artificial dryland pastures. For game, reported stocking rates were considerably lower at 0.17 ± 1.16 SAU/ha/y (less than 5% of dryland pasture stocking rates).

However, the average reported stocking rates for cattle and sheep were above the recommended stocking rates for "veld" of 0.5 SAU/ha/y (A. Fourie, agricultural consultant, pers.

comm.) and well above the level considered sustainable for nutrient-poor Acid Sand Fynbos (1 SAU/8 ha; Le Roux 1988), or even for relatively nutrient-rich Renosterveld (McDowell, 1988; Duckitt, 1995). The latter two references relate to permanent stocking of indigenous veld in the West Coast region, with no supplementation from artificial pastures. With judicious management it may be possible to increase the recommended stocking of certain veld types where supplements from artificial pastures are available. The average grazing period per year on indigenous veld was five months for cattle, four months for sheep and nine months for game.

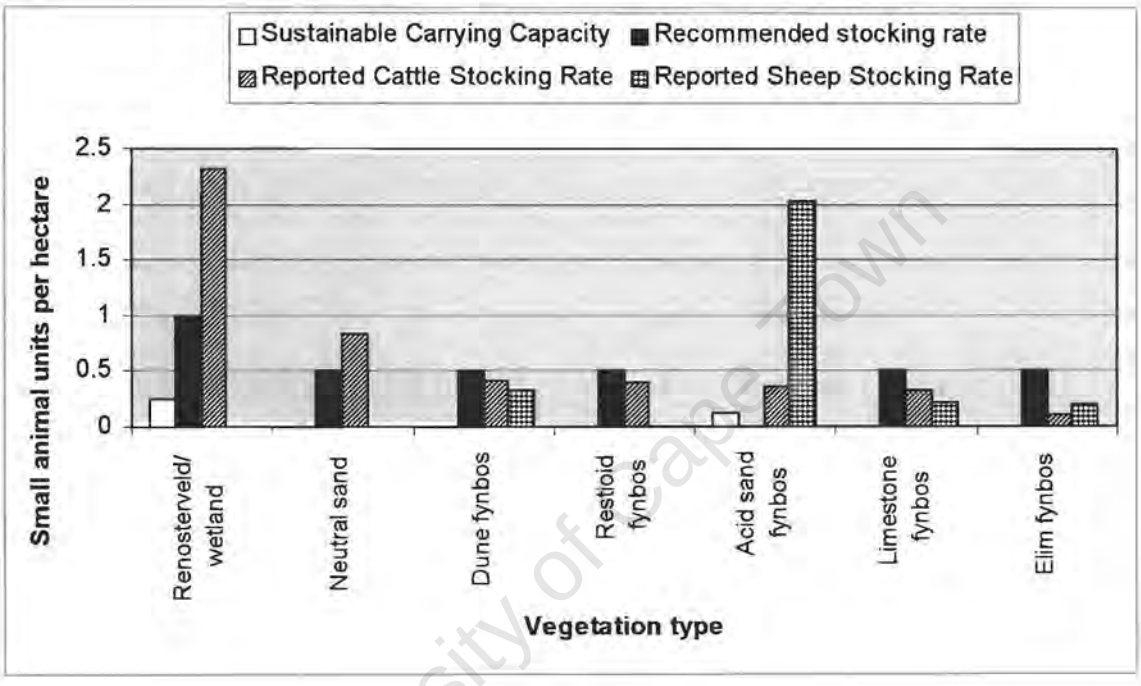


Figure 7.7. Stocking rates for cattle and sheep in different vegetation types reported on the Agulhas Plain with recommended stocking rates (K. Robertson, pers. comm.) and sustainable carrying capacity for Renosterveld (McDowell, 1988; Duckitt, 1995) and Acid Sand Fynbos (Le Roux, 1988), shown for comparison.

The breakdown of reported stocking rates for livestock in different kinds of natural veld in the Agulhas Plain are given in Figure 7.7. Although most of the grazing was within the recommended agricultural stocking rates, two grazing regimes, cattle in Renosterveld/wetland vegetation and sheep in Acid Sand Fynbos clearly indicate overgrazing (Figure 7.7). These figures do not include time spent on artificial pastures.

Cattle

The type of cattle reported to be most reliant on indigenous vegetation were beef cattle (80% of cattle sample). Owing to a variety of indigenous vegetation types on the Agulhas Plain, a number of different grazing practices were reported. For example, certain farmers with pastures prone to waterlogging tended to rely on higher lying Limestone and Neutral Sand Fynbos for grazing during the winter months. Others reported the importance of the moist Renosterveld / wetland vegetation during the summer months, when the pastures were dry. The overstocking in Renosterveld/ wetland vegetation mainly occurs in the summer months when stock are very reliant on these seasonally inundated areas.

Sheep

Although most landowners did not burn their veld for grazing, those that did grazed the veld very soon after the fire (personal observation). This practice of grazing veld immediately after burning requires a permit from the agricultural authorities (W. Alheit, Department of Agriculture, pers. comm.). Although the veld may be able to withstand intensive grazing following fire for short periods, measured by plant cover (Agulhas Plain farmers, pers. comm.), this practice has been shown to reduce fynbos species diversity (Le Roux, 1998).

Game

The reported carrying capacities for game on the Agulhas Plain are low and are acceptable from an ecological perspective (Figure 7.7). Game farming is not always compatible with flower farming since the relatively palatable developing buds of desirable Proteaceae may be selectively and intensively browsed (e.g. *Protea compacta* buds browsed by eland as communicated by P. Cilliers, Waterford Farm). In many fynbos areas on the Agulhas Plain, game is extremely susceptible to disease, and with the low nutrient status of fynbos vegetation, these species do not breed well (Agulhas Plain farmers, pers. comm.). Sufficiently large enough tracts of land, encompassing a high diversity of vegetation types with a variety of edible plants, are required if game is to survive on the indigenous vegetation of the Agulhas Plain.

Summary of Chapter 7

The main findings of this chapter are as follows:

- the ploughing and cultivation methods for fynbos flowers are negatively affecting biodiversity of Acid Sand Fynbos, Neutral Sand Fynbos and Elim Fynbos, but more experimental studies are required to quantify these effects
- pesticides are being used on fynbos crops by approximately 25% of growers, whereas the use of fertilizers is limited
- most cultivation for fynbos flowers is replacing pristine fynbos, and very few areas previously under dense alien infestations, or cultivation for other crops, are being used
- fynbos genetic material for cultivation on the Agulhas Plain comes from a variety of sources, and there are some concerns about the possible genetic contamination of wild stocks
- the average number of stems per hectare reported harvested was 39 $\pm$ 63 for all species (primarily Proteaceae), with an average of 46 $\pm$ 68 for *Protea* spp., - this appears relatively low, but is an area urgently requiring more research
- the reported average annual harvesting rates for fynbos "greens" of 3.2 $\pm$ 11.1 kg/ha/y appear to be relatively low, but more research is required to identify sustainable levels of harvesting of these species
- theoretical knowledge of fire management is good, but is not always applied in practice by Agulhas land-owners
- few red data and endemic plant species are used in the wildflower trade
- grazing of indigenous vegetation by livestock is important to Agulhas Plain farmers, but overstocking is occurring in certain vegetation types.

With the majority of land on the Agulhas Plain in private ownership, and likely to remain so for the foreseeable future, it is important to develop incentives for landowners for "minding" rather than "mining" their land, indigenous vegetation and other natural resources (Young, 1997).

Chapter 8 Invasive alien vegetation on the Agulhas Plain – aspects of the costs and benefits of its management

When making decisions about natural resource use, there are often complex and potentially conflicting management considerations . This is especially true in the case of invasive alien plants on the Agulhas Plain. Here the economic benefits associated with the harvesting of alien species conflict with the benefits derived from indigenous veld use, as well as biodiversity conservation and indirect uses such as eco-tourism. This chapter examines aspects of a cost-benefit analysis of invasive alien vegetation on the Agulhas Plain and addresses key question 9. i.e. What are the costs and benefits of clearing invasive alien plants, ecologically, economically and socially?

Current data on the invasive alien plants of the Agulhas Plain comprises a GIS coverage of dense (defined as more than 50% cover, R.M. Cowling, Institute for Plant Conservation, UCT, pers. comm.) stands (Figure 1.3), produced for a regional structure plan (MLH, 1994) and detailed mapping for specific target areas (e.g. Jeffery & Heydenrych, 1996; Heydenrych, 1998).

Information from landowners sampled, when extrapolated to the entire Agulhas Plain, suggests that approximately 29 400 ha (19%) is infested with invasive alien plants with a breakdown according to broad density classes (used for simplicity, Appendix 1) as follows:

14 200 ha (48%)	light infestations	(5-25% cover);
7 700 ha (26%)	medium density	(25-75% cover);
7 500 ha (26%)	densely infested	(more than 75% cover).

Figure 8.1 indicates that *Acacia saligna (*Port Jackson willow*)* and *A. cyclops* (Rooikrans) were considered by Agulhas Plain landowners to be the worst alien invasive species by far, with *Pinus* spp., *A. longifolia*, *Hakea* spp., *Leptospermum laevigatum*, and *Eucalyptus* spp., also considered problematic.

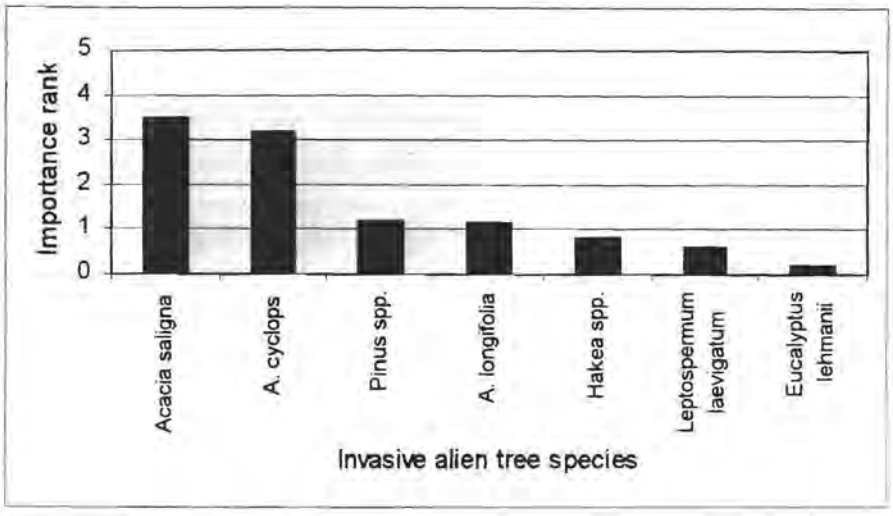


Figure 8.1. Landowner's average weighted rankings of invasive alien tree species on their farms on the Agulhas Plain (n=49) (rank correlates positively with degree of invasion).

The effect of invasive alien plants on the quality of fynbos products

Turpie *et al.* (in press) using data from the Agulhas Plain, estimated various fynbos use values and then indicated the loss in these values at different invasive alien plant densities. In the absence of empirical data, Turpie *et al.* (in press) assumed a direct negative correlation between alien plant density and fynbos value, except for alien firewood where the relationship was positive. Using this assumption, large losses in fynbos values were ascribed to invasive alien plants (Turpie *et al.*, in press; see also Van Wilgen *et al.*, 1996; Cowling *et al.*, 1997b; Higgins *et al.*, 1997a; Higgins *et al.*, 1997b).

Grazing

The extent to which grazing of natural veld is affected by invasive plants has not been quantified on the Agulhas Plain. Although invasive alien plants (e.g. *Acacia cyclops, A. saligna)* are eaten to a small extent by livestock (personal observation), this is not considered economically important, and alien plants (apart from their shade value) are considered a pest in terms of grazing in natural veld (Agulhas Plain farmers, pers. comm.). A report from the Riversdale district to the east of the Agulhas Plain, where Neutral Sand Fynbos is used extensively for veld grazing, indicated a 57% reduction in the quality of fynbos, measured as carrying capacity, when pristine fynbos became infested with *Acacia cyclops* trees (Anonymous, *in litt.*). Here the

carrying capacity went down from 16 ha veld/large animal unit (LAU)/y to 25 ha veld/LAU/y, following *Acacia cyclops* invasion. A concomitant 57% drop in the land value at that time (early 1990s) from R 350/ha to R 200/ha was furthermore reported (Anonymous, *in litt.*). This reduction in carrying capacity needs to be examined for other areas, and the importance of alien trees for shading livestock is an area requiring more research.

Wildflower harvests

Turpie *et al.* (in press) assumed a negative linear relationship between wildflower harvests and invasive alien plants. It is not certain whether this is correct as relatively infested areas of fynbos may still provide large amounts of fynbos wildflowers (personal observation). What needs to be examined is the increase in effort required by pickers to attain harvests in alien infestations as opposed to alien-free stands of fynbos. A number of factors come into question. These include the alien species involved where, for example, *Hakea* spp., with long, spiny foliage, are likely to become a limiting factor for pickers at a lower density class than *Pinus* spp., which have softer foliage. Furthermore, the effect of the age (therefore height) of the alien vegetation will influence the picking effort. At any rate, there is cut-off point of alien plant cover density, after which it is no loner considered viable to harvest wildflowers from a given area of fynbos vegetation (T. Ahrends, Elim Working for Water Project, pers. comm.). There is a need to experimentally determine what this cut-off point is for various alien species in different fynbos types.

Bees

The process of land transformation and the spread of invasive alien plants has a negative effect on the forage plants of honeybees, as these insects rely on the natural diversity of fynbos species for their survival. On the Agulhas Plain, apart from *Eucalyptus* spp., the Australian myrtle, (*Leptospermum laevigatum)* is the only invasive alien tree (Henderson, 1995) considered to have some value as a bee forage plant (N. Esterhuizen, pers. comm.; Johannsmeier, 1995). However, it is not known exactly how extensive the infestation of this species is. Although beekeepers may consider Australian myrtle to be a good bee forage plant, it is considered a major pest by Agulhas Plain landowners (pers. comm.). Other invasive aliens are either of negligible importance as forage crops (*Hakea* spp.; *Acacia* spp.), or provide no food value at all (*Pinus* spp.) (Johannsmeier, 1995) while some are perceived as a massive threat by outcompeting fynbos bee forage species on the Agulhas Plain (N. Esterhuizen, pers. comm.).

It may be assumed that there is a direct negative correlation between invasion of fynbos by *Acacia* spp., and the value (ecological and economical) of these ecosystems, but further research will be needed to test this assumption. A dynamic ecological-economic model which can be used a tool for conflict resolution was recently developed to examine the relationship between invasive aliens plant control and wildflower harvesting (Higgins *et al.*, 1997b) and could be used to test the relationship between invasive alien plants and the products of the beekeeping industry.

Water resources

It has been clearly demonstrated that pristine fynbos, with its low biomass compared with invasive alien trees, is the best land cover for water production in the Cape Floristic Region (Van Wilgen *et al.*, 1996). This has resulted is large-scale funding to clear invasive alien plants from mountain catchments (Marais, 1998), where the water production benefits are perceived to be the greatest (Van Wilgen *et al.*, 1996). However, there is a growing awareness that alien trees impact severely on ground water resources (Visser *et al.*, 1999) and this is particularly relevant on the Agulhas Plain where all towns derive their water from underground sources. The entire Agulhas Plain can therefore be seen as a water catchment area for underground water, for domestic, agricultural and environmental use

Fynbos mountain catchments have been estimated to fulfil about two thirds of the Western Cape's water requirements (Van Wilgen *et al.* 1996), and although lowland regions by implication supply the remaining third of the province's water, the importance of the groundwater aquifers is often overlooked. On the Agulhas Plain, however, the importance of groundwater has now been recognised (Toens *et al.*, 1998), and one of the first studies to quantify the effect of invasive alien trees on underground water supplies has recently been documented (Visser *et al.*, 1999).

The recovery of the underground water level where alien vegetation is being removed by the Elim Working for Water Project , is being carefully monitored in the Nuwejaars River system. Although ground water monitoring studies should ideally be carried out over a period of more than seven years (D. Visser, Groundwater Consultant, pers. comm.), the results obtained thus far show a dramatic recovery in the groundwater levels where aliens have been removed. Based primarily on the behaviour of the groundwater levels observed in the shallow, unconfined

primary aquifer at selected monitoring sites on the Agulhas Plain, some of the main findings of a recent study (Visser *et al.*, 1999) were as follows:

- The volumes of water removed from the aquifer via transpiration by the alien vegetation were estimated using the relative differences between water levels observed beneath cleared and uncleared areas at the monitoring site near Elim. The average daily groundwater consumption of these invasive *Acacia* spp. was estimated to vary between 46 m^3 and 204 m^3 (average 110 m^3) per hectare, assuming an aquifer specific yield of 20%, an average daily evapo-transpiration period of 10 hours and mean monthly maximum temperature of between 17 °C and 26 °C.

- Assuming therefore that there are on average 3,500 trees per hectare in an area with a 50% density coverage, it is estimated that, depending on the mean daily temperature, each mature alien *Acacia* spp. tree uses between 13 and 58 litres (average 31 litres) of groundwater per tree per day.

Taking the area of dense invasive alien trees on the Agulhas Plain into account (17 470 ha, Lombard *et al.*, 1997), the above estimate suggests that invasive alien trees use 1.92 million m^3 / day. To put this into perspective, this is equal to the daily water consumption by 7.7 million people and when converted to years, is the equivalent of one of Cape Town's main water supplies, the Theewaterskloof Dam (480 X 10^6 m^3) being filled up one and a half times per year. Caution should be noted with this extrapolation as the figures are preliminary, and accurate estimates of different species and density classes of invasive alien plants need to be made.

Nevertheless, in terms of underground water resources alone, there is clearly a strong incentive to clear invasive alien plants from the lowlands of the Agulhas Plain. Toens *et al.* (1998) believe that settlements and towns in the Agulhas Plain region will continue to be reliant on underground water for the major portion of their water needs in the future, and should therefore develop the potential of underground resources, particularly from the relatively deep (100 - 150 m) Table Mountain Group aquifer. Without the development of underground water resources on the lowlands, it can be assumed that increased demands will be placed on the already over-subscribed large dams in mountain catchments.

The negative effect of alien plants on underground water resources suggests that there should be a strong economic incentive to clear these plants in terms of water loss alone. However, these incentives need to be developed further, as the tendency remains for engineering solutions, rather that biological solutions, to be applied in the provision of additional domestic water supplies (Agulhas Plain local authorities, pers. comm.).

It is extremely difficult to place a value on the water provision service provided by the indigenous vegetation of the Agulhas Plain. This is due to a number of factors including:

- gaps in the knowledge of agricultural water usage;
- the mosaic of indigenous vegetation and agricultural fields, which both serve as surfaces for water catchment, i.e. difficult to separate in terms of catchment function;
- the paucity of data relating to domestic consumption in certain towns and settlements; and
- the fact that all economic activities, i.e. the entire Gross Geographic Product of the region, are in part reliant on fynbos-clad lowland catchment areas for the provision of water.

Turpie *et al.* (in press) suggested that rather than looking at the positive gains that fynbos catchments have with respect to water production, it is more appropriate to account only for the value of water lost when fynbos areas are degraded (e.g. by invasive alien plants) or lost (by transformation), or the value gained when degraded areas are restored. More experimental data and modelling will need to be carried out before meaningful estimates on the value of underground water loss by invasive alien plants can be calculated.

Estimated costs to clear invasive alien plants on the Agulhas Plain

Figure 8.2 indicates estimated clearing costs in 1995 (Privett, 1995), actual clearing costs for the Fynbos Working for Water Project during the 1996/97 year (Marais, 1998) and current average costs (herbicide excluded) for two alien clearing projects on the Agulhas Plain (A. Appel, Elim Working for Water Project, pers. comm.; R. Bailey, Agulhas Working for Water Project, pers. comm.). These costs represent initial clearing only, and follow-up costs can be over half of the initial clearing costs for some of the denser infestation classes (Privett, 1995). Using average clearing costs of R 100/ha for light infestations, R 1000/ha for medium infestations and

R 4000/ha for dense infestations (Figure 8.2; Working for Water Programme, 1998), the initial costs to clear the area reported invested with invasive alien plants by landowners on the Agulhas Plain is R39 million (1997 currency value).

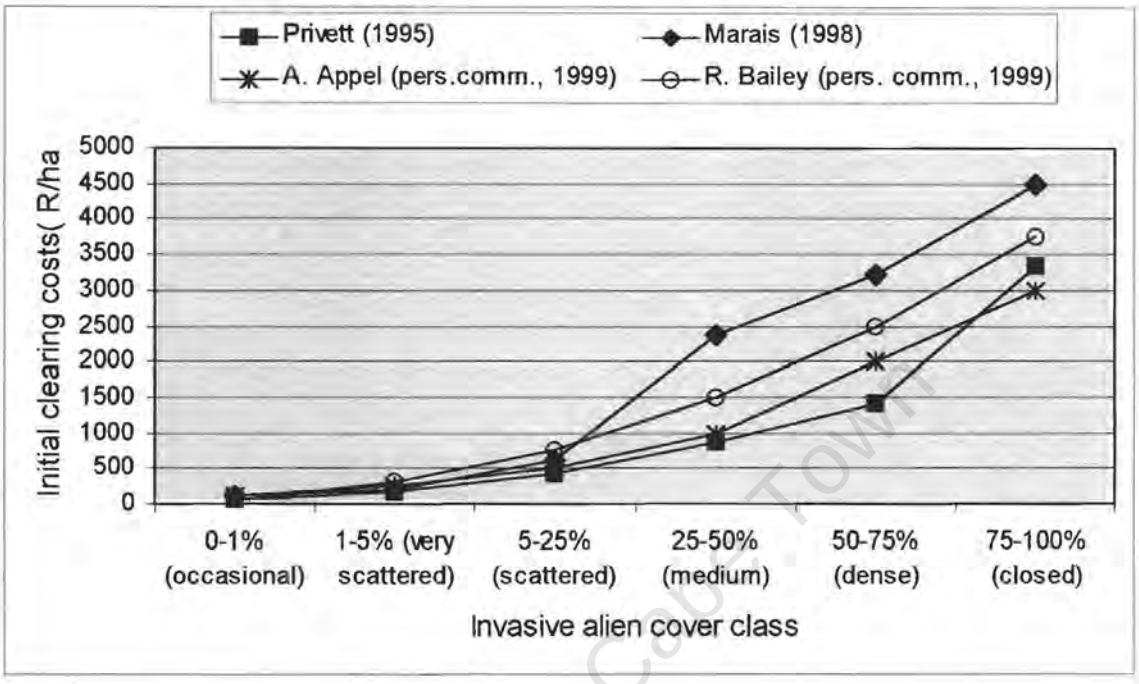


Figure 8.2. A range of initial clearing costs of invasive alien plants reported for different density classes. Data from Privett (1995), Marais (1998), A. Appel, Elim Working for Water Project, pers. comm. and R. Bailey, Agulhas Working for Water Project, pers. comm.

Current invasive alien clearing effort on the Agulhas Plain

Eighty one per cent of the landowners sampled who had invasive alien plants on their property (88% of total), reported that they were clearing invasive alien plants, whereas 19% were not. The amount that private landowners spent on clearing invasive alien plants in 1997 was R377 243 (when extrapolated to the entire Agulhas Plain). This effort represents less than 1% of the funds required for the initial clearing of these plants and for those involved with alien clearing amounts to spending of approximately R 6000/landowner/y. This value was found to represent approximately 200 person days per annum, with work primarily being carried out in the winter season when farm labourers did not have any other pressing tasks (Agulhas Plain landowners, pers. comm.).

During the 1997/98 financial year, South African National Parks spent approximately R 0.8 million on invasive plant clearing on the Agulhas Plain, and to date has spent a total of more than R4 million on this activity. However, this is still a shortfall of R 35 million of the estimated R 39 million to do all initial clearing on the Agulhas Plain. In addition, initial clearing is only a small part of the clearing programme, and a well planned follow-up clearing operation is essential, and is extremely costly to undertake. Clearly, priorities for invasive alien clearing need to be strategic and should be focussed on areas that will achieve the maximum benefit for long term biodiversity conservation.

Biodiversity

Invasive alien organisms are one of the major threats to global biodiversity (Pimm *et al.*, 1995) and are a major threat to the plant biodiversity in the Cape Floristic Region (Richardson *et al.*, 1992). It has been noted elsewhere in the Cape Floristic Region that sites with high plant biodiversity and fragmented populations are most open to invasion by alien plants (Richardson *et al.*, 1996; Higgins *et al.*, 1999). Based on these assumptions therefore, the plant biodiversity of the Agulhas Plain is likely to be severely threatened by invasive alien plants.

Although a reserve selection algorithm for the Agulhas Plain (Lombard *et al.*, 1997) took alien plant data into account, alien data was at a broad scale (Figure 1.3) and did not take differences between species into account. A model for predicting the landscape-scale distributions of alien plants and their threats to biodiversity (Higgins *et al.*, 1999), should be applied to the Agulhas Plain. This model will assist clearing strategies for the region, as it can predict the effect that invasive aliens plant spread will have on indigenous plants, including rare and endemic species. Furthermore, the model can take the rates of spread of different species into account, which is an important tool for identifying priorities for clearing when resources are scarce (Higgins *et al.*, 1999).

Tourism

There are no realistic estimates of the effect of alien vegetation on tourism, and while it has been assumed that biodiversity values for tourism will decrease with increased alien vegetation (Higgins *et al.*, 1997a) certain invasive alien plants, e.g. fields of the agricultural weed, *Echium plantagineum*, are sought-after tourist attractions which are advertised on the Western Cape's "Flower Line" (J. Britz, Cape Overberg Tourism Association, pers. comm.). More research is

necessary to quantify the effects of invasive alien plants on tourists, and most importantly, to identify species-specific differences with respect to tourists' attitudes and perceptions.

Benefits of invasive alien plants

It has been reported that the Australian myrtle (*Leptospermum laevigatum*) is a good bee forage plant (N. Esterhuizen, pers. comm.), certain areas containing *Pinus* spp. and *Eucalyptus* spp. have been used for poles and droppers, and various species of invasive aliens are used for firewood. However, these activities are not considered to be economically very important or sustainable in the Agulhas Plain region (personal observations; A Appel, Elim Working for Water Project, pers. comm.) and are therefore not considered further here.

Nevertheless, one genus, *Eucalyptus* spp. and one species (*Acacia cyclops;* see Chapter 5), both from Australia, are very important economic species on the Agulhas Plain.

Eucalyptus spp. for the bee industry

Using the same arguments presented above, the farm gate values attributable to *Eucalyptus* spp. are estimated to be R1 million, based on the proportion of honey manufactured from these species' nectar. Assuming input costs of 35% for this industry, the 1997 net income for honey production on the Agulhas Plain was R 0.65 million or R 63.05/hive or R 22.17/ha for areas containing alien plants (29 424 ha).
This latter extrapolation needs to be treated with caution as *Eucalyptus* spp.. tend to be restricted to planted thickets or rows alongside fields or near homesteads, and are not distributed randomly throughout the landscape (personal observation).

Using the same arguments presented above for pollination services, Agulhas Plain honeybees spend 13% of their time in *Eucalyptus* spp. and therefore, R 237 231 of the total income which accrued to beekeepers for this service from this region (R1.82 million) can be attributed to these alien trees. Again, assuming 35% input costs for pollination services, a total net income of R 154 200, or R 24.84/hive/year or R 5.24/ha/y is attributable to the areas invested with invasive alien plants on the Agulhas Plain.
Similarly, using the example of Turpie *et al.* (in press) R 34 million of the Western Cape's fruit industry could be indirectly allocated to the *Eucalyptus* spp. of the Agulhas Plain, based on the amount of time (13%) bees spend foraging in these invasive alien trees.

Considerable value can therefore be attributed to *Eucalyptus* spp. on the Agulhas Plain by the beekeeping industry and the question arises: should these trees be cleared?
It may be argued that certain species such as *Eucalyptus lehmannii* (Spider gum) are important for bees as well as for providing shade for sheep, and are not thought to spread vigorously (J. Engel, Elim Opsienersraad, pers. comm.; M. Johannsmeier, Plant Protection Research Institute, Pretoria, pers. comm.). However, certain *Eucalyptus* spp. do invade fynbos (Henderson, 1995). Furthermore, *Eucalyptus* spp., consume large quantities of ground water (D. Visser, Groundwater Consultant, pers. comm.)

A pragmatic approach to the clearing of *Eucalyptus* spp. may therefore be as follows:

- remove trees from water courses and wetlands;
- maintain regular alien clearing operations to contain dense clumps of aggressive invaders and prevent them from spreading; and
- systematically remove isolated thickets which have the potential to spread;

but leave the remainder (outside of protected areas) to support the beekeeping industry.

Mechanized clearing of invasive alien plants
On face value, it seems unwise to pay R 4000/ha to clear dense stands of *Acacia cyclops* (Figure 8.2), when woodcutting contractors can clear these areas and make an average net income that is equivalent to this cost (R 3998/ha based on R0.065 X 61 500 pieces). However, there is a significant management cost which needs to be taken into account to ensure that the woodcutting is carried out in a controlled way. Nevertheless, there appears to be a strong incentive to properly manage woodcutters as part of alien plant clearing operations (R. Ernsten, Cape Peninsula National Park, pers. comm.).

As the estimated rate of clearing by woodcutters on the Agulhas Plain is considerably less than the potential harvest of Rooikrans wood, this activity is highly unlikely to halt the spread of invasive alien trees in this region (see also Azorin, 1992). Indeed, it has been reported that woodcutters may even exacerbate the spread invasive alien species by distributing alien seed across a site (D, Geldenhuys, Cape Nature Conversation, pers. comm.).

A new approach involving a giant mulching machine that attaches to a large tractor and literally "eats 5 m tall trees standing" has been introduced by an entrepreneur on the Agulhas Plain (personal observation). Here, costs are estimated to be in the order of R 1000/ha for dense

stands (25% of costs of an alien clearing team for the same density) with an average production rate of 4 ha/day (960 ha/y at 240 working days/y) (R. Stanniforth, Alien plant clearing contractor, pers. comm.). The machine described above has limited application (relatively flat areas with no rocks are the required terrain) and would need to be complemented by the employment of people to clear steep and rocky areas, as well as for follow-up clearing. It will therefore not replace the need for jobs to clear aliens in this area, but has the potential to augment the existing clearing operations.

The effect that the mulching machine has on the regeneration of fynbos species is another area of research which needs to be examined (Holmes, 1999). Nevertheless, it would appear from preliminary work that this level of mechanisation is not only cost effective on a per-hectare basis, but is also one of the only solutions to speed up the alien clearing and woodcutting operations on the Agulhas Plain to a rate where the spread of invasive plants is firstly curtailed, and later decreased (Working for Water Programme, 1998). Mulching tractors should therefore be thoughtfully considered as a tool for clearing alien trees, if the state is serious about effectively controlling invasive alien plants.

Setting priorities for invasive alien clearing programmes

In general, the clearing strategy for removal of invasive alien plants is to clear the lightest infestation at any given site first, and to then systematically clear increasingly dense stands (Marais, 1998). This is the most cost-effective method of clearing invasive alien plants in time, as the lighter infestations which are less costly to clear (Figure 8.2) will always become denser in time (Richardson *et al.*, 1992). However, given the complexities of real world, static plans to clear alien plants according to a set of priorities, may be not be implemented due to unforeseen factors including, changes in available funds, production days lost/gained, unforeseen wildfires or delayed starting date of the operation. Using cost-benefit models of different alien clearing strategies, a delay in the initiation of clearing operations was found to have the greatest effect on both the final costs of the clearing programme as well as the threat to biodiversity (Marais, 1998; Higgins, 1998).

Higgins (1998), using a dynamic spatial model for managing alien plant invasions, found that the costs to clear aliens from the Cape Peninsula to the west of the Agulhas Plain, varied between R25 million and R 55 million, depending on a a number of factors, in particular, the invasion rate. (more than a 100% increase). This dynamic model, which has developed a series of clearing

protocols (Higgins, 1998), could be adapted to the Agulhas Plain. Results from alien plant clearing models clearly indicate that the shorter the total clearing time, the more viable the clearing programme becomes (Marais, 1998; Higgins, 1998). In this regard, the investigation of a range of clearing strategies, including the mechanised mulching tractor, is suggested.

Biological control

Biological control of invasive alien plants is a vitally-important tool for the long term reduction of these species (Van Wilgen *et al.*, 1992). However, the potential of biological control to reduce clearing costs or future invasive potential of invasive alien plants was not addressed in this study and is an important area for future research. A recently-released, seed-feeding weevil for *Acacia cyclops* (D. Donnelly, Plant Protection Research Institute, pers. comm.), has the potential to thin out the re-growth of dense stands of this species following initial clearing. Theoretically, a reduction in the number of germinating seedlings will result in fewer, but thicker trees which are more desirable than many thin stems in terms of their firewood value. This prediction, however, is in need of experimental verification using field trials.

Invasive alien plants – suggestions for future management

The costs and benefits of clearing invasive alien plants is a complicated issue. The current amounts of money being spent on invasive alien plant clearing are inadequate to reduce the spread of these plants. Apart from a few private landowners who began to eradicate alien plants systematically 20 – 30 years ago and today only need to undertake maintenance clearing, the majority either do not see the long term benefits of clearing invasive alien plants (as reflected by their low spending patterns), or their alien plant problems have reached a level where the problem has overwhelmed their capacity, and consequently do nothing towards clearing these trees off their land (personal observation).

Turpie and Heydenrych (in press), show that farmers are unlikely to clear invasive alien plants from their properties for financial investment reasons alone, unless they are very far-sighted. The state will therefore need to provide an incentive to clear aliens from privately-owned fynbos, as long as the costs for clearing and interest rates remain high. However, on the Agulhas Plain, the only major channel for state-funded clearing on private land currently via the Working for Water Projects administered by South African National Parks. Here, private land which is being cleared is earmarked for inclusion of the park on a contractual basis, an option open to a limited number of landowners.

It is suggested that a new pilot project be implemented on the Agulhas Plain which incorporates a combination of well-managed wood cutting projects, large-scale mechanical-mulcher for the removal of trees and conventional Working for Water teams of alien clearing contractors, in an effort to fully examine what is possible in terms of making a real impact on the alien plants of a lowland fynbos system. Sufficient funds from the state and other sources will be required to implement the project, which is likely to have hugely beneficial socio-economic spin-offs.

A new, extensive GIS data set on invasive alien plants on the Agulhas Plain, incorporating all recognised density classes and species has recently been compiled for the Agulhas Plain (R.M. Cowling, Institute for Plant Conservation, pers. comm.). It is imperative that this data set gets analysed, in order to refine these preliminary attempts at a cost-benefits analysis of invasive alien plants in this region.

Summary of Chapter 8

The key outcomes in this chapter are the following:

- the invasion of natural indigenous veld by alien vegetation e.g. *Acaicia cyclops, A. saligna, Eucalyptus sp.* and Australian myrtle, *Leptospermum laevigatum*, has a negative effect on wildflower harvests, forage plant species' availability for honeybees, underground water resources, and the biodiversity of the region
- invasive alien trees consume extremely large quantities of underground water supplies, and preliminary estimates indicate the on t Agulhas Plain, the amount of water lost to these plants could be as much as 1.92 million m^3 / day!
- although the potential increase in underground water supplies should be an incentive to clear alien vegetation, the estimated cost to clear these plants on the Agulhas Plain is R39 million
- private land-owners spent an estimated R 380 000 and South African National Parks an additional R800 000 during the 1997/1998 financial year on alien clearing, however this only represents a small proportion of the funds required for initial clearing, and in addition more funds for follow up clearing will be required
- benefits accruing from alien plants include the use of *Eucalyptus* spp. for honeybee foraging (net income of approximately R 0.8 million/year), and the wood cutting industry using *Acaicia cyclops* has an annual net income of R0.36 million for the region.

Chapter 9 The implementation of the Agulhas National Park – challenges and solutions

The implementation by the state of a new protected area network in an area where the majority of land is in private ownership naturally presents a number of challenges. This chapter address some of these challenges, offers certain solutions, and addresses key questions 10 and 11 as follows:

- How will the establishment of a national park on the Agulhas Plain influence the existing land use of the area?
- What are the practical considerations to be taken into account when conservation interventions on the Agulhas Plain are implemented?

Background

The implementation of the Agulhas National Park received Board approval in early 1996 and the decision to proceed with the park was made publicly in Bredasdorp adjacent to the Agulhas Plain, in October 1996. The draft vision for the development of the park is as follows:

- To manage 20 000 hectares of the flora, fauna, culture, wetlands and the coastal environment of the Agulhas Plain area as a National Park, by purchasing key properties, acquiring state-owned land and including the remainder on a contractual basis.
- To manage and market the southernmost tip of Africa for the purposes of tourism, conservation and education.

In terms of the National Parks Act (Act 57 of 1976; Table 1.1, Chapter 1) there are two kinds of national park:

1. "Schedule 1 National Park"

These are parks listed as being proclaimed under Schedule 1 of the National Parks Act. This is the traditional national park where the land is owned by the state or South African National Parks (SANP) and is upheld for the purposes of a national park. Land may

either be already state-owned, or it may be purchased by or donated to SANP.

2. "Contractual National Park"

These are parks listed as being proclaimed under Schedule 2 of the National Parks Act. This is a model developed in the mid 1980s at the West Coast National Park (Robinson, 1995) and later applied at the Richtersveld National Park (Boonzaier *et al.*, 1996) which allows for the proclamation of private land (or state land under the control of a parastatal organisation or community) to become part of a national park. In these parks, the land remains the property of the landowner and is managed according to an agreement between SANP and the landowner. With this arrangement private and public interests need to be balanced equitably.

The Agulhas National Park is proclaimed under a combination of Schedule 1 and Schedule 2 (contractual national park) of the National Parks Act.

The development of a national park in the Agulhas area, which represents a new and extensive land-use, is bound to cause some uncertainty amongst the current users of the area, particularly when the state is involved. Many landowners in this region still remember the expropriation of farms near Arniston to the east of Cape Agulhas in the mid 1980s for the development of South Africa's first armaments testing site, and are cautious when new state-aligned initiatives are proposed (Agulhas Plain landowners, pers. comm.).

Landowner's attitudes towards the Agulhas National Park.

Owners of "conservation farms" were strongly in favour (82%) of the Agulhas National Park, with none objecting to the park, although some felt they needed more information or wanted to explore conservation options offered by a different implementing agency (Figure 9.1). In contrast, only 38% of owners of working farms were in favour of the park's establishment with an equal amount being unsure or requiring more information as to how it may affect them (Figure 9.2). Some farmers believed in conservation but not with respect to SANP and 14% were opposed to the park's establishment (Figure 9.2).

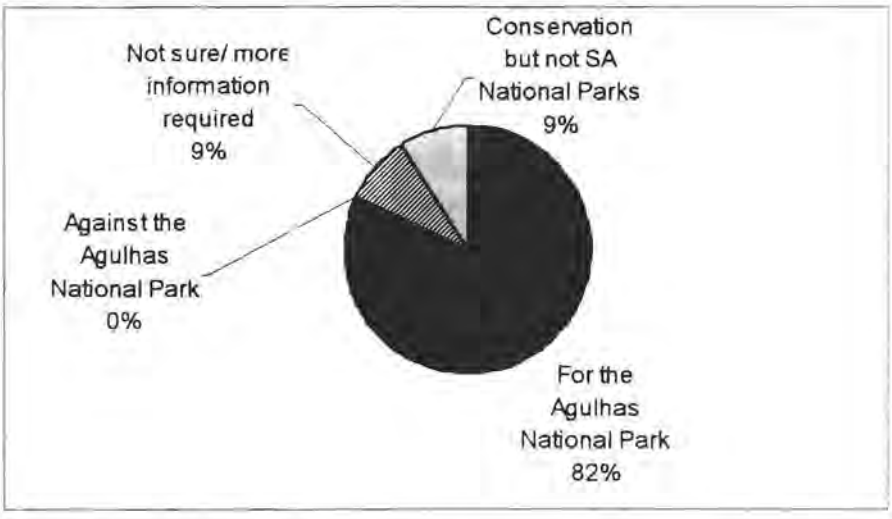


Figure 9.1. Attitudes of Agulhas Plain "conservation farm" landowners towards the Agulhas National Park (n=18).

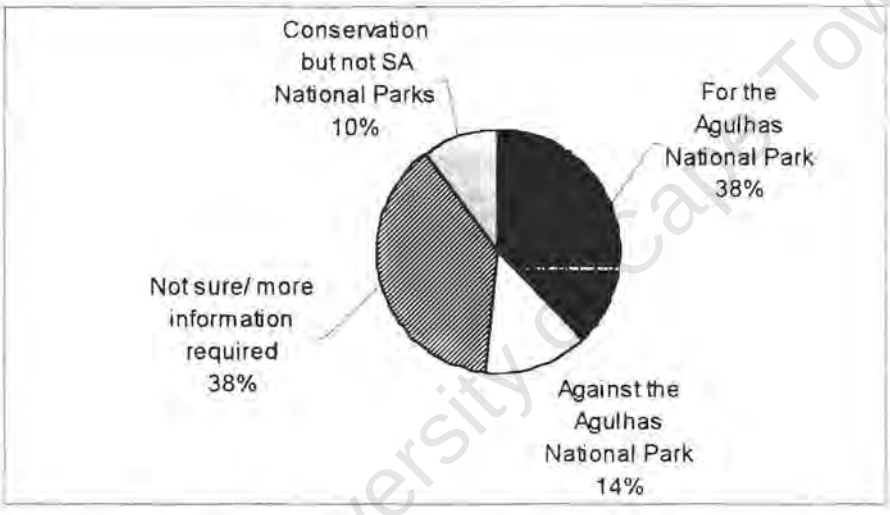


Figure 9.2. Attitudes of Agulhas Plain "working farm" landowners towards the Agulhas National Park (n=42).

Following the first announcement of the proposed Agulhas National Park in 1996, there has been negative reaction from certain landowners with respect to its establishment. This has been primarily as a result of perceived threats that landowners will be forced to join the park or will have to substantially alter their agricultural practices. This attitude has prevailed amongst the same landowners for a period of three years, despite assurances and actions by SANP that contradict these perceptions. Clearly, land ownership issues are extremely sensitive to farmers, and South African National Parks, already a landowner with holdings of more than 2500

hectares (Figure 4.6), will have to wait a while longer to be accepted by certain sectors of the active farming community.

Visitors' attitudes towards the establishment of the Agulhas National Park

In contrast to the landowners' response to the question of the establishment of the Agulhas National Park, by far the majority of visitors were in favour of the park's establishment (Figure 9.3). This pattern was common to both international and domestic visitors. Many comments written on the self fill-in questionnaire reflected visitors' concerns that the natural environment that currently exists should be protected for future generations.

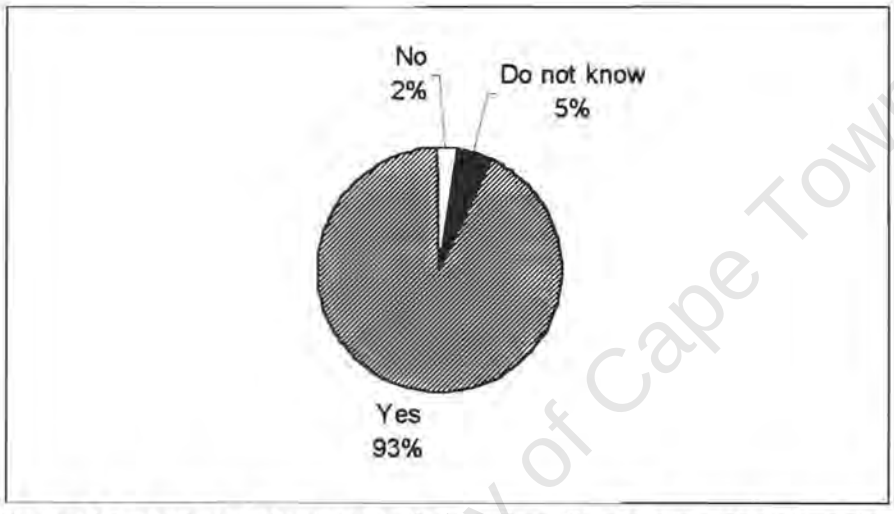


Figure 9.3. Attitudes of visitors to the Agulhas Plain to the establishment of the Agulhas National Park (n=904).

Progress with the implementation of the Agulhas National Park

Subsequent to the completion of the majority of the questionnaire interview surveys in 1997, there has been substantial progress with respect to the implementation of the Agulhas National Park. Figure 4.6 shows the ± 2500 ha which have been contracted in or purchased for inclusion into the Agulhas National Park. In addition to these areas, a further 4000 hectares are expected to be purchased, and approximately 6500 hectares contracted into the park within the next eighteen months. This will bring the park up to 13000 ha, or 65% of the target area of 20 000 within a five year period.

Although the recommendations of Lombard *at al.* (1997) are being used to guide the process of including priority areas into the Agulhas National Park, real world constraints and opportunities, inadequacies in the data set, as well as the selection units used, have resulted in decisions which are partially *ad hoc*, although strategically defendable.

This "defendable *ad hoc*" approach to reservation is a far cry from the traditional *ad hoc* approaches to establishing protected area networks (Rebelo & Siegfried, 1990; Pressey *et al.*, 1994), but falls short of arguably the current best method, where excellent biological data bases, combined with user-friendly computer mapping, enable key stakeholder groups to guide the negotiations with respect to reservation targets (Pressey, *at al.* 1995). At Agulhas it is perhaps less important to examine each property individually in terms of its reservation contribution during the early stages of the park development. However, rigorous examination of priorities will increase in importance as the more "politically unacceptable" land (i.e. higher agricultural value) is targeted, as prices of land increase, and as resources for land acquisition become reduced, in the later stages of the park development.

To date the transactions on the Agulhas Plain have been based on:

- Cultural and scenic value – property at the southern tip of Africa
- Cultural, scenic and tourism value – Cape Agulhas Lighthouse Property
- Plant biodiversity – Bergplaas
- Wetland (including waterbirds) and recreational value – Soutpan
- Wetland (including waterbirds), plant biodiversity and linkage value – ex Ouplaas Trust land.

With the above transactions, all the landowners approached SANP first with respect to selling or contracting their land into the park. In a sense these areas are the "lands nobody wanted" (Pressey, 1994) from an agricultural point of view. The immediate future transactions for inclusion into the Agulhas National Park (apart from one or two properties), are also not being actively farmed, with the main agricultural activity being wildflower harvesting (permissible as sustainable harvesting within a contractual national park).

The reasons for the inclusion of the above properties into the Agulhas National Park indicate the complexities of real world conservation, where the minimum set approach (Lombard *at al.*, 1997) can at best be used to guide the process, and even highly rigorous planning tools incorporating persistence goals (Cowling *at al.*, 1999) will be secondary to socio-economic factors, at least in

the early stages of park implementation. Attitudes of landowners play a major role in determining which areas will be included into the protected area network. For example, during the beginning phases of the park development, many farmers said they would not sell their land for inclusion into the park. Subsequently, and partly as a result of recent agricultural hardship, SANP have been flooded with requests from farmers to buy their land or part thereof. The result is that SANP does not have sufficient funds to purchase this land at present, and raising sufficient funds for land purchase remains one of the biggest challenges to the future development of the Agulhas National Park.

It is suggested that future priorities for inclusion into the Agulhas National Park take the goals of persistence – maintaining processes that sustain ecosystem structure and functioning – and not simply the retention of biodiversity into account (Cowling *at al.*, 1999; Chapter 1), update the biological data required for decision making (particularly for the wetlands), work at the scale of cadastral boundaries rather than grid cells (Cowling *at al.*, 1998), and bring the landowners to the interactive decision making table using GIS-based scenario planning for reservation targets (Pressey *at al.*, 1995).

Land value and tenure

Purchasing land for a national park

It is well known within the South African National Parks network that when new parks are developed, land prices in the region increase (C.J. van der Merwe, Manager: Park Planning and Development: South African National Parks, pers. comm.). This could be as a result of either active farmers making a statement about not wanting to sell their land (unless at a premium), or conservation minded/speculative landowners hoping to make a good profit on their investment (personal observation). SANP is answerable to South Africa's Auditor General, and is therefore bound by certain purchase procedures, which include the appointment of a state-registered valuator to ensure that property transactions are market-related.

Decisions concerning the value of land are complex as they often include a combination of agricultural, conservation, aesthetic and sentimental factors. Although agricultural land value is the starting point for a valuation (C.W.L. Baard, Registered Valuator, pers. comm.) other factors

are also brought into account. The value of fynbos biodiversity is difficult to measure (Turpie *et al.*, in press), and in terms of agricultural potential, good flower producing land is valued higher than wetland, and there is no clear pattern between agricultural value and biodiversity value (Figure 9.4). Figure 9.4 indicates the land value of a few different agricultural and vegetation types (C.W.L. Baard, *in litt.*), measured against a proxy conservation value (% area targeted for reserve selection; Lombard *at al.*, 1997).

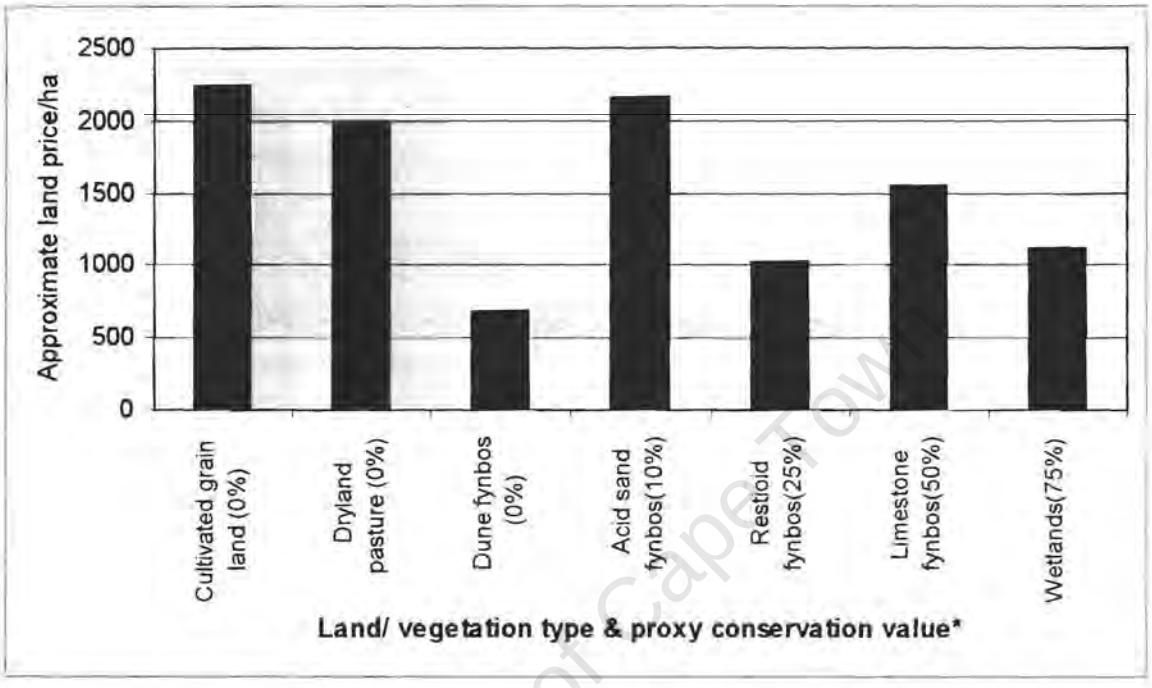


Figure 9.4. Approximate land prices/ha for various kinds of agricultural land/ vegetation types on the Agulhas Plain (C.W.L. Baard, registered valuator, *in litt.*) with proxy conservation value given as a percentage in parentheses. *Proxy conservation value is based on the% areas of the remaining vegetation type targeted for inclusion into a new protected area network (Lombard *at al.*, 1997)

It is interesting to note that good quality Acid Sand Fynbos, important for fynbos flower production (see section 4.3), was found to command an average land value almost equal to that of cultivated grain land, and higher than dryland pastures (Figure 9.4). This figure needs to be treated with caution as it cannot be extrapolated for all of this vegetation type (the sampled land was particularly good flower veld), but nevertheless indicates an interesting result. Limestone Fynbos, also reasonably good for fynbos flowers (section 4.3) commanded a reasonable value per hectare, whereas Dune Fynbos, not particularly good for flowers or livestock grazing, commanded the lowest value (Figure 9.4).

Land that is purchased and proclaimed as a Schedule 1 National Park (Table 1.1), is registered with a nil value on South African National Park's asset register, as a further safeguard to the requirements of the National Parks Act that the land can only be used for the purposes of a national park (and not treated as a tradable commodity). The value of land used for a Schedule 1 National Park transaction is therefore measurable during the negotiation and purchase phase, but becomes literally "priceless" once it is proclaimed as a national park.

Tenure arrangements on the Agulhas Plain

Chapter 1 outlines the tenure arrangements with respect to various conservation options offered by South African National Parks and the Cape Nature Conservation Board. The results of this survey with respect to existing tenure arrangements of Agulhas Plain landowners are summarised as follows:

- only 23% of landowners leased out their land for wildflowers (86%) and livestock grazing (14%)
- only 20% of landowners hired other properties for wildflowers (60%), livestock grazing (20%) and grazing for game (20%)
- the period of tenure varied from 1 - 10 years, and in few cases was a formal contract signed between the lessor and lessee
- there was little information forthcoming with respect to prices paid for hiring and leasing land, and in most cases payment for hiring wildflower harvesting areas was based on a percentage of the number of stems or kilograms harvested
- reported prices for leasing land were R 20 $\pm$ 11/ha/y for wildflower harvesting and R 17 $\pm$ 2/ha/y for indigenous grazing veld.

With the above in mind it is perhaps not surprising that the tenure arrangement with respect to contractual parks; i.e. formal contract with SANP for a period of more than 30 years (preferably 99 years), and the control and monitoring of wildflower harvesting, did not find favour with the majority of farmers when first presented at public meetings (Haasvlakte Farmers Association, pers. comm.). However, it was never the intention of SANP to include the majority of land (and especially not vast tracts of agricultural land) into the Agulhas National Park on a contractual basis. The core of any national park should have Schedule 1 status and contractual areas should be considered only where the land is of exceptional value from a biodiversity/cultural point of view, is strategically situated to provide a natural link between core areas, or when the

property cannot be purchased for some or other reason (e.g. a lack of capital to purchase the land, an unwillingness of the landowner to sell the land, institutional arrangements which prevent the transfer of land, private ownership of mineral rights, and socio-political concerns which may not make the transfer of land desirable).
In terms of the current tenure arrangements which are utilised on "working farms" on the Agulhas Plain, conservation models offered by Cape Nature Conservation (private nature reserves, conservancies, etc.; Chapter 1) are likely to be more "politically acceptable" to many landowners, especially those on "working farms". These categories are less restrictive than contractual national parks in terms of activities permitted by the landowner and can be deproclaimed at the request of either party at any time (Table 1.1). In some cases private nature reserves may confer conservation "status", rather than long term protection of biodiversity on the property, a situation which is not ideal as it is sometimes abused by resort developers to help sell developments as part of a so-called nature reserve, which may not be managed as one..

Communally-owned land

There is only one example of communal ownership of land on the Agulhas Plain, that is at Elim in the heart of the Agulhas Plain. Here the local community is the custodian of approximately 7000 ha of land, including one of the largest and best preserved tracts of Elim Fynbos (Killian, 1995). The land is owned by the Moravian Church of South Africa and is administered by an Overseers Council (*Opsienersraad*). Although all land is communal, the majority of good agricultural land is hired out to a few Elim farmers under what is technically a yearly contract, but is practically regarded as their land (J. Engel. Head of Administration: Elim *Opsienersraad*, pers. comm.). Certain marginal land (including tracts of alien-infested Elim Fynbos) is also hired out to local small-scale farmers who have had limited success with this veld (A. Appel, Elim Small Farmers Association, pers. comm.). One or two large, conservation–worthy areas have not been given out to livestock farmers but are seen as communal assets which are used for wildflower harvesting, conservation and tourism (Killian, 1995; Jeffery & Heydenrych, 1996). One example is the Geelkop hill, situated north east of the town of Elim.

Preliminary discussions have indicated that the Elim community would be willing to investigate the inclusion of the Geelkop area into the Agulhas National Park on a contractual basis. Geelkop is a low hill comprising primarily Elim Fynbos which is home to many endemic Proteaceae. The Elim community, however, are busy with internal negotiations to attempt the

transfer of the title deeds (or part thereof) of the mission station from the nationally-controlled Moravian church to the locally-run community. Further discussion with regards the Agulhas National Park will therefore need to wait until that process has run its course (J. Engel, pers. comm.).

Entrance fees and management costs

Visitors were asked to estimate the amount of money they would be prepared to pay to enter the Agulhas National Park. The average amounts suggested were as follows:
International visitors: R 19 for adults, R 9 for children
Local visitors: R 13 for adults, R 3 for children

Assuming an average of the above prices, i.e. R 16 for adults and R 6 for children, a tourism visitation rate equal to the estimated 40 000 visitors per annum to the Cape Agulhas Lighthouse, and a ratio of 4:1 adults to children, a revenue of R 560 000 per annum could be generated from gate fees for entry into the Agulhas National Park. Although it is likely that the park management budget will be significantly larger than this once the park is established, this revenue would nevertheless contribute significantly to the management costs of this unique cultural and natural landscape at the southern tip of Africa.

There would appear to be a reluctance by people to pay market-related prices for visiting natural areas. In a survey of visitors to the Cape Agulhas Lighthouse carried out in December 1998, only 28% of respondents noted that they would be willing to pay more than R10 (adults) to enter the Agulhas National Park (Cupido, 1998) . The majority would be willing to pay R10 for adults (59%) and R 5 for children (67%) (Cupido, 1998).

It is possible that very low entrance costs to the nearby De Hoop Nature Reserve in 1997, (R5 per vehicle and R3 per person, Turpie, 1996) as well as costs to enter the Lighthouse Museum at Cape Agulhas (R5 adults, R2 children), and other locally administered areas, are influencing peoples' decisions in this regard.

In 1996, the management costs at De Hoop Nature Reserve, under the jurisdiction of Cape Nature Conservation were approximately R 38/ha (Turpie, 1996). Given a similar spending

pattern for the state forests of the Agulhas Plain, approximately R 180 500/y is spent on the management of these protected areas (Cape Nature Conservation, pers. comm.). With the development of the new Western Cape Nature Conservation Board (Chapter 1), there will be a drive to increase commercial activities so that reserves can pay for themselves as far as possible in the future (Cape Nature Conservation, pers. comm.).

However, at present, there is clearly not yet an understanding that conservation must pay for itself amongst the general public in South Africa, and it is likely that few people know that SANP generates 85% of its funds internally, primarily through tourism.

South African National Parks, together with Cape Nature Conservation will need to embark on an education campaign to ensure that the public firstly become aware of the unique biodiversity in the Cape Floristic Region, and secondly, that they understand the financial implications of successfully managing this wealth of biodiversity.

Summary of Chapter 9

This chapter outlines the fact that most visitors to the Agulhas Plain are in favour of the establishment of the Agulhas National Park, whereas landowners, particularly active farmers, are less so, with some needing more information abut the park or preferring to investigate other conservation options.

The purchase of land for a protected area network is a complicated exercise as there are a number of factors which influence the perceived value of the land:

- agricultural value – certain veld types are valued higher than others
- conservation value – the identification of areas as priorities for conservation could raise the asking price of these sites above their agricultural value
- aesthetic value – properties with good views or cultural assets may be perceived as more valuable
- sentimental value – active farmers or farmers with historical family heritages would only be willing to sell at a premium, if at all.

Current tenure arrangements on the Agulhas Plain suggest that the Contractual National Park option will not be favoured by most landowners, but are more likely to be considered by land-owners with long-term conservation goals for their properties.

The price that visitors reported that they would be willing to pay to enter the Agulhas National Park suggests that approximately R 560 000 could be generated by gate fees to the park. However these funds are not likely to cover the management costs of the park, and it is important to educate the general public as to the value of protected areas, in order to be able to lever sufficient funds to manage them.

Table 10.1 summarises the estimated net incomes for various land-use sectors on the Agulhas Plain for 1997. Although this table does not include all values associated with Agulhas Plain landowners, it gives an estimate of some of the main values associated with land-use practices in this area. What is interesting to note is that 54% of the total net income of products is derived from the natural veld (Table 10.1).

This highlights the reliance of the Agulhas Plain land-owners on indigenous veld, particularly for wildflower harvesting, which is the region's largest agricultural income sector (Table 10.1). The beekeeping and firewood industries, perhaps thought of as marginal economic activities, confers substantial amounts of value to the region. The value of veld-based grazing was not readily identified as being economically important by all Agulhas Plain farmers (pers. comm.), but when put into monetary terms was found to contribute a substantial amount of income to landowners (Table 10.1).

Land-use on the Agulhas Plain is based on agricultural practices, with livestock and fynbos farming being the primary agricultural sectors. Although wildflower harvesting was found to be the region's largest industry, there is a growing trend towards the cultivation of many fynbos species. This, together with the threats from invasive alien plants, injudicious fire management, and in some cases over-harvesting of certain species, is having an increasing negative impact on terrestrial biodiversity patterns and processes.

Table 10.1. Estimated net income in 1997 from different major land-uses on the Agulhas Plain, for transformed and natural veld. (* indicates income which primarily accrues to non-landowners)

Land use	Approximate area used (ha)	Net income (R/ha/y)	Total net income (R/y)	Dominant original vegetation
Transformed areas (incl. dense alien plant infestations)				
Cereal crops	3060	300	918,000	Renosterveld
Artificial dryland pasture (beef & sheep)	14076	110	5,748,006	Renosterveld
Irrigated pastures for dairy cattle	680	155	1,581,000	Renosterveld
Cultivated fynbos flowers	4600	328	1,508,960	Acid Sand Fynbos
Firewood (*Acacia cyclops*)	8735	41	*361,177	Neutral and Dune Fynbos
Eucalyptus spp. for beekeeping	29424	27	*804,200	All land
Subtotal			*10,921,343*	
Indigenous vegetation				
Grazing for cattle			1,346,982	Most indigenous veld
Grazing for sheep			1,010,000	Most indigenous veld
Game farming			53,988	Various indigenous veld
Fynbos wildflowers	89767	95	8,550,775	Acid Sand Fynbos
Sour fig harvesting	8298	10	*86,250	Dune Fynbos
Beekeeping	116988	14	*1,680,000	All indigenous veld
Subtotal			*12,727,995*	
TOTAL			23,649,338	

Following a successful period of cultivating fynbos crops in the early 1990s, when new cultivars were experimented with, certain species are now being "over-cultivated", with no outlet for the product (Agulhas Plain flower farmers, pers. comm.). In addition, increased market demands for product quality are causing input costs for cultivation to increase to unrealistic levels. Furthermore, the export flower industry is currently not performing well in Europe, largely as a result of competition with floral products from other countries (Agulhas Plain flower farmers, pers. comm.). As a result of falling prices, particularly for the dry flower industry, flower pickers are tending to harvest more material, thus placing more pressure on the wild stocks of these plants.

In reaction to the above, certain conservation-minded Agulhas Plain flower farmers are exploring the possibility of maintaining the dependence on veld-derived products, where "green labelling" is planned as a method of establishing new niche markets overseas (L. Kabot, Flower Valley Farm, pers. comm.; P. Cilliers, Waterford Farm, pers. comm.). Such labelling could include information that the product has been harvested sustainably from the wild, and could include products from protected areas (e.g. private nature reserves / contractual national parks) together

with the logo of the associated conservation body. This stamp of approval by conservation agencies would afford the floral products both "environmentally-friendly status" as well a unique selling point. Labelling such products in this way is not a new phenomenon and has parallels in the forestry industry (Hauselman, 1999) and the organic vegetable market (Grieshop and Raj, 1992) where a premium is paid for a superior product, and quality, rather than quantity, is the key to success.

An emphasis in the fynbos flower industry to remain veld-based, has the potential to provide bigger incentives to correctly manage fynbos areas than those which currently exist, and could also slow down the rate at which pristine veld is being ploughed to cultivate fynbos species. However, there will be costs for the management of the resources, as harvesting practices will need to be carefully monitored if products are to be labelled as being "sustainably harvested". Furthermore, more research into this field is necessary to allow for sound management decisions in this regard.

The grazing of the Agulhas Plain's indigenous vegetation by livestock is a very important factor (Table 10.1), but there are concerns about the sustainability of these practices in terms of veld carrying capacity. Certain veld types were found to be over-stocked with sheep and cattle, and this is known to lead to a loss of plant biodiversity in the long-term (Le Roux, 1998). One important aspect in the future management of grazing on the Agulhas Plain will be extension work by conservation agencies, where the impact of stocking rates on the long term sustainability of the veld is explained.

A large amount of value is attributable to the indigenous vegetation of the Agulhas Plain by the beekeeping industries of honey production and pollination services (Table 10.1). There is some controversy about whether the indigenous vegetation has the capacity to accommodate more commercial honeybees without negatively affecting natural pollination regimes. The extent to which honeybees provide ecosystem services to fynbos plant species is not well known, but is an important area for new research. This is particularly pertinent at the moment in the light of the fact that honeybee populations in the Cape Floristic Region are being threatened by a parasitic mite (*Varroa jacobsoni*) which is set to cause large scale reduction in honeybess colonies (both commercial and wild) (Allsopp, 1998).

The tourism and recreation industry on the Agulhas Plain represents an important land use which is largely based on the natural environment. The economic impacts and values of tourism are substantial, particularly by domestic visitors and the total value associated with this industry on the Agulhas Plain is estimated to be R33 million per annum, measured by the total costs of travelling to the area, including on-site expenditure in the area, together with the consumer surplus estimated by a travel cost survey. This figure is more than the total net income attributed to agriculture and natural resource use of land on the Agulhas Plain (Table 10.1).

However, it is difficult to know with any degree of accuracy what proportion of this value can be attributed to the biodiversity of the area. However, based on visitor responses, 68% of the reason attracting them to the Agulhas Plain is the natural environment. Approximately R 22 million can therefore be allocated to the natural environment of the Agulhas Plain in terms of its recreational use value. Based on the ratio of the terrestrial:coastal environment's activities of 34:66, the terrestrial natural environment has an estimated recreational use value of R7.58 million per annum, whereas R14.84 million per annum is estimated to be allocated to the coastal environment of the Agulhas Plain. The tourism and recreation industry therefore represents the single largest economic sector on the Agulhas Plain, and is set to grow even more in the future.

Eco-tourism – industry for the future on the Agulhas Plain?

KPMG/WESGRO (1998) predicted that tourist numbers in the Western Cape would increase from 7.3 million in 1997 to 9.6 million in 2002, an increase of 31%. However, these predictions need to tempered against the reality of South Africa's problems of weaknesses in safety and security (KPMG/WESGRO, 1998). Recently, domestic visitors to the relatively crime-free Overberg rated the need to combat crime as a major recommendation to the local authorities (Kellas, 1999). Nevertheless, tourism in the Western Cape continues to grow and it has even been postulated that this industry could overtake gold as South Africa's largest GDP sector in the near future (Muller, 1999).

Using the same growth assumptions presented above, the estimated 70 000 Agulhas Plain visitors could rise to 92 000 by the year 2002. However, additional attractions would undoubtedly see a faster increase in visitor numbers, which given adequate facilities, and in particular a hotel, would ensure longer stay in the area (Bloom, 1998).. The effect that a new

national park at the southern tip of Africa will have is difficult to predict, but with upgraded facilities and a unique, quality experience, visitors numbers to the area are likely to increase substantially in the future. Increased visitor numbers will be able to provide much needed income to the region which if the true definition of eco-tourism is upheld, will also benefit the natural environment which is attracting the visitors, as well as the communities residing here.

The Minister of Environmental Affairs and Tourism recently launched a R 180 million tourism action plan which is the blueprint for the international marketing of South Africa as a top world tourism destination (SATOUR, Press Release, 16 September 1999, *in litt.*). This campaign is a private-public partnership between the state and the corporate business sector, and has as aims to increase South Africa's market share of international tourists, mainly (in the short term) in the "Big Six" markets (UK, USA, Germany, Italy, Netherlands and France) (SATOUR, Press Release, 16 September 1999, *in litt.*).

When developing tourism facilities, care must be taken to ensure that these are in harmony with the environment and the carrying capacity of the site and that environmental quality is not degraded in any way (Munasinghe and McNeely, 1994; Peine, 1999).

Invasive alien plants – negative features and positive opportunities which arise

The stocks of indigenous vegetation are declining steadily on the Agulhas Plain as a result of various natural and man-made processes, measurable by areas of veld transformed (quantity) and (primarily) degree of invasion by alien plants (quality).

Loss of revenue due to increased invasion of fynbos systems is not restricted to the products derived from the fynbos themselves. For example, the failure to clear invasive alien plants from the catchment of the Nuwejaars – Heuningnes River, would result in reduced water flows which could cause the (normally open) estuary to become closed (D. Toens, Geo-hydrologist, pers. comm.). Hofmeyr (1994), estimated that the agricultural loss that would occur should the lower reaches of the system be flooded, due to the mouth of the Heuningnes estuary becoming closed, could mean a financial loss (annual net income and cost of production) of between R 3.9 and R4.9 million.

One of the biggest threats to the biodiversity of the Agulhas Plain is the spread of invasive alien plants. However, private land owners are currently not spending nearly enough to stop the spread of these plants, and even a multi-million rand intervention by the state is only operating in a few key areas. The incentives for clearing invasive alien plants for wildflowers are clear to outsiders, but not to all landowners. It would appear that the current problem with the cash flow, and a lack of taking future values into account should invasive aliens spread (Turpie & Heydenrych, in press), is by and large preventing landowners from clearing invasive alien plants from their properties. This would appear to be the case even when non-invaded or lightly invaded areas are concerned, where invariably landowners to not seem to have the knowledge and/or resources to clear these areas (personal observation).

Where dense thickets of invasive alien plants occur, particularly Rooikrans (*Acacia cyclops*), there is an incentive to harvest this wood for commercial purposes. It may be pragmatic to identify low conservation-worthy areas in which these invasive alien thickets occur, and manage them as fuelwood plantations, dividing them into management blocks and even pruning the trees to sustain harvestable levels of desirable fuelwood sizes. Pruning of Rooikrans trees, is currently being carried out by some Agulhas Plain farmers, and in the West Coast region farmers are even encouraging groves of these trees to facilitate easy loading access by vehicles (J. Ricketts, Professional Woodcutter, pers. comm.). However a question arises as to whether these management costs are offset by the benefits, as the management of resources is complicated, both from the implementing agencies' perspective (e.g. Abbot and Mace, 1999), as well as that of the harvester (Higgins *et al.*, 1997b)

With regards the above, a pilot project to undertake a wood harvesting and invasive plant clearing experiment, which links up with existing alien clearing operations by the Western Cape Nature Conservation Board and South African National Parks, is suggested for the Agulhas Plain. It is envisaged that this project could be under the auspices of the Department of Water Affairs and Forestry's Working for Water Programme and the Landcare Project of the Department of Agriculture,.

The implementation of the Agulhas National Park

A new land use, the development of the Agulhas National Park has had mixed reaction from the Agulhas Plain landowners. Landowners on the Agulhas Plain comprise essentially two groupings, based on whether they derive their income from the land or not. Landowners who own "conservation farms" tend to be keen on the national park, and have similar long term goals with respect to the conservation of biodiversity. The owners of "working farms" have been in the region for a long time and some perceive the Agulhas National Park as a threat to their agricultural practices.

In an area dominated by the agricultural industry (MLH, 1994; WESGRO, 1997; Prins, 1999) in which there are a number of irreplaceable conservation "hot spots" (Lombard *et al.*, 1997), and many suggested strategies for biodiversity conservation (Hill, 1984; Jarman, 1986; Burgers *et al.*, 1987; MLH, 1994; Hanekom *et al.*, 1995; Lombard *et al.*, 1997) it comes as no surprise that conflicts of interest between landowners and statutory conservation bodies arise from time to time. This is particularly so considering that the majority of land on the Agulhas Plain is privately owned (Lombard *et al.*, 1997) and that conservation is a relatively new form of land use in this region. It is both interesting and important for conservation planning to find out what are the areas of conflict and the potential for mutual co-operation between agriculture and conservation, and to try and understand which factors are driving landowners' decisions regarding their land-use practices.

The development of the Agulhas National Park will influence land use on the Agulhas Plain in a number of ways which can be summarised as follows:

- some agricultural land will be included into the national park,
- the land values in the area will increase,
- there will be more "watchdogging" of activities in the region,
- there will be an increase in tourism with the potential for private sector tourism (e.g. farm based tourism, see for example Alexander, 1994) to increase,
- and, last but not least there will be an increase in the protection and enjoyment of the Agulhas Plain's unique biodiversity.

From a farmer's point of view, it may be argued that the second and fourth bullets are positive and the rest are factors which could be seen as negative or not having any noticeable effect. On the other hand, South African National Parks may see bullet two as being negative (threat to park expansion), be neutral about the first bullet and positive about the rest. However, a decision concerning the perceived benefits or disadvantages of the development of a new national park neither rests with the landowners nor with South African National Parks alone. The benefits of a national park are spread to society at large, including the international community (Jansson *et al*, 1994. It is therefore both pertinent and necessary to consult with and present findings of research of this nature, to as broad a spectrum of people as possible.

Access to resources

The primary requirement from certain previously disadvantaged communities relates to access for subsistence fishing and the collection of sour figs (M. Dennis, Struisbaai Noord Community; L. October, Elim Community, pers. comm.). Although the management of the sustainable harvesting of these resources is difficult (D. Geldenhuys, Cape Nature Conservation, pers. comm.) this is one way that the state can provide landless communities access to some of the area's natural resources. Another way is through the harvesting of wildflower products from private land, which is already in existence, although people from this sector were not sampled in this study.

In addition, access to the region's resources by landless communities is already occurring with regard to harvesting of firewood, which is undertaken primarily by people from previously disadvantaged communities. Judging by the requests from wood cutters for areas to harvest, and the current low estimated rates of firewood removal, there is a large potential to increase the number of woodcutters on the Agulhas Plain. This, however, would require a large management input, which should ideally be facilitated by an independent agency and not the landowners themselves.

Convincing the decision makers

Current measurements of South Africa's Gross Domestic Product indicate positive economical benefits when biodiversity is destroyed, for example for agricultural transformation for cultivated products (Davis, 1990).

For politicians and other key decision makers to be kept informed as to the real costs and benefits of biodiversity, it is important to "green up the national accounting system" in South Africa. Turpie *et al.*, (in press) have produced a preliminary attempt to allocate value added in various fynbos-based industries to the sectors from which they are derived. This is part of an attempt to provide some baseline information on the true costs and benefits of woody resources in the whole of South Africa.

More detailed studies on the use and value of natural fynbos resources, will assist conservation planners with their decision-making processes, and can also assist in the long run for the concept of sustainability to get on the agenda of the macro-economic policies of South Africa.

On the Agulhas Plain there has been a dramatic shift in land-use from basic survival by middle and later stone age people (200 000 – 2000 years ago; possibly the only group who can truly claim to have sustainably harvested the area's natural resources), through subsistence-based livestock agriculture of the Khoisan and early colonists (2000 years ago – 1700 AD; semi-sustainable use of natural resources) to modern, profit-oriented farmers. Modern farmers are reliant on cash crops and overseas markets, where financial planning is more important than ecological planning (1700 AD – present; primarily non-sustainable use of natural resources).

As long as humans retain their current cost and benefit perceptions and decisions, the Agulhas Plain's biodiversity will continue to erode, even if individually, farmers are contributing conservation actions (e.g. caring for small patches of veld containing rare plant species). In terms of South Africa's responsibility to protect the country's biodiversity therefore, there is a need for state funds, to be dedicated to the conservation of biodiversity (Kumleben *et al.*, 1998).

As it is not possible to live sustainably off the land anymore, and as the Agulhas National Park will not encompass all of the biodiversity of the Agulhas Plain, it may be better (for biodiversity)

for private landowners to focus on more sustainable forms of land use in which there is a direct incentive to conserve land (Young 1997; Van Schaik and Kramer, 1997). This includes sustainable agricultural use – e.g. niche marketing of fynbos wildflowers, game farming and bee farming, supplemented by a non-consumptive use of the land for eco-tourism.

At present the global extinction rate is at its highest ever (Pimm *et al.*, 1995) and the threats facing biodiversity are escalating rapidly (e.g. see Higgins *et al.*, 1999). Future conservation planning must therefore consider threats first and foremost, and institutions must act strategically to avoid changes in land use that will compromise the attainment of the biodiversity goals of retention and persistence (Cowling *et al.*, 1998). This is especially true of the Agulhas Plain.

Furthermore, the success of conservation interventions on the Agulhas Plain depends to a large extent on a better understanding of the spatial requirements to maintain key ecological and evolutionary processes. In this respect, off-reserve management will be crucial, since it will not be feasible to include all the required features into the national park. A biosphere reserve, comprising a core (Agulhas National Park including contractual areas), a buffer zone of conservancies, and transition zones where environmentally sound practices are encouraged, should be investigated for the Agulhas Plain. A biosphere structure could also be the most effective way of ensuring institutional co-operation in this fragmented landscape. In the Western Cape, the provincial planning department is responsible for implementing biosphere reserves and in this way the bio-regional planning process is not driven by conservation agencies (who could otherwise be accused of not being impartial), although they, together with all stakeholders participate through a biosphere reserve committee.

Of particular importance is the need for a thorough investigation of the financial requirements and economic benefits of strategic conservation initiatives (i.e. those based on priorities) on the Agulhas Plain. Local, regional, national and international institutions must be approached for support for land acquisition and other aspects of implementation, bearing in mind that each institution has a different role to play. Co-financing from South African institutions will be essential for the leverage of international funds.

An education and awareness campaign is imperative to ensure that Agulhas Plain landowners and visitors alike understand the that the mountains are relatively well conserved and how

important it is, ecologically, socially and economically, to have adequate areas of lowland habitat included in the formal protected area network.

Throughout the process of conservation development on the Agulhas Plain, a sense of pride and ownership of the national park and associated conservation areas should be instilled amongst the local inhabitants. Efforts need to be made to demonstrate that conservation areas are working in the interests of humans at local, national and international levels.

The Global Environmental Facility-funded Cape Action Plan for the Environment (CAPE Project), is the first co-ordinated effort to link conservation initiatives in the Cape Floristic Region across the various state and state- aligned departments, together with the private sector (CSIR, 1999). The proposed outcomes of this project, which include a strategic plan and funding plan for the conservation of the biodiversity of the Cape Floristic Region (WWF, 1998), will undoubtedly improve the conservation status of this region, and the Agulhas Plain is likely to be a beneficiary as well.

Chapter 11 References

Abbot, J.L. and Mace, R. 1999. Managing protected woodlands: fuelwood collection and law enforcement in Lake Malawi National Park. *Conservation Biology*. 13(2), 418-421.

Alexander, M. 1994. The Glenlyon experience. *SA Country Life*, July, 1994, 102-105.

Allsopp, M. 1998. Survey for *Varroa jacobsoni* in South Africa. *South African Bee Journal*. 70(1), 145-153.

Allsopp, M. 1999. The *Varroa* mite. *Deciduous Fruit Grower*. September 1999, 24-25.

Annonymous, 1999. Declaration of land in terms of the National Parks Act, 1976 (Act No. 57 of 1976), to be part of the Agulhas National Park. 1135 (20478), 23 September 1999. *Government Gazette*, Pretoria.

Anonymous 1996. *The Constitution of the Republic of South Africa*, 1996. (Act 108 of 1996).

Anonymous 1998a. National Water Act (Act 36 of 1998). *Government Gazette*, 398 (19182), Government Printer, Pretoria.

Anonymous, 1998b. *Southern Write. News from the Overberg*. (Newsletter of the Cape Overberg Tourism Association. Volume 2.(1). January / February 1998.

Anonymous 1998c National Veld and Forest Fire Act (Act 101 of 1998). *Government Gazette*, Government Printer, Pretoria.

Avery, G. 1975. Discussion on the age and use of tidal fish traps (visvywers). *South African Archaeological Bulletin* 30. 105 - 113.

Avery, G., Cruz-Uribe, K., Goldberg, P., Grine, F.E., Klein, R.G., Lenardi, M.J., Marean, C.W., Rink, W.J., Schwarcz, H.P.,Thackeray, A.I. and Wilson, M.L. 1997. The 1992-1993 excavations at the Die Kelders Middle and Later Stone Age Cave Site, South Africa. *Journal of Field Archaeology*. 24,263-291.

Avis, A.M. 1998 Coastal zone management and development. In *Field Guide to the Eastern and Southern Cape Coasts* (eds R.A. Lubke and I de Moor). pp. 446-458, University of Cape Town Press, Rondebosch.

Azorin, E.J. 1992. *The potential of alien Acacias as a woodfuel resources in the south western Cape*. National Energy Council, Department of Mineral and Energy Affairs, Pretoria.

Ball, J-M. 1995. Comparative seed and regeneration biology of two thatching reed species (*Thamnochortus insignis* and *T. erectus*, Restionaceae). MSc Thesis, University of Cape Town.

Barnes, K. N. (ed) 1998 *The Important Bird Areas of Southern Africa*. BirdLife South Africa, Johannesburg.

Batisse, M. 1982 The biosphere reserve: a tool for environmental management. *Environmental Conservation*, 9(2),101-111.

Best, P.B. 1995. *Whale watching in South Africa. The Southern Right Whale*. Mammal Research Institute, Pretoria.

Bickerton, I.B. 1984. Estuaries of the Cape. Part II: Synopsis of available information on individual systems. Heydorn, A.E.F. & J.R. Grindley. (Eds). Report No. 25: Heuningnes (CSW 19). CSIR Research Report 424. Stellenbosch.

Bloom, J. 1998. *Market assessment for an integrated coastal resort development*. University of Stellenbosch, Stellenbosch.

Bolton, J.J. & H. Stegenga 1990. The seaweeds of De Hoop Nature Reserve and their phytogeographical significance. *South African Journal of Botany* 56(2): 233 - 238.

Boonzaier, E., Malherbe, C., Smith, A. and Berens, P. 1996. *The Cape Herders*. David Philip Publishers, Claremont.

Brandon, K. 1997 Policy and practical considerations in land-use strategies for biodiversity conservation. In *Last stand. Protected areas and the defence of tropical biodiversity*. (eds R.A. Kramer, C.P. van Schaik and J. Johnson). pp. 90-114, Oxford University Press, New York.

Brasé, W. !995 Drop wheat – think of rooibos, fynbos flowers. *Farmer's Weekly*. 19 May 1995, 5-7.

Brooke, R.K. 1984. *South African Red Data Book - Birds*. South African National Scientific Programmes Report No. 97. CSIR, Pretoria.

Brooke, R.K., J. Cooper, P.A. Shelton & Crawford, R.J.M. 1982 Taxonomy, distribution, population size, breeding and conservation of White-breasted cormorant *Phalacrocorax carbo*. *Le Gerfaut* 72: 188 - 220.

Brown, A.C. & N. Jarman 1978. Coastal marine habitats. In: *Biogeography and ecology of southern Africa*. Ed. Werger, M.J.A. Dr W. Junk Publishers. The Hague. 1239 -1277.

Burgers, C.J. 1994 *Report on progress with implementation of recommendations of the "Jarman Report" on the conservation of the coastal lowlands of the western and south-western Cape*. Unpublished report, Cape Nature Conservation, Stellenbosch.

Burgers, C.J., Nel, J.G. & Pool R. 1987. *Assessment of proposals for conservation areas in the lowland of the south-western Cape*. NAKOR National Plan for Nature Conservation. Unpublished report, Cape Nature Conservation, Stellenbosch.

Burnie, D. 1994 Ecotourists to paradise. *New Scientist*, 1921, 23-27.

Cape Nature Conservation 1995. *Wildflower utilisation in conservation areas: Resourcism gone wild*. Unpublished report, CNC, Stellenbosch.

Claassen, J. 1999. Fynbosboere moet saamstaan teen wegholbrande. *Landbou Weekblad*. http://www.landbou.com/fynbos1.asp.

Coetzee, D.J. & P. Zoutendyk 1993. Species composition, distribution and standing stock of rocky-shore intertidal communities in the De Hoop Marine Reserve. *Bontebok* 8: 1 - 21.

Cooper, J. 1981. Biology of the Bank cormorant, part I: Distribution, population size, movement and conservation. *Ostrich* 50: 208 - 215.

Cooper, J., R.K. Brooke, D.P. Cyrus, A.P. Martin, R.H. & A.J. Williams 1992. Distribution, population size and conservation of the Caspian tern *Hydroprogne caspia* in southern Africa. *Ostrich* 63: 58 -67.

Cooper, J., R.K. Brooke, P.A. Shelton & R.J.M. Crawford. 1982. Distribution, population size and conservation of the Cape cormorant *Phalacrocorax capensis*. *Fisheries Bulletin of southern Africa* 16: 121 - 143.

Cooper, J., R.K., R.J.M. Crawford, Suter, W. & A.J. Williams. 1990. Distribution, population size and conservation of the swift tern *Sternia bergii* in southern Africa. *Ostrich* 61: 56 - 65.

Costanza R. & Daly H. 1992. Natural Capital and sustainable development. *Conservation Biology*, 6(1):37-46.

Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limbug, K., Naeem, S., O'Neill, R.V., Paruelo, J., Raskin, R.G., Sutton, P. & van den Belt, M. 1997. The value of the world's ecosystem services and natural capital. *Nature:* 387,253-260.

Cowling, R.M. 1990 Diversity components in a species-rich area of the Cape Floristic Region. *Journal of Vegetation Science* ,1,699-710.

Cowling, R.M. (ed) 1992 *The Ecology of Fynbos*. Nutrients Fire and Diversity. Oxford University Press, Cape Town.

Cowling, R.M. 1993. Ecotourism: what is it and what can it mean for conservation? *Veld & Flora,* 79(1), 3-5.

Cowling, R.M. & Holmes, P.M. 1992 Endemism and speciation in a lowland flora from the Cape Floristic Region. *Biological Journal of the Linnaean Society*, 47, 367-383.

Cowling, R.M. & Hilton-Taylor, C. 1994 Plant diversity and endemism in southern Africa: an overview. In *Botanical diversity in southern Africa*.(ed B.J. Huntley). pp. 31-52, National Botanical Institute, Kirstenbosch.

Cowling, R.M. & Mustart P.J. 1994 *Vegetation and conservation*. Volume 2. Appendix 5. Southern Overberg sub-regional structure plan. MLH Architects and Planners, Cape Town.

Cowling, R. & Richardson, D. 1995 *Fynbos. South Africa's Unique Floral Kingdom*. Fernwood Press, Cape Town.

Cowling, R.M. & Pierce S.M. 1999. Cape Floristic Region. In *Biodiversity hotspots of the world*. (eds N. Myers and R. Mittermeier), Cedex, Mexico City.

Cowling, R.M., Campbell, B.M., Mustart, P., McDonald, D.J., Jarman, M.L. & Moll, E.J. 1988 Vegetation classification in a floristically complex area: the Agulhas Plain. *S.Afr.J.Bot.*, 54(3),290-300.

Cowling, R.M., Holmes P.M. & Rebelo, A.G. 1992. Plant diversity and endemism. In *The Ecology of Fynbos*. Nutrients Fire and Diversity. (ed R.M. Cowling) pp. 62-112, Oxford University Press, Cape Town.

Cowling, R.M., Richardson, D.M. & Mustart, P.J. 1997a. Fynbos. In *Vegetation of Southern Africa* (eds R.M Cowling, D.M. Richardson and S.M. Pierce). pp. 99-130, Cambridge University Press, Cambridge.

Cowling, R.M., Costanza, R. and Higgins, S.I., 1997b. Services supplied by South African fynbos ecosystems. In *Nature's Services – Societal dependence on natural ecosystems*. (ed G.C. Daily), pp. 345 – 362. Island Press, Washington D.C.

Cowling, R.M., Pressey, R.L., Heijnis, C.E., Richardson, D.M. & Lombard, A.T. 1998. *Systematic conservation planning for the CAPE Project. Conceptual approach for the terrestrial biodiversity component*. Report No.: IPC 9803 CAPE, Institute for Plant Conservation, University of Cape Town, Rondebosch.

Cowling, R.M., Pressey, R.L., Lombard, A.T., Desmet, P.G. & Ellis, A.G. 1999. From representation to persistence: requirement for a sustainable reserve system in the species rich mediterranean-climate deserts of southern Africa. *Diversity and Distributions. 5,51-71.*

Crawford, R.J.M., P.A. Shelton, R.K. Brooke & J. Cooper. 1982a. Taxonomy, distribution, population size and conservation of the Crowned cormorant *Phalacrocorax coronatus*. *Le Gerfaut* 72: 3 - 30.

Crawford, R.J.M., J. Cooper & P.A. Shelton. 1982b. Distribution, population size, breeding and conservation of the Kelp gull in southern Africa. *Ostrich* 53: 164 - 177.

CSIR 1996. *Environmental Management Plan for the Bantamsklip Nuclear Site*. Environmentek, CSIR, Stellenbsoch.

CSIR 1999. *An assessment and review of the current policy, legal, institutional, socio-economic and financial situation affecting the conservation of biodiversity in the Cape Floristic Region. Part 1 & 2*. Draft Report, CSIR, Environmentek, Stellenbosch.

Cunningham, A.B. and Davis, G.W. 1997. Human use of plants. In *Vegetation of Southern Africa* (eds R.M. Cowling, D.M. Richardson and S.M. Pierce). pp. 474-506, Cambridge University Press, Cambridge.

Cupido, R. 1998. *Market survey report. Proposed Agulhas National Park – southern most point of Africa*. Unpublished report. South African National Parks, Cape Town.

David, J.H.M. 1987. South African Fur Seal, *Arctocephalus pusillus pusillus*. In: *Status, biology and ecology of fur seals; proceedings of an internal symposium and workshop*, J.P. Croxall & R.L. Gentry (Eds). Cambridge, England, 23 - 27 April 1984. NOAA Tech. Rep. NMFS 51. 65 - 71.

Davis, G.W.1990. *Commercial wildflower production in the Fynbos Biome and its role in the management of land-use*. Ph.D. Thesis, University of Cape Town, Cape Town.

Day, J.H., P. Cook, P. Zoutendyk & R. Simons. 1971. The effect of oil pollution from the tanker "Wafra" on the Marine fauna of the Cape Agulhas area. *Zoologica Africana* 6 (2): 209 - 219.

De Lacy,T. and Lockwood, M.1994. Estimating the non-market conservation values of protected landscapes in Australia. In Munasinghe M. & McNeely J. (Eds) *Protected area*

economics and policy. Linking conservation with sustainable development. pp 181 –190. The World Bank, Washington, D.C.

Deacon, 1992 Human settlement. In *The Ecology of Fynbos*. Nutrients Fire and Diversity. (ed R.M. Cowling) pp. 260-270, Oxford University Press, Cape Town.

Department of Water Affairs & Forestry 1997 *The Working for Water Programme*. 1996/97 Annual Report.

Downing, B.H. 1978. Environmental consequences of agricultural expansion in South Africa since 1850. *South African Journal of Science*. 74, 420-421.

Du Preez & Esler, 1997 How to conserve *Carpobrotus* - the edible way. *Veld & Flora*. 83(2):45.

Du Toit, L. and Rehder, A. 1998. *Archaeological reconnaissance report: Agulhas National Park*. Department of Archaeology, University of Stellenbosch, Stellenbosch.

Duckitt, J. 1995. Conservation of West Coast vegetation by farmers. In: *The sustainable use and management of renosterveld remnants in the Cape Floristic Region*: Low, A.B. and Jones, F. E. (eds). FCC report 1995/4. Botanical Society of South Africa, Kirstenbosch.

Emanuel, B.P., R.H. Bustamante, G.M. Branch, Eekhout, S. & F.J. Odendaal. 1992. *A zoogeographic and functional approach to the selection of marine reserves on the west coast of South Africa*. Unpublished report.

Esler K.J., Cowling, R.M., Witkowski, E.T.F. and Mustart, P.M. 1989. Reproductive traits and accumulation of nitrogen and phosphorous during the development of fruits of *Protea compacta* R.Br. (Calcifuge) and *Protea obtusifolia* Beuk. Es Meisn. (Calcicole). *New Phytol*. 112:109-115.

Filion, F.I, Foley, J.P. and Jacquemot, A.J. 1994. The economics of global ecotourism. In Munasinghe M. & McNeely J. (Eds) *Protected area economics and policy*. Linking conservation with sustainable development, pp.235-252. IUCN. The World Bank, Washington, D.C.

Findlay, K.P., 1997. Attitudes and expenditures of whale watchers in Hermanus, South Africa. *S Afr. J. Wildl. Res*. 27(2):57-62

Freeman, A.M. 1993. *The measurement of environmental and resource values*. Resources for the Future, Washington, D.C.

Gale, B. 1998. *Report on the possible impact of a proposed dam on the ecology of the Uilkraal River*. Aquacatch. Report no.AQ 5/4A, Caledon Square, Cape Town.

Geach, B.G.S. 1995. *The Addo Elephant National Park as a model for sustainable land use through ecotourism*. MSc Thesis, University of Port Elizabeth.

Gentry A.H. 1986 Endemism in tropical vs temperate plant communities. In *Conservation biology*. (ed M. Soule), pp. 153-181. Sinauer press, Sunderland.

Glavovic, P.D. 1993. *Flora and the Law*. Botanical Society of South Africa, Claremont.

Goldblatt, P. 1978 An analysis of the flora of southern Africa: its characteristics, relationships and origins. *Annals of the Missouri Botanical Garden,* 65, 369-436.

Greyling, T. and Davis, G.W. (Eds) 1989. *The Wildflower Resource:* Commerce, conservation and research. Report no. 40,. FRD, CSIR, Pretoria.

Grieshop, J. and Raj, A.K.. 1992. Are California's farmers headed towards sustainable agriculture? *California Agriculture*. 46(2): 4-7.

Griffiths, C.L. and Branch, G.M. 1997. The exploitation of coastal invertebrates and seaweeds in South Africa: histroical trends, ecological impacts and implications for management. *Trans. Roy. Soc. S. Afr.*, 52(1), 121-148.

Hall-Martin, A.J. 1997 *Proposed national park development budget 1998/99 to be funded by game sales*. Unpublished internal report. Department of Conservation Development, South African National Parks, Pretoria.

Hanekom, N. ; Randall, R.M., Russel, I.A. & Sachse B. 1995 *The Agulhas Area. An investigation of its potential for proclamation as a national park*. Scientific Services, National Parks Board, Sedgefield.

Harrison, T.D., Cooper, J.A.G., Ramm, A.E.L. and R.A. Singh. 1995. *Health of South African estuaries, Palmiet - Sout*. Executive report. CSIR, Congella.

Hauselmann, P. 1999. FSC General Assembly. *Arborvitae*. October:12, 14.

Heijnis, C., Lombard, A T., Cowling, R.M. & Desmet, P.G. 1999 Picking up the pieces: A biosphere reserve framework for a fragmented landscape – The Coastal Lowlands of the Western Cape, South Africa. *Biodiversity and Conservation, 8, 471-496*.

Henderson, L. 1995. *Plant invaders of South Africa*. Plant Protection Research Institute, Agricultural Research Council, Pretoria.

Heydenrych, B.J. 1994. *Limestone fynbos: Unique but threatened*. FCC Report 94/1, Botanical Society of South Africa, Claremont.

Heydenrych, BJ. 1998. *Agulhas Working For Water Project (Poverty Relief) Final Report. Feb - March 1998*. Unpublished Report, South African National Parks, Stanford.

Higgins, S.I., 1998. *Modelling the spread of invasive alien plants in Cape fynbos landscapes*. PhD Thesis, University of Cape Town.

Higgins S.I., Turpie J., Costanza R, Cowling R.M. 1997a An ecological economic simulation model of mountain fynbos ecosystems: dynamics, valuation and management. *Ecological Economics*, 22,155-169.

Higgins, S.I., Azorin, E.J., Cowling, R.M. and Morris, M.J. 1997b. A dynamic ecological-economic model as a tool for conflict resolution in an invasive-alien-plant, biological control and native-plant scenario. *Ecological Economics*. 22, 141-154.

Higgins, S.I., Richardson, D.M., Cowling, R.M. and Trinder-Smith, T.H. 1999. Prediciting the landscape=scale distribution of alien plants and their threat to biodiversity. *Conservation Biology*. 13(2), 303-313.

Hill, R.C. 1984 (ed). *Environmental evaluation of the proposed Main rd. No. 28 from Die Dam to Struisbaai*, School of Environmental Studies, University of Cape Town, Cape Town.

Hilton-Taylor, C. 1996. Red data list of southern African plants. *Strelitzia* (4), National Botanical Institute, Pretoria.

Hoffman, M.T. 1997. Human impacts on vegetation. In *Vegetation of Southern Africa* (eds R.M. Cowling, D.M. Richardson and S.M. Pierce). pp. 507-534, Cambridge University Press, Cambridge.

Hof, J.G. and King, D.A. 1992 Recreational demand by tourists for saltwater beach days: comment. *Journal of Environmental Economics and Management* 22:281-291.

Hofmeyer, D. 1994. *Memorandum with regard to management of the De Mond Nature Reserve by Cape Nature Conservation*. Unpublished Report, Somerset West.

Holmes, P.W. & Cowling, R.M. 1997 The effects of invasion by *Acacia saligna* on the guild structure and regeneration capabilities of South African fynbos shrublands. *Journal of Applied Ecology*, 34,317-332.

Hoskins, K. and Turner, V.B. 1999. Resource use and foraging patterns of Honeybees, *Apis mellifera*, and native insects on flowers of *Eucalyptus costata*. *Australian Journal of Ecology*. 24, 221-227.

Jansson, AM., Mamer, M., Folke, C. and Costanza, R. 1994. *Investing in natural capital. The ecological economics approach to sustainability*. Island Press, Washington, D.C.

Jarman M.L. (ed.) 1986. Conservation priorities in lowland regions of the fynbos biome. *South African National Scientific Programmes Report*. 87: Pretoria: CSIR

Jeffery, D. and Heydenrych, B. 1996. *A proposed fynbos management plan for Elim*. Commissioned by LANOK. Doug Jeffery Environmental Consultation and Facilitation Services, Klapmuts, Cape.

Jeffery, R.G. 1987. Influence of human disturbance on the nesting success of African black oystercatchers. *South African Journal of Wildlife*. 17(2), 71-72.

Johannsmeier, M.F. 1995. *Beeplants of the South Western Cape*. Department of Agriculture, ~~Directorate of~~ Agricultural Information, Pretoria. 59 pp.

Kellas, B. 1999. *Western Cape Tourism Board travel patterns – Overberg*. Douglas Parker Associates, Diepriver.

Kemper, J., Cowling, R.M., Richardson, D. M., Forsyth, G.C. & Mckelly, D.H. 1999. Landscape fragmentation in South Coast Renosterveld, South Africa in relation to topography and rainfall. *Australian Journal of Ecology* (in press).

Killian. D. 1991. *Seed and seedling ecology of two co-occurring ericoid fynbos species*. MSc Thesis, University of Cape Town.

KPMG/WESGRO, 1998. *The Western Cape tourism sector: Background for investors*. KPMG, Cape Town.

Kruger, B. 1967 *The Pear Tree Blossoms - The history of the Moravian Church in South Africa 1737-1869*. Genadendal Printing Works, Genadendal.

Kumleben, M.E., Sangweni, S.S. & Ledger, J.A. 1998 *Board of Investigation into the Institutional Arrangements for Nature Conservation in South Africa*. Unpublished report, Ministry of Environmental Affairs and Tourism, Pretoria.

Le Maitre, D.C. 1998. *Life history and reproductive ecology of selected Proteacea in the mountain fynbos vegetation of the south-western Cape*. Ph. D. Thesis, University of Cape Town.

Le Roux, G.H. 1988. Die gebruik van die Kaapse fynbos vir weiding en die probleme wat dit skep. *South African Forestry Journal*. 145:51-54

Leiman, 1996. The economics of conserving land. In *The Sustainable Use Of The Western Cape Lowlands* - Can this be achieved? Proceedings of a Symposium. FCC report 96/2. (Eds B.J. Heydenrych, C.J., Burgers, & J.H. Oberholtzer) Botanical Society of South Africa, Kirstenbosch, Cape Town.

Lombard, A. T. Hilton-Taylor, C., Rebelo, A.G., Pressey, R.L. & Cowling, R.M. 1999. Reserve selection in the Succulent Karoo, South Africa: coping with high compositional turnover. *Plant Ecology* (in press).

Lombard, A.T., Cowling, R.M., Pressey, R.L. & Mustart, P.J. 1997. Reserve design on the Agulhas Plain, South Africa: a flexible tool for conservation in a species-rich and fragmented landscape. *Conserv. Biol.*, 11,1101-1116.

Low, A.B. and Rebelo, A.G. 1996. *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria.

Lubke, R.A.. 1998. Marine ecology. In *Field Guide to the Eastern and Southern Cape Coasts* (eds R.A. Lubke and I de Moor). pp. 446-458, University of Cape Town Press, Rondebosch.

Malan, D,G. 1996. *The fynbos ornamental industry 1993-1995*. ARC, Fynbos Unit, Elsenberg. SAPPEX, Bot River.

Marais, C. 1998. *An economic evaluation of invasive alien plant control programmes in the mountain catchment areas of the Western Cape Province, South Africa*. PhD Thesis, University of Stellenbosch.

Maze, K.E. and Bond,W.J. 1996. Are *Protea* populations seed limited? Implications for wildflower harvesting in Cape fynbos. *Australian Journal of Ecology*. 21,96-105.

McDowell, 1988. *Factors affecting the conservation of Renosterveld*. PhD Thesis, University of Cape Town.

McDowell, C. and Moll, E. 1992. The influence of agriculture on the decline of west coast Renosterveld, South-western Cape, South Africa. *Journal of Environmental Management*. 35, 173-192.

McLachlan, A., T. Wooldridge & A.H. Dye. 1981.The ecology of sandy beaches in southern Africa. *South African Journal of Zoology* 16: 219 - 231.

McNeely, J. A., 1993 Economic Incentives for Conserving Biodiversity: Lessons for Africa. *Ambio*, 22(2-3),144-150.

McNeely, J.A. (Ed.) 1995. *Expanding partnerships in Conservation.* The Island Press, Washington D.C.

Middelmann, W.J., Gibson, B and Bell, I. 1989. A commercial perspective. In *The Wildflower Resource* Commerce conservation and research. Report no. 40. (eds T.Greyling and G.W. Davis). FRD, CSIR, Cape Town.

Midgley, J.J., 1989. Season of burn in serotinous Proteaceae: A critical review and further data. *South African Journal of Botany*, 55(2): 165-170.

MLH Architects & Planners 1994 *Southern Overberg Sub-Regional Structure Plan*, MLH, Contract No: CR 991114, MLH, Cape Town.

Muller, J. 1999. Toerisme-inkomste kan die van goud oorskry. *Finansies & Tegniek* 13/8/99.

Munasinghe M. 1994. Economic and Policy Issues in Natural Habitats and Protected Areas. In Munasinghe M. & McNeely J. (Eds) *Protected area economics and policy.* Linking conservation with sustainable development. IUCN, The World Bank, Washington, D.C.

Munasinghe M. & McNeely J. (Eds) 1994. *Protected area economics and policy.* Linking conservation with sustainable development. IUCN, The World Bank, Washington, D.C.

Mustart, P. and Cowling, R. Undated. *Fynbos Ecology for Wildflower Harvesters.* Unpublished document, Botany Department, UCT, Rondebosch.

Mustart, P., Cowling, R. and Albertyn, J. 1997. *Southern Overberg: South African Wildflower Guide 8.* Botanical Society of South Africa, Kirstenbosch.

Mustart, P.J. and Cowling, R.M. 1992. Impact of flower and cone harvesting on seed banks and seed set of serotinous Agulhas Proteaceae. *South African Journal of Botany.* 58(5), 337-342.

Myers, N. 1990 The biodiversity challenge: expanded hot-spots analysis. *Environmentalist*, 10,243-256.

Nabhan, G.P. and Buchmann, S.L. 1997. Services provided by pollinators. In *Nature's Services – Societal dependence on natural ecosystems.* (ed G.C. Daily), pp. 133-146. Island Press, Washington D.C.

OECD. 1995. *The economic appraisal of environmental projects and policies: A practical guide.* OECD, Paris.

Opperman, N., 1998. Negligence in Fire Bill objectionable. *The Farmer.* August, 1998,11

Overberg Conservation Services 1997. *Cape Overberg Fynbos Ecotourism Programme. Stanford/Gansbaai/Elim/Wolvengat.* Unpublished report, Overberg Conservation Services, Gansbaai.

Peine, J.D. 1999. Land use Planning: Sustainable Tourism. In *Ecosystem Management for Sustainability.* (ed. J.D. Peine) pp. 349-374, Lewis Publishers, Boca Raton.

Pithers, L. 1997. *Gansbaai: An investment Profile.* Document prepared for Wesgro. Clovelly Communications.

Pressey, R.L. 1997. Priority conservation areas: towards an operational definition for regional assessments. In *National parks and protected areas: Selection, delimitation and management.* (ed J.J. Pigram and R.C. Sundell), pp. 337-357. Centre for Water Policy Research, University of New England, Armidale.

Pressey, R. L., Johnson, I.R. & Wilson, P.D. 1994. Shades of irreplaceability: towards a measure of the contribution of sites to a reservation goal. *Biodiversity and Conservation,.* 3,242 – 262.

Pressey, R. L., Ferrier, S., Hager, T. C., Woods, C. A., Tully, S. L. & Weiman, K. M. 1996. How well protected are the forests of north - eastern New South Wales? – Analyses of forest environments in relation to formal protection measures, land tenure, and vulnerability to clearing. *Forest Ecology and Management.,* 85,311-333.

Primm, S.L., Russell, G.J., Gittleman, J.L. and Brooks, T.M. 1995. The future of biodiversity. *Science.* 269, 347-350.

Prins, J. 1999. *Ontwikkelingsprofiel van die Overberg*. Draft Document, Overberg District Council, Bredasdorp.

Privett, S. 1995. *Exotic Tree Eradication Plan For Red Hill Landowners Conservation Group.* Unpublished Report. Institute for Plant Conservation, Botany Department, University of Cape Town, Rondebosch

Provincial Administration Western Cape 1998. *Spatial Coastal Zone Policy for the Western Cape Province. Procedural Guidelines for Assessing Development Application Within the Coastal Zone.* Provincial Administration Western Cape, Cape Town.

Raimondo, J.P. & J.A. Barker 1988. *ESKOM nuclear site investigation Southern Cape region, regional study Gansbaai to Agulhas, main report.* Environmental Evaluation Unit, University of Cape Town. 32pp.

Rebelo, A.G. 1987. Management Implications. In *A preliminary synthesis of pollination biology in the Cape flora.* South African National Scientific Programmes Report No. 141:pp. 193-211 (ed A.G Rebelo). FRD, CSIR, Pretoria

Rebelo, A.G. 1992. Preservation of biotic diversity. In *The Ecology of Fynbos*. Nutrients Fire and Diversity. (ed R.M. Cowling) pp. 309-344, Oxford University Press, Cape Town.

Rebelo, A.G. 1995. *Proteas: A field guide to the Proteas of Southern Africa.* Fernwood Press, Vlaeberg.

Rebelo, A.T. 1997. Conservation. In *Vegetation of southern Africa*. (ed R.M. Cowling, D.M. Richardson & S.M. Pierce), pp. 571-590, Cambridge University Press, Cambridge.

Rebelo, A.G. and Holmes, P.M. 1988. Commercial exploitation of *Brunia albiflora* (Bruniaceae) in South Africa. *Biological Conservation,* 45, 195-207.

Rebelo, A.G. & Siegried W.R. 1990. Protection of fynbos vegetation: ideal and real world options. *Biological Conservation,* 54,17-34.

Rebelo, A.G. & Siegfried, W.R. 1992. Where should nature reserves be situated in the Cape Floristic Region, South Africa? Models for the spatial configuration of a reserve network aimed at maximizing the protection of floral diversity. *Conserv. Biol.*, 6,243-252.

Richardson, D.M., Macdonald, I.A.W., Holmes, P.M. & Cowling, R.M. 1992. Plant and animal invasions. In *The Ecology of Fynbos*. Nutrients Fire and Diversity. (ed R.M. Cowling) pp.271-308, Oxford University Press, Cape Town.

Richardson, D.M., Van Wilgen, B.W., Higgins, S.I., Trinder-Smith, T.H., Cowling, R.M., and McKelly, D.H. 1996. Current and future threats to plant biodiversity on the Cape Peninsula, South Africa. *Biodiversity and Conservation* 5, 607-647.

Robinson, G.A. 1989. Marine reserves. In *Oceans if life off South Africa* (eds A.I.L. Payne and R.J.M. Crawford) pp: 339-346, Vlaeberg Publishers, Cape Town.

Robinson, G.A. 1995. Management Plan for New National Park. *Custos,* 14(7), 48-49.

SAPPEX 1997. *News*, No. 93, March 1997

SAPPEX 1999. *News*, No. 102, July 1999.

Scott, A. (Ed.) 1995. *The Overberg Explorer.* Cape Overberg Tourism Association, Caledon.

Scutte-Vlok, A.L. 1998. Not all milk and honeybush tea. *Veld & Flora.* 84(3):90-91

Skead, C.J. 1980. *Historical mammal incidence in the Cape Province. Vol 1. The western and northern Cape.* Cape Department of Nature and Environmental Conservation, Cape Town.

Smith, A.B. 1983. Prehistoric pastoralism in the Southwestern Cape, South Africa. *World Archeology.* 15(1): 79-89

Stock, W.D. and Allsopp, M. 1992. Functional perspective of ecosystems. In: Cowling, R.M. (ed) 1992 *The Ecology of Fynbos*. Nutrients Fire and Diversity. Pp. 241-259. Oxford University Press, Cape Town.

Summers, R.W. & J. Cooper. 1977. population, ecology and conservation of black oystercatchers Haemotopus moquini. *Ostrich* 48: 28 - 40.

Takhtajan, A. 1986. *Floristic regions of the world.* University of California press, Berkeley.

Tew, J.E., 1999. *The effects of Varoosis in North America – A twelve year review*. Proceedings of the 36th Apimondia Congress. Vancouver. 12-17 September, 1999.

Thwaites, R.N. & Cowling, R.M. 1988. Soil vegetation relationships on the Agulhas Plain, South Africa. *Catena,* 15,333-345.

Toens, P.D, Visser, D, van der Westhuizen, CR, Stadler, W and. Rasmussen, JM. 1998. *Report on the Overberg Coastal Groundwater Resources. Volume II.* Tand.P Report No. 980148. Commissioned by the Department of Water Affairs and Forestry. Toens and. Partners cc, Wynberg.

Turpie, J.K. 1996. *A preliminary economic assessment of De Hoop Nature Reserve.* Unpublished report, FitzPatrick Institute, UCT, 97pp.

Turpie J.K. and. Siegfried W.R. 1996. The conservation economic imperative: securing the future of protected areas in South Africa. *Africa: environment & wildlife:* 4:35-37.

Turpie, J.K. & Heydenrych B.J. In press. *Economic consequences of alien infestation of fynbos vegetation.* Proceedings of a GISP project. York 11-13 March 1999.

Turpie J.K., Heydenrych B.J. and. Hassan R. In press. *Accounting for fynbos:A preliminary assessment of the status and economic value of fynbos vegetation in the Western Cape.* EENESA.

Van der Merwe, W.J. and Eloff, B.J. 1995. Byeboerdery in Wes-Kaapland. *South African Bee Journal.* 67(4),105-114.

Van der Walt, D., 1996. Die asemrowende mooi *Protea holosericea. Veld & Flora.* 82(1), 22-23.

Van Schaik, C.P. and. Kramer, R.A., 1997. Towards a new protection paradigm. In *Last stand. Protected areas and the defence of tropical biodiversity.* (eds R.A. Kramer, C.P. van Schaik and J. Johnson). pp. 212-230, Oxford University Press, New York.

Van Wilgen, B.W. and Viviers, M. 1985. The effect of season of fire on serotinous Proteaceae in the Western Cape and the implications for fynbos management. *S. Afr. For. J.*, 133:49-53.

Van Wilgen, B.W., Bond, W. J and. Richardson, D. M, 1992. Ecosystem management. In *The Ecology of Fynbos.* Nutrients Fire and Diversity. (ed R.M. Cowling) pp. 345 - 371, Oxford University Press, Cape Town.

Van Wilgen, B.W., Cowling, R.M. & Burgers, C.J. 1996 Valuation of ecosystem services: a case study from South African Fynbos ecosystems. *BioScience,* 46,184-189.

Visser, D, Norman, N & Stadler, W. 1999. Working For Water *: The Effect Of Invasive Alien Plant Eradication On The Groundwaters Of The L'Agulhas Plains, Western Cape Province.* Toens & Partners Report No,980173b .

Vlok, J.H.J. 1996. *The role of overstorey proteoid shrubs in maintaining species richness in a southern Cape mountain fynbos community.* MSc Thesis, University of Natal.

Walsh, B.N. 1968. *Some notes on the incidence and control of drift sands along the Caledon, Bredasdorp and Riversdale coastline of South Africa.* Dept Forestry Bulletin 44, Govt Printer, Pretoria.

WESGRO, 1997. Growth prospects in the Overberg region. *Western Cape economic monitor.* First issue 1997, p. 2.

WESGRO 1998. *Western Cape Tourism Trends. June 1998.* Wesgro, Cape Town.

WESGRO, undated. *Investment and development opportunities: Overberg region.* WESGRO, CapeTown.

Willis, C.K., Lombard, A.T., Cowling, R.M., Heydenrych, B.J. and Burgers, C.J. 1996. Reserve systems for limestone endemic flora of the Cape lowland fynbos: Iterative versus linear programming techniques. *Biological Conservation,* 77,53-62.

Wilson, M. 1988. Archaeological sites in the Haelkraalrivier - Cape Agulhas Area. In Raimondo, J.P. & J.A. Barker (Eds) *ESKOM nuclear site investigation Southern Cape region, regional study Garnsbaai to Agulhas, supplementary report* Vol.2. Environmental Evaluation Unit. University of Cape Town. Pp. 11.

Working for Water Programme 1998 *1997/1998 Annual Report*. Ministry of Water Affairs and Forestry, Cape Town.

Working for Water Programme 1999 *1998/1999 Annual Report*. Ministry of Water Affairs and Forestry, Cape Town.

World Bank 1998. *Global Environmental facility. South Africa. Cape Peninsula Biodiversity Conservation Project*, The World bank, Washington D.C.

WWF-SA 1999 *Cape Action Plan for the Environment*. Background Document. Unpublished report, WWF-SA, Stellenbosch

Young, M. 1997. *Mining or minding: Opportunities for Australia to improve conservation of remnant vegetation and alleviate land degradation*. Paper presented to an environmental economics round table hosted by the minister for environment in Canberra on July 10, 1997. CSIRO Wildlife & Ecology. Resources Futures Programme, Lyneham.

Appendix 1

AGULHAS PLAIN PROJECT - FYNBOS QUESTIONNAIRE No.....

Motivation: Invasive alien plants are the biggest threat to the indigenous Fynbos of the Agulhas Plain. However, the costs to clear these plants is enormous and outside funding (possibly from overseas) will be needed.
To prepare a motivation for funding, we need information on the importance of Fynbos to the local farmers, as well as information on the how bad the alien plant problem is.

This questionnaire addresses the question: How important is Fynbos to your farming activities? Your co-operation will be greatly appreciated and the information you supply will assist in a motivation for funding the clearing of invasive alien plants.

Name.....Position: Manager/Owner☐ Owner☐ Manager☐
Tel (.....).....Date of Visit...../...../.....
Resident on farm? Yes☐.No ☐.....
Is a manager resident? Yes☐ No ☐
How long have you owned the farm/ farm been in the family?.....
Farm activity
Working farm☐ Holiday/retirement farm☐ Other.....
Pays for itself ☐ Supported from outside ☐
% of income from different activities

Flowers	.....%..Wild.....Cul.....
Sheep	.....%
Beef Cattle	.....%
Dairy Cattle	.....%
Cereal crops	.....%
Bees	.....%
Wood	.....%
Eco-tourism	.....%
Outside funds	.....%
Other	.....%
Total	100%

Member of a farmers association? Yes☐ No☐
If yes, Which one? Stanford☐, Strandveld☐, Haasvlakte☐, Bredasdorp☐

Farm Name (s) & Number (s).....
.....

Address.....
.....

Initial feelings and reasons about proposed national park:
☐ For.....
☐ Against.....
☐ Comments.....

6) Plans for future (5 years) i.t.o. shifts in practices:
Details.....
.....
.....

1) Farm details:

Own farm Farm size.....(Ha) Area of natural Fynbos/ veld.....(Ha).....(%).....
Do you hire out your farm (or part)? No☐ Yes☐ For What.....Who.....Tenure arrangement.....
Do you hire/ pick flowers on, other farms No☐Yes☐ Farm Name(s).....
For What.....Who.....Tenure arrangement.....
Importance of hired area to you (i.e. % of quantities harvested/ area grazed etc.)... Tenure arrangement.....
Farm size.....(Ha)...Area of natural Fynbos.....(Ha).....(%).....

2) Fynbos Farming ***Do you harvest wildflowers? No☐ Yes☐***

Fresh Flowers☐ Turnover .....% Market.....
Dry Flowers☐ Turnover .....% Market.....
Do you burn your veld for flower production? No☐ Yes☐ Plan to ☐ What month(s) of the year? .....
How often? ≤5yr☐ 6-10yr ☐ >10yr☐.....
Do you cultivate fynbos? No☐ Yes☐ Total area of cultivated fynbos.....(Ha)
Of this, area of intensive cultivation.....ha.....%, area of strip cultivation.....ha.....%
Width of cultivated strip.....(meters) Width of natural veld.....(meters)
Original type of veld: F&Th☐.... LF☐ ....AF☐ .....NF☐.... ErF☐ ....RF☐.... DF☐... R☐... ElF☐... W☐....
Original condition of veld: pristine☐..... light aliens☐.....medium aliens☐..... dense aliens☐..... old land☐.....
Soil preparation before sowing in strip cultivated area:
Burnt & loosened soil☐ ploughed once☐ ploughed twice☐.....
Species: Platy☐ Compacta☐ Sabulosum☐ Repens red☐ Repens white☐.Salignum☐ Strictum☐ Other.....
Pesticides/ Fungicides?N☐Y☐ Details.....Fertilizers? N☐ Y☐ Details.....
Propagation material: Own/ local☐.....From outside the area ☐...From where and reasons.....

3) Alien Invasive Plants

Area of natural veld affected.....%.....(Ha) Worst species (Rank) PJ☐.....R☐.....LW ☐.....M☐.....H☐.....Pi☐.....
Other species.....
Area of **light** infestation.....%.....(Ha) **Medium** infestation.....%.....(Ha) **Dense** infestation.....%.....(Ha)
Are you clearing alien invasive plants to improve veld?Yes☐ No☐. Are you working to a plan?Yes☐ No☐
Time spent on alien clearing (man days/year) .....Own.....Hired
How much spent to date? R.....Area.....(Ha).Period.....(months) Density: light ☐.....med☐.....dense☐.....
Are you doing follow up? Yes☐ No☐.. How long after initial clearing? 6mnths☐ 1yr☐ 2yr☐ 3yr☐ 4yr ≥5yr☐.....
How often? Weekly☐ Monthly☐ Yearly☐.....
Do you cut wood commercially? No☐ Yes☐ Quantity: own farm.....Hired farms.....Species.....
Does a contractor cut wood from your farm? No☐ Yes☐ Who.....Quantity.....
Species and conditions of cutting.....

4) Grazing in natural veld ***No☐ Yes☐***

Do you burn your veld for grazing? No☐ Yes☐ Plan to ☐ What month (s) of the year? .....
How often? ≤5yr☐ 6-10yr ☐ >10yr☐.....Veld type(s).....Area burnt per year.....ha

Cattle	Sheep	Game (or other e.g. goats)
% reliance on natural veld.....	% reliance on natural veld.....	% reliance on natural veld.....
Beef☐....Dairy☐.....Mixed☐.....	Mutton☐.....Wool☐....Mixed☐.....	Species.....
Number of animals.....(LAU)	Number of animals.....(SAU)	Number of animals.....(LAU)
Time spent.....(months)	Time spent.....(months)	Time spent.....(months)
Area of natural veld used.....(Ha)	Area of natural veld used.....(Ha)	Area of natural veld.....(Ha)
Type of veld.....	Type of veld.....	Type of veld.....

5) Beekeeping ***No☐ Yes☐***

Main reason for keeping bees: honey production☐ overwintering☐ pollination on your farm☐ Crops pollinated.....
Number of own hives.....Number of outside beekeeper's hives.....Payment from outside beekeepers.....
How many hives leave your farm for pollination? Own hives.....Outside beekeeper's hives.....
Period of time hives are away for pollination..... (months) Crops pollinated.....
Annual yield of honey from your farm: Own hives.....Outside beekeepers hives.....
% reliance on Fynbos veld (time spent).....Type of fynbos veld.....
% Reliance on Eucalyptus/ Spidergum (time spent).....
Other types of veld/ forage.....% reliance (time spent).....

SCIENTIFIC NAME	TRADE NAME	FRESH			DRY			STAGE SOLD
		Stems	Bundles	Kg	Stems	Bundles	Kg	
P. compacta	Compacta							
P. cordata								
P. cynaroides	Giants							
P. longifolia								
P. nitida	Arborea							
P. obtusifolia	Obtusifolia							
P. repens	Repens Red							
P. repens	Repens White							
P. speciosa	Speciosa							
P. susannae	Susannae							
L. cordifolium	Cordifolium							
L. patersonii	Patersonii							
L. trunculatum	Buxifolia							
M. cucullatus								
M. hirtus								
M. saxatilis								
L. coniferum	Sabulosum							
L. gandogeri	Glabrum							
L. laureolum	Decorum							
L. laxum	Vleirosie							
L. linifolium	Tortum							
L. meridianum	Meridianum							
L. muirii	Muirii							
L. platyspermum	Platystar							
L. platyspermum	Platy (Loof)							
L. salicifolium	Strictum							
L. spissifolium	Glabrum							
L. stelligerum								
L. teretifolium	Comosum							
L. tinctum	Tinctum/ Grandiflorum							
L. xanthoconus	Salignum							
Nebelia paleacea	Kwassies/ mnt berzelia							
Staavia radiata	Glass Eyes/ Glasogies							
Brunia laevis	Silver Brunia							
Brunia neglecta								
Brunia nodiflora	Spray Brunia							
Berzelia abrotanoides	Bloed Kol-kol							
Berzelia lanuginosa	Kol-kol							
Athanasia crithmifolia	Klaas Louw							
Berkheya armata								
Disparago ericoides								
Edmondia sesamoides								
Eriocephalus racemosus	White Cotton							
Helichrysum crispum	Kooigoed							
Metalasia muricata	Blombos							
Phaenocoma prolifera	Phaenocoma							
Stoebe plumosa	Slangbos							
Stoebe aethiopica	Slangbos							
Syncarpha argyropsys	Brown eyes							
Syncarpha paniculata	Mini brown eyes							

SCIENTIFIC NAME	TRADE NAME	FRESH			DRY			STAGE SOLD
		Stems	Bundles	Kg	Stems	Bundles	Kg	
Syncarpha vesita	Capblumen							
Erica ampullaceae								
Erica articularis								
Erica axilliflora								
Erica calycina	Salt & Pepper							
Erica campanularis								
Erica cerinthoides								
Erica coccinea								
Erica coriifolia								
Erica cyathiformis								
Erica fastigiata	Four Sisters							
Erica filipendula	Filipendula							
Erica gracilipes								
Erica hispidula								
Erica holosericea								
Erica imbricata	Salt and pepper							
Erica intervallaris								
Erica irregularis	Rysheide							
Erica lineata								
Erica longifolia								
Erica mammosa	Mammosa							
Erica onosmiflora								
Erica parviflora								
Erica perspicua	Prince O' Wales							
Erica placentiflora								
Erica plukenetii	Plukenetii							
Erica pulchella								
Erica quadrangularis								
Erica rhopalantha								
Erica sessiliflora	Groenheide							
Erica sitiens								
Erica spumosa								
Erica tenella								
Erica tenuifolia								
Erica vestita								
Agathosma cerefolium	Anys							
Agathosma serpyllaceae								
Diosma hirsuta								
Diosma subulata	Anys							
Phylica ericoides	White Phylica							
Phylica lasciocarpa	Snow Tops							
Phylica parviflora								
Phylica pubescens	Veerkoppie/Green Phylica							
Passerina vulgaris	Gonna							
Ceratocarym argenteum	Olifant riet							
Elegia capensis	Step reed							
Thamnochortus erectus								
Thamnochortus insignis	Thatch Reed							
Tertraria thermalis	Mountain Reed							
Lanaria lanata	Lambs Tails							
Anthospermum aethiopicum	New Look							

Appendix 2

AGULHAS PLAIN TOURISM & RECREATION SURVEY

University of Cape Town

ENGLISH

The **main aims of this survey** are to improve our understanding of the people that visit the Agulhas Plain area between Hermanus and Arniston, the importance of this area as a travel destination and the economic value of its natural resources. We are also hoping to ascertain the economic impact that visitors have on the local and regional economy and their opinion regarding future developments of the natural environment in the area.

Please assist our research by completing the following questions during your visit and leaving your form at reception, with your host or in your room (as applicable). Thank you for your co-operation.

1. Accommodation establishment _____ Town/farm_____ Date _____
2. Type of accommodation establishment (tick one):
   ☐ Hotel ☐ Guesthouse/B&B ☐ Self-catering ☐ Caravan park ☐ Rented house ☐ Other
3. How many people are there in your party? Adults: _____ Children:_____
4. Where do you come from (town, country)?_____
5. How long are you staying in the Agulhas Plain area? (please refer to map overleaf)
   _____days/_____nights
6. How are you travelling within this area? (tick one)
   ☐ organised tour ☐ self-guided

7. Please tick your group's main interests in the Agulhas Plain area and circle the most important one:
   ☐ Villages, shops etc. ☐ Rural landscapes ☐ Friends/family ☐ Festival ☐ Culture
   ☐ Business ☐ southern tip of Africa ☐ Natural environment (incl. marine resources)
   ☐ Other_____

8. How much of your reason for visiting this area would you ascribe to the **natural environment**?
   ☐ 100% (only reason) ☐ 40% (significant but not the dominant reason)
   ☐ 80% (main reason) ☐ 20% (a small part of the reason for coming)
   ☐ 60% (NB part of my visit) ☐ 0% (wasn't a factor in my decision to come)
   Own estimate _____%

9. Is your group taking part in any of the following activities in this area:
   ☐ Walking/hiking - beach/cliffs ☐ Whalewatching ☐ Scenic drives
   ☐ Walking/hiking - inland ☐ Fynbos appreciation ☐ Plant identification
   ☐ Beach driving (4x4, etc) ☐ Birdwatching ☐ Visiting museums/monuments
   ☐ Scuba/snorkeling ☐ Beach/water sports ☐ Photography
   ☐ Other (please describe)_____

10. How many in your group are doing the following in the area during this trip:
    Angling _____ Spearfishing _____
    Collecting bait _____ Catching crayfish _____
    Collecting perlemoen _____ Collecting other shellfish for eating _____

11. How would you rate your interest in:

Fynbos	☐ none	☐ mild	☐ fair	☐ strong
Coastal & marine ecology	☐ none	☐ mild	☐ fair	☐ strong
Local history & culture	☐ none	☐ mild	☐ fair	☐ strong

PLEASE TURN OVER.....

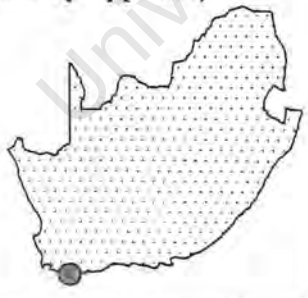
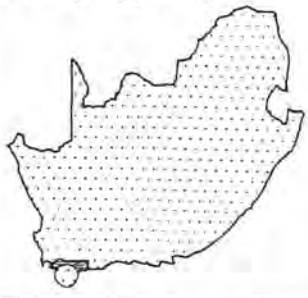
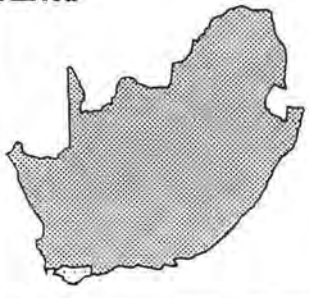
Please describe the **route** and **costs** of your group's trip away from home.
Maps are provided opposite to help with some of the questions on this page.

12. Cost of your group's travel to & from South Africa (if applicable) _____
13. Where did your trip begin in South Africa (town)_____
14. How long is your trip/holiday in South Africa (including travelling time)? _____days
15. Please estimate your group's transport costs for your entire trip (within South Africa).
    Flight costs _____ Train/bus _____
    Own Vehicle _____ Hired vehicle _____Other _____

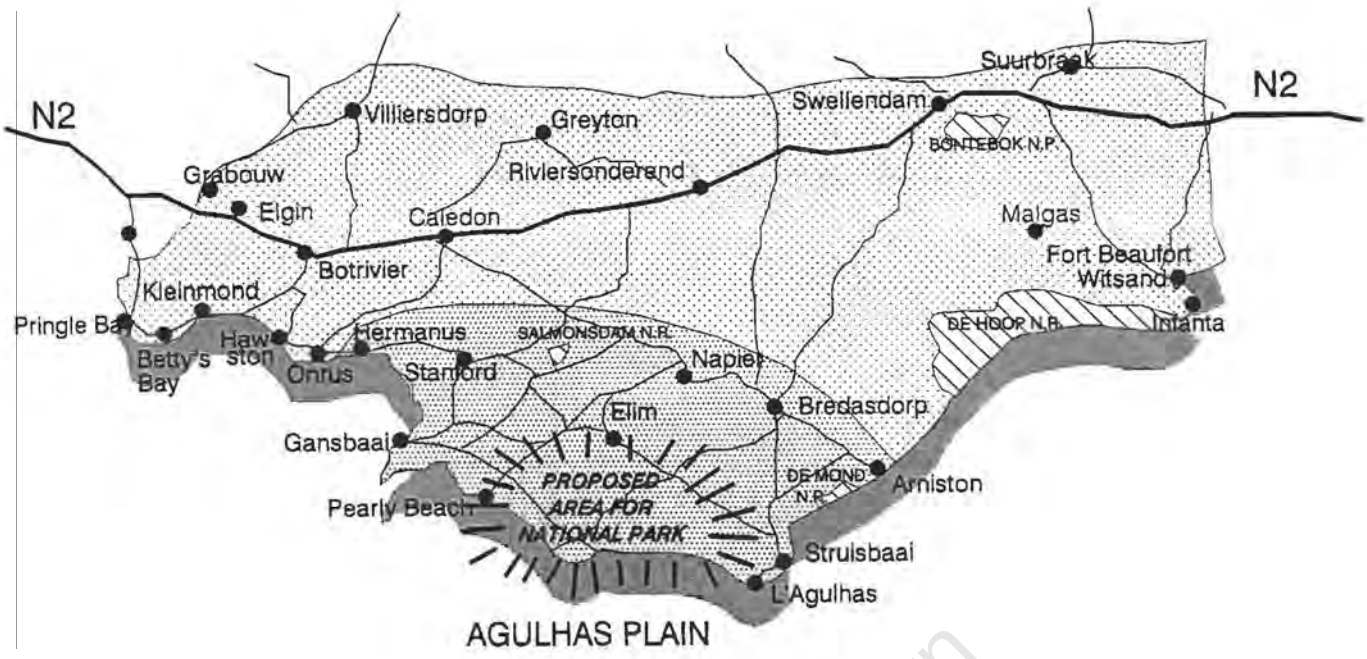
16. What places (if any) did you visit (in South Africa) on the way here and how long did you spend in each?
    _____ _____ days/ _____nights
    _____ _____ days/_____nights
    _____ _____ days/_____nights
    _____ _____ days/_____nights
17. What places (if any) are you planning to visit (in South Africa) after this area?
    _____ _____ days/_____nights
    _____ _____ days/_____nights
    _____ _____ days/_____nights
    _____ _____ days/_____nights

18. How important do you regard your visit to your Agulhas Plain destination(s) (see map) relative to your whole trip away (please tick one)?
    ☐ only reason for trip ☐ about half of the reason ☐ about one eighth of the reason
    ☐ main reason for trip ☐ about a quarter of the reason ☐ own estimate:_____

19. This table is not as complicated as it looks! Please recall your group's expenditures on the way here by filling in the appropriate squares below. If possible, please also estimate the total expenditure for your trip. Refer to the maps opposite to see which towns fall into the different zones.

	in the Agulhas Plain area (see map opposite) 		in the rest of the Overberg (see map opposite) 		in the rest of South Africa 	
	So far	Estimated total	So far	Estimated total	So far	Estimated total
Organised tours	R	R	R	R	R	R
Accommodation restaurants, bars	R	R	R	R	R	R
Transport (petrol, airfare, car hire, etc)	R	R	R	R	R	R
Groceries, other retail purchases	R	R	R	R	R	R
Other.....	R	R	R	R	R	R

PLEASE TURN OVER.....



A **new National Park** has been proposed for the Agulhas Plain area, as shown above. This park will incorporate conventional reserve areas and contractual areas under the joint control of existing landowners and the National Parks Board. The proposed park will provide protection for certain important areas of fynbos and for parts of the coastal and marine environment. Please give your opinions on the following:

Do you think the establishment of this National Park is a good idea?

☐ Yes ☐ No ☐ Don't know

Reasons_____

_____

_____

What is the the maximum you would be willing to pay to enter the Park?

Adults: R_____ Children under 18 years: R_____

Please place each of the members of your group in <u>one</u> of the following categories or income groups (annual income before tax), giving the total number in each category:

	Number:		Number:
Earning less than R35 000	_____	Child/scholar	_____
Earning R35-80 000	_____	Full time student	_____
Earning R80 - 150 000	_____	Pensioner	_____
Earning R150 - R250 000	_____		
Earning more than R250 000	_____		

Thank you for taking the time to complete the questionnaire.
Please leave this form with your host/ at reception when you leave.
If you forget to hand it in, or prefer to fill it in when you get home, please post to:

Agulhas Plain Survey
FitzPatrick Institute
University of Cape Town
Rondebosch 7700

Appendix 3

AGULHAS PLAIN VISITOR SURVEY

University of Cape Town

Interviewer _____ **Place** _____ **Date**_____ **Age**____ **Sex**____ **Code**_____

We are conducting a survey on tourism in the Agulhas Plain area (Hermanus to Bredasdorp to Arniston - see map). We are particularly interested in how the establishment of a proposed national park in this area will affect tourism.

1. Where do you live? _____
2. How many people are in your group? ___Adults ___ Children (<18)
3. How long are you staying in the Agulhas Plain Area?_____Days,_____nights
4. Type of accommodation establishment:
   □ Hotel □ B & B □ Rented House □ Caravan Park □ Own holiday house □ Camping □ Other_____

5. What are the main reasons for your coming to this area?
□ Villages, shops, etc. □ Rural landscapes/ □ Friends / family
   □ Festival □ Culture □ Business □ Southern tip of Africa
   □ Natural environment (including marine resources)/ □ Other_____

6. In terms of the **natural environment**, what activities is your group taking part in in the area?

   □ Beachwalk □ Angling □ Fynbos □ Whalewatching □ Cultural □ Birdwatching □ Diving
   □ Beach Driving (4x4) □ Sharks □ Mountain biking □ Other _____

7. How much of your reason for visiting this area would you ascribe to the **natural environment**?

   _____

8. How long is your entire trip away from home? _____

9. Could you estimate your group's transport costs within South Africa for the entire trip?
   Flights _____Car hire _____Petrol _____

10. (For foreigners) How important was the Agulhas Plain in your decision in coming to South Africa?_____%
    (For everyone) How important is the Agulhas Plain in your total trip within South Africa?/ _____%

11. Roughly how much do you think you will spend in total in the Agulhas Plain on this trip on the following:
Accommodation:_____ Restaurants/bars:_____ Transport/petrol _____
Groceries/ retail purchases: _____ Organised tours: _____ Other:_____

12. There are plans to establish a new National Park in the Agulhas Plain area, including the southernmost tip at Cape Agulhas plus scenic landscapes and important natural and cultural features. The area is considered important for protection because:
    - It contains unique vegetation types and 100 plant species that occur no where else in the world;
    - The area is also of cultural significance and contains important archaeological sites,
    - It is home to important breeding populations of endangered birds and animals.
    - The marine resources are heavily utilised and some species are known to be declining in abundance due to overfishing.

    The national park will include an information centre, accommodation, hiking/mountain biking trails etc. Are you in favour?
    □

    □ Yes □ No/*Nee* □ Don't know Why_____

13. How much more time would you have spent in this area if there were a national park to visit?_____
_____

14. What do you consider to be a reasonable price that you would be willing to pay to enter the park? R _____
    R _____

15. What is your occupation? _____

Appendix 4

SCIENTIFIC NAME	FYNBOS TYPE*	FAMILY	Fresh/ dry	Unit	Yield/ ha	Value/ ha
ACID SAND PROTEOID FYNBOS						
Proteaceae flowers/cones						
Leucospermum. cordifolium	A	Proteaceae	F	STEMS	11.32	3.40
Leucadendron gandogeri	A	Proteaceae	D	STEMS	1.30	0.18
Leucadendron laureolum	A	Proteaceae	D	STEMS	13.44	1.88
Leucadendron platyspermum	A	Proteaceae	D	STEMS	3.48	1.11
Leucadendron salicifolium	A	Proteaceae	F	STEMS	0.29	0.04
Leucadendron salicifolium	A	Proteaceae	D	STEMS	22.16	4.43
Leucadendron tinctum	A	Proteaceae	F	STEMS	1.22	0.12
Leucadendron tinctum	A	Proteaceae	D	STEMS	1.78	0.18
Leucadendron trunculatum	A	Proteaceae	F	STEMS	8.11	0.30
Leucadendron xanthoconus	A	Proteaceae	F	STEMS	3.57	0.36
Leucadendron xanthoconus	A	Proteaceae	D	STEMS	53.35	8.54
Protea compacta	A	Proteaceae	F	STEMS	70.52	21.15
Protea compacta	A	Proteaceae	D	STEMS	200.45	40.09
Protea cordata	A	Proteaceae	F	STEMS	3.04	0.30
Protea cordata	A	Proteaceae	D	STEMS	19.47	1.95
Protea longifolia	A	Proteaceae	F	STEMS	9.73	0.97
Protea longifolia	A	Proteaceae	D	STEMS	11.88	1.43
Protea neriifolia	A	Proteaceae	F	STEMS	2.43	0.73
Protea repens	A+E	Proteaceae	F	STEMS	12.56	3.14
Protea repens	A+E	Proteaceae	D	STEMS	19.30	3.47
Other fynbos products (primarily greens)						
Anthospermum aethiopicum	A+N	Rubiaceae	F	kg	0.41	0.31
Aulax umbellata (male)	A	Proteaceae	F	kg	0.05	0.04
Berzelia abrotanoides	A	Bruniaceae	F	kg	1.73	1.30
Berzelia lanuginosa	A	Bruniaceae	F	kg	5.40	4.05
Brunia laevis	A	Bruniaceae	F	STEMS	34.38	2.58
Brunia laevis	A	Bruniaceae	D	STEMS	48.36	6.77
Brunia laevis	A	Bruniaceae	F	kg	2.09	3.13
Brunia nodiflora	A	Bruniaceae	F	kg	0.37	0.27
Ceratocarym argenteum	A	Restionaceae	F	kg	0.04	0.03
Ceratocarym argenteum	A	Restionaceae	D	BUNCH	2.64	1.19
Edmondia sesamoides	A	Asteraceae	D	STEMS	97.35	0.61
Erica calycina	A	Ericaceae	F	kg	0.61	0.49
Erica campanularis	A	Ericaceae	F	kg	0.02	0.02
Erica coccinea	A+L	Ericaceae	F	kg	0.40	0.32
Erica coriifolia	A	Ericaceae	F	kg	0.18	0.15
Erica cubica	A	Ericaceae	F	kg	0.04	0.03
Erica filipendula	A	Ericaceae	F	kg	0.05	0.04
Erica hispidula	A	Ericaceae	F	kg	0.20	0.16
Erica imbricata	A+N	Ericaceae	F	kg	0.44	0.35
Erica parviflora	A	Ericaceae	F	STEMS	0.05	0.04
Erica perspicua	A	Ericaceae	F	STEMS	0.16	0.13
Erica plukenetii	A+L	Ericaceae	F	kg	2.46	1.97
Erica sessiliflora	A	Ericaceae	F	kg	0.20	0.16
Erica sitiens	A	Ericaceae	F	kg	0.06	0.05
Erica sp1	A	Ericaceae	F	kg	0.08	0.06
Erica sp2	A	Ericaceae	F	kg	0.24	0.19

SCIENTIFIC NAME	FYNBOS TYPE*	FAMILY	Fresh/ dry	Unit	Yield/ ha	Value/ ha
Erica sp3	A	Ericaceae	F	kg	0.06	0.05
Leucadendron gandogeri	A	Proteaceae	F	kg	0.32	0.24
Leucadendron platyspermum	A	Proteaceae	F	kg	0.23	0.17
Leucadendron salicifolium	A	Proteaceae	F	kg	0.28	0.21
Leucadendron salicifolium	A	Proteaceae	D	cones kg	0.30	0.13
Leucadendron tinctum	A	Proteaceae	D	cones kg	0.12	0.05
Leucadendron trunculatum	A	Proteaceae	F	kg	2.45	1.84
Leucadendron xanthoconus	A	Proteaceae	F	kg	2.15	1.61
Leucadendron xanthoconus	A	Proteaceae	D	cones kg	0.83	0.41
Mimetes hirtus	A	Proteaceae	F	kg	0.02	0.02
Metalasia muricata	A+NS+D+E	Asteraceae	F	kg	2.49	2.24
Metalasia muricata	A+NS+D+E	Asteraceae	D	kg	0.12	0.09
Nebelia paleacea	A	Bruniaceae	F	kg	0.11	0.09
Protea cynaroides	A	Proteaceae	D	kg	6.08	5.78
Protea longifolia	A	Proteaceae	F	kg	0.01	0.01
Phaenocoma prolifera	A	Asteraceae	F	STEMS	3.04	0.10
Phaenocoma prolifera	A	Asteraceae	D	STEMS	0.97	0.02
Phaenocoma prolifera	A	Asteraceae	F	kg	0.62	0.46
Retzia capensis	A	Retziaceae	F	STEMS	0.53	0.11
Selago spuria	A	Selaginaceae	F	kg	0.00	0.00
Staavia radiata	A	Bruniaceae	D	STEMS	50.70	1.19
Staavia radiata	A	Bruniaceae	F	kg	1.18	0.88
Stoebe plumosa	A+N	Asteraceae	F	kg	1.41	1.06
Syncarpha vesita	A	Asteraceae	D	STEMS	243.33	3.65
Syncarpha vestita	A	Asteraceae	D	kg heads	0.05	1.10
Unknown restio	A	Restionaceae	D	BUNCH	4.06	1.83
ELIM ASTERACEOUS FYNBOS						
Proteaceae flowers/cones						
Leucadendron laxum	E	Proteaceae	F	STEMS	4.42	0.17
Protea repens	A+E	Proteaceae	F	STEMS	12.56	3.14
Protea repens	A+E	Proteaceae	D	STEMS	19.30	3.47
Other fynbos products (primarily greens)						
Leucadendron laxum	E	Proteaceae	F	kg	8.96	6.72
Leucadendron teretifolium	E	Proteaceae	D	kg	87.21	12.21
Metalasia muricata	A+NS+D+E	Asteraceae	F	kg	2.49	2.24
Metalasia muricata	A+NS+D+E	Asteraceae	D	kg	0.12	0.09
Phylica ericoides	D+E	Rhamnaceae	F	kg	8.60	6.45
Phylica ericoides	D+E	Rhamnaceae	D	STEMS	7.06	0.26
RESTIOID FYNBOS						
Other fynbos products (greens & thatching reed)						
Athanasia crithmifolia	R	Asteraceae	F	STEMS	0.46	0.02
Chondropetalum tectorum	R	Restionaceae	D	BUNCH	29.66	14.83
Chondropetalum tectorum	R	Restionaceae	D	kg	3.19	3.59
Leucadendron linifolium	R	Proteaceae	F	kg	15.11	11.33
Leucadendron linifolium	R	Proteaceae	F	STEMS	12.32	0.46
Leucadendron linifolium	R	Proteaceae	D	STEMS	5.70	0.80
Thamnochortus insignis	R	Restionaceae	F	BUNCH	22.82	19.39

SCIENTIFIC NAME	FYNBOS TYPE*	FAMILY	Fresh/ dry	Unit	Yield/ ha	Value/ ha
LIMESTONE PROTEOID FYNBOS						
Proteaceae flowers/cones						
Leucadendron muirii	L	Proteaceae	D	STEMS	13.23	1.85
Leucospermum patersonii	L	Proteaceae	F	STEMS	125.50	37.65
Protea obtusifolia	L	Proteaceae	F	STEMS	27.57	5.51
Protea obtusifolia	L	Proteaceae	D	STEMS	213.82	21.38
Other fynbos products (primarily greens)						
Erica coccinea	A+L	Ericaceae	F	kg	0.40	0.32
Erica plukenetii	A+L	Ericaceae	F	kg	2.46	1.97
Leucadendron meridianum	L	Proteaceae	D	Cones kg	1.76	0.79
Leucadendron muirii	L	Proteaceae	F	kg	7.72	5.79
Syncarpha argyropsys	N+L	Asteraceae	D	STEMS	8.69	0.09
NEUTRAL SAND PROTEOID FYNBOS						
Proteaceae flowers/cones						
Leucadendron coniferum	N	Proteaceae	D	STEMS	180.31	25.24
Leucadendron coniferum	N	Proteaceae	F	STEMS	11.86	1.19
Protea susannae	N	Proteaceae	D	STEMS	185.63	18.56
Other fynbos products (primarily greens)						
Agathosma cerefolium	N	Rutaceae	F	kg	4.81	3.61
Anthospermum aethiopicum	A+N	Rubiaceae	F	kg	0.41	0.31
Athanasia trifurcata	N	Asteraceae	F	kg	0.02	0.02
Erica imbricata	A+N	Ericaceae	F	kg	0.44	0.35
Erica irregularis	N	Ericaceae	F	kg	3.00	2.40
Erica lineata	N	Ericaceae	F	kg	3.40	2.72
Helichrysum crispum	D+N	Asteraceae	F	STEMS	53.79	2.02
Leucadendron coniferum	N	Proteaceae	D	cones kg	1.41	0.85
Leucadendron coniferum	N	Proteaceae	F	kg	4.10	2.05
Metalasia muricata	A+NS+D+E	Asteraceae	F	kg	2.49	2.24
Metalasia muricata	A+NS+D+E	Asteraceae	D	kg	0.12	0.09
Otholobium frutescens	N	Fabaceae	F	kg	0.07	0.05
Phylica lasciocarpa	N	Rhamnaceae	F	kg	0.43	0.32
Stoebe plumosa	A+N	Asteraceae	F	kg	1.41	1.06
Syncarpha argyropsys	N+L	Asteraceae	D	STEMS	8.69	0.09
DUNE ASTERACEOUS FYNBOS						
Other fynbos products (primarily greens)						
Diosma subulata	D	Rutaceae	F	kg	0.28	0.21
Passerina vulgaris	D	Thymeleaceae	F	kg	0.16	0.12
Phylica ericoides	D+E	Rhamnaceae	F	kg	8.60	6.45
Phylica ericoides	D+E	Rhamnaceae	D	STEMS	7.06	0.26
Helichrysum crispum	D+N	Asteraceae	F	STEMS	53.79	2.02
Metalasia muricata	A+NS+D+E	Asteraceae	F	kg	2.49	2.24
Metalasia muricata	A+NS+D+E	Asteraceae	D	kg	0.12	0.09

Appendix 5

SAPPEX **GUIDING PRINCIPLES FOR THE FYNBOS INDUSTRY**

INTRODUCTION

At the request of the Department of Agriculture and in collaboration with the South African Agricultural Union (SAAU) and Cape Nature Conservation (CNC), a summary of the South African Protea Producers and Exporter's (SAPPEX) policy viewpoints is made in this document. Underlying the policy action of SAPPEX is its objective within the framework of the reason for SAPPEX's existence, its mission, strategy, vision and objectives, (set out below) to protect and improve the profitability of the Fynbos Industry.

BACKGROUND

Although interlinked, the approach for the dried flower industry and the fresh flower industry is widely divergent.

The fresh flower industry relies on cultivar development and therefore orchard type cultivation is encouraged. The standard and quality of veld-grown proteas is in most instances not good enough for export. Most greens are currently still harvested from the veld, but the aim is to phase this out in favour of cultivation as and when technology transfer from the Agricultural Research Council(ARC) makes it possible to cultivate "greens".

The dried flower industry is heavily dependent on harvesting in the veld, although a number of farmers are broadcast sowing various species. While farmers are encouraged to bring popular items into cultivation, the cost is high. Farmer prices within the dried flower industry are lower than that for fresh flowers, and will remain so within the context of worldwide dried flower production and sales. With proper guidelines for veld management and optimum utilization on a sustainable basis, we anticipate that veld harvesting will remain the cornerstone of the dried flower industry.

SAPPEX

The Association is a non-profit organization which aims to represent all South African producers and exporters of Proteaceae and other floral materials originating from the South African indigenous flora, and to further their interests, as set out in its Constitution. SAPPEX is an organization which enjoys the support and active participation of the overwhelming majority of Fynbos farmers and is recognized by the government of the day as well as other sectors and interest groups as being representative and legitimate.

MISSION

To negotiate by means of collective action on national level the best possible economic position for the commercial Fynbos farmer in South African economy.

STRATEGY

To exploit the advantage of collective action on a national level on behalf of the Fynbos Industry. SAPPEX is not a marketing organization and deals mainly with policy and other matters regarding the industry. SAPPEX acts as a coordinating mouthpiece on common issues. SAPPEX respects democratic principles in the decision making process within the Association. SAPPEX has individual farmers and others involved in the Industry as its members, and focus in all actions remains to place the interest of the Industry first.

VISION

Our vision is to ensure that an economically stable and financially sound commercial protea and fynbos industry exists locally in harmony with the environment and that the industry contributes on a national basis towards balanced economic growth and prosperity of the broader community and is recognized on the overseas market as an important role player in the supply of quality products.

OBJECTIVES

To influence and contribute towards policy for the Industry in collaboration with other role-players on matters which have an influence on the Industry.

To disseminate information on all aspects of the Protea and Fynbos Industry to its members by means of the quarterly Journal, Farmers Days and open meetings. This information includes:

- Environmental Conservation
- Fire management
- Cultivar establishment
- Optimum veld harvesting techniques
- Plantation management
- Eradication of Alien plants
- Export regulations Packaging
- Industry levy

ECONOMIC POLICY

It is important that price formation in the economy will be characterized by the operation of market forces, the maximum degree of private initiative and the minimum degree of direct government intervention in economic activities and /or regulatory aspects which influence production or the market. The state has a function in respect of the provision of essential services and social development.

ENVIRONMENTAL POLICY

It is aim of SAPPEX to work closely with the Cape Nature Conservation Department and other conservation agencies, and their counterparts in other provinces where applicable. Whereas the fynbos farmer has the right to utilize the natural resource in a sustainable way, he also has the obligation to play the role of caretaker of our unique floral asset. It therefore remains the responsibility of all fynbos farmers to protect and maintain the diversity of the fynbos vegetation and the stability of our water catchment areas, not only for the benefit of the present generation, but also for those to come. Therefore the conservation, protection and improvement of the natural resource must be the Fynbos farmer's objective. In order to achieve this, it is recommended that Fynbos farmers:

1. Preferably use previously cultivated land for establishing orchard type protea plantations, and where application is made to plough virgin soil, that they be obliged to consult closely with and be guided by the recommendations of the Department of Agriculture and Nature Conservation authorities.

2. Do not cultivate untested alien plants which might become invasive.

3. Co-operate with the authorities and such committees as may be in place or created, for strategic fire management planning, and that no picking should take place in the year prior to a planned burn.

4. Undertake to eradicate alien infestation where possible, and support biological control of alien invasive plants.

5. Continually monitor and record information on genetic contamination and report findings to SAPPEX for relaying to relevant botanical scientists.

6. Work towards biological control and Integrated Pest Control instead of chemical control in orchard plantations.

DISASTER AID

A disaster is defined as a totally uncontrollable and catastrophic occurrence accompanied by substantial loss which seriously threatens the survival and future of a significant sector of the particular community. While the farmer himself must make provision by means of judicious planning and insurance, there may from time to time occur severe disaster conditions in certain areas. The State remains committed to provide the necessary disaster and/or emergency aid in cases where such disasters occur - especially where communities are threatened – in order to stabilize and/or bridge the situation. The provision of aid to farmers during identified disaster and/or emergency situations in accordance with recognized norms is justified and essential. Such aid is considered as temporary support and is not intended as full compensation for all financial losses resulting from the disaster and/or emergency situation. All applications in this regard are to be evaluated by SAPPEX and presented to SAAU for submission to the Government.

Appendix 6

FYNBOS ECOLOGY FOR WILDFLOWER HARVESTERS

"As a user of fynbos, you need to know as much as possible about its ecology"

Wildflower picking is not based on a whim but on scientific understanding

Prepared by: Penny Mustart and Richard Cowling
Botany Department, University of Cape Town

CONTENTS

1. RESEARCH ECOLOGISTS NEED HELP FROM FYNBOS HARVESTERS!

"Your feedback is needed"

The pamphlet outlines information obtained from research efforts that can be of use to fynbos farmers and harvesters. It also appeals for feedback from farmers and fynbos harvesters.

Fynbos is a complex vegetation. You most probably know that it has exceptionally high numbers of plant species in it. The species in any one area are different from those in both nearby and more distant areas. In addition, in any one area there are the large, main plants(proteas, leucadendrons (tolbosse) etc.) forming an over-storey above the smaller, under-storey plants (phylicas, metalasias (blombos)etc). These different kinds of plants have different ways of producing and storing seed. Thus, you can see that in order to understand how all the plants growing in an area will respond to harvesting, is also complex. Research is usually performed on a few species at a time, and it can be difficult to apply this information to fynbos in general.

As a user of fynbos, you would want to know as much as possible about its ecology – especially about how fynbos plants produce and store seed, and how they respond to fire. This would help you to establish your own particular harvesting and fire- management guidelines that would ensure the long-term maintenance of your commercial assets. Please remember that whilst research ecologists can provide you with much basic knowledge, you are the ones applying it, and observing the results. Your feed-back is needed. For example, you need to tell the research community when you find that picking kills a plant, or if a harvested species disappears from the veld after fire.

2. BASIC FYNBOS ECOLOGY

" As a user of fynbos, you need to know as much as possible about its ecology"

2.1 Plant stages after fire

Fire is a natural event in fynbos, and is often needed to regenerate the veld. After fire you will notice a succession of different plants in the veld over the years.

After it has rained, the first regrowth is seen in the plants that are not killed by fire. These resprouters are usually fine-leaved shrubs, restios and grasses that regrow from fire-resistant stem bases. Only a few Proteaceae – including harvested plants such as Protea cynaroides (giants) and Leucadendron salignum (geelbos) – are resprouters. Plants with underground bulbs or root stocks (such as fire lilies, watsonias), as well as annual plants growing from soil-stored seed (some everlastings, grasses etc) are also seen in the first season after fire. During the cool, wet winter months the low soil temperatures are favourable for the germination of seeds of the plants that are killed by fire (many proteas, ericas, phylicas etc) After a few years these re-seeders will grow to be the most conspicuous plants in the vegetation. In most old fynbos (>30 years since the last fire) the main plants are usually large, woody Proteaceae.

2.2 Different ways that plants store seed

Many economically valuable plants are unable to resprout and rely entirely on their seeds to replace themselves after fire. It is useful to have some knowledge of their seed production and storage patterns in order to understand how harvesting will impact their seed numbers, in turn

affecting how the veld recovers after fire. There are two main ways in which fynbos plants store their seed:

a) Seed held by the plant (serotiny)

Serotinous plants retain each year's seed crop in woody cones (leucadendrons, aulax) or old, woody flowerheads (proteas) and thus build up seed stores on their canopies (i.e. the above-ground plant parts). After fire the seeds are released and fall on the ground. Many germinate after the winter rains. The latest season's seed crop often contributes significantly (20% - 80%) to the size of the seed bank. Seed stored from previous years' production (up to 2-5 years) are often extensively eaten by insects. **Harvesting of flowers and cones will obviously reduce the numbers of seed, but since you can actually see the remaining old seed heads on the plant, you can get some idea of the effect your harvesting regime has had on seed stores.**

b) Seed stored in the soil

Most fynbos plants, including the widely harvested "greens", such as Metalasia muricata (blombos) and phylica, accumulate seed banks in the soil. At the end of each season the mature seed are dropped and become buried either by ants, or simply by wind-blown soil.

Recent research on plants with seed stored in the soil has shown that the size of the seed crop varies each year. In some years plants product lots of seed, in others few. Not all species have bumper crops in the same year. The reasons for this are not known. Similarly the amount of viable seed (i.e. seed that are able to germinate) in a crop varies each year. Seed bank sizes are generally small. Large stores do not build up as many seed are eaten by insects before being buried, and some decay. The size of the seed banks is related to the latest season's crop. This means that harvesting will obviously directly reduce the size of the soil seed stores. **Since soil-stored seed are invisible, you cannot gauge the impact of your harvesting on these reserves**.

3. FYNBOS AND NUTRIENTS

"Despite low nutrient levels in the soil, Proteaceae seeds have concentrated nutrients"

Fynbos grows on soils with low nutrient levels. Despite this, the seed of Proteaceae have highly concentrated amounts of nitrogen and phosphorus. **Seeds of the proteas can be quite large, and plants often produce thousands of seeds. Therefore excessive removal of flowers or cones containing seed could lead to significant losses of these nutrients to the overall area.** Estimates of nitrogen and phosphorus losses due to flower (containing immature seeds) harvesting in Protea compacta and P.obtusfolia showed that nutrient losses were negligible in relation to the size of the soil nutrient pools. However, the nutrient drain as a result of extensive cone (containing mature seeds) harvesting of Leucadendron spp. is not known, and needs investigation.

4. FYNBOS AND FIRE

"A knowledge of how fynbos reacts to fire is invaluable for wise burning management"

Fynbos has been subjected to natural and man-made fire for thousands of years, and the plants are adapted to survive it. However, the time of year, and the frequency with which fire occurs, can have major consequences on how the veld recovers.

4.1 When to burn:

A wise policy is to burn in late summer/early autumn (February – April) when the latest seed crop has ripened. This timing also ensures that there is a short period between the fire and the following winter period when the seeds germinate. This reduces the time for the seed released from cones and old flowerheads to be blown away, destroyed by heat, or eaten by small mammals. Spring burning results in the opposite happening. During the long period that seeds lie on the soil surface there is massive loss of seed numbers.

However, there is still much more to be learnt about the consequences of different season of burning for fynbos regeneration. Contrary to expectation, a fire in late summer/autumn in mature vegetation (e.g. 15 years since the last fire), will occasionally result in re-seeding Proteaceae not appearing again after the fire. Conversely, a spring fire will do the reverse and good seedling regeneration will occur! There is also preliminary evidence showing that some small-seed species, such as Metalasia muricata (blombos), produce many more seedlings after autumn/winter than after late summer burns. It is thought that hot, summer fires destroy their shallow soil-stored seed banks. There are no firm explanations for any of these patterns, and, once again more research is needed for full understanding of why this should be so.

Do you have records of any of the above happening in your veld? Do you have any knowledge of the preceeding fire conditions (season and intensity) and vegetation age? Your information would be useful.

4.2 How often to burn:

After a fire, fynbos plants need a time period of some years to grow to maturity and produce good crops of flowers and seed. If you burn too often (e.g. every six years of less) re-seeding species (most proteas, leucadendrons and ericas) which take longer that that time to mature, will disappear from the veld. If there are no seeds, there will be no plants, unless seeds are blown in from neighbouring areas. If burnt too often, the only plants left will be those that resprout after fire, annuals and other short-lived plants. For example, if you burn every three to six years, you will change protea-veld to restio- or everlasting –veld. This is fine if that is what you want, but it is not good idea if your economically valuable proteas are eliminated. Bush-cutting will achieve the same thing, since what this effectively does is to remove all the seeds. Any seeds that fall on the ground (or exist in soil banks) during the process will not germinate, since germination occurs mainly on soils cleared by fire.

On the other hand, waiting very long between fires is also not wise since the plants in old (> 30 years) fynbos produce few seeds. In general, burning every 15 – 20 years is recommended for fynbos growing in areas of moderate rainfall. However, fynbos plants growing in drier areas grow more slowly, and here longer periods between fires would be more appropriate.

4.3 Germination after fire

During the winter after fire, there is large-scale germination in the fire-cleared soil. This is due not only to the soil being wet, but also to the suitable temperature conditions. Research has shown that the alternating soil temperatures occurring in the post-fire winter months – approximately 20°C in the day, and 10°C at night – stimulate maximum germination of seed of serotinous plants, as well as seed from plants with soil stored seed. Between fires, the vegetation growth insulates the soil, and temperatures are not suitable for germination. This is why you do not usually get germination between fires.

5. WHAT CAN THE HARVESTER CONTROL?

" The harvester can control harvesting levels, and, to a certain extent, the fire regime"

5.1 Pruning and harvesting levels

Correct pruning techniques are needed to ensure adequate vegetative (i.e. stem and leaf) and reproductive (flower and seed) growth. A pamphlet giving instructions for harvesting techniques of Proteaceae is available (The pruning of proteas for cut flower production by G.J. Brits, G Jacobs and J.C Steenkamp. flowers and Ornamental Shrubs B.15/1986, printed and published by the Department of Agriculture and Water Supply, Pretoria). Proteaceae such as Leucospermun cuneiforme (goldie) and Protea cynaroides (giants) that have lignotubers (a thickened tem-base which readily resprouts new shoots) respond well to pruning.

Plants without lignotubers are more easily harmed by pruning since their woody stems do not easily resprout. For example, harvested areas of Brunia albiflora (albigreen), a serotinous re-seeder showed much higher plant mortality and 70% less seed production than in unharvested areas. Studies on Protea susannae, P.obtusifolia,, Leucadendron coniferum (sabulosum) and L.meridianum, showed that removal of 70% of the flowers, or the latest cone crop, reduced the following seasons flower or cone production since they do not regrow below the point where stems are cut off.

Experimental harvesting on two re-seeding shrubs with soil-stored seed banks: Phylica ericoides and Passerina paleacea(gonna) showed that they died if more than 75% of the flowers were harvested. Removal of only 50%, or less, of the flowers did not harm plants and led to adequate flowering in the season after harvesting.

Since research does not know the answer to the question: "How many seeds are needed to replace populations of plants after a fire?", it is difficult to know precisely how much, and how often, you can safely harvest. It obviously depends on other factors affecting the level of regeneration after fire. These factors would vary according to climate or the nature of the fire. A very, hot dry summer would lead to many seedling deaths. An unplanned spring burn would result in poor post-fire replacement of plants, as discussed above. Although there is much still to be learnt, we do know that **continued over-harvesting** will deplete seed banks. This will ultimately cause the disappearance of plants from the veld. Thus it makes good sense not to over-harvest and over-deplete the seed reserves. Leucadendron coniferum (sabulosum) which is heavily harvested in the Agulhas Plain, has been found to have low post-fire seedling numbers. It would be wise to moderate harvesting levels (see recommended harvesting levels). Alternatively seed released from picked, dried cones can be returned to the veld after a fire.

Can you report instances where harvested plants have vanished from the veld after a fire? Did this happen when harvesting levels had been high? What kind of burn had it been (season, intensity) and how old was the veld (i.e. how long since the last fire)?

5.2 Suggested harvesting levels

It is obvious that there can be no recommended harvesting level applicable to all fynbos species. Each species needs to be harvested according to its own seed production and storage patterns.

For serotinous Proteaceae it is suggested that not more that 50% of the blooms of current year cones are picked each year, or on alternate years (to allow vegetative recovery), with **no picking before a planned burn**.

Similarly, 50% harvesting levels with **no picking before a planned burn**, is also suggested for Phylica ericoides, and other species with soil-stored seed banks.

5.3 Fire management

The ecological basis for fire management has already been discussed. Perhaps what is important to you in deciding how and when to burn are safety factors, as much as any season or frequency of burn considerations (see fire ecology). However, if you choose to burn when the chance of a wild-fire burning your homestead or your neighbour's veld is low (e.g. during winter), you need to consider the biological consequences of such fires on your harvestable assets. Spring burning, or too frequent burning, for example, could eliminate your harvesting assets.