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

Barry J. Heydenrych, Richard M. Cowling and Amanda T. Lombard

Abstract In terms of the persistence of biodiversity, the siting of conservation areas has traditionally been *ad hoc*. In the Cape Floristic Region, a hot-spot of plant biodiversity and endemism, past conservation interventions have led to the mountains being over-represented in the reserve network, while the lowlands have remained very poorly conserved. Ongoing threats to the lowlands such as the rampant spread of invasive alien plants, and land transformation for agriculture and resort development, continue to undermine biodiversity in these regions. A new conservation intervention, the Agulhas National Park, is in the process of being implemented on the coastal lowlands at Africa's southernmost tip. A flexible, reserve-selection design tool is being used to guide this process. The practical challenges in implementing a new protected area in a fragmented landscape, which has a high biodiversity and vulnerability, are examined. The role of different institutions, in particular state–private partnerships, and current investigations into conservation agencies' policies, legislation and funding mechanisms are dealt with. It is imperative that future conservation planning considers the threats to biodiversity first and foremost. Institutions such as South African National Parks and the Cape Nature Conservation Board must act strategically to avoid changes in land use that will compromise the biodiversity goals of retention and persistence. Conservation efforts will only succeed if institutional and socio-economic considerations are integrated with conservation plans aimed at ensuring the long-term persistence of biodiversity.

Keywords Agulhas Plain, biodiversity, Cape Floristic Region, conservation planning, fynbos, invasive alien plants.

Introduction

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).

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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 recognized as an area of outstanding floristic diversity and endemism (Takhtajan, 1986). With approximately 8600 plant species in only 90,000 sq km, levels of regional-scale diversity (1–100,000 sq km) are comparable with the richest tropical rain-forest 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 5850 species, 195 genera and seven families are endemic to the CFR (Goldblatt, 1978).

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 (Fig. 1; Cowling, 1992; Cowling & Richardson, 1995). Fynbos is also home to the vast majority of the CFR's approximately 1500 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).

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Most conservation interventions in the CFR have occurred in the mountainous landscapes of the Cape Folded Belt. These mountains, which comprise about 45 per cent of the CFR, are extremely rugged, have infertile soils and are almost entirely fynbos-clad (Cowling *et al.*, 1997). Their major economic value lies in the production of water for the fast-developing lowlands (Van Wilgen *et al.*, 1996; Higgins *et al.*, 1997). Approximately 55 per cent of the mountains are formally conserved. Based on data from the Proteaceae, Rebelo & Siegfried (1990) estimated that 93 per cent 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 per cent of mountain fynbos is invaded by alien pines *Pinus* spp., hakeas *Hakea* spp. and wattles *Acacia* spp. 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 have negative impacts on water production—cleared 221,000 ha of alien plants from mountain catchments in South Africa between October 1995 and February 1998 (Working for Water Programme, 1998). 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 per cent (in the west) and 35 per cent (in the east) of its former extent (Heijnis *et al.*, 1999; Kemper *et al.*, 1999), and only 1.5 per cent of the original area is conserved (Rebelo, 1992). Some 40 per cent of lowland fynbos has been transformed by agriculture (Rebelo, 1992), and of the remaining habitat, about 90 per cent (or 7600 sq km) is invaded to some degree by Australian wattles (*Acacia* spp.) (Richardson *et al.*, 1992). Moreover, only 4.5 per cent 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.

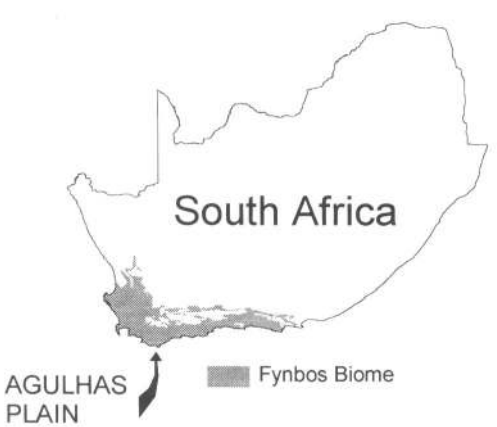

Fig. 1 Extent of the fynbos biome and position of the Agulhas Plain relative to the rest of South Africa.

Clearly, on the basis of their high conservation value (or irreplaceability) and high vulnerability, the CFR's lowland ecosystems 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 (Fig. 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 under private ownership and is used mainly for profitable commercial agriculture; 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). In this paper, we describe the framework for a strategic intervention for the conservation of terrestrial biodiversity on the Agulhas Plain. Given the complexities inherent in conservation interventions in areas such as this, we consider the biodiversity, institutional and socio-economic aspects of a strategy in an integrated way. It is essential to recognize that all these components are equally important and without any one of them, the conservation initiative will not be a success (e.g. Van Schaik & Kramer, 1997).

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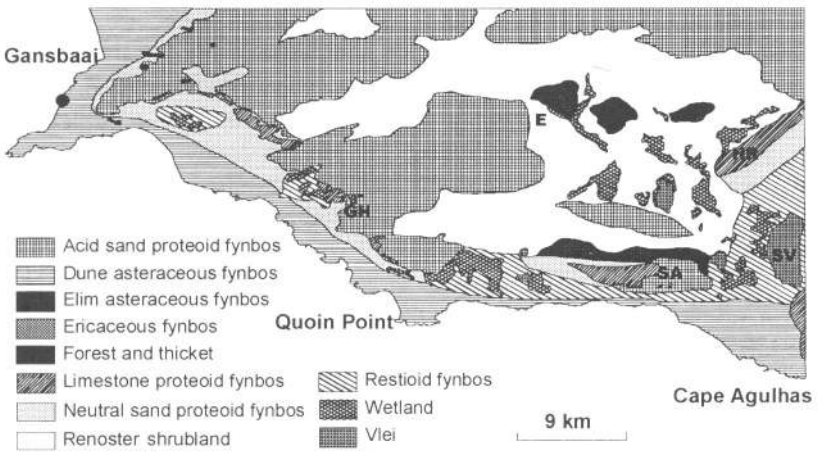

Fig. 2 Indigenous vegetation types, including wetlands and vleis (lakes and pans) on the Agulhas Plain. (SV, Soetendalsvlei; SA, Soetanysberg; HR, Heuningrug; E, Elim; GH, Groot Hagelkraal; after Lombard *et al.*, 1997).

Planning domain

Biodiversity

The planning domain for the conservation interventions described here is the western portion of the Agulhas Plain (Fig. 2). This area of 1540 sq km comprises an ancient weathered landscape broken by low (<800 m), 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 11 distinct vegetation units (Fig. 2; Lombard *et al.*, 1997), one of which is endemic, and 1751 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 specialized to grow on different edaphic surfaces (Cowling & Holmes, 1992).

The extraordinary terrestrial biodiversity of the region is complemented by a series of extremely species- and endemic-rich wetlands that are internationally recognized as habitats for unique amphibian and bird assemblages (Lombard *et al.*, 1997; Barnes, 1998). The wetlands to the west of the Soetendalsvlei (SV, Figs 2 and 3)—a low-lying area of clayey, impermeable soils that is 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.

Two major forces of transformation have changed the face of the Agulhas Plain over the past 200 years. Cultivation of the more fertile shale-derived soils (previously supporting renoster shrubland and Elim fynbos), for cereals and pastures has resulted in a loss of 34,693 ha (22.5 per cent) of the area (Lombard *et al.*, 1997; Fig. 3). Furthermore, invasive alien plants, mainly wattles from Australia, have invaded almost all of the Agulhas Plain to some extent (Plate 1). Approximately 17,470 ha (14.7 per cent) of the remnant natural habitat of the Agulhas Plain has been transformed by dense thickets of invasive alien plants (Lombard *et al.*, 1997; Fig. 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, some form of indigenous plant cover can be readily restored to most areas that 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 [Plate 2], 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.

Conservation planning

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 (Figs 2 and 3), an area of finely juxtaposed fynbos vegetation, high

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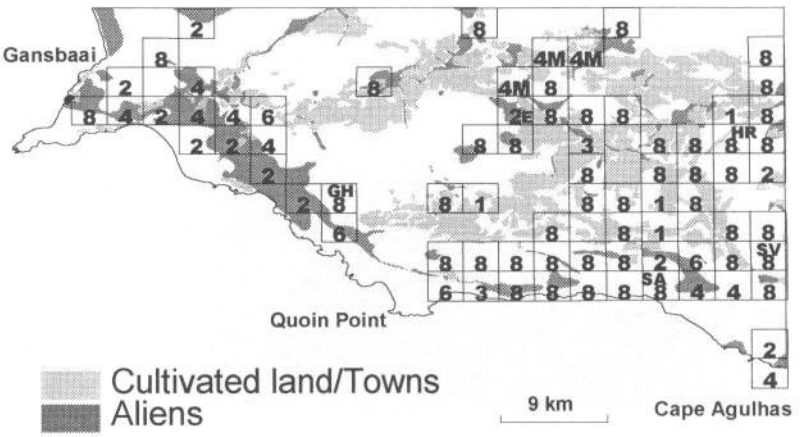

Fig. 3 Cultivated land (and towns) and alien vegetation (dense thickets) on the Agulhas Plain. Blocks represent 3 × 3 km cells selected by eight reserve selection algorithm variations, with the number of different variations selected indicated in each cell. Three mandatory cells selected to conserve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

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; Burgers *et al.*, 1987). However, in over 80 per cent 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—has been used to identify systems of conservation areas in the CFR. 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 & 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). At the same time, 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 select simultaneously different target areas of the 11 vegetation types on the plain (Fig. 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 × 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 per cent with aliens (owing to the high

Plate 1 *Acacia cyclops* (RHS back), a nitrogen-fixing, quick-growing, leguminous tree, was introduced to the Cape from Australia in the 1850s as a sand stabilizer. However, in the absence of its natural pests and pathogens, this plant rapidly spread, and is now responsible for the transformation of vast tracts of fynbos vegetation, including Elim fynbos, a vegetation type endemic to the Agulhas Plain that is home to many locally endemic plant species, such as the endangered *Leucadendron stelligerum* (Proteaceae) shown here (© *C. Paterson-Jones*).

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Plate 2 Strip cultivation of fynbos wildflowers, as can be seen in the species-rich Soetanysberg area of the Agulhas Plain, is a rapidly escalating threat to the region's biodiversity. Fynbos on agriculturally marginal soils is replaced with species not indigenous to the area and important ecological and evolutionary processes are disrupted (*B. J. Heydenrych*).

cost of clearing and loss of biodiversity), and other variations forced the inclusion of three mandatory cells (cells with the biggest contiguous area of renoster shrubland 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 (Fig. 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 north-east (Willis *et al.*, 1996); (ii) the Elim (E) area in the centre (Jarman, 1986; Rebelo 1992); (iii) Groot Hagelkraal (GH) in the south-west (Cowling, 1990); and (iv) the Soetanysberg (SA) hills and environs in the south-east (Jarman, 1986) (Figs 2 and 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 was 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 reserve-system 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 that 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 (Cape Action Plan for the

Table 1 Summary of major terrestrial conservation categories that are currently relevant to the Agulhas Plain, in the Western Cape Province. Much of the legislation pertinent to the Cape Nature Conservation Board is currently under review

Type of Protected Area	Legislation	Administration	Ownership	Finances for management*	Management 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 Cape Nature Conservation Board (CNCB)	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 CNCB	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)	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 and 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 CNCB	Landowners/farmers in co-operation with CNCB	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

* Denotes assistance from the state with respect to privately-owned land.
† A new Forests Act is in the process of replacing the current act.

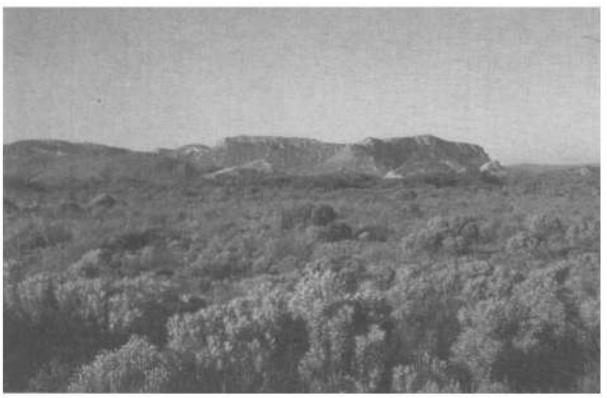

Plate 3 The 500-ha area of limestone hills at Hagelkraal on the Agulhas Plain is the exclusive home to four plant species and supports a further 21 species endemic to the Agulhas Plain (*B. J. Heydenrych*).

Environment) 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 5-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 (Jordan, 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 none the less incorporating the four core areas of Soetanysberg, Heuningrug, Elim and Hagelkraal (Plate 3). Nevertheless, off-reserve conservation will be required to ensure effective conservation of much biodiversity pattern and process of the Agulhas Plain. 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 section we describe the institutional, legal and policy framework for the implementation of a system of conservation areas for the Agulhas Plain.

The role of the state

South Africa has three tiers of government: national, provincial and local (Anon., 1996), and nature conservation responsibilities span all three of these levels. The major organizations 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 Cape Nature Conservation Board (CNCB; previously Cape Nature Conservation), 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 Government has shrunk steadily over the past 5 years and this pattern is likely to continue in the future (Kumleben *et al.*, 1998).

The categories of protected areas that are of relevance to the Agulhas Plain's terrestrial biodiversity are summarized in Table 1. There are three important implications for conservation interventions regarding these categories. First, although national legislation is applicable to many types of protected areas, most of the responsibility for implementation rests with the provincial authority, the Cape Nature Conservation Board (CNCB). Second, public–private partnerships are applicable to many conservation categories. Third, although there may be assistance from authorities in terms of management advice, there is not usually any direct financial assistance for management of privately owned conservation areas.

The role of SANP 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 CNCB. One possible strategic initiative would be the recognition, as part of the

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Agulhas National Park, of CNCB holdings that have IUCN Category II status (Kumleben *et al.*, 1998), and the development of equitable co-management relationships between CNCB 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 Working for Water Programme of the Department of Water Affairs and Forestry, and the Landcare project of the Department of Agriculture. Both projects aim to provide employment for the economically and socially marginalized sectors through ecological restoration works that will provide national economic benefits (Plate 4; 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 (Norman & Stadler, 1998). Because all Agulhas Plain towns derive their water supplies from groundwater sources, and unemployment and social deprivation are widespread in the region, SANP has been able to secure funds from the Working for Water Programme. Two such projects are currently under way, with an overall expenditure since early 1998 of £250,000 that has created almost 300 jobs and cleared approximately 2000 ha of invasive alien plants.

Plate 4 A team of 'ecological restoration workers', responsible for clearing invasive alien trees as part of the Norwegian-funded Elim Working for Water Project (*B. J. Heydenrych*).

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 (Anon., 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, because 97 per cent of the planning domain of the Agulhas National Park is in private ownership, a great deal of money is required for land purchases. Therefore, approximately £2.7 million is required for purchasing 12,000 ha, which would consolidate the major priorities for the effective conservation of the national park's biodiversity. Although SANP has established an internal development fund for land purchase over a 3-year period (Hall-Martin, 1997), the funds generated by this scheme will not be sufficient for consolidating all the important conservation areas.

The prospect of SANP incorporating sufficient land for the effective consolidation of the Agulhas National Park without the co-operation of both the private sector and other conservation agencies, is unrealistic. Indeed, the co-operation with CNCB is a prerequisite for the consolidation of conservation-worthy areas on the Agulhas Plain. There are two ways in which the private sector can invest in the establishment of a conservation system for the region: (i) by donating land for the system, with or without commercial opportunities; or (ii) under an agreement or contract whereby land is included in the system in exchange for various benefits (which are not necessarily financial). It is vitally important, however, that these kinds of relationships ensure equitable benefits to both parties. The experience so far in South Africa is that accrual of benefits favours the private sector (A. J. Hall-Martin, 1998, 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 CNCB (Table 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 only as an incentive for a land-improvement service (e.g. alien-plant control) or for economic opportunities (e.g. ecotourism).

Conservancies, implemented by CNCB in this region, encourage off-reserve conservation through co-opera-

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tive 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 (CNCB, pers. comm.). Ultimately, conservancies could play an important role as a buffer zone for the Agulhas National Park, as well as enabling the continuation of ecological and evolutionary processes that require tracts of natural habitat that extend beyond the boundaries of the national park (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 of the area (CNCB, pers. comm.).

Tourism in the CFR, which is essentially based on natural assets, is the region's fastest growing industry (Wesgro, 1998). There are many opportunities on the Agulhas Plain for state–private sector relationships in this 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). These opportunities are being co-ordinated on the Agulhas Plain by the Fynbos Ecotourism Forum, which aims to promote sustainable, fynbos-based tourism on private and communally-owned land (Overberg Conservation Services, 1997).

There is provision in the new 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 (Anon., 1998). The importance of such committees is highlighted by a group of landowners to the north of the Agulhas Plain, who managed to successfully negotiate for state funding (from the Department of Water Affairs and Forestry) for an alien-plant clearing project (K. Brooke-Sumner, pers. comm.).

Biosphere reserves, which serve to integrate humans and the biosphere through a zoning system of land uses (Batisse, 1982), 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), they are recognized by the United Nations Educational, Scientific, and Cultural Organization (UNESCO), which serves 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 recognized by the Provincial Government of the Western Cape (Provincial Administration Western Cape, 1998). The first biosphere reserve in South Africa was recently registered by CNCB for the Kogelberg area to the west of the Agulhas Plain (CNCB, 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.

Within the CFR, an area of global conservation significance, it is perhaps surprising that there are no World Heritage Sites. However, there are ongoing discussions in this regard and the identification of important areas that would qualify for World Heritage Site status is currently taking place.

Non-governmental organizations

Although there are a number of active NGOs on the Agulhas Plain, these have traditionally focused on social, agricultural and marine issues. In this area, there are relatively few conservation-related NGOs in comparison with the nearby Cape Town metropolis, where an activity such as the infilling of a wetland would cause a huge outcry from many organizations. 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 started to tackle activities such as environmental education (Bredasdorp/Napier Branch of the Botanical Society of SA; Pearly Beach Conservation Society), community-based 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 analyses

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. We deal briefly with each of these topics below.

Social deprivation

The Agulhas Plain is beset by seemingly intractable social problems. While the per capita income is reasonable by South African standards, unemployment stands at 52 per cent (MLH, 1994). About 60 per cent of the region's 45,000 inhabitants live in rural areas where health and educational services are rudimentary. Al-

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though 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 still prevalent (Prins, 1998).

Owing to the peculiar history of South Africa, deprivation is overwhelmingly and disproportionately concentrated among the region's previously disadvantaged 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 some 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, 1998).

Dwindling funds for conservation

As mentioned previously, the contribution by the South African state to conservation activities is decreasing every year. In 1996, only 0.28 per cent 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 through activities such as recreation, accommodation, game sales and other adjuncts to conservation exceed expenditure (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 forthcoming 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 are required to ensure that the continued management and expansion of the conservation system occurs (Hall-Martin, 1997; Working for Water Programme, 1998).

Effective valuation of the costs and benefits of biodiversity conservation

There has been little attempt to value the full complement of monetary and non-monetary costs and benefits of the goods and services provided by conservation areas in the CFR (Cowling & Richardson, 1995). Most work has focused on the impacts of alien-plant invasions on water production from fynbos-clad mountain catchments, where it has been shown that effective control is the most efficient way of ensuring sustainable water supplies (Van Wilgen *et al.*, 1996; Higgins *et al.*, 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.*, 1997). For example, it is estimated that the costs of the initial clearing of alien plants from the proposed Agulhas National Park will be about £3.8 million, a value 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 & Flora International 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 (cf Cowling *et al.*, 1998).

Little attention has focused on the benefits of biodiversity conservation on the Agulhas Plain and elsewhere in the CFR. As already stated, tourism is the CFR's fastest growing industry and in 1998 it comprised about 11 per cent 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 per cent of the aggregate spending of £770 million by tourists. Properly managed ecotourism 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 (B.J.H., 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 £300–500 million after the economic multipliers have been taken into account (Kumleben *et al.*, 1998). Similarly, the Addo Elephant National Park generates some £36 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.

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. Contingent valuation methods use questionnaire surveys to elicit people's willingness to pay for various items. 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 £3.4 million (B.J.H., unpublished data). Despite obvious shortcomings, this exercise nevertheless emphasizes 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 has 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 when 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, a relatively biologically depauperate area, in order to capitilize on the area's substantial tourist population. However, 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 way forward

As we head towards the end of the millennium, extinctions are at their highest levels ever and the patterns and processes underpinning biodiversity are being eroded on all sides. 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, where threats are escalating dramatically.

A better understanding of the spatial requirements to maintain key ecological and evolutionary processes is vital for the success of conservation interventions on the Agulhas Plain. In this respect, off-reserve management will be crucial, because 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 reserve 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, 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.

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 among 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.

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