The process of conserving biodiversity: From planning to evaluating conservation actions on private land in the Cape Lowlands, South Africa

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Thesis presented for the degree of

DOCTOR OF PHILOSOPHY

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13 February 2009

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Abstract

Conservation can be conceptualised as a process of linked phases that contribute to bringing about effective biodiversity protection: (i) a conservation assessment that identifies spatially explicit conservation priorities to provide strategic guidance on where best to invest conservation resources; (ii) a planning phase that takes the spatial priorities forward into implementation processes by setting out a strategy and schedule for undertaking conservation action; (iii) an implementation phase during which conservation interventions are executed; and (iv) an evaluation phase to investigate whether conservation has been successful. In practice, conservation is rarely conducted in this way. The interrelated phases are often undertaken separately, links are neglected, and conservation science to date has focused primarily on the conservation assessment. This has led to the development of highly sophisticated principles and techniques for locating priority conservation areas, but planning and evaluation have received limited research attention: few published studies demonstrate collaborative planning processes that assist with putting conservation assessments into practice, or show on-the-ground conservation success linked to effective conservation planning and implementation processes.

My PhD research aimed to address these knowledge gaps by conducting a conservation assessment and collaborative planning phase that would lead to effective conservation action as determined by an evaluation. The study area was in the critically endangered Cape Lowlands, a conservation priority area in the Cape Floristic Region, South Africa. The highly transformed agricultural production landscape is mostly privately owned; formal biodiversity protection is low; and remnants of natural vegetation (<9% is left) harbour an exceptionally diverse flora. Strategic conservation interventions coordinated across the Cape Floristic Region (CFR) provided the overall implementation context in the Cape Lowlands. My research was conducted in this real-world practical situation and addresses the whole conservation process, from assessment to evaluation of conservation actions.

I first developed a conservation assessment guided by three key questions: 'What are feasible, efficient, defensible and efficacious solutions for (i) deriving a surrogate layer that represents biodiversity in a region which is characterised by exceptional plant species richness and endemism ; and (ii) considering the connectivity of natural areas in an ecosystem that is highly transformed, fragmented and largely unprotected?'; and 'How can a selection method be developed for identifying and prioritising key biodiversity areas in a landscape identified as 100% irreplaceable?' To answer these questions I identified feasible, efficient, defensible methods focusing on three key aspects: (i) producing a biodiversity surrogate map of original vegetation cover using two alternative approaches: simple expert mapping and statistical modelling integrating plant species and environmental data; (ii) designing selection units based on vegetation connectivity in a simple technique to include spatial attributes of conservation areas before identifying key biodiversity areas; (iii) developing a prioritisation method based on a simple scoring system and verifying results with MARXAN-selected priority areas. In all

three cases I found that the simple conservation assessment methods produced suitable outputs for further integration in the assessment and in decision-making during planning. (i) The expert map was as effective as the vegetation model and required fewer resources to be produced since the model relied on resource-intensive species data collection. (ii) In comparison with commonly used cadastre-based units, connectivity-based selection units captured connected vegetation more effectively and area-efficiently in units that served as the basis for priority area selection. (iii) Scoring provided a feasible, defensible mechanism for prioritising key biodiversity areas in the Cape Lowlands where all remaining vegetation has been identified as 100% irreplaceable.

The planning phase complemented the assessment. Key guiding questions here were 'How can collaborative planning be used to translate the conservation assessment's technical outputs into time-based conservation goals and into useful products for implementation?' and 'What constitutes effective planning in the conservation process? Through a collaborative scheduling process, I developed time-based conservation goals for action in the Cape Lowlands. This was undertaken in two work sessions with scientists, planners and conservation practitioners from the implementing agency, CapeNature. Scheduling was guided by (i) scoring-derived biodiversity-driven spatial priorities that made intuitive sense to implementers; and (ii) conservation opportunities and constraints (including resources) identified by the practitioners. Scheduling was conducted with reference to the on-going development of a private land conservation strategy for the CFR to be piloted in the Cape Lowlands. The scheduling process was an effective platform for taking spatial priorities from the assessment towards implementation: the discourse-based collaborative planning was constructive and led to consensus-based final products, including a 20-year and 5-year conservation plan setting out spatially explicit goals for conservation interventions in the Cape Lowlands. The main limitation of the process was that resource planning was not integrated explicitly enough to identify realistic goals. This highlighted the importance of integrating detailed resource considerations in future planning.

Finally, to address the question 'To what extent has the Cape Lowlands conservation plan been implemented after five years of off-reserve conservation interventions in the region?' I developed a protocol for evaluating the effectiveness of conservation action in the Cape Lowlands. I assessed (i) the extent to which the goals conservation plans produced in the planning phase had been implemented; and (ii) the achievements of incentive-based conservation stewardship interventions on private land in the Cape Lowlands and CFR. Achievements were measured as hectares of vegetation protected through voluntary and legally-binding contractual conservation agreements between landowners and conservation organisations. The evaluation revealed that (i) CapeNature's stewardship interventions in the Cape Lowlands focused on priority areas identified in the 5- and 20-year conservation plans, thus demonstrating effective execution of the plans; (ii) private land conservation interventions have been remarkably successful and cost-effective: 68604ha priority vegetation were protected in the CFR under conservation agreements by end 2007, rivalling private land biodiversity conservation in the U.S.A. and Latin America, and more than 8000ha in the critically endangered Cape Lowlands at a cost of R 6.8

Million (<1 million US$). The evaluation identified the long-term financial sustainability of current implementation programmes as the most significant threat to future success in private land conservation interventions in the Cape Lowlands and CFR. There is significant scope to design future monitoring and evaluation systems to measure ecological gains due to specific conservation actions, not done in the Cape Lowlands study, and to tailor approaches to suit specific programme stages.

This PhD provides a rare overview of an entire conservation cycle with linked phases that has led to biodiversity protection. The study highlights that an effective long-term process demands significant investment in (i) a diverse (growing) set of skills and expertise to solve complex conservation situations; (ii) time, especially for visible implementation success; and (iii) well-allocated resources (money, time, skills, research attention) across all phases in the conservation process. This is necessary as each phase is needed to achieve the ultimate conservation goal: I show in the Cape Lowlands that a simple conservation assessment with limited funds (R1.8 million over 3 years) can be highly effective in guiding action towards priority areas. Important here is to develop rapid, defensible methods for cost-effective assessments and linking these with in-depth planning processes. Planning and evaluation in the Cape Lowlands were essential connecting phases that continue to support implementation success. In the context of on-going conservation action, planning and evaluation need to become part of a cyclical conservation process geared towards improved practices. I suggest that significantly greater investment in planning and evaluation research is essential to move conservation science forward in fulfilling its fundamental goal of strategically guiding where, when and how to invest optimally in conservation interventions. This will be exceptionally beneficial for undertaking effective conservation interventions and will help to clearly demonstrate the value of the research for conservation practice.

Acknowledgements

I thank my supervisor Mathieu Rouget and co-supervisor Richard Cowling who encouraged me to undertake the Cape Lowlands research for my doctoral studies. You walked the long road with me, which is what it took to see the first signs that the collective conservation work is bearing fruit. I appreciated the freedom of being able to explore all the different facets of the conservation process and to venture beyond the core of the science. Thank you for guidance in the bigger picture and in the detail. My sincere appreciation also goes to Timm Hoffman for generous support and for providing me with a research home at the University of Cape Town; and to Dave Richardson for putting your mind to some of the early phases involved in the conservation process. I also gratefully acknowledge the role that Kristal Maze played in my Cape Lowlands work. Thank you for inspiring me with your vision, for getting the ball rolling, and supporting me in the early forays.

There are many whose contributions to this wide-ranging body of research I recognise gratitude: Nick Helme for excellent field work, vegetation mapping and for the amazing find of several new plant species in the Cape Lowlands; Tony Rebelo for reviewing vegetation maps and managing their integration into the Vegetation Map of South Africa, Lesotho and Swaziland; Dean Fairbanks for sharing significant statistical expertise; all participants in the collaborative planning process who gave their massive support, and time and expertise; Mark Botha, Sue Winter and many others for their work in developing and piloting the conservation stewardship strategy. Wendy Paisley, Sandy Smuts and Mandy Sauls, I greatly appreciated your company and administrative support.

Thoughts and discussions shared with various colleagues in conservation science and practice were also exceptionally valuable to me. The insights I thus gained helped to shape the research for this thesis and my understanding of conservation processes. I thank especially James Jackelman, Anton Wolfaardt, Donovan Kirkwood, Sarah Frazee, Mandy Driver, Andrew Skowno, Sean Ranger, Nancy Job, Tracey Cumming, Mandy Barnett, Andrew Knight, Susie Brownlie, and Louis de Villiers.

My deep respect and thanks also go to those who, apart from contributing to the theory and planning, are dedicating their energy to making conservation happen on the ground: Inge Kotze and Joan Isham of the Biodiversity and Wine Initiative; and CapeNature staff, particularly Chris Martens and Kerry Purnell of the Conservation Stewardship Programme and the team of stewardship officers doing excellent work in negotiating and maintaining the conservation agreements. Thank you also to both programmes for providing information for evaluating off-reserve conservation achievements in the Cape Lowlands. Researching and most of all putting biodiversity conservation into practice rests on the valuable contribution of committed landowners. My sincere recognition goes to them for being open to the vision of protecting biodiversity and for having the enthusiasm to act on it.

For respecting my research and being there with the rest of life I am grateful to my family and my core of friends. Bruce Anderson, thank you for inspiring me with your infectious love for the natural world and for braving the spring-time muggies in patches of West Coast renosterveld. You taught me to look closer, which is essential not least for seeing the gems when stomping through renosterveld. Malcolm Gowans, thank you for always being there, for immense understanding and interest throughout this work, and for sharing the passion for nature from the cliffs to the waters, via the lowlands, and for knowing the importance of fire in the lives of fynbos plants and other beings.

I acknowledge the National Research Foundation for the grant of a Prestigious Doctoral Bursary; the Table Mountain Fund of the WWF-SA (supported by the Global Environmental Facility) for financial support to the Botanical Society for the first conservation assessment and planning components of the work; the Mazda Wildlife Fund for the loan of a serviced 4x4 vehicle to undertake the initial field surveys; the E.S.R.I. for their contribution of an ArcView and ArcGIS software grant; and the Society for Conservation GIS for the opportunity to participate in GIS training in the U.S.A.

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INTRODUCTION

Humans have changed the earth fundamentally to fulfil their needs and preferences (Western, 2001; Vitousek et al., 1997). This influence is affecting natural systems at every scale and in virtually all parts of the world: the climate is changing at a global scale; biological diversity is declining as a result of land transformation; and human-induced changes to ecological processes are compromising the delivery of ecosystem services that underpin the existence all living species and of humanity (Vitousek et al., 1997; Balmford and Bond, 2005; MEA, 2005). The resources to meet this complex global conservation challenge are as yet limited: the funding requirements far outstrip current allocations for conservation interventions (James et al, 1999) and the distribution of resources across the world is imbalanced (Halpern et al., 2007).

1. Conservation planning: theory and practice

In response to this critical situation, conservation biology was conceptualised as a field of research to provide "the principles and tools for preserving biological diversity" (Soulé, 1985). The sub-discipline of systematic conservation planning specifically addresses the question of how to prioritise areas, based on explicit criteria, to guide strategic conservation action so that biodiversity patterns and processes are adequately protected in situ and conservation resources are optimally spent (Margules and Pressey, 2000). This is not a trivial problem: the challenge is finding real-world solutions for where, when, and how best to protect biodiversity and natural systems in the long term. This depends on many different factors, including biological, political and economic factors (Virolainen et al., 1999) that play out in an environment where change and uncertainty is the rule rather than the exception (Pressey and Taffs, 2001).

Hence systematic conservation planning has developed into a large and rapidly evolving field of research. Operational models or consensus frameworks (Sarkar, 2004) have emerged that set out a generalised sequence of steps involved in systematic conservation planning (e.g. Margules and Pressey, 2000; Groves et al., 2002; Knight et al., 2006a). These frameworks tend to be simplistic representations of exceptionally complex real situations, but they provide a general context and guidelines for conservation planning research. The framework by Margules and Pressey (2000) for example outlines in a series of steps how to achieve the ultimate goal of effective on-the-ground conservation, from identifying priority areas to monitoring the outcomes of conservation actions. Knight et al. (2006a, b) build on this by clarifying the role of particular steps in the process, and by emphasising the network of links and feed-backs between different phases. The overview provided by these frameworks is important as conservation processes tend to be conducted piecemeal with separate effort being invested in the individual components (Fig. 1), including the conservation assessment; the planning phase and strategy development; the implementation of conservation interventions (or management, Knight et al., 2006a); and evaluation (Salafsky et al., 2001, 2002).

Despite the overview from conservation planning to practice that these operational frameworks present, conservation planning research to date has focused primarily on biodiversity-driven systematic conservation assessments (Knight et al., 2006a). Much of this research effort has been invested in developing a variety of highly sophisticated mathematical solutions and computer-based techniques for selecting and designing conservation area networks (see Possingham et al., 2000; Pressey, 2002; Williams et al., 2005). Here conservation science has made significant advances (Justus and Sarkar, 2002). The research has also been concerned with (i) refining surrogate measures for representing biodiversity in the assessment (Ferrier, 2002); (ii) modelling future threats to natural systems (Rouget et al., 2003c); (iii) quantifying spatial attributes such as connectivity that may contribute to biodiversity persistence (Briers, 2002); (iv) spatially representing ecological and evolutionary processes and ecosystem services (Rouget et al., 2003a); and (v) developing procedures for integrating cost measures in conservation area selection (Naidoo et al., 2006; Wilson et al., 2006).

2. From theory to practice: where are the gaps?

However "there is a world of difference between the selection process [..] and making things happen on the ground" (Margules and Pressey, 2000), and while systematic conservation assessments aim to guide decision-making on where conservation interventions should take place, they do not set out how the actions need to be undertaken (Scott and Csuti, 1997). The large research focus on systematic conservation assessment techniques has therefore led to concerns of an 'implementation crisis' (Knight and Cowling 2003). Certainly the understanding amongst researchers of advanced techniques for reserve selection and design tends to be far better than the ability to use these tools in effectively solving pragmatic conservation problems (Knight et al., 2006a). The perceived gap between the theory and practice of conservation is also reflected in that few conservation assessments, at least those in the peer-reviewed literature, have been implemented (Prendergast et al., 1999; Newburn et al., 2005).

This highlights two challenges for conservation research in areas that have received far too little attention in conservation science thus far: planning and evaluation (Fig. 1).

(i) The first challenge is effectively linking the conservation assessment, which produces a theoretical design for a conservation area network, with those activities that need to put the design into practice. Until recently this aspect of systematic conservation planning has been rarely reported in the primary literature (Knight et al., 2006a, b; but see Davis et al., 1999). Much more is needed to achieve effective conservation than a technically and scientifically sound conservation assessment. Moving towards action means complementing the assessment with in-depth planning, to tackle complex issues on the interface between science and practice and make decisions on how to undertake conservation interventions (Knight et al., 2006a, b). This requires collaboration between groups of people, e.g. biologists and managers, who often work in isolation from each other (Balmford and Cowling, 2006).

(ii) The second challenge is investigating whether and how conservation success is taking shape (Balmford and Cowling, 2006; Ferraro and Pattanayak, 2006), especially achievements resulting from effective systematic conservation planning. Very few published studies demonstrate conservation science being used “to optimize the return on conservation investments and to guide conservation actions to places that would most efficiently conserve biodiversity” or that show how research has helped managers “make smarter decisions about how to maximize conservation gains with limited resources” (Higgins et al., 2006). This means that the value of conservation science is easily questioned (e.g. Cleary, 2006, w.r.t. tropical areas) until researchers demonstrate in real-world situations that the science is benefiting conservation practice.

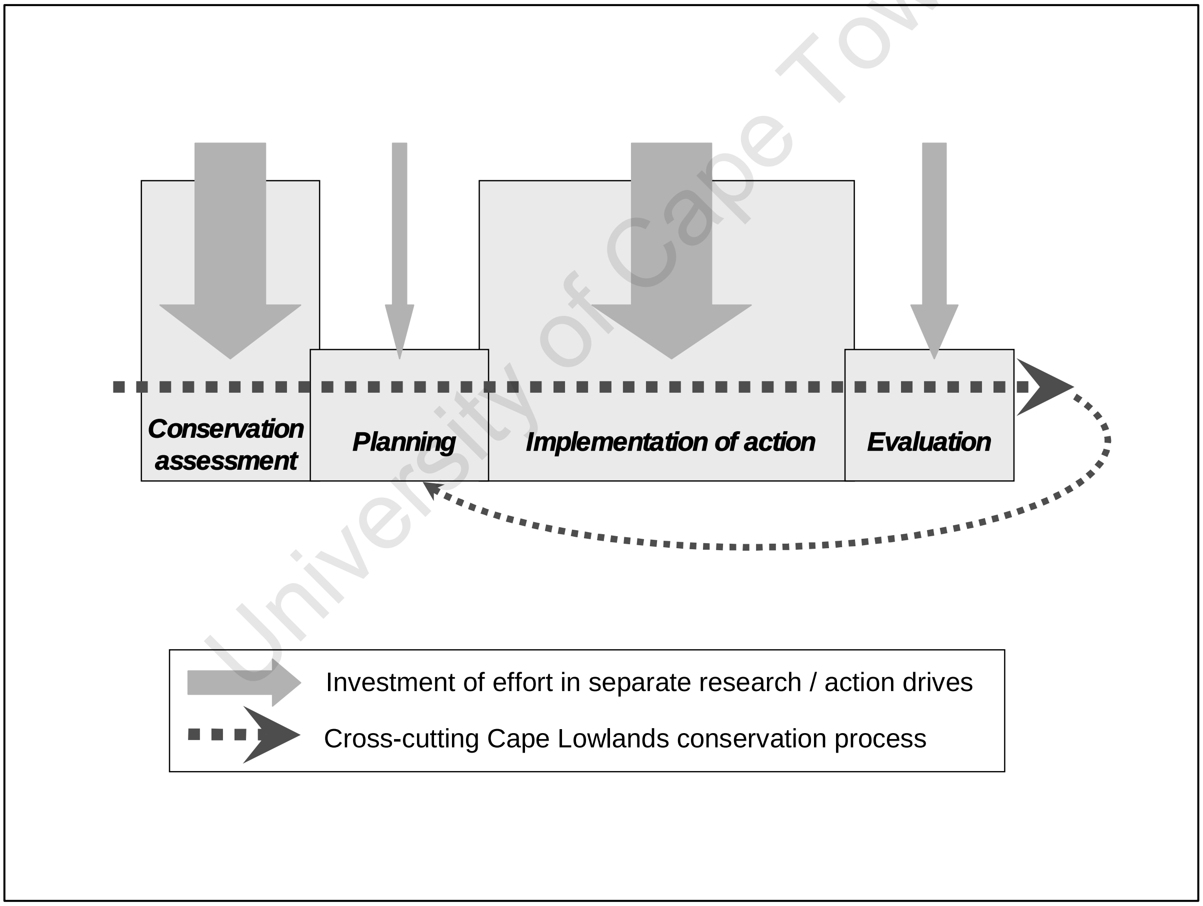

Figure 1. Schematic representation of a conservation process: usually the phases are not connected into a cohesive flow, and effort is separately invested in the individual components. The size of the boxes broadly reflects that current investment is skewed towards assessment and implementation phases.

3. A real conservation process: from assessment to evaluation

The aim of my thesis was to undertake a conservation assessment complemented by collaborative planning for conservation action that would guide effective conservation interventions, as demonstrated through evaluation. The study was designed to span the entire spectrum of conservation activities (Fig. 1) in one ecosystem: the critically endangered, highly transformed Cape Lowlands region in the Cape Floristic Region, South Africa (Fig. 2). This is exceptional: very rarely is conservation undertaken as a cohesive flow of phases. The intention here was to to serve both the theory and the practice of conservation, and to strengthen the links between all the different phases.

The Cape Lowlands conservation process comprised: A conservation assessment (Table 1, chapter 1-3) in which assessment approaches were chosen and evaluated particularly in terms of how well they served the later real-world planning and implementation stages. The conservation assessment then led into a planning phase (Table 1, chapter 4) that guided the implementation of on-the-ground actions to protect biodiversity on private land in the region. The planning focused specifically on conservation actions geared towards negotiating conservation stewardship agreements to ensure the voluntary and legal protection of biodiversity from clearing, rather than on the full spectrum of possible and often necessary conservation actions (e.g. species recovery, threat mitigation). The last phase undertaken and reported on in this study was then an evaluation of achievements relative to the original conservation goals set for the Cape Lowlands (Table 1, chapter 5). I was part of every step in the process, either as leader and participant (chapter 1-5) or as an observer (implementation).

The start of the Cape Lowlands research coincided with a time when the international research community's focus was firmly on conservation assessment techniques. This focus has begun shifting to a more comprehensive view of conservation planning and implementation processes, as also presented in my thesis. Much of the learning and decision-making throughout the Cape Lowlands process therefore rested on the insight of colleagues on both ends of the theory-practice spectrum and their experience of previous conservation assessments (e.g. Cowling et al., 2003); the international peer-reviewed and the grey literature; on common sense; and very importantly on 'learning through doing' (Knight, 2007).

3.1 Key questions

This PhD set out to answer the following highly relevant questions for undertaking effective conservation research, planning and implementation:

1. What are feasible, efficient, defensible and efficacious solutions for:
   (i) deriving a surrogate layer that represents biodiversity in a region which is characterised by exceptional plant species richness and endemism ; and

(ii) considering the connectivity of natural areas in an ecosystem that is highly transformed, fragmented and largely unprotected?

2. How to develop a selection method for identifying and prioritising key biodiversity areas in a landscape identified as 100% irreplaceable?

3. How can collaborative planning be used to translate the conservation assessment's technical outputs into time-based conservation goals and into useful products for implementation?

4. What constitutes effective planning in the conservation process ?

5. To what extent has the Cape Lowlands conservation plan been implemented after five years of off-reserve conservation interventions in the region?

3.2 The study's broader context

I conducted the research in a practical real-world setting embedded within a theoretical context. The opportunity for this was provided by the overall context of conservation planning and implementation taking place in the Cape Floristic Region (CFR): in 2000, a conservation assessment for the entire CFR identified the Cape Lowlands Renosterveld ecosystem as a top priority for which finer-scale conservation planning was required (Cowling et al., 2003). This led to my undertaking the Cape Lowlands conservation process. The work in the Cape Lowlands was aligned with the strategies and structures of the Cape Action for People and the Environment C.A.P.E. programme (see below), which provides the overall implementation framework for conservation in the CFR.

Cape Action for People and the Environment (C.A.P.E.)

C.A.P.E. is a multi-stakeholder programme aimed at conserving terrestrial and marine biodiversity of the Cape Floristic Region while delivering economic benefits (Ashwell et al., 2004,). Four statutory agencies and numerous other partners are implementing the projects and programmes that contribute to the C.A.P.E. goal. The programme was initiated in 1998 with a CFR-wide conservation assessment (Cowling et al., 2003). A broad 20-year implementation strategy was developed (Gelderblom et al., 2003; Lochner et al., 2003). This has since been refined and expanded (www.capeaction.org.za). The first phase of implementing conservation interventions, which were funded by the Global Environment Facility, the Critical Ecosystems Partnership Fund (together contributing US$ 21 million), and many South African organisations, draws to a close at the end of 2009.

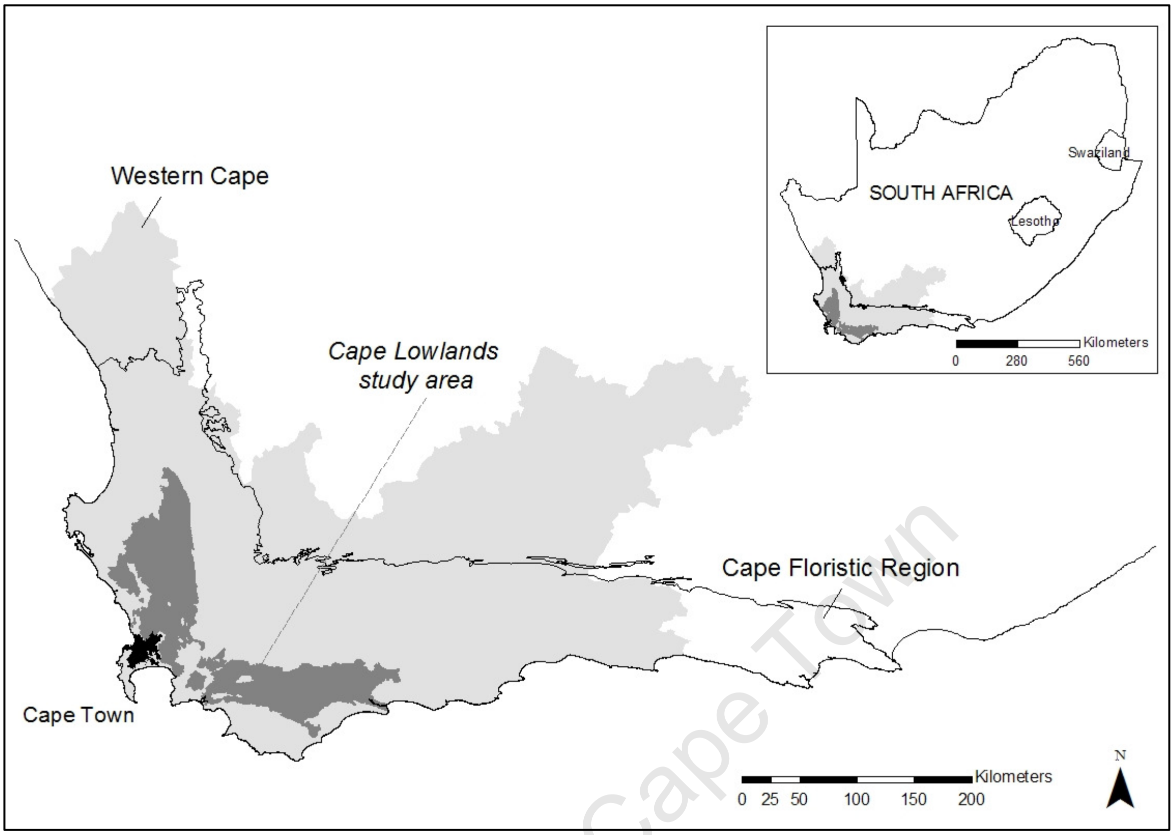

Figure 2. The boundaries of the Cape Lowlands study area, the Cape Floristic Region (CFR) and the Western Cape Province in South Africa.

3.3 The Cape Floristic Region and the Cape Lowlands

The Cape Lowlands study area (12,386 km^2) falls within the Mediterranean-climate Cape Floristic Region at the south-western tip of South Africa (Fig. 2). The CFR (~90,000 km^2) is globally recognised as a region of outstanding biodiversity (Davis et al., 1994; Olson and Dinerstein, 1998; Myers et al., 2000). The CFR is most famous for its exceptionally diverse flora, associated with a wide variety of habitats and landscapes: more than 9500 species have been recorded so far, most of which (>70%) occur nowhere else in the world (Goldblatt and Manning, 2000). Yet the natural systems are highly threatened due to unsustainable agricultural practices, invasive alien plant species, and urban development (Rouget et al., 2003c). The CFR is therefore of high international conservation significance and it has been called a 'conservation bargain' (Frazee et al., 2003) where the spending of conservation resources will bring important gains in biodiversity protection. Indeed, substantial investments from international and national sources have been made over the past ten years. This has created the potential for interesting case study research into conservation successes and perhaps failures throughout this broad region to date (see Redford and Taber, 2000).

The Cape Lowlands region, the study area for this PhD, extends across the flat areas between the coastal plains and the inland Cape Fold Mountains of the CFR. The region is recognised as a priority area for biodiversity conservation at the regional and national scale (Cowling et al., 2003; Driver et al., 2004) and it has been identified at the global scale as presenting an excellent biodiversity investment based on the high biodiversity significance combined with relatively low costs of conservation actions (Wilson et al., 2007).

The Cape Lowlands, like the CFR, are known for its high plant species richness and endemism (Cowling and Holmes, 1992). Spectacular bulb species form an important component of the rare and threatened flora (Fig. 3, Boucher and Moll, 1980). The evergreen, fire-prone coastal renosterveld vegetation grows on relatively fertile shale- and granite-derived soils (Low & Rebelo, 1996) and it is dominated by asteraceous shrubs and a grassy understorey (Boucher and Moll, 1980; chapter 1). Historical evidence suggests that the lowland renosterveld plains used to support herds of game including mountain zebra, bluebuck (now extinct), bontebok antelope, black rhino, buffalo, and even lion, spotted hyena, and leopard (Low and Rebelo, 1996). In 1611 an agent for the British East India Company wrote: "I have never seen a better land in my life", and he describes the abundant wildlife, fresh rivers and lush grass encountered while exploring the north-western parts of the Cape Lowlands. 'Only wheat is lacking,' is stated in another letter, 'and it would be necessary to carry some quantity of this from England for sowing and then it would soon be abundant.' (in Reader, 1998).

Since the arrival of settled agriculture after the seventeenth century then, the cultivation of wheat and other cereal crops has fundamentally shaped the Cape Lowlands' landscape. Today the region is an important agricultural production landscape (Low and Rebelo, 1996). Apart from wheat grown on extensive commercial fields in winter, the production of fruit, wine and olives significantly contributes to the Western Cape's economy. The natural vegetation has mostly been cleared: less than 9% of coastal renosterveld remains scattered throughout the landscape in remnants of varying size (<1 ha to several thousand ha). Only fraction of the land (<1%) is formally protected in statutory reserves (Rouget et al., 2003b). The Cape Lowlands thus contain some of the most critically endangered ecosystems in South Africa (Driver et al., 2004) and all remaining coastal renosterveld is recognised as 100% irreplaceable. This means that all of the vegetation would need to be conserved to meet targets for biodiversity representation and persistence in the CFR (Pressey et al., 2003). As most of the Cape Lowlands region (>90%) is in private ownership the voluntary participation of private landowners in conservation efforts is essential for protecting the region's remaining biodiversity (McDowell, 1988).

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INTRODUCTION

Humans have changed the earth fundamentally to fulfil their needs and preferences (Western, 2001; Vitousek et al., 1997). This influence is affecting natural systems at every scale and in virtually all parts of the world: the climate is changing at a global scale; biological diversity is declining as a result of land transformation; and human-induced changes to ecological processes are compromising the delivery of ecosystem services that underpin the existence all living species and of humanity (Vitousek et al., 1997; Balmford and Bond, 2005; MEA, 2005). The resources to meet this complex global conservation challenge are as yet limited: the funding requirements far outstrip current allocations for conservation interventions (James et al, 1999) and the distribution of resources across the world is imbalanced (Halpern et al., 2007).

1. Conservation planning: theory and practice

In response to this critical situation, conservation biology was conceptualised as a field of research to provide "the principles and tools for preserving biological diversity" (Soulé, 1985). The sub-discipline of systematic conservation planning specifically addresses the question of how to prioritise areas, based on explicit criteria, to guide strategic conservation action so that biodiversity patterns and processes are adequately protected in situ and conservation resources are optimally spent (Margules and Pressey, 2000). This is not a trivial problem: the challenge is finding real-world solutions for where, when, and how best to protect biodiversity and natural systems in the long term. This depends on many different factors, including biological, political and economic factors (Virolainen et al., 1999) that play out in an environment where change and uncertainty is the rule rather than the exception (Pressey and Taffs, 2001).

Hence systematic conservation planning has developed into a large and rapidly evolving field of research. Operational models or consensus frameworks (Sarkar, 2004) have emerged that set out a generalised sequence of steps involved in systematic conservation planning (e.g. Margules and Pressey, 2000; Groves et al., 2002; Knight et al., 2006a). These frameworks tend to be simplistic representations of exceptionally complex real situations, but they provide a general context and guidelines for conservation planning research. The framework by Margules and Pressey (2000) for example outlines in a series of steps how to achieve the ultimate goal of effective on-the-ground conservation, from identifying priority areas to monitoring the outcomes of conservation actions. Knight et al. (2006a, b) build on this by clarifying the role of particular steps in the process, and by emphasising the network of links and feed-backs between different phases. The overview provided by these frameworks is important as conservation processes tend to be conducted piecemeal with separate effort being invested in the individual components (Fig. 1), including the conservation assessment; the planning phase and strategy development; the implementation of conservation interventions (or management, Knight et al., 2006a); and evaluation (Salafsky et al., 2001, 2002).

Despite the overview from conservation planning to practice that these operational frameworks present, conservation planning research to date has focused primarily on biodiversity-driven systematic conservation assessments (Knight et al., 2006a). Much of this research effort has been invested in developing a variety of highly sophisticated mathematical solutions and computer-based techniques for selecting and designing conservation area networks (see Possingham et al., 2000; Pressey, 2002; Williams et al., 2005). Here conservation science has made significant advances (Justus and Sarkar, 2002). The research has also been concerned with (i) refining surrogate measures for representing biodiversity in the assessment (Ferrier, 2002); (ii) modelling future threats to natural systems (Rouget et al., 2003c); (iii) quantifying spatial attributes such as connectivity that may contribute to biodiversity persistence (Briers, 2002); (iv) spatially representing ecological and evolutionary processes and ecosystem services (Rouget et al., 2003a); and (v) developing procedures for integrating cost measures in conservation area selection (Naidoo et al., 2006; Wilson et al., 2006).

2. From theory to practice: where are the gaps?

However "there is a world of difference between the selection process [..] and making things happen on the ground" (Margules and Pressey, 2000), and while systematic conservation assessments aim to guide decision-making on where conservation interventions should take place, they do not set out how the actions need to be undertaken (Scott and Csuti, 1997). The large research focus on systematic conservation assessment techniques has therefore led to concerns of an 'implementation crisis' (Knight and Cowling 2003). Certainly the understanding amongst researchers of advanced techniques for reserve selection and design tends to be far better than the ability to use these tools in effectively solving pragmatic conservation problems (Knight et al., 2006a). The perceived gap between the theory and practice of conservation is also reflected in that few conservation assessments, at least those in the peer-reviewed literature, have been implemented (Prendergast et al., 1999; Newburn et al., 2005).

This highlights two challenges for conservation research in areas that have received far too little attention in conservation science thus far: planning and evaluation (Fig. 1).

(i) The first challenge is effectively linking the conservation assessment, which produces a theoretical design for a conservation area network, with those activities that need to put the design into practice. Until recently this aspect of systematic conservation planning has been rarely reported in the primary literature (Knight et al., 2006a, b; but see Davis et al., 1999). Much more is needed to achieve effective conservation than a technically and scientifically sound conservation assessment. Moving towards action means complementing the assessment with in-depth planning, to tackle complex issues on the interface between science and practice and make decisions on how to undertake conservation interventions (Knight et al., 2006a, b). This requires collaboration between groups of people, e.g. biologists and managers, who often work in isolation from each other (Balmford and Cowling, 2006).

(ii) The second challenge is investigating whether and how conservation success is taking shape (Balmford and Cowling, 2006; Ferraro and Pattanayak, 2006), especially achievements resulting from effective systematic conservation planning. Very few published studies demonstrate conservation science being used "to optimize the return on conservation investments and to guide conservation actions to places that would most efficiently conserve biodiversity" or that show how research has helped managers "make smarter decisions about how to maximize conservation gains with limited resources" (Higgins et al., 2006). This means that the value of conservation science is easily questioned (e.g. Cleary, 2006, w.r.t. tropical areas) until researchers demonstrate in real-world situations that the science is benefiting conservation practice.

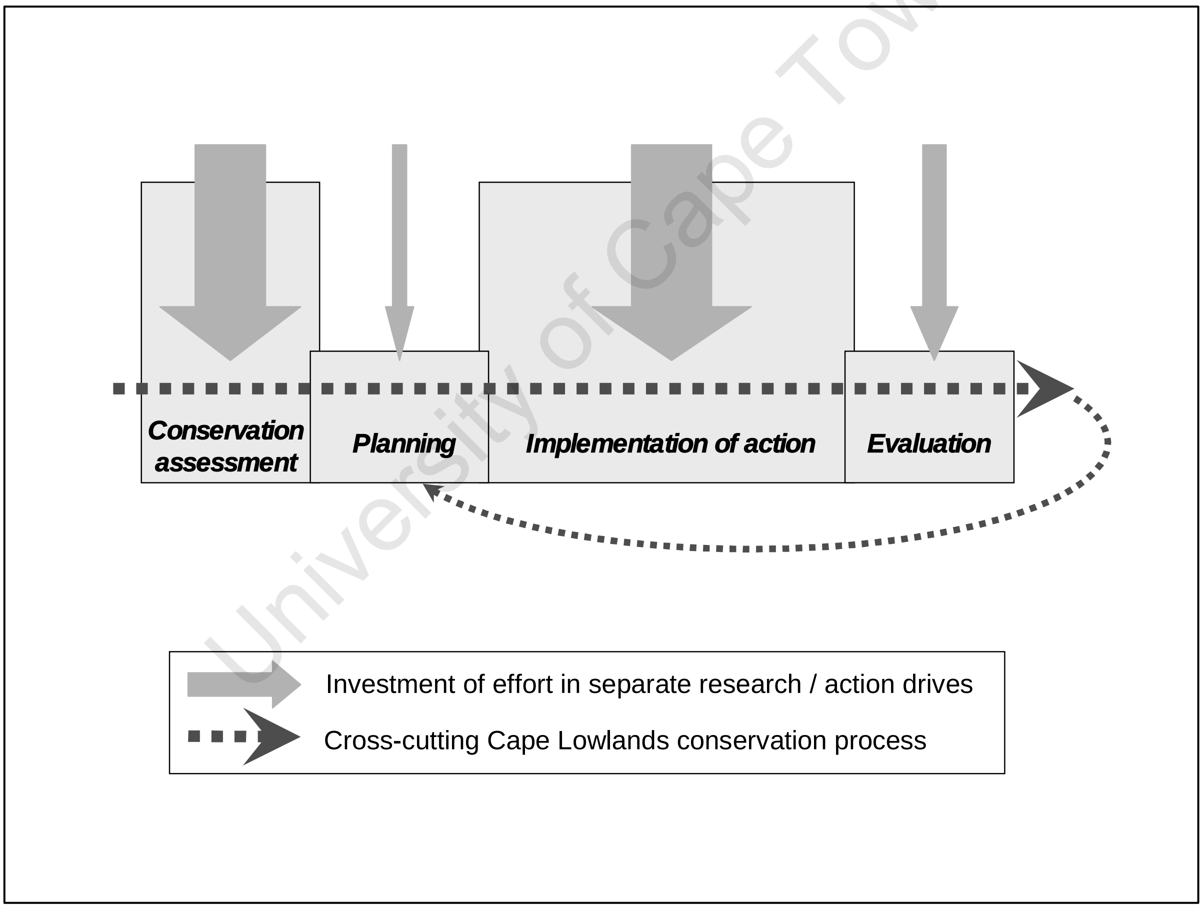

Figure 1. Schematic representation of a conservation process: usually the phases are not connected into a cohesive flow, and effort is separately invested in the individual components. The size of the boxes broadly reflects that current investment is skewed towards assessment and implementation phases.

3. A real conservation process: from assessment to evaluation

The aim of my thesis was to undertake a conservation assessment complemented by collaborative planning for conservation action that would guide effective conservation interventions, as demonstrated through evaluation. The study was designed to span the entire spectrum of conservation activities (Fig. 1) in one ecosystem: the critically endangered, highly transformed Cape Lowlands region in the Cape Floristic Region, South Africa (Fig. 2). This is exceptional: very rarely is conservation undertaken as a cohesive flow of phases. The intention here was to to serve both the theory and the practice of conservation, and to strengthen the links between all the different phases.

The Cape Lowlands conservation process comprised: A conservation assessment (Table 1, chapter 1-3) in which assessment approaches were chosen and evaluated particularly in terms of how well they served the later real-world planning and implementation stages. The conservation assessment then led into a planning phase (Table 1, chapter 4) that guided the implementation of on-the-ground actions to protect biodiversity on private land in the region. The planning focused specifically on conservation actions geared towards negotiating conservation stewardship agreements to ensure the voluntary and legal protection of biodiversity from clearing, rather than on the full spectrum of possible and often necessary conservation actions (e.g. species recovery, threat mitigation). The last phase undertaken and reported on in this study was then an evaluation of achievements relative to the original conservation goals set for the Cape Lowlands (Table 1, chapter 5). I was part of every step in the process, either as leader and participant (chapter 1-5) or as an observer (implementation).

The start of the Cape Lowlands research coincided with a time when the international research community's focus was firmly on conservation assessment techniques. This focus has begun shifting to a more comprehensive view of conservation planning and implementation processes, as also presented in my thesis. Much of the learning and decision-making throughout the Cape Lowlands process therefore rested on the insight of colleagues on both ends of the theory-practice spectrum and their experience of previous conservation assessments (e.g. Cowling et al., 2003); the international peer-reviewed and the grey literature; on common sense; and very importantly on 'learning through doing' (Knight, 2007).

3.1 Key questions

This PhD set out to answer the following highly relevant questions for undertaking effective conservation research, planning and implementation:

1. What are feasible, efficient, defensible and efficacious solutions for:
   (i) deriving a surrogate layer that represents biodiversity in a region which is characterised by exceptional plant species richness and endemism ; and

(ii) considering the connectivity of natural areas in an ecosystem that is highly transformed, fragmented and largely unprotected?

2. How to develop a selection method for identifying and prioritising key biodiversity areas in a landscape identified as 100% irreplaceable?

3. How can collaborative planning be used to translate the conservation assessment's technical outputs into time-based conservation goals and into useful products for implementation?

4. What constitutes effective planning in the conservation process ?

5. To what extent has the Cape Lowlands conservation plan been implemented after five years of off-reserve conservation interventions in the region?

3.2 The study's broader context

I conducted the research in a practical real-world setting embedded within a theoretical context. The opportunity for this was provided by the overall context of conservation planning and implementation taking place in the Cape Floristic Region (CFR): in 2000, a conservation assessment for the entire CFR identified the Cape Lowlands Renosterveld ecosystem as a top priority for which finer-scale conservation planning was required (Cowling et al., 2003). This led to my undertaking the Cape Lowlands conservation process. The work in the Cape Lowlands was aligned with the strategies and structures of the Cape Action for People and the Environment C.A.P.E. programme (see below), which provides the overall implementation framework for conservation in the CFR.

Cape Action for People and the Environment (C.A.P.E.)

C.A.P.E. is a multi-stakeholder programme aimed at conserving terrestrial and marine biodiversity of the Cape Floristic Region while delivering economic benefits (Ashwell et al., 2004,). Four statutory agencies and numerous other partners are implementing the projects and programmes that contribute to the C.A.P.E. goal. The programme was initiated in 1998 with a CFR-wide conservation assessment (Cowling et al., 2003). A broad 20-year implementation strategy was developed (Gelderblom et al., 2003; Lochner et al., 2003). This has since been refined and expanded (www.capeaction.org.za). The first phase of implementing conservation interventions, which were funded by the Global Environment Facility, the Critical Ecosystems Partnership Fund (together contributing US$ 21 million), and many South African organisations, draws to a close at the end of 2009.

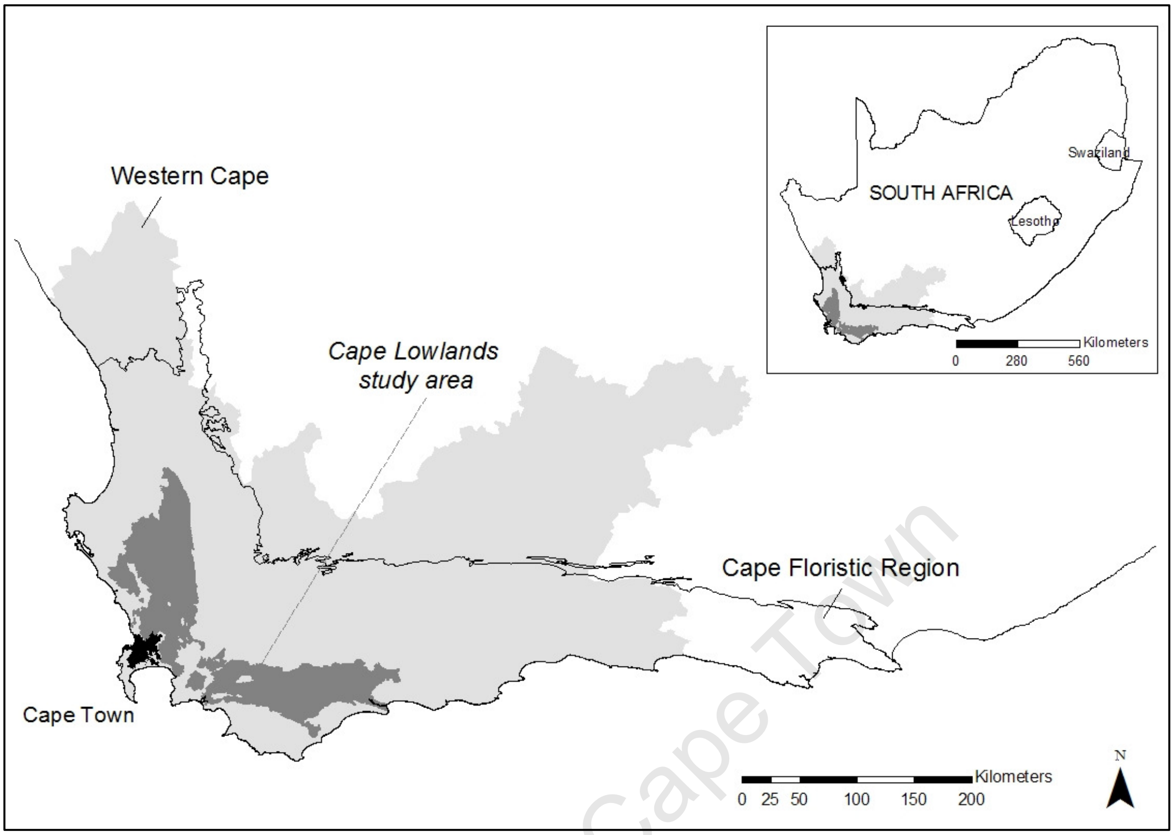

Figure 2. The boundaries of the Cape Lowlands study area, the Cape Floristic Region (CFR) and the Western Cape Province in South Africa.

3.3 The Cape Floristic Region and the Cape Lowlands

The Cape Lowlands study area (12,386 km^2) falls within the Mediterranean-climate Cape Floristic Region at the south-western tip of South Africa (Fig. 2). The CFR (~90,000 km^2) is globally recognised as a region of outstanding biodiversity (Davis et al., 1994; Olson and Dinerstein, 1998; Myers et al., 2000). The CFR is most famous for its exceptionally diverse flora, associated with a wide variety of habitats and landscapes: more than 9500 species have been recorded so far, most of which (>70%) occur nowhere else in the world (Goldblatt and Manning, 2000). Yet the natural systems are highly threatened due to unsustainable agricultural practices, invasive alien plant species, and urban development (Rouget et al., 2003c). The CFR is therefore of high international conservation significance and it has been called a 'conservation bargain' (Frazee et al., 2003) where the spending of conservation resources will bring important gains in biodiversity protection. Indeed, substantial investments from international and national sources have been made over the past ten years. This has created the potential for interesting case study research into conservation successes and perhaps failures throughout this broad region to date (see Redford and Taber, 2000).

The Cape Lowlands region, the study area for this PhD, extends across the flat areas between the coastal plains and the inland Cape Fold Mountains of the CFR. The region is recognised as a priority area for biodiversity conservation at the regional and national scale (Cowling et al., 2003; Driver et al., 2004) and it has been identified at the global scale as presenting an excellent biodiversity investment based on the high biodiversity significance combined with relatively low costs of conservation actions (Wilson et al., 2007).

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CHAPTER 2

Designing connectivity-based selection units for a highly fragmented landscape

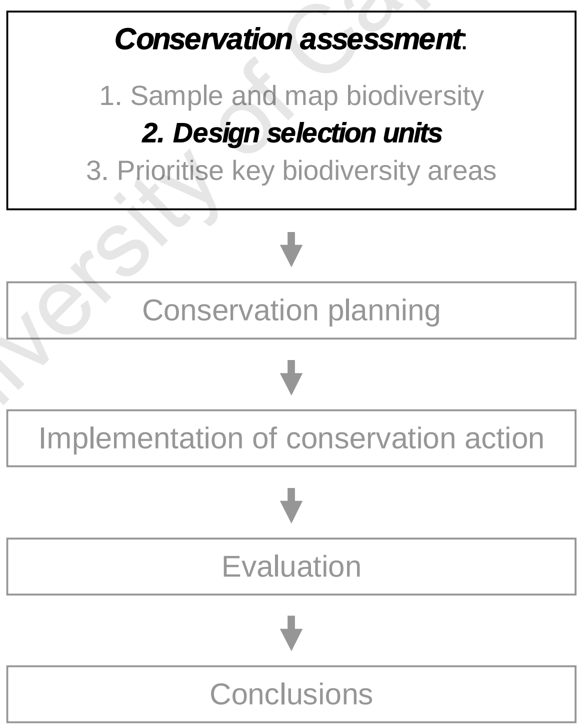


Figure 2.1. The conservation process in the Cape Lowlands region: Designing selection units to incorporate vegetation connectivity to incorporate a likely factor of biodiversity persistence in the conservation assessment.

2. Introduction

Achieving the long-term persistence of biodiversity is a fundamental goal of conservation efforts (Soulé, 1986) and, along with the representation of biodiversity pattern, it forms a key principle in systematic conservation planning (Margules and Pressey, 2000, Cowling and Pressey, 2001). In human-dominated landscapes, where extensive transformation of the natural vegetation has taken place, it is especially important to plan and manage for the capacity of ecological processes to maintain biodiversity in the long term and to facilitate restoration. Our understanding of the mechanisms involved in ecological functioning, and of the implications that human-driven processes such as habitat loss have for biodiversity persistence, does however remain limited.

This is despite a major thrust in research on landscape modification and fragmentation over the past twenty years (reviews by Saunders et al., 1991, Andrén, 1994, Debinski and Holt 2000, Haila, 2002, McGarigal and Cushman, 2002, Fahrig, 2003, Hobbs and Yates, 2003, Fischer and Lindenmayer, 2007). The body of published material is vast. It covers theoretical, observational and empirical approaches that address various aspects of fragmentation such as the link between patch size and species richness; edge effects; and the role of habitat corridors in biodiversity persistence. Little of this research provides clear insight into the effects of landscape modification on biodiversity however (Haila, 2002, McGarigal and Cushman, 2002, Lindenmayer and Fischer, 2007) and detailed recommendations on appropriate conservation management actions are rare.

It is therefore common for a number of general principles or 'rules of thumb' to be applied in conservation planning and practice with the aim of enhancing species persistence. Retaining the connectivity among natural areas is one such rule of thumb (e.g. Saunders et al., 1991; Haila 2002; Fischer and Lindenmayer, 2007). Most ecologists would agree however that connectivity plays a vital role in maintaining populations of organisms and the ecological processes that support the functioning of natural systems (Saunders et al, 1991, Tucker, 2000). Indeed the concept of connectivity is 'almost an article of faith among conservation biologists' (Smith and Hellmann, 2002). Yet empirical evidence that supports the importance of connectivity in biodiversity conservation is increasingly emerging (e.g. Brooker et al., 1999; Brooker and Brooker, 2001, 2002, Rubinoff, 2001, Bennett, 2003).

In conservation planning processes (Fig. 2.1) connectivity is considered as a key factor in the design of conservation area networks. It is one of several important spatial attributes that also include the compactness and size of the areas to be conserved; and the compatibility of adjacent land uses with conservation aims for example (Bedward et al., 1992). These aspects are considered important as they may help to limit edge effects (Laurance; 2000); facilitate the movement of organisms; maintain natural disturbance regimes; and mitigate impacts associated with climate change (Cowling and Pressey, 2001). There are several ways to integrate spatial attributes in conservation planning (Fig. 2.2). One approach is to identify priority areas by means of a reserve selection algorithm and to apply spatial criteria during a subsequent design phase that refines the selection (Fig. 2.2: scenario 3; e.g. Cowling et al., 2003, Desmet, 2004).

A second approach is to incorporate spatial attributes explicitly into the selection process through sophisticated reserve design algorithms (Fig. 2.2: scenario 2; see Cerdeira et al., 2005; Önal and Briers, 2005; Williams et al., 2005 for a review). Various techniques have been developed. The size of the conservation area network can be limited by integrating area as a cost surface in selections (McDonnell et al., 2002). Reserve compactness and connectivity can be enhanced by minimising the distances between pairs of selected neighbouring sites (Briers, 2002); the total distance between all pairs of sites (Nalle et al., 2002); or the reserve boundary's length (McDonnell et al., 2002); or by promoting the choice of adjacent sites (Nicholls and Margules, 1993). A third alternative for integrating spatial criteria in conservation area networks is in a pre-site-selection step. This means making mandatory the selection of areas that are already mapped as spatial surrogates of ecological processes (Rouget et al., 2003a) or of areas with a high probability of species occurrence (Cabeza, 2003; Pyke, 2005).

I propose here to consider structural connectivity as a pre-selection step in the conservation assessment through a connectivity-based approach to selection units (Fig. 2.1; Fig. 2.2: scenario 3). Selection units are used in conservation planning to divide the landscape and its constituent biodiversity into smaller components (see Pressey and Logan, 1998). As selection units are the building blocks of any conservation assessment, it makes sense to design them based on principles of landscape connectivity. My objectives are to (i) quantify the connectivity of the remaining vegetation in the Cape Lowlands study area, a critically endangered ecosystem in South Africa (Driver et al., 2004); (ii) to design selection units based on connectivity, thus incorporating a possible measure of biodiversity persistence and facilitating the implementation of conservation action in large connected areas (see Rodrigues and Gaston, 2000); and (iii) to compare the designed units with commonly used cadastral selection units based on their effectiveness and efficiency in capturing connectivity.

The study area is a good model system for testing a selection units-based approach to integrating connectivity in conservation planning. Less than nine percent of the fragmented natural vegetation is left in an agricultural landscape. All of the remaining vegetation would need to be conserved to meet conservation targets set for ecological processes and representation of biodiversity pattern across the Cape Floristic Region (Pressey et al., 2003). Since conservation resources are limited, conservation actions involving incentive-based protection mechanisms by private landowners (chapter 4) will need to concentrate on those areas that are most likely to persist in the long term.

Maintaining large areas of intact, connected vegetation under an appropriate fire regime is the most likely option for ensuring the persistence of its component biota (Bowie and Donaldson, 1999, Donaldson et al. 2002, Pauw, 2004). This is borne out by research in analogous ecosystems (7% natural vegetation in an agricultural landscape) in Australia where the performance in terms of dispersal, territory establishment and survival of a fairy wren was much higher in well-connected habitat patches than in poorly connected neighbourhood patches, and it varied little with remnant size (Brooker et al., 1999, Brooker and Brooker, 2001, 2002). I therefore decided to give connectivity a central role in an implementation-orientated conservation plan for the Cape Lowlands study area.

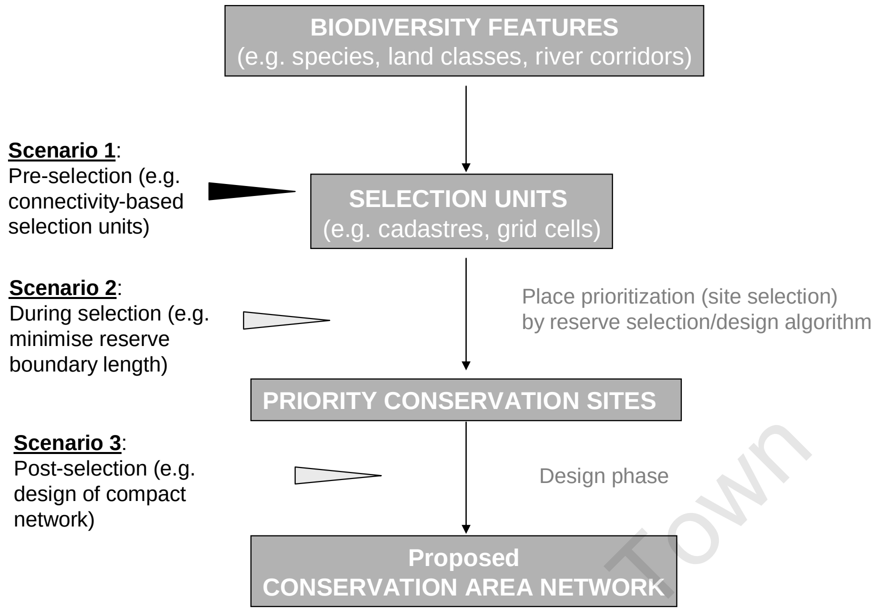


Figure 2.1 Diagram showing at which points in the conservation assessment connectivity of vegetation or conservation areas can be integrated.

3. Methods

The Cape Lowlands study area (12386 km^2) in the Mediterranean-climate Cape Floristic Region, South Africa, was defined by the extent of coastal renosterveld and renosterveld-fynbos mosaic vegetation (Cowling and Heijnis, 2001) and it comprised the Overberg (5535 km^2), Elgin Basin (171.2 km^2) and Boland/Swartland (6680 km^2) sub-regions. A 5km buffer (6918 km^2) of non-renosterveld vegetation types allowed for the consideration of certain ecological processes (e.g. pollination) that extend into adjacent habitats, mainly mountain fynbos.

The Cape Lowlands contain some of the most critically endangered ecosystems in South Africa (Driver et al., 2004). They are of great importance to biodiversity conservation owing to the high species richness and endemism (Cowling and Holmes, 1992). The Cape Lowlands study area is of international significance since it falls within the Cape Floristic Region (CFR), a recognised biodiversity hotspot (Myers et al., 2000) and one of the richest parts of the world in terms of floristic diversity and endemism (Goldblatt and Manning, 2000) especially of geophytes (Procheş et al., 2006). Despite this, less than 1% of land in the Cape Lowlands is formally protected (Rouget et al., 2003c). Owing to extensive clearing of the natural vegetation for commercial agriculture, especially the cultivation of cereal crops, less than 9% of the region's original vegetation remains intact mostly as scattered remnants of varying size. A conservation assessment of the CFR showed that all remaining vegetation patches are required to achieve targets for coastal renosterveld. This vegetation is considered 100% irreplaceable (Cowling et al. 2003; Pressey et al. 2003).

3.2 Spatial representation of natural vegetation

LANDSAT7 TM images (#174/083, 15/12/1997, #175/083, 24/02/1998) were classified using the unsupervised pattern-recognition algorithm in ERDAS Imagine (1997), and the Iterative Self Organising Data Analysis Technique followed by supervised interpolation to derive land cover classes. A 3x3 majority filter was applied to produce a land cover interpretation for the study area (detailed methods in Lloyd et al., 1999). The resulting GIS grid layer, henceforth the natural remnants layer, consisted of 25x25m pixels categorised as remaining natural vegetation and transformed land. Vegetation remnants are areas of at least 0.5 ha consisting of contiguous vegetation-filled pixels, each having at least four neighbouring vegetation cells. Categorical accuracy of the natural remnants layer was 84.59% (+/-4.38, 95% confidence limit) based on 466 randomly distributed ground control points. Boundary accuracy was only visually assessed.

3.3 Capturing connectivity

Connectivity is understood as the way in which the spatial configuration and quality of different landscape components influence the movement of organisms between habitat or resource patches (Taylor et al., 1993). There are two aspects: functional connectivity, determined by organisms' response to the landscape's physical structure (Bennett, 2003); and structural connectivity, defined as the way in which habitats are distributed in the landscape and relative to each other (Metzger and Décamps, 1997). The distance between habitat remnants, patch size and the surrounding land uses are important aspects of the structural component (Bennett, 2003). One may further distinguish between habitat; ecological; and landscape connectivity (Fischer and Lindenmayer, 2007). These refer to the species-specific connectedness of vegetation (functional); the connectivity of ecological processes across various scales (functional); and a human perspective of vegetation in a landscape (structural).

Organisms vary in their experience and of use space and in their habitat connectivity requirements (Steffan-Dewenter et al., 2001; Haila, 2002; Bennett, 2003). Yet limited information on functional connectivity in renosterveld meant I could only consider the structural component, which may relate to functional connectivity. The natural remnants layer formed the basis of the connectivity analysis. I treated the matrix as a single type of land cover as no data were available to differentiate it into areas that may be more or less favourable for organisms. Remnants smaller than 0.5 ha were excluded: they fall below the data layer's resolution. Their long-term persistence is also questionable due to their vulnerability to negative edge effects (Laurance; 2000). Remnants smaller than 5 ha but larger than 0.5 ha were considered given their biodiversity value (Kemper et al., 1999) and potential for enhancing landscape connectivity by acting as 'stepping stones' (Bennett, 2003). They were included only if they had more than one neighbouring (within 500m) renosterveld patch. This was to prevent small isolated remnants from contributing to connectivity. I quantified connectivity for each 25x25m pixel in the remnants layer by calculating the percentage of remaining vegetation within a radius of 100m, 250m, 500m and 1000m (Fig. 2.3), thereby producing four GIS connectivity surface layers.

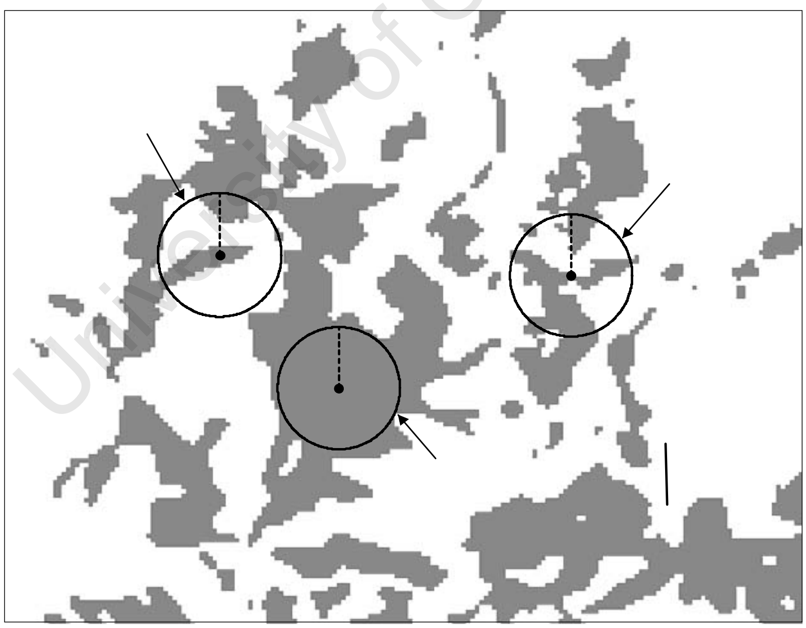


Figure 2.3. Diagram of how connectivity at the 500m threshold was quantified for 25x25m grid cells in the natural vegetation remnants layer. Grey areas show vegetation patches, white areas indicate transformed parts of the landscape.

For each of the 100m, 250m, 500m and 1000m connectivity layers I calculated two measures of connectivity: First, the number and the area of connected remnants in the study area and per sub-region, and second, an index of connectivity, scaled from 0 to 100, where 0 means no connected vegetation and 100 means that all vegetation is connected within the given radius (Fig. 2.3). A mean index was derived for the whole study area and per sub-region, in each case considering a) the entire landscape and b) only areas of connected vegetation (i.e. ignoring areas of the landscape where connectivity is zero).

3.4 Designing selection units

The choice of selection units used in a conservation assessment is flexible: different types have different merits (reviewed by Pressey and Logan, 1998). Thus to incorporate a potential measure of biodiversity persistence before selecting priority areas in Cape Lowlands renosterveld (Fig. 2.2), I designed units primarily around landscape level connectivity. Results from the investigation into the four connectivity levels (previous section and Fig. 2.4a, b) and recommendations by scientists and managers working in renosterveld indicated that the 500m connectivity threshold should inform the design of the selection units layer. This then served as a generic measure representing landscape/structural connectivity rather than species-specific connectivity.

Where vegetation in the study area was relatively extensive and well-connected, I delineated selection units based on the spatial configuration of remaining renosterveld (figure 2.5, inset). I selected areas where connectivity ranged from fully connected (100%) to just over 10%. I used the 10% 'isoline' in the computer-generated 'connectivity layer' as the boundary of the selection units. It was arbitrarily chosen to exclude remnants of which more than three-quarters fell outside the selection unit boundary. Next, for the connectivity-based selection units layer, I chose only units with more than 4 km^2 (400ha) renosterveld as larger areas of connected vegetation are more likely to support sustainable populations of at least some medium-sized mammal species (Kerley et al., 2003). Two units running along large river courses were considered too extensive to serve as sensible selection units and were subdivided into three units each at their points of lowest connectivity.

Owing to the scattered distribution of remnants connectivity-based units were not feasible across the entire landscape. In areas with very sparse vegetation (low connectivity) and in the buffer (mostly intact, 100% connected vegetation) I defined additional selection units based on original farm boundaries. This was done manually in the GIS by aggregating the original cadastres into larger units in which connectivity could be retained across cadastral boundaries and which would yield selection units roughly similar in size to connectivity-based units.

3.5 Comparing the selection units layer with a cadastre-only scenario

To assess the implications of using connectivity to define selection units as opposed to one of the more commonly employed approaches (e.g. grid squares, cadastres), I compared the designed units (connectivity-based and grouped cadastres) with a layer composed of original (ungrouped) cadastres. I used two variables for the comparison: i) mean connectivity index per selection unit and ii) the amount of connected vegetation per selection unit. The GIS layer of original cadastres depicts farm boundaries (average size 9.54 , maximum 230.50) and is based on data compiled by the South African Department of Land Affairs (Surveyor General, 2001).

4. Results

The study area contained approximately 7600 remnants, covering 8.4% of the region's area and around 1045 km² of renosterveld. Most remnants (6737) were in the Overberg where 12.6% of the landscape is still covered with renosterveld. In the Boland/Swartland and Elgin regions significantly fewer patches remained: 731 and 108, respectively occupying 5.0% and 5.7% of the landscape.

4.2 Connectivity

4.1.1 Connected remnants – area and number of remnants

Despite the high level of vegetation loss, more than 94% of the total area of remaining renosterveld was connected within a radius of 100m or more (Fig. 2.4 a). When graphing connected remnants in terms of their number rather than area, differences between the four distance levels became apparent. There was a noticeable decrease in the number of connected remnants at the 100m and 250m-connectivity level (Fig. 2.4 a), at which only 55.2% and 81.9% of remnants counted as connected. The discrepancy between the number and area of connected remnants at these distances was mainly due to the high proportion of small and relatively isolated remnants, which contributed little towards the overall area of remaining vegetation. At the 500m-distance the two curves start levelling out as the number of connected remnants exceeded 93% (Fig. 2.4 a).

Both measures, the number and area of connected remnants, varied spatially across the study area. Connectivity of remnants was lowest in Elgin at the 100m-level, both in terms of the area (89.7%) and the number (33.3%) of connected remnants. It was highest in the Overberg where virtually all renosterveld (>99%) was connected at the 1000m level for both measures.

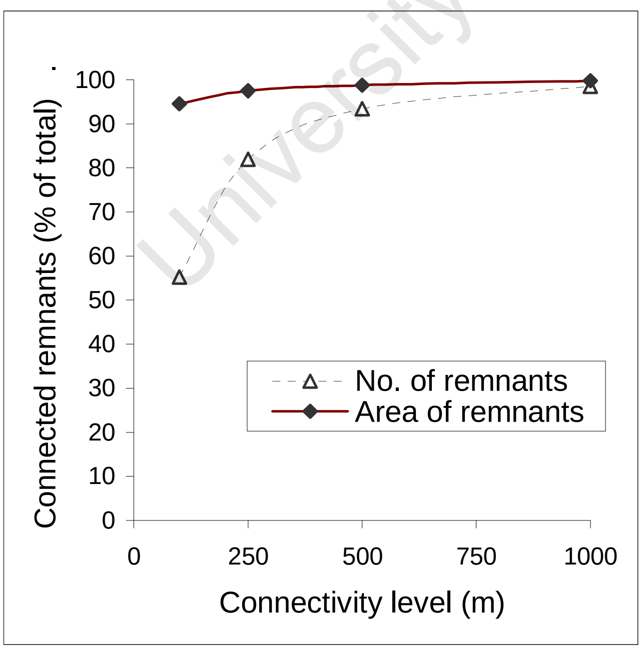


Figure 2.4 a. Connected remnants graphed as a percentage of the total number and area of remnants in the study area, at different connectivity thresholds (100m, 250m, 500m and 1000m).

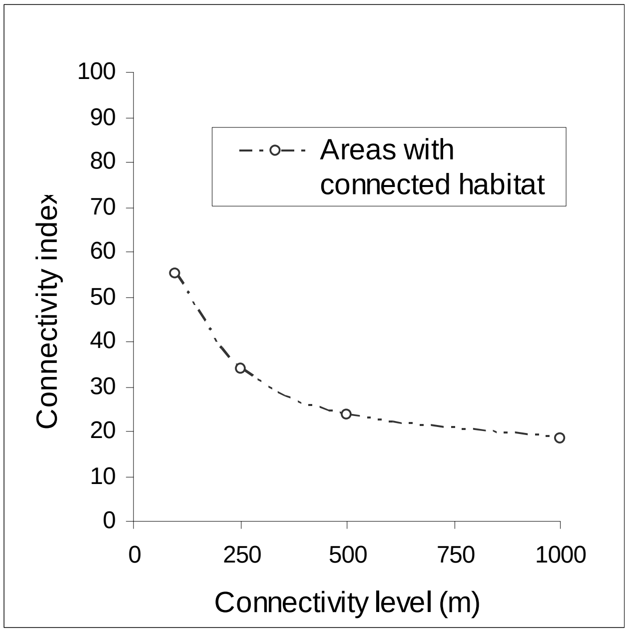


Figure 2.4 b. Connectivity index for areas containing connected vegetation, graphed at different connectivity thresholds.

4.1.2 Connectivity index

At the landscape scale, which includes natural vegetation and cleared land, the connectivity index was exceptionally low, not exceeding 16 at any distance level (Fig. 2.4 b; Fig. 2.5). This reflected the extent to which renosterveld has been cleared for cultivation across the entire study area, creating large tracts of transformed land. When considering the index for clusters of connected vegetation only (areas where connectivity >0, including cells of vegetation and transformed land, see Fig. 2.3) differences between the four distance thresholds were evident. Connectivity was greatest at the 100m level and declined as the distances increased to the 1000m maximum: at this point the curve depicting the index for connected areas approached the curve for landscape level connectivity (Fig. 2.4 b). This makes sense as areas within the 100m radius included the densest areas of vegetation and very little land of low connectivity. By comparison, areas included within the larger 500m and 1000m radii contained a higher proportion of low-connectivity land, thus resembling the landscape-scale connectivity measure more closely.

Spatial variation across the study area was more pronounced in the connectivity index for areas of connected vegetation than it was at the landscape scale. The index was highest for connected areas in the Boland/Swartland (66.4% at the 100m distance level), and lowest in Elgin and the Overberg at the 1000m level (8.8% and 17%, respectively). The difference between the Overberg and Boland/Swartland was due to few but relatively dense vegetation parcels predominating in the Boland/Swartland, while vegetation in the Overberg is more dispersed (Fig. 2.5, 2.6 a, b). Here, connected renosterveld areas consisted not only of large, contiguous vegetation remnants but also of a large number of small remnants connected at the 500m threshold (Fig. 2.6 b).

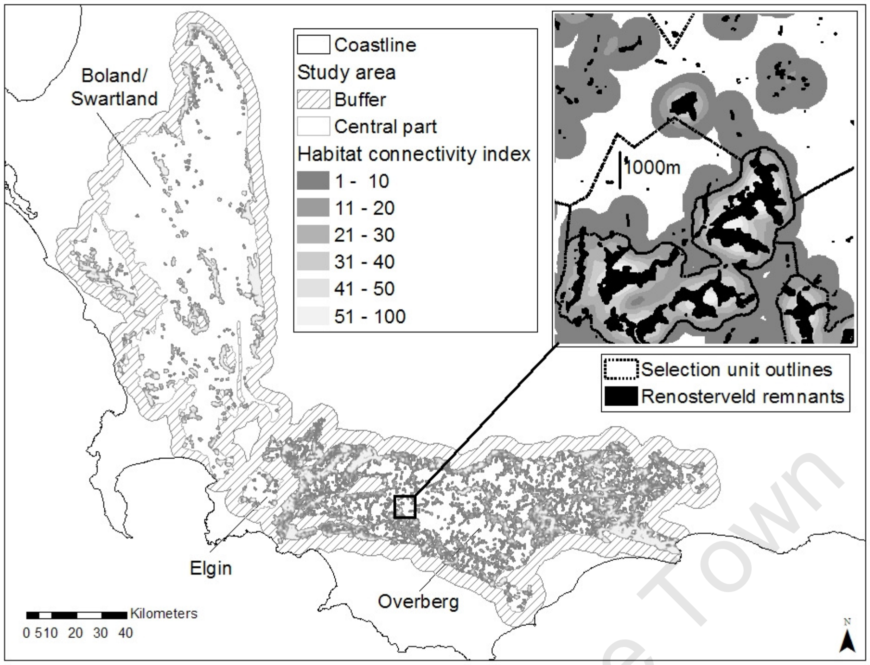


Figure 2.5. Connectivity of renosterveld remnants in the Cape Lowlands (connectivity index, 500m threshold)

4.2 Selection Units

The final layer of connectivity-based and grouped cadastre selection units consisted of 387 units (Table 2.1) ranging in size from 3.56 km² to a 196.13 km² with an average of 48.04 km². Most units were cadastre-based (344 units), covering 90% of the study area but encompassing less than a third of renosterveld (Table 2.1). This highlights the fact that very little natural vegetation remains across the study area. In contrast, there were much fewer connectivity-based units (43, Table 2.1), covering only 10% of the study area (Table 2.1) but containing more than two-thirds of renosterveld overall (69.9% and 72.6% in the Boland/Swartland and the Overberg, respectively, Table 2.1) and >90% of connected renosterveld (defined at the 500m-level) in both sub-regions.

Although connectivity-based units in the Boland/Swartland were on average substantially smaller than in the Overberg (Table 2.1), they encompassed a similar proportion of the area of renosterveld remaining in both regions. This is largely due to the higher levels of vegetation aggregation in the Boland/Swartland (Table 2.1, figure 2.6 a, b). As expected, mean connectivity was far greater in connectivity-based than in grouped cadastre-based selection units: 33.1% vs. 7.3%, respectively, in the Overberg, 46.4% and 7.7% in the Boland/Swartland and 8.0% for grouped cadastres in Elgin.

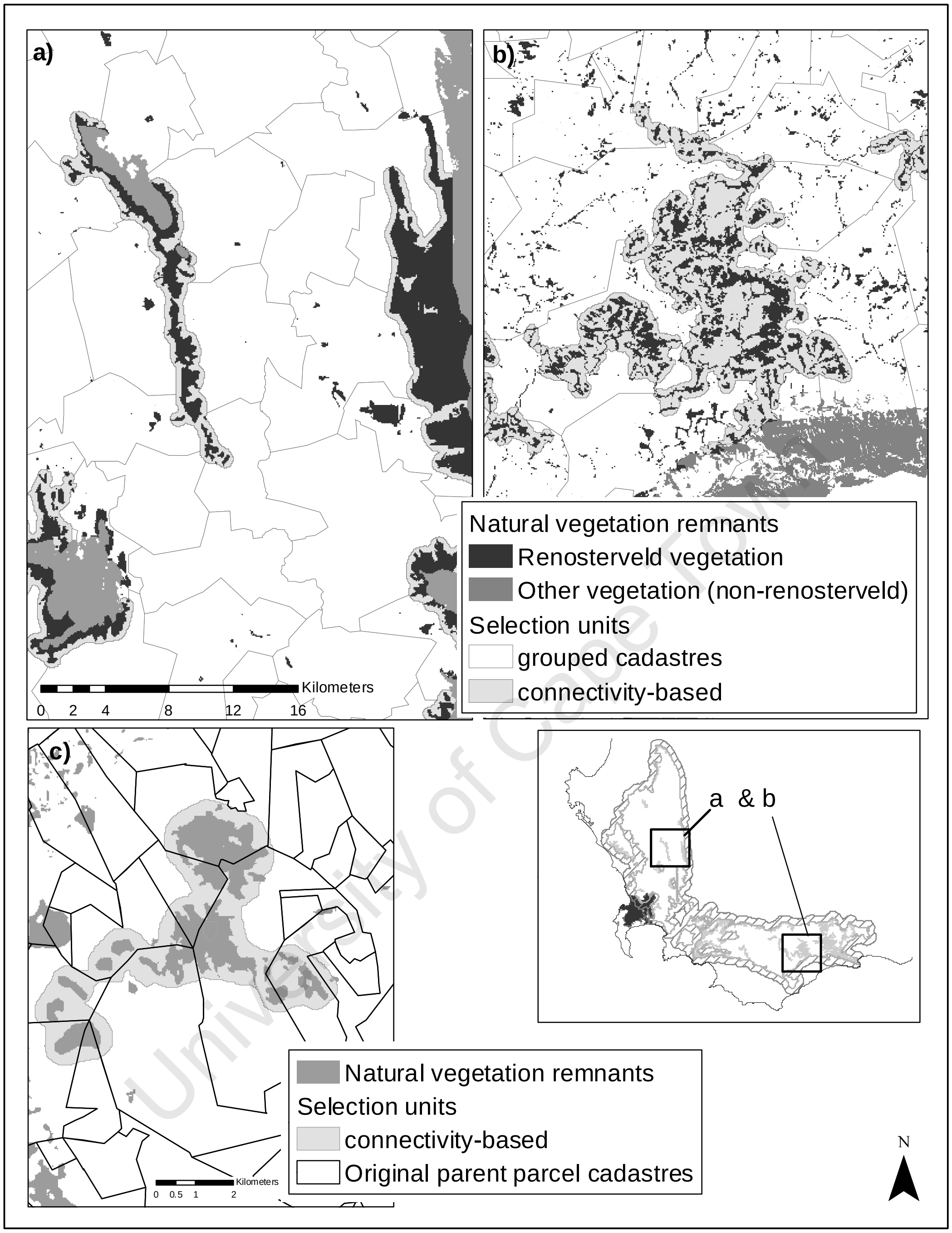


Figure 2.6. Selection Units based on renosterveld connectivity or grouped cadastres.
Vegetation remnants in a sample of connectivity-based selection units (a) in the Boland/Swartland, where vegetation is more densely aggregated, compared with (b) in the Overberg. Fig. 2.6 (c) shows how a connectivity-based selection unit incorporates a renosterveld remnant, compared with the remnant being split up by the original ungrouped cadastral selection units.

Table 2.1. The size and number of selection units in the study area and the extent of renosterveld captured in the units.

Type of selection unit	No. units	Area of units[1]	Mean unit size (km^2)	Renosterveld[1]
Overberg:	186	8528.0 km²	45.9	697.4 km²
a) Connectivity-based	27	16.3%	51.6	72.6%
b) Cadastre-based	159	83.7%	44.9	27.4%
Boland Swartland:	192	9739.2 km²	50.7	338.7 km²
a) Connectivity-based	16	4.8%	29.0	69.9%
b) Cadastre-based	176	95.2%	52.7	30.1%
Elgin Basin:	9	310.0 km²	34.4	9.8 km²
Cadastre-based	9	100%	34.4	100%
Cape Lowlands region:	387	18577.2 km²	48.04	1045.8 km²
a) Connectivity-based	43	10%	40.3	71.1%
b) Cadastre-based	344	90%	44.0	28.9%

[1] measured as km² and % of total for each sub-region

4.3 Comparing selection unit layers

The designed selection units layer (connectivity- and grouped cadastre-based units) consisted of considerably fewer units (387 in total) than the layer of original, ungrouped cadastres (2150 units). The areas covered by 43 connectivity-based units contained 596 of the original cadastres, while areas with 344 grouped cadastral units were covered by 1554 original, ungrouped cadastres. Figure 2.6 (c) illustrates how well a larger connectivity-based selection unit incorporated a cluster of renosterveld remnants, whereas the greater number of smaller original ungrouped cadastres split up the remnants cluster as well as individual patches.

Both measures used to compare the two selection unit layers, i.e. mean connectivity index per unit and amount of connected vegetation per unit, confirmed that connectivity-based units capture renosterveld connectivity more effectively than ungrouped cadastres. Figure 2.7 shows how rapidly connected vegetation accumulated in the designed selection units layer (connectivity-based and grouped cadastres) in relatively few units: the curve rises steeply, levelling out at around 200 units. This is mainly due to the connectivity-based units, with a high median connectivity index (38.1). The median values for grouped and ungrouped cadastre-based units are similarly low at 2.5 and 2.6 respectively. In contrast with the designed selection units layer, ungrouped cadastral units accumulated connected vegetation more gradually (Fig. 2.7). The grey curve rises more slowly, only beginning to plateau at around 800 units, when nearly all connected remnants are included.

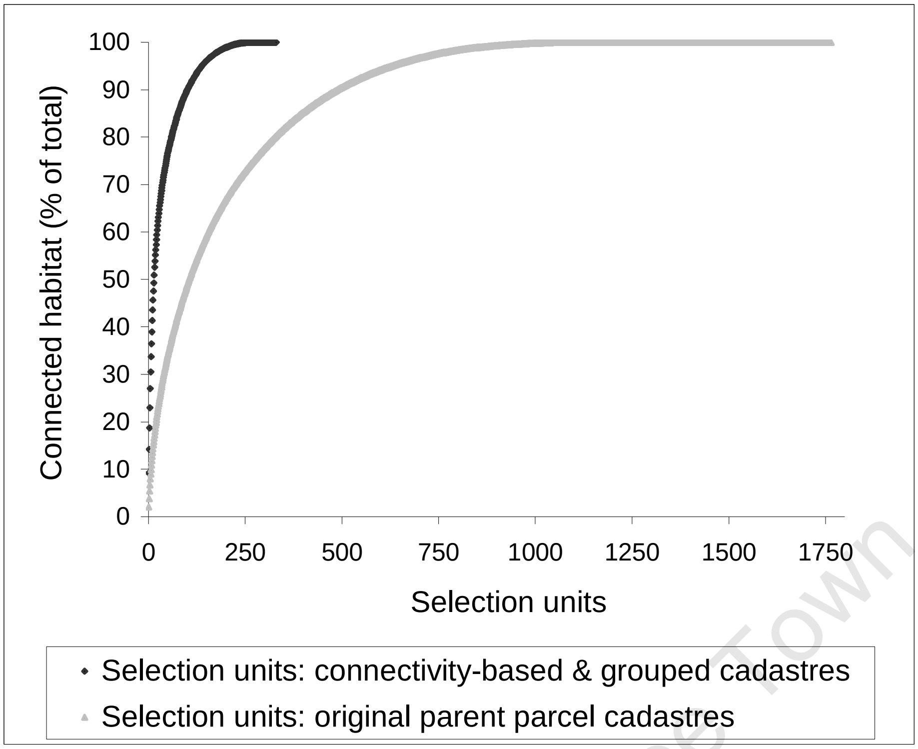


Figure 2.7. Cumulative area of connected vegetation (% of total) for the designed layer of connectivity-based units and grouped cadastres (black) and for the original ungrouped cadastral layer (grey).

5. Discussion

5.1 Connectivity patterns

Connectivity patterns in the Cape Lowlands display strong spatial variation. At the landscape scale connectivity is severely compromised as a result of the high level of land transformation. On this basis, the viability of the ecosystem as a whole seems tenuous. However, the land has been cleared in such a way that while some parts of the region are characterised by small, isolated remnants among extensive cultivated fields, other areas retain quite sizeable, densely aggregated clusters of renosterveld (e.g. along river courses, in less accessible areas on slopes) with reasonably good connectivity between remnants. These often fairly large tracts of remaining connected vegetation are suitable areas for focusing conservation action: they are where the region's characteristic biodiversity is concentrated and are likely to be needed in their entirety for long-term biodiversity persistence in the lowland region (Bond et al., 1988; Pauw, 2004).

Studies on biodiversity patterns and processes in renosterveld indicate that the Cape Lowlands ecosystem still retains a degree of functionality. Many plant and insect populations and pollination syndromes are still intact and even quite small remnants may thus have conservation importance (Bowie and Donaldson, 1999, Kemper et al., 1999; Donaldson et al., 2002; Tscharntke et al., 2002; Pauw, 2004). Yet at the same time there are signs that the system is 'unravelling', and that connectivity will be crucial in efforts to protect the biodiversity. Isolated remnants are the most vulnerable, especially in an urban matrix (Donaldson et al., 2002; Pauw, 2004). More important than patch size then are aspects such as the connectivity, habitat quality and the type of matrix between remnants (Pauw, 2004, Thomas et al., 2001, Brooker and Brooker, 2001), as well as key processes including fire and other natural disturbance events (Bond et al., 1988, Cowling and Bond, 1991, Pauw, 2004) that act at larger scales than the individual vegetation remnant.

This study shows that the way in which connectivity is defined and measured can have a noticeable effect on how an area's connectivity may be perceived (see also e.g. Goodwin and Fahrig, 2002). Take, for example, the distance thresholds describing structural connectivity: within 1000 m nearly all remaining vegetation patches qualify as connected whereas less than 60% of remnants are connected at the 100m cut-off. Similarly, using the number versus area of remnants as a measure can influence the way in which we view connectivity in the system. Thus it seems useful to experiment with several measures, each of which may highlight a different aspect of connectivity, and then to consider which measures are most meaningful in the specific context.

A missing link in this regard is a body of research that would provide the required understanding of both structural and functional connectivity in a particular system (Sih et al., 2000, Tucker, 2000, Villard, 2002, Henle et al, 2004). Given the absence of clear ecologically-based guidelines in my study system, I relied on specialist knowledge (and on results from comparing different levels of structural renosterveld connectivity) to choose a generic 500m threshold for designing selection units. While this may be criticised as arbitrary, I believe the approach used here to integrating connectivity in planning for the fragmented system to be valuable: it is flexible and easily adjustable so that different thresholds can be chosen, for example if suitable data become available or if there is a particular objective such as achieving connectivity for a species of special concern (e.g. Pyke, 2005, Schultz and Crone, 2005). In this context, there is scope for further work to be undertaken to include functional connectivity in renosterveld conservation by integrating behavioural and demographic information on a focal species, the endemic Bontebok antelope *Damaliscus pygargus pygargus*.

5.2 Integration of connectivity into conservation planning using selection units

Although numerous studies include connectivity in reserve selection and design (e.g. Briers, 2002; Cabeza, 2003; Cerdeira et al., 2005; Önal and Briers, 2005; Moilanen, 2005; Rouget et al., 2006), only few have integrated connectivity at the stage of defining selection units. Yet, Pyke (2005) incorporated linear connectivity between salamander breeding habitats in a conservation plan by designing network-based planning units to select areas for the movement of this species' population. Those units were however not directly tied to land cover, except than as linkages between ponds. By comparison, in the present study land cover (remaining connected habitat and transformed areas) across the entire landscape formed the basis of the designed selection units.

The designed selection units cater for different landscape scenarios: they incorporate areas with large chunks of vegetation (high connectivity values) and areas where vegetation patches of all sizes are clustered together. I show that connectivity-based units capture connected and densely aggregated vegetation more effectively the cadastral selection units tested here, and they ensure that vegetation remnants and clusters of connected remnants remain intact in the site selection process (chapter 3). This is particularly useful in a situation where vegetation is 100% irreplaceable and where achieving likely biodiversity persistence in the landscape is a key focus for conservation. Defining connectivity-based selection units would be inappropriate in a largely intact natural system, or a more heavily fragmented one with only small isolated vegetation remnants, due to the difficulty of delineating connected areas. Even in this study it was necessary to draw on cadastre-based units to create a spatially continuous selection units layer for the Cape Lowlands.

5.3 Implementing conservation action focused on landscape connectivity

Implementing conservation action in a system such as the Cape Lowlands is a massive task due to the large size of the area, limited resources, fragmented nature of the remaining vegetation, and its private land ownership. The main tool for securing land for conservation under these circumstances is likely to be through intensive formal engagement with landowners in priority areas (chapter 4; Pence et al., 2003). Connectivity-based selection units promote the concept that the landscape is composed of a system of connected remnants that contribute to the conservation goal for the ecosystem. Focusing attention on those parts of the landscape that retain the largest amount of connected vegetation facilitates the choice of implementers as to where to spend conservation resources most effectively and efficiently in the fragmented, transformed Cape Lowlands landscape. The concept of triage is thus integrated early on in the conservation assessment (Bottrill et al., 2008): the selection of priority areas will mostly focus on biodiverse, connected clusters of critically endangered renosterveld vegetation (chapter 3) and will exclude isolated small remnants that are difficult to conserve and likely to provide limited biodiversity benefit (e.g. ecosystem functioning).

Keeping an eye on the bigger picture (i.e. the entire ecosystem) encourages the possibility of implementing a true landscape-level conservation vision. In certain priority areas this could involve the restoration of converted land between clustered renosterveld remnants and the reestablishment of populations of indigenous mammalian herbivores that require large areas of remaining vegetation to be sustained (Kerley et al., 2003). These mammals may play an important role in re-introducing selective forces and grazing-related processes that shaped the renosterveld biota. This could be a feasible outcome of conservation interventions in the Cape Lowlands region in the long run. Currently it is a largely theoretical issue given the realistic challenges involved in simply conserving a proportion of the remaining vegetation (chapter 5). Yet it is worth maintaining such a bolder conservation vision so that it may be implemented in parts of the landscape when the opportunity arises.

CHAPTER 3

Prioritising areas for conservation in the Cape Lowlands landscape

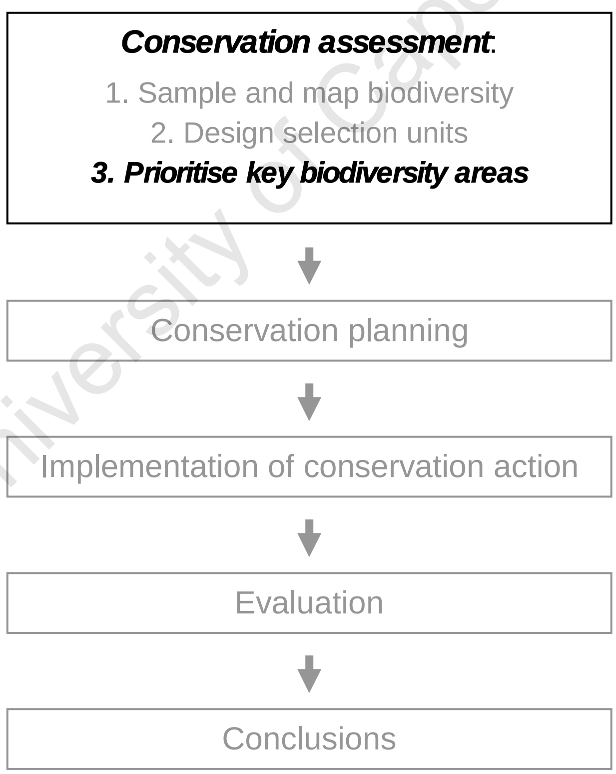


Figure 3.1. The conservation process in the Cape Lowlands Renosterveld region: identifying spatial biodiversity priorities in the fragmented natural landscape as part of the conservation assessment.

1. Introduction

Conservation planning seeks to ensure that limited resources are effectively and strategically directed towards securing key biodiversity areas in the landscape. This means prioritising areas for protection in space, through reserve selection and design techniques, and in time, through sequentially scheduling conservation actions within priority areas. This helps implementers, who put planning into practice, with making difficult 'on-the-ground' decisions on where to act and when.

The identification of spatial conservation priorities has been a major focus for conservation scientists over the past 30 years (Justus and Sarkar, 2002). This has led to the rapid evolution and multiplication of technical methodologies for reserve selection and design (or place prioritisation, Sarkar, 2004). Key developments, reviewed in more detail in the following section 1.1, include (i) the shift from opportunistic selection towards more rational reserve selection according to defensible criteria (e.g. Ratcliffe, 1971, 1977) and explicit targets (Margules and Pressey, 2000); (ii) improvements in the selection efficiency so as to capture all targeted biodiversity features in the smallest possible conservation area network (see Pressey et al., 1993); (iii) the integration of spatial reserve design criteria in order to balance criteria for adequate biodiversity representation with persistence factors (e.g. Williams et al., 2005); (iv) consideration of the temporal aspect of reserve selection so as to accommodate the shifting of spatial priorities over time (e.g. Turner and Wilcove, 2006); and (v) the inclusion of financial or other costs in selecting proposed conservation areas (e.g. Wilson et al., 2006, 2007).

A large variety of reserve selection and design procedures and associated software programmes is now available to assist conservation planners in solving diverse spatial conservation challenges across the world. The trend has been towards increasingly sophisticated, algorithmic and mathematically complex methods (Justus and Sarkar, 2002). Many of these require specialised skills and substantial computing power. Unfortunately no single reserve selection and design method works in every situation (see Virolainen et al., 1999). Choosing a suitable methodology therefore depends on the specifics of the ecosystem and on the aims and requirements of the planning: in some situations a simple method is appropriate, at other times a more complex spatial prioritisation approach is preferable.

This chapter focuses on developing and testing a suitable approach to identifying spatial conservation priorities in the Cape Lowlands Renosterveld ecosystem (Cape Floristic Region, CFR, South Africa). This was done as part of a conservation assessment undertaken for the region (chapter 1-3), with the key aim of investigating and applying approaches that would tailor the assessment to meet the needs of real-world planning and implementation needs in the Cape Lowlands system. The assessment was complemented by a strategy development and scheduling phase that involved conservation planners and implementers in order to set explicit conservation goals for the Cape Lowlands. Together the assessment, strategy development and scheduling of conservation actions constitute a conservation planning process (see Knight et al., 2006; chapter 4). This supported the implementation of urgent conservation interventions delivered by the provincial conservation agency, CapeNature (chapter 5).

The demands of the Cape Lowlands conservation situation are such: Firstly, the land is predominantly privately owned, making it essential for individual landowners to contribute to biodiversity protection. Secondly, the entire Cape Lowlands ecosystem (12,386 km^2) is regarded as a top conservation priority. The region is critically endangered at the national scale (Driver et al., 2004) and has been identified as 100% irreplaceable (Cowling et al., 2003). This means there is no flexibility around the spatial options for conserving the biodiversity characteristic of the region, which is thus needed in its entirity to meet conservation targets set for the Cape Floristic Region (Cowling et al., 2003). Less than 9% of the Cape Lowlands region is still in a natural state and most of the remaining habitat is fragmented into several thousand renosterveld vegetation remnants (>7000).

In this landscape very few options remain for conserving the natural vegetation since all areas identified as 100% irreplaceable would need to be protected to meet conservation targets (Pressey et al., 2003). That is unrealistic, definitely in the short-term, but also most likely in the long-term given, amongst other constraints, the large extent of the region and the limited resources available for conservation interventions. During the implementation of conservation action CapeNature therefore needs to make strategic decisions regarding which areas or clusters of renosterveld remnants (chapter 2) to tackle for protection first; which areas to leave for later intervention (e.g. within a 20-year horizon); and which areas to exclude altogether according to the principle of triage (Myers, 1979, Pressey and Taffs, 2001, Bottrill et al., 2008). This requires, as a first step, the support of a rigorous, defensible decision-support mechanism (i.e. reserve selection and design approach) that enables top conservation priorities to be chosen from amongst the equally irreplaceable areas of the lowlands landscape[1]. It then also requires, as a second step, that these spatial priorities inform the subsequent implementation-rooted planning and decision-making processes over time (chapter 4). The approach to identifying priorities here was specifically developed with these factors in mind.

The objectives of this chapter are (i) to develop a feasible, effective and rational approach to prioritising areas (Fig. 3.1) across the critically endangered, 100% irreplaceable Cape Lowlands landscape; (ii) to apply this approach so as to identify biodiversity priority areas that can be used as a basis for further scheduling of sequential conservation actions over time (see chapter 4); and (iii) to verify the selection of biodiversity priorities in a post-hoc comparison using a widely-applied reserve selection and design procedure.

[1] Note that a distinction is made in systematic conservation planning between prioritising areas b.m.o. a reserve selection/design, and the scheduling of decisions regarding which priority areas should be considered when for conservation action (see Margules and Pressey, 2000). Prioritising areas in the Cape Lowlands here was essentially a first-cut scheduling process, given that the entire system should theoretically be conserved (Cowling et al., 2003). This is a somewhat atypical situation.

1.1 Review of developments in reserve selection and design

Procedures used for identifying biodiversity priorities and designing conservation area networks form the mainstay of technical conservation assessments. These procedures have undergone significant advances over the past 30 years (Justus and Sarkar, 2002). An important step in the 1970's was the development of relatively simple scoring systems that rank potential conservation areas according to a set of explicit criteria (e.g. Ratcliffe, 1971, 1977, Margules and Usher 1981). This was a conscious move towards rational selection methods and away from previously intuitive, opportunistic ways of choosing conservation areas, which frequently led to the establishment of protected areas in regions perceived to be of marginal economic interest (Pressey, 1994).

A drawback of scoring procedures was soon discovered, however, in that they tend to identify inefficient, unrepresentative conservation areas (Pressey and Nicholls, 1989). This prompted the development of iterative, complementarity-based selection procedures (e.g. Kirkpatrick, 1983; see Vane-Wright et al., 1991, Justus and Sarkar, 2002 for more on complementarity). Iterative methods are better at selecting efficient conservation area networks that capture the greatest amount of targeted biodiversity in the smallest possible area, i.e. 'minimum-set solutions' (e.g. see Pressey et al., 1993). A wide range of increasingly complex solution methods has been applied to solve this reserve selection problem. These methods include near-optimal procedures that find approximate solutions through simulated annealing techniques (Kirkpatrick et al., 1983, Possingham et al., 2000) or other heuristic algorithms (e.g. Nicholls and Margules 1993), as well as optimal procedures that find exact solutions using, for example, linear integer programming (Cocks and Baird 1989, Church et. al. 1996). Continual refinements to selection procedures are seeing solution methods being drawn from disciplines such as operations research, computer science and mathematics (Williams et al., 2005; Sarkar, 2004).

Recently, progress has also been made in developing advanced reserve *design* procedures (reviewed by Williams et al, 2005). Instead of simply aiming to maximizing efficiency, and thereby favouring fragmented conservation networks, reserve design methods integrate spatial attributes such as compactness or connectivity in sophisticated algorithms (e.g. Possingham et al, 2000; Cerdeira et al, 2005; Onal and Briers, 2005). This is in an attempt to balance the trade-off between criteria for adequately representing biodiversity patterns and factors that cater for persistence (Cowling and Pressey, 2001; Rothley, 2006).
Other key developments in reserve selection and design are focused on the inclusion of cost factors (Naidoo et al., 2006, Wilson et al., 2007) and on dynamic selection techniques that consider future uncertainties, such as site availability for conservation (Drechsler, 2005; Turner and Wilcove, 2006).

2. Methods:

Spatial prioritisation in the Cape Lowlands was first tested here in the south eastern part of the study area, the Overberg (5534.6 km^2). It was then expanded to the entire Cape Lowlands region. In the early stages of the conservation assessment (Fig. 3.1) biodiversity data describing the region were collected and analysed (see chapter 1). Selection units were developed to integrate vegetation connectivity upfront in the prioritisation of areas (chapter 2). The assessment phase culminated in the selection of spatial biodiversity priorities (this chapter). In a planning phase (chapter 4) the technical outputs were interpreted further for conservation action. The planning phase linked the assessment with the implementation of off-reserve conservation interventions (chapter 5; Fig. 3.1).

The methods below describe:

1. the development of a scoring approach to spatial prioritisation in the Cape Lowlands and the identification of biodiversity priorities in the Overberg;
2. the application of MARXAN, a reserve selection tool based on simulated annealing (see Ball and Possingham, 2000; section 2.2), to identify biodiversity priorities in the Overberg as a means of verifying the scoring-derived priorities post-hoc.

2.1 Developing a spatial prioritisation approach for the Cape Lowlands

2.1.1 Key characteristics of the approach

The prioritisation approach needed to fulfil the several requirements. It had to:

(i) enable the objective and consistent selection of priority sites across the Cape Lowlands;

(ii) be transparent and easily interpreted by implementers, in this case CapeNature staff;

(iii) be suitable for guiding flexible planning and on-the-ground decision-making regarding key interventions by CapeNature over time, without being prescriptive to the implementers; and

(iv) integrate habitat and vegetation connectivity. This was identified as an important criterion by implementers. It was reasoned that in the highly compromised, fragmented Cape Lowlands landscape the larger, more highly connected areas were of critical importance as they might allow for the protection of key ecological processes and have a reasonable chance of persisting into the future. Conservation priority should be given to these connected areas, if necessary above achieving the efficient representation of species and of other biodiversity patterns.

Reserve selection usually involves setting quantitative biodiversity targets aimed at achieving the adequate representation and persistence of the region's characteristic biodiversity. Proposed conservation areas are then selected to meet the targets at a minimum cost in area or finances (e.g. see Pressey et al., 1993). In the case of the Cape Lowlands targets had already been set for the region by a broad-scale conservation planning process for the CFR (Cowling et al., 2003). To meet the above list of requirements for devising a suitable approach to identifying priority areas in the Cape Lowlands I developed a simple scoring system. This approach could be logically applied to the 100% irreplaceable landscape without explicitly lowering the biodiversity targets that had been set for biodiversity in the conservation plan conducted by Cowling et al. (2003).

2.1.2 Identification of biodiversity priorities using the scoring approach

The scoring system was designed to operate in Arcview (E.S.R.I., Redlands, California) via a simple user-interface and an .aml script. I compiled a set of biodiversity variables (Table 3.1) to serve as a basis for prioritising conservation areas. The variables were summarised to selection units that were designed on the basis of vegetation connectivity. This was to individual remnants or clusters of linked remnants to be split in the selection of spatial priorities. In very highly transformed parts of the study area connectivity-based units were complemented with grouped farm cadastral selection units (chapter 2). The matrix of selection units by biodiversity variables was integrated into the scoring system to evaluate the biodiversity significance of each selection unit. The option of differentially weighting biodiversity criteria was built into the scoring system to enable the data to be explored and to determine the contribution of individual selection units to components of the region's biodiversity.

Table 3.1. Biodiversity (pattern features and processes) variables used in prioritisation

Criteria	Measure	Role	Source
	Habitat characteristics		
Area of connected renosterveld vegetation	Amount of renosterveld connected within a 500m radius of all cells belonging to that selection unit	Possible maintenance of key processes within and between patches (e.g. biota migration)	Connected vegetation estimated by this study (chapter 2)
	Biodiversity features		
Vegetation types	1. Number of vegetation types per selection unit 2. Uniqueness/representation index based on remaining extent of different vegetation types in the Overberg	Representation of different habitat types Representation of habitat types confined to one or few selection units	Vegetation layer (see chapter 1) See calculation below[1]
Plant species	1. Number of plant species per unit, based on 720 records of 199 rare, threatened/endemic species across the region 2. Uniqueness/representation index	Captures plant species richness Representation of plant species confined to one or few selection units	Field surveys at 155 sites across region; geo-coding of herbarium records with reliability ratings See calculation below[1]
Animal species	1. Number of animal species per unit, based on 177 records of 31 rare, threatened or endemic species in groups Osteichthyes, Reptilia, Amphibia	Captures animal species richness	Compiled from museum and conservation agency databases (von Hase et al., 2003)

Animal species	2. Uniqueness/representation index	Representation of animal species confined to one or few units	See calculation below [1]
Ecological Processes (spatial surrogates)			
Soil interfaces	Amount of intact vegetation interfaces (250m width) along soil interfaces	Maintenance of ecological diversification	von Hase et al., 2003
River corridors	Amount of intact vegetation corridors along perennial river courses (100m wide small rivers, 250m large rivers)	Maintenance of biota migration and climate refugia, plant dispersal	von Hase et al., 2003
Upland-lowland interfaces	Amount of intact vegetation interfaces (250m width) along upland-lowland interfaces	Maintenance of ecological diversification and biota migration	von Hase et al., 2003

[1] The uniqueness/representation index (U) indicates the proportion of a selection unit's regional occupancy and gives high scores to units with rare/unique species and vegetation types (i.e. occurring in one or few selection units).

The index was calculated as:

$$U_j = \sum_{i=1}^{n} x^i / X$$

where xi is the number of occurrences recorded in the selection unit j for the i^{th} taxon, X the total number of occurrences for the i^{th} taxon across the study area, and n is the total number of taxa.

I rescaled the original values of biodiversity variables to a standardised scale ranging from score = 0 to 1, where 0 (zero) represents the minimum original data value and 1 the maximum. This step is important to standardise variables with very different value ranges (Table 3.2) so that they may be comparable across variables when integrated in the scoring system. To facilitate the interpretation of scores for individual criteria, the score of 0.5 was set to match a meaningful mid-scale original data value (Table 3.2). Original values were then linearly rescaled between the minimum and mid-scale values from 0 to 0.5, original values between the mid-scale value and 99th percentile from 0.5 to 0.99 and values above the 99th percentile from 0.99 to 1 (Table 3.2). The 99th percentile served to minimize effects that outlier values (i.e. high maxima) may have on the score.

Table 3.2. Statistics of biodiversity criteria for prioritising sites across the entire Cape Lowlands region.

Biodiversity criterion	Mean data value	'Mid-scale' data value (Score 0.5)	99^{th} percentile	Maximum
1. Connected vegetation (ha)	368.76	200	4405.23	9318.00
2. Vegetation types (number)	1.59	2	3.00	4.00
3. Vegetation types (representation)	0.44	2	5.38	17.41
4. Plant species (number)	2.71	5	32.34	41.00
5. Plant species (representation)	1.03	1	14.50	20.18
6. Animal species (number)	0.42	4	6.17	12.00
7. Animal species (representation)	0.17	1	3.06	7.08
8. Soil interfaces (ha)	64.57	200	937.57	1004.56
9. River corridors (ha)	58.69	100	654.65	2001.07
10. Upland-lowland interfaces (ha)	55.71	100	865.33	1150.94

2.2 Post-hoc verification of scoring-derived biodiversity priorities using MARXAN

To verify the spatial priorities selected by the scoring approach, I applied MARXAN reserve design software with the Conservation Land-Use Zoning/CLUZ interface (Smith, 2004) to the Cape Lowlands data. Although many reserve selection/design software options are available (e.g. C-Plan, LQGraph, Zonation, and others) I chose MARXAN because: (i) the method allowed for the integration of spatial attributes (e.g. connectivity), a feature which many other programmes did not have (e.g. C-Plan); (ii) MARXAN had already been widely used in South Africa and other parts of the world and was supported by good documentation (Ball and Possingham, 2000) as well as a user list-server; and (iii) sequential selection scenarios could be built (e.g. based on incremental targets, see Stewart et al., 2007) for comparison and verification of scoring derived scenarios.

MARXAN is based on a simulated annealing algorithm (Kirkpatrick et al., 1983) and produces near optimal reserve network solutions, which together represent a sample of all possible solutions to a reserve selection problem (McDonnell et al., 2002). A measure of summed irreplaceability is calculated per selection unit based on the proportion of solutions in which the unit appears (Leslie et al., 2003). This differs somewhat from the statistical way irreplaceability is established by Ferrier et al. (2000) and used by Cowling et al. (2003) for the Cape Floristic Region. MARXAN integrates spatial attributes (e.g. connectivity, compactness) through a boundary length modifier (BLM) function that promotes the clustering of selection units, or sites, by adding a high cost factor to exposed, unconnected boundaries (Ball and Possingham, 2000).

I integrated the following biodiversity variables: remaining natural vegetation; vegetation types; plant and animal species localities; and surrogates for ecological processes in the Overberg (Table 2.1). The uniqueness/representation index variables (Table 3.1) were redundant as MARXAN uses a complementarity-based algorithm. I summarised the variables to 896 selection units defined by farm cadastres in the Overberg (chapter 2). I used the following parameters, given published recommendations (e.g. Ball and Possingham, 2000) and exploration of the lowlands data: the adaptive annealing algorithm with iterative improvement, no cost threshold, 100 runs, 1000000 iterations, BLM equal to 1, species penalty factor (SPF) equal to 10000, initial temperature and cooling factor set adaptively, number of temperature decreases 10000 for each of the biodiversity targets set to 10, 25, 50, 75 and 100% of the total number (e.g. species) or area (e.g. vegetation types) of each biodiversity variable (Table 3.1). Varying the BLM across targets showed a BLM of 1 as most suitable, as it allowed for targets to be met while still integrating compactness in the reserve network solutions.

In order to verify the scoring approach as a means of selecting biodiversity priorities, I set up a range of selection scenarios based on incremental scores (0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7 and 0.8) and target thresholds (10%, 25%, 50%, 75% and 100%). For each score-based and each target-derived scenario I calculated the total area covered by the selected sites, as well as the amount of connected vegetation captured; the representation of plant and animal species; and the representation of vegetation types, ecological processes.

I determined whether the scenarios at incremental targets were well-nested, i.e. whether selections at higher targets included sites chosen at lower targets, to establish whether these could function as sequential conservation priority scenarios over time (see Stewart et al., 2007). Note that the main purpose of applying incremental targets was to determine a suite of sequential selection scenarios to serve as a simplified comparison for the scoring system's scenarios. It is not a standard method used in reserve selection and scheduling efforts to find proposed conservation area networks.

Based on results for the entire range of scores and targets, I chose two scenarios showing comparable spatial priorities: (i) sites selected at a score threshold > 0.3 and (ii) sites selected to meet a 25% target. I mapped the two scenarios and extracted the relevant biodiversity information (number of plant and animal species, hectares of each vegetation type, hectares of processes represented by spatial surrogates, total area covered by selected sites) for each scenario.

3. Results:

3.1. Biodiversity priorities identified by the scoring approach

The biodiversity priorities across the entire Cape Lowlands region are shown in Figure 3.2. Top priorities for the Overberg in the eastern part of the study area are described briefly below.

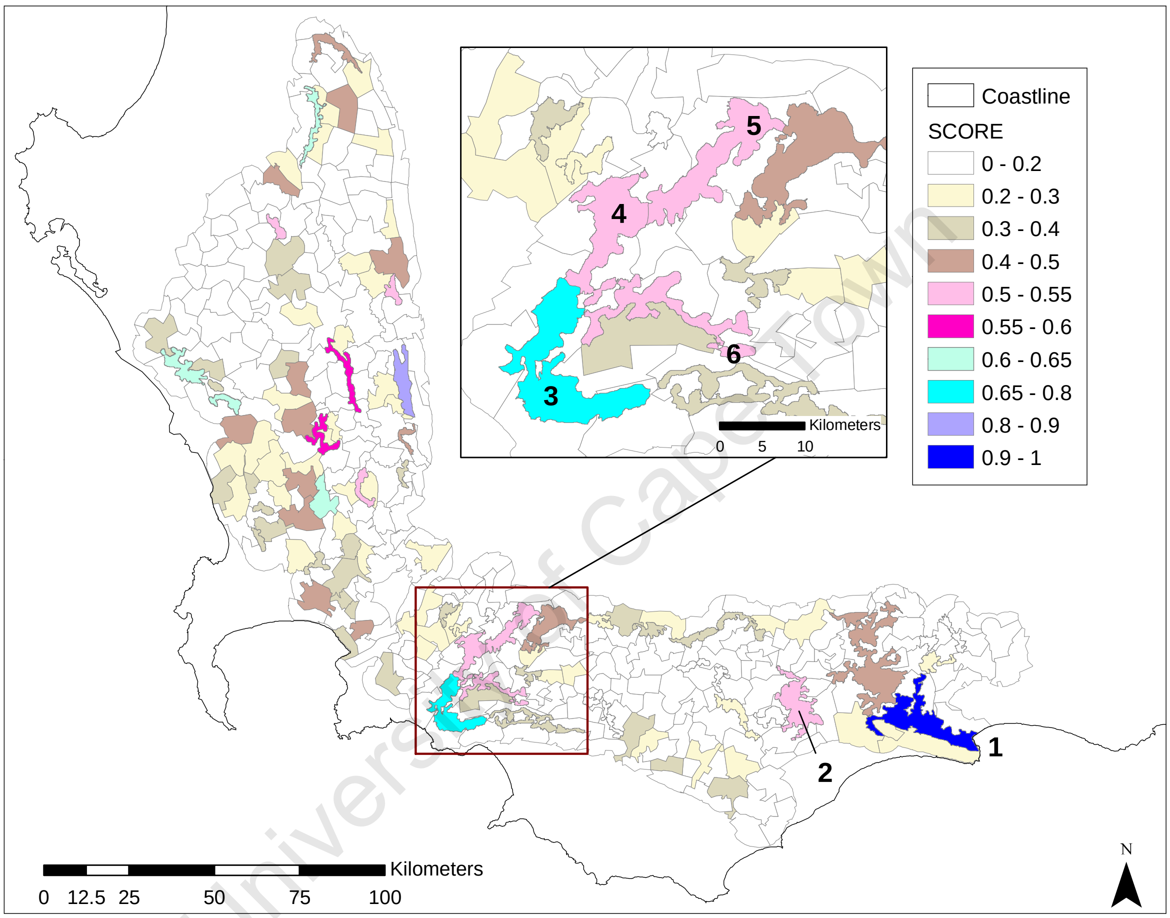


Figure 3.2: Map of biodiversity priority areas identified by the scoring approach. Numbered sites are examples of high scoring sites (described in the text and table below).

The top-scoring site (1) is located in the eastern part of the Overberg along the lower reaches of the Breede River (Fig. 3.2, Table 3.3). The site contains large amounts of connected remnant habitat that belongs to three different vegetation types characterising the Overberg. There is pronounced topographic and edaphic diversity and the area harbours significant numbers of plant and animal species. These include rare and threatened species, and species that are unique, i.e. that have only been recorded in this area. Ecological processes are very well-represented (Table 3.3), making this area valuable from the perspective of maintaining biodiversity persistence features. The Breede river site is also relatively close to an existing provincial conservation area to the west, although this was not a contributing factor to the overall score.

Another important site, Suikerkankop (2), is located in the south eastern Overberg (Fig. 3.2, Table 3.3). The area is very different from the Breede river site. The Suikerkankop area also contains large areas of connected vegetation but it is characterised by extensive silcrete outcrops, quartz patches and saline bottomlands, which contain an interesting set of plant species, many of which are unique to the area (Table 3.3). These biodiversity features contribute substantially to its high rank.

Other high-scoring sites lie in the western Overberg (Fig. 3.2). Parts of these key sites are located along the Botriver from its lower to upper reaches (sites 3-5, see close-up frame in Fig. 3.2). They include the remaining vegetation in very rare habitats and river valleys, and they are characterised by several ecotonal areas associated with great topographic and edaphic diversity. The sites thus contribute substantially to the number of plant species, and unique plant species (Table 3.3), and they contain extensive tracts of connected vegetation. Located within these overall priority areas are several smaller sites, even individual farms that represent key conservation priorities in themselves and in the broader landscape context.

In addition to these top-scoring sites, 14 other sites with a score > 0.3 make noteworthy contributions to the Overberg's biodiversity (Fig. 3.2). Most of the other remaining sites have very low scores, however, which reflect their limited contribution to the biodiversity variables included in the scoring system (Table 3.1). Nevertheless these low-scoring sites may still contain important biodiversity pattern and process features (e.g. small quartz patches with plant species endemic to the Cape Floristic Region), and they retain their 100% irreplaceable status (Cowling et al., 2003). Since the majority contain very small, isolated habitat remnants surrounded by wheat fields, however, their contribution to conservation aims in the context of this study is relatively limited. These sites, in a triage based system of decision-making, will essentially be left 'to their own devices'.

Table 3.3. Biodiversity information for the highest scoring sites in the Overberg. Ecological processes are represented by spatial surrogates, including soil interfaces, river corridors and upland-lowland interfaces.

Area	Score	Size (ha)	Plant species (no.)	Unique plant species	Animal species (no.)	Unique animal species	Vegetation types	Connected vegetation (ha)	Ecological processes (ha)	Description
1. Breede River	0.98	19614	41	11	12	5	Silcrete-ferricrete outcrops, Eastern Overberg Renosterveld, Lower Breede River Mosaic/Potberg	9318.0	5929.6	Ecotonal elements and significant topographic and edaphic diversity (e.g. sandstone, silcrete, shale and colluvial substrates). Rainfall gradients. Links with the Breede river, partly good vegetation. connectivity. Vulnerability: medium to high (alien invasive woody plant species, agriculture).
2. Suikerkankop	0.52	12164	34	11	2	1	Silcrete-ferricrete outcrops, Central and Eastern Overberg Renosterveld	3570.7	256.4	Large areas of habitat with good connectivity, significant topo-graphical and edaphic diversity (quartz patches, saline bottomlands, large silcrete areas). Vulnerability low to moderate (agriculture, grazing).
3. Botriver: lower reaches	0.75	10250	19	6	6	0	Western silcrete outcrops, Lower Botriver Mosaic, Shale and Granite Fynbos	4374.1	1232.3	Rare and ecotonal habitats (e.g. Botriver Vlei gravels). Vulnerability: high (invasive alien plants, quarrying, golf course development).
4. Botriver to Florishoogte ridge	0.55	7033	17	3	3	1	Western & Central Overberg Renosterveld, Small Sandstone Fynbos outcrops	2776.1	755.1	Great topographic variation from river valley to sandstone ridges; important river corridors; and edaphic diversity (esp. sandstone-shale contacts). Several individual smaller key sites in the landscape. Vulnerability: low to moderate. Expert opinion: "Probably one of the most viable and important renosterveld conservation areas."
5. Botriver: valley	0.52	6383	25	6	3	1	Western and Central Overberg Renosterveld	2456.6	449.8	
6. Shaw's Pass and surrounds	0.53	5118	32	5	0	0	Western silcrete outcrops, Moist Mt Fringe, Western Overberg Renosterveld	1669.6	661.8	Edaphic variablility and ecotonal elements (sandstone colluvium over shale, and gravels). Vulnerability: high (invasive alien plants; agriculture; fire).

3.2. Verification of scoring-derived priorities using MARXAN

In the different selection scenarios that were generated to demonstrate how MARXAN and the scoring approach incorporate biodiversity variables (e.g. see Fig. 3.3 to 3.5), MARXAN-selected sites were highly nested across different targets (on average 97.7% nested, minimum 92%), meaning that most sites selected at lower target levels were also amongst the sites included in selections at higher targets. Scoring-derived site selections were 100% nested across all scores: higher scoring sites were naturally included in selection results obtained at a lower score threshold. This indicates that the scores and targets in these approaches could theoretically be used to build incremental reserve scenarios, ignoring changes in site availability over time however (see Stewart et al., 2007).

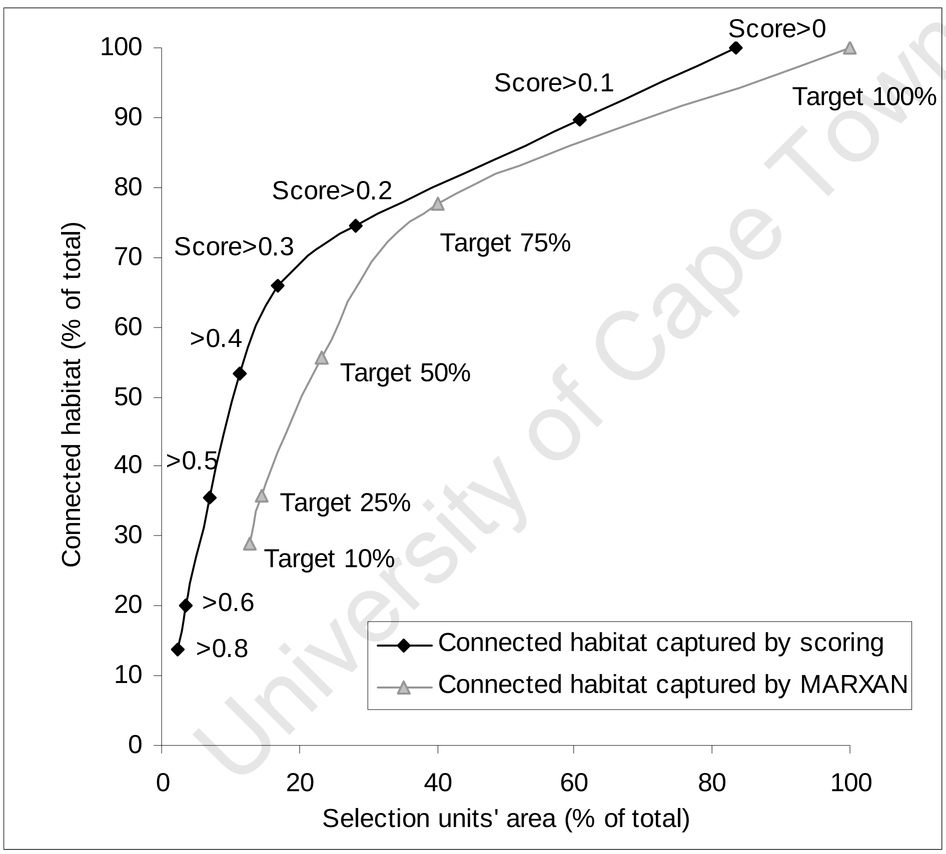


Figure 3.3. Amount of connected vegetation included in sets of selection units chosen for different score thresholds and by MARXAN.

The scoring approach and MARXAN both captured connected vegetation rapidly and area-efficiently (Fig. 3.3). The rate of vegetation accumulation was particularly high in the scoring approach between the scores 0.1 and 0.3 (Fig. 3.3). Sites with a score >0.3 encompassed two-thirds (66%) of all connected vegetation and covered only 17% of the region's total area (Fig. 3.3, 3.4, Table 3.4). Beyond the 0.3 threshold towards the lower scores (e.g. 0.2, 0.1) the accumulation rate started levelling out (Fig. 3.3).

MARXAN (with BLM) showed a similar trend to the scoring approach. Connected vegetation was incorporated relatively rapidly in the site selections between the targets 10% and 75%. Focusing on the 25% target threshold, for example, shows that only 15% of the region was required for 36% of all connected vegetation in the region to be incorporated (Fig. 3.3, 3.4; Table 3.4).

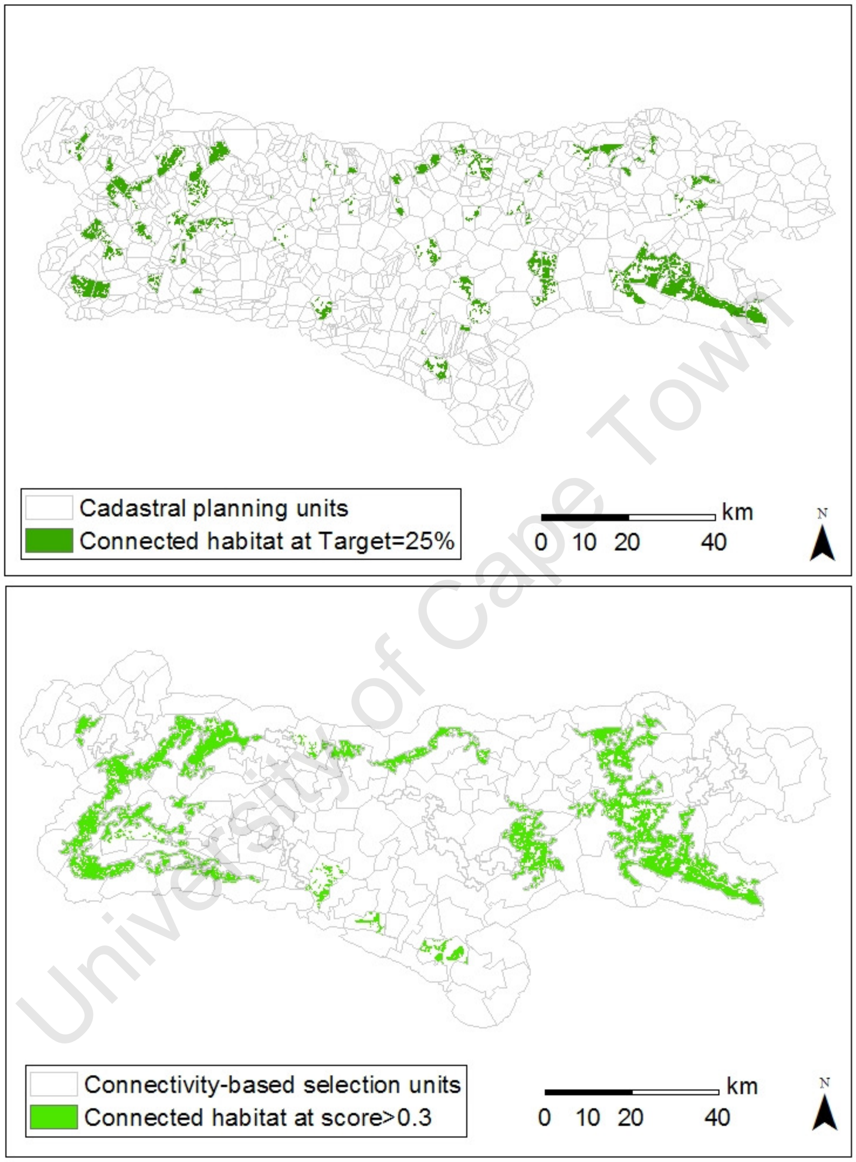


Figure 3.4. Connected vegetation selected at specific thresholds by MARXAN and the scoring approach.

Plant and animal species were captured particularly efficiently by MARXAN. The procedure chose sites to ensure full representation of species regardless of the target set (10%, 25% etc.). All species, i.e. at least one record of each, were represented in a set of 64 units covering 108275.5 ha, only 12.7% of the area (Fig. 3.5). Species accumulated less efficiently in the scoring approach: 19% of the region was needed to incorporate all animal species. To capture all plant species, 43% of the regions' area was selected (Fig. 3.5). For plant and animal species records together, however, 83 units covering 48.3% of the region were required. The species curve (Fig. 3.5) confirmed the score of 0.3 as a suitable cut-off for creating comparative site selection scenarios. Again, there is a slight levelling off in the accumulation of the biodiversity variable, in this case plant species, at the 0.3 score.

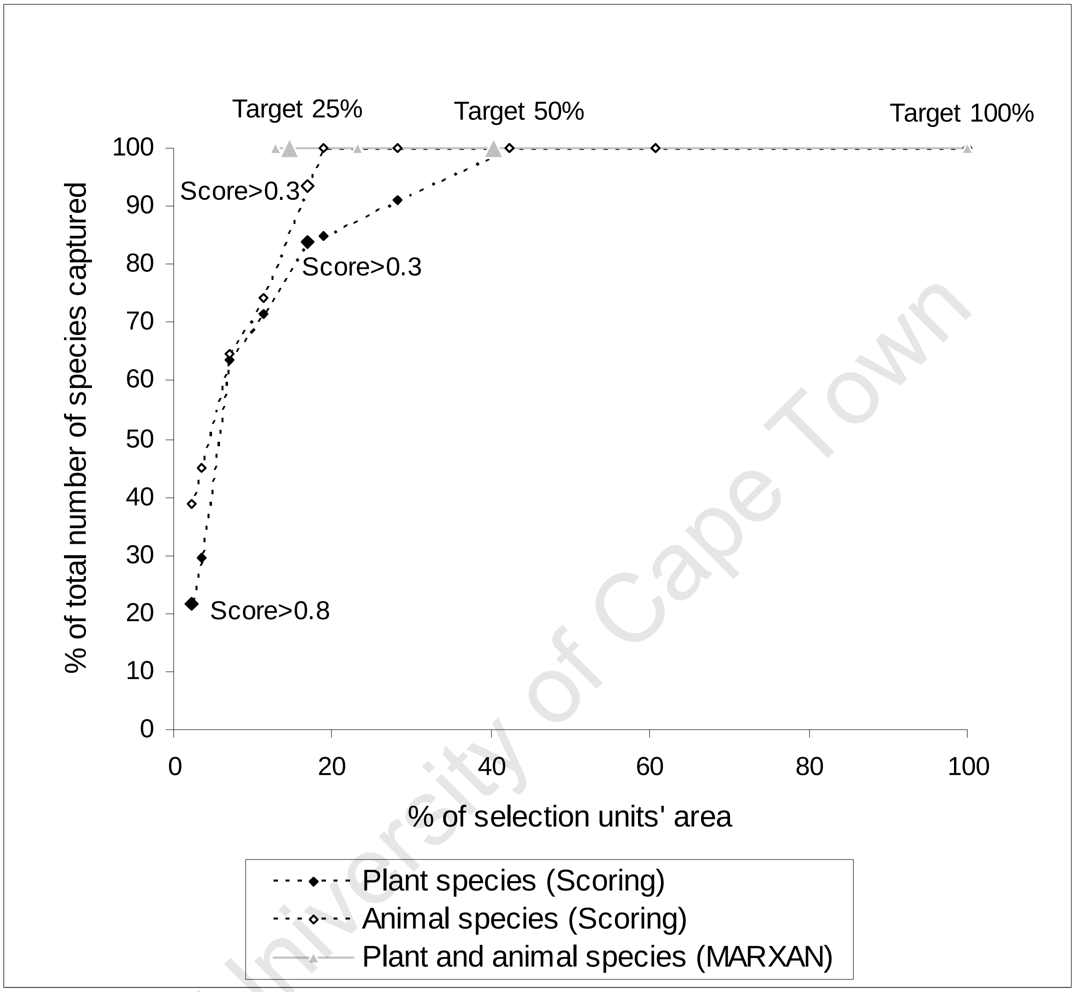


Figure 3.5. Species representation (expressed as a percentage of the total number of species of plants (190) and animals (31) in the region) in sites selected at incremental scores and targets.

Natural areas representing ecological processes and vegetation types accumulated at a very similar rate in both selection approaches. Sites selected by MARXAN for the 25% target, for example, covered 15% of the region and incorporated 33.5% of all processes as well as representative portions of each vegetation type (Table 3.4). At a score threshold of >0.3 (17% of the Overberg) the sites selected through scoring included 41.6% of processes in the region. Most vegetation types were also effectively captured (Table 3.4) with the exception of isolated, outlying vegetation types like the relictual 'Nachtwacht mosaic vegetation' in the very south of the region or 'Vyeboom mesic renosterveld/fynbos' in the far north western Overberg (chapter 1). These vegetation types needed to be more specifically targeted.

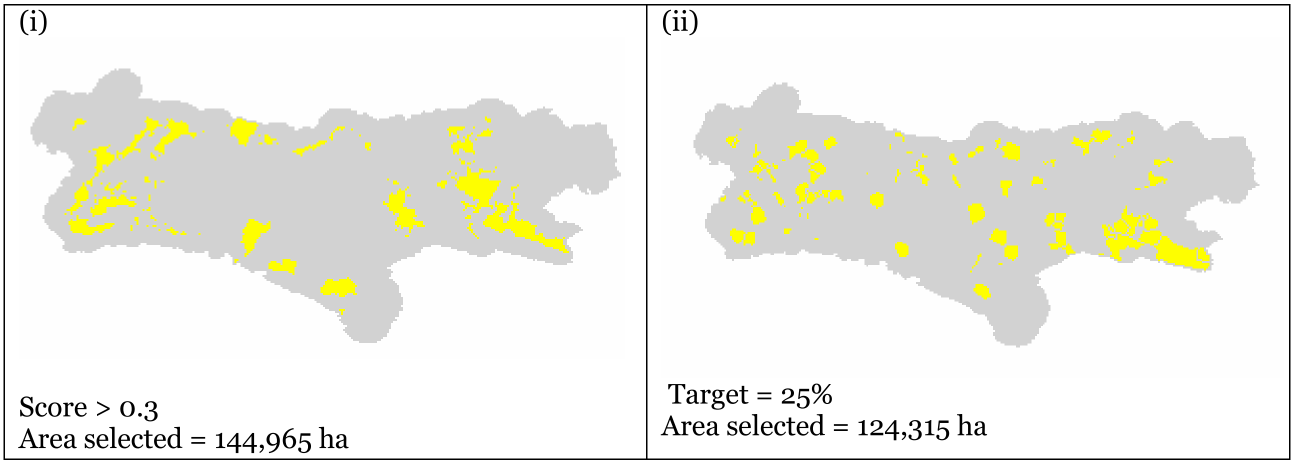


Figure 3.6. Comparable reserve selection scenarios for scoring (i) and MARXAN (ii).

A set of comparable selection scenarios for scoring and MARXAN are displayed in Figure 3.6. Detailed data describing these scenarios are given in Table 3.4. Included in the scenarios were (i) sites with score > 0.3 and (ii) sites selected to meet a 25% target. The two scenarios were of a similar extent, covering 17% and 15% of the Overberg respectively (Table 3.4). The overlap between the two scenarios, when visually detemined from selection units in Fig. 3.6, looks reasonable. Quantitatively determined, the overlap of the underlying biodiversity features is high: vegetation that is included in the MARXAN-selected sites as well as in the scoring-derived sites represents 88% of all vegetation included in the MARXAN scenario at target=25%..

Top priority sites selected by the scoring approach (e.g. in the south east and south west of the Overberg, see Results, section 3.1) were on the whole confirmed by MARXAN selected sites; few sites selected by the scoring approach do not appear in the MARXAN selection (Fig. 3.5). The scoring approach produced a scenario of more highly aggregated sites that formed larger 'corridor-type' conservation areas in the eastern and western Overberg. MARXAN in turn picked up a greater number of discreet sites spread throughout the landscape, including the central Overberg (Fig. 3.6).

Despite this difference in configuration, the two scenarios captured comparable amounts of biodiversity (Table 3.4, see also Fig. 3.3-3.5). This applied to all biodiversity variables included in the selection procedure (Table 3.1). The scoring-selected sites generally matched biodiversity captured in the MARXAN scenario. This included even the more isolated vegetation types (Table 3.4), which are under-represented at lower scores. Plant and animal species, however, which are fully represented in the MARXAN scenario, are not captured as completely in the scoring scenario (Table 3.4, see also Fig. 3.5).

Table 3.4. Amount (in %) of biodiversity variables captured in two comparable selection scenarios at specific target and score thresholds by the MARXAN and scoring approaches.

Biodiversity variables and area captured in selected sites	Scoring scenario Score: >0.3	MARXAN Scenario Target: 25%
Area covered by selected sites (%)	17.0	14.6
Processes (%)	41.6	33.5
Connected vegetation (%)	65.9	35.7
Plant species (%)	83.7	100
Animal species (%)	93.5	100
Vegetation types (%)		
1. Central Overberg renosterveld	45.5	25.1
2. Eastern Overberg renosterveld	63.8	25.0
3. River Terrace Fynbos	93.3	43.0
4. Lower Botriver gravels	94.9	39.5
5. Lower Breede River mosaic and Potberg	100	95.0
6. Moist Mountain Fringe vegetation	81.0	25.4
7. Nachtwacht mosaic	40.8	27.4
8. Hemel en Aarde renosterveld/fynbos	99.8	59.6
9. Eastern silcrete/ferricrete outcrops	28.4	25.5
10. Vyeboom mesic renosterveld/fynbos	59.6	39.1
11. Western Overberg renosterveld	57.7	35.2
12. Western Silcrete/Ferricrete outcrops	99.2	62.6

4. Discussion:

4.1. The selection of spatial conservation priorities

The scoring approach in this study presents a consistent method for selecting spatial conservation priorities across the Overberg landscape. The approach also considers the requirements voiced by implementers, mostly from the provincial conservation agency CapeNature, who are the key recipients of products from the prioritisation process in the Cape Lowlands region. The resulting score-based conservation priorities are plausible, they are based on sound data and are generally supported by results obtained using MARXAN. This indicates that the scoring approach in this particular case is a robust method and an appropriate choice for prioritising conservation areas in the Cape Lowlands region, despite otherwise valid criticisms of scoring systems (e.g. Possingham et al., 2006).

That said, it is important to recognise that the Cape Lowlands region and the associated data set represent a specific case that is unusually well-suited to producing i. efficient results in a scoring system, and ii. a similar set of MARXAN and scoring-derived priorities (see by comparison Smith, 2006). Reasons for this include first, the relatively high species turn-over across the region (see Chapter 1) resulting in dissimilar selection units. Thus a degree of complementarity (ignored by scoring systems, see introduction) is in this case more readily achieved amongst high-scoring units so that there is limited duplication of the same set of species in priority units. Second, the remaining vegetation is quite well aggregated, the connected areas of quite few in number and clearly defined in the landscape. Thus a similar limited set of selection units containing connected vegetation will be preferentially selected by both MARXAN and the scoring approach. And third, the size of selection units, in combination with an options-constrained landscape, is likely to have affected the selection process: a limited number of large units contained most of the biodiversity data (e.g. connected vegetation, species, processes, Table 1), thus making them priorities for both approaches.

In this regard Turner and Wilcove's (2006) remark is particularly relevant to the Cape Lowlands : 'When money is tight, it may be more important to "greedily" purchase the best sites possible than to weigh sites according to how they might fit in to a broader network…' This is because the big network of conservation areas may never come to be. Meir et al. (2004) further suggest that simple rules, such as protecting the most species rich or irreplaceable site first, may be best for decisions on sequential implementation. The scoring approach clearly identifies the 'best' (top-scoring) sites in the landscape, which contain large chunks of connected vegetation and are rich in biodiversity features like plant species. It makes sense for implementation to start with one of these areas that are the 'gems' in the landscape and which may have a greater likelihood of persisting (Rodrigues and Gaston, 2000). In addition, each of the priority sites incorporates numerous landholdings, so that conservation interventions can focus on a community of landowners in the same area.

The scoring approach also facilitates decisions involving triage (see also Bottrill et al., 2008). Areas that have comparatively low scores because they are neither particularly important for connected vegetation, nor for species richness or rarity can be ignored until time, money and their continued presence may justify their eventual conservation (Bottrill et al., 2008). It is necessary to accept that the low-scoring sites may be lost forever. The available resources do not allow for everything to be conserved in situ through active implementation efforts. This applies even or perhaps especially in a landscape like the Cape Lowlands region where all natural areas are irreplaceable. Deciding on priorities for conservation interventions on this basis may appear overly simple. Yet, under the circumstances, this approach is likely to be more advantageous than 'picking up (albeit complementary) pieces' as that would risk spreading implementation efforts thinly across the extensive region. Thus the scoring-derived priority areas represent a more realistic solution to the highly complex conservation challenge in the Cape Lowlands.

4.2 Prioritising Areas for the Implementation of Sequential Conservation Actions

The application of prioritisation methods is only a first step in moving towards the effective implementation of conservation action. As Margules and Pressey (2000) put it: "There is a world of difference between the selection process [..] and making things happen on the ground." Regardless of how efficient or well-designed a conservation assessment is, intervening strategically and meaningfully in practice the long run is far from straightforward. The implementation of conservation action occurs in a constantly changing environment where uncertainty is the rule rather than the exception (Turner and Wilcove, 2006). This brings up several challenges, not all of which can be considered, let alone solved, by the conservation assessment. The identification of biodiversity priority areas in the Cape Lowlands, and the development of the associated scoring-based decision-support system, creates a link between the technical conservation assessment and the further steps towards implementing conservation action in the region (Knight et al., 2006).

The scoring-derived spatial priorities for protecting biodiversity serve as a basis for the subsequent planning phase (chapter 4), during which stakeholders and implementers from CapeNature design a time schedule for pro-active conservation interventions ('action site' selection in Groves et al., 2002). This planning process is best driven by the conservation agency responsible for implementation. The process serves to refine the spatial biodiversity priorities and introduces the temporal element of prioritisation. This is important, as the biodiversity priorities identified here are a snapshot in time: the selection system is static (see also Stewart et al., 2007) and does not incorporate the probability of future change through the degradation or loss of biodiversity in priority conservation sites (see e.g. Drechsler, 2005, Turner and Wilcove, 2005). Neither were cost data integrated in the scoring or MARXAN driven site selection process, a limitation which may well influence the resulting scheduling priorities for on-the-ground action. In addition, most of the biodiversity priorities in the Cape Lowlands are large. Thus, implementing conservation action over a two to five year period requires further detailed decisions to be made on how to target conservation interventions within and between the key sites.

The scoring approach plays a central role in the Cape Lowlands scheduling process (chapter 4) due to its flexibility and intuitively easily interpreted scores. Without being prescriptive to the implementation process the outcomes provide a biodiversity-based foundation for further decision-making. This then also supports the subsequent integration of additional information on conservation opportunities and constraints during the scheduling process, including for example threat status of a piece of land or land-owner attitude to conservation (see Winter et al., 2005). Such data may be crucial for directing conservation interventions over time, but they were not included here in selecting spatial biodiversity priorities. Presently a more feasible and pragmatic way of integrating this information in the Cape Lowlands case is by including specialist knowledge in collaborative planning (chapter 4).

The Cape Lowlands do present an unusual and highly specific case study in that all remaining natural vegetation has been identified as 100% irreplaceable (Cowling et al., 2003). Yet this kind of situation, along with the associated conservation dilemma, is likely to increase in other parts of the world as habitat loss continues (Vitousek et al., 1997). This makes the outcomes of the present study relevant not only in its particular context but also for guiding appropriate responses to reserve selection, planning and scheduling in other similar ecosystems and planning initiatives.

CHAPTER 4

Linking the conservation assessment with implementation: Planning for conservation action in biodiversity priority areas

Figure 4.1. The conservation process in the Cape Lowlands region: conservation planning for action, with a focus on collaborative scheduling of conservation interventions.

1. Introduction

Systematic conservation planning has been accused of "fiddling while Rome burns", in other words as a luxury in the face of urgent real-world conservation problems (see Pressey, 1999, Davis et al., 1999). Such criticism is largely based on misconceptions regarding the perceived limitations of systematic conservation planning and thus seems mostly unfounded (Smith et al., 2006). But a fundamental problem remains evident: there appears to be a persistent gap between scientific conservation planning efforts and on-the-ground conservation actions (Prendergast et al., 1999, Knight et al 2008). Many conservation assessments that have been conducted using the latest technology, advanced algorithms and the best available ecological theory and data have only partly been implemented, if at all (Prendergast et al., 1999, Newburn et al, 2005). Thus, while the science underpinning systematic conservation assessments has been rapidly progressing, the practical conservation of natural areas has generally been slow and erratic. Knight et al. (2006a) speak of an implementation crisis. Salafsky et al. (2002) say that we still need "fully discover the secrets of effective conservation".

Various explanations for the mismatch between systematic conservation planning and conservation practice have been offered and solutions have been suggested for bridging the divide (e.g. Prendergast et al., 1999, Pullin and Knight, 2001, Salafsky et al., 2002, Smith et al., 2006, Knight et al., 2006a,b). There is general agreement on the need for taking a broader perspective on conservation planning, particularly to expand the focus which currently rests on improving conservation assessment techniques and data and to promote collaborative problem-solving and decision-making between different role-players. Constructive communication is especially important between the scientists and planners who generated the conservation assessment's outputs, and the implementers in charge of conservation interventions. Implementers are usually familiar with the opportunities and constraints of conservation practice based on their day-to-day experience, but they want to benefit from scientific outputs that can effectively guide their activities.

Operational models and frameworks are useful tools for providing a broader overview of conservation planning and implementation processes (e.g. Salafsky et al., 2002, Knight et al., 2006a). These frameworks help with conceptualising the different conservation planning and practice phases as well as the desired flows and feedbacks between them. This supports the implementation of an integrated approach that is characterised by stronger links between the different phases and by closer collaboration between the people undertaking the work (Prendergast et al., 1999). In this context Knight et al. (2006b) comment on the importance of distinguishing between conservation assessment and conservation planning: in the assessment, spatial conservation priorities are selected while planning refers to an assessment that is accompanied by a strategy development phase involving stakeholder collaboration.

At the core of the conservation process then is a planning phase that links the technical conservation assessment with the initial steps of implementing on-the-ground conservation action. A central aim of the planning phase is to develop a precise conservation strategy and action plan: where, when and how best to intervene within overall priority areas. Many factors play a role here, and the planning phase has various components including (i) scheduling conservation actions in space and over time; (ii) strategic planning; (iii) operational planning; and (iv) resource planning. Several of these components need to draw on a range of expertise and extensive discussion and negotiation between stakeholders is required to reach agreement and make key decisions (e.g. Theobald et al., 2000; Beratan, 2007). It is therefore during the planning phase that many of the real challenges arise in reconciling implementation realities with the scientific findings and recommendations of the conservation assessment.

Here I examine the collaborative planning phase of the Cape Lowlands conservation process (Fig. 4.1). My specific focus is the scheduling process for conservation actions in the region. This is a key step in systematic conservation planning for taking the conservation priority areas identified by the conservation assessment forward: it is essential for moving towards conservation action by deciding when and also how to implement these priorities. The scheduling process in the Cape Lowlands was based on the spatial biodiversity priorities and other information generated by the conservation assessment (chapter 1-3) and was designed to consider implementation opportunities and constraints. Conservation planners and implementers were involved in the collaborative process.

This aspect of systematic conservation planning, especially when involving collaborative processes, is often neglected and it is hardly documented in the scientific literature (but see Knight et al., 2008). The aim here is therefore to provide an overview of the Cape Lowlands scheduling process and to highlight key factors that need to be considered. To place the scheduling process into perspective, I also briefly describe the broader implementation context for Cape Lowlands-focused conservation interventions in the Cape Floristic Region (CFR); and the implementation strategy that was developed for private land conservation in the Cape Lowlands. Both aspects are integral to the conservation planning in the Cape Lowlands (see summary of the planning framework below) and they have the potential to influence the success or failure of conservation in the region.

Below is an outline of the planning framework applied in the Cape Lowlands. This framework can be used and modified for planning situations elsewhere.

1.1 Summary of the planning framework:

1. *Establish broader conservation planning and implementation context* to ensure alignment local and regional level, and at programme-, institutional- and inter-institutional level;

2. *Develop appropriate implementation strategy for conservation interventions ('HOW'?)*:

(i) *Identify suitable conservation mechanisms in the region:* systematic analysis of options and given case-specific factors, e.g. in the Cape Lowlands: private landownership; available conservation resources; policy environment; international and local experience in other regions; social information derived from landowner study in the region.

(ii) *Pilot the implementation mechanism*/s; and

(iii)	*Refine the implementation strategy.*
3.	*Undertake collaborative scheduling of conservation interventions* ('WHEN' , 'WHERE'?)
(i)	*Identify key objectives, participants; plan and prepare* detailed collaborative process including content aspects and the process.
(ii)	*Develop long-term 20-year conservation 'vision' and spatially explicit goals* based on the conservation assessment;
(iii)	*Define shorter-term 5-year spatially explicit conservation goals for implementation* based on the conservation assessment, 20-year plan, conservation opportunities and constraint factors (e.g. integrate explicit resource and operational considerations that are clearly linked with implementation strategy).
(iv)	*Develop consensus-based products and integrate these in implementation processes.*
4.	*Design suitable monitoring and evaluation system based on implementation goals.* [Not done here as part of Cape Lowlands planning process although it is recommended!]

2. The Cape Lowlands case study:

2.1 Context

The goal of the Cape Lowlands conservation study was to develop suitable outputs for guiding practical conservation interventions in the Cape Lowlands ecosystem (Fig. 4.2). Key outputs of the technical assessment conducted by conservation planners and ecologists were spatial biodiversity priorities and supporting data. These formed the biodiversity-driven basis for the strategy development and scheduling phase (this chapter, Fig. 4.2) when technical outputs were translated by planners and implementers into products and time-based conservation goals to direct practical conservation action in the region. A specifically developed conservation stewardship implementation strategy complemented these products. The conservation assessment and planning phase of the Cape Lowlands study was coordinated under the Botanical Society of South Africa, a non-governmental organisation. The implementation agency responsible for executing on-the-ground conservation interventions is CapeNature, the provincial conservation agency of the Western Cape. CapeNature was the principal stakeholder in the Cape Lowlands conservation process to which the agency's staff contributed significantly. The implementation phase is now underway (chapter 5).

2.2 The broader implementation framework

The Cape Lowlands case study fits into the broader implementation context provided by the Cape Action for People and the Environment C.A.P.E. programme (Fig. 4.2, www.capeaction.org.za). C.A.P.E. aims to conserve terrestrial and marine biodiversity of the CFR while delivering economic benefits (Ashwell et al., 2004). The C.A.P.E. implementation programme was initiated in 2001. Principal implementing agencies include CapeNature, the South African National Biodiversity Institute (SANBI), the Department of Agriculture (DoA), and the Department of Water Affairs and

Forestry (DWAF). The conservation interventions fall under six main directions: 1. Institutional strengthening; 2. Conservation education; 3. Programme co-ordination, management and monitoring; 4. *Unleashing the potential of protected areas*; 5. *Establishing the foundations of the biodiversity economy to enhance stewardship in key lowland landscapes*; and 6. Watershed management (Fig. 4.2). Although not discussed in detail here, C.A.P.E. plays a critical role in providing the overarching framework for conservation interventions throughout the Western Cape and CFR; in giving strategic guidance to the implementing agencies; and in coordinating and maintaining key connections between the programmes and interventions.

The Cape Lowlands conservation process is integral to component 5 of C.A.P.E. and it contributes to component 4. Underlying the implementation strategy for conserving the Cape Lowlands is a production landscape conservation model centred on negotiating with private landowners to protect biodiversity in off-reserve priority areas without establishing state-owned protected areas (section 2.2.1). This strategy is directly aligned with key objectives under C.A.P.E., specifically that: (i) 'priority biodiversity is conserved on private land primarily through the support of a conservation stewardship component'; and that (ii) 'land-use planning, decision-making and regulation enforces the protection of biodiversity priorities in the Cape Floristic Region'. The implementation of practical conservation interventions in the Cape Lowlands ecosystem is currently underway (chapter 5).

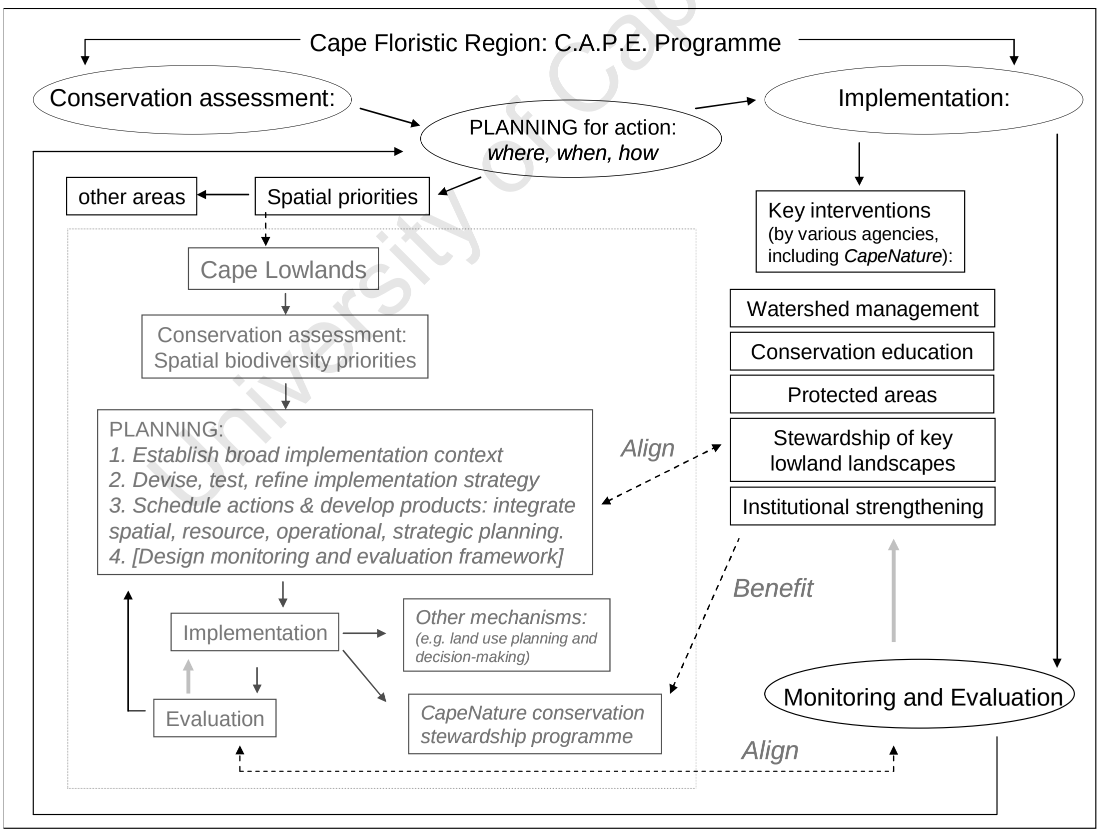


Figure 4.2. The broad implementation context for the Cape Lowlands study was provided by the CFR-wide C.A.P.E. programme. The phases of the Cape Lowlands conservation process and key links with the C.A.P.E. programme components are shown.

2.3 The Cape Lowlands planning phase

2.3.1 Developing an implementation strategy

The implementation strategy refers to the 'how' of conservation action in the Cape Lowlands: how to put the recommendations and spatial conservation priorities identified by the conservation assessment into practice in the mostly privately-owned agricultural production landscape. I review very briefly some background information that informed the development of a pro-active conservation strategy in the Cape Lowlands (section 2.3.1.1) and key characteristics of the conservation stewardship implementation strategy in the region (section 2.3.1.2). The development of the strategy was not a core activity limited to the Cape Lowlands study alone thus only an outline of the process is given here.

2.3.1.1 Private land conservation

The vast majority of land in many countries, including South Africa, the USA, Australia, is under private ownership (e.g. Botha, 2001, Hummon, 2004). This land frequently covers priority areas for biodiversity protection. Any comprehensive landscape-focused conservation strategy should therefore include an 'off-reserve' component to complement public conservation areas (Knight, 1999, Norton, 2000, Dale and Haeuber, 2000). The cost of acquiring land for conservation purposes is prohibitive (Botha, 2001, George, 2002, Pence et al., 2003), especially in agricultural production landscapes such as the Cape Lowlands (Osano, 2005). Therefore private land initiatives usually involve incentive-based mechanisms that encourage the landowners' voluntary committment to protecting valueable natural assets and which aim to engender a sense of sound land stewardship. Stewardship refers to "the responsible use (including conservation) of natural resources in a way that takes full and balanced account of the interests of society, future generations, and other species, as well as of private needs, and accepts significant answerability to society" (Worrell and Appleby, 2000).

Numerous publications have reviewed incentive-based and regulatory instruments for private land conservation (e.g. Gunningham and Younge, 1997, Elmendorf, 2003, Michael, 2003). The instruments vary in their economic efficiency, scientific validity and political or social acceptability; a combination of motivational, informational, financial and market-based incentive mechanisms may be most effective (Gunningham and Younge, 1997). Currently one of the most popular and well-established incentive schemes involves easements (Gutanski, 2000, Michael, 2003, Rissman et al., 2007). A conservation easement is a legal agreement in which a landowner voluntarily limits land uses (e.g. development rights) to a portion of land in order to conserve its conservation values. This is usually in return for a negotiated reward, for example, by a conservation organisation. The relevant conditions, rights and restrictions are framed in the deed to land or real estate and they are binding upon the current owner and all future owners (Gutanski, 2000). Advantages of conservation easement schemes include relatively low transaction costs and high habitat security; drawbacks are potentially high maintenance costs to the implementing agency, and landowner resentment (Michael, 2003).

2.3.1.2 Conservation stewardship mechanisms in the Lowlands

The conservation stewardship strategy for the Cape Lowlands was developed on the basis of (i) the local and international experience; (ii) intensive collaboration between CapeNature, the Botanical Society of South Africa and specialist advisors over an extended time period (Botha, 2001; Conservation Unit, 2004; CapeNature, 2007); and (iii) a two-year pilot phase to test a suitable conservation stewardship approach in three biodiversity priority areas in the Cape Lowlands (Conservation Unit, 2004). The farmers in two of these areas were found to be generally positive towards conserving the natural vegetation on their land (Winter, 2003). This was a significant motivating factor for employing conservation stewardship mechanisms, although it is acknowledged that landowner attitudes do not necessarily predict conservation behaviour (Winter et al., 2005, Guillon-Michel and Moses, 2006).

A long-term conservation stewardship programme was initiated in 2003 (CapeNature, 2007) to implement conservation goals in the Cape Lowlands (chapter 5) and other parts of the Western Cape. The programme aims to secure the conservation status of key biodiversity areas by negotiating and maintaining voluntary, legally binding stewardship agreements with landowners in priority areas. The spatial focus of the conservation stewardship programme is on biodiversity priority areas identified through formal conservation planning processes (chapter 3, 4 for the Cape Lowlands; see also von Hase et al., 2008). CapeNature's conservation stewardship approach is guided by a set of best practice procedures and principles of engagement with landowners (CapeNature, 2007). Stewardship officers engage with landowners to determine the degree of interest in conserving key biodiversity sites. Interested landowners can choose one of three hierarchical conservation agreements. These range from low to high in terms of the required landowner commitment to conservation; the agreement's legal status; the degree of biodiversity protection and the incentives provided (CapeNature, 2007).

2.3.2 Scheduling conservation stewardship interventions

The scheduling of conservation action in the Cape Lowlands was the second component of the planning phase. It was undertaken once the scientific conservation assessment was complete (chapter 3) and in parallel with the piloting phase of the conservation stewardship implementation strategy (section 2.3.1). The aim of the scheduling process was to decide precisely where and over what specific timeframe ('when') CapeNature's conservation stewardship interventions should be directed in the Cape Lowlands region. This provided a key opportunity for collaboration and joint decision-making between implementers, conservation planners and other specialists and stakeholders in Cape Lowlands conservation interventions.

This kind of interdisciplinary collaboration may be difficult: for planners and scientists as the frequently messy implementation issues are far removed from the relative clarity of the scientific assessment process (Knight and Cowling, 2007); and for implementers because they may be suspicious of science and theory that seems unnecessarily obscure, complex or even irrelevant, especially if their own local knowledge and expert understanding of a specific region have previously been disregarded. To facilitate the collaborative approach in the Cape Lowlands study, the scheduling process was therefore well-prepared in advance and it was jointly led by the Botanical Society and CapeNature. Focused work sessions were undertaken using simple, structured collaborative processes that involved guided discussion, problem-solving and agreement on specific goals and products. The scheduling process was done in two steps: 1) a small one-day work session to draft a proposed 20-year spatial conservation plan for the Cape Lowlands; followed by 2) a large one-day workshop to discuss and amend the proposed 20-year plan and to develop a 5-year spatial conservation action plan.

2.3.2.1 Objectives of the scheduling process

The key objectives of the collaborative scheduling process were to use the available planning and implementation expertise (i) to set realistic spatially explicit conservation goals that would allow capitalising on conservation opportunities while being feasible under implementation constraints; (ii) to integrate factors into the decision-making process that were not included in the spatial prioritisation process (chapter 3) but which influence effective, efficient conservation action; (iii) to create well-designed, scientifically defensible, user-friendly and practically relevant products to direct implementation efforts; and (iv) to generate the 'buy-in' of implementers to adopt the resulting conservation plan (Knight and Cowling, 2007).

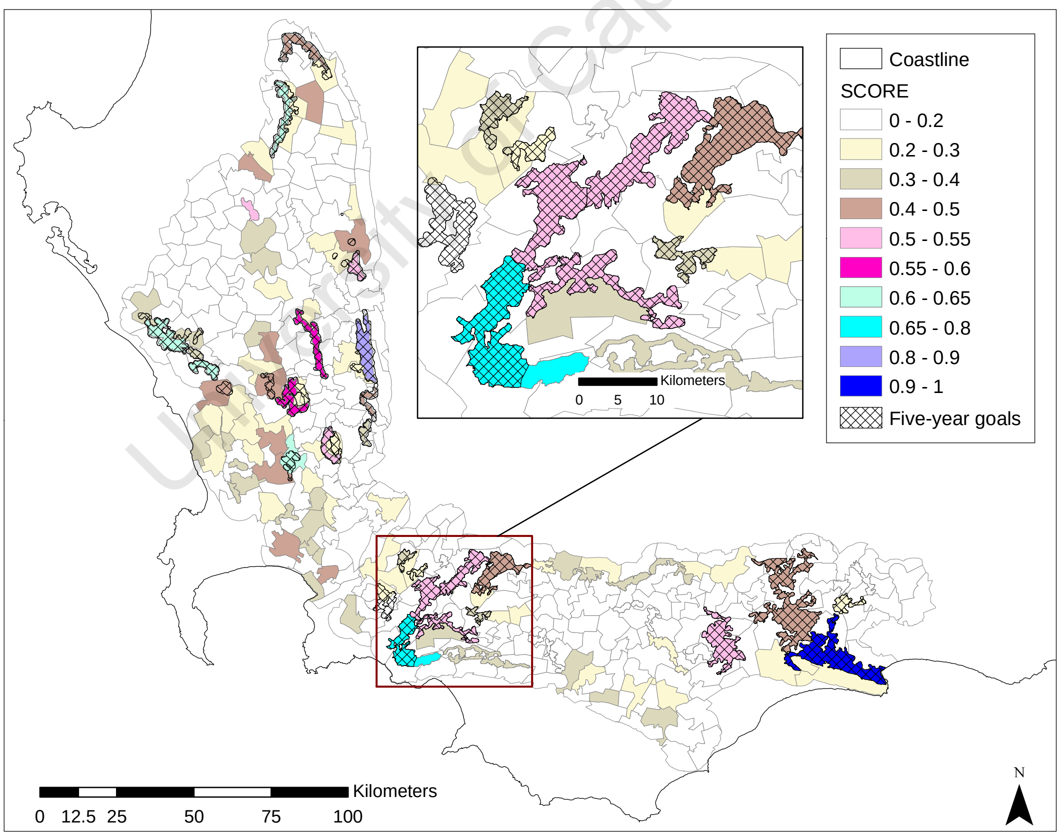


Figure 4.3. Key biodiversity priority areas in the Cape Lowlands shown according to their scores for selection units (chapter 3).

2.3.2.2 Defining a 20-year conservation plan

The 20-year conservation plan was prepared by a group of six people comprising conservation planners, biodiversity specialists and CapeNature's regional ecologists. The goal was to develop a user-friendly, non-technical and easily interpreted spatial product with accompanying information that would serve as a 20-year 'conservation vision' for CapeNature in the Cape Lowlands. The conservation assessment's spatial biodiversity priorities (Fig. 4.3) arranged in a scoring-based decision support system and accompanying information provided the basis for the 20-year conservation plan. Participants needed to have a good understanding of the technical assessment, as well as of the intended use of the final map and its target audience.

Intensive deliberation amongst participants regarding the 20-year plan's content and design led to a draft map showing the following elements:

1. *Core sites* for biodiversity conservation. These were sites scoring >0.5 for at least one biodiversity criterion (see chapter 3).
2. *Clusters of core* sites linked through vegetation connected within a 500m radius (Chapter 2).
3. *Critical habitat.* This comprised all vegetation remnants falling outside cores sites but which were identified as irreplaceable (Cowling et al., 2003). An important decision was to display the biodiversity features such as 'core sites' and 'critical habitat' themselves on the map rather than cadastral units which may need protection. This was to pre-empt possible negative reactions by landowners whose properties stand out as important for conservation.
4. *Ecological gradients* acting as corridors and linkages (Rouget et al., 2003a). Upland-lowland gradients were defined as areas where 2 km of intact vegetation existed on both sides of an identified upland-lowland interface. If an interface was several kilometres long, several options were mapped. Coast-interior gradients were defined as paths of intact vegetation connecting the coast with inland mountains.
5. *Special features.* These included wetlands, silcrete outcrops, quartz patches and spatial surrogates of ecological processes: river corridors, soil interfaces and upland-lowland interfaces that were mapped as part of the conservation assessment.
6. Information on topography and infrastructure to aid orientation (roads, towns, coastline).

The resulting draft of the 20-year conservation plan was printed on large posters and presented for review at the subsequent larger scheduling workshop with the conservation agency. The participants at the larger workshop accepted the 20-year plan in its proposed form and agreed for it to be made publicly available via the Biodiversity GIS portal (http://bgis.sanbi.org/clr/project.asp). Appendix 2 gives details on the 20-year plan and includes a figure of the resulting map. Figure 4.5 shows an outline of the 20-year spatial conservation goals.

2.3.2.3 Developing a 5-year conservation action plan

The second scheduling work session was attended by thirty key participants representing primarily CapeNature, the Botanical Society, the South African National Biodiversity Institute (SANBI) and other conservation organisations involved in practical implementation efforts in the Cape Lowlands

(Appendix 3). Most of the participants were familiar with the Cape Lowlands conservation assessment from having been involved in the assessment itself or through developing the stewardship implementation strategy.

The aim of this scheduling session was to formulate a 5-year spatial plan for conservation stewardship action. The structure of the workshop (outline in Appendix 3) was first to clearly introduce the aim and to give a brief overview of the Cape Lowlands conservation assessment and its outputs. Then, the 20-year conservation plan was presented for intensive review by the participants, who accepted the plan as proposed. The interactive process of scheduling priority conservation areas and actions over the 5-year timeframe followed. Two separate groups were formed: one dealt with the Overberg/Elgin Valley and the other focused on the Boland/Swartland region. Each group clustered around a computer and participants had the opportunity to explore the data layers and information available to support decision-making in the scheduling process. A facilitator managed each group to ensure a structured process and successful completion of the task within the allotted time. Scheduling of sites for the 5-year spatial action plan was done on-screen.

Participants were asked to estimate first what could feasibly be achieved in conserving the Cape Lowlands over the 5-year timeframe (Appendix 3). This was based on their understanding of the conservation stewardship implementation strategy (section 2.3.1.2); specific resource and management constraints and other known implementation constraints. The selection of areas for the 5-year conservation action plan was then guided by biodiversity information including (i) the 20-year conservation plan; (ii) biodiversity scores indicating spatial priorities based on the Cape Lowlands conservation assessment (Fig. 4.3); and (iii) other biodiversity criteria such as ecological gradients and special habitats; and (iv) information on conservation opportunities or constraints identified by workshop participants (Fig. 4.4). This information could include site vulnerability to degradation or biodiversity loss; conservation opportunities in areas belonging to landowners wanting to conserve part of their land; or various management aspects (Knight and Cowling, 2007), most importantly resource estimates.

Although information on threats for example can be incorporated directly in technical site prioritisation and scheduling processes (e.g. Pressey and Taffs, 2001, Costello and Polasky, 2004, Drechsler, 2005) it is often impossible to obtain the relevant data (Turner and Wilcove, 2006). In the Cape Lowlands, the vulnerability of natural areas to degradation, for example, was highly varied in nature and severity. Threats ascertained during field work ranged from subtle (e.g. invasive annual plants) to severe (e.g. ploughing by a landowner). They were difficult to predict reliably across the region (von Hase et al., 2003) and expert information filled this gap. As the information supplied by participants was predominantly fact- and not value-based (see Failing et al., 2007) it was relatively easily evaluated by peers in terms of its quality and it was easily recorded for each site and integrated into scheduling.

Decision-making to develop the 5-year action plan followed a structured, facilitated approach and it required intensive engagement of participants. Explanatory information sheets were provided to aid participants with the task of selecting and ranking of sites (Appendix 3). An advantage was that participants immediately grasped the intuitive concept of biodiversity scores for developing priorities (chapter 3). The scores related well to their knowledge of biodiversity in the Cape Lowlands region, which gave implementers confidence in the conservation assessment's outputs. The different decision-making criteria were discussed for each site to reach consensus on conservation action priority areas. In addition, selected sites were ranked from 1 to 3 to indicate the relative urgency of conservation action. A formal justification, captured per site, completed the inclusion of a site in the 5-year plan. Note that our scheduling approach here is similar to The Nature Conservancy's (TNC) approach. The TNC applies a ranking scheme based on several criteria (diversity, viability of biodiversity features, complementarity and estimates of threat) in conjunction with specialist input to choose 'action sites'. These are immediate priorities and are drawn from a larger portfolio of important conservation areas selected as priorities through heuristic reserve selection and design procedures (Groves et al., 2002).

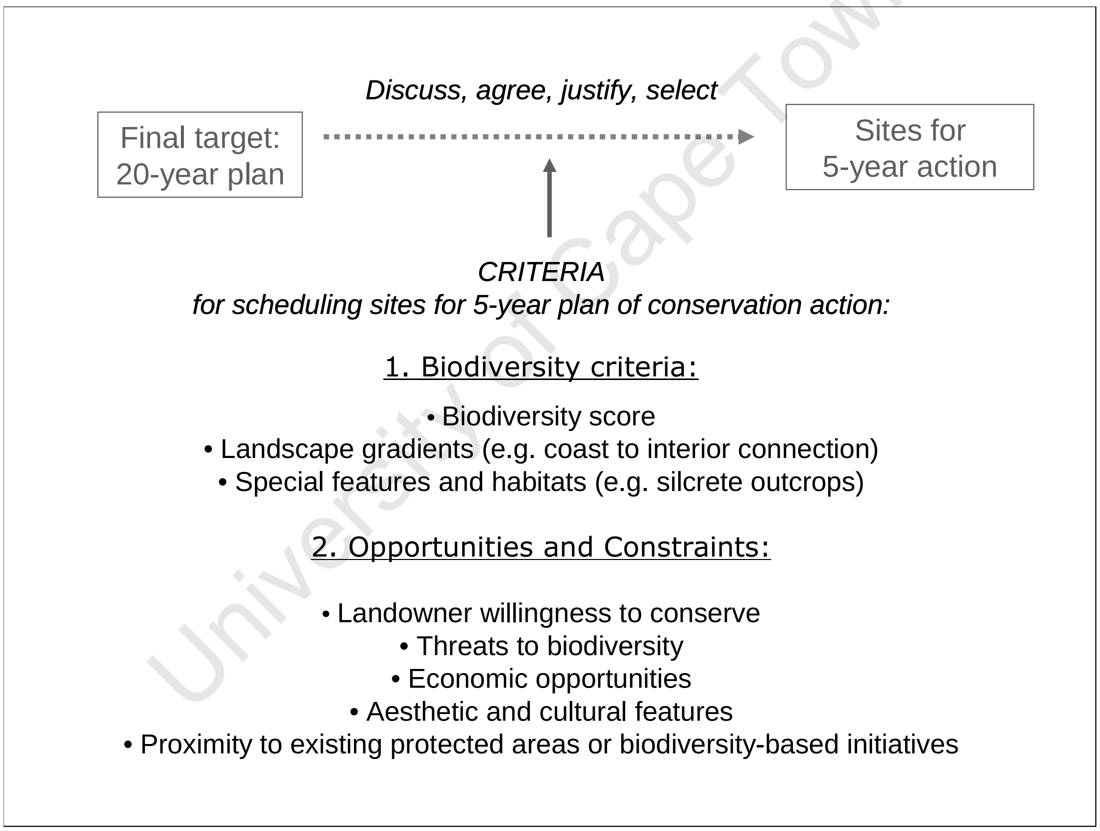


Figure 4.4. The diagram shows the process and criteria applied by workshop participants to schedule conservation action sites for the 5-year period.

The final product of the 5-year spatial plan for the Cape Lowlands region (outline in Fig. 4.5, detailed figure in Appendix 2) was a GIS-enabled map of priority areas for the immediate 5-year time span. The associated attribute table contained information about each site and detailed reasons for the site's inclusion (see Appendix 2 for examples of three priority sites). The 5-year conservation plan was intended as an internal working plan of action for conservation stewardship staff and other

CapeNature staff. The features displayed on the map were kept to a minimum to avoid cluttering the map and because staff were familiar with the region. Additional data may be overlaid in the GIS.

2.3.2.3 Summary of the 5-year and 20-year conservation plans (Appendix 2)

The 20-year spatial plan (outline in Fig. 4.5, detailed figure in Appendix 2) captured most of the critically endangered, 100% irreplaceable Cape Lowlands renosterveld. Large connected areas of vegetation were included but very small, isolated remnants were left out. Nevertheless, the plan encompasses virtually all plant and animal species with sampled occurrence locations as well as important ecological and evolutionary processes identified using spatial surrogates (e.g. see Rouget et al., 2003a). The goals in the 5-year plan targetted an ambitious proportion of the biodiversity contained in the 20-year plan: more than half of all renosterveld and ecological process surrogates and about a third of all species in the 20-year plan.

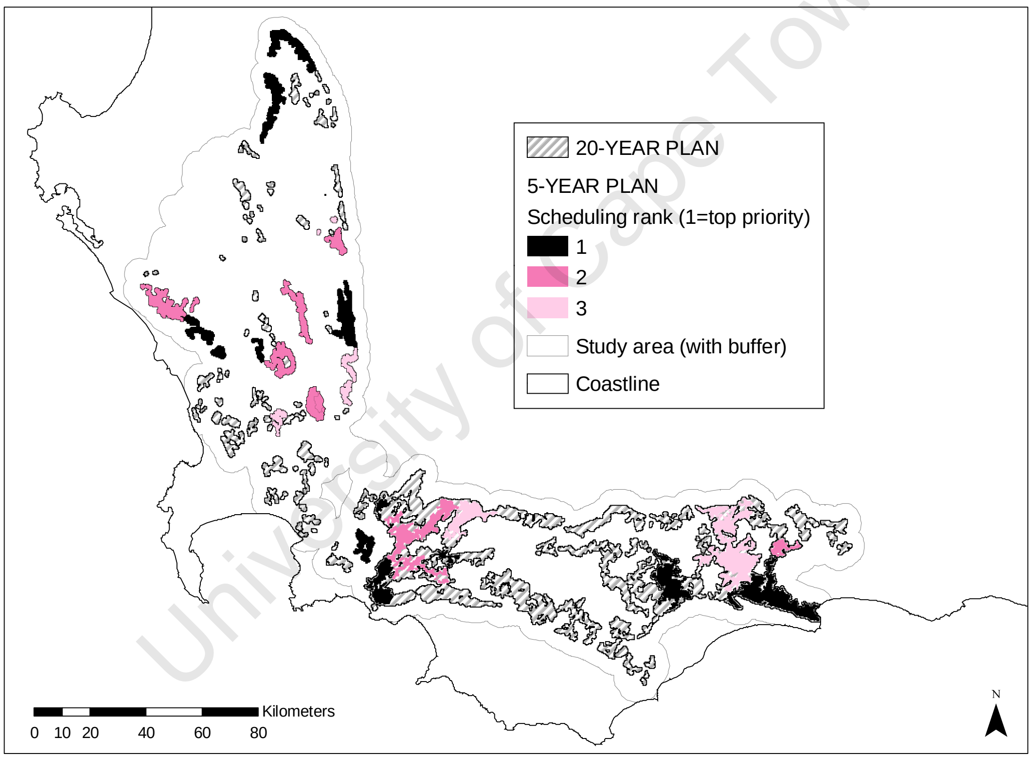


Figure 4.5. Outlines of the collaboratively developed 5-year and 20-year conservation goals.

2.4 Discussion: scheduling conservation action in the Cape Lowlands

The planning phase appears to have been overlooked by conservation planners (Knight et al. 2006b) despite its crucial role in the conservation process: it promotes the application of conservation assessment outputs (Newburn et al., 2005) and influences the chances of implementation success (chapter 5). The scheduling component of planning in the Cape Lowlands created the intended direct link between the assessment and the implementation phase in the conservation process (Fig. 4.2) and met several of its other key objectives (section 2.3.2.1).

2.4.1 What worked well?

(i) Collaboration and buy-in: The collaborative approach to conservation action scheduling was constructive. It narrowed the common communication gulf between planners and implementers (Prendergast et al., 1999). The process created a sense of ownership (or 'buy-in', Knight and Cowling, 2007) of the resulting 5- and 20-year plans by CapeNature staff and it deepended the understanding and acceptance of technical conservation assessments in the implementing agency. This is important: the implementation success of conservation stewardship interventions depends largely on the conservation agency's contributions and the scientific inputs must be seen as relevant by the implementers (Prendergast et al., 1999). The participative approach also encouraged 'champions' to emerge in CapeNature who played a central role in promoting the continued application of the conservation planning products during implementation. As a result the CapeNature conservation stewardship programme has been using the jointly produced planning products to guide their activities in the Cape Lowlands (chapter 5; CapeNature, 2007).

(ii) Integration of specialist information: A key benefit of collaboration is sharing expertise to find solutions and make decisions on issues of common concern (Beratan, 2007). Products for implementation were jointly formulated by planners and implementers who were open to interacting. Expertise from both sides was thus incorporated. As much of the science was already included in the assessment, scheduling was mainly a platform for implementers to complement the existing information base with their knowledge. This demonstrated to participants that their contributions, once reviewed by other specialists, could be usefully integrated into scheduling actions. This applied specifically to data on type and location of existing or emerging threats and opportunities for biodiversity conservation. Implementers' contact with the region's inhabitants was essential here: important decisions are often made at the farm level and depend on many interacting factors that determine an individual landowner's situation or attitude (James, 2002; Winter, 2003).

(iii) Tangible, user-friendly, spatially explicit products: Scheduling resulted in consensus-based, tangible and user-friendly products that are relevant for implementation purposes. This takes the conservation assessment's outputs a key step further: Spatially explicit, time-based goals to direct action in the Cape Lowlands were derived from the priorities based on biodiversity scores (chapter 3). These goals were also used later in evaluation (chapter 5).

(iv) Formulating the implementation approach: Scheduling areas for priority conservation interventions helped to formalise the thinking amongst implementers regarding their precise approach to conserving the Cape Lowlands. This gave structure to the implementation strategy (CapeNature, 2007) and it provided clear spatial direction to the conservation stewardship implementation programme (see Chapter 5). The parallel development of the implementation strategy in turn was a prerequisite for scheduling as it presented a practical outline of how to proceed with conservation action. Without the strategy it would have been difficult to set even vaguely feasible, realistic goals for sequential implementation (but see section 2.4.2 (i)).

(v) Flexibility and the planning cycle: The initial planning phase was instrumental in starting iterative planning and scheduling processes, including a spatial planning component, as part of the current conservation stewardship programme (K. Purnell, pers. comm.). This is important for two reasons. First, things change and this needs to be reflected by adjusting the long-term vision (20-year plan) and detailed action plans to guide ongoing implementation efforts effectively. Second, the areas identified here for conservation action were quite large, leaving scope for implementers to decide on which specific land parcel in a priority area to focus. This may be the farm owned by a conservation-minded landowner keen to participate in conservation initiatives (Winter, 2003) or the farm with most vegetation, the highest quality habitat (Thomas et al., 2001) or confirmed threatened species occurrences. Where available this information was included in the initial planning and scheduling process. But new, perhaps finer-scale information and insights that emerge during implementation need to be included in iterative processes forming part of the programme's planning–implementation–evaluation cycle (see chapter 5, Salafsky et al., 2002).

2.4.2 What can be improved?

Several aspects of the Cape Lowlands scheduling process can be improved in future planning processes. Most important are better integrating conservation opportunities and constraints in planning; and spending more time and effort on all planning components.

(i) Integrating costs: The 20-year and 5-year spatial plans illustrate the enormous conservation task in the Cape Lowlands (Appendix 2). With hindsight it is clear that the conservation goals were wildly optimistic and unfortunately unachievable (chapter 5). Although it may be tempting to aim high, setting realistic goals is essential so that private land conservation interventions in the Cape Lowlands have a chance of success. Protecting any amount of a fragmented, threatened, not particularly charismatic vegetation on private land is likely to be a formidable challenge (e.g. Hocker, 2000; Rissman et al., 2007). This challenge and the associated resources were underestimated in scheduling conservation actions. Asking workshop participants to implicitly estimate the resources required for their planned 5-year conservation interventions was not a successful approach to setting feasible goals: even for a group of implementers it is difficult to come up with reasonable estimates of implementation costs and corresponding conservation goals without good baseline figures.

Cost factors have generally been inadequately addressed in conservation planning to date although this is changing (Naidoo et al., 2006; Polasky, 2008). Increasingly cost is included as a decision-making factor in determining conservation priorities (Wilson et al., 2007; Murdoch et al., 2007; Bottrill et al., 2008). In the Cape Lowlands the most important costs needing explicit considation in future planning and scheduling processes are transaction and management costs of implementing conservation stewardship mechanisms (Jackelman et al., 2008; von Hase et al., 2008).

(ii) Including social data: Ultimately conservation is largely about people and their wants, perceptions and preferences (Prendergast et al., 1999) and less about science or even biodiversity. Several authors emphasise the need to integrate spatial conservation opportunities based on social and socio-economic data in hitherto mostly biodiversity-driven conservation assessments (e.g. Knight et al., 2008, Cowling and Wilhelm-Rechmann, 2007, Polasky, 2008). Conservation opportunities were not extensively mapped across the Cape Lowlands although such data may well have been useful to complement the expert information used in the scheduling process. In addition, a more in-depth 'market analysis' of landowners in the region may be valuable. This would help to elicit more clearly what the targeted landowner community expects from a stewardship programme and would serve to refine the conservation stewardship approach (Pasquini, 2007; The Nature Conservation Corporation, 2008).

(iii) Time for planning: Planning often needs to be detailed, comprehensive, and lengthy to limit problems during programme implementation (Wideman, 2004). The Cape Lowlands scheduling process was completed in a very short timeframe. This is important for the larger collaborative work sessions: 'workshop fatigue' was mentioned by numerous key participants, especially field staff, before the Cape Lowlands scheduling process. The process was therefore limited to one day's focused planning. However, in future significantly more time should otherwise be devoted to the individual planning components; to procedures that properly integrate the different components (e.g. resource planning and scheduling) and which ensure alignment with strategic planning processes at the organisational or regional level, i.e. within the broader implementation framework (Fig. 4.2).

(iv) Approach to planning: The simple scheduling approach used in the Cape Lowlands was effective in achieving most of its key objectives. However, there is a wide range of more sophisticated options for conducting important collaborative stakeholder processes. These include visualisation techniques (Knight et al., 2008), scenario planning (Peterson et al., 2003) and quantitative methods to promote rational decision-making in conservation programme planning (Guikema and Milke, 1999). Such alternative approaches may be very useful in future collaborative planning processes in order to formalise the process and to capitalise on new insights and effective techniques for gaining value from collaborative decision-making processes (Beratan, 2007).

(v) Evaluation: As part of the overall conservation planning process a suitable monitoring and evaluation framework should have been designed (Fig. 4.2; and Introduction: Summary of the planning framework step 4). This is a vital component of good planning. It is fundamental in determining implementation success (chapter 5) and as a basis for adaptive management (Salafsky et al., 2002).

CHAPTER 5

Evaluating the implementation of conservation planning and the achievements in protecting biodiversity on private land

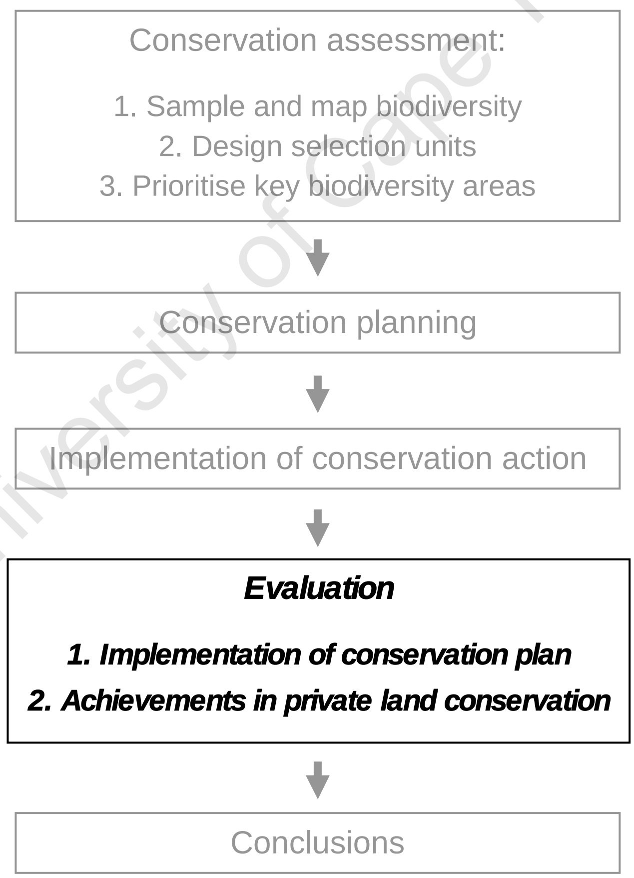


Figure 5.1. The conservation process in the Cape Lowlands region: Evaluating the implementation of the conservation plan and off-reserve conservation achievements in the Cape Lowlands and CFR.

1. Introduction

Intensive resource investment in conservation has not yet significantly slowed the worldwide decline in biodiversity (MEA, 2005). This raises an important question: How can we measure the effectiveness of conservation interventions? Measuring progress, effectiveness and success has not been standard practice in conservation (Saeterson et al., 2004). Reasons for this are that monitoring and evaluation can be expensive and time-consuming, good baseline data and technical support may be lacking; biodiversity is difficult to quantify as a 'commodity;' and organisations may resist assessment given the risk of losing funding (Baker, 2000, Kleiman et al, 2000). Increasingly however, evaluation is being recognised as part of a professional approach to conservation and it is being integrated in programmes of organisations such as The Nature Conservancy, the World Wide Fund for Nature and the World Bank. A key function of evalutations in this regard is to support the judicious allocation and use of limited resources in order to maximise conservation success (Hughey et al., 2003; Ferraro and Pattanayak, 2006).

Evaluation can be understood as "the systematic acquisition and assessment of information to provide useful feedback about some object" such as a conservation programme; useful feedback refers to information that aids decision-making (Trochim, 1992). In keeping with this broad definition is the wide range of approaches currently being applied to conduct monitoring and evaluation, not all of which are equally useful. Several authors have recently reviewed different approaches and appropriate methods for undertaking evaluations (Baker, 2000, Kleiman et al., 2000, Hughey et al., 2003, Sutherland et al., 2004, Stem et al., 2005, Ferraro and Pattanayak, 2006, Trochim, 2007). Choosing or developing a suitable approach is nevertheless difficult: it largely depends on the purpose of the evaluation (e.g. basic research; accounting and certification; status assessment; or effectiveness measurement, Stem et al., 2005). But in practice several other factors may play a role, such as who is doing the evaluation; what is being evaluated and at what stage in its process (Trochim, 2007); and the available financial and data resources (Kleiman et al., 2000).

A problem with many existing monitoring and evaluation procedures is that they collect large amounts of purely descriptive data (Ferraro and Pattanayak, 2006). This focus on 'data acquisition' rather than on 'useful feedback' can add a significant administrative burden on conservation programmes (Murphy, 2000) and may only allow for limited conclusions. The counterfactual approach is a powerful and underutilised way of clearly demonstrating the effectiveness of a conservation intervention (Ferraro and Pattanayak, 2006). Through a controlled experiment one establishes whether progress is the result of a specific intervention, or whether a similar outcome would have occurred without the intervention (see also Baker, 2000). In many cases a counterfactual evaluation is however not practical or even appropriate (Ferraro and Pattanayak, 2006, Trochim, 2007). In those cases a well-designed evaluation that measures achievements against explicitly defined conservation goals can be very productive (Saeterson et al., 2004).

The Cape Lowlands study area has excellent prerequisites for conducting an evaluation in the region. It is a top conservation priority in the Cape Floristic Region, CFR (Cowling et al., 2003) and it has been identified as an important global conservation investment (Wilson et al., 2007). Substantial conservation resources (more than US $20 million, or ~R150 million) have been invested in the CFR, including the Cape Lowlands, over the past ten years. Comprehensive conservation planning was undertaken in the Cape Lowlands (chapters 1-4). Assessing the application of this conservation plan is important since the conservation goals were developed specifically to guide targeted off-reserve conservation interventions in the agricultural production landscape. The intention during the implementation-oriented planning process was thus to avoid the limitation of many conservation assessments which are never used in conservation action decision-making. This is wasteful in terms of the resources spent on detailed spatial planning, and contributes to the lack of explicit, defensible goals that is common in many conservation initiatives (Saeterson et al., 2004).

Most of the land (>90%) in the Cape Lowlands region is privately owned so that conservation efforts focus on off-reserve stewardship interventions outside of the protected areas network. These interventions have now been executed for five years. Investigating the achievements to date is pertinent since conservation stewardship mechanisms are a relatively new and promising conservation tool in South Africa (Botha, 2001). Conservation stewardship mechanisms in the CFR and Cape Lowlands involve the voluntary participation of landowners in biodiversity protection by formally agreeing to secure the conservation status of their land. A major advantage of these mechanisms is the relative cost-effectiveness to protect biodiversity and natural resources on private land (Michael, 2003, Pence et al., 2003) and incentive-based stewardship mechanisms have become one of the most popular off-reserve conservation strategies in use today (Gutanski, 2000, Merenlender et al., 2004). However, private lands conservation has not been simple anywhere in the world (Gutanski, 2000; Cope, 2005, Gunningham and Younge, 1997) even in countries like the U.S.A. where resources are less limited than in South Africa (Hocker, 2000, Halpern et al. 2007). Suitable approaches to private land conservation are still under development (e.g. Vickerman, 1999, SEPA Project, 2007) and the Cape Lowlands and CFR offer significant scope for learning: testing and evaluating the off-reserve conservation interventions is an essential part of this learning.

I used a narrow evaluation approach in the Cape Lowlands to determine the progress in conservation interventions in the region over the past five years relative to the original conservation goals set in the conservation plan (chapter 4). My objective was to collect and assess baseline data to answer the following questions about the conservation process in the Cape Lowlands (5. 1): (i) What has been achieved in terms of protecting biodiversity on private land through off-reserve conservation interventions over the past five years?; (ii) What resources have been spent on the off-reserve interventions?; (iii) To what extent do the conservation achievements meet the spatially explicit 5-year and 20-year conservation goals for the Cape Lowlands region?; and (iv) What are the estimated resources required to meet these conservation goals?

2. Conservation planning and implementation context

A brief overview of the conservation planning process in the Cape Lowlands with associated timelines is given below (see also Fig.5.1). A summary of the private land conservation initiatives active in the region follows (more detail in Appendix 4 and 5).

2.1 Timeframes of the conservation process:

The Cape Lowlands conservation process was designed to guide practical implementation efforts while retaining a scientific and defensible approach. Figure 5.2 illustrates the relevant timeframes. The technical conservation assessment (chapter 1-3) was conducted between 2001 and 2003 in parallel with a strategy development process, in which an incentives-based conservation stewardship implementation strategy was designed to protect biodiversity on private land (Fig. 5.2; CapeNature, 2007). The conservation assessment's outputs and the proposed implementation strategy informed collaborative planning at the end of 2003 (Fig. 5.2): conservation planners and implementers jointly produced a conservation plan with spatially explicit 5-year and 20-year goals to guide practical conservation interventions (chapter 4).

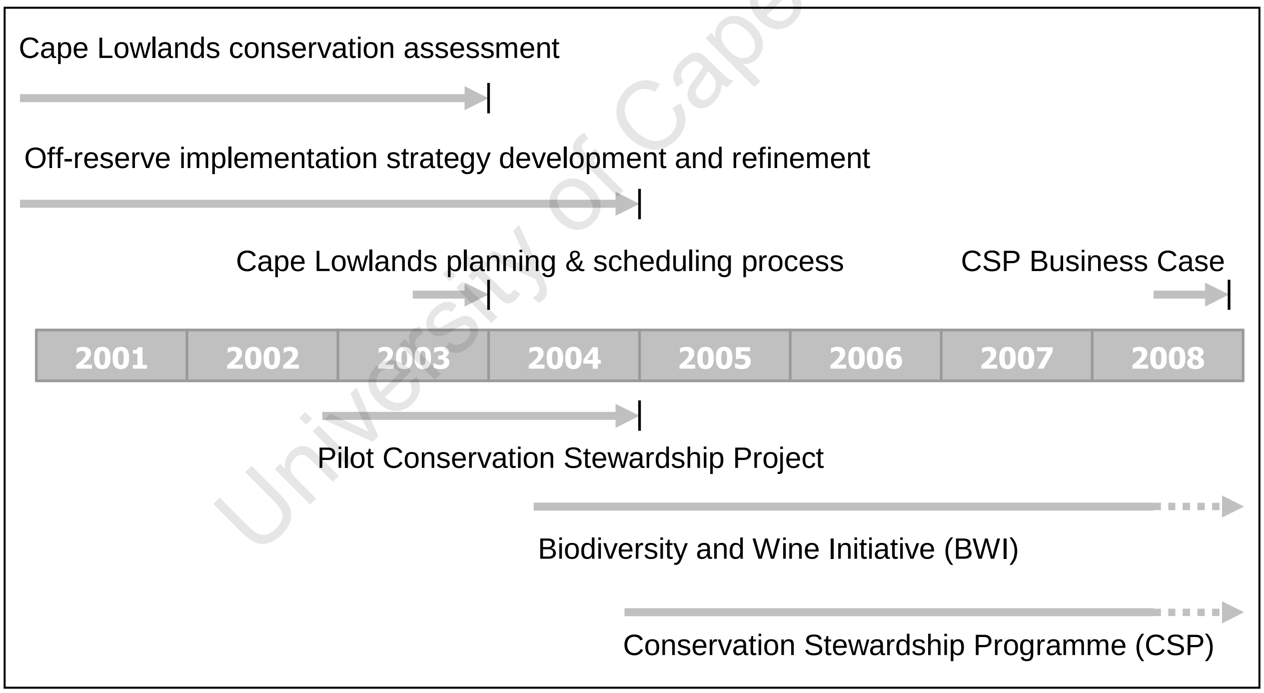


Figure 5.2. Conservation planning and implementation stages in the Cape Lowlands region.

2.2 Implementing off-reserve conservation

The implementation of off-reserve conservation action in the Cape Lowlands started with a two year pilot conservation stewardship project (Conservation Unit, 2004). This was to test the stewardship implementation approach in three pilot areas identified through the Cape Lowlands study. The rollout phase of the Conservation Stewardship Programme (CSP) occurred on the basis of the pilot project. The CSP initially focused on the Cape Lowlands region, but since 2005 its spatial focus has expanded to encompass key biodiversity areas across the Western Cape. A second off-reserve conservation programme, the Biodiversity and Wine Initiative (BWI), was initiated in 2004 (Fig. 5.2).

The current Conservation Stewardship Programme is led by CapeNature, the provincial conservation agency of the Western Cape (CapeNature, 2007). The CSP aims to cost-effectively conserve biodiversity in priority areas by entering into voluntary conservation agreements with private landowners. An interested landowner can choose between a legally non-binding agreement and a legally binding contractual agreement that establishes a formal conservation easement on the land (see Gutanski, 2000, Michael, 2003). The CSP concentrates on concluding contractual agreements, which represent the more secure form of biodiversity protection. Landowners who have signed an agreement with CapeNature and the Western Cape government currently receive mostly non-financial conservation incentives, which are scaled according to the type of agreement. Selected fiscal incentives for contractual agreements will come into effect in 2009 (SANT, 2008; Cumming and Botha, 2008).

To date, the full process of concluding a contractual agreement has taken between six months to over 2 years. This is mostly due to the time-consuming administrative process of finalising the legal agreements. This lengthy process and the associated transaction costs fall away in the case of legally non-binding agreements. Maintenance activities by CapeNature continue throughout the lifespan of all agreements. Maintenance includes the delivery of incentives and services to help landowners fulfil conservation objectives, and regular monitoring and site audits to ensure landowner compliance with the conditions stipulated in the agreement (CapeNature, 2007).

The CSP's staff comprises a programme manager, a coordinator, and a small team of full-time and part-time stewardship staff members who negotiate and maintain conservation agreements. Appendix 4 details the CSP's staff complement and the process of concluding a contractual conservation agreement.

The Biodiversity and Wine Initiative or BWI (www.bwi.co.za) is a partnership between the South African wine industry and non-governmental conservation organisations (Table 5.1). The initiative seeks to limit further critical habitat loss in the CFR by encouraging excellent conservation behaviour, including the use of biodiversity guidelines as part of sustainable wine production, amongst landowners in the wine-growing areas of the CFR. In response to motivational incentives, landowners join the BWI on a voluntary basis. Membership of the BWI requires no legally binding agreement and few restrictions are placed on land-users. This is the equivalent of a voluntary conservation agreement under the CSP (see above). BWI 'champion status' is awarded to particularly conservation-active landowners who join the BWI. In the case of landowners (e.g. champions) who are interested in concluding a legally binding contractual conservation agreement, the BWI collaborates with the CSP. The BWI is currently a small initiative comprising one extension officer and one project coordinator.

Table 5.1. Key characteristics of the Conservation Stewardship Programme and of the Biodiversity and Wine Initiative.

Characteristics	Conservation Stewardship Programme	Biodiversity and Wine Initiative
Implementing agency	CapeNature, conservation agency in the Western Cape Province	South African wine industry, non-governmental organisations: the Botanical Society of South Africa and the World Wide Fund for Nature.
Starting date	2003 (pilot project)	2004
Spatial extent	Western Cape Province	Western Cape/CFR wine-growing areas
Spatial focus	Conservation priority areas identified in conservation plans.	Wine growing areas and conservation priority areas.
Target group	Landowners in priority conservation areas.	Landowners of wine farms and wine producers, wine cooperatives.
Type of conservation agreement	(i) legally binding contractual agreements (preferred by the CSP); (ii) legally non-binding voluntary agreements.	(i) membership status: legally non-binding voluntary agreements. (ii) champion status: may but need not involve a contractual agreement.
Staffing	Four full-time staff (2 coordinators, 2 ‘on-the-ground’ staff); several part-time staff.	Two full-time staff (1 coordinator and 1 ‘on-the-ground’ staff)
Funding	Local and international sources committed until the end of 2009	Local and international sources committed until the end of 2009

3. Methods

3.1 Developing an evaluation approach

3.1.1 Objective: I identified the evaluation objective: to acquire and assess information to answer four key questions about the Cape Lowlands conservation process (see below) and to provide useful feedback on the conservation process in the region (Trochim, 1992).

The questions were: (i) What has been achieved in terms of protecting biodiversity on private land through off-reserve conservation interventions over the past five years?; (ii) What resources have been spent on the off-reserve interventions?; (iii) To what extent do the conservation achievements meet the spatially explicit 5-year and 20-year conservation goals for the Cape Lowlands region?; and (iv) What are the estimated resources required to meet these conservation goals?

3.1.2 Scope: The intention was to provide a first audit of the achievements and limitations of the conservation process in the Cape Lowlands, not to undertake a comprehensive programme evaluation that would include social and biological criteria, and which would cover both substantive and process criteria (see Kleiman et al., 2000). The Conservation Stewardship Programme (CSP) and the Biodiversity and Wine Initiative (BWI) were both investigated, but I focused on the CSP as it had been specifically planned for when developing the implementation strategy for conserving the Cape Lowlands (chapter 4).

3.1.3 Data collection: Given the clear evaluation objective and scope, I collected appropriate baseline data based on available documentation (e.g. CapeNature, 2007; Jackelman and Ferreira, 2007, Pilot project final report, BWI website) and discussions with programme managers, staff and other relevant sources. I acquired information on the CSP and BWI's operations and resources; spatial data of concluded conservation stewardship agreements and vegetation conserved; site assessment forms used to determine whether a property qualifies for biodiversity conservation purposes. Data collection continued over several months as many data were not immediately available in a usable format or needed to be sourced from remote field offices. I set a cut-off for data collection (September 2008). Spatial data for the CSP was available until the end of 2007.

3.1.4 Goals and progress indicators: The conservation goals of off-reserve stewardship interventions in the Cape Lowlands were set during a collaborative scheduling process involving conservation planners and implementers, i.e. CapeNature staff (chapter 4). The goals for the 5-year and 20-year implementation time frame were consensus-derived; spatially explicit; based on biodiversity priorities and available information on conservation opportunities and constraints; and specific in the amount of biodiversity (e.g. recorded plant species, threatened vegetation) included in the goals. I used these original programme goals as the basis for the evaluation.

I decided on two indicators for measuring conservation achievements: (i) the number of concluded voluntary and contractual conservation agreements; and (ii) the amount of natural vegetation included in the sites with conservation agreements. These indicators were suitably simple; were based on available data; and were measurable relative to conservation goals for the Cape Lowlands (chapter 4).

3.1.5 Analysis: I undertook the evaluation by (i) assessing the conservation achievements by the CSP and BWI up to December 2007 in terms of the progress indicators (see 1.4); (ii) establishing the resources associated with implementing the off-reserve conservation interventions; (iii) determining to what extent these achievements contributed to the 5-year and 20-year goals set out in the Cape Lowlands conservation plan; and (iv) estimating the time and staffing complement that are likely to be required to achieve the Cape Lowlands conservation goals.

3.2 Evaluating the conservation process

3.2.1 The extent of conservation stewardship agreements

I mapped contractual and voluntary conservation stewardship agreements concluded by the CSP and BWI in the CFR by the end of 2007 (Fig. 5.3). Where missing I captured attribute data, such as the date, the type of agreement and the area's size. A stewardship agreement may consist of several sites under a single agreement with one landowner or wine producers' co-operative. The BWI did not record the number of agreements in the Cape Lowlands specifically; only the number of individual sites were known. Therefore I estimated the number of agreements based on data for the Western Cape by calculating an average number of sites per agreement.

3.2.2 Resource expenditure

I collated available data on financial resources for off-reserve conservation in the CFR for the period 2003-2007. Much of the funding received by the CSP and BWI to date has been 'seed funding' intended to establish the initiatives. Sustainable funding for the continued implementation of conservation stewardship activities under the CSP is currently being sourced by CapeNature from the South African government's budget allocations (Jackelman et al., 2008; von Hase et al., 2008: Appendix 5).

For the CSP I calculated the total direct expenditure on conservation stewardship actitities (excluding incentives) and the total expenditure that included the 'indirect' cost of incentives (e.g. invasive plant clearing) to landowners until the end of 2007. I also calculated the total expenditure for the BWI 2004-2007. The BWI did not have separate incentives expenditure. I included programme start-up costs and the CSP Pilot project's expenditure in calculations and worked out the South African (local) and international proportion of the total funding. Since the CSP and the BWI did not record their expenditure specifically for the Cape Lowlands Region, I estimated, based on input from the programme managers, that a third of all funding up to 2007 had been dedicated to this region. The funds spent to date reflect mainly the transaction costs of negotiating and concluding conservation agreements rather than the long-term costs of maintaining the agreements. Note also that the global cost estimates only include the cost to the implementing agencies, not opportunity costs or management costs incurred by the landowner for example (see Naidoo et al., 2006).

Based on available data until end 2007, I determined the estimated cost to the implementing agencies of conserving one hectare of vegetation in the Cape Lowlands under a voluntary BWI agreement and under a CSP contractual agreement. Further I calculated the average number of voluntary and contractual agreements negotiated per year in the region. I included all BWI agreements in the Cape Lowlands including those falling outside of the 5-year or 20-year priority areas.

3.2.3 Contribution of conservation achievements to Cape Lowlands goals

Conservation goals were in the form of spatial priority areas depicted within a 5-year and a 20-year conservation plan. These goals included the amount of vegetation to be conserved over the 5- and 20-year timeframes, as well as other biodiversity features included in the spatial priorities (Appendix 2). I converted the spatial priorities into the number of conservation agreements still to be concluded by calculating the number of landowners whose properties coincided with the 5-year and 20-year priority areas. One landowner was considered to represent one conservation agreement, since an agreement may account for several cadastres or portions of cadastres. I used a cadastral layer with ownership information (May 2007) to calculate an average of three cadastres per landowner.

Goals: The 5-year conservation goals comprised 61,503.0 ha (615 km^2) of natural vegetation equating to around 550 conservation agreements to be concluded with landowners in the 5-year priority areas. The 20-year goals comprised 96,390.0 ha (nearly 1000 km^2) natural vegetation which equated to about 1500 conservation agreements. To determine to what extent conservation stewardship achievements have contributed to the Cape Lowlands conservation goals, I established whether stewardship sites fell within or outside of identified 5-year and 20-year priority conservation areas. I calculated the spatial overlap between the stewardship sites and the conservation priorities based on remaining natural vegetation. Note that threatening processes, and the resulting loss of biodiversity, are not accounted for in these calculations due to limited data, nor are they considered in section 3.2.4.

3.2.4 Estimated resources to achieve the Cape Lowlands conservation goals

The resources required to meet the 5-year and 20-year conservation goals in the Cape Lowlands Region depended on the following factors:

a. The number of contractual and voluntary conservation agreements that still need to be concluded;

b. The maximum number of contractual and voluntary agreements that can be concluded per year (i) by the CSP and (ii) by the BWI;

c. The number of stewardship staff to negotiate and to maintain the stewardship agreements.

My intention here was not to estimate the financial costs involved in implementing the conservation goals. This would require a separate, significantly more detailed analysis.

I established the following estimates for the factors listed above:

a. I considered voluntary and contractual agreements as contributing to conservation achievements. I used a proportion of 3 voluntary to 1 contractual agreement being concluded. This is close to the current situation. I subtracted concluded agreements (2007) from the total required to meet the 5-year and 20-year goals to obtain the number of voluntary and contractual agreements still to be concluded.

b. To ensure sustainable progress of the CSP and BWI, it is important to balance resources allocated to negotiating new stewardship agreements and maintaining existing agreements.

(i) CSP: A maximum of 5 contractual plus 2 voluntary agreements can be concluded by one negotiator per year. A maximum of 15 contractual plus 4 voluntary agreements can be maintained by one facilitator per year (Purnell, K. CapeNature, 2008 pers. comm.). Maintenance involves general conservation support, auditing, preparing and revising management plans. To conclude and maintain a contractual agreement is estimated to require four times more resources than a voluntary agreement. The maximum rates given are based on efficient and effective operations and are considered to remain relatively constant throughout implementation.

(ii) BWI: A maximum number of 15 voluntary agreements can be concluded by one negotiator; a maximum 30 voluntary agreements can be maintained by one facilitator.

c. As the starting situation (year one: 2008) for staff dedicated to working in the Cape Lowlands Region I used (i) 3 full-time CSP field staff (2 negotiators; 1 facilitator); and (ii) two full-time BWI field staff (1 negotiator; 1 facilitator).

The resulting predictions assume a linear rate in concluding conservation stewardship agreements. I used this basic assumption to simplify the calculations, and because no data are yet available to improve on it. However, it is likely that progress may slow down or speed up with time, and this would need to be considered in more detailed analysis.

4. Results

4.1 Evaluating the conservation process

4.1.1 The extent of conservation stewardship agreements

Off–reserve conservation achievements by the CSP and the BWI between 2004 and December 2007 are summarised in Table 5.2 and illustrated in Figure 5.3. The contractual agreements were concluded by the CSP and the BWI was responsible for the majority of voluntary agreements. All voluntary agreements in the Cape Lowlands were concluded by the BWI (Fig. 5.3).

In the Cape Lowlands 52 contractual and voluntary agreements had been concluded by the end of 2007 (Table 5.2). Collectively the contractual agreements (n = 12) contribute a similar amount of conserved vegetation as do the voluntary agreements (n = 40). Each contractual agreement includes around three times more vegetation than each voluntary agreement.

The contractual and voluntary agreements in the Cape Lowlands account for 42% of all agreements in the CFR but they capture only 12.4% (8479.0 ha) of the vegetation conserved under conservation agreements. This is likely due to comparatively small vegetation remnants being conserved in the Cape Lowlands. Within the region, contractual and voluntary agreements account for 163ha per agreement on average whereas outside of the Cape Lowlands each agreement contains 835.0 ha vegetation on average.

Table 5.2. Conservation achievements (up to December 2007):
The number of contractual and voluntary conservation agreements and amount of vegetation conserved in the agreements concluded by the Conservation Stewardship Programme (CSP) and Biodiversity and Wine Initiative (BWI) in the Cape Lowlands, in the CFR excluding the Cape Lowlands and overall.

Region	Conservation achievement	CSP Contractual[1] agreements	CSP Voluntary[2] agreements	BWI Voluntary[2] agreements	Total per region
Cape Lowlands	No. agreements	12	0	40	52
	Vegetation (ha)	3787.0	0	4692.0	8479.0
CFR (excl. Lowlands)	No. agreements	9	4	59	72
	Vegetation (ha)	18291.0	5118.0	36716.0	60125.0
TOTAL CFR	No. agreements	21	4	99	124
	Vegetation (ha)	22,078.0	5118.0	41,408.0	68604.0
	Vegetation (%)	32.2%	7.4%	60.4%	(100%)

[1] *More than 95% of contractual agreements are negotiated by the CSP*

[2] *More than 95% of voluntary agreements are negotiated by the BWI*

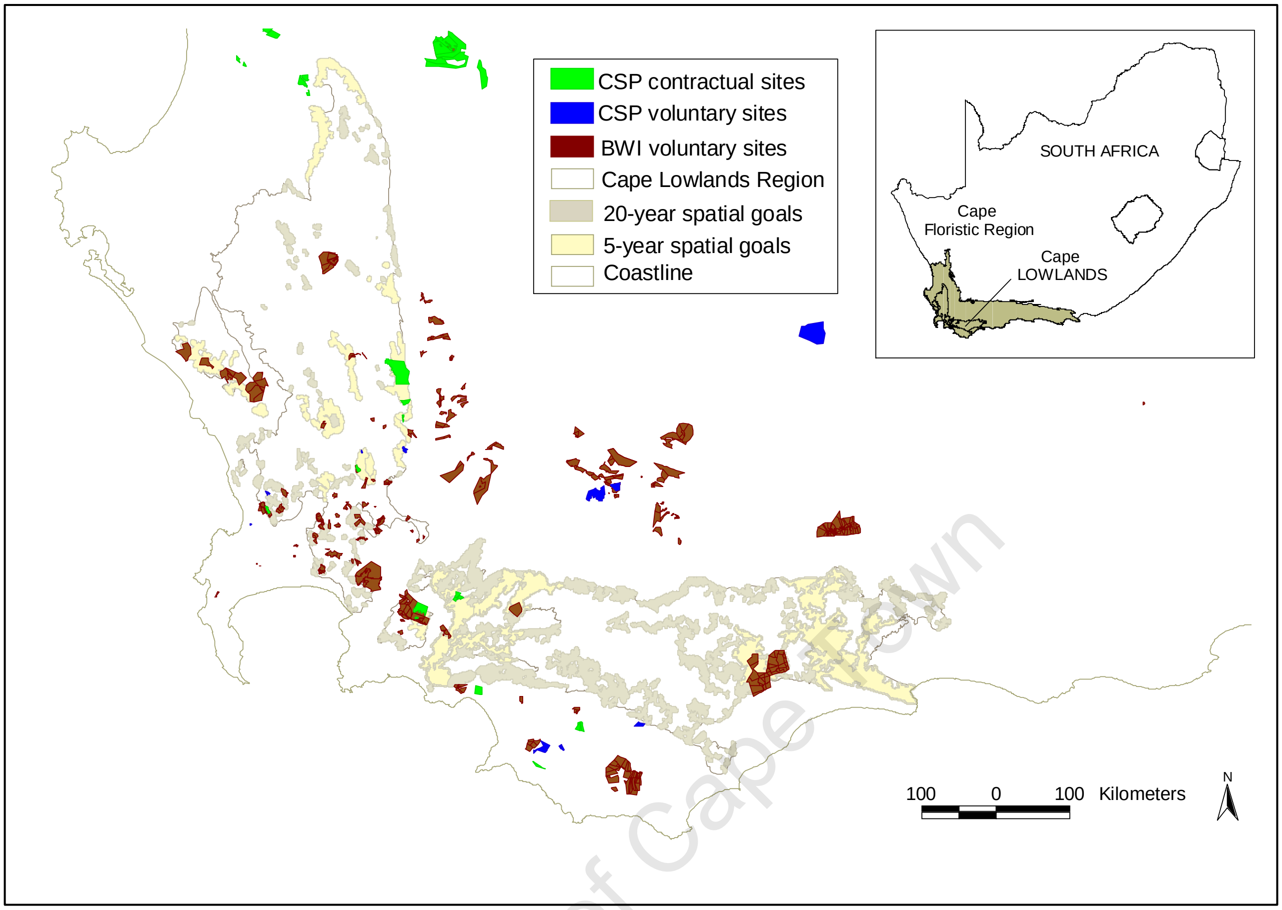


Figure 5.3. Sites with contractual and voluntary stewardship agreements concluded by the Conservation Stewardship Programme and Biodiversity and Wine Project by December 2007.

4.1.2 Resource expenditure

A total of nearly R7 million has been spent on off-reserve conservation interventions in the Cape Lowlands between 2003 and 2007 (Table 5.3). This is ~R 1.14 million per year. Around 14% of the funding was dedicated on the BWI's activities in concluding voluntary conservation agreements. The largest proportion of the funds has been allocated to concluding contractual conservation agreements by the CSP (Table 5.3). The same applies to the CFR where around R 4.4 million has been spent per year. Of this 12.5% was on average allocated to the BWI annually. The international proportion of the total funding is around 45%.

Table 5.3. Estimated total expenditure (in Rands) on off-reserve conservation initiatives by the CSP and the BWI from 2003-2007 in the Cape Lowlands Region and CFR.

	CSP Funding: including incentives costs	CSP Funding: excluding incentives costs	BWI	Total
Cape Lowlands	R 5,818,622	R 3,942,622	R 929,173	R 6,747,79
CFR	R 19,517,427	R 13,889,427	R 2,787,520	R 22,304,947

The conclusion of a voluntary agreement under the BWI has been much cheaper and faster than a contractual agreement under the CSP in the Cape Lowlands (Table 5.4). Conserving a hectare of vegetation under a voluntary agreement has involved about 10% of the cost required to protect a hectare of vegetation under a contractual agreement. In addition, concluding a voluntary agreement has been four to five times faster than a contractual agreement. The cost per hectare of vegetation conserved when combining voluntary and contractual agreements amounts to R 796 (including incentives costs) or R 575 (excluding incentive costs).

Table 5.4. A summary of the relative costs and time investment into concluding contractual and voluntary conservation agreements in the Cape Lowlands Region (2003-2007). The estimated overall expenditure is shown with and without incentives costs.

Cape Lowlands	CSP: Contractual agreements	BWI: Voluntary agreements
Total costs	R 5,818,622 (incl. incentives) R 3,942,622 (excl. incentives)	R 929,173
Area of vegetation conserved	3,787 ha	4,692 ha
Cost/ha vegetation conserved	R 1,536/ha (incl. incentives) R 1,041/ha (excl. incentives)	R 198/ha
Total number of agreements	12	40
Total time for negotiatiations	5 years	4 years
No. of sites/year	2-3 sites	10 sites

4.1.3 Contribution of conservation achievements to meeting Cape Lowlands goals

The contractual stewardship agreements in the Cape Lowlands all conserve sites within the top priority conservation areas identified for conservation action during the collaborative scheduling process (see Fig. 5.2; chapter 4). These priority areas comprise important and threatened biodiversity and key ecological corridors and they form part of the 5-year and 20-year conservation goals. Many of the voluntary sites concluded by the BWI similarly fall within the top conservation priority areas (Table 5.5). There are some exceptions though: twelve of the 40 voluntary agreements in the Cape Lowlands (Table 5.2) conserve sites outside of the 5-year and 20-year goals. These sites capture small vegetation remnnants. In this context it is important to note that the BWI does not explicitly confine its activities to mapped conservation priority areas but to wine-growing areas.

The contractual and voluntary agreements concluded up to the end of 2007 (Table 5.2) meet 11% of the 5-year conservation goals set for the Cape Lowlands region and just less than 9% of the 20-year goals (Table 5.5, Fig. 5.3). Contractual agreements account for slightly more vegetation conserved for the 5-year goals while voluntary agreements capture more of the 20-year goals.

Table 5.5. Contribution of contractual and voluntary stewardship agreements towards the Cape Lowlands 5-year and 20-year conservation goals. Contributions are shown in terms of the number of hectares (and % of goal met) of vegetation.

Cape Lowlands Region	Conservation stewardship achievements			
	CSP Contractual	BWI Voluntary	Total: CSP + BWI Vegetation (ha)	Total: CSP + BWI Vegetation (%)
5-year goal (61503 ha vegetation)	11 agreements: 3581 ha (5.8%)	16 agreements: 3095 ha (5.1%)	6676 ha	**11%** of goal
20-year goal (96390 ha vegetation)	12 agreements: 3787 ha (3.9%)	28 agreements: 4570 ha (4.7%)	8357 ha	**8.7%** of goal
Outside priority areas	No agreements	12 agreements 122 ha	122 ha	-

4.1.4 Estimated resources to achieve the Cape Lowlands conservation goals

To meet the 5-year conservation goal (523 contractual and voluntary agreements, Table 5.6) through off-reserve interventions is estimated to take another 20-21 years. This is five times longer than initially anticipated. To reach the 20-year goal (1460 agreements) is estimated to take nearly three times as long as originally envisaged during collaborative planning (chapter 4). Under the prediction here, the CSP and BWI will need to make dedicated conservation investments to meet the Cape Lowlands goals. This investment requires a large, consistent increase in the number of stewardship facilitors to adequately maintain conservation agreements over time (Table 5.6). The staff expected to maintain the full contingent of conservation agreements is 36 for the CSP and 26 for the BWI after 53 years. Negotiation staff would remain constant (Table 5.6).

Table 5.6. Estimates for achieving the original 5-year and 20-year conservation goals for the Cape Lowlands region through off-reserve conservation interventions.

	5-year goal	20-year goal
Total no. agreements still to conclude[1]	523	1460
1. CSP: Contractual agreements	171	480
2. CSP: Voluntary agreements	89	213
3. BWI: Voluntary agreements	263	767
No. years to implement	20-21 years	52-53 years
No. negotiating staff (constant)	CSP: 2 BWI: 1	CSP: 2 BWI: 1
No. staff to facilitate maintenance: year one (2008) to completion	CSP: 1-13 BWI: 1-9	CSP: 1–36 BWI: 1-26

[1] Finalised agreements (Table 5.2) are accounted for in the maintenance requirements.

5. Discussion

5.1 The evaluation: strengths and limitations

This evaluation after five years of off-reserve conservation interventions was designed as a first audit of the outputs to date. The simplicity of the approach, and its specificity, are its principal strengths. It is also repeatable and may be well suited for integration into regular future planning and monitoring and evaluation processes without being burdensome to the implementation process (Murphy, 2000; see section 5.1.1). The timing was also appropriate: a relatively simple, flexible evaluation is useful for investigating young programmes (Trochim, 2007). The CSP and BWI have passed through their initiation phase, which is when programmes pilot their approach and typically encounter a range of start-up difficulties (Wideman, 2004). Both programmes are now in the early developmental/growth phase: procedures are starting to fall into place and the interventions are being put into practice (Trochim, 2007). This is a good time to obtain the first estimates of on-the-ground progress.

The simple indicators I chose to evaluate conservation achievements made it feasible to obtain and assess adequate data to fulfil the evaluation objective. This led to valuable insights on planning and implementing off-reserve conservation interventions in the Cape Lowlands (see section 5.2). The successes and limitations of the conservation process now provide an excellent opportunity for reflection and learning (Redford and Taber, 2000; Salafsky et al., 2001) and for initiating appropriate management responses, e.g. adaptive management procedures or project cycle management (Salafsky et al., 2002, Stem et al., 2005). The earlier this is done in implementing a programme, the easier and cheaper it is to make important changes (Wideman, 2004).

The greatest limitation of the evaluation was its post hoc nature as its detailed design had not been integrated upfront into the Cape Lowlands conservation process. This is a common problem in evaluation (Trochim, 2007), which limited the scope of this evaluation to its present focus: I had to ignore key aspects of the conservation process even though feedback on these aspects may be crucial to guide future off-reserve conservation interventions. For example, it would have been exceptionally useful to investigate the perceptions of landowners with contractual agreements (e.g. see The Nature Conservation Corporation, 2008). However, conducting the required detailed interviews was not feasible here.

The post-hoc design also meant that accurate and current data, even on some key factors (e.g. concluded costs, conservation agreements), were sometimes difficult to obtain. This was due to complex resource allocation mechanisms as well as limited dedicated capacity and a lack of well-functioning monitoring and evaluation procedures. While this may be a classic case of conservation work that is focused on 'doing' above 'stopping and reflecting', there is a keen awareness amongst the CSP and BWI's conservation practicioners that programme evaluation is important (e.g. C.A.P.E., 2008a).

A constraint of the evaluation approach was also the limited number of progress indicators used, which focused on programme outputs to date rather than true outcomes. Of course a conservation agreement, essentially an output, does not in itself constitute successful habitat conservation (also Cope, 2005). On-the-ground biodiversity conservation success, an outcome, can only be determined through measuring suitable ecological indicators in- and outside of the conservation sites (Ferraro and Pattanayak, 2006).

5.1.1 Future monitoring and evaluation

This narrow evaluation needs to fit into a broader monitoring and evaluating framework that assesses the full range of interlinked and interdependent conservation interventions in the CFR over time (C.A.P.E., 2008b). Developing the components of such a framework is not a trivial task given the potential scope of monitoring and evaluation (Kleiman et al., 2000, Stem et al., 2005). Thoughtful planning and considerable knowledge of the different programmes and their interactions is required (Salafsky et al., 2002). Designing the broad framework is therefore best done through a collaborative process between specialists and key stakeholders: involving programme implementers can greatly facilitate later evaluation processes (Baker, 2000).

Two types of monitoring and evaluation are relevant to individual programmes (Kleiman et al., 2000):
(i) Regular, quite narrowly focused programme-internal monitoring and evaluation is needed for the purpose of status assessment and effectiveness measurement (Stem et al., 2005). Simple, easily reported indicators of specific programme outputs are measured relative to agreed-on, clearly defined conservation goals. This helps to determine how efficiently and effectively the programme is working and informs operational management and tactics. The present evaluation shows that important insights can thus be gained (see section 5.2), although it may be advisable to integrate indicators for a wider range of outputs (e.g. improved conservation skills, Salafsky et al., 2002).
(ii) In-depth, comprehensive evaluations that reveal actual conservation outcomes are needed to address specific questions and problems, and to assess individual programmes at key points in their development. These more detailed evaluations are best done programme-externally given the substantial time investment involved; the need to deal with cross-cutting issues; and the benefit of impartiality (Baker, 2000; Kleiman et al., 2000). These evaluation results can inform policy and high-level management.

Untested assumptions and 'conventional wisdoms' often form the basis of decision-making in the conservation field (Ferraro and Pattanayak, 2006) and in conservation stewardship interventions (Cope, 2005; SEPA Project, 2007). An example here is the assumption that "The signing and implementation of a conservation easement generates benefits for landowners" (Cope, 2005). Research using an appropriate experimental set-up is needed to evaluate such assumptions. In the Cape Lowlands and CFR it would be very useful to test the relative costs and benefits of voluntary versus contractual conservation agreements. This information would aid decision-making on where and how best to apply these alternatives and how to allocate respective resources. This calls for rigorous evaluation that integrates cost-effectiveness, cost-utility or return on investment analysis (Hughey et al., 2003; Murdoch et al, 2007).

Detailed evaluation of outcomes is also useful at key stages in programme implementation: towards the end of the development/growth phase; the maturity/stability phase; and the final translation phase (Trochim, 2007). The evaluation method should match the particular phase to gain the most relevant insights: although randomized experiments (e.g. Baker, 2000) may be viewed as a 'gold standard' for evaluation, this methodology is likely to be most appropriate in the latter stages of a programme (Trochim, 2007). The relevant experimental set-up needs to be established early on though, as long-term research is required. In the Cape Lowlands and CFR, for example, an ecological monitoring study would be valuable to ascertain how effectively off-reserve conservation mechanisms protect biodiversity in the long run. This may well be an opportunity for counterfactual evaluation (Ferraro and Pattanayak, 2006): some of the relevant data are already being collected by the CSP as part of auditing its conservation agreements (CapeNature, 2007) and suitable control areas can be identified in the Eastern Cape Province: the Humansdorp flats, a lowland region resembling the Cape Lowlands, and the Baviaanskloof Megareserve, with similar conditions as the Cederberg Megareserve in the Western Cape.

5.2 Evaluating the conservation process:

The evaluation reveals key achievements of and challenges to the conservation process in the Cape Lowlands and CFR. I elaborate on the successes and problems and discuss some of the implications for effective off-reserve conservation interventions.

5.2.1 Achievements

(i) The first significant achievement is that the Cape Lowlands conservation plan is being used by the Conservation Stewardship Programme to guide their practical conservation interventions in the region. The plan is not 'sitting on the shelf and gathering dust' as has been the case with many systematic conservation plans (Prendergast et al., 1999). Instead, the goals that were developed for and with the CSP are being translated into action by the programme. This shows that the conservation process has functioned up to this point. The critical link between conservation planning and implementation has been maintained (Knight et al., 2006b). Ensuring this cohesion was a major focus of the Lowlands study.

The plan's application is in itself a sign of success. But it has also been effective in ensuring goal-driven implementation: the CSP's interventions have targeted the priority areas identified in the Cape Lowlands plan rather than easy opportunities for example (Hummon and Cochran, 2005). The conservation investment in the region has thus led to securing several of the top priority sites under stewardship agreements. Contrary to the global situation, where conservation priority areas and conservation spending are not well-matched (Halpern et al., 2006), conservation planning in the Cape Lowlands thus channelled investment towards priority areas. Unfortunately, the CSP did not have clearly defined spatial goals for large parts of the Western Cape until very recently (October 2008). This prevented measuring the achievements relative to goals in key priority areas outside the Cape Lowlands.

(ii) The second major achievement is off-reserve biodiversity protection by the CSP and the BWI: over a five-year period 22,078 hectares vegetation (27,800 ha of land) have been included in contractual agreements and 46,526ha vegetation (90,000 ha land) in voluntary agreements in the CFR. Indeed these figures have increased in 2008, mostly due to the conclusion of numerous agreements that had been in preparation for a long time: now contractual agreements alone include 42,437ha of vegetation and ~50,000 ha land (September 2008). This is remarkable given the challenge of private land conservation: many different 'types' of landowners need to be addressed. Each has specific motives and aspirations for owning, managing and potentially conserving biodiversity on their land (Fischer, 2004, Davis and Hodge, 2007). Most are protective of their land and land use rights (McDowell, 1988, James, 2002). To these landowners formal conservation agreements that restrict land use and involve government bodies pose a big risk and incentives are still limited (Parker, 2006). Land ownership is also a particularly acute topic in South Africa due to the urgent need for land reform, aimed at distributing land against compensation across a more equitable share of the population (S. African Land Policy White Paper, 1997).

The CSP and BWI's conservation achievements are noteworthy by global standards. In selected Latin American countries, for example, where conservation easement use dates back to the early 1990s, around 15,000 ha of land had been secured in 65 easements by 2005 (Cope, 2005). In the U.S.A. by comparison, conservation easements have been a popular tool for several decades (Gutanski, 2000). The majority of these is held by government agencies (ELI, 2003). By 2005 conservation easements covered more than 2.5 million hectares of land (LTA, 2005), although a large proportion of land protects resources other than biodiversity, e.g. agricultural or scenic resources (Gutanski, 2000, Rissman et al., 2007). This is in contrast with contractual agreements in the CFR that specifically protect only priority biodiversity.

The off-reserve achievements make an important and cost-effective contribution to conservation in the Cape Lowlands and CFR: key biodiversity sites on private land have been conserved at half the cost previously predicted for off-reserve conservation interventions in the CFR (Frazee et al., 2003). This is in contrast to the frequently conflict ridden and expensive alternative of acquiring and managing land for conservation purposes (Pence et al., 2003). Land acquisition (excluding subsequent management) would cost around R2500-R 10,000/ha (Frazee et al., 2003; Pence et al., 2003; Osano, 2005) and in many instances significantly more (Osano, 2005). This is at least twice, and likely much more of the cost of concluding contractual conservation agreements, especially considering the increased number of agreements finalised over the past year but not taken into account in this study's cost per agreement calculations (see above). Of course, an important additional cost-benefit consideration relating to stewardship mechanisms and traditional protected areas is that biodiversity on land under conservation stewardship agreements is likely to be less secure in the long term.

(iii) A third achievement is that the CSP[1] and BWI offer complementary solutions: both contractual and voluntary agreements are important to protect biodiversity in the CFR. So far this has been a sucessful off-reserve strategy that avoids promoting a single conservation option as a 'panacea' for the private land conservation challenge (see Berkes, 2007). Contractual agreements have the advantage of offering greater habitat protection under a legally binding arrangement (Michael, 2003). Voluntary agreements contribute more vegetation to conservation to date. They are cheaper and faster to establish and since they are less risky, even highly conservation-oriented landowners often prefer voluntary agreements (BWI, pers. comm. 2008). Thus voluntary agreements reduce the barriers for landowners to become involved in efforts to protect biodiversity and are likely to expose more landowners to conservation practices. This can be a powerful way of promoting conservation behaviour: Michel-Guillon and Moser (2006) show that farmers adopting environmentally friendly practices as a result of pressures other than their environmental conscience often undergo a change in their values that generates interest in conservation behaviour.

5.2.2 The challenge: sustaining off-reserve conservation interventions

Despite significant conservation gains to date the task of protecting priority biodiversity remains substantial (Cowling et al., 2003). Off-reserve conservation interventions are expected to take on a large part of this conservation task due to the predominance of privately owned land in the CFR and their cost-effectiveness relative to land acquisition. Still the resources to deliver a stewardship strategy may be substantial, especially to ensure the long-term maintenance of conservation agreements (Hocker, 2000). The CSP and BWI's financial support is secure until the end of 2009. Ensuring the sustainability of their interventions and continued success is currently the biggest challenge for the programmes.

Adequate funding needs to be sourced and detailed planning is required to match available resources and conservation goals and to balance funding for concluding new conservation agreements and maintaining them. Resource planning was not done effectively enough in the past: The large discrepancy between the 5-year conservation achievements and the 5-year goals in the Cape Lowlands shows that goals were overambitious in the light of implementation realities. While the exact requirements for implementing stewardship mechanisms were not known at the time of planning, the procedure to estimate costs, time, and skills was also inadequate (chapter 4). Better methods for including costs in conservation planning and decision-making are now more readily available (Hughey et al., 2003, Naidoo et al., 2006, Wilson et al., 2007, Bottrill et al., 2008). They may be useful to develop realistic conservation goals in the Lowlands.

Conservation agreements, once concluded, need to be effectively maintained to ensure incentives delivery as well as compliance. Although this is essential for the success of any off-reserve conservation pro-

[1] The CSP also offers voluntary agreements but concentrates its efforts on negotiating contractual agreements (Table 5.1). It has developed significant capacity and skill to deal with contractual agreements.

gramme, limited resources often result in little or no maintenance of conservation easements (Hocker, 2000). The CSP is committed in its contractual agreements to providing ongoing conservation support (von Hase et al., 2008). But the present evaluation indicates that maintaining conservation agreements in priority areas in the Cape Lowlands alone will require a large complement of stewardship staff and other resources. The implications of maintaining an extensive network of conservation agreements in the CFR will also be significant (Jackelman et al., 2008).

This requires careful iterative planning, ideally as part of a programme management cycle comprising implementation – evaluation – and planning and with the aim of improving the success of interventions (Stem et al., 2005). The first round of this cycle has been completed for the CSP: conservation planning in the Cape Lowlands led to on-the-ground implementation of conservation stewardship interventions (Fig. 5.2). Five years of conservation action were assessed in the present evaluation. The cycle continues. A second detailed planning process has been completed (Fig. 5.2: CSP business case): this is based on the preferred long-term implementation scenario for the programme that was developed together with the implementing agency CapeNature (von Hase et al., 2008, Appendix 5). The planning drew on five years' implementation experience and better data (e.g. transaction costs) than was previously available. The business case and associated implementation plan motivate for significantly increased resource allocation to sustain the CSP's conservation commitments in the Western Cape Province: to achieve the goal of protecting 210,000 ha of key biodiversity areas over the next three years the required financial investment is estimated at R33.5 million (Jackelman et al., 2008). Given the CSP and BWI's success in private land conservation to date these resources will most likely be very well-invested.

CHAPTER 6

Overview of the Cape Lowlands conservation process: conclusions, future research needs, and the evolving discipline of conservation planning and practice

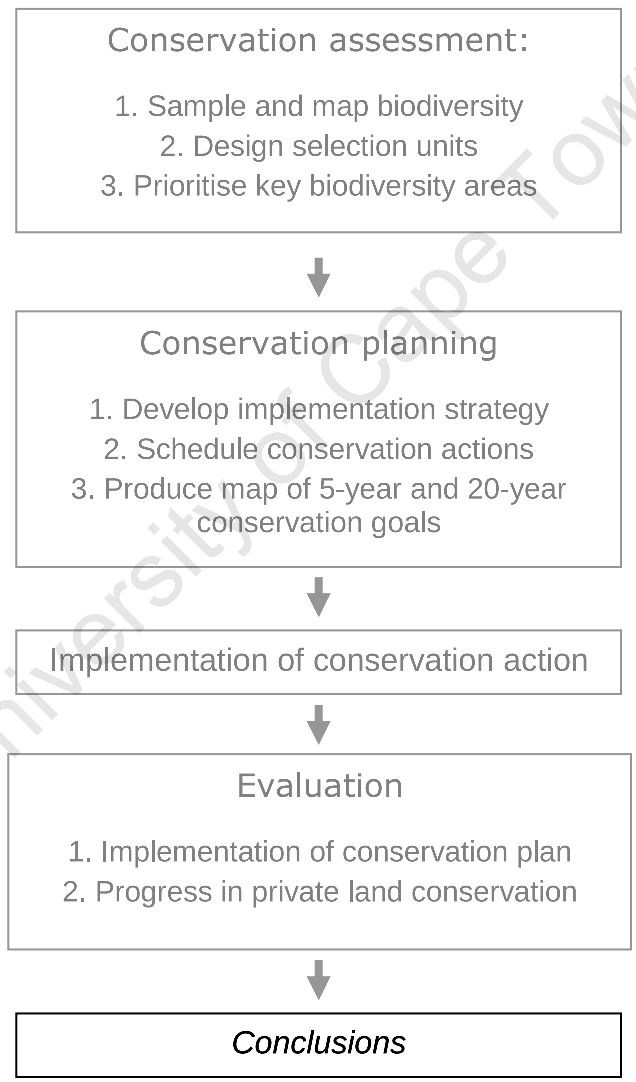


Figure 6.1. The full spectrum of phases comprising the conservation process in the Cape Lowlands. I present major conclusions based on the research; I identify future research directions, and conclude with a brief summary linking this study with the evolution of conservation planning as a discipline.

This study has demonstrated that conservation is a process of interrelated phases (Fig. 6.1) which has lead to the successful protection of key biodiversity sites in the Cape Lowlands (Cape Floristic Region, South Africa). This is remarkable for two reasons: First, conservation is most often undertaken piecemeal, with different phases being addressed separately by different groups of people. As a result the links and feedbacks between interdependent components have been neglected and sight of the real goal of conducting conservation planning has sometimes been lost (Knight et al., 2006a, b). Second, conservation assessments rarely appear to achieve their actual aim which is to lead to effective on-the-ground conservation interventions.

The process conducted in the Cape Lowlands therefore allows for a broader perspective on the theory and practice of conservation. My research provides important insight into how conservation processes should be run, and on which parts of the process it is critical to focus. The study also highlights knowledge gaps that currently limit the effective application of conservation science in real-world situations. My principal conclusions based on the Cape Lowlands conservation process are discussed below, followed by suggestions for future research in conservation science. I conclude with a brief summary of the evolution of conservation planning and practice.

1. Conclusions

1. Conservation is a cyclical process requiring significant investments from its participants:

Conservation should be viewed and run as a cyclical process integrating the conservation assessment with planning, implementation, and evaluation as in the Cape Lowlands study. This is crucial so that (i) effort may be suitably invested in all activities (e.g. Cleary, 2006); and (ii) to ensure that each phase fulfils its specific purpose and contributes to the overall goal of effective and efficient on the ground conservation interventions that ensure the persistence of regional biodiversity. An important contribution is therefore required from the people who are coordinating and involved in the conservation process:

- Process- and systems-thinking (Senge, 1990) needs to take shape in the minds and actions of conservation planners and practitioners. This means to see beyond the individual components of the conservation process, to understand how the activities are connected and affect each other, and how this can change over time (Salafsky et al., 2001, chapter 1-6). It also extends to considering the economic and associated political and legal systems within which conservation occurs.
- Complexity needs to be addressed through interdisciplinary collaboration that promotes the sharing of expertise amongst specialists (Beratan, 2007) as in the Cape Lowlands planning phase (chapter 4). Other options for dealing with complexity include working towards trans-disciplinarity (Max-Neef, 2005); applying creative methods to planning (e.g. scenario planning, Peterson et al., 2003); and, in implementation, considering a variety of strategies for interventions (Berkes, 2007).

- It is essential to take a long-term view. The Cape Lowlands process has taken eight years so far and only now are real results becoming visible (chapter 5). The long-term view applies also to funding on which the sustainability of conservation ventures hinges (e.g. Sinclair et al., 2000).
- A commitment to learning, adapting, improving, and dealing with often rapid change is necessary (see also Salafsky et al., 2001).

Conservation will progress only when there is a real appreciation of these substantial requirements and what they mean for the individual and institutions involved in conservation, and when there is the willingness and ambition to acquire at least some of these qualities.

2. The conservation assessment is a small but critical phase:

The assessment, a major focus of conservation research to date (Knight et al., 2006b), is currently the phase that is likely to benefit most from adopting a perspective over the entire process: most conservation planning research still focuses on the assessment only. There is no doubt that the conservation assessment has an important purpose: to strategically guide conservation interventions towards conservation priority areas. And, although it happens quite rarely, it is possible to achieve this. A major success of the Cape Lowlands study is that the assessment has been put effectively into practice: conservation agreements between CapeNature and private landowners have been concluded to protect numerous top priority sites in the region (chapter 5). It is important to recognise however that the assessment is generally not the limiting factor for successful conservation (see also Knight, 2007). In fact, it is a small component of the conservation process especially relative to the implementation phase (Fig. 6.2). This should be reflected in terms of time and cost: in the Cape Lowlands the assessment took 3 years (still relatively long, Fig. 2) and cost R1.8 million. The implementation of conservation interventions has been a much bigger part of the process: the cost to date stands at ~R6.8 million over the past 5 years and implementation is on-going (Fig. 6.2). An improved conservation process needs to reflect this even more clearly with a shorter assessment relative to the implementation of action phase (Fig. 6.2).

3. Suitable assessment approaches need to be selected:

A key to the success of the Cape Lowlands assessment was to find solutions based on methods that were (i) feasible; (ii) efficacious, implementation-relevant; (iii) efficient; and (iv) defensible. These qualities matter in the practice of conservation (assessments). Smart decision-making should be informed by the question: ‘What is the benefit of choosing a particular method, and what is the cost (not only financial), in view of the ultimate goal of the assessment?’ This reasoning to selecting suitable methodologies was central in the Cape Lowlands assessment (chapter 1-3). It determined the choice of expert mapping over vegetation modelling since both were equally efficacious, but the expert approach was significantly more efficient in this case, saving time and money (chapter 1). Similarly, the use of scoring as a prioritisation method in the 100% irreplaceable landscape was motivated by its efficacy in reaching a defensible solution, and by the simplicity of the method and underlying rationale (chapter 3). The approach made intuitive sense to implementers, who were ultimately responsible for using the prioritisation system and translating the results into products for implementation (chapter 4). Note that these specific methods were appropriate in the case of the Cape Lowlands, but that they are not necessarily the most suitable solutions for other areas or assessments.

Conservation planners have to be creative and pragmatic regarding their approaches, especially given the choice of a multitude of different methods for every step in the conservation assessment. Applying 'cost-benefit' considerations helps with choosing a suitable method for a particular region and assessment: the method of choice will not necessarily be the latest, most sophisticated or complex technique. The point is that unless the assessment can fulfil its ultimate purpose, as in the Cape Lowlands, and do so efficiently, the resources and time spent on this phase in the conservation process are difficult to justify (see also Cleary, 2006).

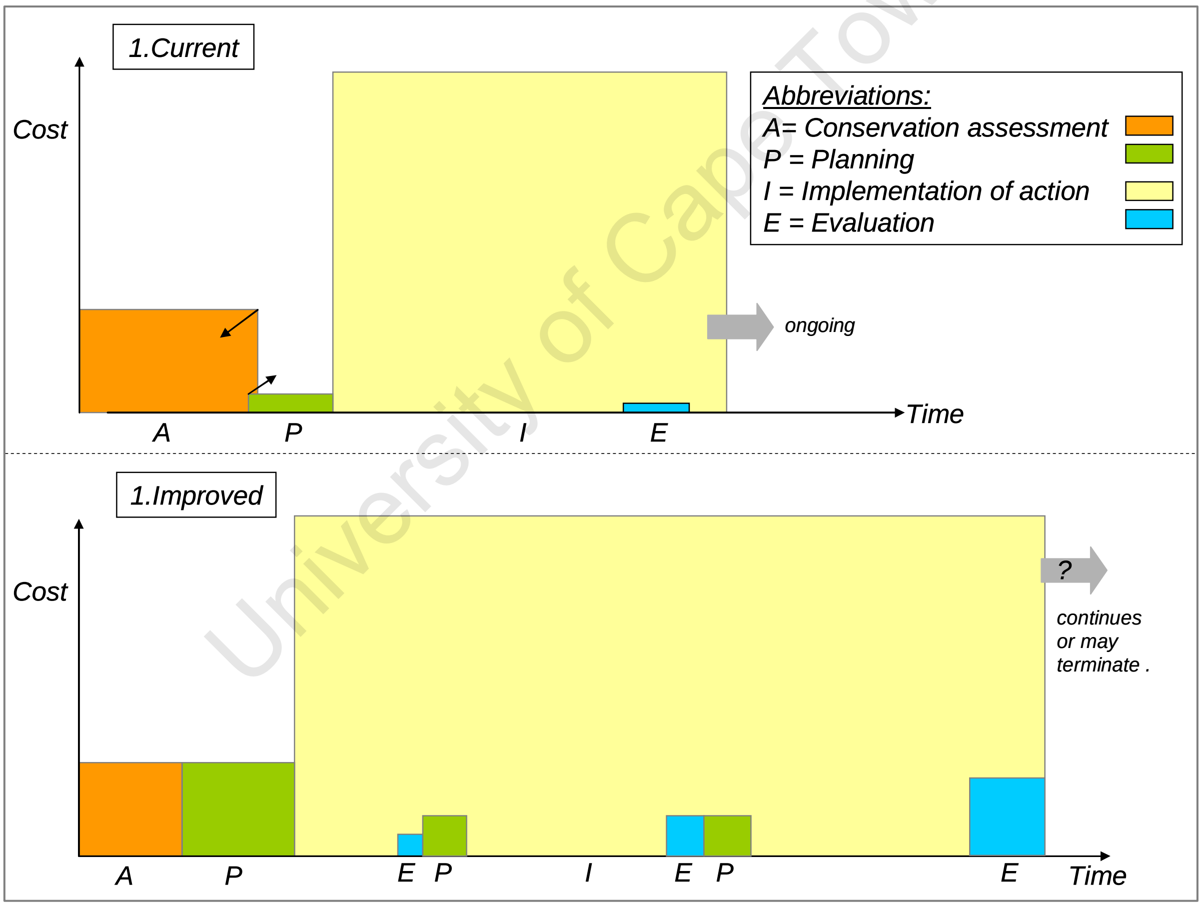


Figure 6.2. Diagram of the estimated amount of time and resources (cost) allocated to different phases of the conservation process. 1. Current: indicates the actual situation in the Cape Lowlands, where rectangles represent the relative time and cost of each component of the conservation process, including the assessment (A), planning phase (P), implementation phase (I), and evaluation (E); 2. Improved: suggests how resource allocation could be improved in future conservation processes, i.e. by balancing the assessment and planning, undertaking iterative planning during implementation, as well as regular evaluation.

4. Planning is fundamental to implementation success:

The phases from planning through to evaluating conservation achievements are the biggest challenges to effective conservation. The importance of planning and evaluation has often been underestimated in the past (Stem et al., 2005 Knight et al., 2006b). Yet both play a key connecting role in conservation process and are critical for success. Planning in the Cape Lowlands on the one hand was very successful: it ensured the conversion of technical, scientific outputs from the assessment into consensus-based products that are being used by the implementing agency in conservation practice (chapter 5). Collaboration associated with the constructive discourse between conservation planners and implementers was essential for conducting an effective process (chapter 4).

Yet on the other hand, many short-comings in the overall Cape Lowlands conservation process resulted from planning that was still not quite adequate, and which should be expanded to improve the process (Fig 6.2). Its scope was limited: the focus was on scheduling conservation actions in time and space and on developing a suitable strategy for private land conservation (chapter 4). But these and other elements of strategic planning that influence effective implementation (e.g. operational planning, see Jackelman et al., 2008; von Hase et al., 2008) were not addressed comprehensively enough and needed better integration. This applies particularly to in-depth resource planning, which is fundamental to every aspect of the conservation process. Spatial, resource, strategic and operational planning for a programme should also relate to the broader operational context of institutional-level, regional and even national level processes and structures. In addition, risk management, enabling innovation and learning, and alternative pathways are desirable elements of sound planning, that supports effective conservation and the sustainability of interventions (see also C.A.P.E., 2008a).

5. Evaluation is essential for gauging conservation success:

Evaluation, which is rarely done, was essential for demonstrating conservation success in the Cape Lowlands (chapter 5). It also indicated challenges for effective and sustainable conservation interventions in the region. The simple approach chosen to conduct this first audit was suitable for ascertaining achievements of the intervention programmes in their early implementation stages (Trochim, 2007). The evaluation phase completed the conservation process in the Cape Lowlands and initiated a new planning-implementation-evaluation cycle. This is crucial for future improvements to conservation in the region: iterative evaluation together with subsequent planning and implementation (Fig. 6.2) is the key to learning and adaptive or project cycle management (Stem et al., 2005).

In future, as part of the conservation cycle in the Cape Lowlands simple, consistent programme-internal monitoring and evaluation of the conservation interventions will remain important throughout implementation (Fig. 6.2). In addition, in-depth evaluations need to be designed to resolve some of the conventional wisdoms that determine conservation decision-making (Ferraro and Pattanayak, 2006). The results and insights from all evaluation procedures should feed into learning processes to improve the way conservation is undertaken in the entire Cape Floristic Region (C.A.P.E., 2008b). Further they are valuable tools to support higher-level decision-making on policy and resource allocation.

6. Implementation and visible conservation success take time:

Implementation is the 'reality of conservation'. It is the most difficult and revealing phase in the process when conservation successes and failures start becoming visible. Conservation interventions usually take many years, large amounts of effort and patience, and sufficient funding to show results. This is often underestimated by planners, implementers, and funding agencies alike (e.g. see Sinclair et al., 2000). Implementation success can certainly be improved when it is supported by a good conservation assessment, planning processes, and evaluation, and by integrating conservation actions into an overall conservation cycle or operational framework. But there is no quick fix even if those involved get all the elements of the process 'right' and it is important to recognise that some aspects may still beyond our immediate control (e.g. political changes, economic forces; human behaviour).

Table 6.1. Conclusions that emerged as part of research conducted during this thesis, as linked to the relevant chapter, and to future research needs.

Major conclusions	Relevant chapter	Future research needs
1. Conservation is a cyclical process requiring significant investments from its participants	Chapter 1-6	• Identifying ways to promote effective collaboration and learning in conservation processes leading to improved practices.
2. The conservation assessment is a small but critical phase	Chapter 1-3	• Designing rapid, reliable conservation assessments.
3. Suitable assessment approaches need to be selected	Chapter 1-3	• Designing rapid, reliable conservation assessments.
4. Planning is fundamental to implementation success	Chapter 4-5	• Integrating resource considerations throughout the conservation process. • Identifying ways to promote effective collaboration and learning in conservation processes leading to improved practices. • Investigating the influence of the broad conservation implementation context on success.
5. Evaluation is essential to gauge conservation success	Chapter 5	• Developing suitable evaluation methods for key programme stages. • Investigating the influence of the broad conservation implementation context on success.
6. Implementation and conservation take time	Chapter 5	• Developing suitable evaluation methods for key programme phases. • Identifying ways to promote effective collaboration and learning in conservation processes leading to improved practices. • Investigating the influence of the broad implementation context on success

3. Directions for future research

The evaluation undertaken in this study shows significant conservation achievements as part of the Cape Lowlands conservation process (chapter 5). But several knowledge gaps remain where more research is needed to further develop conservation processes leading towards effective implementation. Major research priorities are listed below and in Table 6.1, as they relate to the conclusions.

1. Towards designing rapid, reliable conservation assessments:

Simple, rapid and defensible procedures need to be developed for use in systematic conservation assessments which integrate socio-economic and biological data. This is crucial as conservation planning research has been consistently developing in the opposite direction: the inclusion of socio-economic factors is uncommon (Polasky, 2008) and research is often characterised by the use of increasingly complex and algorithmic procedures (Justus & Sarkar, 2002); this has even led to suggestions of a new discipline 'eco-informatics' (Williams et al., 2005). Efficient and effective methods are essential however as limited data, funding, and skills are the norm in many places in the world where assessments should be undertaken (e.g. Hayden, 2007). Simple procedures are also important to facilitate rapid regular updating of assessments so that these remain relevant to implementation efforts. The Cape Lowlands study has made a start here but more comparative research is needed to weigh up the relative costs and benefits of different assessment methods and inform decision-making.

2. Integrating resource considerations throughout the conservation process:

Planning and evaluation in the conservation process are major knowledge gaps that warrant a concerted investment by the conservation community to improve theory and practice. Significant expertise and insights can be gained from fields outside of conservation. Particularly, the integration of conservation costs into the assessment and the planning phase needs further development. Research needs to build on work being done on the resource allocation problem, currently mostly focused at the global scale (e.g. Wilson et al., 2006; 2007) in order to adapt this for finer-scale detailed conservation assessments and planning. Case study-based research would be useful to demonstrate ways of applying the theoretical resource allocation and planning to real-world conservation processes. Integrating additional factors, such as those relating to costs, may lead to increasingly complex assessments. Since this may conflict with the need for simpler and more rapid procedures (see 1. above), it is important to identify methods that allow, as far as possible, for the inclusion of costs in relatively simple ways.

3. Identifying ways to promote effective collaboration in conservation processes and learning that is converted into improved practices:

Discourse between and within disciplines is likely to be fundamental for most constructive conservation processes (e.g. see Mace et al., 2006 for its importance within conservation assessment research). More knowledge is however needed regarding good strategies for integrating effective collaboration, harnessing of expert knowledge and for promoting learning. These areas of research require significant inputs from other fields of expertise, including for example natural resource management (e.g. Beratan, 2007), risk assessment (e.g. Goosens et al., 2008) and conservation psychology (e.g. Saunders, 2006). Some of the important questions include: Which collaborative techniques that are used effectively for planning and decision-making in other fields of research are particularly suitable for conservation planning purposes?; At which points in the conservation process is collaboration most effective?; and, with respect to improved learning: How can learning processes and learning institutions be established so as to (i) encourage learning of the individual and of organisations; and so that (ii) learning is applied constructively to improving how conservation is done.

4. Developing suitable evaluation methods linked to programme phases and embedded in the conservation process:

Work is needed to design and test suitable evaluation techniques for specific stages of a conservation programme or intervention. This is to determine, for example, which monitoring and evaluation approach is useful in the initiation stage, the growth/development stage, the maturity/stability stage and the dissemination stage (Trochim, 2007). Guidelines are needed for individual conservation processes so that well-designed monitoring and evaluation can be fully embedded in the process early on, and to avoid unnecessary work and the associated waste of resources.

5. Investigating the role of the broad conservation implementation context in success:

The broader regional and national conservation context is likely to play a significant role in the success of individual conservation processes and on-the-ground interventions. It is worth systematically investigating the enabling role of an overarching implementation framework, such as C.A.P.E., including the individual components (e.g. institutional arrangements, policies, conservation strategies etc.) and the network of processes comprising the framework. Here, regional and national level conservation frameworks in South Africa present themselves for comparative research. These include the programmes C.A.P.E. in Cape Floristic Region (Western Cape Province), S.K.E.P. in the Succulent Karoo Biome (mostly Northern Cape Province) and S.T.E.P. in the Sub-Tropical Thicket Biome (mostly Eastern Cape Province). This is a large topic of investigation requiring an interdisciplinary approach that will benefit from data collated in overarching monitoring and evaluation systems for these programmes.

3. Summary: Linking the evolution of conservation planning and practice and the Cape Lowlands process

During my PhD research, it became apparent that conservation planning is a rapidly evolving field of conservation science. The evolution has shaped, and is partly reflected, in this thesis (see Fig. 6.3). The major conclusions and research gaps presented here reflect the rapid evolution of this discipline.

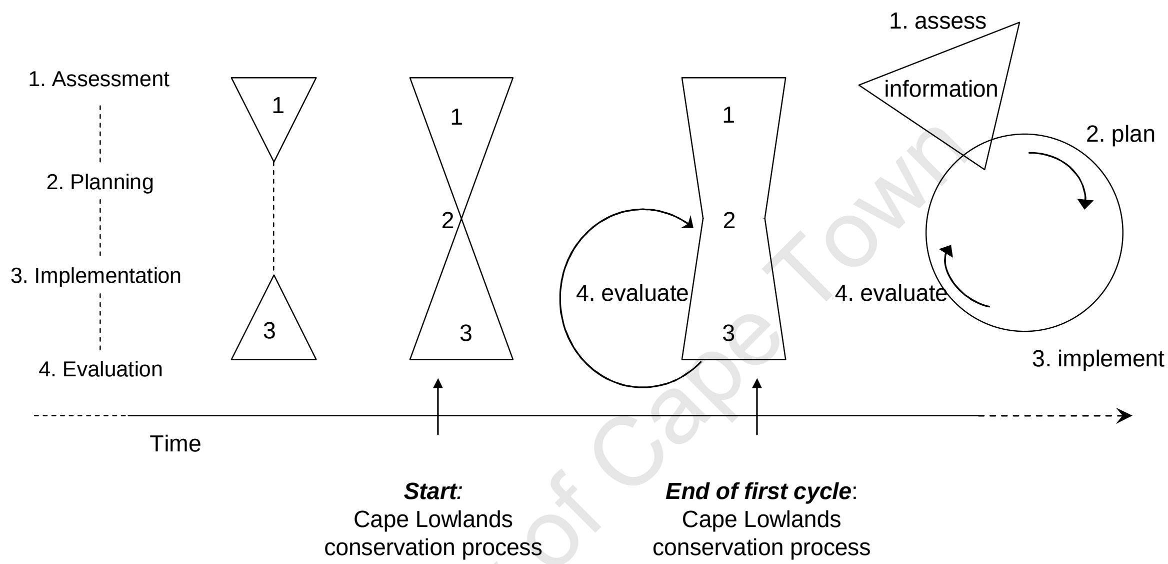


Figure 6.3. A sketch of how the conservation planning discipline has evolved with respect to its focus on different components of the conservation process and the relationship between the phases.

Conservation planning started out with efforts to make the selection of conservation areas (reserves) more rational, based on a set of explicit criteria integrated in a scoring system (Ratcliff, 1971, 1977). Subsequently, increasingly complex, technically advanced methodologies were developed to solve complex questions that centred on the reserve selection problem (Possingham et al., 2000). The ultimate goal remained essentially the same however: guiding strategic conservation interventions so as to protect priority areas that had been identified through systematic scientific conservation planning procedures (Margules and Pressey, 2000; Sarkar, 2004). Research concerns were intensely focused on the technical component of the conservation process: the systematic conservation assessment (Knight et al., 2006a,b). The link with conservation practice was tenuous at the time (Fig. 6.3). This is reflected to some extent in this thesis: the first three chapters are concerned with questions relating to the conservation assessment although from a practical, implementation-relevant perspective.

The distinction between the conservation assessment, and conservation planning as a process that embeds the assessment within procedures aimed at strategy development for implementation, has only recently been clarified (Knight et al., 2006a,b). This was in an effort to understand and remedy the perceived implementation crisis (Knight and Cowling, 2003), and a situation where the science of conservation is rapidly advancing and becoming more complex, while conservation practice is struggling to make progress (Salafsky et al., 2002) and rarely appears to be directly benefiting from the science. Awareness of this problem and of the need to close the gap between conservation theory and practice has grown over the past five or so years: it certainly strongly influenced the Cape Lowlands conservation process. Key developments in conservation research and practice that coincided with the unfolding of the Cape Lowlands study have been (i) to place more emphasis on the planning phase with the aim of connecting the assessment and implementation phase, and (ii) to include an evaluation component (see also Fig. 6.3). These aspects have been gaps that this study set out to address in its investigation of a real-world conservation process. In addition, the value of undertaking social assessments to feed information into the conservation process (step 1, Fig. 6.3) is increasingly being recognised, although this is not demonstrated as a central component in the Cape Lowlands process.

In future, the significance, extent, and sophistication of planning processes is likely to increase in conservation processes (as illustrated in Fig. 6.2). Indeed, the planning was still relatively limited in the Cape Lowlands process. Yet, judging by conservation achievements in the region, the collaborative planning that was undertaken did perform a crucial function chapter 4). However, there is a need to cater for a growing quiver of alternative and complementary conservation implementation strategies (Berkes, 2007). These are being devised and applied to address increasingly complex conservation situations in more sophisticated and creative ways: through traditional nature conservation in official parks, different models for community conservation (Berkes, 2007), private land conservation (Michael, 2003; Pence et al., 2003), and consideration of conservation needs in landuse-planning and decision-making processes (Brownlie et al., 2005), to name but a few.

Evaluation, until recently a rare phenomenon in conservation (Saeterson et al., 2004), is increasingly becoming a key component of conservation processes and programmes (e.g. C.A.P.E., 2008b; TNC, 2008; WWF, 2008). Procedures for effective monitoring and evaluation are beginning to receive more research attention in conservation (Ferraro and Pattanayak, 2006). Along with this comes the call for adaptive and project cycle management (Salafsky et al., 2002; Stem et al., 2005; Fig. 6.3): these systems integrate the different phases of conservation with the intention of improving how conservation is done (Salafsky et al., 2002). The significance of the cyclical conservation process, and the perspective that it provides on undertaking effective conservation, has become evident with the completion of the first round of the cycle in the Cape Lowlands (chapter 5).

The evolution in conservation planning (and practice) means that there needs to be a concomitant development in skills (Possingham et al., 2001; Balmford and Cowling, 2006). Scientific and reserve management skills need to be complemented with expertise in project cycle management and governance, for example, and decision theory, economics, planning, psychology, negotiation and facilitation and other fields. These areas signal some of the emerging frontiers that conservation work will need to navigate. The merging of different fields of knowledge, through skills gains in the conservation field itself and through increasing inter- and trans-disciplinary ways of working, will help to (i) run conservation processes more successfully; (ii) to embed these processes in the complex social-ecological systems where they are needed to contribute to improving in the sustainability of life on earth; and (iii) to integrate the different levels of the pyramid of disciplinary knowledge (Max Neef, 2005), which should naturally form the basis of solving complex conservation situations: the empirical level (e.g. biology, which deals with 'what exists'); the pragmatic level (e.g. agriculture, which addresses 'what are we as humans capable of doing'); the normative level (e.g. planning, which deals with 'what is it that we want to do?') and most critically the value level (e.g. ethics which deals with 'what should we do?' or 'how should we do what we want to do?').

BIBLIOGRAPHY

Andelman, S.J. and Fagan, W.F. 2000. Umbrellas and flagships: efficient conservation surrogates or expensive mistakes? Proceedings of the National Academy of Sciences 97: 5954-59.

Andrén, H. 1994. Effects of habitat fragmentation on birds and mammals in landscapes with different proportions of suitable habitat: a review. Oikos 71: 355-366.

Ashwell, A., Sandwith, T., Barnett, M., Parker, A. & Wisani, F. 2006. Fynbos Fynmense: People making biodiversity work. SANBI Biodiversity Series 4. South African National Biodiversity Institute, Pretoria. [URL= http://www.capeaction.org.za: Resources, accessed 18/12/2008].

Austin M.P., Meyers J.A., Belbin L.. and Doherty M.D. 1995. Modelling of landscape patterns and processes using biological data; subproject 5: simulated data case study. Consultancy report for ERIN. Division of Wildlife and Ecology, Commonwealth Scientific and Industrial Research Organisation, Canberra, Australia.

Baker, J. 2000. Evaluating the impact of development projects on poverty: a handbook for practitioners. Washington D.C.: LCSPR/PRMPO, The World Bank [URL= http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTPOVERTY/EXTISPMA/0,,contentMDK:20194198~pagePK:148956~piPK:216618~theSitePK:384329,00.html accessed 17/11/2008].

Ball, I. R. and Possingham, H.P. 2000. MARXAN (V1.8.2): Marine Reserve Design Using Spatially Explicit Annealing, a Manual. [URL= http://www.ecology.uq.edu.au/ index.html?page=27710 last accessed 17/09/2007].

Balmford, A. 2003. Conservation planning in the real world: South Africa shows the way. Trends in Ecology and Evolution 18: 435-438.

Balmford, A. and Bond, W. 2005. Trends in the state of nature and implications for human well-being. Ecology Letters. 8: 1218-1234.

Balmford A. and Cowling, R.M. 2006. Fusion or failure? The future of conservation biology. Conservation Biology 20: 692–695.

Bedward, M., Pressey, R.L. and Keith, D.A. 1992. A new approach to selecting fully representative reserve networks: addressing efficiency, reserve design and land suitability with an iterative analysis. Biological Conservation 62: 115-125.

Belbin, L. 1993. Environmental representativeness: regional partitioning and reserve selection. Biological Conservation 66: 223-230.

Bennett, A.F. 2003. Linkages in the Landscape. The Role of Corridors and Connectivity in Wildlife Conservation. IUCN – The World Conservation Union. Gland, Switzerland.

Beratan, K.K. 2007. A cognition-based view of decision processes in complex social–ecological systems. Ecology and Society 12: 27. [URL= http://www.ecologyandsociety.org/vol12/iss1/art27 accessed 15/03/2008].

Berkes, F. 2007. Community conservation in a globalised world. Proceedings of the National Academy of Sciences 104: 15188–15193

Bond, W.J., Midgley, J. and Vlok, J. 1988. When is an island not an island? Insular effects and their causes in fynbos shrublands. Oecologia 77: 515-521.

Botha, M. 2001. Incentives for Conservation on Private land: Options and Opportunities. Summary Report 02/2001. Cape Conservation Unit. Botanical Society of South Africa. Cape Town. [URL= http://www.botanicalsociety.org.za accessed 11/12/2007].

Bottrill, M.C., Joseph, L.N., Carwardine, J., Bode, M., Cook, C. Game, E.T., Grantham, H., Kark, S., Linke, S., McDonald-Madden, E., Pressey, R.L., Walker, S., Wilson, K.A. and Possingham, H.P. 2008. Is conservation triage just smart decision making? Trends in Ecology and Evolution.23: 649-654.

Boucher, C. and Moll, E.H. 1980. South African Mediterranean shrublands. In: di Castri, F., Goodall, D.W. and Specht, R.L. (eds.) Mediterranean-type Shrublands. Pp. 233-48. Elsevier, Amsterdam.

Bowie, R.C.K. and Donaldson, J.S. 1999. Behaviour and dispersal of butterflies in renosterveld vegetation: implications for reserve design in a highly fragmented system. In Lepidoptera: ambassadors of biodiversity. pp.9. Proceedings of the 2nd International Lepidopterists' Conference of Africa, Kirstenbosch, Cape Town.

Briers, R. 2002. Incorporating connectivity into reserve selection procedures. Biological Conservation 103: 77-103.

Brook, R.K., and S.M. McLachlan. 2005. On using expert-based science to “test” local ecological knowledge. Ecology and Society 10: r3. [URL=http://www.ecologyandsociety.org/vol10/iss2/resp3 last accessed 12/12/2007]

Brooker, L., Brooker, M. and Cale, P. 1999. Animal dispersal in fragmented habitat: measuring habitat connectivity, corridor use and dispersal mortality. Conservation Ecology 3: 4. [URL= http://www.consecol.org/vol3/iss1/art4 last accessed 12/12/2007]

Brooker, L. and Brooker, M. 2001. Breeding biology, reproductive success and survival of blue-breasted fairy-wrens in fragmented habitat in the Western Australian wheatbelt. Wildlife Research 28: 205-214.

Brooker, L. and Brooker, M. 2002. Dispersal and population dynamics of the blue-breasted fairy-wren, *Malurus pulcherrimus*, in fragmented habitat in western Australian wheatbelt. Wildlife Research 29: 225-233.

Brooks, T., da Fonseca, G.A.B., Rodrigues, A.S.L., 2004. Species, data and conservation planning Conservation Biology 18: 1682-1688.

Brownlie, S., de Villiers, C., Driver, A., Job, N., von Hase, A. and Maze, K. 2005. Systematic Conservation Planning in the Cape Floristic Region and Succulent Karoo, South Africa: enabling sound spatial planning and improved environmental assessment. Journal of Environmental Policy Assessment and Management 7: 201-228.

Cabeza, M. 2003. Habitat loss and connectivity of reserve networks in probability approaches to reserve design. Ecology Letters 6: 665-672.

C.A.P.E. (Cape Action for People and the Environment). 2008a. The Pathfinder process for the C.A.P.E. Programme. [URL= http://www.capeaction.org.za: Resources, accessed 19/12/2008].

C.A.P.E. 2008b. Monitoring and Evaluation. [URL= http://www.capeaction.org.za/index.php?q=monitoring&C=about&P=15, accessed 13/12/2008]

CapeNature. 2007. Operational Procedures Manual of the Conservation Stewardship Programme. Cape Action Plan for the Environment (C.A.P.E.). Cape Town.

Causton, D.R. 1988. Introduction to vegetation analysis. Unwin-Hyman press, London.

Cawsey, E.M., Austin, M.P and Baker, B.L. 2002. Regional vegetation mapping in Australia: a case study in the practical use of statistical modeling. Biodiversity and Conservation 11: 2239–2274

Cerdeira, J.O., Gaston, K.J. and Pinto, L.S. 2005. Connectivity in priority area selection for conservation. Environmental Modeling and Assessment 10: 183-192.

Chalmers, N. and Fabricius, C. 2007. Expert and generalist local knowledge about land-cover change on South Africa's Wild Coast: can local ecological knowledge add value to science? Ecology and Society 12 (1): 10. [URL= http://www.ecologyandsociety.org/vol12/iss1/art10/ last accessed 12/12/2007]

Church, R.L., D.M. Stoms, and F.W. Davis. 1996. Reserve selection as a maximal covering location problem. Biological Conservation 76:105-112.

Cleary, D. 2006. Letter in response to Higgins et al., 2006. Conservation Biology 20: 1567-1568.

Cocks, K.D. and Baird, I.A. 1989. Using Mathematical Programming to Address the Multiple Reserve Selection Problem: An Example from the Eyre Peninsula, South Australia. Biological Conservation 49: 113-130.

Cole, N.S., Lombard, A.T., Cowling, R.M., Euston-Brown, D., Richardson, D.M. and Heijnis, C.H. 2000. Framework for a Conservation Plan for the Agulhas Plain, Cape Floristic Region, South Africa. Report 0001, Institute for Plant Conservation. University of Cape Town. South Africa.

Conservation Unit. 2004. Project completion report to the Critical Ecosystems Partnership Fund: Partnerships, Cooperative Management and Incentives to Secure Biodiversity Conservation in Priority Areas in the Cape Floristic Region (Conservation Stewardship Pilot Project). Botanical Society of South Africa, Cape Town

Cope, J. 2005. The Conventional Wisdom on conservation easements in Latin America. PHASE 1. Improving and Expanding Use of Conservation Easements in Latin America: A Learning Portfolio. [URL=http://www.fosonline.org: Resources, accessed 18/12/2008]

Costello, C. and Polasky, S. 2004. Dynamic reserve site selection. Resource and Energy Economics 26: 157–174.

Cowling, R.M. 1987. Fire and its role in coexistence and speciation in Gondwana shrublands. South African Journal of Science 83: 106-11.

Cowling, R.M. and Bond, W.J. 1991. How small can reserves be? An empirical approach in Cape fynbos, South Africa. Biological Conservation 58: 243-256.

Cowling, R.M., Gibbs Russell, G.E., Hoffman, M.T. and Hilton-Taylor, C. 1989. Patterns of plant species diversity in southern Africa. In: Huntley, B.J. (ed.). Biotic diversity in southern Africa. Concepts and Conservation, pp. 19-50. Oxford University Press, Cape Town, South Africa.

Cowling, R.M. and Heijnis, C.E. 2001. Broad Habitat Units as biodiversity entities for conservation planning in the Cape Floristic Region. South African Journal of Botany 67: 15-38.

Cowling, R.M. and 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. and Pressey, R.L. 2001. Rapid plant diversification: Planning for an evolutionary future. Proceedings of the National Academy of Sciences (USA) 98: 5452-5457.

Cowling, R.M., Pressey, R.L., Rouget, M. and Lombard, A.T. 2003. A conservation plan for a global biodiversity hotspot - the Cape Floristic Region, South Africa. Biological Conservation 112: 191-216.

Cowling, R.M., Richardson, D.M. and Mustard, P.J. 1997. Fynbos. In: Cowling, R.M., Richardson, D.M. and Pierce, S.M. (eds.) Vegetation of Southern Africa. Cambridge University Press, Cambridge.

Cowling, R.M., and Wilhelm-Rechmann, A., 2007. Social assessment as a key to conservation success. Oryx 41, 135.

Cumming, T. and Botha, M. 2008. A brief summary of the tax incentives in support of Protected Areas Expansion and Securing Threatened Ecosystems. Botanical Society of SA. Cape Town [URL= http://www.capeaction.org.za: Resources, accessed 18/12/2008].

Dale, V.H. and Haeuber, R.A. 2000. Perspectives on Land Use. Ecological Applications 10: 671-672.

Davies, B.B. and Hodge, I.D. 2007. Exploring environmental perspectives in lowland agriculture: A Q Methodology study in East Anglia, UK. Ecological Economics 61: 323-333

Davis, F.W., Stoms, D.M. and Andelman, S.J. 1999. Systematic reserve selection in the U.S.A.: and example from the Columbia Plateau ecoregion. Parks 9: 31-41.

Davis, S.D., Heywood, V.H. and Hamilton, A.C. (eds.). 1994. Centres of Plant Diversity. A guide and strategy for their conservation. Volume 1. Europe, Africa, South West Asia and the Middle East. WWF and IUCN. IUCN Publications Unit, Cambridge.

Debinski, D.M. and Holt, R.D. 2000. A survey and overview of habitat fragmentation experiments. Conservation Biology 14: 342-355.

Desmet, P.G. 2004. Designing a Living Landscape for Biodiversity Conservation in the Knersvlakte Region of the Succulent Karoo, South Africa: A Systematic Conservation Planning Approach. PhD Thesis. University of Cape Town. South Africa.

Donaldson, J., Nänni, I., Zachariades, C. and Kemper, J. 2002. Effects of habitat fragmentation on pollinator diversity and plant reproductive success in renosterveld shrublands of South Africa. Conservation Biology 16: 1267-1276.

Drechsler, M. 2005. Probabilistic approaches to scheduling reserve selection. Biological Conservation 122: 253-262.

Driver, A., Maze, K., Cowling, R.M., Desmet, P., Goodman, P., Harris, J., Jonas, Z., Lombard, A.T., Nel, J., Reyers, B., Rouget, M., Sink, K., Strauss, T., Turpie, J. 2004. South African Spatial Biodiversity Assessment 2004: Summary Report. South African National Biodiversity Institute, Pretoria. [URL=http://www.sanbi.org/biodiversity/nsba.htm last accessed 12/12/2007]

Driver, A., Cowling, R.M. and Maze, K. 2003. Planning for Living Landscapes: Perspectives and Lessons from South Africa. Washington, DC: Center for Applied Biodiversity Science at Conservation International; Cape Town: Botanical Society of South Africa.

Elmendorf, C.S. 2003. Ideas, incentives, gifts and governance: toward conservation stewardship of private land in cultural and psychological perspective. University of Illinois Law Review. Vol 2003. 423-506.

Environmental Law Institute (ELI). 2003. Legal Tools and Incentives for Private Lands Conservation in Latin America: Building Models for Success. Washington D.C.

Fahrig, L. 2003. Effects of habitat fragmentation on biodiversity. Annual Review of Ecology, Evolution and Systematics 34: 487-515.

Failing, L., Gregory, R. and Harstone, M. 2007. Integrating science and local knowledge in environmental risk management: A decision-focused approach. Ecological Economics 64: 47-60.

Fairbanks, D.H.K. and Benn, G.A. 2000. Identifying regional landscapes for conservation planning: a case study from KwaZulu-Natal, South Africa. Landscape and Urban Planning 50: 237-257.

Faith, D.P., Margules, C.R., Walker, P.A., Stein, J. and Natera, G. 2001. Practical application of biodiversity surrogates and percentage targets for conservation in Papua New Guinea. Pacific Conservation Biology 6: 289-303.

Ferraro, P.J. and Pattanayak, S.K. 2006. Money for nothing? A call for empirical evaluation of biodiversity conservation investments. PLoS Biology 4: e105.

Ferrier, S. 2002. Mapping Spatial Pattern in Biodiversity for Regional Conservation Planning: Where To From Here? Systematic Biology 51: 331-63.

Ferrier, S., Pressey, R.L. and Barrett, T.W. 2000. A new predictor of the irreplaceability of areas for achieving a conservation goal, its applicability to real-world planning and a research agenda for further refinement. Biological Conservation 93: 303-325.

Fischer, J. and Lindenmayer, D.B. 2007. Landscape modification and habitat fragmentation: a synthesis. Global Ecology and Biogeography 16: 265-280.

Fischer, P. 2004. Listening to Landowners. Defenders of Wildlife, West Linn, Oregon. [URL= http://www.biodiversitypartners.org accessed 12/12/2008].

Frazee, S., Cowling, R.M., Pressey, R.L., Turpie, J.K., Lindenberg, N., 2003. Estimating the costs of conserving a biodiversity hotspot: a case study of the Cape Floristic Region, South Africa. Biological Conservation 112: 275–290.

Gadgil, M., Olsson, P., Berkes, F. and Folke, C. 2003. Exploring the role of local ecological knowledge in ecosystem management: three case studies. Pp 189–209 in F. Berkes, J. Colding, and C. Folke (eds.) Navigating social–ecological systems: building resilience for complexity and change. Cambridge University Press, Cambridge, U.K.

Gelderblom, C.M., van Wilgen, B.W., Nel, J., Sandwith, T., Botha, M., Hauck, M. 2003. Turning strategy into action: implementing a conservation action plan in the Cape Floristic Region. Biological Conservation 112: 291–297.

George, S. 2002. Conservation in America: State Government Incentives for Habitat Conservation. A Status Report. Defenders of Wildlife. Washington, D.C.

Goldblatt, P. and Manning, J. 2000. Cape Plants. A conspectus of the Cape Flora of South Africa. National Botanical Institute, South Africa and Missouri Botanical Gardens, U.S.A.

Goodwin, B.J. and Fahrig, L. 2002. How does landscape structure influence landscape connectivity? Oikos 99: 552-570.

Goosens, L.H.J., Cooke, R.M., Hale, A.R. and Rodic´-Wiersma, Lj. 2008. Fifteen years of expert judgement at TUDelft. Safety Science 46: 234–244.

Groves, C., Jensen, D., Valutis, L., Redford, K., Shaffer, M., Scott, M., Baumgartner, J., Higgins, J., Beck, M. and Anderson, M. 2002. Planning for biodiversity conservation: Putting conservation science into practice. Bioscience 52: 499-512

Guikema, S. and Milke, M. 1999. Quantitative decision tools for conservation programme planning: practice, theory and potential. Environmental Conservation 26: 179–189.

Guillon-Michel, E. and Moses, G. 2006. Commitment of farmers to environmental protection: from social pressure to environmental conscience. Journal of Environmental Psychology 26: 227-35.

Guisan, A. and Zimmerman, N.E. 2000. Predictive habitat distribution models in ecology. Ecological Modelling 135: 147-186.

Gunningham, N. and Young, M.D. 1997. Toward optimal environmental policy: The case of biodiversity conservation. Ecology Law Quarterly 24: 243-281.

Gustanski, J. A. (2000). Protecting the Land: Conservation Easements, Voluntary Actions, and Private Lands. pp. 9-25 in J.S. Gustanski & R.H. Squires (eds.). Protecting the Land: Conservation Easements Past, Present, and Future. Island Press, Washington D.C.

Haila, Y. 2002. A conceptual genealogy of fragmentation research: from island biography to landscape ecology. Ecological Applications 12: 321-334.

Halpern, B.S., Pyke, C.R., Fox, H.E., Haney, J.C., Schlaepfer MA, and Zaradic, P. 2006. Gaps and mismatches between global conservation priorities and spending.Conservation Biology 20: 56–65.

Harper, J.L. and Hawksworth, D.L. 1994. Biodiversity: Measurement and estimation. Preface. Phil. Transactions of the Royal Society of London B 345: 5-12.

Hayden, T. 2007. Ground Force. Nature 445: 481-83.

Henle, K., Lindenmayer, D.B., Margules, C.R., Saunders, D.A. and Wissel, C. 2004. Species survival in fragmented landscapes: where are we now? Biodiversity and Conservation 13:1-8.

Higgins, J., Touval, J.L., Unnasch, R.S., Reichle, S., Oren, D.C., Waldman, W.R. and Hoekstra, J.M. 2006. Who Needs to Spend Money on Conservation Science Anyway? Conservation Biology 20:1566-1567

Hobbs, R.J. and Yates, C.J. 2003. Impacts of ecosystem fragmentation on plant populations: generalising the idiosyncratic. Australian Journal of Botany 51: 471-488.

Hocker, J. (2000). Foreword. In J.S. Gustanski & R.H. Squires (eds.).Protecting the Land: Conservation Easements Past, Present, and Future.(pp. xvii-xix). Island Press. Washington D.C.

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

Howard, P.C., Viskanic, P., Davenport, T.R.B., Kigenyi, F.W., Baltzer, M., Dickinson, C.J., Lwanga, J.S., Matthews, R.A., Balmford, A., 1998. Complementarity and the use of indicator groups for reserve selection in Uganda. Nature 394: 472–75.

Hughey, K.F.D., Cullen, R. and Moran, E. 2003. Integrating economics into priority setting and evaluation in conservation management. Conservation Biology 17: 93-103.

Hummon, C. 2004. Conservation Incentives Programs: Improving Effectiveness for Habitat and for Landowners - Summary and Recommendations from the Habitat Conservation Incentives Workshop June, 2004. Defenders of Wildlife. Washington, D.C.

Hummon, C. and Cochran, B. 2005.Voluntary Conservation Tools and Programs. Defenders of Wildlife: Oregon. [URL=http://www.biodiversitypartners.org accessed 12/12/2008]

Jackelman, J. and Ferreira, D. 2007. Conservation Stewardship: A rapid appraisal of C.A.P.E. partner activities. C.A.P.E. Cape Town. [URL= http://www.capeaction.org.za: Resources accessed 19/12/2008]

Jackelman, J., von Hase, A., Balfour, D. and Ferreira, D. 2008. Conservation Stewardship: Implementation plan: 2009-2012. CapeNature. Cape Town.

James, S. 2002: Bridging the gap between private landowners and conservationists. Conservation Biology 16: 269-271.

Justus, J. and Sarkar, S. 2002. The principle of complementarity in the design of reserve networks to conserve biodiversity: a preliminary history. Journal of Bioscience, Supplement 2, 27: 421–435.

Kemper, J., Cowling, R.M. and Richardson D.M. 1999. Fragmentation of South African renosterveld shrublands: effects on plant community structure and conservation implications. Biological Conservation 90: 103-111.

Kerley, G.I.H., Pressey, R.L., Cowling, R.M., Boshoff, A.F., Sims-Castley, R. 2003. Options for the conservation of large and medium-sized mammals in the Cape Floristic Region hotspot, South Africa. Biological Conservation 112: 169–190.

Kerr, J.T. and Ostrovsky, M. 2003. From space to species: ecological applications for remote sensing. Trends in Ecology & Evolution 18: 299-305.

Kirkpatrick, J.B. 1983. An Iterative Method for Establishing Priorities for Selection of Nature Reserves: An Example From Tasmania, Biological Conservation 25: 127 - 134.

Kirkpatrick, S., Gelatt Jr, C.D., and Vecchi, M.P. 1983. Optimization by Simulated Annealing, Science 220: 671-680.

Kleiman, D.G., Reading, R.P., Miller, B.J., Clark, T.W., Scott, J.M., Robinson, J., Wallace, R.I., Cabin, R.J. and Felleman, F. 2000. Improving the evaluation of conservation programs. Conservation Biology 14: 356-355.

Knight, A.T. 2007. Towards Knowing Through Doing: Improving the Societal Relevance of Systematic Conservation Assessments. PhD Thesis. Nelson Mandela Metropolitan University. South Africa.

Knight, A.T., Cowling, R.M., and Campbell, B.M. 2006a. An operational model for implementing conservation action. Conservation Biology 20: 408-419.

Knight, A.T and Cowling, R.M. 2003. Conserving South Africa's "lost" biome: a framework for securing effective regional conservation planning in the Subtropical Thicket Biome. TERU report no. 44. Terrestrial Ecology Research Unit, University of Port Elizabeth, South Africa.

Knight, A.T and Cowling, R.M. 2007. Embracing Opportunism in the Selection of Priority. Conservation Biology 21: 1124–1126.

Knight, A.T., Driver, A., Cowling, R.M., Maze, K., Desmet, PG., Lombard, A.T., Rouget, M., Botha, M.A., Boshoff, A.F., Castley, G.J., Goodman, P.S., MacKinnon, K, Pierce, S.M., Sims-Castley, R, Stewart, W.I. and von Hase, A. 2006b. Designing Systematic Conservation Assessments that Promote Effective Implementation: Best Practice from South Africa. Conservation Biology 20: 739–750. [Appendix 6].

Knight, A.T., Cowling, R.M., Rouget, M., Balmford, A., Lombard, A.T., Campbell, B.M. 2008. Knowing but not doing: Selecting priority conservation areas and the research-implementation gap. Conservation Biology, 22: 610-617

Knight, R.L. 1999. Private lands: The neglected geography. Conservation Biology 13: 223-224.

Land Trust Alliance (LTA). 2005. 2005 National land trust census report. Land Trust Alliance. Washington, D.C. [URL= http://www.lta.org/census accessed 12/12/2008]

Laurance, W. F. 2000. Do edge effects occur over large spatial scales? Trends in Ecology and Evolution 15: 134-135.

Leslie, H., Ruckelshaus, M., Ball, I.R., Andelman, S. and Possingham, H.P. 2003. Using siting algorithms in the design of marine reserve networks. Ecological Applications 13 Supplement: S185-S198

Lindenmayer, D.B. and Fischer, J. 2007. Tackling the habitat fragmentation panchreston. Trends in Ecology and Evolution 22: 127-132.

Linder, H.P. 1985. Gene flow, speciation and species diversity patterns in a species-rich area: the Cape Flora. In: Vrba, E. (ed.). Species and Speciation, pp. 53-57. Transvaal Museum Monograph 4. Transvaal Museum. Pretoria.

Linder, H.P. 1991. Environmental correlates of patterns of species richness in the south western Cape Province of South Africa. Journal of Biogeography 18: 509-518.

Linder, H.P., Meadows, M.E. and Cowling, R.M. 1992. History of the Cape Flora. In: Cowling, R.M. (ed.) Ecology of Fynbos – Nutrients, Fire and Diversity, pp. 113-134. Oxford University Press, Cape Town.

Lloyd, JW, van den Berg, EC, van Wyk, W. 1999. CAPE Project: The Mapping of threats to biodiversity in the Cape Floristic Region with the aid of remote sensing and geographic information systems (Climate and Soil Report No. GW/ A1999/ 54). Agricultural Research Council, Institute for Soil, Climate and Water. Pretoria.

Lochner, P., Weaver, A., Gelderblom, C., Peart, R., Sandwith, T., Fowkes, S. 2003. Aligning the diverse: the development of a biodiversity conservation strategy for the Cape Floristic Region. Biological Conservation 112: 29–43.

Lombard, A.T., Cowling, R.M., Pressey, R.L. and Rebelo, A.G. 2003. Effectiveness of landclasses as surrogates for species in conservation planning for the Cape Floristic Region. Biological Conservation 112: 45-62.

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

Mace, G.M., Balmford, A., Boitani, L., Cowlishaw, G., A. P. Dobson, A.P., Faith, D. P., Gaston, K.J., C. J. Humphries, C.J., Vane-Wright, R.I., Williams, P.H., Lawton, J.H., Margules, C.R., May, R. M., Nicholls, A.O., Possingham, H.P., Rahbek, C. and van Jaarsveld, A.S.. 2000. It's time to work together and stop duplicating conservation efforts… Nature 405: 393.

Margules, C.R. and Pressey, R.L. 2000. Systematic conservation planning. Nature 405: 243-253.

Margules, C. and Usher, M.B. 1981. Criteria used in assessing wildlife conservation potential: a review. Biological Conservation 21: 79–109

Martin, T.G., Kuhnert, P..M., Mengersen, K. and Possingham, H.P. 2005. The power of expert opinion in ecological models using Bayesian methods: impact of grazing on birds. Ecological Applications 15: 266–280.

Max-Neef, M.A. 2005. Foundations of trans-disciplinarity. Ecological Economics 53: 5-16.

McBride, M.F., Burgman, M.A., and Fidler, F.M. 2007. Making use of experts in ecology. Conference presentation at the ESA/SER Joint meeting. San Diego. U.S.A.

McDonnell, M.D., Possingham, H.P., Ball, I.R. and Cousins, E.A. 2002. Mathematical methods for spatially cohesive reserve design. Environmental Modeling and Assessment 7: 107–114.

McDowell C. 1988: Factors affecting the conservation of Renosterveld by private landowners. PhD Thesis. Department of Botany. University of Cape Town.

McDowell, C, & Moll, E. 1992. The influence of agriculture on the decline of west coast renosterveld, South-western Cape. South African J. Environ. Management 35: 173-192.

McGarigal, K. and Cushman, S.A. 2002. Comparative evaluation of experimental approaches to the study of habitat fragmentation effects. Ecological Applications 12: 335-345.

Meir, E., Andelman, S. and Possingham, H.P. 2004. Does conservation planning matter in a dynamic and uncertain world? Ecology Letters 7: 615-622.

Merenlender, A., L. Huntsinger, G. Guthey, and S. Fairfax. 2004. Land trusts and conservation easements: who is conserving what for whom? Conservation Biology 18:65–75.

Metzger, J.P. and Decamps, H. 1997. The structural connectivity threshold: an hypothesis in conservation biology at the landscape scale. Acta Oecologica-International Journal of Ecology 18: 1-12.

Michael, J.A. 2003. Efficient habitat protection with diverse landowners and fragmented landscapes. Environmental Science and Policy 6: 243-251.

Millennium Ecosystem Assessment (MEA). 2005. Ecosystems and Human Well-being: Biodiversity Synthesis. World Resources Institute, Washington, DC. [URL= http://www.milleniumassessment.org last accessed 18/02/2008]

Moilanen, A. 2005. Methods for reserve selection: interior point search. Biological Conservation 124: 485-492.

Morgan, M.G., Pitelka, L.F. and E. Shevliakova. 2001. Elicitation of expert judgments of climate change impacts on forest ecosystems. Climate Change 49: 279-307.

Mucina, L., Rutherford, M.C. and Powrie, L.W. (eds.). 2005. Vegetation map of South Africa, Lesotho and Swaziland, 1:1 000 000 scale sheet maps. South African National Biodiversity Institute, Pretoria, South Africa.

Mucina, L. and Rutherford, M.C. (eds.). 2006. The Vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria, South Africa.

Murdoch, W., Polasky, S. Wilson, K.A., Possingham, H.P., Kareiva, P. and Shaw, R. 2007. Maximising return on investment. Biological Conservation 139: 375-388.

Murphy, J. 2000. Improving the value of conservation programs: letter in response to Kleiman et al. Conservation Biology 14: 1569-70.

Myers, N. 1979. The Sinking Ark: A New Look at the Problem of Disappearing Species. Pergamon, Oxford.

Myers, N., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B. & Kent, J. 2000. Biodiversity Hotspots for Conservation Priorities. Nature 403: 853-858.

Naidoo, R., Balmford, A., Ferraro, P.J., Polasky, S., Ricketts, T.H. and Rouget, M. 2006. Integrating economic costs into conservation planning. Trends in Ecology and Evolution 21: 681-687.

Nalle, D.J., Arthur, L. and Sessions, J. 2002. Designing compact and contiguous reserve networks with a hybrid heuristic algorithm. Forest Science 48: 59-68.

The Nature Conservancy (TNC). Conservation auditing tools. [URL = http://conserveonline.org/ work-spaces/Conservation_Audit -accessed 03/11/2008]

Newburn, D., Reed, S., Berck, P. and Merenlender, A. 2005. Economics and land-use change in prioritizing private land conservation. Conservation Biology 1411–1420

Nicholls, A.O. and Margules, C.R. 1993. An upgraded reserve selection algorithm. Biological Conservation 64: 165-169.

Norton, D.A. Conservation Easements: Biodiversity Protection and Private Use. Conservation Biology 14: 1221-1223.

Noss R.F. and Csuti B. 1994. Habitat fragmentation. Principles of Conservation Biology (eds. Meffe GK & Carrol CR), pp. 237-264. Sinnauer Associates Inc, Sunderland, MA.

Olson,D.M. and Dinerstein, E. 1998. TheGlobal 200: a representation approach to conserving the earth's most biologically valuable ecoregions. Conserv. Biol. 12, 502–515.

Önal, H. and Briers, R.A. 2005. Designing a conservation reserve network with minimal fragmentation: a linear integer programming approach. Environmental Modeling and Assessmenet 10: 193-202.

Osano, P.P.M. 2005. Estimating the opportunity costs of biodiversity conservation in the Western Cape, South Africa. Unpublished MSc Thesis. Percy Fitzpatrick Institute. University of Cape Town.

Pasquini, L. 2007. Privately-owned land and biodiversity conservation: analyzing the role of private conservation areas in the Little Karoo, South Africa. PhD Thesis, University of Sheffield, UK.

Parker, S.R. 2006. Incentives And Disincentives For Conserving Renosterveld Remnants And The Potential Impacts Of Property Rate Rebates. Unpublished MSc Thesis. Percy Fitzpatrick Institute, University of Cape Town.

Pauw, A. 2004. Variation in pollination across a fragmented landscape at the Cape of Africa. PhD Thesis, University of Cape Town, South Africa.

Pearce, J. and Ferrier, S. 2001. The practical value of modelling relative abundance of species for regional conservation planning: a case study. Biological Conservation 98: 33-43.

Pence, G.Q.K., Botha, M.A. and Turpie, J.K. 2003. Evaluating combinations of on-and off-reserve conservation strategies for the Agulhas Plain, South Africa: a financial perspective. Biological Conservation 112: 253–273.

Peterson, G.D., Cumming, G.S., and Carpenter, S.R. 2003. Scenario planning: a tool for conservation in an uncertain world. Conservation Biology 17: 358-366.

Pierce, S.M. and Cowling, R.M. 1984. Phenology of fynbos, renosterveld and subtropical thicket in the south eastern Cape. South African Journal of Botany 3: 1-16.

Polasky, S. 2008. Why conservation planning needs socioeconomic data. Proceedings of the National Academy of Sciences 105: 6505–6506.

Possingham, H.P., Andelman, S.J., Burgman, M.A., Medellin, R.A., Master, L.L. and Keith, D.A. 2002. Limits to the use of threatened species lists. Trends in Ecology & Evolution 17: 503-7.

Possingham, H.P., Andelman, S., Noon, B.R., Trombulak, S. and Pulliam, H.R. 2001. Making smart conservation decisions. In Soule, M.E. and Kohm, K. (eds.). Research priorities for nature conservation. Island Press. Washington D.C., USA.

Possingham, H., Ball, I. and Andelman, S. 2000. Mathematical methods for identifying representative reserve networks. Pp. 291-305 in: Quantitative methods for conservation biology. Ferson, S. and Burgman, M. (eds). Springer-Verlag, New York.

Possingham, P.H., Wilson, K.H., Andelman, S.J. and Vynne, C.H. 2006. Protected areas: goals, limitations and design. Pp. 509-533. In Groom, M.J., Meffe, G.K. and Carroll, C.R. (eds.). Principles of Conservation Biology 3rd edition. Sinauer Associates, Inc. Sunderland. MA.

Prendergast, J.R., Quinn, R.M. and Lawton, L.H. 1999. The gaps between theory and practice in selecting nature reserves. Conservation Biology 13: 484-492.

Pressey, R.L. 1994. Ad hoc reservations: forward or backwards steps in developing representative reserve systems? Conservation Biology 8: 662-8.

Pressey, R.L. 1999. Editorial – systematic conservation planning for the real world. Parks 9: 1 –6. IUCN. Gland, Switzerland.

Pressey, R.L. 2002. The first reserve selection algorithm—a retrospective on Jamie Kirkpatrick's 1983 paper. Progress in Physical Geography 26:434–442.

Pressey, R.L., Cowling, R.M. & Rouget, M. 2003. Formulating conservation targets for biodiversity pattern and processin the Cape Floristic Region, South Africa. Biological Conservation 112: 99-127.

Pressey, R.L., Humphries, C.J., Margules, C.R., Vane-Wright, R.I., and Williams P.H. 1993. Beyond Opportunism: Key Principles for Systematic Reserve Selection. Trends in Ecology and Evolution 8: 124-128.

Pressey, R. L. and Logan, V.S. 1998. Size of selection units for future reserves and its influence on actual vs. targeted representation of features: a case study in New South Wales. Biological Conservation 85: 305-319.

Pressey, R.L. and Nicholls, A.O. 1989. Efficiency in Conservation Evaluation: Scoring Versus Iterative Approaches. Biological Conservation 50: 199-218

Pressey, R.L. and Taffs, K.H. 2001. Scheduling conservation action in production landscapes: priority areas in western New South Wales defined by irreplaceability and vulnerability to vegetation. Biological Conservation 100: 355–376

Privett, S.D.J. 1998. Determinants of pattern in fynbos vegetation: physical site factors, disturbance regime, species attributes and temporal change. MSc Thesis, Botany. University of Cape Town. South Africa.

Procheş, Ş., Cowling, R.M., Goldblatt, P., Manning, J. and Snyman, D. 2006. An overview of Cape geophytes. Biological Journal of the Linnaean Society 87: 27-43.

Pullin, A.S. and Knight, T.M. 2001. Effectiveness in Conservation Practice: pointers from medicine and public health. Conservation Biology 15: 50-54

Pyke, C.R. 2005. Assessing suitability for conservation action: Prioritising interpond linkages for the California Tiger Salamander. Conservation Biology 19: 492-503.

Ratcliffe, D.A. 1971. Criteria for the selection of nature reserves. Adv. Science. 27: 294–296

Ratcliffe, D.A. 1977. The selection of biological sites of national importance to nature conservation in Britain. Cambridge University Press, Cambridge, Britain.

Reader, J. 1998. Africa. A Biography of the Continent. Penguin Books, London.

Redford, K.H., Taber, A., 2000. Writing the wrongs: developing a safe-fail culture in conservation. Conservation Biology 14, 1567-1568.

Rebelo, A.G., Siegfried, W.R., 1992. Where should nature reserves be located in the Cape Floristic region, South Africa? Models for the spatial configuration of a reserve network aimed at maximizing the protection of floral diversity. Conservation Biology 6: 243–252.

Reyers, B., Wessels, K.J. and van Jaarsveld, A.S. 2002. An assessment of biodiversity surrogacy options in the Limpopo Province of South Africa. African Zoology 37: 185-195.

Rissman, A.R., Lozier, L., Comendant, T., Kareiva, P., Kiesebecker, J.M., Shaw, M.R., and Merenlender, A.M. 2007. Conservation Easements: Biodiversity Protection and Private Use. Conservation Biology 21.

Rodrigues, A.S.L. and Gaston, K.J. 2001. How large do reserve networks need to be? Ecology Letters 4: 602-609.

Rothley, K.D. 2006. Finding the tradeoffs between the reserve design and representation. Environmental Management 38: 327-336.

Rouget, M. Cowling, R.M., Lombard, A.T., Knight, A.T. and Kerley, G.I.H. 2006. Designing large-scale conservation corridors for pattern and process. Conservation Biology 20: 549-561.

Rouget, M., Cowling, R.M., Pressey, R.L. and Richardson, D.M. 2003a. Identifying spatial components of ecological and evolutionary processes for regional conservation planning in the Cape Floristic Region, South Africa. Diversity and Distributions 9: 191- 210.

Rouget, M, Richardson, D.M. and Cowling, R.M. 2003b. The current configuration of protected areas in the Cape Floristic Region – reservation bias and representation of biodiversity patterns and processes. Biological Conservation 112: 129-145.

Rouget, M., Richardson, D.M. Cowling, R,M., Lloyd, J.W. and Lombard, A.T.. 2003c. Current patterns of habitat transformation and future threats to biodiversity in terrestrial ecosystems of the Cape Floristic Region, South Africa. Biological Conservation 112: 63-85.

Rubinoff, D. 2001. Evaluating the California gnatcatcher as an umbrella species for conservation of southern Californian coastal sage scrub. Conservation Biology 15: 1374-1383.

Salafsky, N., Margoluis, R., and Redford, K.H. 2001. Adaptive management: A tool for conservation practitioners. Washington, D.C.: Biodiversity Support Program.

Salafsky, N., Margoluis, R., Redford, K.H., and Robinson, J.H. 2002. Improving the practice of conservation: a conceptual framework and research agenda for conservation science. Conservation Biology 16:1469–1479.

Sarkar, S. 2004. Conservation Biology. The Stanford Encyclopedia of Philosophy. Winter 2004 Edition. Zalta, E.N. (ed.). [URL =http://plato.stanford.edu/archives/win2004/entries/ conservation-biology/ last accessed 12/12/2007].

Saeterson, K.,A., Christensen, N.L., Jackson, R.B., Kramer, R.A., Pimm, S.L., Smith, M.D. and Wiener, J.B. 2004.Disconnects in evaluating the relative effectiveness of conservation strategies. Conservation Biology 18: 597-599.

Saunders, D.A., Hobbs, R.J. and Margules, C.R. 1991. Biological consequences of ecosystem fragmentation: A review. Conservation Biology 5: 18-32.

Saunders, C.D., Brook, A.T. and Myers, O.E. Jr. 2006. Using psychology to save biodiversity and human well-being. Conservation Biology 20: 702-705.

Schulze, R.E. 1997a. Climate. In: Cowling, R.M., Richardson, D.M. and Pierce, S.M. (eds.) Vegetation of Southern Africa. Cambridge University Press, Cambridge.

Schulze, R.E. 1997b. South African Atlas of Agrohydrology and Climatology. Water Research Commission, Pretoria, Report TT82/96.

Schultz, C.B. and Crone, E.E. 2005. Patch size and connectivity thresholds for butterfly habitat restoration. Conservation Biology 19: 887-896.

Scott, J.M. and B. Csuti. 1997. Noah worked two jobs. Conservation Biology 11:1255–1257.

Senge, P.M. 1990. The fifth discipline: The art and practice of the learning organization. Currency Doubleday. New York, U.S.A.

SEPA Project, 2007. Experiences from Ecuador and Mexico with the Implementation of Conservation Easements: A Case Study. Agnès Sibileau (Fundación Neuquén), Jorge A. Rojas Tomé (Consultant), Maria Fernanda Morillo (Centro de Derecho Ambiental (CEDA) and Caroline Stem (Foundations of Success). [URL=http:// http://www.fosonline.org: Resources, accessed 18/12/2008]

Sih, A., Gunnar Jonsson, B. and Luikart, G. 2000. Habitat loss: ecological, evolutionary and genetic consequences. Trends in Ecology and Evolution 15: 132-134.

Sinclair, A.R.E., Ludwig, D. and Clark, C.W. 2000. Conservation in the real world. Science 289: 1875.

Smith, J.N.M. and Hellman, J.J. 2002. Population persistence in fragmented landscapes. Trends in Ecology and Evolution 117: 397-399.

Smith, R.J. 2004. Conservation Land-Use Zoning (CLUZ) Software. Durrell Institute of Conservation and Ecology, Canterbury, UK [URL=http://www.mosaic-conservation.org/cluz/ last accessed 14/09/2007].

Smith, R.J., Goodman, P.S. and Matthews, W. 2006. Systematic conservation planning: a review of perceived limitations and an illustration of the benefits, using a case study from Maputaland, South Africa. Oryx 40:400-410.

Soulé, M.E. (ed.). 1986. Conservation biology: the science of scarcity and diversity. Sinauer Press, Sunderland, Massachusetts.

Soulé, M.E. 1985. What is Conservation Biology? BioScience 35: 727-734.

South African Government. Land Policy White Paper, 1997. [URL=http://www.info.gov.za/documents/whitepapers/index.htm, accessed 3/1/2009]

South African National Treasury (SANT). 2008. Announcement of possible fiscal incentives for biodiversity conservation in budget speech [URL=http://www.treasury.gov.za/documents/national budget/2008, last accessed 05/05/2008] and publishing of fiscal incentives in the Revenue Laws Amendment Bill 2008, Section 46 and in amendments to the Income Tax Act, 1962. [URL=http://www.treasury.gov.za/].

Steffan-Dewenter, I., Muenzenberg, U. and Tscharntke, T. 2001. Pollination, seed-set and seed predation on a landscape scale. Proceedings of the Royal Society of London: Series B 268: 1685-1690.

Stewart, R.R., Ball, I.R. and Possingham, H.P. 2007. The effect of incremental reserve design and changing reservation goals on the long-term efficiency of reserve systems. Conservation Biology 21: 346–354.

Stem, C., Margoluis, R., Salafsky, N. and Brown, M. 2005. Monitoring and evaluation in conservation: a review of trends and approaches. Conservation Biology 19: 295-309.

Sutherland, W.J., Pullin, A.S., Dolman, P.M. and Knight, T.M. 2004. The need for evidence-based conservation. Trends in Ecology and Evolution 19: 305-308.

Taylor, P.D., Fahrig, L., Henein, K. and Merriam, G .1993. Connectivity is a vital element of landscape structure. Oikos 68: 571-573.

Ter Braak, C.J.F. and Šmilauer, P. 1998. CANOCO Reference Manual and User's Guide to CANOCO for Windows. Software for Canonical Community Ordination. Centre for Biometry Wageningen.

The Nature Conservancy (TNC) 2008. Conservation auditing tools. [URL = http://conserveonline.org/work-spaces/Conservation_Audit - last accessed 3 November 2008]

Theobald, D.M., Hobbs, N.T., Bearly, T., Zack, J.A., Shenk, T. and Riebsame, W.E. 2000. Incorporating biological information in local land-use decision making: designing a system for conservation planning. Landscape Ecology 15 35-45.

Thomas, J. A., Bourn, N. A. D. Clarke, R.T., Stewart, K.E., Simcox, D.J., Pearman, G.S., Curtis, R. and Goodger, B. 2001. The quality and isolation of habitat patches both determine where butterflies persist in fragmented landscapes. Proceedings of the Royal Society of London Biological Sciences 268: 1791-1796.

Trochim, W.M.K 1992. Developing an evaluation culture for international agricultural research. In: Proceedings from a Symposium at Cornell University. Ithaca, NY. U.S.A. [URL= http://www.socialresearchmethods.net last accessed 08/01/2009]

Trochim, W.M.K. 2007. Evolutionary Perspectives in Evaluation: Theoretical and Practical Implications. Paper presented at the Eastern Evaluation Research Society. Cited with permission by the author: 12/1/2008. [URL=http://www.socialresearchmethods.net/research/EERS2007/Evolutionary%20Perspectives%20in%20Evaluation%20Theoretical%20and%20Practical%20Implications.pdf last accessed 08/01/2009].

Tscharntke, T, Steffan-Dewenter, I., Kruess, A. and Thies, C. 2002. Contribution of small habitat fragments to conservation of insect communities of grassland-cropland landscapes. Ecological Applications 12: 354-363.

Tucker, B.N.I.J. 2000. Linkage restoration: interpreting fragmentation theory for the design of a rainforest linkage in the humid Wet Tropics of north-eastern Queensland. Ecological Management and Restoration 1: 35-41.

Turner, W., Spector, S. Gardiner, N. Fladeland, M., Sterling, E. and Steininger, M. 2003. Remote sensing for biodiversity science and conservation. Trends in Ecology & Evolution 18: 306-314.

Turner, W.R. and Wilcove, D.S. 2006. Adaptive decision rules for the acquisition of nature reserves. Conservation Biology 20: 527-537.

Vane-Wright, R.I., Humphries, C.J. and Williams, P.H. 1991. What to protect–systematics and the agony of choice. Biological Conservation 55: 235–254

Villard, M.A. 2002. Habitat Fragmentation: Major Conservation Issue or Intellectual Attractor? Ecological Applications 12: 321-334.

Virolainen, K.M., Virola, T., Suhonen, J., Kuitunen, M. Lammi, A. and SiikamÌki, P. 1999. Selecting networks of nature reserves: methods do affect the long-term outcome. Proceedings of the Royal Society of London B 266: 1141-46.

Vitousek, P.M., Mooney, H.A., M. Lubchenco, J. and Melillo, J.M. 1997. Human domination of Earth's ecosystems. Science 277: 494-505.

Vlok, J.H.J., Cowling, R.M. and Wolf, T. 2005. A vegetation map for the Litte Karoo. Unpublished maps and report for a Succulent Karoo Ecosystems Profile project supported by the Critical Ecosystems Parterships Fund (C.E.P.F.), grant no. 1064410304.

Von Hase, A., Jackelman, J., Balfour, D. and Ferreira, D. 2008. Conservation Stewardship: Business Case. CapeNature. Cape Town. [See Appendix 5]

Von Hase, A., Rouget, M., Maze, K. and Helme, N. 2003. A fine-scale conservation plan for Cape Lowlands Renosterveld: Technical Report. Report CCU 2/03, Conservation Unit, Botanical Society of South Africa. [URL=http://cpu.uwc.ac.za/clr/project.asp last accessed 12/12/2007]

Vickerman, S. 1999. A state model for implementing stewardship incentives to conserve biodiversity and endangered species. The Science of the Total Environment 24: 1999.41-50

Western, D. 2001. Human-modified ecosystems and future evolution. Proceedings of the National Academy of Sciences 98: 5458–5465.

Wideman, M. 2004. A Management Framework for Project, Program and Portfolio Integration. Trafford, British Columbia.

Wilson, K.A., McBride, M.F., Bode, M., Possingham, H.P. 2006. Prioritising global conservation efforts. Nature 440: 337–340.

Wilson, K.A., Underwood, E.C., Morrison, S.A., Klausmeyer, K.R., Murdoch, W.W., Reyers, B., Wardell-Johnson, G., Marquet, P.A., Rundel, P.W., McBride, M.F., Pressey, R.L., Bode, M., Hoekstra, J.M., Andelman, S., Looker, M., Rondinini, C., Kareiva, P., Shaw, M.R., Possingham, H.P. 2007. Conserving biodiversity efficiently: What to do, where and when. PLoS Biol 5(9):e223. doi:10.1371/journal.pbio.0050223.

Williams, J.C., ReVelle, C.S. and Levin, S.A. 2005. Spatial attributes and reserve design models: A review. Environmental Modeling and Assessment 10: 163-181.

Winter, S.J. 2003. Attitudes and behaviour of landowners towards the conservation of renosterveld, a threatened vegetation type in the Cape Floral Kingdom. MSc Thesis. University of Stellenbosch, South Africa.

Winter, S.J., K.J. Esler, and M. Kidd. 2005. An index to measure the conservation attitudes of landowners towards Overberg Coastal Renosterveld, a critically endangered vegetation type in the Cape Floral Kingdom, South Africa. Biological Conservation 126, 383-394.

World Wide Fund for Nature (WWF). WWF Standards of Conservation Project and Programme Management. [URL=http://www.panda.org/about_wwf/how_we_work/conservation/programme_standards - accessed 03/11/2008]

Worrell, R. and Appleby, M.C. 2000. Stewardship of natural resources: Definition, Ethical and practical aspects. Journal of Agricultural and Environmental Ethics 12: 263–277.

APPENDICES

Appendix 1

Figure A1.1. Illustrating the conservation process in action (clockwise from top left):
The author (right) in field; specialist botanist Nick Helme with new *Freylina* species; Landowners and botanists in the field; collaborative planning process in small and larger groups involving planners and CapeNature staff; author finalising GIS products from collaborative work session; Conservation Stewardship officers engaging with landowners over a conservation agreement; view into Botriver valley with areas of connected renosterveld (centre); field of spring flowers in West coast Darling renosterveld.

Appendix 2

Biodiversity in the 20-year and 5-year conservation plan

The planning and scheduling process for the Cape Lowlands Renosterveld region resulted in a conservation plan that set out 20-year and 5-year conservation goals (chapter 4). I calculated the total area covered and biodiversity features captured in these goals. The final products illustrating the goals were in the form of maps and associated digital, spatial (GIS) and non-spatial data. The final maps of the 20- and 5-year plans along with selected accompanying data are given below.

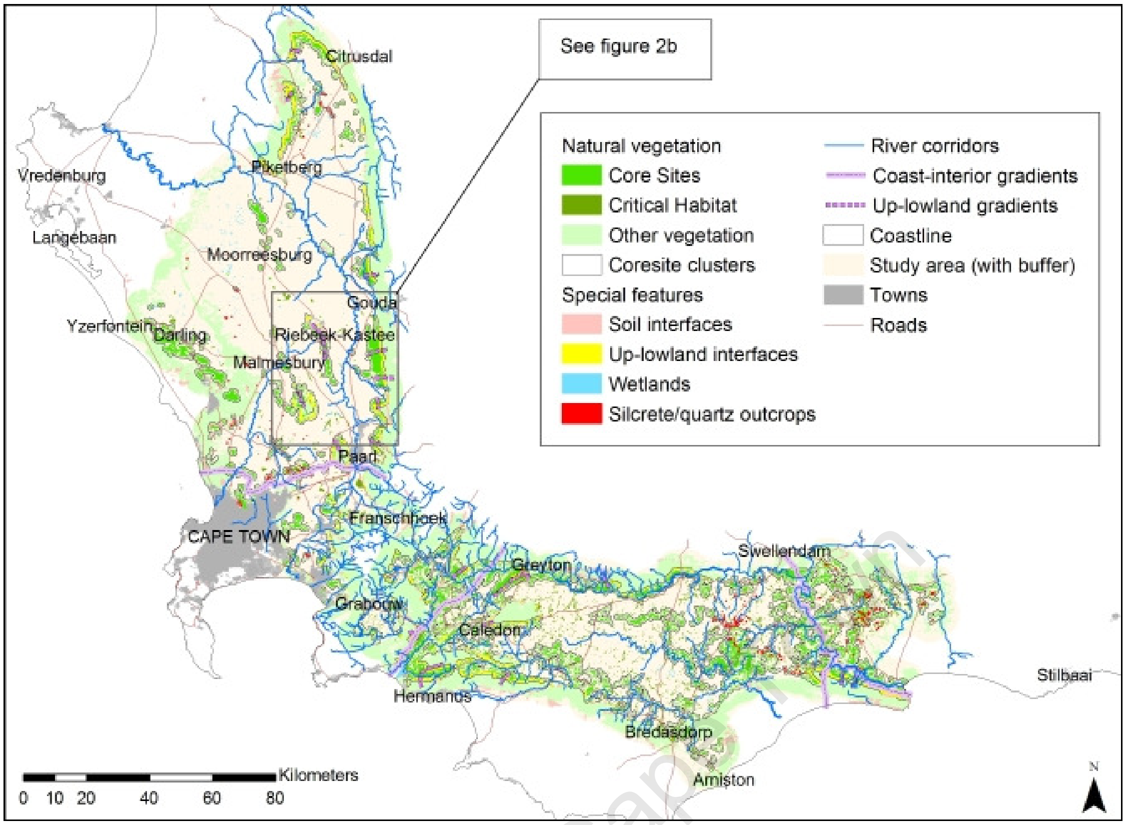
In addition I compared the 5-year plan in the Overberg with outputs derived by selecting conservation sites using only the scoring approach (chapter 3) without drawing on additional criteria used during the collaborative process (chapter 4). I used the score thresholds 0.3, 0.4 and 0.5 for the comparison.

1. The 20-year conservation plan

The 20-year conservation plan (Fig. A2.1 a, b) covered 460,644 hectares (37%) of the Cape Lowlands region, and it encompassed most of the remaining renosterveld vegetation: 96,390 ha or 92.3% (Fig. A2.2). The landscape-focused design of the conservation assessment (chapters 2 and 3) ensured that connected areas were prominent in the plan (Fig. A2.3 a, b). The plan also captured the majority of sampled plant and animal species records (Fig. A2.2) although it excluded four of the 350 endemic and threatened plant species and 8 of 54 faunal species. The plan represented less than a third of the total extent of ecological process surrogates (Fig. A2.2). The main reason for this was that around half of the intact parts of ecological process features occurred in the 'buffer area' that surrounds the Cape Lowlands region and which was dominated by less threatened vegetation types such as mountain fynbos. The conservation assessment did not explicitly include these vegetation types in the planning.

2.1 The 5-year plan

Overall, 32 sites were included in the 5-year spatial action plan (Fig. A2.2). The sites covered an area of 180,848 ha (15%) of the Cape Lowlands region; Overberg sites accounted for a larger proportion of the overall area than Boland/Swartland sites. More than half of all remaining renosterveld vegetation (61,503ha or 59%, Fig. A2.2) was included in the 5-year plan, as well as half of all plant species records, 27% of animal species records and 15% of the extent of surrogates for ecological processes (Fig. A2.2).



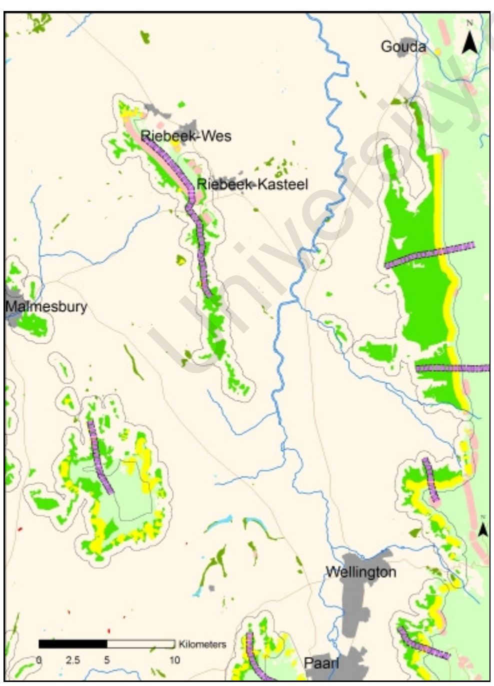


Figure A2.1.a) The 20-year conservation plan for renosterveld conservation; and A2.1.b) a close-up of the Kasteelberg area in the Boland/Swartland.

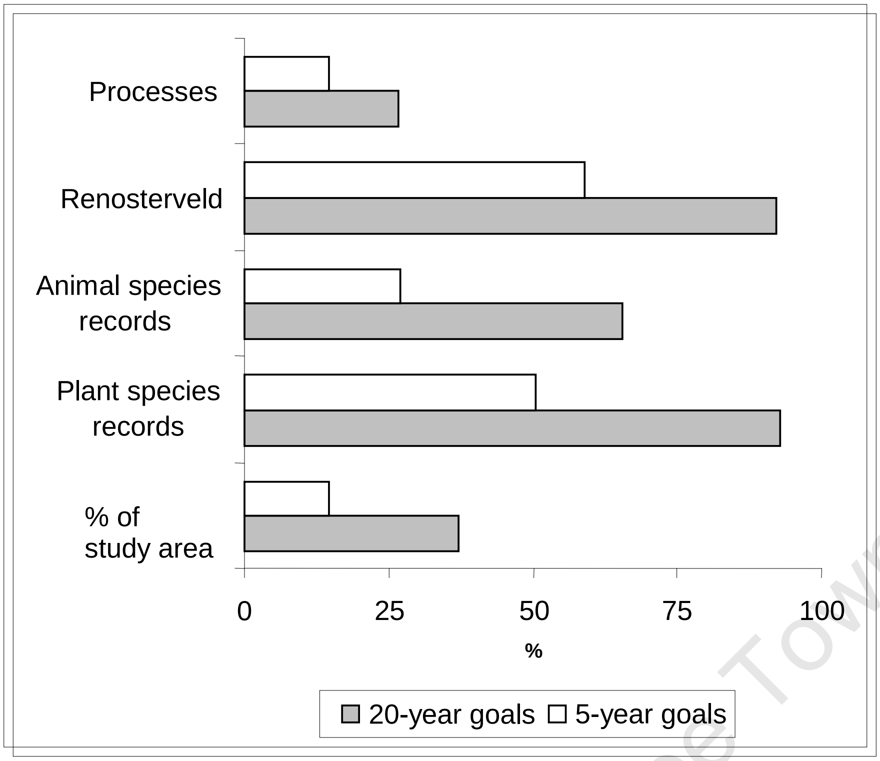


Figure A2.2. Biodiversity features captured and area covered (graphed as percentages) in sites forming part of the 5-year and 20-year plans..

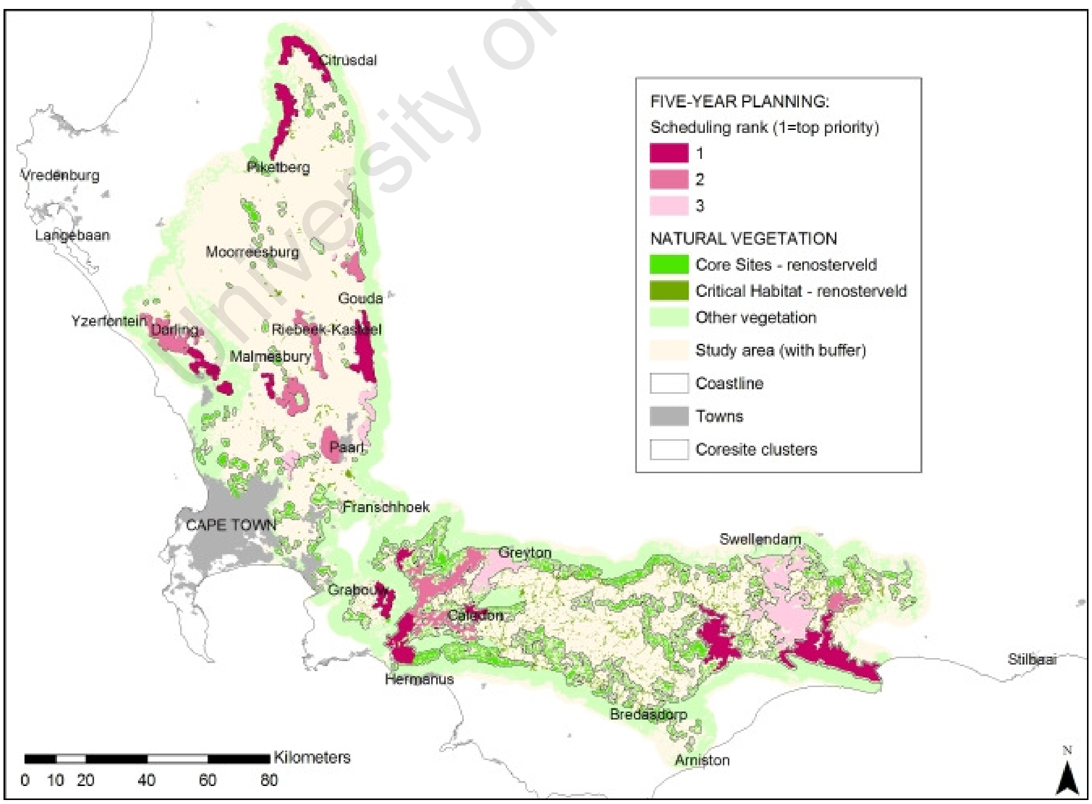


Figure A2.3. The 5-year plan for conservation interventions in the Cape Lowlands study area.

2.2 Comparison of the Overberg's 5-year goals with sites selected by scoring

Sites scoring >0.5 overall for biodiversity criteria (Fig. A2.4a) were included in the 5-year plan (Fig. A2.4b). Half of these had been given rank 1 during the collaborative work session and half had been given rank 2 indicating their priority for intervention during the implementation phase (Table A2.1). Similarly, all sites scoring >0.4 were part of the 5-year plan, only that they were divided in thirds according to rank 1, 2 and 3 for priority action. Of the twenty sites with scores >0.3, eleven were included in the 5-year plan. The majority of these sites were ranked as priority 1 (Table A2.1). The 5-year plan incorporated two sites with relatively low overall biodiversity scores but with high values owing to conservation opportunities based on excellent relations with landowners at one site and the presence of unique silcrete habitat at the other site.

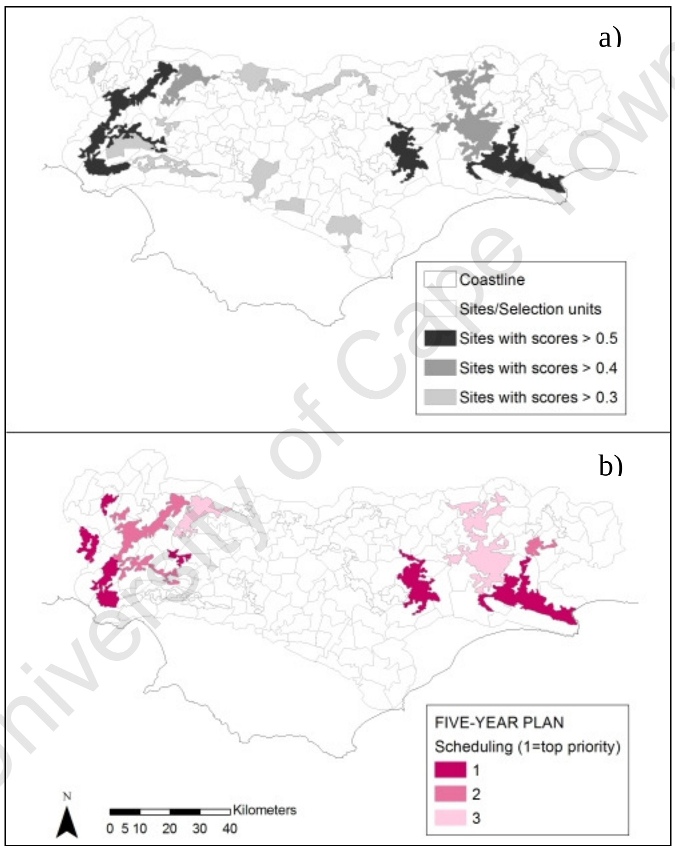


Figure A2.4.a) Sites in the Overberg selected at incremental scores; and b) sites scheduled for conservation action as part of the five-year plan defined by the conservation agency.

Table A2.1. Information on sites chosen for the 5-year plan and for selection scenarios according to overall biodiversity scores alone

Selection scenario	Area of all sites (ha)	No. sites included	Priority rank of sites
5-year plan	144,965.0	13	5 sites rank 1; 5 sites rank 2; 3 sites rank 3
Score >0.3	1,067,354.0	20	5 sites rank 1; 3 sites each for rank 2 and 3, remainder no rank
Score >0.4	96,727.0	9	3 sites per rank
Score >0.5	60,562.0	6	3 sites each for rank 1 and 2

The collaborative formulation of the 5-year plan by conservation planners and implementers made significant changes to 'automatic' site selection scenarios based solely on biodiversity criteria evaluated through the scoring approach (chapter 3). The scoring system was helpful to the participative planning process as it enabled the comparison of different areas' biodiversity value and the identification of overall priorities for action (see examples in Table A2.2). Yet, score-derived outputs were only one component in collaborative decision-making and scheduling. This process relied on the biodiversity scores in addition to expert-derived knowledge of the study area and of conservation opportunities and constraints. The process resulted in the inclusion of several areas that scored relatively low for overall biodiversity but which were chosen as priorities in the 5-year plan based on explicit justifications.

Table A2.2. Information captured by workshop participants for selected priority sites in the 5-year plan.

Site name	Agter-Groenberg Renosterveld Conservancy	Renosterhoek	Paardeberg
Rank	1	1	2
Biodiversity score	0.82	0.55	0.62
Ecological gradients	Upland-lowland gradients	Upland-lowland gradient, Cederberg Megapark corridor	Upland-lowland gradients
Special features	Extensive upland-lowland interface, soil interface	Extensive upland-lowland interface, soil interface, wetland; quartz patches	Upland-lowland interface
Other special habitats	Wetland seeps	Variety of other vegetation types	Variety of other vegetation types
Landowner willingness to conserve	Very good, already 9 members of conservancy	About 30 landowners appear generally willing to participate in stewardship ventures.	Generally high, already a conservancy and a National Heritage Site.
Economic opportunities	-	Land is marginal for farming	Tourism opportunities
Aesthetic or cultural features	-	Views from Pikenierskloof Pass	Canon with historical value
Proximity to existing protected area	Close proximity to Voelvlei Reserve.	Forms S boundary of proposed Cederberg Megapark	None close
Other initiatives in the area	Core site for CEPF project, Area-wide planning to be conducted in the near future.	Blue Crane conservation work, two adjoining conservancies (Groot Winterhoek, Sneeuberg)	Existing conservancy
Threats	Alien grasses, veld fires, alien feral pigs, small-scale farming initiatives being planned.	-	Frequent fires, vineyards, 4x4 vehicle trails and activity, invasive alien vegetation.
General comments	CapeNature extension officers have details on strategic plan divided into five year phases, Game an important concept in area.	This is the only corridor linking to Piketberg.	-

Appendix 3

Workshop: Collaboratively building a conservation plan for the Cape Lowlands Region

1. Work session participants: Role and Organisation

The table below summarises details about the participants at the work session held to develop the 5-year conservation plan for the Cape Lowlands.

Position	Organisation	Number of participants
Conservation services and reserve management staff (general conservation services)	CapeNature	6
Conservation Stewardship staff (stewardship managers and extension officers)	CapeNature	6
Conservation planners	CapeNature, Botanical Society of South Africa	3
Scientific Services and Data Management staff (e.g. regional ecologists, GIS technicians, scientists)	CapeNature and independent specialists	6
Conservation of Rare and Endangered Plants staff	South African National Biodiversity Institute	1
Programme managers	Botanical Society of South Africa	2

2. Outline of the work session's structure

1.	Welcome and workshop objectives
2.	Introduction to the Cape Lowlands Renosterveld conservation study What data are available to decide on a schedule for implementing conservation action? How was the summary biodiversity layer produced? How was the 20-year conservation plan produced?
3.	Questions & discussion
4.	Computer-based exploration of the spatial data, including the 20-year plan and the scoring system, in small groups (break in to 4 groups)
5.	Towards a 20-year conservation plan: Questions & discussion of the 20-year plan Decision to adopt or revise 20-year plan
6.	From 20-year vision to 5-year action plan: Discussion on criteria to guide the 5-year action plan

7.	Break into two groups for the 5-year Swartland-Boland and Overberg plan: a) explore how to integrate data layers into a 5-year action plan b) explore how to use the criteria
8.	Work in groups to develop 5-year plans according to guidelines provided
9.	Report back to plenary on 5-year plans: Present the 5-year plan Were the criteria helpful? Did you come up with additional criteria? Did you identify any critical information gaps? Are there better ways to present these maps in a user friendly way?
10.	Plenary discussion on mapped products What accompanying products do you need?
11.	Way forward and close

3. Hand-out to participants: Proposed method for planning in the 5-year term

3.1 Aim of the 5-year planning session

The purpose of the planning session is to collaboratively identify sites in the Cape Lowlands on which CapeNature will focus its off-reserve conservation actions over the next 5 years. Draft site selection criteria are given below for discussion. We will finalise a set of criteria in the morning session. The criteria will then be used in the afternoon session to agree on focus sites for the conservation stewardship programme. To identify the 5-year conservation sites, we will further draw on the 20-year conservation plan and the biodiversity summary map. The 5-year action plan will be mapped on-screen and reasons for site selections will be captured.

3.2 How much of the 20-year vision can we achieve in the first 5 years?

First, it is important to consider an approximate upper limit for the number of hectares (or % of the 20-year plan) that can be served by the CapeNature stewardship programme's extension service over the next 5 years. This limit represents the cut-off for the number of hectares to be included in the 5-year action plan. The limit depends on estimated extension capacity and resources required for negotiating and maintaining conservation stewardship agreements.

So, how much of the 20-year plan can be conserved in the first 5 years?
Approximately 10%, 20% or 25% or more?

Remember that this is just renosterveld – there may be other lowland or upland priority areas in the Cape Floristic Region that will demand resources from your business unit.
Note also which areas are taken care of already (conserved or appropriately managed) and require less ongoing effort from the extension service.

3.3 Criteria for choosing priority areas in renosterveld

3.3.1 Primary criteria: biodiversity

The following biodiversity criteria should be used as the primary reasons for selecting priority sites. These criteria are listed in order of importance.

Biodiversity:

1. Does the site fall in the top levels of the biodiversity summary ranking as identified on the biodiversity summary map (a different map to the 20-year plan)?
2. Does the site fall within a coast-interior, upland-lowland gradient or other ecological process identified on the 20-year plan? If so list them.
3. Does the site contain any special features identified on the 20-year map? If so list them.

3.3.2 Secondary criteria: opportunities and threats

Once a set of sites has been chosen using the above criteria you may need to make further choices between sites that have similar biodiversity values. What you know about potential threats and opportunities of particular sites should be used here (i.e. this information is in your heads – we do not have it all on maps!). The following list of criteria is in no particular order of importance:

Opportunities:

- Is the landowner interested in conservation and relatively more willing to conserve the land?
- Are there any opportunities for linking the site with tourism initiatives; has the site got tourism potential; any other economic value of the biodiversity of the site?
- Has the site got features of particular aesthetic importance?
- Is it near an existing protected area/CapeNature initiative so that costs of serving are reduced?
- Are there any other initiatives (e.g. Department of Agriculture: Area Wide Planning) that make this site a logical choice?

Threats

- Is the site potentially threatened by future land uses that are incompatible with biodiversity conservation goals? (such as ploughing, mining, afforestation or urban development)

You may add criteria here, as they emerge in discussions of the plenary and groups. Please record these criteria.

Appendix 4

Conservation stewardship programme: conservation options, timeframes and staffing

The appendix gives additional information on the Conservation Stewardship Programme (CSP):

1. the different conservation stewardship agreements offered by the CSP (Table A4.1);
2. the steps and estimated timelines required to negotiate contractual conservation stewardship agreements (Table A4.2); and
3. the staffing situation (2007/2008) for the CSP.

1. Conservation stewardship agreements

The Conservation Stewardship Programme (CSP) offers three types of conservation stewardship agreement scaled from non-binding to legally binding contractual conservation easements (Table A4.1). These agreements vary in (i) the degree of conservation commitment required from the landowner; (ii) the restrictions imposed on land-uses; and (iii) the level of incentives offered (Table A4.1, CapeNature, 2007). In chapter 5, I combined 'contact nature reserves' and 'biodiversity agreements' into a single category of contractual agreements to faciliate the analysis and interpretation.

Table A4.1. Types of conservation stewardship agreements offered to landowners by the Conservation Stewardship Programme (adapted from CapeNature, 2007)

	Voluntary Conservation Area (Voluntary)	Biodiversity Agreement (Contractual)	Contract Nature Reserve (Contractual)
Description	Legally non-binding agreement relying on landowners' commitment to conserve land.	Negotiated legal agreement to conserve biodiversity between the landowner and conservation agency. No rezoning of land or transfer of title deeds.	Legal contract to conserve biodiversity between the landowner, conservation agency and the provincial Member of the Provincial Executive Council for Environmental Affairs. Protected portion of land is rezoned to conservation zoning. Land use restrictions are placed on title deed.
Criteria for inclusion	Any land in a natural state (unploughed)	Conservation-worthy land identified in conservation plans.	Core conservation sites identified in conservation plans.
Examples	Areas within largely intact, currently not threatened ecosystems	Areas with small vegetation remnants; water catchments; threatened ecosystems.	Areas in threatened ecosystems; areas forming part of an ecological corridor or gradient (e.g. coast-to-interior linkage)

Timeframe	Not specified	Five years or more	In perpetuity
Benefits Services	Basic habitat management advice and information.	Conservation management advice; biodiversity management plan; possibly invasive alien plant clearing assistance; limited financial incentives[1].	Municipal rates exclusion for conservation land; detailed biodiversity management plan; assistance with alien invasive plant clearing, fire and game management; financial incentives[1].
Restrictions	Land must retain its 'natural character'.	Land must be managed to promote conservation of habitat and natural processes. No threatening activities (e.g. mining, construction, agriculture)	Land set aside must be managed for biodiversity conservation. Restrictions are consistent with the land's legal and protected area status.

[1]Fiscal mechanisms (e.g. income tax deductions) will come into effect from 2009 (South African National Treasury, 2008; Cumming and Botha, 2008)

2. Conservation stewardship process: timelines and approach

Table A4.2 outlines the general approach followed by the CSP stewardship staff in engaging with private landowners. By far the most time-consuming part of finalising contractual stewardship agreements to date has been the administrative component (step 5 and 6, Table A4.2) that follows once an in-principle agreement between the landowner and CapeNature is in place.

Table A4.2. Implementation phases of the Conservation Stewardship Programme with estimated timelines. Some flexibility exists in the process as outlined below (CapeNature, 2007).

Step	Activities	Who	Time
1. Site selection	Selection of in priority areas for intervention and specific target cadastres, based on conservation planning products and specialist input.	Conservation planners, stewardship implementers, specialists	1 day+ planning session/s
2. Landowner contact	Initiation of contact with landowner to determine particular situation, needs and perceptions and to introduce concept of conservation stewardship and options. Recording of information in database.	Stewardship staff (negotiator), landowner	1 week
3. Field assessment and site review	Field assessment of the area's biodiversity, presentation to committee for review of property's conservation importance and appropriate options, determination and costing of main management requirements, feed-back to landowner.	Stewardship negotiator, review committee, landowner	2-4 weeks
4. Negotiation and agreement	Negotiation with landowner regarding conservation stewardship agreements, drafting of chosen type of agreement, drafting of management plan for proposed conservation area, consultation of legal expertise and completion of documentation.	Stewardship negotiator, landowner, legal expertise.	3-12 months

5. Administrative process	Completion of official process for declaring protected area: Contract design and signature by landowner, CapeNature management, publishing of declaration for new conservation area, submission for Provincial MEC's approval and gazetting.	Negotiator, landowner, CapeNature management, Provincial Minister: Environment, public	6-18 months
6. Final approval	Registration with National Deeds Office of amended notarial deeds for conservation area, by landowner.	Landowner, Deeds Office	Unknown
7. Maintenance	Guidance by stewardship staff on managing conservation area, delivery of incentives and on-going support (e.g. technical assistance with invasive alien plant clearing) to help landowner fulfil conservation objectives in contract.	Stewardship staff (facilitator: maintenance), landowner, contractors to provide incentives	On-going: lifespan of agreement
8. Auditing	Monitoring and auditing of property according to management plan. Revision and updating of plans. Addressing of potential non-compliance.	Stewardship facilitator	1 – several days
Step 7. & 8	These activities form part of an annual cycle.	Stewardship facilitator, land-owner, contractors.	Ongoing

3. Staffing

Methods: I quantified the number of full- and part-time conservation stewardship extension officers in CapeNature's business units (management units in the Western Cape) as well as contract staff. I combined the numbers into 'full-time staff units' per business unit and converted these to person-hours per month. I worked out 'full-time staff units' relative to the number of CSP stewardship sites negotiated per business unit to establish whether a link exists between number of staff and number of stewardship agreements negotiated per business unit.

Results: Around thirty CapeNature staff in eight business units contribute to conservation stewardship work. Eight staff members (including three contract staff) are currently in full-time conservation stewardship positions. The majority of staff are however engaged in conservation stewardship activities on a part-time basis (<50%). 'Full-time staff units' are estimated at 12 stewardship staff in the Western Cape although the contribution of part-time staff is most likely an overestimate (Purnell, pers. comm.).

There is a noticeable link between the number of staff engaged in conservation stewardship in different business units and the number of agreements negotiated. For example, in the Cederberg Unit with 3.5 full-time positions, 14 contractual agreements have been concluded; and in the Boland Mountain Unit with 3.15 stewardship positions, 9 contractual and 2 voluntary agreements have been negotiated. However, in the West Boland Unit (0.55 full-time position) one contractual agreement has been concluded, while in the Langeberg Unit (0.25 full-time position) one voluntary agreement has been achieved (Table A4.3).

Table A4.3. Concluded stewardship agreements and full-time stewardship staff positions in CapeNature business units (size in hectares).

Business Unit	Full-time positions	Contractual agreements	Voluntary agreements
Cedarberg (2,766319 ha, focus area is ~ 60%)	3.50	14	0
Boland Mountain (361,761 ha)	3.15	9	2
Gouritz (4,651 711 ha, focus area is 70% or less of this)	2.30	6	2
Overberg-Hessaqua (595,158 ha)	1.25	9	4
Cape Metro (231,370 ha)	0.70	3	2
West Boland (1,604 351 ha)	0.55	1	0
Langeberg Karroo (1,359 724 ha)	0.25	0	1

Appendix 5

Confidential Draft

CONSERVATION STEWARDSHIP:

Business Case

August, 2008

CapeNature

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Abbreviations and Key definitions

ASGISA	Accelerated and Shared Growth Initiative South Africa
BSSA	Biodiversity Stewardship South Africa
BWI	Biodiversity and Wine Inititative
CAPE	Cape Action for People and the Environment
CEC	Committee for Environmental Coordination
CEPF	Critical Ecosystems Partnership Fund
CBA	Critical Biodiversity Area
CBD	Convention on Biological Diversity
CCRS	Western Cape Climate Change Response Strategy and Action Plan
CFR	Cape Floristic Region
DEA&DP	Department of Environment Affairs and Development Planning, Western Cape
DEAT	Department of Environment Affairs and Tourism
EPWP	Expanded Public Works Programme
EWT	Endangered Wildlife Trust
GEF	Global Environment Facility
IDP	(Municipal) Integrated Development Plan
MDG	Millenium Development Goals
MEC	Provincial Member of the Executive Council
MEDS	Micro-Economic Development Strategy
MINTEC	Ministerial Technical Committee
MTEF	Medium Term Expenditure Framework
NBF	National Biodiversity Framework
NBSAP	National Biodiversity Strategy and Action Plan
NEMA	National Environmental Management Act
NFDS	National Framework for Sustainable Development
NGO	Non Government Organisation
NPAES	National Protected Area Expansion Strategy
NSBA	National Spatial Biodiversity Assessment
NSDP	National Spatial Development Plan
PAA	National Environmental Management: Protected Areas Act
PGDS	Provincial Growth and Development Strategy (iKapa GDS)
PGWC	Provincial Government of the Western Cape
PSDF	Provincial Spatial Development Framework
SANBI	South African National Biodiversity Institute
SDF	(Municipal) Spatial Development Framework
SDIP	Sustainable Development Implementation Plan
SO	Strategic Objective
UNFCCC	United Nations Framework Convention on Climate Change
WCDA	Western Cape Department of Agriculture
WfW	Working for Water
WWF-SA	World Wide Fund for Nature South Africa
WoF	Working on Fire

Key Definitions	
Biodiversity	Biological diversity, or biodiversity, includes genetic diversity (within individual species), diversity of species and the diversity of ecosystems.
Sustainable development	Development that meets the needs of the current generation without threatening the ability of future generations to meet their own needs and choose their own life-style. This requires for environmental protection, economic growth and social justice to be reconciled with one another. (Brundtland Report, 1987)
'Off-reserve'	*'Off-reserve'* refers to (the conservation focus on) natural systems and parts of the landscape that are not part of the established system of formal protected areas.
'On-reserve''	*'On-reserve'* refers to (the focus on) parts of the landscape that are included in the formal system of protected areas and nature reserves: 'Protected areas' in the National Environmental Management: Protected Areas Act (PAA, Act 57 of 2003, as amended) currently include: National Parks, Nature Reserves, Special nature reserves, Protected Environments, World Heritage Sites, Marine Protected Areas, Specially Protected Forest Areas and Mountain Catchment Areas.
Land Stewardship	The careful and responsible use, including conservation, of natural resources in a way that (i) ensures the maintenance or enhancement of biodiversity and ecosystems and (ii) takes full and balanced account of the interests of society, future generations, and other species, as well as of private needs, and (iii) accepts significant answerability to society. (see Worrel and Appleby, 2000)
Conservation Stewardship (as a sub-component of land stewardship)	Landowners[1] voluntarily participate in biodiversity conservation by formally agreeing (through a conservation stewardship agreement) to secure the conservation status of their land to (i) protect important ecosystems; (ii) enable the more sustainable use of natural resources and (iii) effectively manage threats to natural systems and biodiversity. Incentives may be offered to the landowner.
Conservation Stewardship Programme	A programme that pursues conservation stewardship and seeks to encourage, build and sustain a stewardship ethic in landowners through the negotiation and maintenance of conservation stewardship agreements.
Conservation Stewardship Agreement	A conservation stewardship agreement is a voluntary agreement that may be informal or legally binding, and which commits a landowner and a public conservation agency to mutually agreed conservation management objectives. Incentives may be linked to the stewardship agreement. The CapeNature Conservation Stewardship Programme offers the choice of *three types of stewardship agreement*: • *Conservation Area:* a flexible agreement that is not legally binding and has no defined period of commitment. • *Biodiversity Agreement:* a negotiable, legally binding agreement to conserve biodiversity in the medium term. • *Contract Nature Reserve* – a negotiable, legally binding contractual agreement to protect biodiversity in the long term.
Incentives	Incentives are financial or non-financial factors that motivate individuals to take a specific course of action, in this case the action is to conserve (protect and manage) biodiversity and natural systems on their land. The primary reason for offering incentives is that the landowner incurs a potential opportunity cost while providing a public good.

[1] Landowners may be individuals, organisations or communities.

Executive summary

The Conservation Stewardship Programme in CapeNature seeks to secure the conservation status of priority landholdings in the Western Cape through the voluntary negotiation of formal stewardship agreements with targeted landowners. The successful outcome of concluded stewardship agreements is an official partnership between CapeNature and the landowner to manage and protect the affected land for mutual benefit. The Conservation Stewardship Programme uses a suite of incentives to encourage landowners to conclude and maintain formal stewardship agreements, and to ensure the socio-economic viability of conservation as an alternative form of land use.

Traditionally the expansion of the protected area estate has involved the acquisition of land (including land purchase, land lease, land donation and expropriation) and the subsequent management of this land by the state. The limited availability of funds to acquire and manage conservation-worthy land however means that this mechanism increasingly has limited applicability. If South Africa and the Western Cape are to meet their provincial, national and international conservation commitments, it is suggested that conservation stewardship could be developed as a more cost-effective mechanism to complement existing initiatives to expand the protected area estate.

Conservation stewardship has been successfully piloted by CapeNature in the Western Cape over the last five years with significant funding support from the Global Environment Facility (through C.A.P.E.) and Conservation International. With the incremental phasing out of this funding due in 2009/10, CapeNature needs to make key business decisions about whether to continue to fund the already well-established programme, and if so, at what scale of implementation. This Business Case then presents the rationale for a sustained public investment in maintaining, and preferably strengthening, the existing Conservation Stewardship Programme in CapeNature. The Business Case articulates the social, environmental, economic and political benefits of this strategic decision, the characteristics of the recommended option for implementing the Programme, the anticipated scale of investment required and potential risks.

The Business Case suggests that a continued moderate public investment in conservation stewardship will yield significant financial, environmental, political, and social returns to the Western Cape. The key benefits may be summarized as follows:

(i) **Financial**: It is estimated that the Conservation Stewardship Programme would cost between 50-80% less to expand and administer the protected area estate when compared to land acquisition and subsequent protected areas management by the state.

(ii) **Environmental**: The vast majority (>90%) of untransformed threatened ecosystems of high biodiversity conservation value in the Western Cape are privately owned. The cost of acquisition of this land for conservation purposes is not financially viable, or desirable. Similarly the conservation of landscape-scale ecosystem processes that support the provision of critical ecological goods and services (e.g. potable water supply, flood attenuation, mitigation of impacts of climate change on agricultural productivity) cannot be achieved without the conservation of critical corridors of privately owned land between the existing state protected areas. The adoption of a conservation stewardship programme provides a cost-effective mechanism for integrating key private landholdings under a conservation management regime in the Western Cape.

(iii) **Social**: The establishment of conservation stewardship sites provides a vehicle for strategic investments from public, private and donor institutions in public works-type programmes, conservation works and tourism enterprises, which generate significant opportunities for direct employment; skills development; youth development; and education, particularly in rural communities. In areas of low agricultural production, stewardship sites are developed by landowners and CapeNature to demonstrate the economic feasibility of conservation and nature-based tourism enterprises. With catalytic funding from partner public and donor agencies, the entrepreneurial opportunities for local rural communities on these stewardship sites are developed.

(iv) **Political**: The conservation stewardship programme is strongly aligned with national and provincial political priorities. It specifically seeks to optimally develop strategic partnerships between the state, donor agencies, private landowners and rural farm workers. It ensures the protection of the rights of landowners and farm workers through the stewardship negotiation processes, and strives to enhance the socio-economic benefits generated from a change to conservation tenure of the land.

To demonstrate the nature and scale of these benefits, the Business Plan quantifies selected data from the current programme. These may be summarized as follows:

(i) **Employment**: Direct employment in hospitality industry (30 permanent jobs); Part-time employment in conservation works (>250 jobs)

(ii) **Skills development and training**: Conservation management skills (>1 staff/contract site); Vocational training programmes (15 workers on pilot programme); Environmental education programmes (500 children/annum)

(iii) **Opportunities for alternative income generation**: Eco- and adventure tourism ventures (>60% of contract stewardship sites attracting >5000 tourists/year); sustainable harvesting of high value natural goods (>25% of stewardship sites).

(iv) **Security of land tenure of farm dwellers**: (>350 rural residents).

(v) **Biodiversity and landscape conservation**: Protection of key habitats (nearly 50,000 ha); conservation of areas in threatened and previously unprotected ecosystems (10 ecosystems represented); and landscape linkages (Cederberg and Gouritz corridors).

The Business Case also unequivocally shows that, for a comparatively small investment, the Conservation Stewardship Programme makes a substantial contribution towards realising key national and provincial strategies and meeting institutional key performance indicators. Important government strategies include:

(i) **Climate change**: The Conservation Stewardship Programme's activities are integral to lead interventions identified by the Western Cape's Climate Change Response Strategy and Action Plan ("Key outcome 3: Land stewardship and Livelihoods Programme",).

(ii) **Provincial growth and development**: The Programme contributes significantly to path-breaking, path-shaping and path-consolidating interventions aimed at achieving the long-term goals of the iKapa elihlumayo, the Western Cape's Provincial Growth and Development Strategy (Goal 1 'Grow and share the economy' and goal 3: 'Promoting ecologically sustainable development'). The Programme achieves this by facilitating skills development and job creation; and by protecting biodiversity and key natural resources, including limited water resources.

(iii) **Spatial development**: The Programme is central to meeting the objectives set out in the Western Cape's Provincial Spatial Development Framework (Objective 8: 'Protect biodiversity and agricultural resources') and the aims of the Micro-Economic Development Strategy.

(iv) **Biodiversity conservation**: The Programme's activities are a key component of the National Biodiversity Strategy and Action Plan, which seeks to conserve a representative sample of South Africa's biodiversity and to maintain key ecological processes across the landscape (Strategic Objective 5). The Programme constitutes one of four priority actions identified in the National Biodiversity Framework for the period 2008-2012. The Programme contributes to meeting South Africa's commitments to the *Convention for Biological Diversity* and towards reaching the United Nation's *Millennium Development Goals* (Goal 7: 'Ensure environmental sustainability') by 2015.

The Business Plan assesses different implementation options for the Conservation Stewardship Programme and it describes the characteristics of the 'preferred implementation option' of the Programme in CapeNature. These can be summarized as follows:

1. Strategic focus	• Negotiation and maintenance of conservation stewardship agreements on private, communal and state land. • Three types of agreement: voluntary conservation areas; biodiversity agreements; contract nature reserves (highest conservation status).
2. Spatial focus	• Stewardship interventions are limited to objectively-defined conservation priority areas in the Western Cape.
3. Institutional arrangements (provincial level)	• The Provincial Stewardship Task Team, led by CapeNature, coordinates the collaboration between partner institutions in implementing conservation stewardship across the Western Cape. • Cooperation of CapeNature programmes and business units is ensured through internal review structures and performance indicators.
4. Institutional arrangements (CapeNature)	• Full-time staff implement the Programme. • Specialist staff is allocated to either negotiating or maintaining stewardship agreements. A team of negotiators is incorporated in the Conservation Stewardship Programme while Stewardship facilitators work within the relevant Business Units. • Conservation works (e.g. alien clearing) may be outsourced.
5. Resourcing	• Core public funding is supplemented by donor agency and other funding sources. • Minimum staffing requirements are estimated at 27 professional and technical staff.

A detailed *implementation plan* (*2009/10 to 2011/12*) has been developed for the 'preferred implementation option'. The implementation plan describes the detailed objectives, governance arrangements, spatial and performance targets, priority actions and financial and staffing requirements for the Conservation Stewardship Programme in CapeNature.

The implementation plan identifies the following optimal resource requirements for the Programme in the medium-term:

(i) **Human resource requirements**:

Post description	*Staff complement*
1. Programme Manager	1
2. Assistant Programme Manager	1
3. Programme Administrator	1
4. Conservation Stewardship Negotiator	8
5. Conservation Stewardship Facilitator	16

(ii) **Financial requirements**

Budget (estimate) 2009/10	*Budget (estimate) 2010/11*	*Budget (estimate) 2011/12*
R 4,716,453	R 6,169,033	R 7,628,613

1. Introduction

The business case focuses on the CapeNature *Conservation Stewardship Programme* (the 'Programme'). The Programme was formally launched in the provincial conservation agency in 2003 after a successful two-year pilot phase. The Conservation Stewardship Programme aims to secure and maintain priority habitats in the Western Cape as part of CapeNature's broader 'off-reserve' conservation strategy. The Programme seeks to establish formal partnership agreements with landowners to facilitate their contribution to biodiversity conservation.

The institutional motivation for adopting conservation stewardship as a core strategy for CapeNature is that conservation stewardship is widely regarded as one of the most cost-effective and feasible mechanisms for protecting important natural systems across the world (Michael, 2003). This applies especially in areas where land is predominantly under private ownership, such as the Western Cape.

Although the Conservation Stewardship Programme is reflected as a core programme in CapeNature's current Strategic Plan (2008/9), adequate resources have not been secured from within the agency or from provincial government. A large proportion of the Programme's funding is currently derived from international donor sources and does not sustain the initiative in the long term. This then limits the Programme's ability to fulfill its objectives in the medium- and long-term (Jackelman and Ferreira, 2007).

Given the importance of conservation stewardship as an integral part of any comprehensive and cost-effective conservation strategy, and the development over the past five years of important skills, competencies and structures to support the Conservation Stewardship Programme in CapeNature, there is a need to make a case for the allocation of adequate and sustainable resources to maintain and grow the Programme.

1.1 Purpose of the business case

The purpose of this business case is to motivate for the *adequate resourcing of the Conservation Stewardship Programme* in CapeNature. The information presented here is to guide key funders and decision-makers in determining the scale and extent of resource allocations to the Programme.

The business case summarises the value of an appropriately resourced and organised Conservation Stewardship Programme to CapeNature's overall conservation strategy. An accompanying implementation plan details the medium-term activities to be undertaken by the Programme.

A secondary purpose of the business case (and implementation plan) is to improve the quality and validity of the Conservation Stewardship Programme's contribution to CapeNature's submission for the 2009/10 to 2011/12 Medium Term Expenditure Forecasting (MTEF) cycles[2].

[2] An indepenent business case for CapeNature was developed in parallel with the Conservation Stewardship Programme's business case and implementation plan.

The intended audience of the business case is the Western Cape's provincial conservation agency, CapeNature. Given the secondary purpose, however, the information is also relevant to other key decision-makers, particularly the Western Cape government and donor institutions.

1.2 Scope of the business case

What does the business case do?

- The business case was developed as a desktop study. It presents the value of the Conservation Stewardship Programme in terms of:
    - The Programme's *alignment with government goals and priorities;*
    - The *cost-effectiveness* of conservation stewardship as a conservation strategy;
    - The environmental, economic, political and social *benefits* of the Programme.
- As part of the business case, various options for implementing the Conservation Stewardship Programme were considered. A *preferred implementation option* was identified by stakeholders. This constitutes the recommended implementation option for the Programme in the medium-term and is the basis of the implementation plan.
- The business case briefly outlines *risks* associated with:
    - CapeNature *implementing* the recommended implementation option; and
    - *Not supporting* the Conservation Stewardship Programme.
- The business case provides the *context for the implementation plan*. The implementation plan describes the objectives, governance arrangements, targets, priority actions and financial and staffing requirements for the Programme's *recommended implementation option*.

What does the business case not do?

It does not present:

- The Conservation Stewardship Programme's *value to landowners and other stakeholders* and their perceptions. An assessment of landowners' perceptions of conservation stewardship was conducted by the Nature Conservation Corporation (2008).
- The *general case for biodiversity* and conservation
- A detailed *review* of the current Programme's *strengths and weaknesses (*see Jackelman and Ferreira, 2007).
- A *comprehensive outline* of the *legal context* for conservation stewardship in South Africa. This was completed by the Biodiversity Stewardship South Africa programme (BSSA), Phase 1.
- The *implementation arrangements* for the Programme or the priority activities.

1.3 Outline of the business case

The Business Case is structured as follows:

Section 1: Introduction to the business case: Purpose; Scope; Outline.

Section 2: Programme overview: the Conservation Stewardship Programme
- Background: environmental and socio-economic situation, Western Cape;
- Goals and objectives of the Programme and CapeNature;
- Key features of the Programme's current state.

Section 3: Strategic alignment with government goals and priorities
- Legal context;
- Strategic linkages: environmental and socio-economic context.

Section 4: Value assessment, including
- Relative costs and benefits of securing conservation areas through (i) a conservation stewardship strategy; and (ii) a protected areas establishment and management approach involving land acquisition by the state;
- An overview of strengths, weaknesses, opportunities and threats;
- Environmental, social and economic benefits of the Programme.

Section 5: Appraisal of implementation options and selection of preferred option

Section 6: Risks

Section 7: Conclusions and Recommendations

2 Programme Overview

The programme overview addresses the following aspects:

Section 2.1 Overview of selected *issues* in the *Western Cape* that shape government policy and which provide a backdrop for the Programme's activities;
Section 2.2 Goals, objectives and corporate structure: CapeNature and the Conservation Stewardship Programme;
Section 2.3 Key features of the current Conservation Stewardship Programme.

2.1 Background: the situation in the Western Cape

This section describes key aspects of the ecological and socio-economic situation in the Western Cape. This provides a backdrop for the Conservation Stewardship Programme's activities in the province.

<u>2.1.1 Ecological context:</u>

The Western Cape Province covers an area of 129,386 km^2, 10.6% of South Africa. Most of the province falls within the Cape Floristic Region (CFR), famous for its unique biodiversity. The CFR is the smallest of six plant kingdoms in the world, the only one contained in a single country, and it is internationally recognised as a global Biodiversity Hotspot and an Endemic Bird Area. The exceptional richness in plant species (9600 recorded so far), endemic amphibian, reptile, fish and invertebrate species, is associated with a wide variety of habitats and landscapes. Apart from supporting this rich biodiversity, the Western Cape's ecosystems provide an irreplaceable source of goods and services for the province's inhabitants and the economy. For example, river catchments ensure the protection of water supply systems, wetlands help regulate water yield and quality, indigenous plant and marine resources provide valuable harvest material, pollinators support the fruit industry and natural landscapes attract domestic and international tourism.

At the same time, the natural systems in the CFR and Western Cape are under serious threat from a range of factors. These include historical patterns of unsustainable natural resource use, extensive alien species infestations and rapid, inappropriate infrastructural development. Many areas, particularly in the lowlands, have been reduced to a fraction of their original extent and very little of what remains is protected.

Spatial conservation assessments[3], conducted at national and regional levels, demonstrate the current level of biodiversity protection in the CFR and identify priority areas for conservation interventions. These assessments are based on the systematic conservation planning *principles* of *representation* (the need to conserve representative samples of biodiversity features, including ecosystems, habitats and species) and *persistence* (the need to conserve important ecological and evolutionary processes that sustain biodiversity in the long term, Margules and Pressey, 2000). By setting *quantitative targets for biodiversity features*, the conservation assessments determine (i) how much of each biodiversity feature needs to be conserved to the attain adequate representation and persistence of natural

[3] These include the National Spatial Biodiversity Assessment, NSBA, 2004 (Driver et al. 2005), the CFR-focused Cape Action Plan for the Environment (Cowling et al., 2003) and finer-scale plans for parts of the Western Cape.

systems; (ii) to what extent protected areas are contributing to conserving these features in the landscape; and (iii) which ecosystems are threatened or under-protected.

The current system of protected areas across South Africa and in the Western Cape does not meet biodiversity targets and many of the terrestrial ecosystems are considered threatened (Driver et al., 2005, DEAT, 2008). The Western Cape harbours 163 terrestrial ecosystems, including the majority of the country's critically endangered and vulnerable systems[4]. Virtually all of the main stem river ecosystems are in a critically endangered state. In addition, more than half of all terrestrial ecosystems in the Western Cape are poorly, hardly or not protected at all.

The National Spatial Biodiversity Assessment (NSBA) identifies the CFR as one of nine key priority areas for biodiversity conservation in the country. This finding is consistent with scientific assessments done at international and regional scales. Conserving this region is a major challenge however, given the immense diversity in species and ecosystems and the significant threats to their persistence. This requires a collective, structured approach - C.A.P.E. was thus developed as a targeted long-term intervention involving numerous partners to conserve the biodiversity of the CFR while delivering significant benefits to the people in the region.

<u>2.1.2 Socio-economic context</u>

The Western Cape has a population of at least 4.5 Million people (2001 Census). The population is ethnically, linguistically and culturally diverse and mostly urbanised: 68% of people live in the Cape Town Metropolitan Area; 32% in smaller towns and rural areas. Significant disparities in people's socio-economic conditions, skills and access to resources exist although the government has been successful at implementing measures to improve equity and socio-economic conditions. These remain a priority motivating government spending (PGWC, 2007)[5].

Positive economic growth (estimated at 5.1%, 2007/08) is mainly driven by the services and construction sectors. Tourism is a growth sector. The agriculture, forestry and fishing sector is the biggest employer particularly in rural areas, where much of the province's critical biodiversity is found. Agriculture is declining, however, with negative implications for employment levels. The persistently high unemployment rate of 22.6% (September 2006) remains a major challenge in the Province and South Africa. The skills profile is also concerning: 75% semi- and unskilled labour (75%); 25% skilled labour (PERO, 2007). Job creation and skills development, especially amongst women and youth, are therefore top government priorities.

<u>2.1.3 Climate change</u>

South Africa as a whole is vulnerable to climate change, yet the negative impacts are predicted to affect particularly the Western and Northern Cape (DEAT, 2003). It is anticipated that the Western Cape will become warmer and drier over time, with less winter rainfall and possibly more irregular and intense rainfall events (Midgley et al., 2005). This will have various likely consequences for the region's economy, ecological integrity and people's livelihoods (Midgley *et al*., 2005) including:

[4] Of the Western Cape's terrestrial ecosystems 10% are critically endangered, 17% endangered; 10% are vulnerable.
[5] A more detailed analysis of social and economic indicators is given in the Western Cape Provincial Government (PGWC). 2007. Medium Term Budget Policy Statement 2008 – 2011.

- Diminishing water resources;
- Negative impacts on rivers, wetlands and estuaries;
- Detrimental effects on biodiversity, including significant species losses in the CFR. This is concerning given the role of biodiversity in maintaining ecosystem functioning, its proven economic value for tourism and its role in supporting subsistence lifestyles.
- Increased fire danger and frequency;
- Threats to livelihoods, especially of poor people who are most vulnerable to the effects of climate change;
- Impacts of economic sectors such as fishing, forestry and agriculture, insurance, banking, infrastructure and construction.

2.2 Goals, objectives and corporate structure

2.2.1 CapeNature

CapeNature's **vision** is to establish a successful conservation economy in the Western Cape by locating biodiversity conservation in the mainstream of local economic development.

The agency's **principal role** is to contribute towards the conservation of biodiversity and the natural environment in the Western Cape. This is encapsulated in its mandate (Western Cape Nature Conservation Board Act, 15 of 1998) to:

> *a) promote and ensure nature conservation and related matters in the Province;*
> *b) render services and provide facilities for research and training in connection with nature conservation and related matters in the Province; and*
> *c) pursue the objectives set out in paragraphs (a) and (b), to generate income.*

CapeNature's **strategic goals and objectives** are specified in the Strategic Plan (2008/09). The following are relevant in guiding the Conservation Stewardship Programme:

Goal 1	*'Provide cutting-edge leadership and* innovative approaches *to biodiversity management and environmental integrity.'*
Objective 1.1	*'Improve the reach and quality of biodiversity management*'
Goal 4	*'Demonstrate impact on and contribution to the reconstruction and development of social capital'.*

The launch in 2003 of the Conservation Stewardship Programme in CapeNature marked the agency's formal involvement in a set of focused 'off-reserve' conservation stewardship activities.

This was supported by the adoption of conservation stewardship as a strategic priority activity by the Cape Action for People and the Environment (C.A.P.E.) partners in 2004[6].

[6] C.A.P.E. report chapter 4 (Ashwell et al., 2006) gives an overview of the Conservation Stewardship Programme. C.A.P.E. is a multi-stakeholder programme aimed at conserving terrestrial and marine biodiversity of the Cape Floristic Region, while delivering economic benefits. CapeNature is one of the key implementing agencies and the Western Cape government is a signatory of the C.A.P.E. strategy.

2.2.2 The Conservation Stewardship Programme

The Conservation Stewardship Programme focuses its interventions in the Western Cape on biodiversity priority areas that fall outside of formal protected areas. Here, the Programme seeks to encourage, build and sustain a stewardship ethic in landowners[7] through the negotiation and maintenance of conservation stewardship agreements. The sites are thus protected through formal conservation stewardship mechanisms. These sites then complement and expand the formal system of protected areas with a view to adequately protecting critical biodiversity areas and natural habitats at the landscape-scale[8].

The Conservation Stewardship Programme's **primary goal** is:

> *'To secure and maintain the conservation status of land in high priority areas for protecting the natural systems and biodiversity of the Western Cape'.*

The Programme's **key objectives** are aligned with the agency's (section 2.2.1). They are to:

> *'Enhance biodiversity protection and conservation in areas outside the formal network*.'
>
> *'Ensure the implementation of effective conservation management interventions in the Western Cape.'*
>
> *Contribute to 'an adequate and representative protected area network (incorporating terrestrial, freshwater and marine priorities) is secured and effectively managed.'*
>
> *'Enhance co-operative governance and institutional strengthening through biodiversity and corporate partnerships.'*

Supporting **objectives** are to:

Promote socio-economic development through the conservation economy.
Support the development of policies, systems and processes that enhance service delivery.

The Programme plays a **central role** in assisting CapeNature and the Western Cape government in *cost-effectively* (through leveraging the investment of landowners) *fulfilling their mandate to conserve and manage biodiversity outside of state-owned protected areas* in terms of provincial and national legislation (see Section 3.1).

2.2.3 Institutional and corporate structure

CapeNature functions as a public entity, the Western Cape Nature Conservation Board (trading as CapeNature), under the Western Cape Department of Environmental Affairs and Development Planning (DEA&DP). The provincial department engages with the national government regarding functions where concurrent legislative competence is accorded. This includes most aspects of biodiversity conservation such as: environmental management;

[7] More than 80% of the province resides in the hands of private and communal landowners, who thus have a critical contribution to make in building and managing living, functioning landscapes.
[8] The Programme therefore integrates 'off-' and 'on-reserve' conservation strategies.

nature conservation (excluding national parks and botanical gardens); and regional planning and development.

The Conservation Stewardship Programme is included in CapeNature's Strategic Plan 2008/09 under the overarching Programme 2: Biodiversity, Planning and Operations:

CapeNature	
Programmes	Sub-Programmes
1. Administration	• 3 sub-programmes
2. Biodiversity, Planning and Operations.	• **Conservation Stewardship (*strategic management)*** • **Business Units (*in-situ operations)*** • 10 other sub-programmes
3. Business Development	• 3 sub-programmes

The Conservation Stewardship Programme's activities and reporting lines are divided between two sub-programmes: strategic management falls under the Programme itself while its *in situ* operations occur through the Business Units.

'Biodiversity, Planning and Operations' includes additional programmes that are collectively implementing the broader *land stewardship* strategy of CapeNature: Community Based Natural Resource use Management; Youth Development; Land use Planning; Invasive Species Management; Fire Management; Wildlife Management; Biodiversity Crime Services; and Extension Services.

2.3 Current state of the Programme

At present, the Conservation Stewardship Programme is a well-established programme in the conservation agency. It receives significant financial support from international donor funds, as part of the larger C.A.P.E. programme.

Key characteristics of the Conservation Stewardship Programme are outlined below.

- Goal: The Programme has a clear goal and a set of objectives (see Section 2.1).

- Strategy: The Programme is based on a conservation approach that enjoys considerable support internationally[9]. Its focus is on establishing long-term conservation security and legal status for high priority habitats by negotiating *new* conservation stewardship agreements, and pursuing the maintenance of concluded stewardship agreements. Currently, private land is predominantly targeted.

- Spatial focus: In parts of the Western Cape, the Programme has identified spatially explicit targets using a range of bioregional plans, associated fine-scale conservation plans and expert processes. A single consistent plan for the province is not yet available.

[9] Australia and New Zealand face a number of similar challenges as South Africa and are actively implementing conservation stewardship-type approaches. See e.g. http://www.nrm.gov.au/nrm/index.html and http://www.environment.gov.au/biodiversity/incentives/index.html

- Principles: The Programme has developed a set of overarching principles for its activities:
    - o Focus on biodiversity conservation outcomes
    - o Target biodiversity priority areas identified in conservation plans
    - o Be responsive to the needs of landowners and residents
    - o Secure the highest conservation tenure possible
    - o Provide ongoing support to landowners
    - o Build cooperation and partnerships.

- Conservation agreements: The Programme has adopted three clearly defined types of conservation agreement with landowners, based on results from its pilot phase in 2002-2003. These agreements are aligned with national legislation and include:
    - o *Conservation areas*
    - o *Biodiversity agreements*
    - o *Contract nature reserves*

- Implementation: Programme implementation is currently through the Conservation Stewardship Unit and the Business Unit's conservation services staff, as well as by associated funded initiatives in the northern and eastern parts of the Western Cape (Greater Cederberg and Gouritz Biodiversity Corridors).

- Staff: The Programme and Business Units have a limited number of dedicated full-time staff. The majority of staff involved in conservation stewardship are located in the Business Units and undertake stewardship part time as one of several other key functions.

- Approach to landowners: A general, structured approach is used to guide stewardship officers in engaging with landowners to source new stewardship agreements (CapeNature, 2007: Conservation Stewardship Operational Procedures Manual).

- Achievements: A number of conservation agreements have been negotiated in priority areas; audits of existing agreements have been conducted; certain incentives have been developed and implemented; and a skills development pilot programme involving farm workers has been initiated (see section 4.4).

- Partnerships: C.A.P.E. partners have prioritised conservation stewardship. Key partnerships exist with Western Cape Department of Agriculture's (WCDA) LandCare initiative, Working for Water (WfW) and Working on Fire (WoF).

- Resources: International donors (committed until 2009) and CapeNature have funded the Programme's operations to date. The pilot project 2002/03 was funded by the international CEPF (R 1.7Million). The current Programme has an average annual budget of R469,000 (CapeNature), the CapeNature Business Units contribute roughly R1.24 Million (Jackelman and Ferreira, 2007) and C.A.P.E.'s GEF grant contributes an estimated R830,000. These figures exclude co-funding for landowner incentives.

3. Strategic alignment

This section addresses the legal context and strategic alignment of the Conservation Stewardship Programme. The aim here is to demonstrate the Programme's contribution to implementing the government's goals, not to present a full review of the legal, institutional and strategic context within which the Programme fits[10].

Section 3.1 *Legal context* for the Conservation Stewardship Programme;

Section 3.2 Summary of strategies with which the Conservation Stewardship Programme is aligned (environmental and socio-economic context).

3.1 Legal context

The Conservation Stewardship Programme's activities in terms of formally protecting biodiversity on land outside of the current protected areas system and on non state-owned land are enabled in terms of national and provincial legislation:

Legislation	Provisions for formal biodiversity protection on land outside of the state-owned protected areas system
National Environmental Management: Biodiversity Act (Act 10 of 2004)	The Act provides important spatial and strategic planning instruments that enable conservation outside of formally protected areas, including: • the publishing of bioregional plans that identify critical biodiversity areas outside of the protected areas system; • the listing of threatened or protected ecosystems and species; and • the development of biodiversity management plans and biodiversity management agreements (e.g. with landowners other than the state).
National Environmental Management: Protected Areas Act (Act 57 of 2003) as amended	One of the objectives of the Protected Areas Act is to provide for a representative network of *protected areas on state land, private land and communal land* (Chapter I, Section 2). The Act recognises a streamlined set of categories for protected areas and details the legal procedure for declaring Special Nature Reserves; Nature Reserves; National Parks; and Protected Environments (Chapter 3). The protection of private and communal land is specifically catered for under these categories. It requires the mutual agreement of landowners and the National Minister or MEC (depending on the category of protected area).
The Western Cape Nature Conservation Board Act (Act 15 of 1998)	The Act provides for CapeNature to negotiate and cooperate with *any other party* in order to achieve its objectives for conserving biodiversity. (Chapter II, Section 9: 1c, d, f) CapeNature may therefore enter into conservation stewardship agreements with private and communal landowners as well as the state.
Nature and Environmental Conservation Ordinance, (No. 19 of 1974)	The Ordinance provides for the establishment of nature reserves on private land (see Chapter II, Section 12, 13, as amended in the Western Cape Nature Conservation Laws Amendment Act 3 of 2000).

[10] An excellent overview of 'Biodiversity policy, legislation and institutional arrangements' in South Africa is provided in chapter 2 of the Country Study that informed the NBSAP (DEAT, 2005).

3.2 Strategic alignment and linkages

South Africa is committed to protecting its biodiversity while growing the country's economy and building solid foundations for the well-being of its society. Socio-economic priorities are currently very high on the agenda at all levels of government[11]. At the same time, the fundamental goal of conserving the diversity and integrity of natural systems is reflected in numerous policies and strategies.

The Western Cape government, in particular, has adopted sustainable development as a key principle underpinning development in the province. This is based on the understanding that intact landscapes, including their biodiversity, ecological processes and people living in them, create the foundation that supports the economy and society in the long term.

This section summarises the national, provincial and local strategies (Table 1 below) with which the CapeNature *Conservation Stewardship Programme* is aligned in terms of its objectives. The Programme's alignment is closest with well-developed national biodiversity conservation strategies. These also apply at provincial and local levels. A degree of alignment also exists with socio-economic strategies due to the Programme's contribution to skills development and job creation (see Section 4.4)

Table 1. Key strategies and relevant linkages with the Conservation Stewardship Programme[12].

Name (Agreements, Strategies, Programmes and Plans)	Type	Relevant goal, objective or intervention
Biodiversity conservation and sustainable use of biological resources		
Convention on Biological Diversity (CBD)	International agreement	The CBD provides the framework, norms and standards for the conservation, sustainable use and equitable benefit-sharing of South Africa's biological resources. The Conservation Stewardship Programme contributes to the aim of significantly reducing 'the current rate of loss of biological diversity' by the year 2010 (Conference of Parties, COP, 2002) by developing an effectively managed and ecologically representative system of national and regional protected areas (COP, 2004) across South Africa.

[11] See the President's State of the Nation Address, 2008; the Western Cape Premier's State of the Province Address, 2008; and the national and provincial budget speeches and policies.
[12] Appendix 1 expands on the relevant strategies and linkages.

National Biodiversity Strategy and Action Plan (NBSAP)	National strategy	The NBSAP provides a 20-year framework for the conservation and management of terrestrial and aquatic biodiversity in order to ensure sustainable and equitable benefits to the people of South Africa. The Conservation Stewardship Programme is closely aligned with activities under strategic objective 5 (SO5): SO5: '*A network of conservation areas conserves a representative sample of biodiversity and maintains key ecological processes across the landscape and seascape*'. Outcome 5.2: '*The protected area network is secured, expanded and managed to ensure that a representative sample of biodiversity and key ecological processes are conserved*'. Outcome 5.3: '*Biodiversity is effectively managed in key ecological corridors and in high priority fragments of natural habitat across the landscape and seascape, using tools such as incentives*'.
National Biodiversity Framework (NBF)	National strategy	The NBF identifies for the Strategic Objective 5 of the NBSAP four top priority actions for the period 2008-2012. Included is the priority action to *'establish and strengthen provincial stewardship programmes'.*
National Protected Areas Expansion Strategy (NPAES)	National strategy	The NPAES is based on the premise that effective conservation in South Africa is best achieved through strategies that *integrate* the following two approaches across regions or landscapes: *i) 'The establishment and management of a secure comprehensive, adequate and representative national protected areas system'. And* *ii) 'The ecologically sustainable management of natural resources across the broader landscape and seascape for areas that are outside the national protected areas system. This is especially important in areas that have been identified as biodiversity priorities*'. The Conservation Stewardship Programme is implementing such an integrated strategy though formally securing priority biodiversity areas outside of current protected areas with landowners. Further, the NPAES explicity identifies the *negotiation of contractual arrangements with landowners* as one of four key mechanisms for expanding protected areas by conservation agencies throughout South Africa.
Biodiversity Stewardship of South Africa (BSSA)	National programme	The BSSA provides a national coordinating framework for the implementation of conservation stewardship initiatives by provincial conservation agencies across South Africa. It sets out guiding principles and approaches for conservation stewardship that the Conservation Stewardship Programme is fully aligned with.
Cape Action for People and the Environment (C.A.P.E.)	Bioregional programme	This bioregional partnership programme seeks to integrate biodiversity conservation in the Cape Floristic Region (CFR) with developmental needs. It is a key programme contributing to the goals of outlined in the Western Cape's Sustainable Development Plan (SDIP, see below). CapeNature is a key implementing agencies of C.A.P.E. and the Conservation Stewardship Programme is a priority activity under component 5: '*Establishing the foundations of the biodiversity economy to enhance Conservation Stewardship in key lowland Landscapes'* with the output: *'Enhanced understanding of economic incentives to induce changes in land user behaviour in favour of Conservation Stewardship'.*

Climate change		
National Climate Change Response Strategy (NCCRS)	National strategy	This strategy addresses priority issues for dealing with climate change in South Africa. A key action is to: '*Develop protection plans for plant, animal and marine biodiversity*'. Specific recommendations to which the Conservation Stewardship Programme is contributing are: *'Land use practices and land use patterns outside conservation areas should be adapted to minimise the negative impacts of climate change on biodiversity conservation and future dispersal probabilities'.* And *'Adaptation options for maintaining animal diversity could include the implementation of a conservation area network that would buffer the effects of climate change.*
Western Cape Climate Change Strategy and Action Plan (CCRS)	Provincial strategy	The CCRS provides a strategic approach for the provincial government to minimise negative climate change impacts. A lead intervention in the proposed adaptation response is a *Land stewardship and Livelihoods Programme* (key outcome 3) with four focus areas: *1.Wetland conservation, Riverine and Estuary Integrity; 2. Integrated Invasive Alien Species Programme; 3. Extension of protected areas and 4. Fire risk management and control.* The CCRS recommends under focus area 3: *'Increasing protected areas requires a focus on public land and privately owned land.'* The Conservation Stewardship Programme already plays a pivotal role in the extension of protected areas and contributes directly to the following action identified in the CCRS: '*Engage private land owners in conservation activities through facilitative actions (Stewardship & LandCare programmes) accessing funds from the Adaptation Fund.'*
Sustainable development and socio-economic context		
Millennium Development Goals (MDGs)	International agreement	The United Nations' Millennium Development Goals (MDGs) require of governments, including South Africa, to "Ensure environmental sustainability (Goal 7)" by 2015. An important indicator, the 'Ratio of Area Protected to Maintain Biological Diversity to Surface Area' is of direct relevance to the Conservation Stewardship Programme.
New Partnership for Africa's Development (Nepad)	International agreement	Nepad identifies six sectoral priorities. The Conservation Stewardship Programme's goals and activities are aligned with two of these: • *Build human resources* (relevant here: in the conservation sector) • *Ensure and safeguard or defend the environment*.
Accelerated and Shared Growth Initiative South Africa (ASGISA)	National strategy	ASGISA identifies binding constraints on the economy and the interventions required to undo these barriers. Alignment between ASGISA and the Conservation Stewardship Programme is limited and exists only with regard to the Programme's pilot skills development initiative which addresses the following: Constraint*: Shortage of skilled labour* Intervention: *Skills-development strategies, aimed at alleviating skills shortages and poor quality of education*.

Sustainable development and socio-economic context		
The Provincial Growth and Development Strategy, PGDS (iKapa elihlumayo)	Provincial strategy	The Western Cape's *iKapa* GDS provides the vision ('A Home for All') and framework for future development in the province. It contextualises national imperatives and sets out short and long-term goals and objectives. The Conservation Stewardship Programme contributes to Goal1: ***Grow and share the economy*** by increasingly facilitating skills development in conservation management and job creation (primarily due to improved income generation from informal-sector activities and public sector programmes). The Programme further contributes substantially to Goal3: ***Promote ecologically sustainable development*** through its achievements in protecting biodiversity and key natural resources, including water. The Programme plays a key role in several path-breaking, path-shaping and path-consolidating interventions that have been identified to achieve the long-term goals of the iKapa GDS. The Conservation Stewardship's activities can also be tracked using a variety of the PGDS's indicators, e.g. '% skills training per occupational type'; 'Increasing land areas protected to maintain biological diversity'. Key sectoral strategies have been formulated under the iKapa GDS. The Conservation Stewardship Programme is aligned to some extent with the MEDS (see below) and Poverty Reduction Strategy aimed at achieving Goal 1 and *closely aligned* with the *CCRS, SDIP and PSDF* that relate to Goal 3.
The Provincial Spatial Development Framework (PSDF)	Provincial strategy	The PSDF guides the geographic focus of public and private investment in the Western Cape within a paradigm of sustainable development. The Conservation Stewardship has close links with Objective 8: '*Protect biodiversity and agricultural resources'* in order to achieve the goal of '*Environmental sustainability: ensure there is sufficient environmental capital for future generations.'* The PSDF sets out key strategies, action plans and controls relevant to objective 8. These include land use planning and management guidelines as well as spatial planning categories that cater for formal and informal conservation areas on public and private land.
The Sustainable Development Implementation Plan (SDIP)	Provincial strategy	The SDIP aims to reduce the ecological footprint of long-term investments in growth and development in the Western Cape and to reverse the degradation of ecosystem services and resources. A key initiative underpinning the SDIP is the C.A.P.E. Programme, of which the Conservation Stewardship Programme is a key component.
Western Cape Micro-Economic Development Strategy (MEDS)	Provincial strategy	The MEDS guides targeted interventions by the provincial government aimed at stimulating economic development in high-potential sectors, including *tourism*. TheConservation Stewardship Programme's activities create opportunities that support the establishment of eco and adventure tourism ventures.

Sustainable development and socio-economic context		
Integrated Development Plans (IDPs) and Spatial Development Frameworks (SDFs)	Local government strategic plan and spatial plan	Municipalities are charged with a wide range of responsibilities, including environmental management and the conservation and sustainable use of biodiversity. This is integrated within municipal IDPs. These critical planning tools enable municipalities to align national, provincial and local government objectives and to articulate how public and private investments should relate to local needs, planning frameworks and budgets. A fundamental principle underpinning the IDP is sustainable development. This is reflected in the vision, goals and objectives, as well as in practical programmes in the Implementation Plan (e.g. alien clearing, establishing a biosphere reserve). These programmes require partnerships with public and private entities. Here, the Conservation Stewardship Programme can contribute significantly to realising environmental and sustainable development goals and interventions that meet a municipality's specific identified need. The municipal land use planning and management component is developed as part of the SDF. This needs to follow similar principles as the PSDF, including the application of spatial planning categories outlined in the provincial framework. Issues relating to biodiversity protection and environmental management are included in spatial terms in the SDF. This may include the planning for, and reflection of spatial focus areas identified as priorities for conservation stewardship activities.
Expanded Public Works Programme	National programme	The Western Cape is actively implementing the national EPWP. This seeks to address the challenges of poverty and unemployment by creating a large number of temporary work opportunities. The Conservation Stewardship Programme facilitates the implementation of the EPWP through opportunities created on stewardship sites, including invasive alien clearing, fencing, tourism development and fire management work.
Land Reform Programme	National programme	The acceleration of land reform is viewed as an urgent priority by the national and provincial government. The Conservation Stewardship Programme can make a significant contribution by supporting beneficiaries of the land reform process in setting up sustainably developed, income generating ventures that are compatible with biodiversity conservation goals. This applies particularly to new landowners in areas that are not viable for agricultural activies or where significant potential for ecotourism exists.
Landcare Programme	Provincial programme	The LandCare Programme is part of the Western Cape Department of Agriculture's Natural Resource Management component. Its concerns around conservation and the sustainable use of agricultural resources (e.g. water, soil) link closely with many of the Conservation Stewardship Programme's objectives (e.g. biodiversity persistence and ecosystem processes for a functional landscape) and significant cooperation occurs in implementing these Programmes.

4 Value Assessment

The following sections give an overview of the value presented by implementing the Conservation Stewardship Programme:

Section 4.1 Objective of the value assessment;
Section 4.2 Relative costs and benefits of conservation stewardship and a protected areas establishment and management strategy involving land acquisition;
Section 4.2 Brief review of strengths, weaknesses, opportunities and threats;
Section 4.3 Benefits associated with the Conservation Stewardship Programme.

4.1 Objective

The value assessment is intended to give decision-makers sound and, where possible, quantitative information on the advantages and disadvantages associated with the Conservation Stewardship Programme.

CapeNature is tasked primarily with *conserving the biodiversity* of the Western Cape Province for the benefit of the natural environment and South African society (see Sections 2.2 and 3.2). Thus values relating to the environment form a critical component of assessing the Conservation Stewardship Programme. They are complemented by social and economic value components.

A Note on Measuring Values

Values can be expressed in qualitative and quantitative terms, the latter including financial and non-monetary units of measurement (e.g. number of jobs created). Economic valuation, in monetary terms, is often considered a powerful way of weighing up situations that demand a trade-off as standard units reduce complexity and facilitate comparison. Yet, elements that are not reflected in the 'real economy', i.e. that are not traded and therefore have no market price, are difficult to estimate in financial terms. A prominent example would be the value of goods and services provided by natural ecosystems.

These goods and services are, however, not free even in an economic sense, as they perform specific and crucial functions. Substantial efforts are being made internationally to place financial values on ecosystem services[1], and the underlying biodiversity, so that they may be integrated in the economy. At present they remain inadequately represented though and significantly undervalued in real terms. *It is therefore vital to recognise the value of many environmental (and social) goods and services in a non-monetary sense and to make knowledge-based rather than simply financially-based decisions for safe-guarding them (Heal, 2000)*.

4.2 Costs and Benefits: Alternative Conservation Strategies

This section places the value of conservation stewardship into a financial and cost-benefit perspective, specifically relative to an alternative strategy for achieving conservation goals.

The following conservation mechanisms are examined:
(i) conservation stewardship as implemented by the Conservation Stewardship Programme;
(ii) protected areas establishment involving land acquisition and subsequent management by the state.

Section 4.2.1 addresses the *financial implications* of the two conservation strategies; and
Section 4.2.2 presents an overview of the *relative costs and benefits* of these strategies.

4.2.1 The financial perspective

Conservation stewardship is increasingly recognised as one of the most cost-effective mechanisms for securing the protection of important landscapes across the world. Two recent studies (Frazee, et al., 2003; Pence et al., 2003) demonstrate this in a South African and Western Cape context. The studies focus on the economic implications of conserving land through ‘off-reserve’ and ‘on-reserve’ conservation strategies. The ‘on-reserve’ approach entails protected area expansion and management through land acquisition and subsequent management by the state. The ‘off-reserve’ strategy refers to the use of conservation stewardship mechanisms to encourage private and other landowners to protect valuable natural areas on their properties. The relative implementation costs of the ‘on-reserve’ and ‘off-reserve’ strategies are summarised in Table 2 below.

Table 2. Estimated establishment and maintenance costs (Frazee et al., 2003) and incentives costs for two alternative conservation strategies in the Cape Floristic Region.

	Establishment costs	Management/Monitoring costs[13]
Conservation Stewardship (‘off-reserve’)	R 6 /ha (negotiation)	R 60 /ha (excluding incentives or invasive alien plant clearing)
Protected areas conservation (‘on-reserve’)	R 1660- 2100 /ha (acquisition of intact land only or intact plus some productive land)	R 100 /ha (excluding invasive alien plant clearing)

The once-off establishment costs for the ‘on-reserve’ approach vary according to the type of land acquired – intact natural areas usually cost less than productive land. Yet, some productive land is likely to be needed to connect important parts of landscapes or preserve ecosystem processes. Regardless of the type of land involved, however, the large costs of land acquisition (Table 2) present a massive obstacle to significantly expanding protected areas through the ‘on-reserve’ strategy.

[13] Presenting maintenance costs on a per hectare basis simplifies comparison, but the costs depend on numerous factors other than hectares conserved. Economies of scale come into play, as well as differential costs for managing different habitat types. Annual operational costs for a fully representative protected areas system in the Cape Floristic Region are estimated (Frazee et al. 2003) to be R115.5 Million for maintaining the ***on-reserve*** component of this system (~1.22 Million ha) and R11.25 Million for the much smaller off-reserve component (~192,000 ha).

The cost of negotiating contract agreements is significantly smaller than land acquisition. This shows the conservation stewardship approach to be a cost-effective mechanism for conserving land. It is a powerful argument for adopting conservation stewardship mechanisms to complement traditional 'on-reserve' conservation strategies.

The annual maintenance costs (Table 2) for the two strategies further show significant savings to the government by devolving a large proportion of the management responsibility to individual landowners. The maintenance costs given here are purely the management/monitoring costs that conservation agencies need to cover, excluding the landowner's management costs. The cost of financial incentives (e.g. management assistance or tax rebates) to landowners is also excluded. Incentives are critical however to motivate landowner compliance and for the state to meet its commitment to equity.

The financial implications of offering incentives to landowners are indicated by Pence et al. (2003). This study evaluated different scenarios involving both 'on-reserve' and 'off-reserve' conservation mechanisms on the Agulhas Plain, Western Cape. The principal findings are as follows: Combining 'on-reserve' and 'off-reserve' conservation strategies in the landscape (i.e. 40% of the total conserved area is under stewardship agreements) means an 80% saving in acquisition costs to the government. By offering a fair incentives package to landowners with conservation stewardship agreements[14] the cost to the State is still reduced by 50% compared with a full 'on-reserve' conservation strategy to protect biodiversity on the Agulhas Plain.

An approach to conservation that thus integrates 'on-reserve' and 'off-reserve' (including fair incentives) distributes the responsibility and cost of protecting land to national, provincial and local government, and private and communal landowners to be shared in an equitable manner.

4.2.2 Relative costs and benefits of alternative conservation mechanisms

The financial perspective shows conservation stewardship to be a vastly more cost-effective solution to conservation efforts in the Western Cape than traditional 'on-reserve' protected areas mechanisms. There are advantages to both mechanisms, however, and a combination is often recommended. The tables 3 and 4 below present additional costs and benefits associated with the two mechanisms.

Table 3. Benefits and costs of implementing 'off-reserve' conservation mechanisms.

Conservation mechanism: securing conservation stewardship agreements	
Benefits	Costs
1. Cost-effective strategy in the short- and long-term	1. Conservation of biodiversity and landscapes is not free: allocation of funds is required to negotiate and maintain stewardship agreements.
2. Land ownership and the tenure of farm workers and other residents retained.	2. No public access to conservation stewardship sites

[14] Suggested incentives include management assistance in the form of 80% of initial costs of invasive alien plant removal and the cost of two follow-up clearings, 50% of annual firebreak maintenance and property rates exemption for all natural portions of the land (Pence et al., 2003). These incentives are critical to obtain landowner buy-in for conservation and for continued compliance with maintenance requirements.

3. Landowner contribution to government goals of conservation and sustainable development (i.e. to the common good of society).	3. Coordination of on-going conservation efforts (involving numerous partners) required by the government
4. Landowners and residents remain economically active in rural areas.	4. Government support for alternative industries and ventures (e.g. tourism) required.
5. Improved access for landowners to information and support for conservation and land management.	5. Government support required to provide information and technical assistance of landowners
6. Government gains degree of oversight in the management of important conservation areas to ensure best possible maintenance of South Africa's natural heritage.	6. Conservation management of land not guaranteed in perpetuity. This applies particularly to voluntary conservation areas and biodiversity agreements.
7. Creation of opportunities in rural areas to diversify activities and for alternative livelihoods.	7. Government incentives required to encourage changes in land use

Table 4. Benefits and costs of implementing 'on-reserve' based conservation mechanisms.

Conservation mechanism: establishing protected areas through land acquisition and state management	
Benefits	Costs
1. Conservation of the protected area guaranteed.	1. Expensive strategy due to the need for land acquisition.
2. The government implements its own vision of protected areas management, including the social and economic benefits to be realised.	2. No support to adjacent landowners who may want to conserve part of their land
3. Affordable access for public use and recreation.	3. The state bears all the costs of conserving land for the public good.
4. Revenues are collected from tourism in profitable conservation areas.	4. Conservation areas that are not profitable need to be funded.
5. Land is owned by the state	5. Residents (owners, managers, farm workers) may need to be resettled if the land is acquired
6. Effective enforcement of regulations within the boundaries of the protected area.	

4.3 Strengths, Weaknesses, Opportunities and Threats

This section shows a brief analysis of the overall strengths, weaknesses, opportunities and threats currently relevant to the Conservation Stewardship Programme.

Strengths	Weaknesses
• Alignment with key national and provincial goals and strategies, including environmental, social and economic priorities (see Section 3) • Programme meets the need for an ‘off-reserve’ focused, integrative conservation strategy in CapeNature • Solid foundations and excellent capacity created by pilot project and current Conservation Stewardship Programme. • Contribution to meeting national and provincial conservation targets through expanding protected areas system • Cost effective strategy (see section 4.2) • Considerable external resources leveraged • Innovative and spatially flexible approach to conservation: ability to address conservation of critical biodiversity areas, key landscape linkages • Shared conservation responsibility between government and society/landowners • Important partnerships initiated and growing	• Sustainable funding to meet obligations and capitalise on opportunities not yet secured. • Corporate support for conservation stewardship strategy not fully entrenched in CapeNature. • Incentives for landowners need to be expanded to enhance participation • Administrative process for finalising contract agreements very slow so far • Alignment with other CapeNature Programmes not adequately capitalised on. • The term ‘*conservation stewardship*’ is not clear, has been confused with ‘land stewardship’ and is even rejected by some stakeholders • Benefits difficult to demonstrate visibly ‘on the ground’ in the short-term.
Opportunities	**Threats**
• Harnessing increased landowner interest in voluntary conservation and in ecologically sustainable land use options. • Closer spatial and strategic alignment with land stewardship programmes and activities in CapeNature • Leading role for CapeNature in conservation stewardship initiatives in the Western Cape. • Leveraging of considerable additional co-funding from various sources. • Scope for contributing to social and economic upliftment in rural areas. • Opportunities for replication of strategy and approach across other conservation agencies and provinces, knowledge sharing	• Too few resources are allocated to the Conservation Stewardship Programme to function effectively, retain skilled staff and meet key objectives in the medium- to long-term. • CapeNature fails to deliver on its commitments due to limited resources or capacity • Slow implementation deters landowners or partners from participating • Landowners fail to comply with agreements and regulatory mechanisms are required, which distract from core stewardship business. • High skill level required of staff for negotiating and maintaining agreements limits the capacity that the programme can access.

4.4 Benefits

The key *social, economic, political and environmental* benefits[15] associated with the Conservation Stewardship Programme are detailed in Table 5, and complemented by brief descriptions in the text. The benefits listed here *contribute directly to the goals and objectives* outlined for *CapeNature and the Conservation Stewardship Programme (section 2.2), as well as to the strategic perspectives as outlined in* section 3.2.

4.4.1 Environmental Benefits

To date, nearly 50,000 hectares of habitat under conservation stewardship agreements have been added to the conservation estate in the Western Cape, and this includes areas in several threatened and previously unprotected ecosystems (see Table 5). This land contributes significantly toward meeting national targets for biodiversity "representation" and "persistence"[2] by ensuring that high biodiversity value land, outside of the formally managed protected area network, is managed appropriately. In so doing, fundamental environmental values, such as the existence value of biodiversity and its future option value (e.g. the potential to use particular species for medicinal purposes) are retained.

In addition the Conservation Stewardship Programme plays an important role in retaining and re-building functional large-scale landscapes. This is a long-term goal which is achieved by acknowledging the importance of linkages in the landscape. Intact corridors are important for broad-scale ecological and evolutionary processes that sustain the diversity and functionality of the natural environment, which support the provision of ecosystem goods and services (e.g. securing the quality and quantity of water produced by catchment areas; maintaining the pollinators which agriculture requires; buffering agricultural land from floods and promoting soil genesis; see Table 5), potentially will contribute toward climate change adaptation (through retaining the variability and adaptability of fully functioning natural systems) and can enhance sustainable development objectives (section 3).

An important contribution of the Conservation Stewardship Programme is found in the way it builds a collective responsibility for conserving South Africa's globally unique biodiversity. Since the land required for maintaining important connections may be under any form of tenure, the Conservation Stewardship Programme's flexibility in operating across ownership patterns is a significant advantage for ensuring that the landscape linkages are conserved. Conservation stewardship agreements thus present a vital tool for filling 'gaps' in the landscape (e.g. between statutory protected areas) that have been identified as critical for landscape functioning. In addition to this it brings about a cost effective win-win situation where private land owners engage in activities which benefit themselves (e.g. alien plant clearing and wild fire management) as well as the greater national conservation effort.

The Programme's focus on threatened ecosystems[16] is significant, as many of these are close to their ecological thresholds and further degradation in such ecosystems can lead to irretrievable loss and unsustainable development.

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[15] These categories are interrelated: an environmental benefit can have important positive social impacts.

[16] South Africa is in the process of listing threatened ecosystems in terms of NEMA:Biodiversity Act (Section 52 of Act No. 10, 2004) to reflect systems that are approaching ecological thresholds. See also Section 3.2 for the number of threatened ecosystems in the Western Cape.

In addition to the economic argument, there are important social, economic and environmental arguments[17] for supporting the conservation of ecosystem goods and services. Particularly important to note is that the failure to sustain such services tends to have the most detrimental effects on poor and marginalised rural communities, which directly counters socio-economic goals at international, national and regional level (Section 3).

4.4.2 Social Benefits

The social benefits of the Conservation Stewardship Programme affect particularly rural communities in the Western Cape but also visitors, including tourists. Some of the most important benefits relate to income generation and training, as well as educational opportunities and recreation (Table 5). These aspects all have important social implications for improving the quality of life of all affected rural residents.

Skills development facilitated by the Conservation Stewardship Programme includes, for example, the offer of vocational training to farm workers. This project is currently being piloted and entails representatives from contractual nature reserves attending further education at a nature college. The skills gained are required for conservation management, field guiding and field ranger positions and can significantly benefit the workers' chances of improved employment in their local environment.

The security of land tenure is another important benefit that enhances social stability. People resident on the land that now includes areas under conservation tenure can remain living as before, without needing to be resettled as a result of changing conditions of land-use.

4.4.3 Economic Benefits

The Conservation Stewardship Programme is committed to unleashing economic benefits related to the conservation of critical biodiversity. Economic benefits are of great importance to the people involved in stewardship agreements and for creating the foundations of a broadly sustainable initiative. Addressing unemployment and skills shortages is critical as these are particularly pronounced in the rural setting where the Programme is focused and they are priorities for the government (see Section 3).

A range of opportunities for alternative income generation is facilitated through conservation stewardship agreements (Table 5). This has positive implications for the viability of rural households and for long-term economic adaptability and flexibility. Sustainable tourism ventures that are economically attractive and ecologically sensitive are an important option[18], which is being pursued on many of the newly created nature reserves. The impact of these alternative ventures on socio-economic upliftment in rural areas depends largely on the extent to which opportunities can be created and will most likely increase substantially with the continued roll-out of a successful Conservation Stewardship Programme, as envisaged.

Employment generation is currently both directly and indirectly related to conservation stewardship activities. Jobs are created directly through alien clearing contract work on land under stewardship agreements and through other conservation management work (further

[17] The Millennium Ecosystem Assessment (2005) gives a detailed global analysis of the importance of biodiversity and ecosystem services for humans, while Biggs et al. (2004) ***Nature supporting people: the Southern African Millennium Ecosystem Assessment*** focuses on the Southern African context. See also Appendix 2.
[18] This is demonstrated by the Business Case for Biodiversity (2007, PriceWaterhouseCoopers for WWF Germany).

facilitated by skills development opportunities); and indirectly through tourism, the service industry and through other income generating opportunities that are facilitated through conservation stewardship agreements. External funding support has been successfully leveraged by the Conservation Stewardship Programme in order to contribute to realising opportunities for job creation. The Conservation Stewardship Programme is currently in the process of expanding its socio-economic benefits though forging closer partnerships with programmes such as the Expanded Public Works Programme (EPWP). Through its conservation stewardship activities and sites the Programme creates opportunities for socio-economically focused strategies to meet their specific goals.

A range of incentive-related benefits (detailed in Table 5) is linked to contractual stewardship agreements. These are directed specifically at landowners and serve as an important motivating factor for protecting and managing biodiversity on their land. Incentives may be of direct or indirect economic benefit and the Programme is involved in initiatives to develop additional financial incentives[19].

It is important to note that for many rural landowners conservation management is not part of their core business (which is usually agriculture). This means that many landowners require significant assistance with managing land for conservation, and incentives simply help to offset some of the investments that landowners are making in order to conserve biodiversity. The benefits gained to sustainable development in the long run however are gained through the savings in costs.

4.4.4 Political Benefits

The Conservation Stewardship Programme presents several opportunities that may be translated into significant political benefits by CapeNature and the Western Cape government (Table 5). The Programme creates the platform for pursuing an integrated conservation strategy where mutually beneficial partnerships are developed between the state and the private sector. This can allow for greater productivity on fallow and non-productive land in rural areas (an important political imperative) while at the same time providing for greater alternatives and more sustainable livelihood options for rural communities. All this is achieved with no need to engage in the politically conflict-ridden (and potentially costly) process of expropriation and land purchase.

This is valuable for positioning the agency in the future of conservation in the country and for enabling its continued alignment with progressive conservation and sustainable development strategies at national and provincial level. Recognition from various sources, including key decision-makers, for the agency's contributions and its role as excellent stewards of the Western Cape's and South Africa's biodiversity would be a key political benefit.

[19] The National Treasury is currently considering proposals under the Biodiversity and Fiscal Reform Project to provide critical financial incentives to landowners in return for conserving important land (threatened or protected ecosystems) under contractual stewardship agreements.

Table 5. Key benefits associated with the Conservation Stewardship Programme.

1. Environmental Benefits		
Key Benefits	Implications	Programme's contribution to date (quantified / examples)
Biodiversity and landscape conservation*:* • Protection of critical biodiversity components: species, genes, ecosystems. • Functional landscapes are maintained or built: conservation stewardship sites can contribute toward vital parts of the landscape being connected.	• Option value is retained: biodiversity is conserved for possible future uses (e.g. commercial products, medicines). • Existence value of biodiversity for its inherent sake and scientific interest is retained. • Ecological and evolutionary processes supporting the provision of ecosystem services to humans are maintained. • Reduced alien plant invasion levels • More biodiversity friendly fire regimes	Conservation stewardship agreements negotiated to date and vegetation conserved: • 21 Contract nature reserves: (25588ha) • 16 Biodiversity agreements (16849ha) • 16 Voluntary conservation areas (6298 ha) Vegetation conserved = 48735 ha; of this 42437ha through legally binding agreements; 10 new threatened vegetation types included. Landscape linkage initiatives (e.g. Cedarberg and Gouritz River biodiversity corridors)
Provision of key ecosystem services[20] by intact natural systems, e.g. • Provision of water resources • Flood attenuation • Pollination and seed dispersal • Retention of soil, prevention of erosion	• Ecosystem services make vital contributions to human well-being, including: basic material income, health and nutrition, good social relations, environmental security.	De Wit (2006)[21] estimates the value of ecosystems for the whole of South Africa at ~R27 Billion, translating into R20 000/km^2. Using these estimates the value of ecosystems in the Western Cape is ~R1.4 Billion[22].
Climate change adaptation*:* • Greater resilience to climate change by intact ecosystems. • Climate regulation through carbon sequestration and energy absorption, exchange with the atmosphere.	• Functioning natural systems buffer against negative impacts of climate change[23]. • Higher number of species and diverse gene pools means more likely to survive negative effects of climate change.	48735 ha of land and many species gene pools in a better position to respond to climate change due to Stewardship programme.

[20] The Millenium Ecosystem Assessment (2005) gives a comprehensive review of provisioning, regulating, cultural and supporting ecosystem services.

[21] The study's results are indicative but based on rigorous analysis. It represents flows but not stock values (capital assets). Certain values were excluded, e.g. non-use existence, option and bequest values. There is evidence though that they constitute ***high values*** making a critical contribution to the economic value of biodiversity in South Africa (de Wit, 2006). ***Note that financial estimates reflect a limited economic perspective which complements the ecosystems' biophysical values.***

[22] For the Fynbos biome, the value derived here using de Wit (2006) is R 14 000 / km^2 or R 1.08 Billion. The Western Cape includes parts of several other biomes, thus working out to around R1.4 Billion for the Western Cape. By comparison, Turpie et al. (2003) estimated the value of terrestrial biodiversity and ecosystem services in the Cape Floristic Region at around R 8.3 Billion, ***broad nature-based*** tourism being by far the largest contributor. Excluding passive nature-based tourism, the values add up a total economic value of R 2.7 Billion.

[23] Active climate change mitigation requires substantial additional measures (e.g. generating energy through alternative sustainable means e.g. wind/wave power).

3. Social benefits		
Key Benefits	Implications	Programme's contribution (quantified / examples)
Diversification of rural income-generating opportunities related to conservation stewardship activities.	• Improved quality of life for people in rural setting due to income generation and the positive social consequences of employment. • Positive implications are particularly important for farm workers, previously unemployed rural people and women.	Implications of the Programme for social well-being are highly valued but not quantified here.
Skills development and training *in rural communities through conservation stewardship activities:* • Conservation management training (e.g. fire management and alien plant control). • Field guide and ranger training: vocational farm worker training course. • Environmental education opportunities.	• Opportunities for gainful employment through acquisition of new skills are improved. This is particularly important for farm workers, previously unemployed rural people and women.	Farm staff (1 or more per contract site) acquires conservation management skills through implementing management plan. 15 participants on pilot Vocational Farm Worker Training Programme to field guide and ranger level (with Programme to be expanded) 500+ children per year attend classes and Junior Landcare Camps.
Stability of land tenure*:* People remain living on the land and/or retain access to the land (landowners, farm workers with residential rights)	• Greater stability in rural communities. • Lower likelihood of resettlement.	Per stewardship site, this currently affects: • 1-2 landowner families • 3-10 farmworker families • Other residents
Recreational, cultural and education values are offered by the conserved land on stewardship sites.	• Tourists, visitors and residents can enjoy the natural environment. • Natural environment offers educational and knowledge-related values to people.	• People with access rights to conservation stewardship sites: landowner and farm worker families, communities, learners (school with stewardship site): 400+ per year • Tourists (avg. no. per year): 5000
Sustainable non-commercial harvesting of natural products on conserved land.	• Products are used for medicinal or subsistence purposes. • Traditional harvesting practices are maintained. • Traditional knowledge systems are maintained.	Non-commercial sustainable harvesting takes place on approximately 25% of the sites with conservation stewardship agreements.
Greater level of conservation ownership due to collective effort as more landowners engage in the Stewardship programme	• As more private individuals become involved in the Conservation Stewardship Programme there will be greater levels of public knowledge and ownership of conservation efforts.	There are 53 agreements functioning to date.

3. Economic benefits		
Key Benefits	Implications	Programme's contribution (quantified / examples)
Conserving land through stewardship agreements offers ***opportunities for alternative income generation,*** *including:* • appropriate tourism ventures; • conservation management (as the support base for tourism) • credit derived from carbon sequestration (not yet used); • supply to commercial ventures of sustainably harvested products; • related industries such as services provided by local community to visitors (catering, accommodation).	• Diversifying sources of income provides rural residents with greater **economic flexibility** and a buffer from economic/ agricultural down-turns. • This is particularly valuable in situations where land is under some form of **land reform** but where agriculture is not a feasible/ideal option for generating an income. • It also facilitates alternative livelihood options where **climate change impacts** on economic **viability** of agricultural use of the land.	• Eco/agri-tourism, bird watching, botanical tours on >60% of contract nature reserves; • Sustainable commercial harvesting ventures (flowers, seeds, thatch) on 25% of stewardship sites • Junior LandCare camps requiring 20 local facilitators per year and local caterers. • Adventure tourism (cycling, running events) involving several hundred participants per year and associated services.
Rural employment *is* created through conservation stewardship and associated income-generating activities: • Employment conducting conservation management (e.g. invasive alien plant clearing, fire management contracts) • Employment in the tourism and hospitality/service industry; • Employment in conservation related activities: field guides and rangers	• Job creation and the diversification of opportunities for gainful employment are critical for the South African economy, particularly in marginalised rural communities - the implications are particularly important for farm workers, previously unemployed rural people and women.	• 30+ people are directly employed on stewardship sites as guides and hospitality staff related to tourist visitors (3600 person days) • 250-300 people employed in part-time alien clearing and fire management work per year (~5500 person days) • 5-10 people are employed on a regular basis in managing conservation areas on stewardship sites (~ 100 person days). Overall: ~9200 person days/annum
Conservation stewardship ***incentives***[24] for landowners may include: • Facilitated access to markets and publicity for commercial products (e.g. wine, flowers, potatoes, rooibos tea); • Access to funding sources (e.g. WWF-SA	• Incentives provide landowners with relief of certain financial and other responsibilities associated with signing conservation stewardship agreements and conserving land. This land contributes to the expansion of the protected areas system, for the public good.	• Facilitated market access for >50% of stewardship sites; • Funding from partner agencies for conservation land management, including alien clearing, fire management and other activities: R1.2 Million per year. This comes

[24] The delivery of incentives is scaled to the level of the conservation agreement (biodiversity agreement or contractual agreement).

Stewardship Fund, WCDA Landcare, Working for/on Water//Fire); • Access to labour for land management (e.g. Expanded Public Works Program) and fire-fighting capacity; • Access to technical advice and assistance with management of conservation area and drafting of a conservation management plan • Property rates exclusion for contract nature reserves.	• Incentive provision affects job creation on contract agreement sites due to work generated by active land management (e.g. invasive alien clearing).	mainly from the WCDA LandCare Project, Working for Water, Working on Fire, WWF-SA. • CapeNature estimated contribution to conservation management (fire management, technical advice and assistance, development of management plans) = R 1.1 Million per year
Greater cost efficiency in achieving the conservation agenda when it is partly owned by private participants (i.e. conservation stewardship provides a higher return on investment compared to land acquisition.	• The national fiscus benefits when there is private interest and opportunity harnessed to achieve national objectives	
4. Political benefits		
Key Benefits	Implications	
*Opportunity to pursue an **innovative and integrative conservation strategy**.*	• Future-orientated positioning of conservation activities; • Platform for better integrating biodiversity conservation and developmental needs • Alignment with government strategies.	
***Partnership** opportunities with landowners and other agencies.*	Opportunities for: • Expansion of protected areas in priority biodiversity areas without land acquisition or expropriation; • Facilitating conservation-related opportunities for land reform beneficiaries; • Influence on sustainable land management practices in the wider landscape and on new reserves; • Win-win beneficiation between government and private interests.	
***Leveraging of co-funding** from donors, other agencies, private landowners.*	• Enhanced sustainability of CapeNature and the Conservation Stewardship Programme; • Increase in effectiveness of conservation interventions.	
Improved recognition of CapeNature's role as land and conservation steward	• Improved sentiments increasing likelihood of obtaining requisite core funding; • Enhanced recognition improves ability of Cape Nature to act as lead institution for Western Cape Conservation Stewardship initiatives.	

5. Appraisal of implementation options

This chapter appraises alternative options for implementing the Conservation Stewardship Programme and details the selection of the stakeholder preferred implementation scenario:

Section 5.1	introduces and briefly discusses the appropriateness of four options for implementing the Conservation Stewardship Programme in the medium term;
Section 5.2	describes the stakeholder-driven process undertaken to define the *consensus-derived preferred* medium-term implementation scenario for the Programme;
Section 5.3	contrasts characteristics of the current Programme and the preferred scenario;
Section 5.4	summarises the preferred implementation scenario.

5.1 Implementation options

Four alternative options are considered below to determine their suitability *for implementing* the Conservation Stewardship Programme in the medium term.

5.1.1. Option 1: 'Unfunded mandate'

The Conservation Stewardship Programme is no longer funded by CapeNature or by external funders, and leads to the iterative phasing out of the programme. The consequences of this option include:

- Willing landowners in the Western Cape wanting to enter into conservation stewardship-type agreements with conservation agencies are limited to SANParks or other NGO initiatives (e.g. Biodiversity and Wine Initiative[25])
- Existing stewardship agreements are not maintained by CapeNature, creating legal conflicts between landowners and CapeNature and/or lapsed agreements

This option would however result in CapeNature not realizing its publicly stated goals and objectives, and will compromise a number of government's legal and policy commitments outlined in Section 3.

5.1.2. Option 2: 'Business as Usual'

The Conservation Stewardship Programme continues to be funded internally at current levels while external funding falls away over time. The consequences of this option include:

- No further stewardship agreements are negotiated
- Utilitarian maintenance of existing stewardship agreements
- Loss of skilled staff.
- A number of areas of high conservation value remain un-conserved

[25] The Biodiversity and Wine Initiative is a joint project between the South African wine industry and the Botanical Society of South Africa, a non-governmental organisation (NGO). See www.bwi.org for more information.

Only very limited objectives are achieved by the programme. The growth of the Conservation Stewardship Programme is severely constrained and opportunities for expansion and growth are not realized. Option 2 is not desirable as the programme will rapidly stagnate, fail to maintain momentum and lose skilled competent staff.

5.1.3. Option 3: 'Cooperative governance'

The Conservation Stewardship Programme retains its 'institutional home' in CapeNature but the Programme's coordination and implementation are restructured to become the shared responsibility of CapeNature in partnership with one or several independent entities (e.g. conservation NGOs). The Programme's activities are then managed according to a set of collaboratively agreed criteria and procedures that align with each institutions overarching objectives and strategies, and are governed by an official Memorandum of Understanding (MOU) between the partners.

This is a potentially viable option and is currently being explored as a mechanism for implementing a conservation stewardship strategy in the Northern Cape, under the Department of Tourism, Environment and Conservation (DTEC)[26]. Cooperatively governed programmes in South Africa however typically enjoy short-term success, but are often unable to sustain momentum without external funding support. The lessons learnt from the pilot project in the Northern Cape should however guide future considerations for restructuring conservation stewardship in the Western Cape, but any decisions now on adopting this option may be premature.

5.1.4. Option 4: 'Focused and adequate resources'

An adequately resourced Conservation Stewardship Programme is a core programme in CapeNature and pursues an effective, integrated conservation strategy aimed at conserving areas of high conservation significance.

5.2 Defining the characteristics of the preferred implementation option

A stakeholder driven process was used to select the preferred implementation option.

A one-day work session was organised with key stakeholders in the CapeNature Conservation Stewardship Programme (Appendix 3: work session attendance register) to describe the characteristics of the preferred option.

The ***objective*** of the work session was to "select a preferred implementation option for CapeNature's conservation stewardship programme by collectively agreeing on the desired characteristics (functionally grouped into strategic focus, spatial focus, targeted outcomes, governance arrangements, implementation arrangements, staffing requirements and financial requirements) for the programme over the medium-term."

[26] DTEC, 2008. Biodiversity Stewardship Programme Northern Cape: 5-year strategy and 3-year action programme.

The anticipated ***outcome*** was a consensus-based preferred 3-year implementation option (linked to the MTEF cycle for the Conservation Stewardship Programme).
The work session was broadly ***structured*** as follows:

- Following an introduction to the plenary, two separate groups of participants evaluated options for each characteristic relating to the focus areas of s*trategy, spatial focus*, *institutional arrangements* and *resourcing* of the Conservation Stewardship Programme.

- The preferred characteristics selected by each group were presented and discussed in the plenary to find agreement on the preferred implementation option.

Certain aspects relating to the specific operational arrangements (e.g. performance targets and reporting arrangements) were not discussed in detail at the work session but were discussed with conservation stewardship staff after the work session. These are then documented in the i*mplementation plan* associated with this business case.

5.3 Outcomes: current and preferred state of the Programme

Key characteristics describing and contrasting the current Conservation Stewardship Programme and the preferred medium-term implementation option are reflected in Table 6.

Table 6. Characteristics (grouped by functional focus areas) of the current Conservation Stewardship Programme and defined for the preferred implementation option.

FOCUS AREA	CHARACTERISTICS	Current state of the Programme ('Business as usual' option)	Preferred IMPLEMENTATION OPTION for the Programme
1. STRATEGY			
Overall focus	*The Programme's focus is on securing formal conservation agreements in biodiversity priority areas.*	YES	YES Conservation stewardship is construed as a complementary, cost-effective mechanism to achieve provincial biodiversity conservation targets.
	The Programme pursues other land stewardship activities, including extension and outreach services to landowners.	PARTIALLY Distinction between conservation and land stewardship not always clear in Programme activities	NO The Programme is limited to negotiating and maintaining stewardship agreements.
Types of conservation stewardship agreements	*Voluntary conservation areas are negotiated.*	YES Voluntary conservation areas are however less actively pursued than contractual agreements. It remains unclear how Conservancies and Private Nature Reserves (PNR) are addressed.	YES Voluntary conservation areas are actively pursued. The conservation value of existing Conservancies and Private Nature Reserves are reviewed, incorporated into the relevant stewardship category where feasible, and actively maintained.
	Biodiversity agreements are negotiated.	YES It remains unclear how Protected Environments are addressed.	YES Protected Environments are incorporated into this type of stewardship agreement.
	Contract agreements are negotiated.	YES These are preferentially pursued.	YES These are preferentially pursued.
Negotiation of new conservation	*New conservation stewardship agreements are negotiated.*	YES The Programme will however limit the number of new stewardship agreements due to the limited	YES The Programme will source additional resources to ensure the negotiation of new stewardship agreements.

stewardship agreements		capacity to maintain agreements.	Opportunities for new agreements are sourced via the Programme's *proactive* approach. *Alternatively*, opportunities for biodiversity agreements and contracts may arise due to *reactive land use decision-making processes*. This is the case when a landowner/developer located in a conservation stewardship priority area (see 2. Spatial focus) is required to apply conservation stewardship mechanisms in mitigation of proposed development.
1. STRATEGY (ctnd.)			
Maintenance of concluded stewardship agreements	*Voluntary conservation areas are maintained.*	PARTIALLY Limited resources for maintenance.	YES Staff and resources are allocated.
	Biodiversity agreements are maintained.	PARTIALLY Limited resources for maintenance.	YES Staff and resources are allocated to ensure the maintenance of existing, concluded biodiversity agreements.
	Contract agreements are maintained	YES Staff and resources allocated.	YES Staff and resources are allocated to ensure the maintenance of existing, concluded biodiversity agreements.[27]
Extension	*General extension and outreach services are provided to landowners, and land residents, generally.*	PARTIALLY Limited resources are available for extension and outreach.	NO Although broad-based extension and outreach remains a function of the Business Unit, *it is not a core function of the Conservation Stewardship Programme.* The Programme will focus on providing ongoing information and support to landowners within the Stewardship Programme.
Landowner focus	*Land under private tenure is considered*	YES If land in biodiversity priority area.	YES If the land is in a biodiversity priority area.
	Land under State tenure is considered	PARTIALLY The focus is however still on private landowners.	YES If the land is in a biodiversity priority area.

[27] Effort in implementing maintenance measures is not necessarily equal for all 3 levels of conservation stewardship agreements.

	Land under communal tenure, or land owned by beneficiaries of land reform processes, is considered	PARTIALLY The focus is however still on private landowners.	YES If the land is in a biodiversity priority area.
Decision-making	*Adaptive management approach underpins the Programme implementation.*	PARTIAL Decision-making is well founded on lessons learnt in implementation. Programme lacks strategic framework to contextualise the adaptive management approach.	YES The Programme decision-making is framed by a strategic operating framework (the 'Implementation Plan')
		2. SPATIAL FOCUS	
Spatial focus	*Negotiation, and maintenance, of stewardship agreements occurs within a clearly defined spatial area.*	PARTIALLY There remain some inconsistencies in the spatial priorities for the Programme. Biodiversity priority areas have not yet been objectively identified. Spatial targets are weak.	YES The *spatial focus* of the Conservation Stewardship Programme is defined by s*ubsets* of *Critical Biodiversity Areas* identified in a province-wide layer of biodiversity priority areas, based on current conservation assessments. A commonly agreed long-term (20-year) and medium-term (3-year) spatial map of biodiversity priority areas then determine the spatial focus for the Programme. The negotiation of new agreements, whether sourced pro-actively or via reactive land use decision-making processes (see 1. Strategy), is confined to the spatial focus areas. Clear spatial targets are developed and monitored.
Spatial focus	*Ad-hoc conservation stewardship opportunities are developed outside of spatial focus areas*	NO	PARTIALLY Stewardship agreements outside of priority areas are considered ONLY *if additional resources have been secured* and/or if the opportunity constitutes a significant strategic benefit to the Programme or CapeNature.
		3. INSTITUTIONAL ARRANGEMENTS	
External	*CapeNature is the coordinating agency for conservation stewardship activities in the Western Cape.*	NO C.A.P.E. continues to fulfill the overarching coordinating role	YES CapeNature coordinates conservation stewardship activities in the Province, through the Provincial Stewardship Task Team.

	Linkages and alignments with complementary programmes in other agencies are strong.	PARTIALLY Linkages and alignments tend to be effectively implemented at the local levels, but are not always supported at the institutional levels.	YES The Provincial Stewardship Task Team plays an active role in facilitating close cooperation and collaboration.
Internal	*Conservation stewardship is a core strategy within CapeNature.*	YES Inadequate institutional resourcing of Programme. Strong dependence on external donor agency funding.	YES Adequate institutional resourcing of Programme, supplemented by donor agency (and other sources) funding.
	Coordination and cooperation across CapeNature programmes and Business Units is effective	PARTIALLY Stewardship Programme, other CapeNature programmes and the Business Unit activities not always effectively aligned.	YES Institutional restructuring and proper resourcing of the Stewardship Programme, provides an enabling environment for more effective cooperation and collaboration within CapeNature. This will support, for example, the collaboration between the Stewardship Programme and CapeNature's Land Use Unit, through which opportunities for negotiating new conservation agreements may arise due to the reactive land use decision-making process.
4. ORGANISATIONAL STRUCTURE			
Organizational structure	*Dedicated (full-time) staff implements conservation Stewardship Programme activities*	PARTIALLY Most staff are part-time, or are funded by external donor agencies.	YES Number of staff is increased, staff are permanent appointments and >80% of their time is dedicated to conservation stewardship.
	Negotiation and maintenance functions are conducted by separate individuals.	PARTIALLY In many instances, the same person may do both negotiation and maintenance functions.	YES Specialist skills are sourced for each discrete function. Dedicated Stewardship Negotiators are incorporated into the Conservation Stewardship Programme, while Stewardship Facilitators are incorporated into the relevant Business Units.
	Outsourced service provision for extension and maintenance services (e.g. alien clearing, creation of fire breaks)	YES This is however currently limited.	YES Many programme activities may be outsourced

5. RESOURCING			
Staff complement	*Staffing is adequate to implement an effective Programme.*	PARTIALLY Staffing numbers are limited.	YES: *Minimum staffing requirements*: 1 Programme Manager 1 Assistant Programme Manager 1 Programme Administrator 8 Stewardship Negotiators 16 Stewardship Facilitators 1 Legal Adviser.

5.4 Summary of the characteristics of the preferred implementation option

The following key characteristics then describe the preferred medium-term implementation option for the Conservation Stewardship Programme.

1. Strategic focus: conservation stewardship and biodiversity conservation outcomes

The Programme's primary focus is on securing conservation stewardship agreements for protecting biodiversity. Land under any form of tenure (private, communal and State) can be considered.

2. Spatial focus: biodiversity priority areas

The spatial focus of the Programme activities is limited to priority areas identified for biodiversity conservation. The Programme then responds to opportunities for new conservation stewardship agreements that arise (i) through the Programme's proactive interventions or (ii) due to reactive land use decision-making procedures, provided that the land in question falls within the spatial priority areas identified for the Programme.
Opportunities outside of spatial focus areas are only responded to if resources have specifically been secured for the purpose and/or if there is a significant strategic benefit for CapeNature.

3. Responsiveness to landowner needs and concerns

The Programme is driven by landowner willingness. The attitudes, concerns and needs of landowners and residents of targeted properties are considered by the Programme and every attempt is made to accommodate the requirements in engagements with willing landowners.

4. Importance of conservation tenure

The highest legal status for conservation stewardship agreements (contract agreements) is pursued by the Programme in order to obtain the most secure level of conservation commitment by landowners.

5. Maintenance of agreements and ongoing support

The Programme honours its ongoing commitments to landowners with concluded conservation stewardship agreements. This entails active, regular maintenance of agreements, including the provision of assistance, support and relevant technical information to landowners.

6. Programme structure, staff and resourcing

Full-time, permanent staff is employed to implement the Programme. Negotiation staff report directly to the Programme management team while Facilitation staff report directly to the Business Unit Managers. The Programme ensures sufficient resourcing to implement the programme activities and realise realistic and pragmatic performance targets. The Programme provides a desirable work environment for its staff, including career development opportunities and training support.

7. Cooperation and partnerships with other conservation initiatives

The Programme plays a leading coordinating role in conservation stewardship initiatives in the Western Cape through the Provincial Stewardship Task Team. The Programme actively seeks opportunities for aligning its activities with those of partner CapeNature programmes, public institutions and organisations in order to link land under conservation stewardship agreements with broader landscape-wide conservation initiatives.

6 Risks

A number of risks associated with either adopting or not supporting the Conservation Stewardship Programme in CapeNature. These are outlined in two sections below:

Section 6.1 presents *risks* involved in implementing the preferred option and *adequately resourcing* the Programme; and

Section 6.2 presents *risks* associated with *not adequately resourcing* the Programme.

6.1 Risks associated with adequately resourcing the Programme

Risks associated with and *adequately resourcing* and *implementing the preferred option* (Section 5: Option 4, recommended option) for the Conservation Stewardship Programme are listed below, along with possible mitigation measures.

Table 7 Risks and mitigation measures for *adequately resourcing and implementing* the recommended option for the Conservation Stewardship Programme (***Option 4***)

Risks	**Mitigation measures**
1. CapeNature's other programmes are under-funded.	• Rationalise and eliminate programmes to concentrate available budgets; • Align activities of different programmes spatially and strategically; • Closely match resource levels with commitments in implementation plans across all programmes.
2. Inefficient use of resources and capacity by the Conservation Stewardship Programme.	Conduct regular monitoring of Programme in accordance with medium-term implementation plan to ensure adherence to activities, targets and costs set out in the plan.
3. Slow finalisation of stewardship agreements limits Programme's achievements.	• Base working arrangements on formal agreements (e.g. with DEA&DP- signing stewardship agreements) • Maintain regular communication with landowner about status of agreement
4. Failure of landowners to adopt or maintain conservation stewardship commitments limits Programme's achievements.	• Maintain clear and consistent communication with landowners to determine attitudes and needs; • Contributes to development of additional incentives; • Anticipate, and plan for conflict mediation between CapeNature and affected landowners
5. Limited availability of appropriately skilled staff limits the Programme's activities.	• Promote staff training in CapeNature; • Structure posts to facilitate sourcing of specialist skills (e.g. contract positions for negotiators)

6.2 Risks associated with not supporting the Programme

CapeNature and other decision-makers may decide not to resource and support the Conservation Stewardship Programme (Section 5: Option 1: No Conservation Stewardship Programme in the Western Cape). Risks associated with this option and mitigation measures are listed below.

Table 8 Risks and mitigation measures related to *not resourcing* and implementing the Conservation Stewardship Programme in CapeNature (***Option 1***).

Risks	**Mitigation**
1. Biodiversity loss continues unabated outside of the protected areas network. Irreversible loss occurs in ecosystems nearing ecological thresholds and in essential landscape linkages.	• SANParks and LandCare expand mandates to include conservation stewardship; • NGOs take over conservation stewardship functions.
2. Key goals and objectives of CapeNature and the government not fulfilled. Benefits of conservation stewardship and opportunities for strategic alignment not realised by CapeNature.	• CapeNature finds alternative mechanisms for meeting goals; • CapeNature integrates conservation stewardship into protected areas management function as means for protected areas expansion strategy.
3. Partnership agreements (formal and informal) not met.	• CapeNature communicates clearly with partners; and • Partnership transfer to SANParks/LandCare/NGOs
4. Little or no assistance from CapeNature to landowners wanting to participate in conservation	Referral to alternative conservation stewardship initiatives.
5. Landowners committed to contract agreements receive inadequate support and are discouraged from further conservation efforts.	• Renegotiation with landowners; and • Possible transfer to alternative conservation stewardship initiatives.
6. CapeNature's image as good conservation stewards of the CFR's rich biodiversity damaged.	CapeNature maintains honest communication and concentrates on achievements in other programmes to demonstrate commitment to biodiversity conservation.
7. CapeNature loses opportunity of leading an innovative, integrative and cost-effective conservation strategy.	CapeNature focuses on opportunities offered by its other conservation programmes.

7 Conclusions and Recommendations

7.1 Conclusions

The business case demonstrates that the Conservation Stewardship Programme is an important investment for CapeNature and the Western Cape government:

- The Programme fills the need for a comprehensive conservation strategy in CapeNature that integrates *off-reserve and on-reserve conservation* of biodiversity. This assists CapeNature and the Western Cape government in fulfilling their mandate.
- The Programme provides a *cost-effective conservation mechanism* for expanding the protected areas system in the Western Cape through leveraging the voluntary investment of landowners.
- The Programme targets priority areas for biodiversity conservation. This contributes to national targets for protecting threatened ecosystems; to maintaining the diversity and integrity of natural systems and landscapes; and to the provision of vital ecosystem goods and services.
- The Programme provides social, political, economic and environmental benefits.
- The Programme is currently already well-developed in CapeNature. Growth will be based on sound foundations.
- The Programme is closely aligned with CapeNature's goals and objectives. It contributes to key government strategies aimed at biodiversity conservation and sustainable development.

7.2 Recommendations

The following recommendations are made to support CapeNature in implementing a successful Conservation Stewardship Programme in the medium term:

1. Ensure the adoption of the Conservation Stewardship Programme's business case and implementation plan by the CapeNature Executive Committee and the Board, with an assurance of concomitant allocation of funds in the preceding financial year (2009/10).
2. Restructure and staff the Programme as indicated in the implementation plan.
3. Develop a detailed financing plan for the Programme that reflects and allocates co-financing sources.
4. Ensure the ongoing spatial and strategic alignment of programme activities with partner programmes within CapeNature.
5. Formalise partnerships with partner programmes external to CapeNature and DEA&DP.
6. Support the functioning of the Provincial Conservation Stewardship Task Team.
6. Contribute to development of additional, tangible benefits provided by the Programme, particularly incentives to landowners.
7. Complete a detailed, spatially explicit, protected areas expansion strategy for the Western Cape in line with the NPAES.
9. Ensure the ongoing monitoring and review of the programme and, based on the review outcomes, adapt and refine the implementation plan and associated annual plans of operation.

8 References

Ashwell, A., Sandwith, T., Barnett, M., Parker, A. & Wisani, F. 2006. *Fynbos Fynmense: People Making Biodiversity Work*. Sanbi Biodiversity Series 4. South African National Biodiversity Institute, Pretoria.

Biggs, R., E. Bohensky, C. Fabricius, T. Lynam, A. Misselhorn, C. Musvoto, M. Mutale, B. Reyers, R. J. Scholes, S. Shikongo, and A.S. van Jaarsveld. 2004. *Nature supporting people: the Southern African Millennium Ecosystem Assessment*. Council for Scientific and Industrial Research (CSIR), Pretoria.

CapeNature 2007. *The Stewardship Operational Procedures Manual*.

CBD. 2004. *Convention of Biological Diversity*. http://www.cbd.int

Cowling, R.M., Pressey, R.L., Rouget, M. and Lombard, A.T. 2003. *A conservation plan for a global biodiversity hotspot - the Cape Floristic Region*, South Africa. Biological Conservation 112: 191-216.

De Wit, M.P. 2006. *The value of biodiversity to the South African economy. A preliminary study. Report prepared for South African National Biodiversity Institute as part of the project "Development of the SANBI Business Case"* by the Cooperative of Independent Consultants (CIC). De Wit Sustainable Options (Pty) Ltd Report No. SO 6001.

Department of Environmental Affairs and Tourism (DEAT), 2003. *South African Country Study on Climate Change* Synthesis Report for the Vulnerability and Adaptation Assessment Section.

DEAT. 2005. *South Africa's National Biodiversity Strategy and Action Plan*. Department of Environmental Affairs and Tourism, Pretoria.

DEA&DP. 2007. *A climate change strategy and action plan for the Western Cape*. Report prepared for the DEA&DP by OneWorld Sustainable Investments.

DTEC. 2008. *Biodiversity Stewardship Programme Northern Cape: 5-year strategy & 3-year programme of action*. Draft report prepared by Corcoran, B. and McCann, K.

Driver, A, Maze, K, Rouget, M, Lombard, AT, Nel, J, Turpie, JK, Cowling, RM, Desmet, P, Goodman, P, Harris, J, Jonas, Z, Reyers, B, Sink, K & Strauss, T. (2005). *National Spatial Biodiversity Assessment 2004: Priorities for Biodiversity Conservation in South Africa*. Strelitzia 17. South African National Biodiversity Institute. Pretoria.

Frazee, S.R., Cowling, R.M., Pressey, R.L., Turpie, J.K. and Lindenberg, N. 2003. *Estimating the costs of conserving a biodiversity hotspot: a case-study of the Cape Floristic Region, South Africa*. Biological Conservation 112: 275-90.

Heal, G. 2000. *Valuing ecosystem services*. Ecosystems 3:24–30

Jackelman, J. and Ferreira, D. 2007. *Conservation Stewardship: A rapid appraisal of C.A.P.E. partner activities*.

Michael, J.A. 2003. *Efficient habitat protection with diverse landowners and fragmented landscapes*. Environmental Science and Policy 6: 243-251.

Midgley, G.F., Chapman, R.A., Hewitson, B., Johnston, P., de Wit, M., Ziervogel, G., Mukheibir, P., van Niekerk, L., Tadross, M., van Wilgen, B.W., Kgope, B., Morant, P.D., Theron, A., Scholes, R.J., Forsyth, G.G. 2005. *A Status Quo, Vulnerability and Adaptation Assessment of the Physical and Socio-economic Effects of Climate Change in the Western Cape*. Report to the Western Cape Government, Cape Town, South Africa. CSIR Report No. ENV-S-C 2005-073, Stellenbosch.

The Millennium Ecosystem Assessment, 2005. *Ecosystems and Human Well-being: Biodiversity Synthesis*. World Resources Institute, Washington, DC. gives a detailed global analysis of the importance of biodiversity and ecosystem services for humans.

The Nature Conservation Corporation. 2008. *Biodiversity value & management effectivity assessment of priority voluntary conservation sites, Western Cape*. Report prepared for the Western Cape Conservation Stewardship Association and CapeNature.

Provincial Government of the Western Cape (PGWC). 2007. *Medium Term Budget Policy Statement (MTBPS) 2008 – 2011*.

Provincial Government of the Western Cape (PGWC). 2007.*Provincial Economic Review & Outlook 2007*.

Pence, G., Botha, M., Turpie, J.K., 2003. *Evaluating combinations of on-and 'off-reserve' conservation strategies for the Agulhas Plain, South Africa: a financial perspective*. Biological Conservation 112: 253–273.

SANBI & DEAT. 2008. *National Protected Areas Expansion Strategy 2008 – 2012: A Framework for Implementation*. Report prepared for South African National Biodiversity Institute (SANBI) and the Department of Environmental Affairs and Tourism (DEAT). Pretoria.

Worrell, R. and Appleby, M.C. 2000. *Stewardship of natural resources: Definition, Ethical and practical aspects*. Journal of Agricultural and Environmental Ethics 12: 263–277.

WWF Germany. 2007. *Sustainable Investments for Conservation: The Business Case for Biodiversity.* Prepared by PriceWaterhouseCoopers on behalf of WWF Germany.

Designing Systematic Conservation Assessments that Promote Effective Implementation: Best Practice from South Africa

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Abstract: *Systematic conservation assessment and conservation planning are two distinct fields of conservation science often confused as one and the same. Systematic conservation assessment is the technical, often computer-based, identification of priority areas for conservation. Conservation planning is composed of a systematic conservation assessment coupled with processes for development of an implementation strategy and stakeholder collaboration. The peer-reviewed conservation biology literature abounds with studies analyzing the performance of assessments (e.g., area selection techniques). This information alone, however, can never deliver effective conservation action; it informs conservation planning. Examples of how to translate systematic assessment outputs into knowledge and then use them for "doing" conservation are rare. South Africa has received generous international and domestic funding for regional conservation planning since the mid-1990s. We reviewed eight South African conservation planning processes and identified key ingredients of best practice for undertaking systematic conservation assessments in a way that facilitates implementing conservation action. These key ingredients include the design of conservation planning processes, skills for conservation assessment teams, collaboration with stakeholders, and interpretation and mainstreaming of products (e.g., maps) for stakeholders. Social learning institutions are critical to the successful operationalization of assessments within broader conservation planning processes and should include not only conservation planners but also diverse interest groups, including rural landowners, politicians, and government employees.*

Keywords: adaptive improvement, conservation-area selection, conservation planning, operational model, social learning institutions

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Paper submitted May 27, 2005; revised manuscript accepted November 22, 2005.

Conservation Biology Volume **, No. *, ***–***

DOI: 10.1111/j.1523-1739.2006.00452.x

Diseño de Evaluaciones Sistemáticas de la Conservación que Promueven la Implementación Efectiva: La Mejor Práctica en África del Sur

Resumen: *La evaluación sistemática de la conservación y la planificación de la conservación son dos campos distintos de la ciencia de la conservación que a menudo son confundidos como uno y lo mismo. La evaluación sistemática de la conservación es la identificación técnica, a menudo computarizada, de áreas de prioridad para la conservación. La planificación de la conservación esta compuesta por una evaluación sistemática de la conservación aunada a procesos para el desarrollo de una estrategia de implementación y colaboración de grupos de interés. En la literatura de biología de la conservación revisada por pares abundan los estudios que analizan el rendimiento de las evaluaciones (e. g., técnicas de selección de áreas). Sin embargo, esta información por si sola no puede derivar en acciones de conservación efectivas; informa a la planificación de la conservación. Son raros los ejemplos de cómo traducir los resultados de evaluaciones sistemáticas en conocimiento y luego utilizarlo para "hacer" conservación. África del Sur ha recibido generoso financiamiento internacional y doméstico para la planificación de la conservación regional desde mediados de la década de 1990. Revisamos ocho procesos de planificación sudafricana e identificamos los ingredientes clave de la mejor práctica para emprender evaluaciones sistemáticas de la conservación de manera que facilite la implementación de acciones de conservación. Estos ingredientes clave incluyen el diseño de procesos de planificación de la conservación, habilidades para los equipos de evaluación, colaboración con grupos de interés e interpretación e integración de productos (e. g., mapas) para grupos de interés. Las instituciones de aprendizaje social son críticas para la operatividad exitosa de las evaluaciones en el contexto de procesos de planificación más amplios y deben incluir no solo planificadores de la conservación sino a diversos grupos de interés, incluyendo a propietarios rurales, políticos y empleados gubernamentales.*

Palabras Clave: instituciones de aprendizaje social, mejoramiento adaptativo, modelo operacional, planificación de la conservación, selección de áreas de conservación

Introduction

Systematic conservation assessments are technical activities that identify the location and configuration of priority areas for conservation action. The techniques for conducting assessments have advanced rapidly since the 1980s. Major impetus has derived from concern about unprecedented environmental decline (Lawton & May 1995), development of iterative algorithms (Kirkpatrick 1983), and rapid advances in computer technology. Systematic conservation assessments (hereafter "assessments") alone, however, do not deliver the actions necessary to conserve nature, they merely generate data to support the planning and implementation of conservation interventions (Cowling et al. 2004). Documented understanding of assessment techniques is comprehensive. Between 1980 and 2000 at least 245 published studies employed reserve selection algorithms (Pressey 2002). The fascination of many conservation planners with the incremental improvement of assessment techniques has drawn focus away from their real goal—directing conservation actions—because relatively few assessments published in the peer-reviewed literature actually lead to nature conservation (Prendergast et al. 1999; Knight et al. 2006).

In attempting to address this "implementation crisis" (Knight & Cowling 2003), it is essential to distinguish between conservation assessment and conservation planning. Conservation assessment involves identifying spatial priorities for conservation action (i.e., area selection). When complemented with the development of an implementation strategy, in the context of stakeholder collaboration (i.e., the involvement of agencies that will take implementation of the plan forward), these activities constitute conservation planning (Fig. 1).

Assessment is often conflated with conservation planning, with no attention paid to implementation strategy development or stakeholder collaboration. In such cases it is no surprise that conservation activities at the priority areas identified by an assessment are not implemented. Compared with assessments, our documented understanding of how to effectively undertake planning processes is poor. Techniques for normative activities such as developing stakeholder collaboration, integrating expert and systematic approaches, designing and mainstreaming planning products, and collaboratively developing implementation strategies are rarely documented in the peer-reviewed conservation biology literature, yet are fundamental to effective planning processes. This lack of documented experience seriously hinders the advancement of conservation planning theory and practice. A culture of presenting case studies (a powerful tool in the social sciences) has yet to evolve in conservation biology but will be essential for distilling best practice. Documenting experiences and distilling key ingredients of best practice should help assessments focus on the development of implementation strategies and encourage academic involvement in planning processes. Case studies from planning processes (e.g., Pressey 1998; Davis et al. 1999; Clark & Slusher 2000) clearly demonstrate the value of documenting experiences of undertaking assessments.

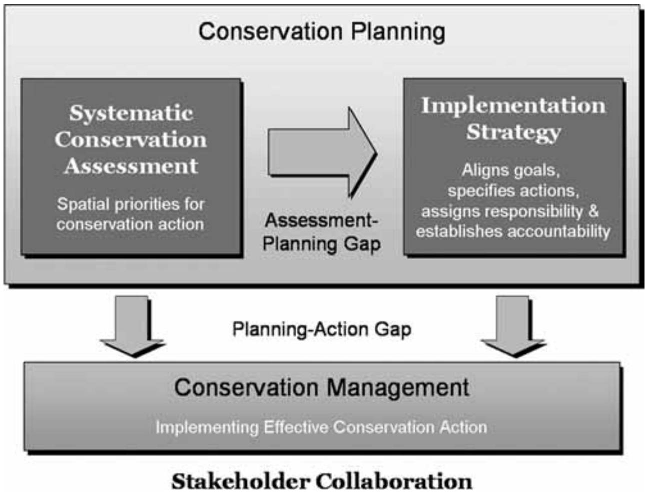

*Figure 1. A systematic conservation assessment is only one component of a conservation planning process and should be complemented with a process for developing an implementation strategy in the context of stakeholder collaboration. The "knowing-doing gaps" (Pfeffer & Sutton 1999), comprising the assessment-planning gap and the planning action gap, are real obstacles to the effective implementation of outputs from the assessment. Adapted from Driver et al. (2003*a*).*

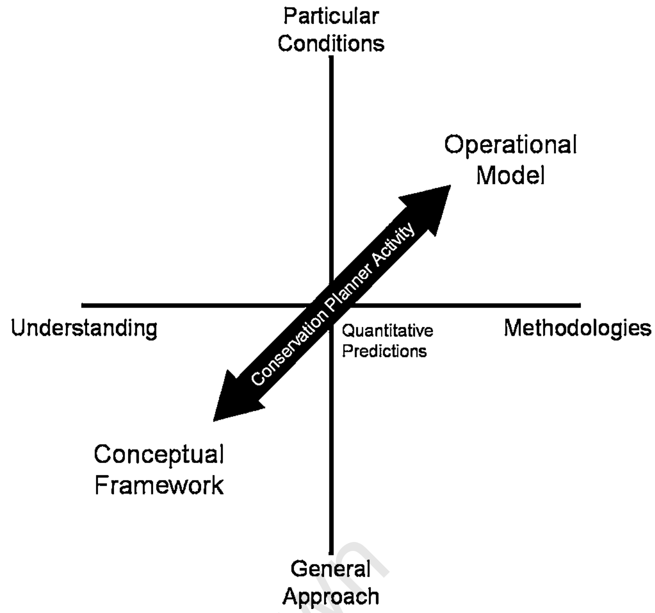

Figure 2. An effective conservation planner moves between a conceptual framework that aims to provide a general understanding of social-ecological systems and the role and approach of conservation planning processes and an operational model that aims to provide methodologies on how to "do" conservation assessments and planning processes for particular contexts at specific scales. This action research approach better ensures a conservation planner is effective at translating conservation assessments into conservation action because theory regularly informs practice and practice regularly informs theory. Adapted from Lawton (1996).

Conservation planners' focus on assessment has meant there are few well-established principles of planning practice. Although prescriptive approaches are best avoided in conservation biology because they stifle innovation (Meffe et al. 1997), generic elements of an idealized planning process are required for formulating operational models. An operational model is a simplified conceptualization of a process for implementing conservation action at priority conservation areas (e.g., Margules & Pressey 2000; Poiani et al. 2000; Groves et al. 2002; Knight et al. 2006). They guide and assist understanding of how these processes function (Knight et al. 2006), embody best practice, and provide an entity that can be adapted as techniques and approaches improve. The current absence of emphasis in the peer-reviewed literature on development of operational models is a concern.

Operational models should be complemented with a conceptual framework to facilitate adaptive learning (Fig. 2). A conceptual framework is a cognitive tool that helps people conceptualize and think about planning phenomena by providing context for their actions and from which operational models can be developed and improved. Effective conservation planners move continuously between their conceptual framework and application of their operational model, constantly refining each from advances provided by the other (Fig. 2).

Documenting experiences and distilling lessons promote the development of best practice by maximizing the benefit of individuals' experiences of formulating and testing operational models (e.g., Driver et al. 2003*a*; Noss 2003; Knight et al. 2006) and by facilitating transdisciplinary knowledge sharing and critique. It also provides a process for building the strong partnerships required to foster social learning within and between groups of planners. These groups benefit from the development of a "safe-fail culture" (Redford & Taber 2000; Knight 2006), the strengths of collective decision-making (Hill 1982), and enhanced intra- and interinstitutional social capital (Pretty & Ward 2001). In turn, the transaction costs of knowledge sharing are reduced (North 1990).

Recognizing the importance of knowledge exchange between the conceptual and operational aspects of planning processes, the Botanical Society of South Africa's Conservation Unit hosted a 3-day workshop to capture our experiences, focusing on assessment and bridging the gap between planning and implementation. The experiences of 16 conservation planners involved in eight South African planning processes (Table 1) were distilled as key

Table 1. South African systematic conservation planning processes from which workers contributed experiences and lessons for the synthesis of the key ingredients* of effective systematic conservation assessments.

Process	*Planning region*	*Scale*	*Focus*	*Status*	*Conservation assessment references*
C.A.P.E. Cape Action Plan for the Environment	Cape Floristic Region	1:250,000	biome-wide priority setting	assessment and strategy completed 2000; formed basis for C.A.P.E. implementation program	Cowling et al. 1999*b*, 2003*b*
S.K.E.P. Succulent Karoo Ecosystem Plan	Succulent Karoo Biome	1:250,000	biome-wide priority setting	assessment and strategy completed 2002; formed basis for the SKEP	Cowling & Lombard 1998; Driver et al. 2003*b*
S.T.E.P. Subtropical Thicket Ecosystem Planning Project	Subtropical Thicket Biome	1:250,000	biome-wide priority setting	assessment and strategy completed 2003; sets direction for Fish River Biodiversity Initiative	Cowling et al. 2003*a*; Knight & Cowling 2003; Pierce 2003; Pierce et al. 2005; Rouget et al. 2006; Knight et al. 2006
KwaZulu-Natal provincial conservation plan	KwaZulu-Natal Province	1:50,000	province-wide priority setting	assessment and strategy completed 2002; adopted by provincial conservation agency	Goodman 2000
Cape Lowlands Renosterveld conservation plan	Cape Flats occupied by critically endangered renosterveld vegetation	1:50,000	fine-scale priority setting; priority subregion identified in C.A.P.E.	assessment and strategy completed 2003; adopted by provincial conservation agency	von Hase et al. 2003
Greater Addo Elephant National Park conservation plan	area surrounding and including the Greater Addo Elephant National Park	1:50,000	planning for protected area expansion	assessment and strategy completed 2002; adopted by South African National Parks	Nel et al. 2002
N.M.M.O.S.S. Nelson Mandela Metropolitan Open Space System	City of Port Elizabeth and surrounding area	1:10,000	fine-scale priority setting to inform development of an urban open space system	assessment and strategy completed 2002; adopted directly by Nelson Mandela Metropolitan Municipality	Stewart et al. 2003
Agulhas Plain conservation plan	Agulhas Plain	1:10 000	fine-scale priority setting; priority subregion identified in C.A.P.E.	initial assessment and strategy completed 2000, subsequently extended through the Agulhas Biodiversity Initiative	Cole et al. 2000

**Key ingredients: (1) a systematic assessment, (2) identification of stakeholders and goals of the process, (3) assessments conducted at different scales, (4) attention to assessment design, (5) assessment teams that include implementing organizations, (6) focused collaboration to address stakeholders' needs, and (7) interpretation of assessment outputs and mainstreaming products.*

ingredients of best practice for designing and implementing assessments. Greater detail is provided in Driver et al. (2003*a*) and was presented at the World Parks Congress in Durban in 2003 (by A.D.). We set our experience in a broader conservation planning context (e.g., Knight et al. 2006), highlighting the importance of social learning institutions for facilitating the rapid advancement of conservation planning theory and practice. Social learning institutions are the processes and structures used for facilitating a continuous dialog and deliberation among scientists, planners, managers, and natural resource users to explore problems and their solutions (Maarleveld & Dangbégnon 1999).

South Africa is a conservation planning hotspot. The combination of a strong research sector, capable implementing institutions, major development needs, and globally significant nature have secured generous international funding, with more than 30 conservation planning processes undertaken since the 1970s (Rouget & Egoh 2003). This abundance of planning processes, their sequential timing that promoted the "rollover" of staff so later processes benefited from the experiences of earlier ones, and the injection of international expertise have stimulated the development of an "invisible college" of conservation planners. Strong relationships have been forged between conservation planners from diverse organizations, promoting the rapid advancement of conservation planning theory and practice in South Africa since the mid-1990s.

Toward Best Practice: Key Ingredients of an Operational Model

An assessment is worth little if it fails to deliver local-scale conservation action. We recommend that assessments be embedded within a broader operational model (Fig. 1) that is focused on and lays the basis for implementing planning outcomes. This is achieved, in large part, by involving implementing organizations and stakeholders in the process, thereby offering an explicit pathway for bridging the assessment-planning gap and the planning-action gap, forms of the "knowing-doing gap" (Pfeffer & Sutton 1999) that are very real obstacles to translating information (e.g., a map of priority areas) into conservation action on the ground (e.g., private land conservation agreements). There is no recipe for establishing an operational model, but there are some key ingredients. We have identified seven that underpin an approach we call *planning for implementation* (Knight et al. 2006): (1) a systematic assessment, (2) identification of stakeholders and goals of the process, (3) assessments conducted at different scales, (4) attention to assessment design, (5) assessment teams that include implementing organizations, (6) focused collaboration to address stakeholders' needs, and (7) interpretation of assessment outputs and mainstreaming products.

Systematic Assessment

CONDUCT A SIMPLE ASSESSMENT EVEN IF DATA ARE LIMITED

An assessment is a potentially powerful tool for conservation action and provides a scientifically sound, and therefore defensible, basis for land-use decision making. In regions with high conservation values and extensive, rapidly encroaching land-use pressures, however, spending years generating vast data sets for sophisticated assessments does little to further conservation efforts. Rapid assessments based on key data layers are more effective strategically at preserving landscapes and allow timely motivations of decision makers for the retention of priority areas. A simple assessment is better than none. Assessments can, and should, be revised as new data or implementation occurs. Scientists, who often chase quantifiable certainty, struggle to accept this lesson, especially when the questions are complex and the answers uncertain. Rapid assessments require team members with experience from previous processes, which allows teams to work within tighter timeframes and to simplify the assessment without making it simplistic.

PURSUE GOALS OF REPRESENTATION AND PERSISTENCE

The effectiveness of any assessment depends on the principles on which it is based (Noss 2003). Two principles are of particular importance: representation and persistence (Cowling et al. 1999*a*). Representation is, perhaps, the most widely advocated principle and ensures that typical examples of the full spectrum of environmental pattern are sampled comprehensively. Protected-area networks, however, should not simply be stamp collections. Ensuring the persistence of environmental pattern requires maintenance of environmental processes, inclusive of ecological, evolutionary, geomorphological, and hydrological processes (Cowling et al. 1999*a*) for the entire landscape inside and outside protected-area networks. Representation and persistence avoid ad hoc protected-area establishment, which produced the highly biased and fragmented protected-area networks currently in many countries (Pressey 1994).

INTEGRATE EXPERT INPUT AND SYSTEMATIC TECHNIQUES

Assessments can be expert driven (e.g., Mittermeier et al. 1995) or systematic (Margules & Pressey 2000). Consensus has emerged that expert knowledge is crucial for planning but is best applied within systematic conservation assessments (Pressey & Cowling 2001) because of their methodological rigor and scientific defensibility (Noss 2003), which we have found better received by stakeholders than purely expert-driven approaches. An assessment provides a basis for constructive interaction between land-use sectors because it focuses on priority areas, recognizes competing land uses, and sets defensible and transparent targets. Ecological knowledge of local experts, however, is crucial for mapping land classes, environmental processes, habitat transformation, and future land-use pressures. Experts are also essential for developing rules for decision-support analysis and identifying other experts and key stakeholders.

GATHER AND APPLY DATA USEFUL TO ACHIEVING YOUR GOALS

Gathering all available spatial data should be avoided. Not all spatial data are useful, so the utility of data should be carefully considered before investing time and resources acquiring or developing them. Basing your assessment on five spatial data sets (minimum)—environmental pattern, environmental processes, habitat transformation, future land-use pressures, and planning units—will better ensure the assessment is implemented effectively. Environmental pattern data, where resources are limiting, are most effectively represented as land classes. A continuous land-class layer for the entire planning region, ideally mapped by experts with local ecological and biological knowledge, is essential. Species data can supplement land class data where survey bias and scale are not limiting (Cowling et al. 2004) and may be useful for fine-scale planning or identifying priority subregions. Limited resources for species data collection should be focused on rare, endemic, vulnerable, and economically useful species. Locations are best given as coordinates, not grid squares. Plot-scale inventory data are also useful for target setting (Desmet & Cowling 2004). Environmental processes (e.g., speciation, migration) are essential for ensuring the persistence of living landscapes and are usually represented by spatial surrogates (Cowling et al. 1999*a*). Expert knowledge is essential to map them.

Ideally three categories of habitat transformation need to be identified: (1) irreversibly transformed areas, (2) potentially restorable areas, and (3) intact areas. Mapping potentially restorable areas is difficult and requires careful conceptual planning and verification. Mapping future land-use pressures allows avoidance of areas likely to be compromised in the future and is a conceptually and technically complex task (Hulse et al. 2004). Keeping time frames short (5 to 10 years), avoiding complex statistical models, and drawing on expert knowledge make the task manageable and produce more realistic and defensible predictions.

Planning units are the building blocks of protected-area networks and allow the value or priority of different areas to be compared. Their size and shape affect efficiency (Pressey & Logan 1998). Other useful data include keystone species (Noss et al. 2002), critical natural capital (Lombard et al. 2004), and contextual data (e.g., roads, rivers).

Some authors believe environmental pattern data (e.g., land classes, species localities) are usually inadequate to conduct conservation assessments (e.g., Prendergast et al. 1999; Dinerstein et al. 2000). In our experience, the lack of spatially explicit data on environmental processes is a far greater hindrance. Spatial layers showing transformation and predicted future pressures are usually relatively expensive and complex to develop. If limited resources are available for developing additional data sets, these resources should be invested in mapping land classes, ecological processes, and transformation (including restorable habitat) rather than in collecting species distribution data. Cost-effective ways of mapping partially transformed restorable habitat need to be explored (e.g., grazing impacts, invasive alien plants).

SET QUANTIFIED TARGETS

Assessments founded on explicitly stated quantitative and qualitative targets facilitate the implementation of outputs because they provide a clear purpose for conservation decisions, lending them accountability and defensibility (Pressey et al. 2003). We use *target* differently from other authors for whom targets are the features sampled in protected areas (e.g., Noss 2003). Quantitative targets describe the amount of each feature to be conserved and should be set for individual features (e.g., land classes) based on scientific methods if data are available. We found the use of biological heterogeneity and species-area relationships within land classes effective (Desmet & Cowling 2004). Our experience confirms others' opinion that the widely adopted 10 or 12% targets are inadequate because they lead to underrepresentation of most features and fail to account for biological heterogeneity (Soulé & Sanjayan 1998; Pressey et al. 2003; Desmet & Cowling 2004). Qualitative targets can apply to decision protocols for protected area design criteria, for example, prioritizing planning units adjoining existing protected areas. Explicit quantitative and qualitative targets should form the basis for monitoring implementation.

Our recent experience suggests that incorporating future land-use pressures into target-setting procedures (e.g., Pressey et al. 2003) should be avoided. Spatial predictions of land-use pressures are extremely difficult to derive in a defensible manner. Combining biological heterogeneity with a measure of land-use pressure (e.g., vulnerability) masks the criteria driving the target value. This lacks transparency, and we have found it conceptually confusing for stakeholders. Moreover, representation targets are "artificially" increased for highly transformed land classes irrespective of their biological diversity. Vulnerability data are best used to prioritize sites and schedule conservation action.

Identification of Stakeholders and Goals

The clarity of the reasons for undertaking an assessment affects the success of implementation. Processes with a poorly defined problem are less likely to result in effective conservation action. Solutions must include goals clearly articulated by the staff of implementing organizations and formulated cognizant of those affected by the outputs, who will inherit and implement the assessment outcomes and products, existing organizational capacity for implementation; instruments to operationalize the plan, and implementation opportunities and constraints. Assessments should be demand led, not supply driven, and should meet real needs of implementing organizations. In some instances, unsolicited assessments can offer significant contributions to an organization's strategic direction, but planners must demonstrate the potential of assessments to contribute to corporate goals. This requires sensitivity to the implementation challenges and capacity constraints faced by organizations.

Assessments should inform two distinct sets of activities: (1) land-use planning, including environmental assessment, to slow habitat loss in priority areas, and (2) proactive implementation actions by conservation organizations to achieve targets in protected areas. It is important to be clear whether an assessment is aimed at one or both of these applications.

Assessments at Different Scales

Assessments at different scales meet different aims and should be applied in different ways. When designing the planning process, determine the appropriate scale given the goals of the assessment. Spatial error of data inputs and intended assessment outputs and their interpretation and application on the ground are critical considerations affecting implementation. Broad-scale assessments (e.g., 1:250,000) best identify broad priority areas for entire regions. Fine-scale assessments (e.g., 1:50,000) are usefully undertaken within priority subregions and can be used to design protected-area networks and inform land-use planning outside protected areas. Fine-scale assessments may be necessary in regions that are highly fragmented and have heterogeneous land use or high biological or landscape diversity. Fine-scale assessments complement broad-scale assessments (Rouget 2003).

Attention to Assessment Design

There is no single best recipe for a planning process, so prescriptive approaches are best avoided. Significant investment of time and resources should be dedicated to involving key stakeholders (e.g., influential staff in implementing organizations) in the design of the planning process. Process design should vary according to the aims and spatial scale of the assessment, institutional and sociopolitical context, timeframe, and budget. Major design tasks include (1) designing linked components (e.g., conservation assessment, socioeconomic analysis), (2) establishing teams for different components, (3) establishing an advisory group, (4) designing processes for stakeholder collaboration, and (5) establishing timeframes and management systems.

Assessment Teams that Include Implementing Organizations

CAREFULLY RECRUIT ASSESSMENT TEAMS

An assessment is a transdisciplinary activity that requires coordination skills, specialist skills, and a group of advisors. Specialist skills include high-level analytical GIS skills, assessment expertise, and regional natural-history and biogeographical knowledge. A specialist's most basic combination of required skills is highly specialized GIS and assessment skills and an intimate understanding of regional ecology. Intimate expert knowledge of regional land uses, people, and organizations greatly facilitates integrating implementation issues into assessments.

Investment in project coordination is crucial, especially in rapid, low-budget processes. A dedicated coordinator is more effective than combining coordination and specialist functions in one person. The coordinator must be an effective manager and should understand the basics of assessment and, more broadly, conservation planning. An advisory group of experienced, respected people can provide guidance, credibility, and a forum for reporting on progress.

INVOLVE IMPLEMENTING ORGANIZATIONS

Implementing organizations are key stakeholders, and their staff should be intimately involved in the assessment. Ideally the implementing agency should lead the planning process and be involved in the day-to-day work of the assessment team. This greatly enhances the probability of successful mainstreaming (Pierce et al. 2002) by ensuring that assessments meet the needs of implementing organizations and so inform their ongoing work without a complex and time-consuming handover from the assessment team to the implementing organization. Involvement also provides on-the-job training to build capacity. If implementing organization involvement in the assessment team is not possible, then key staff should be involved in other aspects of the planning process (e.g., developing the implementation strategy) or, at the least, be kept fully informed of the process through regular update sessions.

INVOLVE THE TEAM IN PLANNING PROCESS DESIGN

The assessment team should be involved in initial process planning to ensure clear understanding of goals and approaches and to avoid poor integration with teams working on other process components. Ideally, all team members should be located together within the planning region (Dick 2000) to facilitate communication within and beyond the team. Regular meetings, plus liaison with other participants, is essential for ensuring effective integration. Team members can be employed full time or part time and are ideally based in an implementing organization.

Focused Collaboration to Address Stakeholders' Needs

A great deal of time and resources can be wasted on poorly conceived, unfocused stakeholder collaboration. It is clearly important to collaborate with a broad range of stakeholders from different sectors, but this should be done in a focused way.

IDENTIFY KEY STAKEHOLDERS FIRST

Identifying and understanding the needs of key stakeholders sets the foundation for implementation. A stakeholder analysis should be conducted in the context of the specific aims of the process and should include identifying stakeholders' needs and interests, their geographic influence, and constraints to their participation (e.g., transport, time). Key stakeholders should be relevant, important, or influential, and include local-level stakeholders such as local communities and high-level stakeholders such as politicians. Different stakeholders possess distinct mental models, which necessitates managing multiple realities (Sayer & Campbell 2004).

DESIGN A COLLABORATION PROGRAM WITH CLEAR OBJECTIVES

It is important to clearly communicate the objectives of the assessment and of stakeholder collaboration to avoid unrealistic expectations (e.g., local officials expecting a broad-scale assessment to provide all the environmental information needed for local-scale decision making). Objectives of stakeholder collaboration can include building awareness, gathering information, building consensus on a regional vision or priority actions, securing commitment from stakeholders for implementation, and building capacity for implementation.

Different stakeholders should be involved in different aspects of the process, and each requires different levels of information on the assessment. Detailed technical information is often not necessary or constructive for most stakeholders. Although everyone involved should understand the basics of the approach, the precise methodological details of an assessment are less relevant for most stakeholders.

Key high-level stakeholders, implementing organizations, and key experts with specialized ecological or socioeconomic knowledge of the planning region, may be valuable contributors to the design of the process because of their political or institutional knowledge or influence. The scientific community and expert stakeholders need to be involved in the assessment, perhaps through an initial workshop to get input on the approach and possible data sources. Reporting results of draft assessments for comment to a forum of scientists with regional expertise may also be useful. Stakeholders from a range of social and economic sectors, notably local government, agriculture, tourism, and community groups, are critical for development of an implementation strategy and local-scale action plans (e.g., Knight et al. 2003). It is important to be conscious of language when engaging with stakeholders. For example, describing production activities as "threats" to nature alienates stakeholders with legitimate land-use interests.

AVOID BROAD, UNFOCUSED STAKEHOLDER WORKSHOPS

A centralized process with little collaboration is generally inappropriate. Large numbers of stakeholder workshops, however, are not necessarily the solution. Although broad workshops may efficiently achieve some objectives, such as raising awareness, reporting results, and building consensus on priority actions, many broad workshops can simply produce workshop fatigue, frustration, and resentment. Focused, one-on-one meetings or small-group sessions with key stakeholders addressing their needs or specific issues often are more effective. Geographically decentralized workshops may be useful for a broad-scale assessment covering a large area. If large workshops are held, impeccable workshop planning and facilitation are crucial; professional facilitation is often warranted. Caution is required when planning with local stakeholders—they often deal with practicalities of land use and are understandably frustrated when planning occupies significant time and resources with no perceived link to action.

MAKE THE CASE FOR NATURE

Specialists often fail to explain why nature matters and how it contributes or could contribute to livelihoods. Making the case for nature, and hence the need for assessment, should be an integral part of stakeholder collaboration. Promoting conservation as a valid land use that contributes to development, rather than preventing development, is useful. Compelling local or regional examples of nature's central role in maintaining flows of ecosystem goods and services can be powerful. Focus on aspects not perceived as detrimental by stakeholders. As a case in point, farmers often believe large predatory mammals kill stock, making these animals a poor choice for promoting the importance of nature (Davie 1997).

Interpretation of Assessment Outputs and Mainstreaming of Products

A GIS linked to planning software (e.g., C-Plan; Ferrier et al. 2000) can apply targets to feature data and develop spatially explicit assessment outputs (i.e., expert maps) and planning products (i.e., maps for implementers). Minimum-set analyses (e.g., Kirkpatrick 1983) are often impractical because they select a dispersed arrangement of areas, with little consideration to reserve design. They also represent only one of many possible solutions, offering no information on options outside the minimum set (Ferrier et al. 2000). A map of conservation options (e.g., irreplaceability; Ferrier et al. 2000) is often better for planning protected areas expansion. Alternatively, land-use planners prefer the certainty of a minimum set of areas meeting quantitative and qualitative targets, coupled with information on options for land use outside candidate protected areas (e.g., Pierce 2003).

DELIVER ASSESSMENT OUTPUTS AS USEFUL PLANNING PRODUCTS

Assessment outputs are usually technical, complex, and often meaningless to implementers. Although a potentially powerful tool, they present information in formats not equally useful for all implementers; they often need to be interpreted and redesigned as planning products to facilitate decision making (e.g., Pierce 2003) by distinct implementer groups. Time and resources should be allocated by the assessment team to developing these products, tailoring them specifically to implementer needs and capacity. Staff from implementing organizations, who have local knowledge of implementation opportunities and constraints, are in the best position to advise on the effects of individual land-use decisions, with the assistance of meaningful planning products.

Planning products should display the results of the assessment with features (e.g., land classes), not planning units, whose values are misleading when calculated from "underlying" features. For example, stakeholders unfamiliar with assessment techniques may assume their entire property is a priority, when the priority area is only a small section. In our experience, land-use planners find artificial planning units (i.e., grids, hexagons) impractical. Cadastral boundaries often make a useful overlay on a map of features but, depending on the specific purpose of the assessment, are sometimes best not used as planning units. Although irreplaceability maps have been well received by high-level managers within land management organizations (Ferrier et al. 2000), our experience suggests they are both confusing and difficult to apply for land-use planners and rural landowners. They are, however, a useful input layer into more complex analyses (Rouget et al. 2006). Use of red as a color for priority properties should usually be avoided because it may signal danger to stakeholders.

Interpretive land management guidelines (e.g., Pierce 2003) should accompany planning products, especially for land-use planners wanting to know what particular activities are appropriate for an area. Other supporting products (e.g., explanatory posters) may also be useful. Further experience and testing into how to redesign conservation options maps into planning products are required. Valuable lessons are emerging from two projects under way in the Cape Floristic Region and the Subtropical Thicket Biome of South Africa.

MAINSTREAM PLANNING PRODUCTS INTO ACTION

Planning products, complemented with an implementation strategy, must be actively mainstreamed—incorporated into the policies, decisions, and day-to-day actions of the diverse range of people and organizations whose activities affect natural resource management (Pierce et al. 2002). Mainstreaming planning products is not a once-off activity; rather, it requires continuous input and involvement. It cannot be led effectively from outside the region, and employing outsiders to conduct an assessment and develop an implementation strategy almost guarantees mainstreaming failure.

Successful mainstreaming depends on continuity between those leading the planning process and those leading subsequent implementation. Several people centrally involved in the planning process, who understand and believe in the vision and are committed to its success, should champion mainstreaming and implementation at the policy level and at the level of day-to-day action. Champions must exhibit tenacity, leadership, empathy, and an ability to build capacity in a broad range of individuals and organizations.

Committed individuals and organizations, flexible funders willing to take calculated risks with new approaches, effective cross-sectoral partnerships, and approaches that actively seek and highlight opportunities to link nature to socioeconomic gains (e.g., job creation) are essential for mainstreaming. Mainstreaming should be driven through projects rather than organizational structures.

Conclusions

Conservation assessment is the technical task of identifying priority areas for conservation. When coupled with implementation strategy development, in the context of stakeholder collaboration, these activities constitute a conservation planning process (Fig. 1). Knowing-doing gaps are real phenomena in planning processes (Knight et al. 2006) that lead to failure in the implementation of effective conservation action. Bridging the gaps between assessment and implementation strategy development—the assessment-planning gap—and between conservation planning and implementing conservation action—the planning-action gap—requires specific, explicit techniques. Assessments published in the peer-reviewed litera-ture overwhelmingly focus on development of area-selection techniques, with little attention to how assessment outputs can be translated into effective conservation actions.

Our experiences in South Africa (Table 1) suggest that the approach and structure of an assessment determine, in part, the effectiveness of a planning process. Given the current lack of consideration of how assessments will be implemented in the face of ongoing environmental decline, an urgent need exists to document best practice for conservation assessments. Our seven key ingredients underpin an approach we call planning for implementation: (1) a systematic assessment, (2) identification of stakeholders and goals of the process, (3) assessments conducted at different scales, (4) attention to assessment design, (5) assessment teams that include implementing organizations, (6) focused collaboration to address stakeholders' needs, and (7) interpretation of assessment outputs and mainstreaming products (see also Driver et al. 2003*a*; Knight et al. 2006). These key ingredients represent a South African consensus on current best practice for undertaking assessments and situate them within broader planning processes (e.g., Knight et al. 2006), blending the science of assessment with the pragmatic issues surrounding real-world planning.

We present the fruits of an informal social learning institution—our network of conservation planners who periodically work together on a range of different processes, testing, swapping, and debating approaches. We, among a growing group of conservation planners, formally meet every year. A common cause, coupled with the belief we are more effective as a group than we are individually, provides the foundation for our social learning institution. Ultimately, we learn more from our difficulties and failures than our successes; openness, trust, and mutual respect have been essential elements in developing the "safe-fail" culture (Redford & Taber 2000; Knight 2006) that underpins our advancement. Documenting experiences so they can be shared is vitally important (Redford & Taber 2000). Our diverse approaches then offer opportunities for rapidly improving the practice of both assessment and planning. Quantifying and formally monitoring our improvements constitute the next logical advance in our social learning institution.

The best practice presented herein, however, represents a snapshot in time, derived from a small group of individuals working in one country under a common philosophy. There is the risk we may create a dogma and entrench an orthodoxy that stifles innovation and limits the adaptive ability of this group to grapple with the constant change we face. Orthodoxy precedes organizational decline into the "pathology of natural resource management" (Holling & Meffe 1996), where maintaining the efficiency of planning activities becomes more important than implementing conservation action. Ultimately, our success in fostering consilience—the fusion of different knowledge traditions (Wilson 1998)—through the continued effective operation of our social learning institution will determine our ability to adapt our approaches to ensure we are effective conservation planners.

Acknowledgments

The Botanical Society of South Africa and the Global Environment Facility (through the Subtropical Thicket Ecosystem Planning Project) funded our Lessons Learnt Workshop at Cape St. Francis, South Africa, in November 2002. M. Bakarr's support and publication funding provided by the Centre for Applied Biodiversity Science at Conservation International, the Botanical Society of South Africa, and the South African National Biodiversity Institute is gratefully acknowledged. Conservation International, the Critical Ecosystem Partnership Fund, the Development Bank of South Africa, Ezemvelo KwaZulu-Natal Wildlife, the Global Environment Facility, the South African National Biodiversity Institute, South African National Parks, the Table Mountain Fund, the Nelson Mandela Metropolitan University, the World Bank, and World Wide Fund for Nature–South Africa supported our individual processes. We thank R. Pressey for introducing systematic conservation assessment to many of us. Insightful comments from three anonymous referees and E. Main significantly improved the manuscript.

Literature Cited

Clark, F. S., and R. B. Slusher. 2000. Using spatial analysis to drive reserve design: a case study of a national wildlife refuge in Indiana and Illinois (USA). Landscape Ecology **15:**75–84.

Cole, N. S., A. T. Lombard, R. M. Cowling, D. Euston-Brown, D. M. Richardson, and C. E. Heijnis. 2000. Framework for a conservation plan for the Agulhas Plain, Cape Floristic Region, South Africa. 2nd edition. Institute for Plant Conservation, University of Cape Town, Cape Town.

Cowling, R. M., et al. 2003*a*. A conservation assessment for the Subtropical Thicket Biome. Report 46. Terrestrial Ecology Research Unit, University of Port Elizabeth, Port Elizabeth, South Africa.

Cowling, R. M., and A. T. Lombard. 1998. A strategic and systematic framework for conserving the plant life of the Succulent Karoo. Institute for Plant Conservation Report to the Leslie Hill Succulent Karoo Trust. IPC 9802 LHSK. Institute for Plant Conservation, University of Cape Town, Cape Town.

Cowling, R. M., R. L. Pressey, M. Rouget, and A. T. Lombard. 2003*b*. A conservation plan for a global biodiversity hotspot—the Cape Floristic Region, South Africa. Biological Conservation **112:**191–216.

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

Cowling, R. M., R. L. Pressey, A. T. Lombard, C. E. Heijnis, D. M. Richardson, and N. Cole. 1999*b*. Framework for a conservation plan for the

Cape Floristic Region. Institute for Plant Conservation, University of Cape Town. Cape Town.

Cowling, R. M., A. T. Knight, D. P. Faith, S. Ferrier, A. T. Lombard, A. Driver, M. Rouget, K. Maze, and P. G. Desmet. 2004. Nature conservation requires more than a passion for species. Conservation Biology **18:**1674–1677.

Davie, J. 1997. Is biodiversity really the link between conservation and ecologically sustainable management ? A reflection on paradigm and practice. Pacific Conservation Biology **3:**83–90.

Davis, F. W., D. M. Stoms, and S. J. Andelman. 1999. Systematic reserve selection in the U.S.A.: an example from the Columbia Plateau ecoregion. Parks **9:**31–41.

Desmet, P., and R. M. Cowling. 2004. Using the species-area relationship to set baseline targets for conservation. Ecology and Society **9**(11)**:** http://www.ecologyandsociety.org/vol9/iss2/art11.

Dick, R. C. editor. 2000. A multi-faceted approach to regional conservation assessment in the Cobar Peneplain biogeographic region. New South Wales National Parks and Wildlife Service, Sydney.

Dinerstein, E., et al. 2000. A workbook for conducting biological assessments and developing biodiversity visions for ecoregion-based conservation. Part 1: terrestrial ecoregions. World Wildlife Fund, Washington, D.C.

Driver, A., R. M. Cowling, and K. Maze. 2003*a*. Planning for living landscapes: perspectives and lessons from South Africa. Center for Applied Biodiversity Science at Conservation International, Washington, D.C., and the Botanical Society of South Africa, Cape Town.

Driver, A., P. Desmet, M. Rouget, R. M. Cowling, and K. Maze. 2003*b*. Succulent Karoo ecosystem plan: biodiversity component technical report. Conservation Unit Report CCU 1/03. Botanical Society of South Africa, Cape Town. Available from www.botanicalsociety.org.za (see "Conservation Unit," then "Downloads") (accessed May 2004).

Ferrier, S., R. L. Pressey, and T. W. Barrett. 2000. A new predictor of the irreplaceability of areas for achieving a conservation goal, its application to real-world planning, and a research agenda for further refinement. Biological Conservation **93:**303–325.

Goodman, P. S. 2000. Determining the conservation value of land in KwaZulu-Natal. Final report. KwaZulu-Natal Nature Conservation Service, Cascades, South Africa.

Groves, C. R., D. B. Jensen, L. L. Valutis, K. H. Redford, M. M. Shaffer, J. M. Scott, J. V. Baumgartner, J. V. Higgins, M. W. Beck, and M. G. Anderson. 2002. Planning for biodiversity conservation: putting conservation science into practice. Bioscience **52:**499–512.

Hill, G. W. 1982. Group versus individual performance: are $N + 1$ heads better than one? Psychological Bulletin **91:**517–539.

Holling, C. S., and G. K. Meffe. 1996. Command and control and the pathology of natural resource management. Conservation Biology **10:**328–337.

Hulse, D. W., A. Branscombe, and S. G. Payne. 2004. Envisioning alternatives: using citizen guidance to map future land and water use. Ecological Applications **14:**325–341.

Kirkpatrick, J. B. 1983. An iterative method for establishing priorities for the selection of nature reserves: an example from Tasmania. Biological Conservation **25:**127–134.

Knight, A. T. 2006. Failing but learning: writing the wrongs after Redford and Taber. Conservation Biology **20:** 10.1111/j.1523-1739.2006.00366.x.

Knight, A. T., and R. M. Cowling. 2003. Conserving South Africa's "lost" biome: a framework for securing effective regional conservation planning in the Subtropical Thicket Biome. Report 44. Terrestrial Ecology Research Unit, University of Port Elizabeth, Port Elizabeth, South Africa.

Knight, A. T., R. M. Cowling, and B. M. Campbell. 2006. Planning for implementation: an operational model for implementing conservation action. Conservation Biology **20:**408–419.

Knight, A. T., A. F. Boshoff, R. M. Cowling, and S. L. Wilson. 2003. Keeping people on the land in living landscapes: a cooperative strategy for conserving landscapes and enhancing livelihoods in the Subtropical Thicket Biome, South Africa. Report 46. Terrestrial Ecology Research Unit, University of Port Elizabeth, Port Elizabeth, South Africa.

Lawton, J. H. 1996. Corncrake pine and prediction in ecology. Oikos **76:**3–4.

Lawton, J. H., and R. M. May, editors. 1995. Extinction rates. Oxford University Press, Oxford, United Kingdom.

Lombard, A. T., T. Wolf, and T. Strauss. 2004. GIS specialist services, Gouritz initiative: final report. Sedgefield, South Africa.

Maarleveld, M., and C. Dangbégnon. 1999. Managing natural resources: a social learning perspective. Agriculture and Human Values **16:**267–280.

Margules, C. R. 1986. Conservation evaluation in practice. Pages 297–314 in M. B. Usher, editor. Wildlife conservation evaluation: attributes, criteria and values. Chapman & Hall, London.

Margules, C. R., and R. L. Pressey. 2000. Systematic conservation planning. Nature **405:**37–47.

Meffe, G. K., C. R. Carroll, and Contributors. 1997. Principles of conservation biology. Sinauer Associates, Sunderland, Massachusetts.

Mittermeier, R. A., I. A. Bowles, R. B. Cavalcanti, S. Olivieri, and G. A. B. da Fonseca. 1995. A participatory approach to biodiversity conservation: the regional priority setting workshop. Conservation International, Washington, D.C.

Nel, J., S. Davies, I. Kotze, C. Gelderblom, B. van Wilgen, L. Schonegevel, S. Hughes, G. I. H. Kerley, R. M. Cowling, and A. F. Boshoff. 2002. Terrestrial conservation planning for the Greater Addo Elephant National Park. Final report. Environmentek CSIR, Stellenbosch, South Africa.

North, D. C. 1990. Institutions, institutional change and economic performance. Cambridge University Press, Cambridge, United Kingdom.

Noss, R. F. 2003. A checklist for wildlands network designs. Conservation Biology **17:**1270–1275.

Noss, R. F., C. Carroll, K. Vance-Borland, and G. Wuerthner. 2002. A multicriteria assessment of the irreplaceability and vulnerability of sites in the Greater Yellowstone ecosystem. Conservation Biology **16:**895–908.

Pfeffer, J., and R. I. Sutton. 1999. Knowing "what" to do is not enough: turning knowledge into action. California Management Review **42:**83–107.

Pierce, S. M. 2003. The S.T.E.P. handbook. Integrating the natural environment into land use decisions at the municipal level: towards sustainable development. Report 47. Terrestrial Ecology Research Unit, University of Port Elizabeth, Port Elizabeth, South Africa.

Pierce, S. M., R. M. Cowling, T. Sandwith, and K. MacKinnon. 2002. Mainstreaming biodiversity in development: case studies from South Africa. The World Bank, Washington, D.C.

Pierce, S. M., R. M. Cowling, A. T. Knight, A. T. Lombard, M. Rouget, and T. Wolf. 2005. Systematic conservation assessment products for land-use planning: interpretation for implementation. Biological Conservation **125:**441–458.

Poiani, K. A., B. D. Richter, M. Anderson, and B. Richter. 2000. Biodiversity conservation at multiple scales: functional sites, landscapes, and networks. BioScience **50:**133–146.

Prendergast, J. R., R. M. Quinn, and J. H. Lawton. 1999. The gaps between theory and practice in selecting nature reserves. Conservation Biology **13:**484–492.

Pressey, R. L. 1994. Ad hoc reservations: forward or backward steps in developing representative reserve systems. Conservation Biology **8:**375–384.

Pressey, R. L. 1998. Algorithms, politics & timber: an example of the role of science in a public, political negotiation process over new protected areas in production forests. Pages 73–87 in R. T. Wills, R. J. Hobbs, and M. D. Fox, editors. Ecology for everyone: communicating ecology to scientists, the public and the politicians. Surrey Beatty and Sons, Sydney.

Pressey, R. L. 2002. The first reserve selection algorithm—a retrospective on Jamie Kirkpatrick's 1983 paper. Progress in Physical Geography **26:**434–442.

Pressey, R. L., and R. M. Cowling 2001. Reserve selection algorithms and the real world. Conservation Biology **15:**275–277.

Pressey, R. L., and V. S. Logan. 1998. Size of selection units for future reserves and its influence on actual vs. targeted representation of features: a case study in western New South Wales. Biological Conservation **85:**305–319.

Pressey, R. L., R. M. Cowling, and M. Rouget. 2003. Formulating conservation targets for biodiversity pattern and process in the Cape Floristic Region, South Africa. Biological Conservation **112:**99–128.

Pretty, J., and H. Ward. 2001. Social capital and the environment. World Development **29:**209–227.

Redford, K. H., and A. Taber. 2000. Writing the wrongs: developing a safe-fail culture in conservation. Conservation Biology **14:**1567–1568.

Rouget, M. 2003. Measuring conservation value at fine and broad scales: implications for a diverse and fragmented region, the Agulhas Plain. Biological Conservation **112:**217–232.

Rouget, M., and B. Egoh. 2003. Planning in South Africa: opportunities and limitations for the NBI. Institute for Plant Conservation, University of Cape Town, Cape Town.

Rouget, M., R. M. Cowling, A. T. Lombard, A. T. Knight, and G. I. H. Kerley. 2006. Designing large-scale conservation corridors for pattern and process. Conservation Biology **20:**549–561.

Sayer, J. A., and B. M. Campbell. 2004. The science of sustainable development: local livelihoods and the global environment. Cambridge University Press, Cambridge, United Kingdom.

Soulé, M. E., and M. A. Sanjayan. 1998. Conservation targets: do they help? Science **279:**2060.

Stewart, W. I., R. M. Cowling, A. P. Martin, D. R. du Preez, and A. T. Lombard. 2003. Framework for a conservation plan for the Nelson Mandela Metropole (the Five Biome City), Cape Floristic Region, South Africa. 1st edition. World Wide Fund for Nature (WWF)–South Africa, Cape Town.

von Hase, A., M. Rouget, K. Maze, and N. Helme. 2003. A fine-scale conservation plan for Cape Lowlands Renosterfeld: technical report. Report CCU 2/03. Cape Conservation Unit, National Botanical Institute of South Africa, Cape Town.

Wilson, E. O. 1998. Consilience: the unity of knowledge. Abacus, London.