Towards Knowing Through Doing: Improving the Societal Relevance of Systematic Conservation Assessments

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Dedication

This research is dedicated to
Mitchell, Rohan and Jessica,
and to all of their generation.

And to the memory of Mat Garrod.

"Like all young men I set out to be a genius,
but mercifully laughter intervened."

C*lea* Lawrence Durrell

"In the varied topography of professional practice, there is a high, hard ground where practitioners can make effective use of research-based theory and technique, and there is a swampy lowland where situations are confusing "messes" incapable of technical solution. The difficulty is that the problems of the high ground, however great their technical interest, are often relatively unimportant to clients or to the larger society, while in the swamp are the problems of greatest human concern."

Donald Schön
The Reflective Practitioner: How Professionals Think In Action
Basic Books, New York, 1983

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Summary

Systematic conservation assessments are spatially-explicit techniques for prioritising areas for the implementation of conservation action. There has been considerable reference in the peer-reviewed literature as to the usefulness of these tools, which appear to be primarily used by academics for theoretical research. A literature review and author survey reveals the peer-reviewed literature is largely theoretical, although conservation action results more frequently than reported. The effectiveness of these interventions is generally described as only 'fairly effective'.

This general trend, coupled with previous personal failures in translating systematic conservation assessments into effective conservation action triggered an explicit process of social learning implemented as action research. It examined the workings of the Subtropical Thicket Ecosystem Planning (STEP) project, which included development of a systematic conservation assessment.

Systematic conservations assessments simply provide information on *where* action should be implemented, and so are only useful if situated within broader operational models for conservation planning. Most operational models presented in the peer-reviewed literature are primarily focused upon the testing ecological data, not upon the delivery of conservation action. A new operational model for conservation planning is presented which more accurately reflects the 'real-world' process of conservation planning.

An implementation strategy is an essential complement to a systematic conservation assessment. It describes *how* specific, explicitly-stated goals will be achieved, who is accountable for undertaking these activities, and the resources required. As the Implementation Specialist for the STEP Project, I co-lead the collaborative development of an implementation strategy with stakeholders that aimed to mobilise resources towards achieving common goals. Whilst the development and initial uptake of the strategy was good, subsequent implementation has flounder. The reasons for this are explored.

The ultimate pragmatic goal of a conservation planning process is the establishment of effective social learning institutions. These develop common visions, mobilise collective action, and adaptively learn and refine their conservation activities. Thicket Forum is one such institution established through the STEP Project. My involvement with Thicket Forum since 2004 in implementing an adaptive learning approach facilitates collaboration between land managers, government and research organisations.

Systematic conservation assessments evolved in response to the *ad hoc* way in which protected areas were implemented, leaving unrepresentative, biased protected area networks. Most research is theoretical and without an intimate understanding of the social-ecological system of a planning region, notably opportunities and constraints for implementing conservation action. Highlighting the importance of an approach which is flexible, not only in space, but in time, which can capitalise upon implementation opportunities, is important for stemming the myth that opportunism is the nemesis of systematic conservation assessments.

To this end, conservation planners have been slow to include factors influencing effective implementation in systematic conservation assessments. Many studies which identify candidate protected area networks, first, fail to identify the specific instrument(s) to be applied, and second, assume all intact land is available. Having mapped the willingness of land managers in the Albany District, South Africa, to sell their land, it is demonstrated the majority of targets fail to be achieved because land managers will not sell.

Knowing this, the current focus of gathering ever-more ecological data is misplaced. Human, social and economic factors influence target achievement, efficiency and spatial configuration of priority areas. Selecting important areas for conservation, particularly at the local-scale, requires the mapping of factors which define opportunities for conservation. Land manager willingness to collaborate and participate, entrepreneurial orientation, conservation knowledge, social capital, and local champions were applied using a method of hierarchical clustering to identify land managers who represent conservation opportunities for private land conservation initiatives.

Keywords:
action research; area selection; conservation planning; effectiveness; knowing-doing gap; research-implementation gap; social learning; social research; systematic conservation assessment

Introduction

Doing in an Attempt to be Knowing

"So, authors try, in part through repackaging and updating, to somehow get managers to not only *know* but to *do* something with what they know. And managers continue to buy the books filled with ideas they already know because they intuitively understand that knowing isn't enough. They hope that by somehow buying and reading one more book they will finally be able to translate this performance knowledge into organizational action."

Jeffrey Pfeffer and Robert I. Sutton

Knowing "what" to do is not enough: turning knowledge into action
California Management Review 42(1): 83-107, 1999

Read through the pages of any of the peer-reviewed journals dedicated to the conservation of nature and one can be assured that the world is in a sorry environmental state. Species are disappearing, habitats are being degraded and destroyed, and the processes that sustain life are being compromised at unprecedented rates, and to the point where the future existence of human beings is now questioned. It is little wonder conservation science has been criticised for being one long lament (Young 2000; Redford and Sanjayan 2003). The discipline of conservation biology emerged in response to this situation; a mission-driven 'crisis' discipline which aimed to stem the tide of destruction. The science of systematic conservation assessment, which identifies spatially-explicit priority areas for investing our limited conservation resources, has become a main-stay of the peer-reviewed literature and university qualifications.

I spent the first six years of my working life as a conservation planner – conducting systematic conservation assessments and prioritising the acquisition of new protected areas using the (then) innovative new software (C-Plan) – for the New South Wales National Parks and Wildlife Service in Sydney, Australia. Despite our agency funding the development of this software, our aggressive land acquisition programme did not employ systematic techniques, and our bioregional plans failed to be implemented (see Prologue). These failures did not sit easily with me. I quit my job and embarked on a PhD to learn how to do effective conservation planning.

The research detailed in this thesis was conceived and designed as an action research project (*sensu* McNiff & Whitehead 2003), whereby my studies investigated 1) my role as the Implementation Specialist for a World Bank funded regional conservation planning initiative known as the Subtropical Thicket Ecosystem Planning (STEP) Project; 2) the overall process of the STEP Project, and 3) my role as the Chairperson of the Thicket Forum Organising Committee. In this position, I was directly involved in designing, situating and implementing approaches for a range of stages in the conservation planning process, and was able to collaboratively reflect upon the utility and effectiveness of our efforts. My investigations comprised social learning (see Keen et al. 2005) – or 'learning by doing' (Holling 1978; Lee 1993; Salafsky et al. 2002), which assisted me to identify a pathway for developing an approach which provides solutions to conservation planning problems.

This research aims to provide answers to a number of questions fundamentally important for improving the theory and practice of conservation planning, both personally, and as a discipline:

1. Is the divide between research on systematic conservation assessment techniques and the application of their outputs (e.g., Prendergast et al. 1999) a real phenomenon?
2. What constitutes an effective conservation planning operational model? How are systematic conservation assessments effectively integrated into broader processes which lead to effective implementation? Are current conservation planning operational model effective?
3. Has the historical focus upon the sole use of biological / environmental data for systematic conservation assessments provided less useful outputs than analysing a range human, social, economic data and biological and/or environmental data?
4. How do we best ensure that the information provided by systematic conservation assessments on 'where' conservation should be done is complemented with a process for 'how' effective conservation action is implemented?
5. What institutions are required to support the translation of systematic conservation assessments into action, how should they be structured, and what roles do they play in supporting conservation plans?

I investigated these questions through a variety of methods including literature reviews, case studies, historical accounts, interview surveys, psychometric statistical analyses, and quantitative reserve selection techniques. It has been an intensive learning-by-doing experience. I believed that finding answers to these questions would not only make me a better conservation planner, but would make a useful contribution to conservation planning theory and practice.

The tangible products of this research are presented in this thesis. It comprises a suite of eight integrated publications, each of which was specifically designed to "plug a hole" I had observed in the theory and practice of usefully applying systematic conservation assessments to solving conservation planning problems. They reflect a process of social learning. Table 1 below outlines the purpose and the techniques applied for each publication. The Appendices complementing these eight core papers document stages of the STEP conservation planning process in which I was involved and which formed an integral part of my action research process.

The reader will be assisted in conceptualizing the role of each individual paper towards the thesis as a whole if each is contextualized in the operational model for conservation planning presented in Paper II (Figure 1). This approach was consciously developed, and highlights the importance of founding research in a truly applied context by linking it to explicitly-stated operational models which can then be refined and improved through practice. Papers do not mirror the exact flow of the operational model, but rather, the chronology of the learning process I have undergone.

By way of formatting, the thesis comprises a *Summary* which outlines the body of work, an *Introduction* which explains and provides context for individual papers, and eight core *Papers* comprising the body of the thesis. These are formatted according to the journal in which they have been, or are destined to be, published. A *Discussion* synthesises and concludes the main body of work. The literature cited for each individual paper has been compiled collectively as a single *Bibliography*. The *Appendices* provide greater context for my social learning process. Note that page numbers in *Appendices I* to *IV* are per the original published version of these publications.

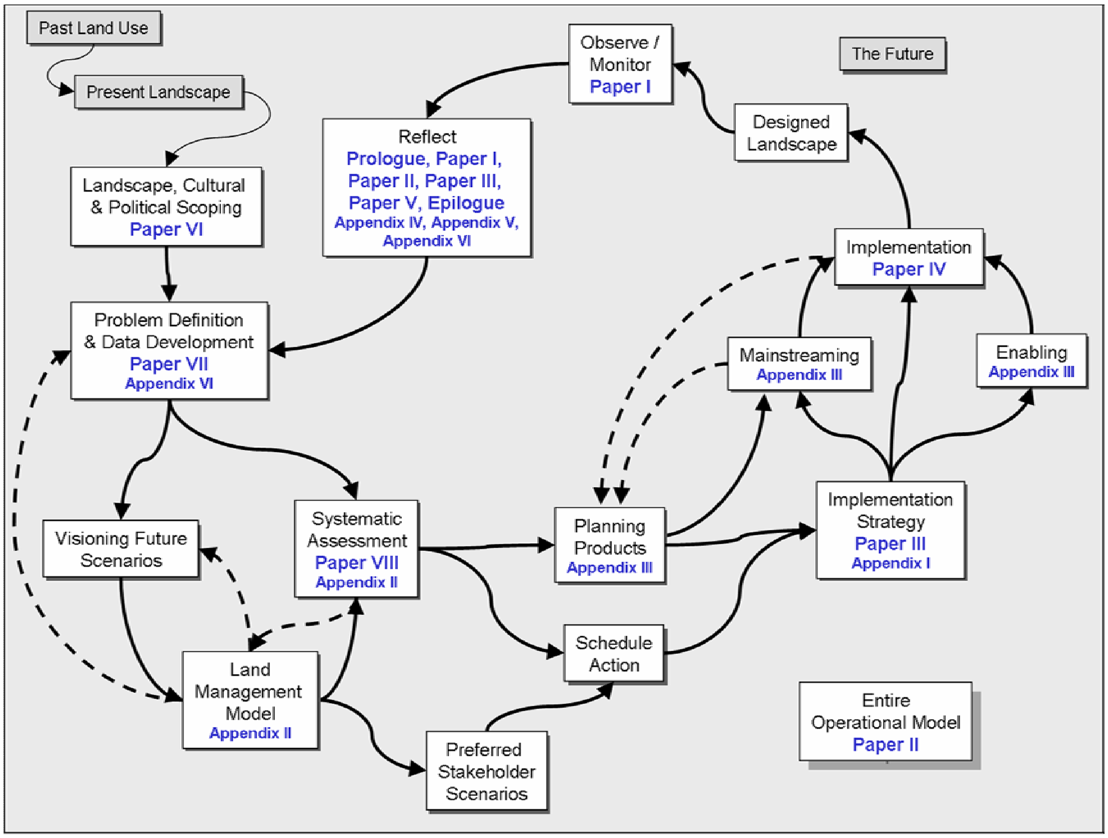

Figure 1 – The publications contributing towards this thesis, presented in the context of an operational model for conservation planning (*sensu* Knight et al. 2006a; Paper II).

Publication	Objective	Technique(s)
Prologue.	♦ To provide context for why I undertook this specific research project ♦ To highlight importance of documenting failure for learning to better design, situate and implement systematic conservation assessments	▪ Self-reflection
Paper I.	♦ To determine the existence, or not, of a research-implementation gap between the science of conservation assessment and conservation action ♦ To promote reform (i.e., a Kuhnian crisis) in the practice of the science of conservation assessment	▪ Literature review ▪ Questionnaire survey
Paper II.	♦ To examine the relevance and utility of existing operational models for conservation planning ♦ To highlight the importance of an explicitly-stated operational model as a basis for social learning and adaptive refinement in conservation planning ♦ To develop a more effective operational model for conservation planning	▪ Literature review ▪ Self-reflection
Paper III.	♦ To highlight the importance of complementing a systematic conservation assessment with an implementation strategy ♦ To self-examine our practice so as to improve our process for future implementation strategy development processes ♦ To provide practitioners with lessons learned so they avoid making the same mistakes we did in the STEP Project	▪ Visioning ▪ Facilitation ▪ Case study ▪ Self-reflection

Publication	Objective	Technique(s)
Paper IV.	♦ To document the emergence of a social learning institution which specifically supports a systematic conservation assessment ♦ To highlight the importance of supporting a systematic conservation assessment, and conservation planning processes generally, with appropriate social learning institutions ♦ To promote Thicket Forum in the South Africa ♦ To outline collaboratively-developed future research required on the Subtropical Thicket Biome	▪ History ▪ Case study ▪ Reflection
Paper V.	♦ To highlight the importance of situating systematic conservation assessments in broader conservation planning operational model which engages society ♦ To encourage conservation planners to fuse environmental and social data to identify 'conservation opportunities', as an alternative to the currently popular practice of identifying 'priority conservation areas' (*sensu* Pressey 1997)	▪ Opinion piece
Paper VI.	♦ To test the importance of including a 'real-world' human factor (i.e., willingness to sell) on the expansion of formally protected areas networks	▪ Experimentation ▪ Spatial prioritisation ▪ GIS
Paper VII.	♦ To investigate a method for assessing the social dimension of 'conservation opportunity' in systematic conservation assessment	▪ Interview survey ▪ Psychometric statistics ▪ GIS

Table 1 – The objectives and techniques applied for each of the eight core papers comprising this thesis.

Prologue

Failing but Learning:
Writing the Wrongs after Redford and Taber*

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"I have learned throughout my life ….. chiefly through my mistakes and pursuits of false assumptions, not by my exposure to founts of wisdom and knowledge."

Igor Stravinsky

Quoted by Kent H. Redford and Andrew Taber in
Writing the wrongs: developing a safe-fail culture in conservation
Conservation Biology 14: 1567-1568, 2000

* Published as: Knight, A.T. 2006. Failing but learning: writing the wrongs after Redford and Taber. *Conservation Biology* 20(4): 1312-1314.

Nobody enjoys failure, particularly scientists. The competition for funding is fierce and the importance of reputation paramount. Conservation scientists also bear the added burden of knowing that although successes may directly contribute toward stemming the ongoing environmental crisis, failures probably mean fewer resources and even more significantly, less time available for nature conservation.

Although failure is usually considered best avoided, Redford and Taber's (2000) insightful paper highlights the vital importance of acknowledging and sharing failures for learning to "do" effective conservation. They call upon conservation organizations to willingly admit and document failures so as to promote the "safe-fail" culture essential for establishing adaptive resource management systems. Unfortunately, to the best of my knowledge, no conservation organizations have heeded their call.

Reading Redford and Taber's (2000) editorial proved a seminal moment in my evolution as a conservation professional. I felt challenged and compelled to heed their call for "writing the wrongs;" my own experience concurred with their wisdom. So, I offer an account of failure in conservation, along with a few hard-won lessons, in the hope this small contribution triggers the snowballing of a safe-fail culture within the conservation community. Learning to do conservation better depends on it.

Between 1995 and 2000 the Australian Nature Conservation Agency funded the New South Wales National Parks and Wildlife Service (NPWS) to pilot a bioregional approach to the expansion of the National Reserve System. Founded upon a national, cooperatively developed, bioregionalization (Thackway & Cresswell 1995), the Cobar Peneplain Project (CPP; see Dick 2000) was the flagship project of a national program designed to usher in a new era in systematic conservation planning.

We had ambitious and noble goals. We aimed to establish a learning approach to develop and test new methodologies for the integrated application of the range of activities required for enacting bioregional management, which included application of environmental surrogates for priority-area identification and acquisition, inclusive of Aboriginal heritage values, active community involvement, and off-reserve conservation. We attempted to redefine the manner in which the NPWS practiced conservation by integrating geographically and operationally diverse sections of the organization through a shared "bioregional planning mindset" (Miller 1996) that could be replicated in other bioregions.

Despite the best efforts of a small band of individuals who were passionate about the prospects of bioregional planning for nature conservation, the project was, by almost any measure, a failure. The identified candidate priority conservation areas (Smart et al. 2000) still await purchase, and off-reserve conservation initiatives await implementation. The systematic assessment techniques have not been applied to land acquisition generally. The goodwill and relationships built through the Aboriginal liaison and community involvement programs and the integration of expertise throughout the organization have faded. The report series (see Dick 2000), gathering dust on shelves, is the only tangible evidence remaining of an ambitious, potentially revolutionary initiative.

So what went wrong? The reasons for the failure of CPP are complex but typical of real-world conservation planning initiatives: no high-level political champion with vision, agency failure to fund corporate objectives, external funding reallocated to competing initiatives, institutional in-fighting, land acquisition priorities sidestepped for managers' personal preferences, and knowledge drain through high staff turnover. We tried to document these failings in the concluding report series; the technical limitations are easily explained (e.g., Smart et al. 2000), but on rereading the accounts of the management failings (some of which were mine) they seem to lack incisive direction to future workers, perhaps because we lack a culture of documenting failure in the conservation sciences and hence an honesty that brings clarity to written works.

Definitions of failure depend on one's perspective; as a learning opportunity the CPP was particularly rich. So, what did we learn? The most important lessons concerned people. The project was unsuccessful at encouraging staff toward the bioregional planning mindset (Miller 1996). As individuals, we lacked the "people skills" to close the deal; being passionate about nature conservation was not enough. Scientists receive little or no training in the skills required for functioning in the real world (Soulé 1986), and we were no exception. We discovered that being an effective conservation planner is as much about how to collaborate with people as it is about having the technical, systematic conservation assessment skills and knowledge of a region's natural history to decide where conservation action is required. Knowing what to do is just not enough (Pfeffer &

Sutton 1999). Through this experience dawned the realization of the importance of fusing good science with a good bedside manner. Stakeholders became individual people with idiosyncratic values and behaviors, rather than a collective to be ushered toward our desired goal.

We also learned the importance of experimentation (Redford & Taber 2000) and, inadvertently, the essential significance of a safe-fail culture. My colleagues provided a context in which testing new approaches was encouraged and failure was informally assessed through discussion. They were respectful, humble, and accepting, and as a result, we were strengthened by our failures because we collectively learned from them. Redford and Taber (2000) proclaim that developing a safe-fail culture within conservation organizations is critical for effective conservation and that documenting experiences, particularly our failures, is a fundamental activity for doing effective conservation. I wish to extend the value of failure further.

We cannot act wisely without knowledge, and we will not act wisely without feeling (Allendorf 1997). Conservation professionals and stakeholders are people, and as individual people, failure defines our collective humanity. If we cannot admit our failures, we forsake our vulnerability as individuals and hence abandon our opportunities for professional (and personal) improvement. It is in the acknowledgment of our own and others' vulnerability that trust is nurtured. Trust provides the fertile ground for nurturing the relationships on which social learning and adaptive management depend, and cultivates in others the humility, respect, and acceptance essential to the safe-fail culture.

Humility, respect, and acceptance are not scientific principles. However, they are the defining characteristics of conservation professionals who are effective at implementing conservation on the ground because they are emotionally intelligent (Ciarrochi et al. 2001), equally value different knowledge traditions, consciously foster consilience (Wilson 1998), and pursue excellence over the need for influence (R. Cowling, personal communication). They refuse to be party to the much-cited divide between scientists and practitioners or be shielded from public scrutiny by the ivory towers of elitist scientific institutions (Soulé 1986). They do not measure their success with publications in influential journals or hide behind the often senseless jargon of scientific disciplines (Peters 1991). I applaud and admire my colleagues who have put the improvement of conservation practice above personal success, who not only muddy their boots in the trenches of real-world conservation activities, but who then bare their souls to criticism by documenting the failings through which they have learned how to do conservation (e.g., Groves 2003, p. 43; Gelderblom et al. 2003, p. 295).

Although science favors questions it knows it can solve (Medawar 1967), those involved in on-the-ground conservation grapple with problems regardless of the surety of finding answers because once conservation opportunities are gone, they are lost forever. So conservationists should not fear uncertainty, but rather embrace it as the rich source of our failing and hence our learning to do more effective conservation.

Conservation Biology is committed to circulating good information to support the practice of our discipline (Meffe 2001). I believe documenting and learning from failures is so important that I challenge the journal to implement a new manuscript category, "Failing but Learning." Herein, short case studies would detail learning processes that lead to improvements in conservation practice through failures. Knowing that failure is worth a publication in a leading journal might encourage conservation professionals to take their courage in hand, publicly document their failures, and thereby promote the safe-fail learning culture essential for ensuring we individually and collectively do better conservation. I (perhaps wistfully) hope this paper triggers an avalanche of similar narratives of failure and learning to counter the bravado of those consistently reporting only success. Who among you will heed Redford and Taber's call?

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Paper I

Knowing But Not Doing: Selecting Priority Conservation Areas and the Research-Implementation Gap*

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"Given their rigorous, objective approach, there is no doubt that reserve selection programs are able to configure reserve networks that are efficient in terms of land allocation. So why, when they clearly have such potential to inform planning decisions, are they rarely used by managers?"

John R. Prendergast, et al.
The gaps between theory and practice in selecting nature reserves
Conservation Biology 13: 484-492, 1999

* In press as: Knight, A.T., R.M. Cowling, M. Rouget, A. Balmford, A.T. Lombard and B.M. Campbell. Knowing but not doing: selecting priority conservation areas and the research-implementation gap. *Conservation Biology*.

ABSTRACT

Conservation assessment is a rapidly evolving discipline whose stated goal is the design of networks of protected areas that represent and ensure the persistence of nature (i.e., species, habitats and environmental processes) by separating priority areas from the activities that degrade or destroy them. However, despite a burgeoning scientific literature that ever-refines these techniques for allocating conservation resources, it is widely believed that conservation assessments are rarely translated into actions that actually conserve nature. We reviewed the conservation-assessment literature in peer-reviewed journals and conducted survey questionnaires of the authors of these studies. Two-thirds of conservation assessments published in the peer-reviewed scientific literature do not deliver conservation action, primarily because most researchers never plan for implementation. This research-implementation gap between conservation science and real-world action is a genuine phenomenon and is a specific example of the "knowing-doing gap" that is widely recognized in management science. Given the woefully inadequate resources allocated for conservation, our findings raise questions over the utility of conservation assessment science, as currently practiced, to provide useful, pragmatic solutions to conservation-planning problems. A re-evaluation of the conceptual and operational basis of conservation-planning research is urgently required. We recommend the following actions for beginning a process for bridging the research-implementation gap in conservation planning (1) acknowledge the research-implementation gap is real, (2) source research questions from practitioners, (3) situate research within a broader conservation-planning model, (4) expand the social dimension of conservation assessments, (5) support conservation plans with transdisciplinary social-learning institutions, (6) reward academics for societal engagement and implementation, and (7) train students in skills for 'doing' conservation.

INTRODUCTION

Unnaturally high rates of species extinction and habitat loss through anthropogenic activities have plunged the world into an environmental crisis (Pimm et al. 1995; Vitousek et al. 1997). The resources allocated to stemming this crisis are minute compared with the resources allocated to the activities causing the massive decline (James et al. 1999). A great deal of time, money, and effort has been invested in the development of spatially explicit techniques for identifying candidate areas for conservation action. These techniques, commonly called conservation assessments, provide scientifically defensible information for the efficient deployment of conservation resources. They enhance the effectiveness of implemented conservation actions by better ensuring ecological functioning and resilience of protected areas, minimizing implementation and opportunity costs, reducing conflict between interest groups, and avoiding reactive litigation by developers (Noss et al. 1997; Soulé & Terborgh 1999; Margules & Pressey 2000).

When perceived as a subdiscipline of conservation biology, the science of conservation assessment has evolved from a strong belief in the importance of conservation researchers doing research of societal relevance (Soulé & Wilcox 1980). Undertaking research that is not only innovative, but useful, is a recently expressed goal of the Society for Conservation Biology (Meffe et al. 2006). There has been an exponential increase in the number of conservation assessments published in the peer-reviewed literature since the late 1980s (Pressey 2002).Despite this growth in productivity, however, a wide spectrum of practitioners and researchers have suggested that few conservation assessments published in the peer-reviewed literature are translated into conservation action (e.g., Noss et al. 1997; Prendergast et al.1999; Cabeza & Moilanen 2001; Whitten et al. 2001; Balmford 2003). If the science of conservation assessment is not leading to actions that effectively conserve nature then what is the point of it (Whitten at el. 2001)?

This research-implementation gap in conservation planning manifests in a number of ways. Documented cases of conservation assessments successfully being translated into conservation action are relatively rare in the peer-reviewed literature (Ehrenfeld 2000; Maddock & Benn 2000), as are conservation assessments that attempt, but fail, to be translated into effective action (Jepson et al. 2002; Knight 2006). Global-scale conservation assessments are thought to lack effectiveness in informing the delivery of conservation action (Mace et al. 2000; Whitten et al. 2001; Brummitt & Lughadha 2003). Rather than doing conservation, researchers appear preoccupied with describing the lack of representiveness of existing protected-area networks, experimentally testing data, and improving the efficiency of area-selection algorithms in theory (Rodrigues et al. 2000; Knight et al. 2006a). The activities of conservation organizations rarely appear to be informed by published research (Pullin et al. 2004), and conservation and land management organizations typically develop their own conservation-assessment techniques independently of research in published in journals (Hopkinson et al. 2000; Prendergast et al. 1999);

This gap between research and implementation is almost certainly the norm for other subdisciplines of conservation biology (Saunders et al. 1991; Pickett et al. 1997; Ehrenfeld 2000; Stinchcombe et al. 2002; Linklater 2003). For example, Linklater (2003) found that the quantity of scientific literature on endangered rhinoceros increased in response to its decline, but became dominated by ex situ laboratory-based studies despite conservation action plans identifying in situ and ecological studies as priorities. More generally conservation biology has a poor record of translating research into action because most research has been theoretical (Salafsky et al. 2002). Whitten et al. (2001) laments our impotence as a discipline to stem habitat destruction and species extinction in priority areas. Fazey et al. (2005) found that only 20% and 37% of studies had high relevance to policy and management, respectively. Many more examples of this gap between published conservation biology research and priorities for action could be cited.

This "knowing-doing gap" (Pfeffer & Sutton 1999) is also widespread in many other applied sciences, for example management and organizational science (Pfeffer & Sutton 1999; Starbuck 2006), environmental psychology (McKenzie-Mohr 2000; Sommer 2003), ecology (Ehrlich 1997), restoration ecology (Higgs 2005), landscape ecology (Opdam et al. 2001), and ecosystem management (McNie 2007). It is clear that the science of conservation assessment is not alone in facing the challenge of translating research into action.

In the conservation sciences, we rarely ask of ourselves how well we are performing (Ehrenfeld 2000), so here we focused on the importance of critiquing the design and application of area-selection studies (Cowling et al. 2004). We sought, first, to establish whether the research-implementation gap in conservation planning is a real phenomenon by assessing the extent to which conservation assessments published in the peer-reviewed literature have been translated into action. Second, we examined whether authors of conservation assessments intended to implement research outcomes. Third, we examined whether or not the objectives of a conservation assessment influenced the perceived effectiveness of implemented actions. Our objective is to highlight current limitations in the way the science of conservation assessment is practiced, with a view toward improving the societal relevance and effectiveness of this research (Cowling et al. 2004). Confirming or denying the research-implementation gap is fundamental to identifying new and more effective approaches to the design and implementation of conservation assessments.

METHODS

We investigated the research-implementation gap in conservation planning through a literature review linked to an international questionnaire survey of authors. We identified all articles containing a conservation assessment that appeared in a peer-reviewed journal written in English between 1998 and 2002. We defined a conservation assessment as any spatially explicit, repeatable approach that identified areas as potential priorities for nature conservation activities. We did not include expert-based approaches because these appear to be considered by many conservation researchers as distinctly less defensible approaches and because they form a relatively small proportion of the peer-reviewed literature. Gap analyses and assessments of representativeness were also excluded, unless they specifically took the step beyond the assessment of conservation status to area selection, because conservation status and area selection are related but different activities (Pressey & Cowling 2001). Where a suite of publications was developed from one project, we assessed only the paper detailing the conservation assessment. Grey literature was excluded because of the difficulties of comprehensively collating it. We reviewed the literature from 1998 to 2002 because (1) conservation assessment is a relatively young science, and technique testing early in the life of the discipline was essential for establishing the relative benefits and limitations of different approaches, (2) examination and understanding of recent trends in the discipline is of far greater use for identifying the existence of, and solution for, the research-implementation gap than trends in the mid- to distant past, and (3) our experience with a significant and growing number of pragmatic regional conservation planning initiatives (e.g., Knight et al. 2006b) suggests that implementation may take several years to get underway, meaning the four-year lag between 2005 (when the review was undertaken) and the 2002 cut-off provides sufficient time for implementation to have begun.

The questionnaire comprised four questions and was specifically designed to be simple and rapidly completed by respondents, so as to secure a high response rate. It was e-mailed to lead authors, or the author listed for contact, of identified articles. If the first author could not be located, another author was contacted. Questionnaires were sent to authors of 159 conservation assessments.

RESULTS

We secured a 55.3% response rate (88 responses received). Responding authors were primarily from universities (59.1%), but also were from research groups (22.7%), government departments (11.4%), and nongovernmental organizations (4.5%).

We reviewed the literature for the degree to which questionnaire responses from authors of published conservation assessments reported implementation activities. Only 5.7% (5) documented the implementation of actions that promoted nature conservation on the ground. Almost one third of conservation assessments (29.5%, 26) discussed implementation in theory (i.e., the actions which could be undertaken). Implementation was not mentioned in 62.5% (55) of the articles reviewed. Questionnaire results revealed that implementation of action occurred more often than the peer-reviewed literature indicates, with 33.0% (29) of conservation assessments leading to implementation of action.

Overall, 26.1% (23) of conservation assessments had the objective of implementing some form of action. The identification of areas for implementation of conservation action was the primary objective in 19.3% of the studies, and an additional 6.8% (6) sought to identify areas for the implementation of action and to improve research techniques for priority-area identification. Almost 70% (60) of conservation assessments were formulated primarily to improve research techniques, with little or no intention to implement action.

Actual attempts to translate conservation assessments into action were marginally higher than indicated by their objectives: in 33.0% (29) of the studies, implementation attempts were made. The intention to implement action was strongly linked to the objective of the conservation assessment. Ninety-four and one-tenths percent (16) of conservation assessments whose objective was to implement action and 83.3% (5) whose objectives were to implement action and improve conservation assessment techniques actually were implemented. Only 11.7% (7) of conservation assessments whose primary objective was to advance science through improvement of conservation assessment techniques resulted in action being implemented.

Respondents were also asked to rate the perceived effectiveness of the actions implemented. Of the 108 actions reported from the 29 conservation assessments that attempted implementation, only 13.0% (14) were considered "highly effective." The majority of implemented actions – 58.3% (63) – were considered only "fairly effective." "Poorly effective" and "ineffective" actions were reported by almost one-fifth (19.4%, 21) of respondents. These results are researcher's perceptions and are not the result of quantified monitoring of conservation effectiveness.

DISCUSSION

The research-implementation gap in conservation planning is a real phenomenon. It is possible that our results overestimate the extent of this gap because authors may be unaware of implementation activities that use their research. However, we regard this as unlikely, because practitioners typically do not access the peer-reviewed literature (Redford & Taber 2000) in search of techniques to implement, and most implementing organizations have developed their own (often unpublished) conservation assessment techniques (Hopkinson et al. 2000; Prendergast et al. 1999). Additionally, the research-implementation gap may be narrower in the grey literature, which we did not analyze because it is not systematically accessible.

It is of great concern that the majority of conservation assessments published in the peer-reviewed literature were not designed with the intention to implement conservation action. Unsurprisingly, conservation assessments not designed to be implemented were not translated into action. Of those that were intended for implementation, the majority led to the implementation of conservation action, albeit with questionable effectiveness. This raises an important question. Why are conservation researchers, who have chosen a mission-orientated career, failing to do science that contributes meaningfully toward stemming the environmental crisis?

Basic research is doubtless an essential complement to the genesis and continuing effectiveness of all applied sciences, including conservation science (Noss 1999). However, our theoretical understanding of the technical dimensions of conservation assessment now far exceeds our ability to apply this knowledge effectively to solving pragmatic conservation planning problems. For example, conservation assessments should include economic costs of implementation if interventions are to be cost effective (Naidoo et al.

2006); however, we are far from being able to establish institutional structures that ensure the effective spending of conservation funds in priority areas (e.g., Smith et al. 2003).

Conservation assessment is but one relatively small, but essential, stage of operational models for conservation planning (Pressey et al. 1996; Knight et al. 2006a). Unfortunately, the majority of conservation planning research is focused on conservation assessment at the expense of other stages that are arguably more important for implementing effective conservation action. The rich literature on conservation assessment manifests as a preoccupation by researchers with developing ever more elegant techniques to apply to a diminishing pool of increasingly well-known subjects (Kirkpatrick & Brown 1991). The causes of the research-implementation gap are undoubtedly a complex suite of factors, so how does one improve the societal relevance of conservation assessments?

Recommendations for Bridging the Research-Implementation Gap

Ensuring that conservation assessment techniques are of societal relevance requires a move beyond the trickle down, transfer, and translate models of knowledge dissemination (van Kerkhof & Lebel 2006). Much more is required than merely publishing research in high-impact journals in the hope that the outcomes will trickle down to practitioners. Moreover, providing practitioners access to the literature (Prendergast et al. 1999), or even assisting them through the translation of research outputs and direct transfer of skills (Rodrigues et al. 2000), is likely to have limited success in closing the knowing-doing gap (Pfeffer & Sutton 1999; van Kerkhof & Lebel 2006). Below we present recommendations for both scientific institutions and individual researchers to better ensure conservation assessments are usefully applied to pragmatic conservation problems.

1. Acknowledge the Research-Implementation Gap is Real

First, the research-implementation gap in conservation planning must be acknowledged as a real phenomenon. Management science has been researching the knowing-doing gap for several decades. Earlier refutations of the research-implementation gap in conservation planning (e.g., Pressey 1999; Pressey & Cowling 2001) have successfully clarified lingering misunderstandings and promoted the benefits of adopting conservation assessment techniques, but have not denied the existence of this gap. Bridging the research-implementation gap requires that we, as a scientific community, acknowledge and agree we generally are not conducting research of societal relevance and move beyond simply noting the existence of the research-implementation gap to implementing tangible changes to correct it.

2. Source Research Questions from Practitioners

Those doing conservation assessment research typically do not have responsibility for processes that implement conservation action. If they wish to translate their research into action, then they must engage practitioners (Knight et al. 2006b). In short, conservation planners must facilitate a solution to a specific practitioner's need; it is generally not effective to conduct a conservation assessment and then attempt to promote it post hoc to a practitioner (Knight et al. 2006b). Researchers should therefore formulate problems collaboratively with stakeholders so as to comprehensively understand implementation opportunities and constraints and design user-useful, user-friendly assessments (e.g., Theobald et al. 2000; Pierce et al. 2005).

3. Situate Research within a Broader Conservation Planning Operational Model

Conservation assessment techniques are useful tools for allocating conservation resources; however, alone, these can never manifest conservation action (Cowling et al. 2004; Knight et al. 2006a). Conservation assessments that are translated effectively into action are typically situated within a broader conservation-planning operational model (e.g., Brunckhorst 2000; Knight et al. 2006a). These operational models typically integrate a range of activities as a suite of multiple stages, of which conservation assessment is but one early stage. Conservation assessment is complemented with other stages, including stakeholder visioning, development of planning products and an implementation strategy, mainstreaming of outcomes, enabling (i.e., capacity building) of stakeholders, and finally the implementation of conservation instruments and social learning institutions (Knight et al. 2006a). Specifically, conservation assessments should be linked to implementation strategies that detail the actions required to manifest conservation opportunities at areas identified as important for achieving conservation goals. Together these strategies comprise an effective conservation plan (Knight et al. 2006a, b).

4. Expand the Social Dimension of Conservation Assessments

If a conservation assessment is to be usefully applied, it must be conducted in a context that situates it within the real world. This requires an accurate understanding of how social-ecological systems function (Meffe 2001; Carpenter & Folke 2006). This can be operationalized in two ways. First, conduct a social assessment of a planning region prior to, and with equivalent resourcing as, a conservation assessment (Cowling & Wilhelm-Rechmann 2007). This ensures a sound understanding of implementation opportunities and constraints and may serve as an early means of engaging stakeholders. Second, it is more useful to map conservation opportunities than priority areas on the sole basis of biological or environmental data (Knight & Cowling 2007). Mapping conservation opportunities with a range of human, social, and economic data greatly facilitates the translation of maps of important areas into action (Knight et al., in prep b and c). Researchers should focus on natural systems and processes compromising valued nature (Margules & Pressey 2000) and on key people, networks, and institutions affecting decision making and conservation instruments appropriate for implementation (Salafsky et al. 2002; Knight et al. 2006a). This allows the development of a land management model that can be collaboratively developed with stakeholders to guide implementation (Hulse et al. 2004).

5. Support Conservation Plans with Transdisciplinary Social Learning Institutions

Many practitioners appear not to realize the benefits of science for decision making (Pressey 1999). There is an urgent need for institutions that translate science into action by fostering relationships between researchers and practitioners (Prendergast et al. 1999). Examples include high-level, multijurisdictional, decision-making committees (e.g., Lee 1993), thematic bioregional initiatives (e.g., Soulé & Terborgh 1999), and local-scale forums for engaging stakeholders in conservation and natural resource management (e.g., Knight & Cowling 2006). These should focus on a transdisciplinary approach to social learning and adaptive management (Salafsky et al. 2002; Carpenter & Folke 2006; Knight et al. 2006a) so as to constantly improve decision-making processes through learning. This requires researchers to cease overstating the importance of theoretical research (Prendergast et al. 1999), be humble and interested in practitioners needs, and refocus their world view on the effectiveness of actions rather than the efficiency of algorithms (Prendergast et al. 1999; Rodrigues et al. 2000). In doing so, they will need to fit-in with broader planning processes, build networks with a diverse range of stakeholders of complementary skills, and advocate the value of nature, the importance of science to establishing effective management, and the benefits of conservation assessments.

6. Reward Academics for Societal Engagement and Implementation

Academics appear generally to regard societal engagement and implementation activities as unprofitable (Diamond 1986). Researchers who (understandably) wish to advance their careers, achieve progress by conforming to existing structures and processes (Starbuck 2006). However, research institutions typically promote inward-looking, unidisciplinary approaches (Max-Neef 2005) and so place little value on implementation, which is outward-looking and multi- and interdisciplinary in practice. Few institutions offer incentives encouraging researchers to do useful research (Burbidge & Wallace 1995) and perversely discourage useful research by valuing the production of information above doing conservation through institutional structures that reward researchers for publications in high-impact journals that eschew implementation issues (Campbell 2005). It is therefore imperative that organisations such as the Society for Conservation Biology (1) convince administrators of research institutions of the value and importance of applied research; (2) encourage reformation of staff progression criteria, inclusive of incentives for researchers to engage society and conduct pragmatic research (Hobbs 1998; Briggs 2001); (3) convince funding bodies to encourage applied research and demand accountability for implementation; and (4) promote the publication of pragmatic studies in peer-reviewed journals.

Academic conservation planners will find the move beyond conservation assessment into a broader conservation-planning process challenging, because they will be required to balance their personal values against the values and challenges of working collaboratively with practitioners (Davis et al. 1999; Kiker et al. 2001; Hulse et al. 2004); the extended time periods required for effective implementation, which counters the demand for regular publications (Pressey & Taffs 2001); the prospect of their recommendations being drastically modified by political, social, and economic imperatives (Peters 1991; Soulé & Terborgh 1999; Margules & Pressey 2000); and the reality that even the best-designed and engaged conservation-planning process can fail to be implemented for unforeseen reasons.

7. Train Students in Skills for Doing Conservation

Universities produce conservation professionals with excellent skills for describing the current environmental decline, but without the skills to stem it (Soulé 1986; Jacobson & McDuff 1998; Penn 2003). Conservation biology courses must embody consilience – the fusion of knowledge traditions (Wilson 1998) – complementing knowledge and skills from the humanities, social sciences, and natural sciences. Students must be taught the skills required to do effective conservation and about the formulation of scientific thought, the mission of conservation science, the responsibilities of being a conservation professional, how projects operate in the real world (see Salafsky et al. 2002 for an excellent example), and specifically about the research-implementation gap.

A CALL TO ACTION

The science of conservation assessment has lost its way and become a displacement behavior for academia (Whitten et al. 2001), one in which research identifies where conservation needs to be done, but is silent on how to actually achieve it (Knight et al. 2006a). This impotence can be remedied because conservation assessment techniques have much potential to transform conservation planning (Prendergast et al. 1999; Salafsky et al. 2002). However, we are not in the business of "what might be." Our collective fascination with ever-refining computer-based conservation assessment techniques must be tempered by the need to develop techniques that can deliver products that are useful for implementation.

Ultimately, an effective conservation planner is one who links knowing and doing. Inevitably, this requires engaging people and the choices they make. Excellent examples exist in which conservation planners have built productive partnerships with practitioners, collaboratively identified conservation problems so as to understand implementation opportunities and constraints, and designed conservation assessment approaches and conservation-planning products tailored to meet practitioners' needs for achieving conservation goals (e.g., Kirkpatrick 1983 from Pressey 2002; Pressey 1998; Cowling et al. 1999; Stoms et al. 2002; Rouget et al. 2006). Although the science of conservation assessment, alone, will only ever be able to solve a small proportion of conservation problems (Schön 1983; Cowling et al. 2004), it is, however, an important component of broader conservation planning processes that deliver effective conservation action. We have much to learn about how to situate conservation assessments and translate them into effective action, but conservation researchers who engage society and the needs of practitioners (Salafsky et al. 2002; Knight et al. 2006b) are well on the way toward bridging the research-implementation gap in conservation planning.

ACKNOWLEDGEMENTS

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Attachment 1

Questionnaire – Implementation of Systematic Conservation Assessments 1998 to 2002

The balance between science and on-ground action is important for biodiversity conservation. We are examining the differences between science and action of published conservation planning studies in an attempt to improve the effectiveness of our conservation science. It would be useful and greatly appreciated if you might complete answers to the four very short questions below on your publications between 1998 and 2002. If you have more than one publication during this period they will be sent as separate e-mail messages.

Title of your published study:
Publication name inserted here

1. Was this study primarily designed to: (A) improve, through science, techniques for the identification of areas for conservation; OR (B) identify areas where on-ground conservation action would be implemented through a 'real-world' conservation planning project; OR (C) some other reason (if so, please list)?

(A) / (B) / (C)   (please **delete** the **incorrect** responses)

2. Have attempts been made to implement conservation activities on the ground at the priority areas identified by this study?

Yes / No   (please **delete** the **incorrect** response)

3. If you answered 'Yes' to Question 2, what form has implementation taken? Please place the letter best describing the effectiveness of each type of implementation approach attempted before each and every 'Implementation Approach', with implementation effectiveness classified as : A = No implementation attempted; B = Ineffective; C = Poorly effective; D = Fairly effective; and E = Highly effective.

Implementation Approach
1. Land purchased or transferred for formal protected area
2. Private land conservation agreements established (e.g. covenants, easements)
3. Integrating conservation into land-use, e.g., 'biodiversity business'
4. Integrating conservation into existing land-use planning process (e.g. E.I.A., local govt. land zoning)
5. Targeting extension service activities (e.g. face-to-face support from people in govt. or NGOs)
6. Restoration / rehabilitation / species re-introduction
7. Contributing towards conservation policy
8. Other (please specify)

4. Are there any other systematic conservation assessments you have completed as primary author, published 1998 to 2002, peer-reviewed or 'grey literature', not listed here? Please cite them, and attach a copy if you have one available.

Sincerest thanks for taking the time to complete this questionnaire – it will make a difference.

Paper II

An Operational Model for Implementing Conservation Action*

Formatted for *Conservation Biology*

"It won't be long before many conservation biologists are spending more time at community meetings than in the field or laboratory."

Michael E. Soulé

Conservation Biology: The Science of Scarcity & Diversity, p.5
Sinauer Associates, Sunderland, 1986

* Published as: Knight, A.T., R.M. Cowling and B.M. Campbell. 2006a. An operational model for implementing conservation action. *Conservation Biology* 20(2): 408-419.

ABSTRACT

The preoccupation of many conservation planners with the refinement of systematic assessment techniques has manifested an "implementation crisis" in conservation planning. This preoccupation has provided systematic assessments with well-tested tools (e.g., area selection algorithms) and principles (e.g., representation, complementarity), but our understanding of these techniques currently far exceeds our ability to apply them effectively to pragmatic conservation problems. The science is informative about where one needs to do conservation, but silent on how to achieve it. Operational models, defined as simplified conceptualizations of processes for implementing conservation action at priority conservation areas, are essential for guiding conservation planning initiatives because they assist understanding of how these processes function. Operational models developed to date have largely been linear, simplistic, and focused on the systematic assessment of biological entities. Experience in the real world indicates that operational models for conducting conservation planning initiatives should explicitly complement a systematic conservation assessment with activities that empower individuals and institutions (enabling) and explicitly aim to secure conservation action (implementation). Specifically, implementing effective conservation action requires that systematic assessments be integrated functionally with a process for developing an implementation strategy and processes for stakeholder collaboration while maintaining a broad focus on the implementation of conservation action. A suite of hallmarks define effective operational models (e.g., stakeholder collaboration, links with land-use planning, social learning, and action research). Greater development and testing of the practical application of operational models should lead to higher levels of effective implementation and alleviate the implementation crisis. Social learning institutions are essential for ensuring ongoing improvement in the development and application of operational models that deliver effective conservation action.

OPERATIONAL MODELS AND THE IMPLEMENTATION CRISIS

The future of our environment and quality of life depends largely on the effectiveness of in situ conservation; resources allocated to implement conservation activities, however, are woefully inadequate (World Resources Institute 1992; Balmford et al. 2002). These realizations have promoted great investment in and rapid development of systematic conservation assessment techniques (Prendergast et al. 1999; Groves 2003). Many of these techniques have been formalized as operational models for conservation planning (e.g., Margules & Pressey 2000). We restricted our definition of conservation planning to regional- or local-scale initiatives that apply quantified targets to identify spatially explicit areas for implementing conservation action to ensure the persistence of nature (sensu Margules & Pressey 2000). These operational models represent attempts to devise generic solutions to the challenge of sustainable use of regional-scale natural resources. Systematic conservation planning (Margules & Pressey 2000) differs from expert-based planning (e.g., Mittermeier et al. 1995) in that it applies explicit quantifiable targets to spatially explicit surrogates of valued elements of nature (e.g., species, ecosystems) to design conservation area networks that achieve the goals of representation and persistence (Margules & Pressey 2000). An operational model describes a simplified conceptualization of how a conservation planning process functions. Such generic approaches are useful because conservation solutions are rarely unique (Murphy & Noon 1992) and, in our experience, an operational model focused on implementing conservation action and explicitly situated within the unique context of a regional social-ecological system (sensu Berkes et al. 2002) promotes effective conservation planning. Operational models should aim to deliver on-ground conservation action, not to simply generate information. Many operational models, however, fail to adequately address practical implementation issues to guide responses to the social, economic, and institutional issues so critical to effective implementation.

Conservation activities can be conceptualized across a spectrum of three broad types—systematic assessment, planning, and management. Systematic assessment involves the scientific evaluation of valued elements of nature, for example, the technical activities of gap analysis and conservation area network selection and design. These activities generate information to assist decision making on where conservation should be enacted, but not on how those initiatives should be undertaken (Scott & Csuti 1997). Planning takes the next step toward action by linking systematic assessments to processes for developing an implementation strategy (i.e., how conservation initiatives are undertaken) in collaboration with stakeholders (Fig. 1). Management comprises activities undertaken to maintain or enhance the continued flow of benefits to society from valued elements of nature, for example, conservation covenants on private land and habitat restoration. Defining the scope of each of these activities is essential for ensuring effective conservation action because some activities conserve nature whereas others do not. By our definition, many of the publications in peer-reviewed journals represent systematic conservation assessments, not conservation planning, because they contain no links to processes for developing implementation strategies or stakeholder collaboration and so are unlikely to be effectively implemented.

Systematic conservation planning is currently mired in an "implementation crisis" (Knight & Cowling 2003*a*). Most conservation planning studies published in peer-reviewed journals consist of scientific analyses in pursuit of ever-more precise information on, and efficient techniques for, prioritizing elements of nature (i.e., area selection algorithms). Far less scientific attention has been dedicated to planning the activities required to ensure the persistence of species, landscapes, and the processes that support them at selected priority areas (Salafsky et al. 2002). Ehrlich (1997) laments, ". . . journal[s] [are] still packed with papers describing more and more sophisticated analyses applied to more and more trivial problems." Despite numerous references to the implementation crisis in the literature (e.g., Kirkpatrick & Brown 1991; Prendergast et al. 1999; Salafsky et al. 2002), few academic conservation planners regularly climb down from their ivory towers to get their shoes muddy in the messy, political trenches, where conservation actually takes place. Several conservation organizations are applying systematic conservation planning but rarely publish in the peer-reviewed literature (e.g., Poiani et al. 1998; Sanderson et al. 2002), making assessment of their effectiveness difficult. If systematic assessments published in journals are not actually resulting in the implementation of effective conservation action, then what is their purpose (Whitten et al. 2001)?

Existing operational models provide an important foundation for conservation planning (e.g., Margules & Pressey 2000; Groves et al. 2002); most, however, oversimplify the reality of real-world initiatives. Typically they focus on biological entities and not the broader social-ecological systems in which conservation planning initiatives operate. Most are linear operational models and so can only provide partial conservation solutions because they prescribe positivist, biologically focused solutions to what are normative, complex conservation problems typically driven by social and economic issues. Activities such as stakeholder collaboration and implementation strategy development, which are as important for effective conservation initiatives as systematic assessments, are given

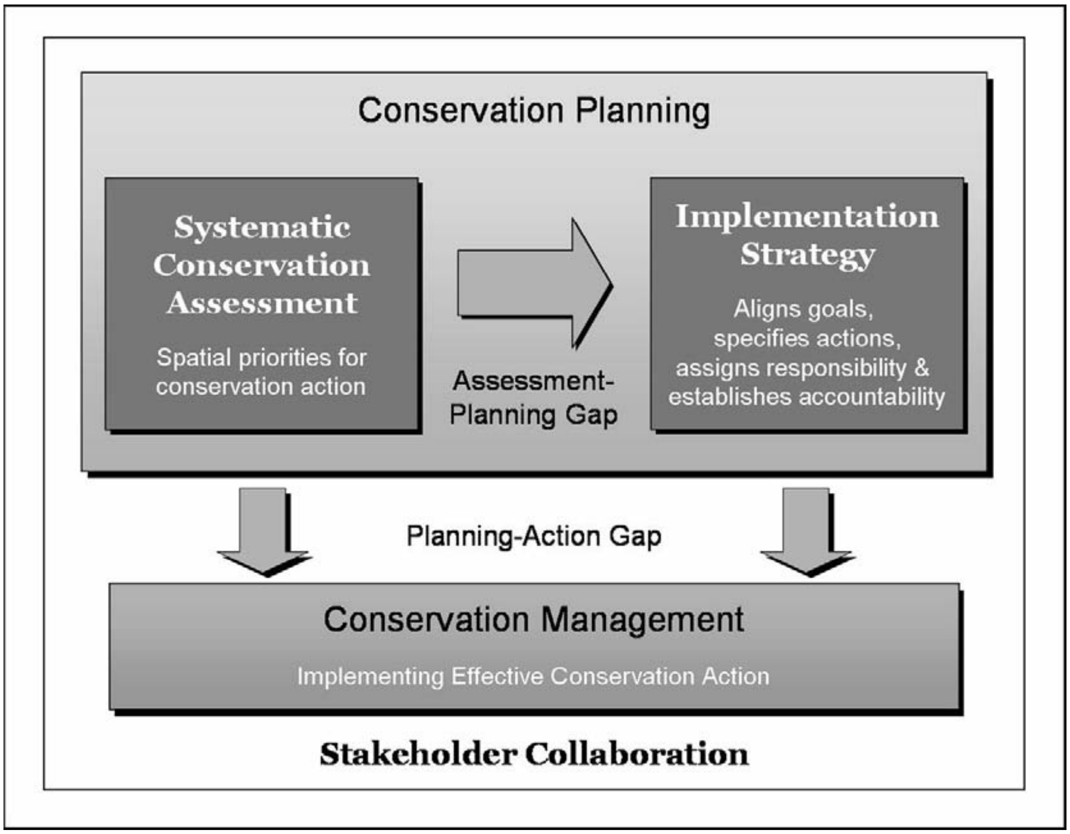

Figure 1 – A simple model of an effective conservation planning process, highlighting the essential and complementary processes of (1) undertaking a systematic conservation assessment, (2) developing an implementation strategy, and (3) stakeholder collaboration. The assessment-planning gap and the planning-action gap are forms of the "knowing-doing gap" (Pfeffer & Sutton 1999) and are very real obstacles to translating knowledge or information (e.g., a map of priority conservation areas) into conservation action on the ground (e.g., private-land conservation agreements such as covenants). Adapted from Driver et al. (2003).

insufficient attention (e.g., Margules & Pressey 2000; Pressey & Cowling 2001; Gaston et al. 2002). Alternatively, some operational models artificially separate systematic assessment from the complementary processes of stakeholder collaboration and implementation strategy development (e.g., Groves et al. 2002). This structures a "knowing-doing gap" (Pfeffer & Sutton 1999)—a well-recognized phenomenon in management science—between assessment and planning (Fig. 1) that can potentially make implementation problematic. Refinement and greater elaboration of the scope and structure of existing operational models are required to ensure their effectiveness.

Systematic assessments are, however, essential tools for implementing conservation action (Driver et al. 2003). When integrated with expert knowledge (Dick 2000; Pressey & Cowling 2001) and coupled with implementation strategy development in the context of stakeholder collaboration (Driver et al. 2003), they provide a foundation for effective conservation planning. A major value of systematic assessments lies not only in the priority conservation areas these approaches identify but also in the mechanism they provide for stakeholder collaboration.

In response to these limitations, we (1) present a case for why conservation planners must place greater emphasis on developing and testing operational models, (2) propose and examine the hallmarks of effective conservation planning models, and (3) present two generic operational models (Figs. 2 & 3) for critique and wider application. All are founded on earlier work and are formulated from our involvement in at least nine conservation planning initiatives in Australia and South Africa (A.T.K. and R.M.C.) and extensive natural resource management experience (B.M.C.). Specifically the operational model we present evolved throughout the Subtropical Thicket Ecosystem Planning (STEP) Project in South Africa, situated in one of the expanded suite of hotspots (Steenkamp et al. 2004); and we illustrate various points with examples from the STEP Project.

IMPORTANCE OF OPERATIONAL MODELS

Operational models better ensure the effective implementation of societally relevant conservation planning initiatives (Johnson et al. 1999; Margules & Pressey 2000; Groves et al. 2002). Conservation planning is a highly complex process (Cowling et al. 1999), and an operational model intellectually simplifies the functioning of conservation planning

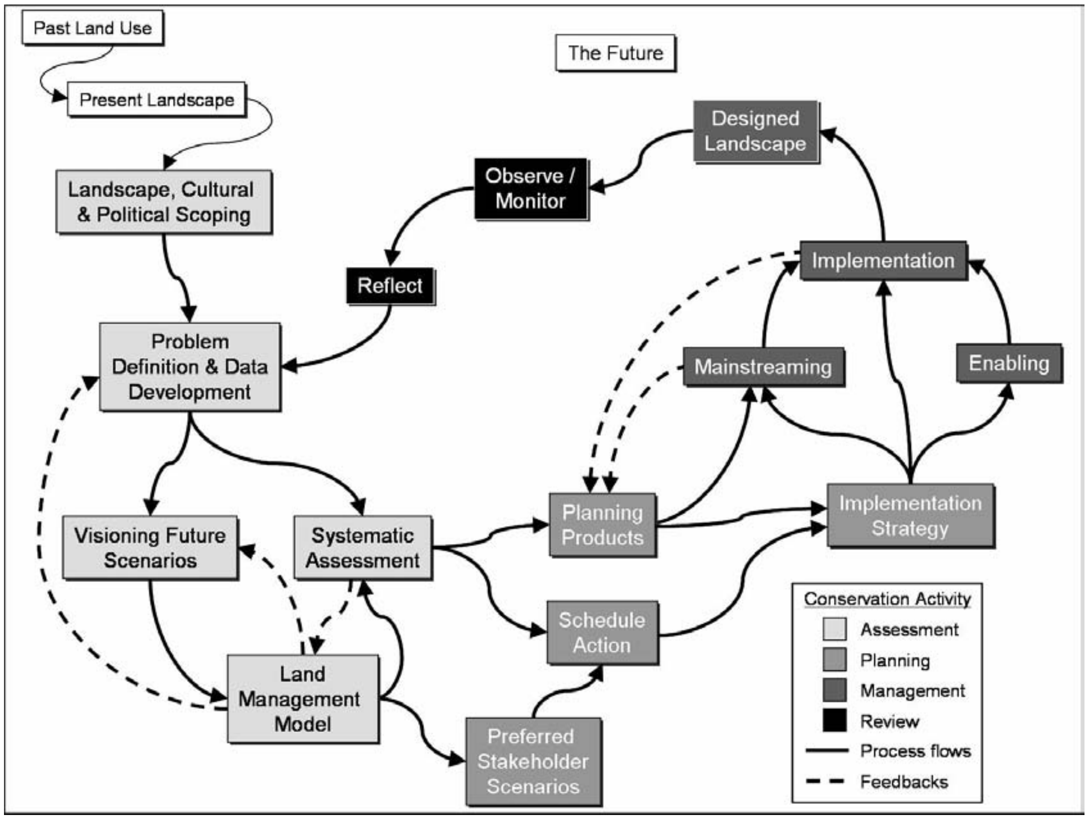

Figure 2 – An operational model should reflect a complex, heuristic, web-like structure because conservation planning processes rarely unfold as a suite of linear stages. Feedbacks (dashed lines) are typically required between stages to ensure the effectiveness of conservation planning processes, for example, iteratively refining planning products with stakeholders before delivering them for use (see Pierce et al. 2005). Stages of systematic assessment, planning, and management are followed by stages of review, which completes an action research cycle (sensu McNiff & Whitehead 2003). This requires the linking of social learning institutions (Fig. 4), such as research forums and landowner groups to the planning process to ensure the ongoing refinement of the operational model, empowered stakeholders, and a more effective conservation planning process. Adapted from Brunckhorst (2002).

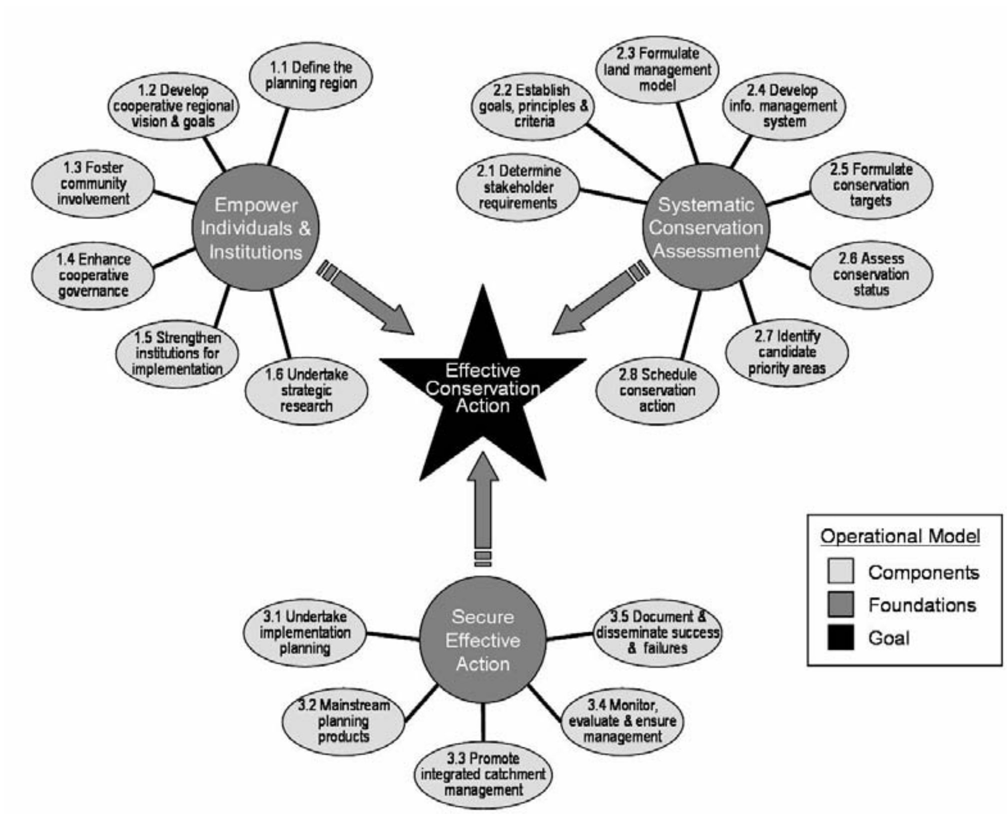

Figure 3 – Components of an operational model for "doing" pragmatic conservation planning. Thematic but integrated components are grouped into three interlinked foundations: (1) empower individuals and institutions, (2) systematic conservation assessment, and (3) secure effective action. Each foundation is essential for an effective conservation planning process.

processes so they can be more easily conceptualized. This better enables the integration of diverse and dynamic disciplines (e.g., landscape ecology, land-use planning, management science), approaches (e.g., expert and systematic), activities (e.g., stakeholder collaboration, systematic assessment, plan implementation, site management) and stakeholders (e.g., landowners, government, scientists) across a range of temporal, geographical, ecological, economic, and social scales. Effective coordination of these diverse activities and a comprehensive approach inclusive of all essential tasks are better ensured. Information transfer of tested best practice between individual people, project stages, or projects is facilitated, improving the likelihood of success. Preemptive action and more cost-effective assessments are encouraged (Purdie 1987; Groves et al. 2002), delivering representative, less biased, and better designed conservation area networks (Margules & Pressey 2000) and reduced financial costs of implementation (Ando et al. 1998). An operational model assists planners in documenting, justifying, and defending decisions (Murphy & Noon 1992).

Conservation initiatives ultimately stand or fall on their ability to encourage and empower stakeholders to implement sustained conservation action (Yaffee & Wondolleck 2000). An operational model provides stakeholders a clear and transparent explanation of the stages of a conservation planning process (Fig. 4); this brings people with diverse interests together under a common understanding and vision of the planning approach and provides enhanced defensibility by facilitating public critique. Roles and responsibilities are situated in a broader context that can then equally promote the value of different knowledge traditions. This facilitates the fusion of practitioners' pragmatic experience with researchers' scientific knowledge. Essential links between stakeholders can be clearly identified and used to forge new and revitalize existing partnerships.

An operational model can facilitate action research, social learning, and adaptive management when applied as a testable hypothesis of best-practice conservation planning that complements and enhances (not supplants) a practitioner's intimate understanding of a region (Pressey & Cowling 2001). This facilitates the development of generic planning approaches that are widely effective and repeatable, more effective diagnosis of conservation problems, and more accurately focused conservation initiatives.

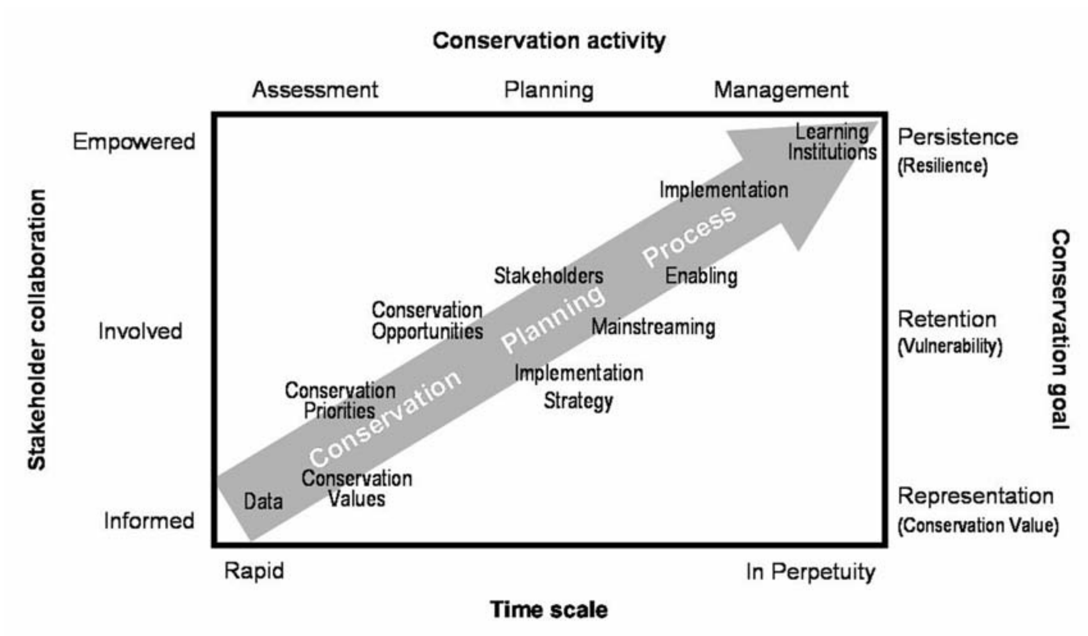

Figure 4 – Conservation planning processes that deliver effective conservation action on the ground (arrow) achieve a minimum suite of milestones (stages). Although those milestones constituting systematic assessment (bottom left) underpin effective conservation planning processes, they are best undertaken at the regional scale, are completed relatively rapidly, and do little to empower stakeholders and so alone do not directly deliver effective conservation action. In the long term, persistence of nature and effective conservation management (top right) are more closely linked to processes that empower stakeholders: ultimately, the establishment of social learning institutions provide for adaptive management.

Operational models can, however, hamper conservation efforts when promoting an orthodoxy that supplants critical thinking, innovation, and a practitioner's intimate understanding of a planning region. A diversity of operational models is best for conservation (Becker & Ostrom 1995), for no single model can ever be "The Answer." The need for detail (and hence prescription) must be balanced against the need for generic solutions because the utility of any operational model is established, in part, by how widely it can be applied. The operational models we present (Figs. 2 & 3) do not supplant existing models; rather, they are alternatives for consideration.

HALLMARKS OF EFFECTIVE OPERATIONAL MODELS

A surprisingly large number of operational models, both assessment and planning, have emerged since the 1980s, all remarkably similar. Most are focused on assessment of biological entities, reflecting a fascination with the refinement of systematic assessment techniques (e.g., Purdie 1987; Cowling et al. 1999; Davis et al. 1999; Margules & Pressey 2000; Groves et al. 2002). A well-established suite of systematic assessment principles has emerged as best practice (see Groves 2003 for review): representativeness, efficiency (through complementarity), flexibility and irreplaceability (Pressey et al. 1993; Davey 1998), and more recently, retention and persistence (Cowling et al. 1999). These guide the science of selecting areas for conservation, but reveal little of how to operationalize systematic assessments in conservation planning processes.

Conservation planning models (e.g., Bastedo et al. 1984; Dick 2000; Groves et al. 2000; Cowling & Pressey 2003), in contrast, are less common, and our understanding of the principles defining effective planning is poor (Salafsky et al. 2002). Transparency, accountability (Margules & Pressey 2000), and stakeholder involvement (Cowling & Pressey 2003) are important, but relatively little documented research exists on how to operationalize these into planning processes. Systematic conservation planning has emerged very recently compared with other planning disciplines (e.g., collaborative planning [Healey 1997], urban and regional planning [Hall 2002], or natural resource management [Sayer & Campbell 2004]) and will benefit greatly by adopting principles, as well as philosophies and techniques, from these disciplines.

A generic suite of "stages" have also emerged, suggesting a minimum set of activities are essential for effective conservation planning (e.g., Margules & Pressey 2000). The detail of these stages has been admirably addressed elsewhere (e.g., Margules & Pressey 2000; Groves et al. 2002; Groves 2003). Here we propose and discuss five hallmarks, in addition to systematic assessments, that define effective operational models.

Hallmark 1: Links to an Appropriate Conceptual Framework

Effective scientists move consciously and routinely between the operational and conceptual perspectives of their discipline (Fig. 5; Lawton 1996; Hobbs & Harris 2001; Sayer & Campbell 2004) to ensure that application informs theory and vice versa. This facilitates improved conservation planning practice through learning and adaptation and delivers more effective conservation action. A conceptual framework is therefore an essential complement to an operational model. Although an operational model describes how a conservation planning process functions, a conceptual framework provides context and helps people think about planning phenomena so as to order knowledge and reveal patterns from which models and theories can be developed and improved (Rapaport 1985). We suggest that a conceptual framework comprise a nested suite of conceptual models that include (1) the regional-scale social-ecological system in the context of national and global processes, (2) a model of landscape management (e.g., conservation corridors, biosphere reserves), (3) the conservation planning process (i.e., the model we present here), and (4) the role and scope of the conservation planner. Understanding a planning region's social-ecological system is a prerequisite for effective conservation (Johnson et al. 1999; Salafsky et al. 2002; Sayer & Campbell 2004) because although conservation problems manifest ecologically, their root causes are typically social and economic.

Systematic assessment expertise without understanding of regional social-ecological system functioning is a major limiting factor to conservation planning (Driver et al. 2003). Managing social-ecological systems requires an explicit approach that can serve as a vision for stakeholders. A model of landscape management is essential so we know not just where we want to intervene but how landscapes will be managed. For example, in the STEP Project we developed the concept of the Megaconservancy Network, where opportunities for enhancing capital flows (e.g., natural, social, financial) specifically at play throughout the Subtropical Thicket Biome were identified and targeted for intervention at multiple scales (Knight & Cowling 2003*b*), specifically to complement the systematic assessment (Rouget et al. 2006). Conservation corridors (Sanderson et al. 2003)

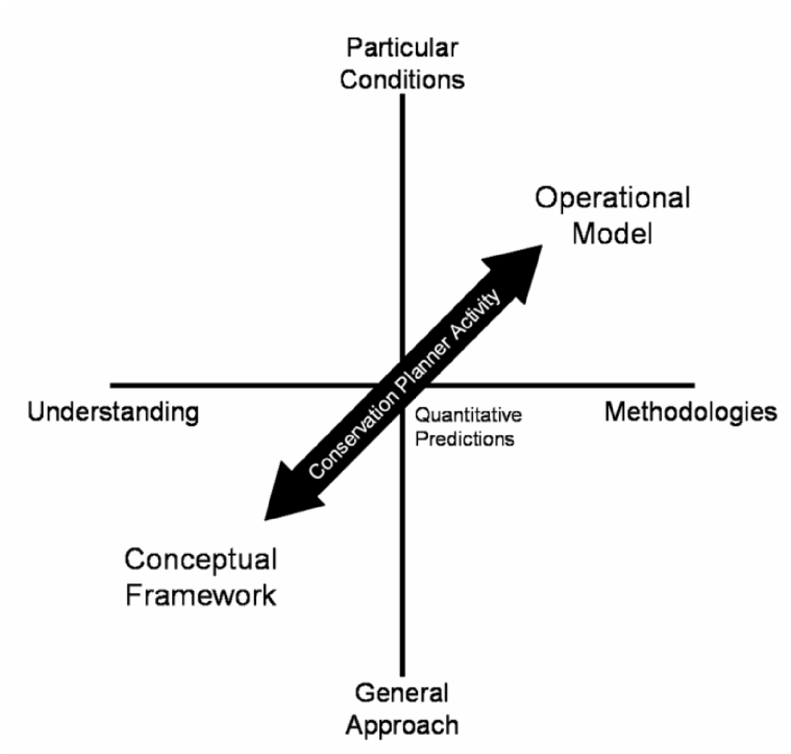

Figure 5 – The relationship between an operational model, which should aim to provide methodologies on how to "do" conservation planning for particular scales and contexts, and a conceptual framework, which should aim to provide a general understanding of social-ecological systems and the role and approach of conservation planning processes. The arrow represents a path adopted by conservation planners effective at translating systematic assessments into conservation action on the ground by employing an action research approach where practice in applying an operational model informs conceptual advances and vice versa. Adapted from Lawton (1996).

and biosphere reserves are other examples of models of landscape management. An understanding of the complex, nonlinear, and heuristic nature of planning processes (Fig. 2) should reflect the complex and dynamic nature of social-ecological systems and detail the relative importance, timing, and spatial influence of planning process activities, including explicit recognition of the knowing-doing gap that hinders implementation (Fig. 1). Understanding the role of the conservation planner is critical because it influences the ways in which conservation planning initiatives are designed and run. Conservation planners should avoid perceiving themselves as empiricists that operate outside rather than within social-ecological systems (Sayer & Campbell 2004).

Hallmark 2: Attention to Social Learning and Action Research

Systematic assessments are rarely implemented quickly on the ground (Cowling et al. 1999), so conservation planning initiatives should be highly dynamic processes capable of adapting to changes in the complex and dynamic character of social-ecological systems. Social learning processes aim to increase human capacity to solve problems and adapt to changing conditions (Holling et al. 1998) and thus are essential components of operational models for establishing a collective capacity for adaptive management (Salafsky et al. 2002). Social learning should be supported by monitoring and evaluation processes (Salafsky et al. 2002).

Operational models are testable expressions of best practice and a major opportunity for learning at both institutional and individual scales (Dick 2000; Driver et al. 2003). Applying operational models requires continuous testing and the transformation of these experiences into knowledge (Senge et al. 1994) through an action research approach (e.g., McNiff & Whitehead 2003). Lessons learned from practice can then be incorporated into future planning processes and past mistakes can be avoided.

Operational models should aim to (1) establish social learning institutions that engage conservation planning initiatives as experiments and (2) position conservation planners as learners and facilitators—not just imparters of knowledge—through active collaboration with stakeholders. These aims require investment in the social capital of social-ecological systems through excellent facilitation, leadership, and interpersonal relationships (Hagmman et al. 2002). Learning requires that different knowledge traditions (e.g., traditional knowledge, science) are valued equally; this promotes creativity and innovation, links technical and social processes, and formalizes social learning approaches (Sayer & Campbell 2004). The current divide between scientists and practitioners (Prendergast et al. 1999) is a significant impediment. The STEP Project developed a handbook (Pierce 2003) in collaboration with land-use planners, many of whom had limited skills in or understanding of the importance of nature conservation. The handbook aimed to interpret the systematic assessment (Rouget et al. 2006) for these land-use planners so it could be explicitly incorporated into new land-use planning legislation. The process for developing the handbook was interactive, iterative, and collaborative, ensuring that the land-use planners received a handbook useful to them. The process took almost a year, and through it conservation planners learned how to design better products for land-use planners and land-use planners learned about conservation planning and the importance of environmental processes (Pierce et al. 2005).

Hallmark 3: Stakeholder Collaboration

The importance of stakeholder collaboration is understated in most operational models presented in peer reviewed journals (e.g., Margules & Pressey 2000). Stakeholder collaboration, however, is widely acknowledged as a hallmark of effective planning for natural resource management at all spatial scales (e.g., Western et al. 1994; Johnson et al. 1999; Yaffee &Wondolleck 2000; Driver et al. 2003; Sayer & Campbell 2004). Although people are the cause of conservation problems, they are also part of the solution.

Three key challenges face conservation planning regarding stakeholder collaboration: (1) testing and identifying where in conservation planning initiatives stakeholder collaboration is most appropriate and effective (Driver et al. [2003] suggest stakeholders are critical to the development of an implementation strategy but systematic assessments are best undertaken by scientists); (2) developing and testing conservation planning products to support the mainstreaming (integration) of conservation knowledge into other land-use sectors (Sandwith 2002) (e.g., maps of priority conservation areas for land-use planners; e.g., Pierce et al. 2005); and (3) testing and implementing the most effective approaches for empowering stakeholders through facilitation and training (e.g., determining how best to apply visioning methods for adaptive management; e.g., Wollenberg et al. 2000). Over 4 years the STEP Project used a variety of techniques to actively engage a broad spectrum of stakeholders, including information meetings, visioning workshops, and training courses, to achieve specific goals (Younge 2003). These were tailored to stakeholder needs because their goals, needs, capacity, primary spoken language, and geographic interest varied widely.

Hallmark 4: Development of an Implementation Strategy

Effective operational models include a process for developing an implementation strategy (Driver et al. 2003). Although systematic assessments provide spatially explicit information on where priority conservation areas are located, little information is provided on how to transform the management of these candidate areas so as to alleviate the land-use pressures compromising their conservation values (Scott & Csuti 1997). An implementation strategy complements products such as maps resulting from assessments of priority conservation areas delivered from conservation assessments. A strategy interprets a clear pathway for manifesting the actions required to implement a landscape management model that effectively achieves regional-scale conservation goals reflecting a common vision and shared values. Absence of a clear strategy has been linked to burnout in local stakeholders (Byron et al. 2001).

The process of developing an implementation strategy provides a mechanism for stakeholder collaboration: (1) it aligns the goals and values of typically diverse groups of stakeholders across a planning region and (2) it coordinates the institutional accountability of stakeholders for completion of actions required to achieve goals (e.g., Stephens et al. 2002). It forms the basis of cooperative agreements between stakeholders that bind them to collective collaborative action. These agreements are important tools for building the resilient institutions required for social learning and adaptive management and should be stated explicitly, driven by explicit and quantifiable objectives, supported widely by stakeholders, resourced effectively, and having a clear intent to implement action. An implementation strategy was collaboratively developed by stakeholders for the STEP Project (Knight et al. 2003). A visioning technique was used to align the goals of more than 60 stakeholders, and then a variety of techniques were applied to identify actions essential to the implementation process.

Hallmark 5: Links with Land-Use Planning

Processes of land-use planning (e.g., environmental impact assessments) operate in many countries to regulate development. Mutually satisfactory outcomes for both production and conservation are probably exceptionally rare (Sayer & Campbell 2004), so land-use planning ultimately involves trade-offs among land uses (Faith et al. 1996). Conservation planning initiatives provide opportunities to alleviate immediate development pressures from priority conservation areas, providing more time to arrange for management interventions that maintain conservation values if they can incorporate meaningful information on priority conservation areas into existing land-use planning processes (Driver et al. 2003). This information also provides an opportunity for a regional-scale context to be integrated into local-scale decision making (Dale et al. 2000; Groves 2003), which is essential to ensure the maintenance of many environmental processes (e.g., migration routes). Operational models limited to the assessment of biological entities fail to make the essential link to established land-use planning processes and so fail to influence these processes beyond biological interests. The STEP Project specifically targeted its mapping (Pierce et al. 2005) and handbook products (Pierce 2003) to land-use planners because of the conservation intervention opportunity they provided given recently introduced legislation.

To be meaningful to land-use planning, operational models should provide processes for forging close working relationships between conservation planners and land-use planners, educate land-use planners on the importance of maintaining regional-scale ecological function and techniques of systematic assessment, and complement data on priority conservation areas with interpretive information (e.g., Pierce et al. 2005), training, and, if necessary, decision-support systems (Theobald et al. 2000).

PLANNING FOR IMPLEMENTATION: AN OPERATIONAL MODEL

Pragmatic conservation planning is complex, dynamic, and often iteratively reactive, so it is not accurately represented as a simple linear process of stages (e.g., Margules & Pressey 2000; Groves et al. 2002; Fig. 4). Schematic, two-dimensional representations of planning processes represent "synoptic illusions" and cannot accurately communicate the four-dimensional reality of planning experiences (Bourdieu 1990). Conceptual models of planning processes (Figs. 1 & 4) must be complemented by more detailed operational models explaining the "logic of practice" (Bourdieu 1990; Figs. 2 & 3).

We present an operational model outlining an idealized conservation planning process (Fig. 2) along with the "components" for effectively operationalizing this process (Fig. 3). The model embodies both the hallmarks of planning best practice (discussed above) and the lessons learned from a diversity of pragmatic South African planning initiatives (Driver et al. 2003). The model aims to represent the way in which pragmatic planning processes function, providing a context for systematic assessment that links it to other essential activities for delivery of effective conservation action. The model is expected to have utility for most regional-scale planning initiatives (e.g., implementation of conservation corridors; Sanderson et al. 2003) and could be adapted to meet local-, national-, or continental-scale needs.

The model comprises three "foundations" (Fig. 3) essential for ensuring conservation planning that lead to the implementation of effective conservation action: (1) empower individuals and institutions, (2) systematic conservation assessment, and (3) secure effective action. A foundation embodies a group of thematic components (tasks), each comprising a suite of actions. We have avoided detailed discussion of specific tasks because application is context specific and our written account will never fully convey our planning experience. Links between components ensure that foundations are integrated as a complex web-like structure (e.g., Dick 2000), representing an advance from linear models (e.g., Purdie 1987; Margules and Pressey 2000; Groves et al. 2002) that more accurately reflect the operation and heuristic nature of pragmatic planning initiatives (Groves et al. 2002). Components of different foundations often proceed in parallel.

"Recipe" solutions to conservation problems are best avoided (Meffe & Carroll 1997) because initiatives should be tailored to individual contexts rather than applied broadly as generic strategies (Higgs 1981). Accordingly, components describe broad suites of tasks and have been structured to facilitate explicit testing to enable application to specific regional contexts, refinement of the entire model, and to promote social learning and adaptive management. Individual planners must decide on the ways in which components are best operationalized in their planning region because effective approaches probably vary widely according to context (e.g., stakeholder collaboration approaches may vary between cultures). The model aims to complement (not supplant) conservation practitioners' intimate understanding of regional social-ecological systems. Few of the components represent new ideas; their integration and the philosophy and principles that underpin them, however, present an emerging approach that aims to fuse the social and natural sciences.

OPERATIONAL MODELS AS CONSERVATION TOOLS

The peer-reviewed literature contains many more examples of systematic conservation assessments than conservation planning initiatives attempting to implement conservation action. The reasons behind this unfortunate trend are cryptic and lie in the drivers and social processes of research institutions, the values and beliefs of academic conservation planners, and the publication focus of journals such as *Conservation Biology*. Systematic assessments are essential for identifying defensible priority conservation areas but can never, alone, lead to the implementation of conservation action. Operational models focused on the implementation of conservation action provide an explicit means of integrating rigorous systematic assessments with the normative processes of implementation strategy development and stakeholder collaboration, and thus provide the foundation for effective conservation action.

We have presented a preliminary suite of hallmarks of effective conservation planning, conceptual models of an idealized planning process (Figs. 1 & 4), and operational models of effective conservation planning initiatives outlining their complex heuristic nature (Fig. 2) and essential components (Fig. 3). These aim to promote learning through the testing and ongoing improvement of conservation planning approaches, thereby refocusing conservation planners on the establishment of the social learning institutions essential for managing complex and dynamic social-ecological systems.

Operational models are but one tool required for effective conservation planning initiatives. No single model is best and we present ours as an alternative to, not a replacement for, existing models. We must be vigilant against the proliferation of an orthodoxy, recognizing that a diversity of planning approaches is desirable, so we strongly encourage others to begin work on operationalizing and testing planning approaches. These experiences must be documented, inclusive of the failures (Redford & Taber 2000). We strongly encourage journals such as *Conservation Biology* to go further toward providing a forum for studies fusing the social and natural sciences because conservation biology should be a discipline that is as concerned with the social environment in which we practice conservation as it is with biology (Hunter 2002). The operational models we present represent one possible approach for structuring and complementing practitioners' intimate understanding of a planning region to a defensible, effective conservation planning process. Our greatest collective strength lies in the partnerships and synergies we foster with each other, so we look forward to engaging in constructive debate so as to learn from our conservation colleagues.

Ultimately, operational models must focus primarily on people—individuals and their values (e.g., Brunckhorst 2000; Theobald et al. 2000), institutions (e.g., Brunckhorst 2002; Gunderson & Holling 2002), organizations (e.g., Stephens et al. 2002), and management instruments and practices (e.g., Young et al. 1996)—because people are both the cause of and solution to environmental decline and destruction. We believe people are the currency of conservation initiatives, and the purpose of conservation is not to only ensure the persistence of nature but also to help present and future generations of people live to their potential, live healthy enriched lives, and be engaged with the nature of which they are a part. In terms of systematic assessments, the state of our natural heritage is simply one measure used to see whether we are achieving our goals (Cowling et al. 2004). Perhaps the most significant legacy a conservation planner can provide is lasting partnerships and a strong stewardship ethic among landowners. The ultimate aim of conservation planning initiatives is not to provide ever-improving measures of priority areas for conservation but rather to provide a process that ensures the persistence of nature and sustainable stakeholder livelihoods. We contend this can be achieved through social learning institutions that can manage landscapes in an ecologically sustainable manner in response to inevitable, ongoing use, enjoyment, and change in social-ecological systems. Social capital and institutional processes are therefore defining factors of effective conservation planning (Pretty & Ward 2001) and associated human welfare. This requires transdisciplinary teams to actively engage social learning partnerships.

ACKNOWLEDGMENTS

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Paper III

The 'Where' and the 'How': The Importance and Challenges of Complementing Systematic Conservation Assessments with a Process for Implementation Strategy Development*

Formatted for *Ecology & Society*

> "… it is important that [conservation] theorists do not overestimate the contribution that conservation theory can make in a field that, whether we like it or not, is driven largely by socio-economic imperatives."
>
> John R. Prendergast, et al.
> The gaps between theory and practice in selecting nature reserves
> Conservation Biology 13: 484-492, 1999

* To be submitted as: Knight, A.T., R.M. Cowling, A.F. Boshoff, S.L. Wilson and S.M. Pierce. The 'where' and the 'how': the importance and challenges of complementing systematic conservation assessments with a process for implementation strategy development. *Ecology & Society*.

ABSTRACT

Systematic conservation assessments are increasingly being undertaken to allocate the investment of limited conservation resources. These techniques are highly effective at identifying important areas for conservation, but of limited use for deciding how implementation of conservation action should be undertaken. This should be a collaborative social process, and requires that systematic conservation assessments be complemented with an implementation strategy. We undertook a conservation planning initiative in the Subtropical Thicket biome in South Africa, complementing a systematic conservation assessment with an implementation strategy. We detail our activities and techniques, and document the successes and failures of our approach. We synthesize lessons from our experience of collaboratively developing an implementation strategy with stakeholders, in such a way as to ensure it effectively complements a systematic conservation assessment.

INTRODUCTION

Regional-scale conservation planning initiatives are becoming a standard process for strategically designing and implementing networks of protected areas which secure valued nature. Quantitative, spatially-explicit systematic conservation assessment techniques are being used to identify networks of candidate areas for investing conservation resources in these regions (Margules & Pressey, 2000). These techniques have been developed primarily in response to the short-comings of an historically *ad hoc* approach to siting protected areas (Pressey, 1994). They also better ensure that the woefully inadequate resources committed to conservation (World Resources Institute, 1992; Balmford et al., 2002) are allocated more efficiently and effectively. The number of these systematic conservation assessments in the peer-reviewed literature has grown exponentially in recent years (Pressey, 2002), and the discipline is now a mainstay of conservation science.

Effective conservation planning is a social process informed by science, not a scientific process which engages society (Theobald et al., 2000; Knight et al., 2006a). Accordingly, the scientific selection of areas important for conservation is but one of many inter-dependent stages in operational models applied for 'real-world' conservation planning (e.g., Margules and Pressey, 2000; Groves et al., 2002; Cowling and Pressey, 2003; Knight et al., 2006a) (Fig. 1). However, the vast majority of conservation planning literature published in peer-reviewed journals is narrowly focused upon the theoretical scientific aspects of systematic conservation assessment (i.e., area selection). Relatively few studies investigate fundamental human, social and organisational aspects of conservation planning processes which are as equally essential for delivering effective conservation action. In short, conservation planning science is informative about *where* we need to do conservation, but silent on *how* to achieve it (Knight et al., 2006a).

Effective conservation planning initiatives couple quantitative, spatially-explicit systematic conservation assessment techniques with processes for developing an implementation strategy and stakeholder collaboration (Gelderblom et al. 2003; Groves 2003; Knight et al., 2006a and b) (Fig. 2). We define an implementation strategy as a common plan of action for partners involved in a conservation planning initiative which details the underlying principles, directions, and tasks for translating a systematic conservation assessment (or more accurately conservation planning products; e.g., Theobald et al. 2000; Pierce et al., 2005) into conservation action. Implementation strategies developed to complement local- or regional-scale systematic conservation assessments are uncommon in both the peer-reviewed literature (but see Lochner et al., 2003; Gelderblom et al., 2003), and the 'grey' literature (but see Raynor et al. undated; Knight et al., 2003), although both systematic conservation assessment and strategies are, separately, very common. This is a manifestation of the 'research-implementation gap' in conservation planning – known more generically as the 'knowing-doing gap' (Pfeffer & Sutton 1999) – whereby the science of systematic conservation assessment fails generally to contribute towards conservation action which ensures the persistence of elements of valued nature on-the-ground (Knight et al., in press a).

If conservation planners, ourselves included, are to narrow the research-implementation gap in conservation planning, and usefully contribute towards actually 'doing' conservation, it is essential they become involved in processes of strategy development for the implementation of the assessments they have conducted. They must also document their successes and failures, and synthesize lessons learnt (Redford and Taber, 2000; Knight, 2006). In so doing, they will contribute towards rectifying the imbalance in the peer-reviewed literature between the reporting of the scientific (and invariably nature focused), versus the social, dimensions of conservation planning processes.

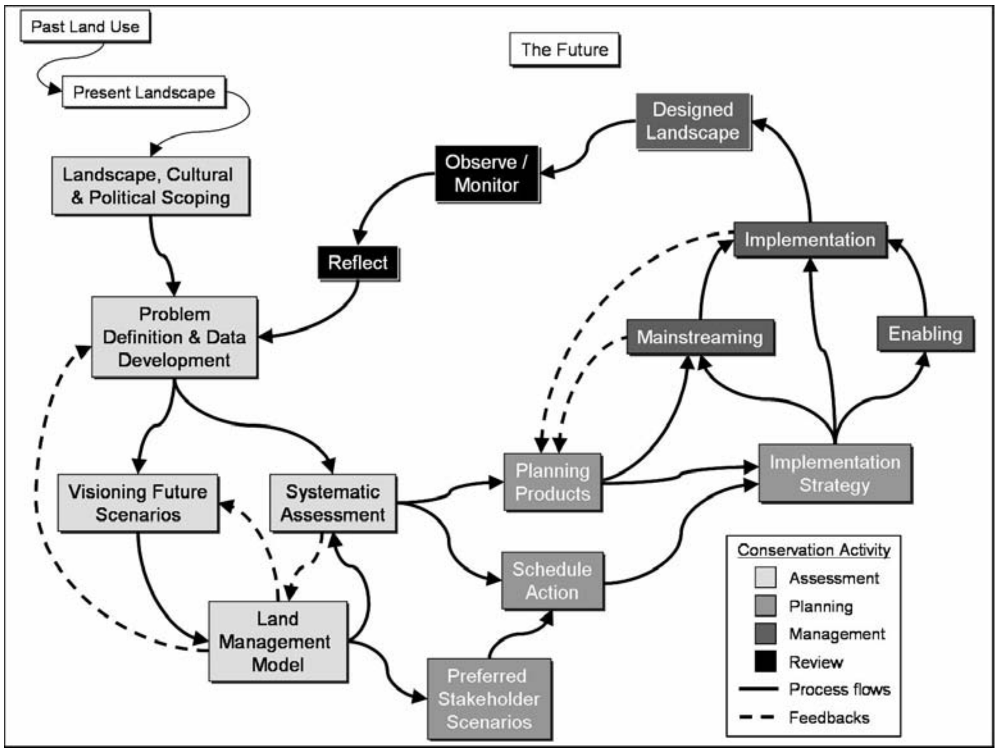

Figure 1 – An operational model for conservation planning highlighting the complex, heuristic, web-like structure of 'real-world' conservation planning initiatives. Note the links between the stages of 'Systematic Assessment' and 'Implementation Strategy' development. Feedbacks (dashed lines) are typically required between stages to ensure the effectiveness of conservation planning processes, for example, iteratively refining planning products with stakeholders before delivering them for use (see Pierce et al. 2005). Stages of assessment, planning and management are followed by stages of review which completes an action research cycle (sensu McNiff & Whitehead 2003). From Knight et al. (2006a).

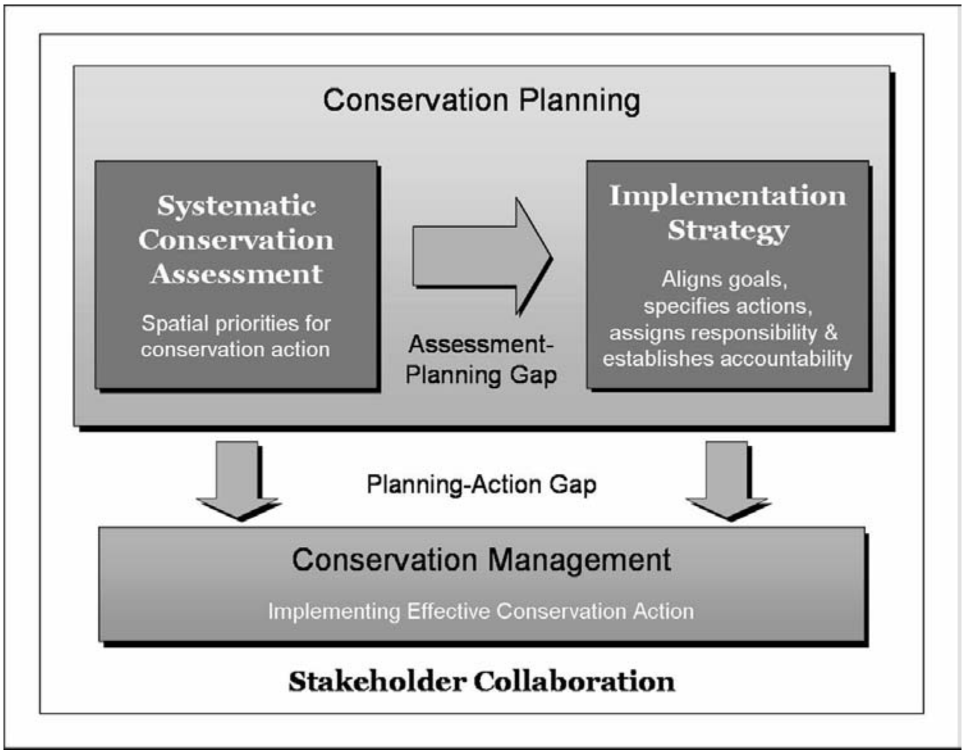

Figure 2 – A simple model of an effective conservation planning process, highlighting the essential and complementary processes of (1) undertaking a systematic conservation assessment, (2) developing an implementation strategy, and (3) stakeholder collaboration. The assessment-planning gap and the planning-action gap are forms of the "knowing-doing gap" (Pfeffer and Sutton 1999), and are very real obstacles to translating knowledge or information (e.g., a map of priority conservation areas) into conservation action on the ground (e.g., private land conservation agreements such as covenants). Adapted from Driver et al. (2003).

With this in mind, we document here our experience of collaboratively developing with stakeholders an implementation strategy for the Subtropical Thicket biome in South Africa (Knight et al., 2003), which was developed specifically to complement a systematic conservation assessment (Rouget et al., 2006) and conservation planning products (Pierce et al., 2005). We detail our methods for developing the implementation strategy, its final structure and content, and our successes and failures of both the strategy development and subsequent implementation processes. We conclude by synthesising several hard-learnt lessons: hallmarks for more successfully translating systematic conservation assessments into effective conservation action by linking them to a implementation strategy.

CONSERVATION PLANNING IN THE SUBTROPICAL THICKET BIOME

The Subtropical Thicket biome is located largely within South Africa and forms the south-west portion of the Maputaland-Pondoland-Albany 'hotspot', one of three identified for southern Africa (Mittermeier et al., 2004). It is home to over 1550 plant species, 20 percent of which are endemic (Vlok et al., 2003). Commercial small stock grazing (i.e., goats, sheep) dominates the region, though farming of indigenous game for both eco-tourism, and meat and trophy hunting, has expanded rapidly in recent times (Smith and Wilson, 2002; Langholz and Kerley, 2006). Cropping of vegetables, citrus, pineapples and chicory, and plantation forestry, occurs in small areas along the major rivers where irrigation is available, and along the coast where rainfall is relatively high. Large areas have been degraded in the early to mid 1900s by over-grazing, with 42 percent of all solid thicket vegetation types, and 77 percent of mosaic thicket vegetation types having been transformed (Lloyd et al., 2002) to the extent that conservation, ecotourism and animal production values have been severely compromised (Hoffman and Cowling, 1990; Lechmere-Oertel et al., 2005). Rural poverty and unemployment are widespread, with social upliftment a critical need throughout most of the Subtropical Thicket biome.

STEP Phase One

The Subtropical Thicket Ecosystem Planning (STEP) Project was initiated in July 2000 in response to a suite of conservation-related opportunities and constraints: 1) globally-valued nature; 2) regional lack of awareness of the importance of nature and the processes which sustain it; 3) escalating land use pressures; 4) diminishing institutional capacity; 5) changing land use patterns; 6) an unrepresentative protected area network; 7) an absence of existing conservation initiatives; and 8) opportunities for mainstreaming biodiversity into legislation and policy (Boshoff and Cowling, 1999). Mainstreaming is the process of integrating nature conservation issues into relevant sectoral and cross-sectoral plans, programmes and policies (Cowling et al. 2002). The STEP Project operated across the majority of South Africa's Subtropical Thicket vegetation (Fig. 3), and was funded by the Global Environment Facility through the World Bank. It aimed to raise awareness of the plight of the Subtropical Thicket biome and to present a strategy for its conservation. "*Living on the land in living landscapes*" – the project motto – captures the objective of the STEP Project to meet the dual aims of nature conservation and sustainable livelihoods. Phase One concluded in December 2003.

The three years of Phase One were spent developing a foundation for on-going conservation efforts. This included development of 1) an operational model for regional conservation planning (Knight et al., 2006a), 2) a public participation programme to engage key implementing organizations, 3) a systematic conservation assessment to design priority conservation areas (Rouget et al., 2006), 4) an implementation strategy, inclusive of its mainstreaming (Knight et al., 2003; this paper), and 5) conservation planning products, inclusive of training, so as to improve land-use decision-making, thereby ensuring the retention of nature in priority areas (Pierce et al., 2005).

STEP Phase Two

Phase Two – the implementation stage – began in January 2004, marking the transition of the STEP Project from an externally-funded, short-term project to an on-going programme. In practice, funding for the STEP Project team ended, with responsibility for implementing the STEP Implementation Strategy (and other activities such as managing the spatial data) adopted by the Bioregional Planning Directorate South African National Biodiversity Institute (SANBI). The Directorate was supported by the Eastern Cape Department of Economic Affairs, Environment and Tourism (DEAET), whose mission is to build a sound, growing and sustainable economy which facilitates economic empowerment and delivers an optimal quality of life for all citizens of the province, especially through the efficient utilisation and management of environmental resources. Generally, the focus of Phase Two was prescribed as the mainstreaming of the STEP planning products, the enabling (i.e., training) of land-use decision-makers and consultants to apply these products, the strategic implementation of proactive

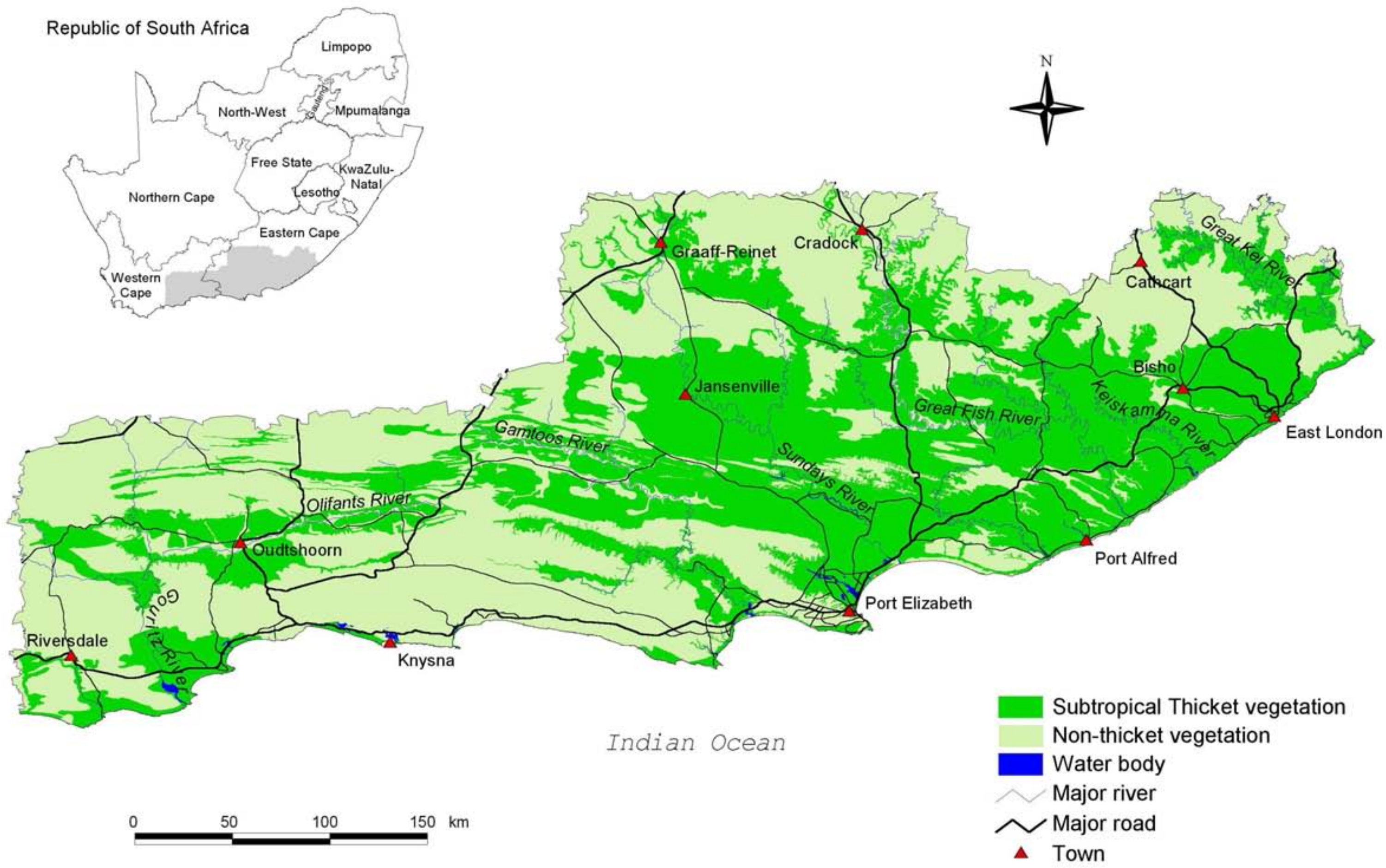

Figure 3 – The STEP planning region, for which an implementation strategy was developed to complement a systematic conservation assessment. It covers a 105 454km² portion of the Maputaland-Pondoland-Albany hotspot, and includes most of the globally significant plant diversity of South Africa's Subtropical Thicket vegetation, including the Albany Centre of Plant Endemism.

conservation initiatives particularly throughout the Fish-Kowie STEP Corridor (one of seven priority corridors identified by Rouget et al., 2006), and the formation and support of social learning institutions which promote these processes.

WHY COMPLEMENT A SYSTEMATIC ASSESSMENT WITH AN IMPLEMENTATION STRATEGY?

Although systematic conservation assessments provide spatially-explicit information on *where* priority conservation areas are best located, little or no information is provided on *how* to transform the management of these candidate areas so as to alleviate the land-use pressures compromising their conservation values. Recent developments in techniques for linking conservation instruments directly to areas are a pragmatic advance (e.g., Wilson et al. 2007; Nelson et al., in press), but provide no information on the non-scientific processes required for implementing action at these areas.

These processes are primarily human, social, political, institutional and organisational; they are complex and highly diverse, for example, lobbying for political support, aligning the goals and activities of the array of implementing organisations, securing further funding and stakeholder support, and mobilising organisational resources. Detailing and integrating these processes and resources effectively is essential – the process of developing an implementation strategy manifests this opportunity. It also provides an opportunity to cost the implementation process.

An implementation strategy also better integrates the suite of products produced by a regional conservation planning initiative. In the case of the STEP Project these included the 1) *implementation specialist* (whose duties included ensuring the link between the systematic conservation assessment and an implementation strategy); 2) *operational model* (which provided the project structure for integrating STEP products; Knight et al. 2006a); 3) *empowered stakeholders* (as collectively mobilising them provides a solution to environmental problems); 4) a *systematic conservation assessment* (which provides maps of priority conservation areas; Rouget et al. 2006); 5) *conservation planning products* for land-use planners (Pierce et al. 2005), and 6) a context-specific *landscape management model* (which provides a vision for stakeholders, a marketing tool, and a mechanism for focusing stakeholders, implementers and planners upon the specific conservation instruments which will be implemented to secure conservation goals). Developing an explicit landscape management model (Knight et al., 2006a) forms another important mechanism for linking a systematic conservation assessment and an implementation strategy.

Implementation of systematic conservation assessments never goes exactly as forecast – the world is too complex to reliably predict the implementation process. An approach of "informed opportunism" is therefore best adopted (Noss et al., 2002; Knight and Cowling, 2007). This requires knowledge of the implementation opportunities and constraints existing across a regional social-ecological system, which is best gained through conducting a comprehensive social (or scoping) assessment prior to undertaking a systematic conservation assessment (Cowling and Pressey 2003; Knight et al., 2006a; Cowling and Wilhelm-Rechmann, 2007). The complexity of these systems demands input from a diverse range of stakeholders.

Typically, little collaboration between implementers and conservation planners occurs when a systematic conservation assessment is being undertaken (Hopkinson et al. 2000; Prendergast et al. 1999), despite the benefits of including implementers in the systematic conservation assessment process (Cowling et al. 2003; Knight et al., 2006b). The process of developing an implementation strategy provides a mechanism for stakeholder collaboration: 1) it aligns the goals and values of typically diverse groups of stakeholders across a planning region (e.g., Mittermeier et al. 1995) by challenging and changing deeply entrenched world views or mental models; 2) it coordinates accountability of stakeholders for actions required to achieve goals (e.g., Stephens et al., 2002), and 3) formally initiates the mainstreaming process (although foundations for mainstreaming begin much earlier in the conservation planning process). The process forms the basis of cooperative agreements between stakeholders that bind them to collective collaborative action. These agreements are important tools for building the resilient social learning institutions required to implement adaptive management (Holling 1978; Lee 1993; Brunckhorst 2002; Salafsky et al. 2002; Folke et al. 2005), and should be stated explicitly, driven by explicit and quantifiable objectives, widely supported by stakeholders, effectively resourced, with a clear intent to implement action.

The process of developing an implementation strategy is also essential for providing a sound human resource foundation for implementation, specifically by 1) securing the 'buy-in' of stakeholders, especially implementers and enablers, to subsequent implementation activities (Gelderblom et al., 2003; Lochner et al., 2003), and 2) avoiding or minimizing 'burnout' in local stakeholders, which has been linked to the absence of a clear implementation strategy (Freudenberger 1982; Maslach & Leiter 1997; Byron et al., 2001).

DEVELOPING THE STEP STRATEGY

The processes of developing 1) conservation planning products (Pierce et al., 2005; Rouget et al., 2006) and 2) the STEP implementation strategy (Knight et al., 2003) were specifically designed to complement each other. Below we detail how this was achieved.

Principles Supporting Our Strategy

It is beneficial to found an implementation strategy upon a suite of principles which can be used for guiding both the development process and the structure of the final document. The principles adopted as a foundation for the implementation strategy should overlap with those of the systematic conservation assessment and conservation planning product development processes; both are tools required for the implementation of effective conservation action, and aim to achieve the same goal. Our principles were identified in advance of establishing the process for developing our implementation strategy, but may have been better developed co-operatively with stakeholders. Our principles include:

1. *collaboration*: building strong relationships between stakeholders which empower them, tapping their relative strengths, and sharing responsibility (Yaffee & Wondolleck 2000);
2. *consilience*: the process of fusing knowledge traditions (Wilson, 1998), strengthens i) implementation strategies by ensuring a diversity of knowledge types are included, and ii) stakeholder 'buy-in' as all knowledge traditions (e.g., scientific, experiential, traditional) are valued equally;
3. *implementation of conservation action*: ensures that pragmatic actions are designed which target areas of greatest benefit for achieving conservation goals, rather than doing excellent science which contributes little to implementation (Knight et al., 2006a);

4. *targeting root causes of land-use pressures*: ensures that the reasons behind declining natural values are addressed (Wood et al., 2000), through the human, social, political, legal, and institutional processes responsible for managing land-use decision-making (Theobald et al. 2000);
5. *refinement through social learning*: linking the implementation strategy to two living institutions – the Thicket Forum (Knight and Cowling, 2006) and the Eastern Cape Implementation Committee – aimed to provide stakeholder-driven mechanisms for collective action and adaptive management (Keen et al. 2005).

These principles underpin a philosophy which, when integrated with the STEP products, is better placed to enact conservation planning initiatives which are effective and self-sustaining in the long-term.

Attendees

Fifty-six stakeholders, including the STEP Project team, attended the implementation strategy workshop representing national, provincial and local governments, non-government organizations, and rural and urban landowners. Attendees were targeted from the STEP stakeholder database, developed from the three year public participation programme. STEP staff had developed good working relationships with many stakeholders, who, by this time, were familiar with the STEP Project, were supportive of conservation, influential and knowledgeable staff in implementing organizations, and would therefore potentially be good champions of the STEP process. Most had attended previous STEP meetings and workshops. Stakeholders from key implementing agencies were invited to attend via mail, and followed-up with phone calls. If a targeted stakeholder was unable to attend, a substitute representative was sought.

The STEP team, comprising twelve people, facilitated the strategy workshop. The team presented background briefings, facilitated workshop sessions, recorded minutes and took photographs for the final strategy document and related media releases. Importantly, those consultants involved in the systematic conservation assessment were actively involved, in an attempt to maintain the research-implementation continuum (Cowling, 2005).

Process and Techniques

The STEP implementation strategy workshop was held over two days in April 2003. A remote location, the hamlet of Seaview, was chosen close enough to Port Elizabeth (the largest and most centrally located city in the planning domain) to encourage targeted stakeholders to attend, but far enough away to discourage people only staying one day. Most stakeholders stayed over-night, which facilitated social functions, which were designed to promote working relationships between stakeholders. The workshop process is outlined in Fig. 4.

The effectiveness of conservation science generally suffers from a negative perspective (Young 2000; Redford and Sanjayan, 2003). In response, the workshop process adopted vision-based planning (e.g., Senge 1990; Wollenberg et al., 2000), a forward-looking, positive approach to problem solving which avoids the negativity of approaches focused upon identifying constraints to achieving goals (Wollenberg et al., 2000). Scenario planning has a long history in business science where it has been used to challenge mental models, facilitate behaviour change, promote collaborative learning and confront trade-offs (Senge 1990). It has been widely used in natural resource management (Sayer & Campbell 2004; Huntley et al. 1989). Accordingly, goals were defined as desired future scenarios, and strategies defined to achieve this vision through capitalising on stakeholder strengths and opportunities for implementation.

A suite of carefully-considered presentations were delivered by a range of experts on a range of topics designed to provide stakeholders with knowledge for the visioning process. Topics included the history of the STEP Project; purpose and background of the workshop; the conservation planning operational model; the STEP systematic conservation assessment; integrating the conservation planning outputs into land-use decision-making; implementing Megaconservancy Networks (a proposed landscape management model); and an example of a similar initiative from the Agulhas Plain, South Africa. Each presentation was followed by a discussion session where stakeholders queries could be addresses; this promoted innovative ideas.

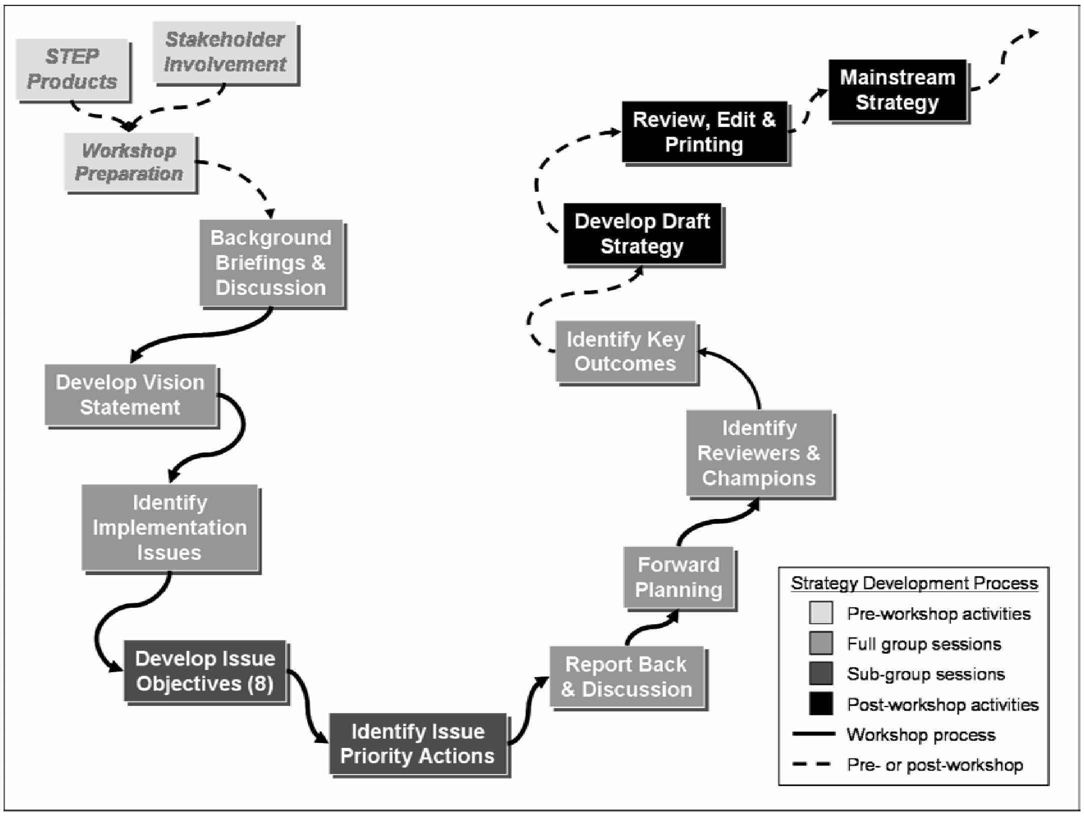

Figure 4 – A schematic representation of the process adopted by the STEP Project for developing an implementation strategy collaboratively with stakeholders.

Stakeholders were asked to identify an ideal regional scenario twenty years into the future (i.e., 2023). A vision statement was collaboratively developed in English, peoples common language. This was translated into Afrikaans and Xhosa, to provide the vision in the three primary languages of the study region, so as to assist in ensuring ownership and accessibility for all stakeholders.

Manifesting the vision statement a reality prompts two main questions. First, what are the major obstacles that prevent us from achieving the vision? Second, what critical elements must exist for the vision to manifest as reality? Discussion identified a large number of factors which were summarised into eight broad groups: 1) stakeholder involvement; 2) political will, legislation and enforcement; 3) incentives; 4) funding; 5) public education and awareness; 6) land-use planning; 7) capacity; and 8) research, interpretation and implementation. Stakeholders were divided into eight session groups, one for each factor, based upon their expertise, professional responsibilities and interests, and so as to ensure expertise was spread across groups, where necessary. Each session group developed, through discussion and debate, at least one quantifiable objective for each factor, that would facilitate monitoring, and identified the suite of priority actions required to reach the objective. All stakeholders then re-convened to discuss and debate individual factors with each group presenting the objective(s) and priority actions required to achieve the STEP vision.

Four Immediate Priority Actions were identified as immediate priority actions and initiated prior to completion of the final strategy document: 1) the establishment of Thicket Forum (see Knight and Cowling, 2006); 2) the establishment of a land management forum; 3) the identification and involvement of Champions; and 4) the urgent delivery of conservation planning products (e.g., maps of priority areas) and appropriate training for land-use decision-makers (Pierce et al., 2005).

Subsequently, suites of Critical Elements were identified as the essential ingredients for achieving each Key Theme Strategic Objective under the headings: Key Partnerships, Capacity Improvements, Funding Needs, Legislative and Policy Support, Information Needs, and Strategic Research Directions. Priority Actions were then identified representing tangible pragmatic tasks essential for realising each Key Theme Strategic Objective. Finally, the success of the workshop was evaluated by the attendees. The implementation strategy was drafted in consultation with relevant stakeholders, including the STEP Steering Committee, to ensure accuracy and utility.

The practicalities of developing and mainstreaming the final strategy document were then discussed. A STEP staff member was identified to draft the STEP implementation strategy, as were nine reviewers, to ensure the final product matched the workshop outcomes. Champions within implementing agencies and the broader stakeholder populace were identified for promoting the STEP implementation strategy.

Marketing Our Strategy

Marketing has become a process as important as the selection of priority areas in conservation planning initiatives, as programmes compete for limited donor funding and attempt to secure stakeholder 'buy-in' and support (Smith et al., in press). In an attempt to secure its profile and stakeholder support, the Strategy was formally launched by the Chief Director of Environment Affairs in the Eastern Cape Government on 7th October 2003. The co-hosting implementing agencies, the Department of Economic Affairs, Environment and Tourism and the South African National Biodiversity Institute, also formally announced their partnership, and adopted the Strategy as part of their core business. The launch event included a number of presentations from experts, as well as discussion sessions designed to foster knowledge sharing. A total of 112 targeted stakeholders from implementing agencies and interest groups attended the launch; all were presented copies of the Strategy. In addition, the Strategy was provide (by hand delivery where possible) to an extensive group of stakeholders from all implementing agencies, many of whom had been involved in earlier stages of the STEP Project. The Strategy was also placed on the internet (see http://bgis.sanbi.org/STEP/project.asp). Articles in the popular media advertising the launch and/or the Strategy were also placed in newspapers, media mouthpieces for pro-nature NGOs and magazines that serve the farming community.

OUR STRATEGY FOR SECURING LIVING LANDSCAPES

The STEP implementation strategy opens with a co-operative Vision Statement in the planning regions major languages, Afrikaans, Xhosa, and English:

The people of the Thicket biome take custodianship of their unique living landscapes and work together to conserve, enhance and use their natural resources to ensure sustainable ecological processes and livelihoods, now and in the future.

Our Vision is a summary of our goal for achieving *living landscapes* – large areas of land displaying a patchwork of repeating patterns of ecosystems and land uses, in which ecological, agricultural and social systems are managed sustainably, ensuring that natural and cultural resources are available for future generations of South Africans.

The STEP implementation strategy contains four Key Themes, each of which has a collaboratively developed, explicitly-stated Strategic Key Theme Objective, which states the goal of the them, and which is comprised of Critical Elements (support essential for achieving the Strategic Key Theme Objective) and Priority Actions (Fig. 5):

Key Theme 1: Enhance Partner Involvement, Co-operation, and Capacity

Strategic Key Theme Objective: Key partners and the broader community actively support the STEP Vision, based upon their sound understanding of the importance of conservation, the opportunities provided by ecologically sustainable land management for livelihood enhancement, and effective capacity to actively access, utilize and conserve knowledge and resources through participation in STEP aligned activities.

Key Theme 2: Support Planning for Conservation and Land Use

Strategic Key Theme Objective: To secure the effective integration of nature conservation information (i.e., the STEP Conservation Priority Map) into Provincial and Municipal land-use planning processes (e.g., Spatial Development Frameworks) and conservation planning initiatives (e.g., regional- and local-scale conservation activities), through the tangible support of key partners.

Key Theme 3: Enhance the Effectiveness of the Protected Areas Network

Strategic Key Theme Objective: To promote the establishment of a suite of "mega-reserve" protected areas (including the Gouritz, Baviaanskloof and Greater Addo Elephant National Park "mega-reserves") along with a collection of smaller protected areas, which are effectively and efficiently managed in partnership with adjacent interests to achieve

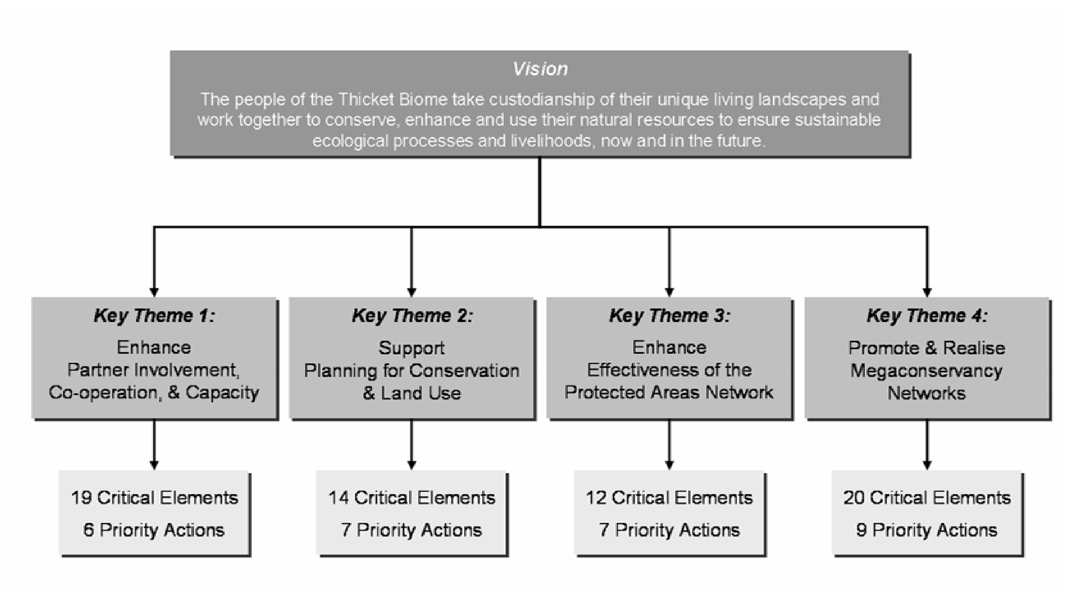

Figure 5 – The structure of the STEP implementation strategy, outlining the links between the Vision statement, the four Key Themes, and their respective critical Elements and Priority Actions.

targets for ecological pattern and process and provide livelihood enhancement through nature-based employment.

Key Theme 4: Promote and Realize Megaconservancy Networks

Strategic Key Theme Objective: To balance and achieve the goals of nature conservation, agricultural production and water use thereby ensuring ecologically sustainable land management and the equitable disbursement of benefits and costs through the implementation of Megaconservancy Networks.

The Strategy includes recommendations for future research directions, particularly on implementation issues.

MAINSTREAMING, ENABLING AND IMPLEMENTATION – PUTTING OUR STRATEGY TO WORK

Mainstreaming, enabling and implementation are processes which enact effective conservation management in a conservation planning initiative (Knight et al. 2006a; Fig.1). Mainstreaming is the process of integrating nature conservation issues into relevant sectoral and cross-sectoral plans, programmes and policies (Cowling et al., 2002). To be effective, mainstreaming must be complemented with "enabling" processes (i.e., capacity building), especially where skills and resources are limiting. These two processes, in turn, support the processes of implementation, which we define as the establishment of instruments and actions which positively alter land management activities on-the-ground towards achieving conservation goals, for example, the establishment of private land conservation agreements (see Knight et al., 2006a).

Phase Two of STEP focused upon mainstreaming, enabling and implementation, and was run by SANBI with support from DEAET. A Bioregional Programmes Co-ordinator was appointed by SANBI (and housed by DEAET) in 2004 and in place for over three years, and a Projects Co-ordinator and an administrator were also later appointed to support the implementation process (although both co-ordinator posts have recently been vacated). Their role is to catalyse partnerships, secure funding, align partner goals, and mainstream the STEP conservation planning products. They also support the Eastern Cape

Implementation Committee (ECIC), another STEP initiated institution, which aims to co-ordinate and align the institutional directions of land management agencies.

Where Have We Succeeded?

The workshop process for developing the Strategy (Phase One) was effective in generating a very positive response from stakeholders, despite their diverse interests and responsibilities, the technical nature of the assessment, and conservation planning being new to most of them. No conflicts were evident; indeed, a feeling of a 'new beginning' pervaded the workshop. There was a genuine enthusiasm amongst stakeholders to conserve the natural resources of the Subtropical Thicket biome. SANBI and DEAET engaged and committed to Phase Two, and individuals volunteered as Champions.

The final strategy document came together well, and was considered by stakeholders to be representative of their vision for the Subtropical Thicket biome. It offered a practical fusion of the expertise, knowledge and ideas of the broader stakeholder community and STEP staff. The detail of the Strategy directly linked to the activities of implementing organisations. The final Strategy document was non-technical, attractively presented, of direct relevance to stakeholders, and linked to the STEP conservation planning products through their institutional processes.

Immediate Priority Actions One and Two (establishment of forums for researchers and landowners) were integrated, and Thicket Forum was established. Thicket Forum is an annual workshop which aims to link land managers and researchers throughout the Subtropical Thicket (Knight and Cowling, 2006) to share information and jointly search for solutions to land management and conservation problems, and to provide a forum for identifying future research directions. The format has evolved over the four years of its existence from presentations largely by academics and their students to workshops on topical land management and conservation issues. Despite an increased effort towards relevance for rural landowners (for example, a farm fieldtrip was added to promote relevance to farmers), Thicket Forum struggles to attract rural landowners (who manager the majority of land in the Subtropical Thicket biome). It must now make a concerted effort to not only attract key rural landowners, government officials and academics, but also to integrate their interests and deliver tangible outcomes. Attendance numbers are steady at around sixty people annually.

Immediate Priority Action Four (delivery of conservation planning products and training for land-use decision-makers) was also quite successful. As part of Phase One, the majority of local government officials and consultants throughout the Subtropical Thicket biome were provided a Mapbook detailing the STEP Conservation Priority Mapping, GIS data for those with this capacity, a Handbook detailing the application of this information (Pierce et al., 2005) and training on how to operationalise these conservation planning products. Informal investigations revealed that the majority of municipalities were using the products. It was also very widely adopted by consultants supporting municipalities. Subsequently, DEAET stated that it would not sanction any Environmental Impact Assessment that had not consulted the STEP products; this further broadened the adoption of the STEP products.

DEAET also committed R500,000 for eight local projects implemented generally throughout the proposed Fish-Kowie Megaconservancy Network for the Fish River Biodiversity Initiative (FRBI). These projects were managed by SANBI, and included the Bathurst Commons Community Conservancy Project, the Umthathi Africulture Centre, the Vukani Greenbelt Initiative, the Mhala Heritage Tourism Development Project, the Ndlambe Community field Guide Training Project, the Kap River Conservancy Project, the Tyefu Community Nature Reserve, and the Ecca Pass Nature Reserve Trail Project.

There has also been progress in consolidating mega reserves, but this was not co-ordinated specifically as a STEP activity. However, the planning products did assisted both the Gouritz Initiative and the expansion of the Baviaanskloof World Heritage Area. The expansion of both the Addo Elephant National Park and the Camdeboo National Park was aligned with the Fish-Kowie and Sundays-Camdeboo Megaconservancy Networks. The STEP philosophy – *keeping people on the land in living landscapes* – has underpinned both the Gouritz Initiative and the expansion of the Baviaanskloof World Heritage Area

Where Have We Failed?

The success of Immediate Priority Action Three (securing STEP champions) has been minimal in Phase Two. Whilst all ten Champions identified at the workshop were passionate about the STEP Project, most have not driven STEP forward strongly, primarily because of a lack of leadership, support and direction from SANBI and DEAET, which results from a lack of effective resourcing and vision. Several Champions not identified at the strategy workshop have subsequently emerged (for example, a local environmental consultant who champions the application of the STEP conservation priority mapping through the Integrated Development Planning process). The STEP implementation strategy is not being used for setting direction in any of the implementing agencies for whom champions were employed.

Immediate Priority Action Four (mainstreaming of STEP products and training of land-use decision-makers) was initially quite successful in Phase One, but has stalled recently in Phase Two. Given the absence of strategically important local government officials and consultants, and high staff turnover in local municipalities, it was decided that Phase Two should focus upon further training, and refinement of the Mapbook and Handbook. Significant funding (R2.1 million) was sourced from SANBI and the Development Bank of South Africa (DBSA) in 2005 for training and product refinement, but most was spent on the marginal refinement of the Mapbook and Handbook. Over half the new Mapbooks and Handbooks produced have failed to be distributed to users (A. Mader, pers. comm.). Accordingly, the mainstreaming of the STEP products to address reactive planning has stalled. Whilst anecdotal evidence indicates the STEP products are being used by local municipalities and consultants, an assessment of their use is urgently required. However, a recently concluded Eastern Cape Biodiversity Conservation Plan, which was prepared by consultants and was not reviewed by members of the original STEP team, and which was funded (R1.2 million) by Development Bank and DWAF (national), and endorsed by DEAET - has now effectively superseded the STEP products. Confusion has arisen because training at the District Municipal level will soon be undertaken using the refined STEP products whereas training will also soon commence at the provincial level using the Eastern Cape Biodiversity Conservation Plan.

Pro-active conservation planning initiatives have performed even more poorly than the mainstreaming of STEP products into reactive land-use planning processes. In Phase One, we focused the majority of time and resources of the three-year public participation programme on government officials and stakeholder organizations with land-use decision-making interests, as 1) these stakeholders are responsible for applying and enforcing natural resources and planning legislation, which is a major avenue for slowing activities degrading and destroying nature, 2) a suite of new legislation provided opportunities for rapidly advancing the conservation agenda through land-use planning frameworks in local municipalities, and 3) these organizations were under-going rapid institutional reform which provided a major opportunity for integrating nature conservation, through education and training, into some important institutional processes responsible for land management. However, this focus upon land-use decision-makers resulted in a failure to secure the active involvement of rural landowners, the Department of Agriculture, and the Department of Land Affairs, who are the key stakeholders for driving proactive conservation interventions, such as the establishment of the Megaconservancy Networks recommended by the strategy.

Furthermore, the DEAET-funded Fish River Biodiversity Initiative (FRBI) which provided support to eight existing local conservation initiatives throughout the southern reaches of the proposed Fish-Kowie Megaconservancy Network has struggled. True to the Vision of the Strategy, the projects aim to both implement conservation action and improve livelihoods of local people. Success of these ventures has been generally poor.

The Eastern Cape Implementation Committee (ECIC) was established in 2004 as the driver of Phase Two and the mechanism for aligning the goals and activities of organisations with natural resource management responsibility. However, none of the original STEP team was invited to serve on this Committee. It was hoped that the STEP strategy would provide the common vision for these stakeholder organisations, assistance for identifying synergies between organisations, and guidance on how implementation activities could be prioritised and executed. The STEP strategy is not being applied in guiding the ECIC, which has instead become preoccupied with the detail *within* existing programmes (many of which have dedicated co-ordination units which involve Eastern Cape personnel) at the expense of co-ordination *between* programmes, leaving the STEP strategy stalled.

Targeted research has been undertaken, but has had limited positive impacts. Development of an Action Plan which schedules the deployment of a range of instruments and actions along the STEP Fish-Kowie Conservation Corridor using the concept of “conservation opportunities” is underway, but is overdue and has not been mainstreamed effectively into implementing agencies. Research has recently been completed on examining incentives for rural landowners in the southern portion of the Fish-Kowie MCN (Cumming, 2007), but is yet to be applied. A manual to assist game managers to manage their landscapes in accordance to the STEP strategy was scheduled for release in 2005, but is yet to be completed (A. Boshoff, pers. comm.). However, considerable financial support from the Department of Water Affairs and Forestry through the Working for Woodlands programme and Rhodes University has initiated a flourishing research programme into the restoration of landscapes, primarily Subtropical Thicket, with a view to payments for ecosystem services through accessing the carbon economy.

In short, implementation activities have floundered, and the STEP strategy is having few positive effects. Opportunities exist for resuscitating the STEP strategy, as Conservation International has begun sourcing funds to facilitate and implement the recommendations of the implementation strategy through its hotspots programme for the Maputaland-Pondoland-Albany hotspot.

LESSONS LEARNED: TOWARDS BEST PRACTICE

Adaptive improvement in conservation planning is essential if we are to maximise our achievements and advance our approaches in an ever-changing world (Redford and Taber, 2000; Salafsky et al. 2002; Knight et al., 2006a). Documenting experiences, especially failures, is fundamental to establishing social learning and adaptive management (Redford and Taber, 2000; Knight, 2006). The STEP Project has proven, at times, professionally and personally highly challenging to those involved, and as such, has been a rich source of learning, as conservation planning initiatives tend to be (e.g., Johnson et al., 1999; Soulé and Terborgh, 1999; Dick, 2000; Cowling and Pressey, 2003; Groves, 2003). Here we synthesize lessons we have learned through this process, and offer preliminary recommendations of best practice for effectively complementing a strategy development process with a systematic conservation assessment.

Conduct a Comprehensive Social Assessment

Conservation planning is ultimately a process whose success depends upon conservation planners 1) understanding the choices people make (Cowling and Pressey, 2003), 2) facilitating the manifestation of stakeholders values for landscapes (Theobald et al., 2000;

Sayer & Campbell 2004), and 3) ability to identify and initiate processes which capitalise upon conservation opportunities, whilst negotiating conservation constraints (Cowling et al., 2004; Knight & Cowling 2007). It is therefore essential that conservation planners conduct a social assessment as the initial stage in a conservation planning process which provides a detailed and comprehensive understanding of the functioning of the social-ecological system of the planning region (Cowling & Wilhelm-Rechmann 2007), and hence an ability to better target both the systematic conservation assessment and the implementation strategy.

We did not allocate sufficient resources for a STEP social assessment, and hence, as in most conservation planning exercises, invested the bulk of resources in ecological, rather than social, survey. This produced a superficial, and therefore uninformative, understanding of the Subtropical Thicket social-ecological system. As a result, we were unaware of several key constraints (i.e., capacity and philosophy of key implementing agencies) and opportunities (i.e., the potential of the spiritual value of nature as a means of mainstreaming STEP in communal lands; Cocks and Wiersum 2003). In retrospect, the approach, and perhaps the effectiveness, of both the systematic conservation assessment and the implementation strategy could have been improved.

Employ a Truly Multidisciplinary Team

Our team (as we suspect most conservation planning teams are) was composed overwhelmingly of people trained as natural scientists. However, the vast majority of the activities of the STEP Project, and especially the strategy development process, were social, not scientific, activities such as social marketing, lobbying, facilitation, negotiation and conflict resolution. As a team we were under-skilled in social research techniques, but did not realise it at the time. Scientific rigour and sophistication are comparatively minor elements of a successful implementation development process, as stakeholder uptake and 'buy-in' does not depend upon scientific principles. Furthermore, the qualities of a great scientist – e.g., precision, rigour – are different to a great facilitator – e.g., empathetic, synthetic. It is therefore essential to embrace consilience – the fusion of knowledge traditions – and engage highly competent social researchers for developing and mainstreaming the implementation strategy. This highlights the importance of establishing networks of conservation professionals composed of the diverse range of skills and expertise required to do effective regional conservation planning. The social processes required to successfully develop and mainstream an implementation strategy require far greater time and resources than environmental research needs; team resourcing and funding should reflect this need.

Collaborate with Key Stakeholders

People are both the cause of the need for conservation action, and the means by which conservation action manifests, and so, ultimately, conservation is mostly about the choices that people make (Cowling and Pressey, 2003), both as individuals and collectively as institutions. It is not the role of conservation planners to dictate societal values for nature through systematic conservation assessments and implementation strategies; instead, they should facilitate the manifestation of society's values in a conservation plan (Theobald et al., 2000). Accordingly, effective implementation strategies are developed collaboratively with stakeholders (Knight et al. 2006b).

The values, interests, knowledge, capacities, responsibilities and influence exerted by stakeholders is highly heterogeneous. We did not fully understand the values of important stakeholder groups (i.e., Department of Agriculture, DEAET, rural landowners), and this hindered both the development of the strategy and it's effectiveness. It is critically important that a stakeholder analysis is undertaken as part of a social assessment, prior to developing both the systematic conservation assessment and implementation strategy. Well established methods of stakeholder analysis are available (e.g., Schmeer 1999). This ensures that stakeholders can be appropriately involved throughout the conservation planning process generally, and builds 'buy-in' and support prior to, and specifically for, the development of the implementation strategy. Those identified as key stakeholders are essential for involving in the implementation strategy development process, and will vary depending upon the goals of the process, the instruments envisaged for implementation, and political structures. Mainstreaming of the strategy is greatly facilitated if active, self-motivated local champions are identified (see Knight et al., in prep. b) and actively supported. Champions are very difficult to specifically target or consciously cultivate; rather, they emerge through the planning process, another benefit of situating the implementation strategy development processes in a broader conservation planning process.

Collaboration with stakeholders may take many forms, which are context dependent. It is not sufficient to simply inform or involve stakeholders; they must be active collaborators in the strategy development process, with selected stakeholders often usefully involved in the team conducting the systematic conservation assessment (Knight et al. 2006b). To this end, the process (i.e., the techniques) of involving people in the development of our Strategy (and other facets of the STEP Project) is at least as important as the final document in determining the effectiveness of the Strategy. If conservation planners are going to be effective, then Michael Soulé's (1986) vision of conservation scientists spending more time at community meetings than in the field or laboratory, must become a reality.

Map Conservation Opportunities, Not Simply Biodiversity Priorities

Implementation strategies should take the location of 'where' conservation should be enacted from a preceding systematic conservation assessment (Mace et al. 2000; Knight et al. 2006a and b). Typically, an implementation strategy outlines a diverse suite of instruments for implementation (ideally, an optimal mix; Young et al. 1996, but see Pressey 1998 for an exception), as social-ecological systems are highly complex and heterogeneous (Gunderson and Holling 2002) and so require sophisticated conservation solutions. This complexity and heterogeneity extends not only to the spatial and temporal distribution of natural capital and the anthropogenic processes threatening it. Human, social and financial capital are major determinants of the effectiveness of implemented conservation action (e.g., Sanz & Grajal 1998; Holmes 2003; Smith et al., 2003; Steinmetz et al. 2006), and are also highly complex and heterogeneous. For example, land acquisition costs (Ando et al., 1998; Polasky et al. 2001), and the willingness of people to sell their land to conservation interests (Meir et al. 2004; Knight et al., in prep. c), for the expansion of a protected area network can both vary significantly across a planning region. Conservation plans must design solutions to complex social-ecological problems, and these solutions require implementing comprehensive, sophisticated landscape management models. It is therefore inadequate for systematic conservation assessments to simply identify biodiversity priorities. Instead, systematic conservation assessments are more effectively linked to implementation strategies, and deliver more effective conservation action, if they identify "conservation opportunities" (Cowling et al., 2004; Knight et al., in prep. b). We need to know, not only where the most valued nature is located, but also, for example, where the most effective people and institutions are located. Mapping conservation opportunities requires mapping human and social factors, which provides the opportunity for 1) integrating fieldwork for gathering human and social data and the environmental data typically required so that fieldwork serves not only to provide data but also as an mechanism for stakeholder collaboration, and 2) encouraging truly transdisciplinary conservation planning teams.

Mainstream the Strategy into Implementing Institutions

Conservation planning initiatives are often conducted as short-term projects, which are then 'handed-over' to implementing organisations. The STEP project was conducted this way – Phase One, the short-term project; Phase Two, the mainstreamed long-term programme. This two-phase approach hinders both mainstreaming and implementation. Ideally, conservation planning initiatives are undertaken within a key implementing organisation, however, the required expertise typically is not available within key implementing organisations, and international donors have tended to fund 'experts' as external consultants. This situation makes mainstreaming a critically important process in conservation planning initiatives.

Mainstreaming can struggle for a multitude of institutional reasons: poor capacity, inadequate funding and resourcing, lack of political support, absent or inactive champions, the absence of input from conservation planners who undertook the systematic conservation assessment and/or the implementation strategy (Cowling 2005), and corruption (Smith et al., 2003). Whilst the mainstreaming of an implementation strategy formally begins upon completion of the strategy document, practically mainstreaming begins when a conservation planning initiative commences. For example, if the STEP strategy had been mainstreamed more effectively into key implementing organisations – DEAET, Department of Agriculture, and SANBI – during Phase One, it would probably have improved implementation effectiveness in Phase Two. It is critically important to mainstream an implementation strategy into two different but complementary types of implementing organisations – 1) reactive land-use decision-making organisations, to slow or stem activities degrading or destroying nature (e.g., development planning), and 2) proactive conservation organisations (e.g., those establishing protected areas).

It is not typically the responsibility of academics to implement strategies; they can be considered enablers or facilitators of conservation planning processes (Theobald et al., 2000; Sayer and Campbell, 2004; Knight et al., 2006a and b). Implementing institutions and organisations include government departments, local municipalities, and some non-government organisations and community groups. Long-term regular involvement is more effective at changing institutional activities than short-term intensive involvement, so mainstreaming should be planned over long timeframes, supported with sufficient funding and resources.

Establish and Promote Social Learning Institutions

The reality of conservation planning initiatives is that neither a systematic conservation assessment, nor an implementation strategy document, alone, implement conservation action – people individually, and collectively, make land management choices for achieving conservation goals. These choices aim to manage social-ecological systems, for which change is typically the norm (Gunderson and Holling 2002). For this reason, the establishment of a complementary suite of social learning institutions is a fundamental goal of conservation planning initiatives (Knight et al., 2006a). These are essential if a Strategy is to be effective in the long-term. Our Strategy identifies several social learning institutions including 1) a broad multi-sectoral governance institution whose primary aim is to align the goals of implementing organizations (i.e., the Eastern Cape Implementation Committee), 2) an institution for fostering consilience (Wilson, 1998) between scientists and managers (i.e., Thicket Forum; see Knight and Cowling, 2006), and 3) Megaconservancy Networks as a land management institution which attempt to link the interests of individual land managers to facilitate co-operative landscape scale management at the (Rouget et al., 2006). All are potentially important foundations for operationalizing the Strategy, however, none are currently effective, and implementation has stalled as a result. For example, our failure to complete a comprehensive social assessment meant that we did not effectively understand farmers values and context and so have struggled to attract them to Thicket Forum. Social learning also allows an implementation strategy to be regularly reviewed and adaptively improved.

CONCLUSIONS

Effective conservation planning initiatives comprise a systematic conservation assessment complemented with a process for developing an implementation strategy, in the context of stakeholder collaboration. However, the peer-reviewed conservation planning literature is dominated by systematic conservation assessments, with few studies documenting or analysing processes for developing implementation strategies. In effective 'real-world' conservation planning initiatives, the process of developing, mainstreaming and operationalising an implementation strategy typically requires greater time, funding and resources, is more poorly understood, and requires different skills, to that for completing a systematic conservation assessment. A significantly greater proportion of research funding and effort is urgently required into the processes for developing, mainstreaming and operationalising effective implementation strategies complementing systematic conservation assessments. Our preliminary review concludes that the major challenges to developing, mainstreaming and operationalising resilient, self-sustaining implementation strategies are human, social and institutional, not technical. We recommend conservation planners: 1) conduct a social assessment to identify implementation opportunities and constraints, 2) employ a multidisciplinary team 3) collaborate with key stakeholders, 4) map conservation opportunities, 5) mainstream the strategy into implementing institutions, and 6) establish social learning institutions.

Whilst the lack of effectiveness of many of our own efforts on the STEP programme has caused us sleepless nights (bulldozers still rumble in our dreams), our reporting of not only our successes, but more importantly, our failures, should not be interpreted as a lament for opportunities missed. We are committed to learning how to be more effective conservation planners. As such, publicly acknowledging and documenting our failures not only provides our mechanism for learning how to 'do' increasingly effective conservation (Redford and Taber, 2000), but also manifests our personal vulnerability, which provides the basis for developing the trusting relationships and 'safe-fail' culture (Redford and Taber 2000) upon which effective conservation planning ultimately depends (Knight, 2006). We hope that our candour and our hard-won lessons prove useful to our colleagues, and encourages them to document their experiences to advance their own learning.

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Paper IV

Into the Thick of It: Bridging the Research-Implementation Gap in the Thicket Biome through the Thicket Forum*

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"Nothing truly valuable can be achieved except by the unselfish co-operation of many individuals."

Albert Einstein, 1940

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We outline the evolution of the Thicket Forum as a social learning institution in the thicket biome; highlight recent research findings and future research directions, with a focus on new insights into how thicket functions; and what has been done to conserve it. We also report on the outcomes of the forum's 2006 meeting.

South Africa's thicket biome is enigmatic; ecologists have long struggled to place this weird assemblage of spiny, evergreen shrubs and bulky succulents into any of the pre-existing biomes (Vlok et al. 2003). Only in 1996 was thicket recognized as a distinct biome (Low & Rebelo 1996). It is characterized by a unique suite of plant forms: evergreen shrubs (predominantly), tall succulents (think of tree aloes and euphorbias), a wealth of climbers, and—intriguingly—very little grass. Thicket is most extensive in the southeast of the country, principally along the coastal parts of the Gouritz, Gamtoos, Sundays and Great Fish River valleys. It forms the western (Albany) sector of the Maputaland–Pondoland–Albany biodiversity 'hotspot', which is defined by the high incidence of endemic plants, these being mostly succulents and bulbs.

The difficulty encountered in placing thicket in an appropriate ecological context has made problematic the identification of a suitable institutional home for coordinating research. Thus, when the erstwhile, highly successful Co-operative Scientific Programmes of the CSIR were introduced in the early to mid-1980s, the question arose: where do we place thicket? Is it karoo? (perhaps, since it thrives where annual rainfall is less than 250 mm); savanna? (surely not, where are the grasses?); fynbos? (definitely not, it doesn't burn, and there are no restios or proteas); forest? (a Lilliputian one maybe, as John Acocks aptly put it). By the late 1980s, ecologists were dissatisfied with the marginalized, in-limbo status of thicket. So they launched their own—albeit informal—programme, and held a meeting in 1990 which yielded many important insights on the workings of thicket (Zacharias et al. 1991). Thereafter, as a result of the demise and decline in the early 1990s of organizations that spearheaded thicket research, the rate of accumulation of knowledge on thicket slowed markedly.

Save for the spirited initiatives by Graham Kerley and associates at the former University of Port Elizabeth, and some excellent work on indigenous plant use by Michelle Cocks from Rhodes University, thicket research languished for almost a decade. However, the focus on thicket was re-established in 2001, when the World Bank, through the Global

Environment Facility (GEF), funded the Subtropical Thicket Ecosystem Planning (STEP) Project, specifically to raise awareness of the thicket biome's globally important status as a biodiversity 'hotspot', and of the rate at which the thicket biome was being transformed; it also aimed to lay a foundation for the implementation of nature conservation activities. This was achieved by undertaking an innovative, systematic conservation assessment to identify priority conservation corridors (Rouget et al. 2006), and developing STEP Implementation Strategy with land managers, government and academics (Knight et al. 2003). This strategy outlines the actions required to ensure the conservation and sustainable management of the thicket biome, and recommends the establishment of social learning institutions to facilitate the fusion of research and management through an adaptive approach, which meets the challenges posed by the ever-changing landscapes of the thicket biome.

The STEP Project, together with the GEF-funded Conservation Farming Project (Turpie 2003), has provided great impetus for learning more about thicket. We now have an expanded concept of thicket in southeastern South Africa that encompasses the mosaics that it forms with other biomes (Vlok et al. 2003). We also have an hierarchical classification of thicket for this region that recognizes four major types (Dune Thicket, Mesic Thicket, Valley Thicket, and Xeric Thicket), subdivided according to biogeographic locality and grain (solid or mosaic) (Vlok et al. 2003). We are beginning to appreciate that thicket, as we know it now, was part of an ancient global biome that preceded the rise of the fire-prone savannas, grasslands and sclerophyllous shrublands (Cowling et al. 2005). Thus, our earlier concept of thicket as a relatively young vegetation type, comprising a mixture of species derived from adjacent biomes, appears to be erroneous; indeed, phylogenetic analyses suggest that the evolutionary age of thicket surpasses that of all adjacent biomes (Procheş et al. 2006). We also now know—as had been postulated (Midgley et al. 1997)—that at the ecosystem level, thicket functioning is more similar to that of a rainforest than a semi-arid shrubland (Mills et al. 2005). More light has been shed on the enigma of plant recruitment in thicket: while ramet recruitment predominates in the Xeric and Valley Thicket types (Sigwela 2004), seedling recruitment may be significant in the Mesic Thicket and some Dune Thicket types (Midgley & Cowling 1993; Cowling et al. 1997), as well as among tree succulents (Kamineth et al. 2003). We also have a better picture of the extent and effects of degradation of thicket ecosystems at local (Sigwela 2004; Fabricius et al. 2003; Hall et al. 2003; Mills & Fey 2004; Lechmere-Oertel et al. 2005a

Figure 1 – There is increasing evidence that thicket, such as this milkwood (*Sideroxylon inerme*)-dominated community, is an ancient and once globally widespread biome, having developed as the response of an early Tertiary rainforest flora to pervasive drying and cooling, starting in the late Eocene, some 40 million years ago. Contemporary thicket has retained its rainforest-like functioning, even when growing under low and erratic rainfall. Thus, Arid Thicket, which grows where the annual rainfall is less than 350 mm, stores the same amount of carbon per hectare as the dune forests of Maputaland, arguably South Africa's most productive region. As Lilliputian forests, thicket offers great potential for restoration aimed at carbon sequestration.

and b) and regional scales (Lloyd et al. 2002), and have gained insights on constraints and opportunities for restoring it, at least to a functional state (Sigwela 2004; Lechmere-Oertel et al. 2005b; Mills & Cowling 2006).

Although the research of the 1980s delivered major breakthroughs in our understanding of thicket, this new wave of research contributes important new knowledge of thicket ecology and evolution. For example, unlike the situation in the 1980s, there has been a trend to acknowledge and understand the central role people play as agents of transformation, restoration, conservation and sustainable management of thicket's natural resources. Resource use by the rural poor is receiving increasing attention from several departments at Rhodes University; specifically, its importance for sustaining rural livelihoods (Cocks & Wiersum 2003; Gyan & Shackleton 2005; Pote et al. 2006).

Research on the effects of domestic stock on thicket has declined somewhat. However, progress has been made in identifying and understanding other services that thicket provides for people, notably wildlife and ecotourism (Turpie 2003; Pote et al. 2006; Smith & Wilson 2002; Langholz & Kerley 2006). We also know that some thicket types are, amazingly, capable of sequestering carbon from the atmosphere at rates equivalent to some types of forest that receive two to three times the amount of rainfall (Mills et al. 2005; Mills & Cowling 2006). The Department of Water Affairs and Forestry's Working for Woodlands pilot project is currently investigating opportunities for driving the restoration and conservation of thicket through the carbon economy (Mills et al. 2007).

Increasingly, research is being conducted into the requirements for successful nature conservation initiatives, including: the effectiveness of conservancies in the Eastern Cape; the potential role of conservation incentives for private commercial farmers in the Bathurst District; situation analysis for implementation of a local-scale conservation initiative for the Bathurst Commonage; and the identification and mapping of the social and institutional factors which define successful conservation opportunities in the Albany District. This recent conservation-focused research complements and builds upon the products delivered by the STEP Project, which include a rigorous and defensible assessment of priority conservation corridors (Rouget et al. 2006), a model for ecologically sustainable land management (Knight & Cowling 2003b), a tractable strategy for implementing these (Knight et al. 2003), along with mapping products which facilitate environmentally sound decision-making for land-use planners (Pierce et al. 2005; Pierce & Mader 2006).

THE THICKET FORUM

The Thicket Forum was established as one of the institutions to fulfill the STEP strategy. The inaugural meeting was held in 2004 at Zuurberg, near Addo; the second in 2005 in Grahamstown; and the third at the Döhne Agricultural Development Institute near Stutterheim from 17–20 July 2006. The theme for this year's meeting was 'Partnerships for prosperity: ensuring production and persistence.'[1]

Back in 1990, as evident from the proceedings of the meeting held that year (Zacharias et al. 1991), great strides had been made in thicket research. Thus, the rationale for identifying thicket as a distinct biome was provided; its unusual biogeography was explored; its environmental correlates were identified; the puzzling preponderance of vegetative regeneration (save for tree aloes and euphorbias) was highlighted; the impact of domestic and indigenous browsers on thicket structure and composition was evaluated; and a special session was devoted to the biology of spekboom (*Portulacaria afra*), a keystone plant species. Much attention was given to the management of thicket as an agricultural resource. There was healthy representation by government agency personnel, who comprised about 70% of the 69 participants (at that stage, the provincial conservation agency had considerable research breadth and depth, and the Döhne Research Centre was a hive of activity). About one in five of the delegates hailed from academia. All researchers were from the ecological or natural resource management sciences; no social scientists were present. Even more disturbing, landowners were represented by only four participants, while only two delegates were women and none was black. The emphasis of all presentations was on understanding the natural resource base, and there was scant reference to the people who lived in the thicket and were

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[1] In total, 57 people attended, of whom 22 were women, with the social and institutional demographics much better reflected than the 1990 meeting. Of the delegates, 42 were white and 15 were black. Universities provided the bulk of attendees with 16 participants, including four social scientists. Other participants were from a wide range of organizations, including national government (11), provincial government (8), municipalities (6), non-governmental organizations (6), farmers and other landowners (5), and consultants (3). A survey of the participants revealed a strong sense of satisfaction with the meeting, and optimism about the forum's potential to provide a platform for implementing the STEP Strategy.

dependent on it for their livelihoods. Nonetheless, the mood was buoyant: participants felt that they were on the brink of a deeper understanding of the ecology and management of this fascinating ecosystem. The subsequent collapse of the Eastern Cape conservation agency's research capacity, however, and the exodus of accomplished researchers from agricultural institutions, rapidly extinguished this sense of optimism. In contrast to previous years, workshops were held in the morning sessions of the 2006 meeting; these focused on a diverse range of conservation, social and sustainable management issues, including common property resource management, land-use planning needs, the status of game-based industries, the opportunities for accessing the global carbon economy, the challenges of managing subsistence livelihoods, and the role of protected areas. The new workshop format was designed to facilitate 'knowledge interfacing' and promoted often lively discussion, and several important outcomes regarding the implementation of conservation action. The final workshop session brought together the outcomes of earlier workshops, and allowed delegates to identify knowledge gaps and research needs, and to offer valuable insights for refining the future directions of the STEP Implementation Strategy (see Box 1). Thicket Forum is now explicitly structured as a social learning institution, and aims to provide a mechanism for bridging the research-implementation gap, which typically exists between science and management (Roux et al. 2006). It is a critically important institution for implementing the STEP strategy because it brings together researchers, implementers (such as landowners) and enablers (for instance, government officials) every year to discuss and identify research problems and management directions. It is a tangible attempt to manifest consilience—the fusion of knowledge traditions—in the land management institutions and organizations operating throughout the thicket biome, and will provide a foundation for meeting the complex challenge of delivering sustainable management of the thicket biome. The key, now, is to sustain the momentum.

Box 1. What research do we still need to do on thicket?

What research remains to be done if we are both to have the knowledge base to implement ecologically and economically sustainable land management in the thicket biome, and to convince stakeholders of its merits? Suggestions from the Thicket Forum include:

- We need to test the notion of thicket as the 'mother of all South African vegetation' through comprehensive phylogenetic and phylogeographical analyses of its component plant and animal lineages. This will provide a charisma and the basis for a narrative for marketing the importance of thicket that is currently lacking.
- We need a better understanding of the biology of keystone plant species, including spekboom (Portulacaria afra), wild plum (Pappea capensis), boerboon (Schotia afra), and aloes.
- More research is required on ecosystem processes, especially with regard to water, nutrient and carbon dynamics.
- The population and community dynamics of Xeric and Valley Thicket remains an enigma: much more needs to be done. Of importance is teasing-out the role of fire in maintaining thicket boundaries and the composition of thicket clumps in mosaic formations.
- Given that thicket supports much more herbivore biomass than vegetation at equivalent latitudes elsewhere in the world (A.V. Milewski, pers. comm.), we need to know why this is so and what are the requirements for maintaining this biomass.
- The massive rise in the wildlife industry, often involving extra-limital species, challenges us to understand the influences of these species on biodiversity and ecological processes.
- While there is some appreciation of stocking rates for both domestic and indigenous livestock, government-prescribed rates are generally out-of-date for domestic stock, and absent for indigenous stock; much finer-(farm) scale assessments are required.
- How do we monitor thicket, and what are the indicators and thresholds of potential concern?
- We also need a better understanding of the many services, both direct and indirect, that intact thicket provides for the people who live in its midst, particularly for those for whom subsistence harvesting is critical to their livelihoods.

- We urgently need an assessment of the likely impact of anthropogenic climate change on thicket vegetation types and keystone species.
- Private land conservation initiatives are the cornerstone of the STEP Implementation Strategy, and so we require research into the characteristics of, and incentives for, conservancies to deliver environmentally sustainable land management.
- We need to identify the opportunities for mainstreaming the STEP Implementation Strategy through the land reform process.
- It is important that we begin monitoring the effectiveness of decisions made by land-use planners using the STEP handbook and mapbook products, and so we need to develop indicators, and monitor the uptake and the consistency of application and interpretation of these products.
- Finally, and most importantly, we require a much better appreciation of the ways in which people view thicket, especially the cultural links between people, species and priority areas, and the choices they make regarding its use or abuse. Without these insight we are unlikely to be in a position to mainstream the sustainable use of thicket into sectors traditionally seen as adversaries of conservation, namely agriculture, subsistence use and infrastructure development.

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Paper V

Embracing Opportunism in the Selection of Priority Conservation Areas*

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> "A prejudice is more easily detected in the primitive, ingenuous form in which it first arise than as the sophisticated dogma it is apt to become later. Science does appear to be baffled by ingrained habits of thought, some of which seem to be very difficult to find out, while others have already been discovered."
>
> Erwin Schrödinger
>
> Nature and the Greeks, p.18
> Cambridge University Press, 1996

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SYSTEMATIC TECHNIQUES

There has been much written of the vagaries and shortcomings of the current global protected-areas network (e.g., Bibby et al. 1992; Rodrigues et al. 2004). A history of protected-area establishment for reasons other than nature conservation has produced a global protected-areas network that is biased toward infertile or rugged landscapes that are not economically valuable for production (Pressey 1994). Consequently, many areas of high priority for nature conservation are located on unprotected private lands (Knight 1999). This disparity between the intention and practice of protected-area selection (Pressey et al. 1993), the deepening environmental crisis (Vitousek et al. 1997), and the woefully inadequate resources committed to nature conservation (Courrier 1992) have furthered the development and application of systematic techniques for the selection of priority conservation areas. These techniques are said to take selection of nature conservation areas "beyond opportunism," toward scientific defensibility and greater effectiveness (Pressey et al. 1993).

The push for the improvement and widespread adoption of systematic techniques has been driven largely by the recognition that the ways in which areas for nature conservation were identified in the past were largely opportunistic. Protected areas were predominantly established on "worthless lands" (Pressey et al. 1996), where the opportunity costs of setting aside land for nature conservation were minimal (Balmford & Whitten 2003). Scientifically defensible techniques were seen as the panacea for this problem of poorly targeted nature-conservation efforts; accordingly, computer-based techniques have become the mainstay of area-selection approaches because protected area networks designed solely by experts tend to be highly biased toward the experts' best-known areas (Cowling et al. 2003). The focus of the bulk of peer-reviewed, area-selection studies has therefore been on testing biological data and techniques to quantifiably establish their limitations. The size of planning units (e.g., Pressey & Logan 1998), the appropriate resolution and scale of environmental data (e.g., Pressey et al. 1999), effects of species-distribution records (e.g., Freitag et al. 1998), taxonomic surrogacy (e.g., Lombard et al. 2003), and differences between computer-based algorithms (e.g., Csuti et al. 1997) have become the mainstay of area-selection studies published in the peer-reviewed literature.

A Broader Planning Context

Nevertheless, in the real world, the successful selection and implementation of protected areas is the product of a complex suite of factors that are typically neither biological nor reliably predictable. The pressures of economic forces, available funding, organizational and institutional capacity, political defensibility, land tenure, corruption, donor regulation and so on, push and pull on the recommendations of systematic area-selection initiatives (Peters 1991; Soulé & Terborgh 1999). Consequently, the recommendations of systematic conservation assessments are often difficult to implement because they have adopted a purely scientific and biological approach to area selection and have not accounted for those social, economic, and political factors that actually determine the success of conservation planning (Cowling et al. 2004).

Although the natural sciences play a critical role in conservation planning initiatives by providing transparent and defensible information on which to base land-use decisions (Cowling et al. 2004), those of us involved in pragmatic real-world conservation planning realize that a more effective approach to planning situates a systematic conservation assessment in a broader conservation planning context (Knight et al. 2006*a*, 2006*b*) that embraces normative institutional process and adopts an approach of "informed opportunism" (Noss et al. 2002) to securing protected areas. In this way human-centred factors that actually determine effectiveness can be accounted for in the conservation planning process, which leads to more rapid and cost-effective gains for conservation.

Conservation scientists typically pursue quantifiable certainty as the basis for decision making (Knight et al. 2006*b*). Nevertheless, greater accuracy and precision in area-selection techniques does not make for increased effectiveness of conservation planning initiatives. It is now apparent that when undertaking conservation assessments, it is insufficient to simply map areas of conservation priority with measures of conservation value and vulnerability (sensu Pressey 1997). Instead one must map and analyze a range of social, economic, and political factors that define opportunities for implementing nature conservation actions in the specific context of the social-ecological system of the planning region. These factors could include, for example, costs of land acquisition (Ando et al. 1998; Polasky et al. 2001); costs of differential implementation of a range of conservation instruments (Frazee et al. 2003; Pence et al. 2003; Wilson et al. 2007); policy instruments available to mainstream conservation priorities into land-use planning

(Theobald et al. 2000; Pierce et al. 2005); willingness of landowners to be involved in conservation initiatives on private land (Winter et al. 2005); the resources of agency staff to service such initiatives (von Hase et al. 2003); social capital within local and regional land-management institutions (Grootaert & van Bastelaer 2001); and levels of entrepreneurship (Seidl et al. 2003) and burnout in rural communities (Byron et al. 2001).

OPPORTUNISM

Conservation planning has now come full circle, and although opportunism has historically been the nemesis of conservation planning initiatives (Pressey et al. 1993), it is actually a critical component of their effectiveness (Noss et al. 2002; Cowling et al. 2004; Knight et al. 2006*a*). Conservation intervention processes need to be designed, that explicitly bridge the "knowing-doing gap" (Pfeffer & Sutton 1999) between the information generated by the technical activities of conservation assessment and the normative activities of stakeholder collaboration and strategy development and implementation. This can be done by establishing social learning institutions that deliver conservation action. These interventions should proactively drive implementation forward and be poised and ready to take advantage of the ad hoc opportunities that typically arise. Making this link requires mapping of conservation opportunities that assist in decision making that pertains to not only where conservation action is required, but also when and how to implement actions when opportunities appear. In this way the historical nemesis of opportunism is embraced and turned into an advantage.

The concept of priority conservation areas (Pressey 1997) shackles conservation planning with a negative perspective that is difficult to sell to land managers because it complements conservation value with a measure of threat (vulnerability). It is time to retire Cassandra (Redford & Sanjayan 2003), recast the obstacles to achieving our conservation goals as opportunities, and adopt a positive attitude toward the enormity of the challenge of the conservation task before us (Young 2000). For example, experts involved in expert-driven conservation assessments have been much maligned for their biased outputs; however, they present an opportunity to improve the effectiveness of conservation assessments. The flexibility of systematic approaches to configure alternative networks of proposed protected areas allows the unmapped knowledge of experts—the valued elements of nature and implementation opportunities and constraints—to be meaningfully integrated into a conservation assessment, which, in turn, enhances the assessment's acceptability with implementers and hence the effectiveness of implementation (Cowling et al. 2003). To do this successfully, conservation planners must acknowledge the importance of consilience (Wilson 1998)—the fusion of knowledge traditions—and not only apply the natural sciences to conservation planning problems, but also embrace the knowledge and techniques of social research that will be essential for gathering the information to support the identification and implementation of conservation opportunities (Balmford & Cowling 2006). In the words of Aldo Leopold (Meine & Knight 1999), "The inevitable fusion of the[se] two lines of thought will, perhaps, constitute the outstanding advance of the present century."

Paper VI

Landowner Willingness to Sell Constrains the Expansion of Protected Area Networks*

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"...proper (reserve) design is a balance among the competing non-ecological exigencies of economic forces, available funds, defensibility of the preserve, availability of land, and social disruption and demands plus a series of biological considerations concerning the ranges of available habitats in different areas and the demands of the target species for preservation."

Robert H. Peters

A Critique for Ecology, p.189
Cambridge University Press, Cambridge, United Kingdom, 1991

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ABSTRACT

Formally protected areas are regarded as the cornerstone of nature conservation efforts. Systematic conservation assessment techniques, which are increasingly employed in the design networks of protected areas, are becoming increasingly sophisticated, though still are generally focused upon environmental data. One common assumption is that most, if not all, land throughout the planning region is available for acquisition. We mapped the willingness of landowners to sell their land, and examined, i) the degree to which land class targets are achieved, ii) the efficiency, iii) the spatial configuration, and iv) the cost effectiveness, of areas identified as important for achieving conservation targets. We found that only 10 out of 48 landowners were willing to sell their land, which equated to 20.8 percent being unavailable. Only seven, five and one of the 19 vegetation types were represented to 10%, 30% and 50% target levels. Assuming landowners would be willing to sell for prices inflated above current market value, the cost of acquiring all lands was variously between 6.20 and 30.67 percent more expensive than the estimated 2006 land price. Accounting for implementation opportunities and constraints, such as landowner willingness to sell, is of fundamental importance when designing systematic conservation assessments.

INTRODUCTION

The resources available for conservation action are woefully inadequate compared to the resources invested in activities which degrade or destroy nature (World Resources Institute, 1992; Balmford et al., 2002). Formally protected areas are widely regarded as the cornerstone of nature conservation efforts defying this destruction (Margules & Pressey, 2000; IUCN, 2003). As a result, considerable research has been directed towards developing computer-based area selection algorithms which identify locations where conservation action could be implemented to efficiently achieve conservation targets (i.e., numbers or extents of valued natural features). These systematic conservation assessment techniques have become standard procedures for identifying candidate networks of protected areas at regional (e.g., Noss et al. 2002; Rouget et al. 2006; Smith et al. 2006) and local scales (CSIR 2002; Pence et al. 2003; von Hase et al. 2003). More generally, they are used to prioritize conservation investments at continental (e.g., Flather et al. 1998; Moore et al. 2004) and global scales (see Brooks et al. 2006 for review).

Historically, conservation planners applying algorithms have been primarily interested in valued nature when selecting protected areas. Accordingly, systematic conservation assessments have generally applied biological and/or habitat data (hereafter 'ecological data') alone, typically species (e.g., Kirkpatrick 1983; Margules et al. 1988; Brooks et al. 2001; Polasky et al. 2001, 2005) or land classes (e.g., Pressey et al. 1996; Stoms et al. 1998; Rouget et al. 2006), although increasingly these are being complemented with vulnerability, cost and other data (see Wilson et al. 2005; Naidoo et al 2006 for reviews). Conservation planners have lamented the apparent inadequacy of existing ecological data, and called for greater resources to be focused upon collecting more comprehensive ecological datasets (e.g., Balmford & Gaston 1999; Margules & Pressey 2000; Brooks et al. 2001; Meir et al. 2004).

However, the expansion of formal protected area networks (i.e., IUCN I-IV categories) fundamentally hinges upon two questions to which ecological data can not provide answers. First, do funds exist for the purchase of lands important for securing valued nature? Second, are these important lands available for acquisition? The expansion of protected area networks depends pragmatically upon answers to these questions because the majority of land in the majority of regions across the world is privately owned.

There has been a recent flurry of research incorporating economic factors (i.e., costs) into systematic conservation assessments (see Naidoo et al. 2006 for review), which improves the cost effectiveness of expanding protected area networks (e.g., Ando et al. 1998; Balmford et al. 2000; Polasky et al. 2001, 2005; Moore et al. 2004; Wilson et al. 2006). However, many systematic conservation assessments in the peer-reviewed literature, including our own, assume that most, if not all, land is available for acquisition. Land availability is a fundamental consideration if areas are to be purchased (Tans 1974; Margules & Usher 1981; Peters 1991; Pressey et al. 1994; Meir et al. 2004; Wilson et al. 2006), as it is known, generally, to be heterogeneous across most regions (Meir et al. 2004), primarily because it is fundamentally a function of the idiosyncratic values and choices made by individual people (Cowling & Pressey 2003). Why then has so little effort been directed towards mapping land availability?

Increasingly, it is recognised that the willingness of private landowners to engage conservation initiatives is crucial to their success (Curtis et al. 2001; Cowling & Pressey

2003; Meir et al. 2004; Winter et al. 2005; Nelson et al., in press). However, we are unaware of any study which incorporates the willingness of landowners to sell their land to conservation agencies in a systematic conservation assessment. Tans (1974) included land availability as one of six criteria when applying a scoring approach in Wisconsin. Meir et al. (2004) accounted for the heterogeneity of land availability for purchase (effectively a function of landowner willingness) using a probability of availability. Nelson et al. (in press) applied a discrete-choice land-use change model which explicitly accounted for the stochastic nature of land-use decisions made by private landowners, based upon the economic benefits accrued from payments for ecosystem services.

Government conservation organisations in South Africa have funds for land acquisition, specifically the Eastern Cape Parks Board is considering expansion of the Great Fish River Reserve. We interviewed private landowners in a production landscape in the Albany District of the Eastern Cape, and mapped and analyzed their willingness to sell their land, so as to test whether the inclusion of data on landowners willingness significantly influences i) the degree to which land class targets are achieved, ii) the efficiency, iii) the spatial configuration, and iv) the cost effectiveness, of areas identified as important for achieving conservation targets. Our aim is to investigate the importance of including data on implementation opportunities and constraints in systematic conservation assessments (Cowling et al. 2004; Knight & Cowling 2007).

RESULTS

The achievement of targets is significantly compromised by landowner willingness to sell. Only seven, five and one of the 19 vegetation types were represented to 10%, 30% and 50% target levels, respectively, when unavailable cadastres were removed from the analysis (Figure 1). The number of targets achieved for each minimum set analysis was uniform across each target level, regardless of varying compactness (i.e., BLM) and cost constraints. The number of cadastres selected was reduced significantly with application of the compactness constraint, with the total area of all selected cadastres increasing only marginally. The Spearman rank correlation showed there was little similarity between the 'best', the compactness constrained, and the willingness constrained minimum set analyses. Land acquisition costs were homogenous across all compactness constraint values (i.e., 0, 10, 100) for both the 30% and 50% targets for the Low scenario, with a maximum cost of R117,555,909.66. The 30% and 50% targets were homogenous for both the High and Even scenarios. Interestingly, the Low scenario was significantly less cost effective than either the High or Even scenarios, despite the lower purchase costs.

All nine 'best' near-optimal minimum set analyses unconstrained by landowner willingness to sell achieved representation of 19 vegetation types to targets levels. The most area- and cost-efficient scenarios, for all three targets (10%, 30 and 50%), were consistently those without the compactness constraint. The number of cadastres selected typically decreased with increasing weighting of the compactness constraint, the exception being for the 10% target. The 27 analyses comprising the Low, High and Even scenarios were variously between 6.20 and 30.67 percent more expensive than estimated 2006 land prices (Figure 2). Notably, costs varied little for the three 50% target analyses.

In comparison, random selections of areas securing 10%, 30% and 50% of the planning region represented, respectively, only three, nine and eight of the 19 vegetation types to target levels. In comparison to the three analyses unconstrained by the compactness constraint, the area, cost and number of cadastres were all lower for the 10% and 30% targets, but higher for the 50% target. Random sampling of cadastres by willingness classes constrained to the total area selected in the 'best' analyses selected significantly fewer cadastres than the purely random selections, though their total area was similar. Random selections of cadastres performed better than minimum sets constrained by landowner willingness to sell. Sampling of cadastres by willingness classes which preferentially selected the largest available cadastres first (similar to how some conservation agencies purchase lands), chose significantly fewer sites than either of the random selections.

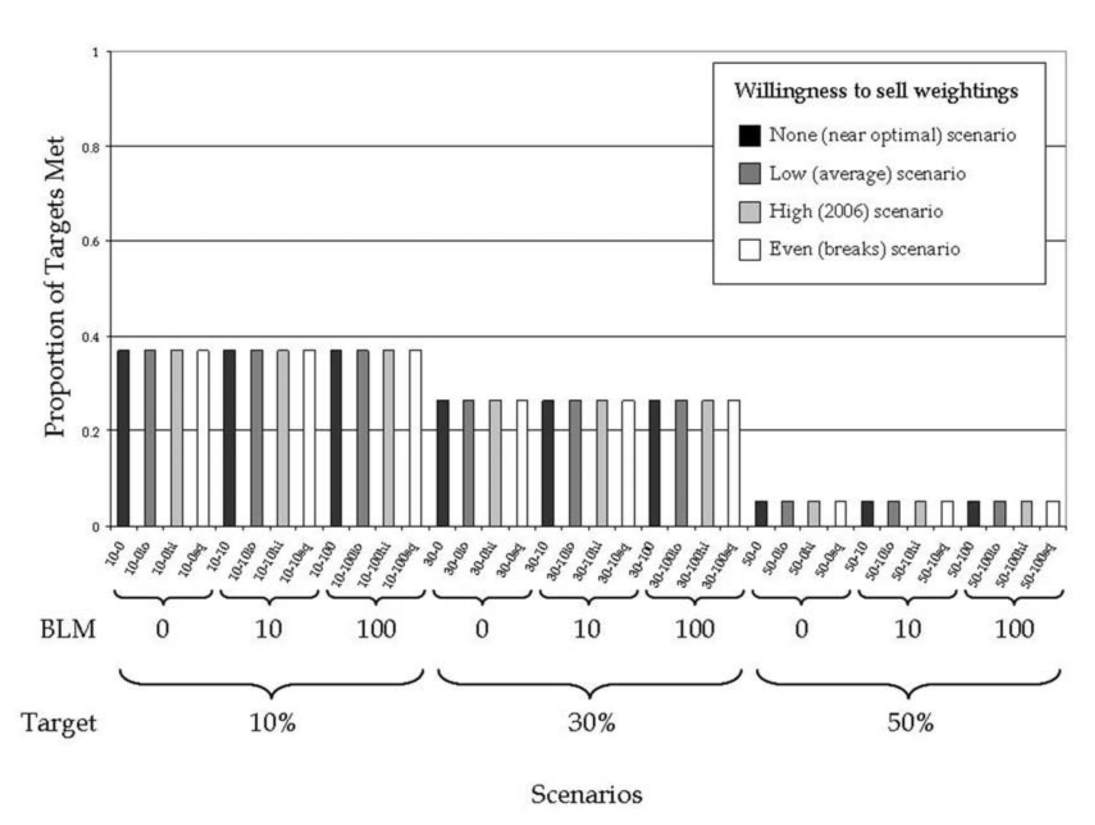

FIGURE 1 - The achievement of targets for 19 vegetation types for minimum set analyses constrained by landowners willingness to sell. Increasing areal targets leads to a decrease in the proportion of targets achieved. Codes along the X-axis (e.g., 10-100sq) denote factors in three parts as : i) the target level (e.g., 10%), ii) the Boundary Length Modifier weighting which promotes compactness (e.g., 100), and iii) the cost weighting based upon landowner willingness to sell.

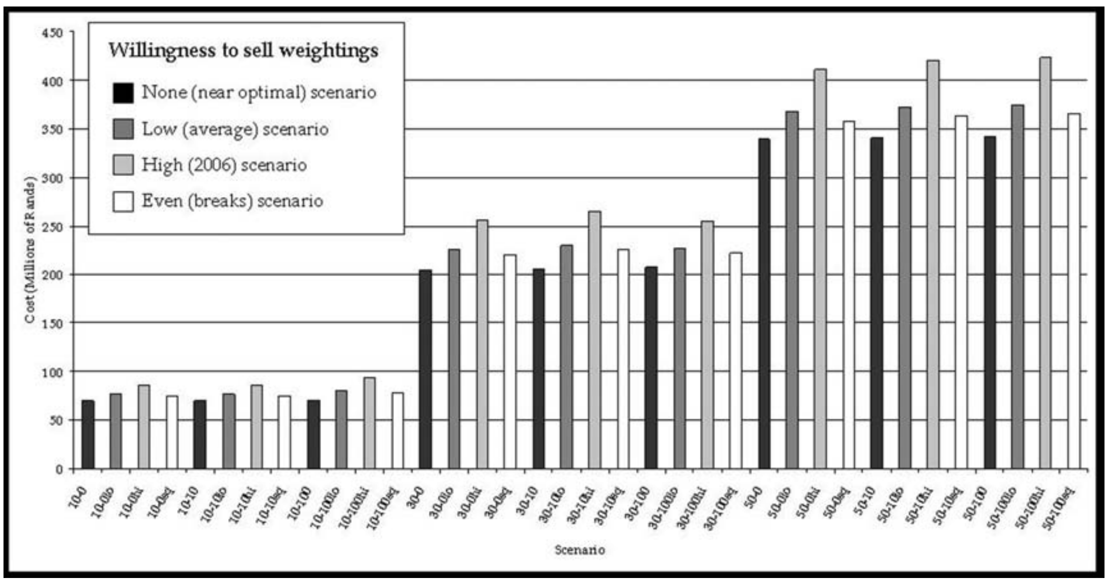

FIGURE 2 – Minimum set analyses not constrained by landowner willingness to sell finds a proportional increase in the cost of acquiring selected cadastres, both for the variable willingness weightings, and as target level increase. Codes along the X-axis (e.g., 10-100sq) denote factors in three parts as : i) the target level (e.g., 10%), ii) the Boundary Length Modifier weighting which promotes compactness (e.g., 100), and iii) the cost weighting based upon landowner willingness to sell.

DISCUSSION

The majority of systematic conservation assessments published in the peer-reviewed literature, including our own, make a fundamental assumption – that most, if not all, land in a planning region is available for acquisition. This study found that only 23.1 percent of the planning region, or 44 of the 301 cadastres (14.6 percent), is, in fact, available for acquisition. This equates to 10 of 48 (20.8 percent) landowners who would consider selling their land. There appears to be no pattern to the distribution of landowner willingness to sell, which is both low and spatially heterogeneous. Landowners adjacent to existing protected areas are no-more willing to sell than any other landowners, making compact options for acquisition limited.

As a result, targets for the majority of vegetation types can not be achieved (Figure 1). Only seven of 19 vegetation types (36.8 percent) are represented to 10 percent target levels. The situation becomes more dire as target levels rise. Only five and one of 19 vegetation types (26.3 and 5.3 percent) are represented to 30 and 50 percent target levels, respectively. Attempting to purchase the entire area would only secure just under a quarter of the region. How then do we achieve our conservation goals when landowner willingness to sell is low?

If conservation targets are to be achieved through acquisition, it may be necessary to pay premium land prices to provide an incentive for landowners to sell, and so increase the availability of land (Meir et al. 2004). Several landowners who were unwilling to sell indicated they would consider selling if offered considerably more than market value. All scenarios weighted by landowner willingness to sell produced an increase in the cost for purchasing the entire planning region (Figure 2). At the 10 percent target level, weighted costs increased between 6.2 and 30.7 percent, with similar results for the 30 and 50 percent target levels. The total cost of purchasing the entire planning region decreased marginally with increasing target levels. For the 30 percent target level, acquisition could cost between R255,177,550 and R265,240,809. Given our conservative weightings of land prices for landowners willingness to sell, the expansion of the protected area network could obviously prove very costly. The compactness constraint produced a marginally higher cost.

Paying premium land prices not only increases the funds required to establish the protected area network, but may inadvertently drive-up land prices (Armsworth et al. 2006). The degree to which purchases for conservation which pay a premium price drive-up prices will relate to the amount of land purchased, and the degree of development pressure (Armsworth et al. 2006). We have witnessed this phenomenon in the planning region, where large tracts of land have been purchased by wealthy foreign nationals for private game reserves. Land prices have increased from roughly 500 R/ha to over 5000 R/ha since 2001. Meir et al. (2004) have demonstrated that increased cadastre availability is better than increased funding when selecting protected areas over the medium-term. The work of both Armsworth et al. (2006) and Meir et al. (2004) suggests an alternative strategy to land acquisition. Although many landowners may be unwilling to sell, they may be interested in committing to some form of private land conservation instrument (e.g., covenant, voluntary conservation agreement) (Knight et al. in prep. b). This has the advantage of costing significantly less in both the short- and long-term (Pence et al. 2003), although the security of the valued nature sampled may be less certain. Willingness to collaborate data could be usefully gathered when gathering willingness to sell data. Ideally, data could be gathered on landowners willingness to engage a range of conservation instruments and institutions forming an optimal mix (Young et al. 1996).

Interestingly, the trade-off between cost and the number of cadastres selected when all sites are available is small (Figure 3). It is therefore useful to apply compactness and cost constraints when purchasing cadastres (or establishing private land agreements) in areas where land availability is high. The significant reduction in the number of cadastres required to achieve targets for relatively little additional cost will be beneficial for implementers – significantly fewer sales to be negotiated, and a less time- and cost-consuming process which reduces protracted liaisons with sellers and the likelihood of them becoming disillusioned. Management costs for conservation agencies could also be reduced.

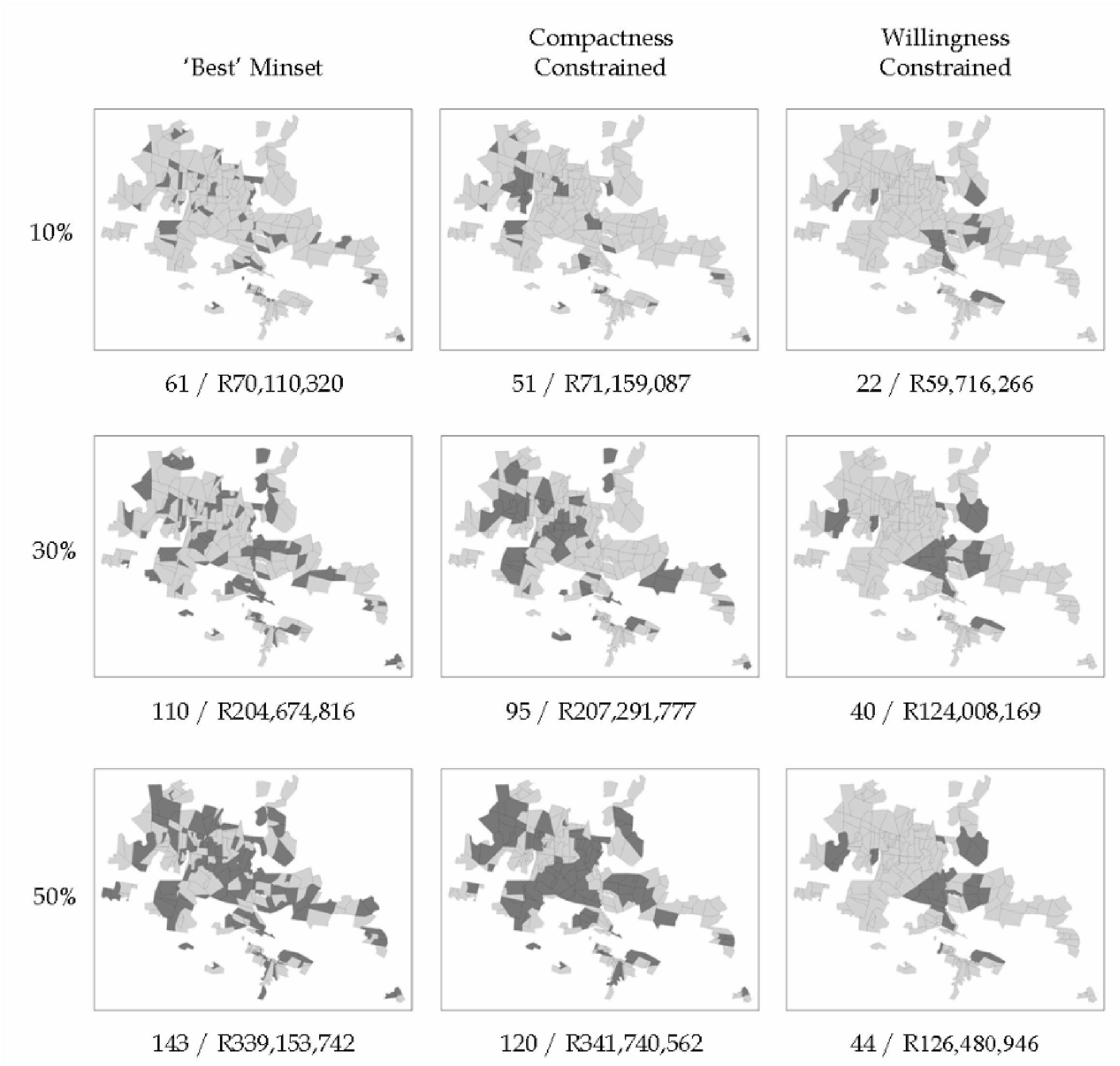

FIGURE 3 – The spatial configuration of selected cadastres varies markedly between minimum set analyses depending upon the relative level of constraint by both compactness and willingness to sell. The compactness constraint produces a significant reduction in the number of cadastres required to achieve targets, whilst willingness to sell compromises target achievement.

This study was specifically designed to be simple, so as to clearly demonstrate a point – that landowner willingness to sell compromises the implementation of recommendations by systematic conservation assessments. However, the simplicity of this study brings limitations. A minimum set analysis only provides a temporal 'snap-shot' of the region, and landowner attitudes may change rapidly. Since this data was collected, several landowners have sold-up and moved-on. Gathering data can also be time consuming, but is a worthwhile investment (Balmford & Gaston 1999). The opportunity can also be used to liaise with landowners so as to build trust in, and support for, conservation initiatives.

Protected area expansion often occurs on public lands (e.g., Pressey 1998; Stoms et al. 1998; Knight 1999; Dobson et al. 2001), which are essentially available, suggesting securing public land is simpler, and probably less expensive, than acquiring private lands. Our results support this belief. Our experience purchasing protected areas in Australia and South Africa (Cowling & Lombard 1998; Knight 2006), which prompted this study, also suggests landowners willingness to sell their land varies, sometimes dramatically, both between, and within, different regions. We suggest our results are probably typical for production landscapes which provide their inhabitants healthy economic returns, and regions being developed for urban living. In economically marginal landscapes, land availability may, in fact, be high, and land acquisition costs correspondingly low.

Our finding that available land comprises such a small proportion of the planning region prompts a re-evaluation of the importance of two foundation principles of systematic conservation assessment (Pressey et al. 1993; Margules & Pressey 2000). First, efficiency (measured as area) has dominated methodological developments in systematic conservation assessment for two decades. The benefits of efficiency are clear when all cadastres are available – many choices exist to build efficient protected area networks. However, in regions, such as the Albany District, where landowner willingness and funding for acquisition are limited, measuring areal efficiency may become almost irrelevant for land acquisition programs, and is of little practical use to implementers purchasing land, who must make decisions. Second, flexibility has been heralded as a major advantage of systematic conservation assessments on the pretext it allows alternative networks of sites to be configured which avoid land-use conflicts (Pressey et al. 1993). Whilst the importance of flexibility is apparent when regional networks of protected areas are being interactively negotiated and most lands are available (e.g., Pressey 1998), our results indicate that although alternative configurations may exist for sampling elements of valued nature, in fact, these alternatives may be non-existent, especially when target levels are high, due to landowners being unwilling to sell. The importance and relevance of both these principles has been over-stated by theoretical studies in the peer-reviewed literature due to an absence of focus upon real-world implementation opportunities and constraints.

The inclusion of landowners willingness to sell in systematic conservation assessments which inform land acquisition programs means implementers receive conservation planning products (e.g., maps) which detail land availability. This reduces the likelihood that conservation planners will have to repeat their analyses when selected areas are found to be unavailable (Margules & Pressey 2000). Conservation planners and the staff of implementing agencies will appear more professional and capable to stakeholders, which promotes confidence and trust. This also saves time and money, and better promotes the usefulness of systematic conservation assessments for solving real-world problems amongst both implementers and stakeholders.

More generally, there has been considerable discussion of the merits of fusing the natural and social sciences for conservation planning (Leopold 1935 in Meine & Knight 1999; Soulé 1986; Meffe 2001; Balmford & Cowling 2006; Hunter & Gibbs 2007), however few practical directives have emerged. Consilience – the fusion of knowledge traditions (Wilson 1998) – can be operationalized at local- and regional scales by designing and implementing systematic conservation assessments which identify conservation opportunities (Knight & Cowling 2007), rather than simply priority conservation areas employing ecological data alone (*sensu* Pressey 1997). Data on conservation value and vulnerability should be complemented with human and social data on factors which influence the effectiveness of conservation actions on-the-ground, including landowner willingness to sell and to participate in conservation initiatives (e.g., Curtis et al. 2001; Winter et al. 2005), landowner burnout (e.g., Byron et al. 2001), entrepreneurial orientation (e.g., Hermansen-Kobulnicky & Moss 2004), social capital (e.g., Grootaert & van Bastelear 2001), and people who are potential champions for conservation initiatives. We implore conservation planners to cease their calls for ever-more ecological data (Balmford & Gaston 1999; Margules & Pressey 2000; Brooks et al. 2001; Meir et al. 2004), and their testing of theoretical conservation problems (Knight et al. 2006a, In press a), and to source human and social data from people making decisions which affect landscapes day-to-day – landowners. This begins practically with situating systematic conservation assessments within a broader operational model for conservation planning (e.g., Knight et al. 2006a), in which it is preceded by a rapid, comprehensive social assessment (Cowling & Pressey 2003; Cowling & Wilhelm-Rechmann 2007).

MATERIALS AND METHODS

Study Area

The planning region is located in the Albany District of the Eastern Cape of South Africa, and forms the south-western portion of the Maputaland-Pondoland-Albany hotspot (Steenkamp et al. 2005). It was chosen for its high level of plant endemism, the negligible rates of vegetation clearing, its proximity to the proposed Fish-Kowie Megaconservancy Network identified for the Subtropical Thicket Ecosystem Planning project (Rouget et al. 2006), and the absence of major existing conservation initiatives.

Data

We adopted the vegetation types of Vlok et al. (2003) as a surrogate for valued nature. Such surrogates are widely regarded as useful for practical area selection studies (Noss 1987; Higgins et al. 2004; Cowling et al. 2004). The planning region was sub-divided into planning units (n = 301) using cadastral data secured from the Surveyor General (2001). Cadastral data are useful for practical area selection studies as these are the legally recognised portions of land for management and transfer of ownership (Pressey & Logan 1998; Knight et al. 2006b).

Willingness to sell data was collected through semi-structured face-to-face interviews with 48 landowners in the planning region during June to November 2006 (see Appendix V in this thesis for the interview questionnaire). Draft questionnaires were initially reviewed by social researchers with interview experience, and subsequently piloted and refined with landowners. Landowners were identified from the telephone directory or from information provided by other landowners during interviews ('snowballing', *sensu* Goodman 1961). We monitored the spatial extent of cadastres as interviews proceeded, targeting landowners who owned cadastres which improved the contiguity of the final sample. A contiguous sample was not possible due to landowner illness, death, or unknown owner. Most landowners were small stock (i.e., sheep, goat) pastoralists who own, and whose income is primarily generated from, their properties. A significant number supplement income with small-scale eco-tourism ventures (e.g., hunting), whilst a small number are exclusively eco-tourism. Face-to-face interviews lasted one to six hours, were conducted generally in the landowners residence, and addressed a wide range of topics beyond their willingness to sell (see Knight et al. in press b). Questions relating to landowners financial situation were specifically avoided as an earlier study indicated significant sensitivity to this topic (Cumming 2007).

Land acquisition cost data was sourced from the South African Property Transfer Guide (SAPTG). Acquisition costs were estimated using only 2006 land sales records for cadastres located within a ten kilometre radius of interviewed landowners and adjoining protected areas, first, as property prices have increased by at least an order of magnitude over the last six years, apparently driven by overseas buyers (e.g., Armsworth et al. 2006), and second, veld grazing capacity can be highly heterogeneous and affects land values. Records in communal lands east of the Great Fish River were excluded as these lands prices are strongly influenced by the history of Apartheid. Cadastres less than 10 hectares were also excluded from land cost calculations, as these are typically housing blocks whose sale prices are inflated relative to farming land due to, for example, additional infrastructure. Land sale records which did not match cadastres in the spatial data were excluded.

Typically, land is owned and sold not as single cadastres, but as collections of cadastres managed as a single property. Sale values were calculated in Rands per hectare (R/Ha) for individual cadastres using cadastral areal extents calculated from the Surveyor General's (2001) spatial data matched to textual sale price data from the SAPTG, as areal extents of cadastres in the SAPTG are known to have a high probability of being incorrect (M. Powell, pers. comm.). The median cadastre sales price of R4700/ha was adopted, and matches anecdotal evidence for sales prices. Property area from the spatial data was multiplied by the median R4700/ha value. These values were then multiplied by a willingness factor derived from the interview data (Table 1) to estimate a cost for individual cadastres.

	Willingness Weighting		
Response Class	**Low**	**High**	**Even**
Very keen to sell	0.9	0.75	0.8
Keen to sell	0	0	0.9
Unsure	1.05	1.1	0
Will not sell	1.1	1.25	1.1
Definitely will not sell	1.2	1.5	1.2

Table 1 – Willingness to sell weightings applied to mean property sale prices (i.e., 4700 Rands/hectare) according to the five willingness response classes from the landowner survey. The Low scenario represents 'average' land conditions where returns on agriculture and land cost both moderate, offering little incentive for landowners to sell. The High scenario represents conditions akin to conditions in 2006. Some stock farmers are keen to sell because financial returns are poor, whilst most game farmers keen not to sell as returns are good. The Even scenario represents weightings with even breaks for 'objective' comparison.

Weightings for willingness factors were estimated based upon three scenarios (Table 1) and the interview data. The Low scenario reflects average conditions, where returns on agriculture and land cost are both moderate, there being little incentive for landowners to sell. The High scenario reflects conditions prevalent in 2006, where some landowners experienced better conditions than others (i.e., private game farming lucrative, but stock farming not). This scenario may also reflect a situation where land redistribution (a current government initiative) is proactively underway. The Even scenario applies uniformly distributed weightings where a zero value is centred around the middle 'Unsure' questionnaire category. It aims to test an 'objective' weighting structure. Our experience interviewing landowners suggests that a significant number of landowners who selected 'Definitely will not sell' as their response in the questionnaire would sell their land if they "got a deal too good to refuse". Accordingly, we have applied weightings to the 'Unsure', 'Will not sell' and 'Definitely will not sell' categories.

Targets

We applied three targets – 10, 30 and 50 percent of the areal extent of each vegetation type. The 10 percent target was chosen as it is a generally accepted (though widely criticized) standard (McNeely 1993; Soulé & Sanjayan 1998). The 30 percent target was chosen as it is a recent international recommendation (IUCN 2003). The 50 percent target was chosen because it is a general estimate of the proportion of a region required to ensure the persistence of all species (Soulé & Sanjayan 1998).

Marxan Spatial Prioritization Software

MARXAN software applies a simulated annealing algorithm to select near-optimal minimum sets of planning units which are both cost effective in achieving explicitly-stated targets (i.e., numbers or extents of elements of valued nature) and which incorporate spatial design principles (Ball & Possingham 2002). The cost objective can be stated as:

$$\sum_{i=1}^{M} c_i x_i + BLM(\sum_{i=1}^{M} x_i l_i - 0.5\sum_{i=1}^{M} x_i \sum_{k=1}^{M} x_k b_{ik})$$

subject to the constraints:

$$\sum_{i=1}^{M} a_{ij} x_i \geq t_j \sum_{i=1}^{M} a_{ij} \text{ for all j = 1..N,}$$

$$x_i \in \{0,1\} \text{ for all i = 1..M,}$$

where *xi* denotes whether planning unit *i* is selected for the reserve network (*xi* = 1) or not (*xi* = 0). The planning unit *i* has a "cost" for inclusion in the reserve network of *ci* (i.e., area or land purchase cost, depending upon the scenario), a boundary length, *li*, and a common boundary length with planning unit *k*, *bik*. The Boundary Length Modifier (BLM) is a user-defined constant that weights the selection of compact groups of planning units.

The extent of each vegetation type, *j,* represented in planning unit *i* is *aij*, and *tj* is the target amount of that feature for representation in the reserve network (e.g., *tj* = 0.2 means at least 20% of the feature should be included). The algorithm seeks to identify sets of planning units (from *M* different units) that meet the targets for all *N* features while minimizing the objective function (Ball & Possingham 2002).

Analysis

We ran a total of 81 analyses to test the effect of landowners willingness to sell their land upon the selection of near-optimal minimum sets of cadastres required to achieve conservation targets (i.e., extents to be represented in a notional protected area network) (Table 2). Marxan was used to run 72 analyses applying the simulated annealing algorithm complemented with heuristic summed irreplaceability and normal iterative improvement, so as to ensure targets for all available vegetation types were achieved. Half of the analyses (36) had cadastres excluded whose landowners were unwilling to sell. 10,000 simulations were each run for each analyses. Interestingly, the Boundary Length Modifier values identified through earlier testing by Stewart and Possingham (2005) (i.e., 0, 0.01, 0.1 and 1) had little influence upon the compactness of selected cadastres, and so BLMs of 0, 10 and 100 were applied. The species penalty factor was set at 10, after initial experimentation to find an appropriate value that would achieve all conservation targets. Nine analyses were run without a willingness cost weighting or being constrained by willingness to sell (i.e., cadastres owned by unwilling landowners excluded). For these analyses, which comprise the 'best' analyses (i.e., near-minimum set) cost values were set at equal to the area value for individual cadastres, and no cost threshold was applied (Table 2).

Three scenarios (27 analyses in total) were run which mirrored the 'best' minimum set analyses so as to test the influence of willingness upon the efficiency and cost of results. Two scenarios reflect 'real-world' conditions for the planning region experienced during 2006 and the third aims to provide an 'objective' analyses (Table 2).

Nine analyses were conducted without using Marxan, as non-systematic 'real-world' approaches which reflect approaches similar to those employed for protected area network expansion by some conservation organisations. First, areas were ranked randomly by willingness classes to secure 10%, 30% and 50% of the planning region. For example, the 'Very keen to sell' willingness class values were randomized then ranked, then willingness class 4, and so on. This reflects the way in which some land acquisition programmes prioritize land, by purchasing only those lands which might be opportunistically available. Second, areas ranked by willingness class, and then by largest area per willingness class to secure 10%, 30% and 50% of the planning region. Large areas are often valued by agency staff purchasing protected areas, as politicians and bureaucrats tend to measure conservation effectiveness in hectares. Third, a random selection of cadastres meeting the 10%, 30% and 50% targets was conducted as the null hypothesis. We note, however, the debate surrounding the utility of null hypotheses to the generation of useful knowledge (Starbuck 2006).

We investigated the influence of landowner willingness to sell upon land availability by excluding cadastres owned by unwilling landowners and calculating the proportion of targets achieved. We compared analyses using i) the number of targets achieved, ii) financial acquisition costs, and iii) summed willingness weightings. These were compared to analyses unconstrained by willingness to sell. Marxan does not guarantee optimal solutions, so we investigated the similarity of cadastres contributing towards targets by applying Spearman rank correlation analysis to the summed solutions for all 10,000 runs of each pair of analyses (i.e. same target and boundary length modifier, but one including willingness to sell and one not).

Scenario	No. of Analyses	Targets	Compactness Constrained[2]	Willingness Cost[3]	Willingness Constrained[4]	Description
Best	9	10%, 30%, 50%	0, 10, 100	None	No	Identifies the near-optimal solution for comparison to willingness constrained minsets
Low	9	10%, 30%, 50%	0, 10, 100	Low	No	'Average' conditions. Returns on agriculture and land cost both moderate, therefore no incentive for landowners to sell.
High	9	10%, 30%, 50%	0, 10, 100	High	No	2006 conditions. Some stock farmers keen to sell as returns poor. Landowners in eco-tourism not keen to sell as returns good.
Even	9	10%, 30%, 50%	0, 10, 100	Even	No	'Objective' willingness weightings which apply zero as the value for the 'unsure' response for landowners, and even weightings
Best W-ex	9	10%, 30%, 50%	0, 10, 100	None	Yes	Identifies the near-optimal solution for comparison to willingness constrained minsets
Low W-ex	9	10%, 30%, 50%	0, 10, 100	Low	Yes	'Average' conditions. Returns on agriculture and land cost both moderate, therefore no incentive for landowners to sell.
High W-ex	9	10%, 30%, 50%	0, 10, 100	High	Yes	2006 conditions. Some stock farmers keen to sell as returns poor. Landowners in eco-tourism not keen to sell as returns good.
Even W-ex	9	10%, 30%, 50%	0, 10, 100	Even	Yes	'Objective' willingness weightings which apply zero as the value for the 'unsure' response for landowners, and even weightings
W2Sell-Area	3	10%, 30%, 50%[1]	None	Average	No	Areas ranked by willingness class and then largest area. Reflects (ineffective) approach where greater area = greater effectiveness
Random 1	3	10%, 30%, 50%[1]	None	Average	No	Areas ranked randomly to test if i) minsets are more effective than random selections, ii) region-wide % targets achieve representation
Random 2	3	10%, 30%, 50%[1]	None	Average	No	Areas ranked randomly by willingness classes. Reflects the way some land acquisition programmes prioritize land
TOTALS	81	81	72	63	36	

Table 2 – A total of 81 analyses and were conducted across 11 scenarios. [1] denotes targets expressed as a proportion of the planning region, not as a proportion of individual vegetation types. [2] denotes application of the Boundary Length Modifier (BLM) in Marxan. [3] denotes willingness cost weightings as detailed in Table 1. [4] denotes willingness constrained minimum sets analyses which have had cadastres owned by landowners unwilling to sell excluded.

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Paper VII

Towards Defining the Human and Social Dimensions of Conservation Opportunity for Private Land Initiatives in the Albany District, South Africa *

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> "One of the anomalies of modern ecology is that it is the creation of two groups, each of which seems barely aware of the existence of the other. The one studies the human community as if it were a separate entity, and calls its findings sociology, economics and history. The other studies the plant and animal community and comfortably relegates the hodge-podge of politics to the liberal arts. The inevitable fusion of the two lines of thought will, perhaps, constitute the outstanding advance of the present century."
>
> Aldo Leopold, 1935
>
> The Essential Aldo Leopold: Quotations and Commentaries, p.355
> C. Meine and R.L. Knight, editors
> University of Wisconsin Press, Madison, Wisconsin, 1999

* To be submitted for publication as: Knight, A.T., R.M. Cowling, M. Difford and B.M. Campbell. Towards Defining the Human and Social Dimensions of Conservation Opportunity for Private Land Initiatives in the Albany District, South Africa. *Conservation Letters*.

ABSTRACT

Spatial prioritisations have become a common technique for allocating conservation resources. Typically they employ ecological surrogate data (e.g., species, habitats, ecological processes). Increasingly they are also including data on non-ecological dimensions of social-ecological systems, including, the vulnerability of valued nature (e.g., probability of destruction) and economic costs of implementation (e.g., cost of acquiring protected areas). However, the effectiveness of conservation actions implemented on-the-ground is invariably a function of human and social dimensions of social-ecological systems. We interviewed 48 land managers who own 301 cadastres (legal units of land ownership and transfer) in the Albany District of the Eastern Cape of South Africa to identify those who represent opportunities for conservation. We measured a range of human and social factors hypothesized to influence the effectiveness of conservation action including conservation knowledge; conservation behaviour; entrepreneurial orientation; burnout potential; champion potential; willingness to participate, collaborate or sell their land to conservation interests, and social capital. Groups of land managers were ranked for conservation opportunity using cluster analysis. An original set of 165 items (i.e., questions) was reduced by 73 percent to a subset of 45 items, a preliminary step towards identifying surrogates for these human and social factors which can be gathered using a rapid survey methodology. These human and social factors could be complemented with measures of conservation value, vulnerability, and economic costs of conservation to more effectively schedule conservation action.

INTRODUCTION

Although historically the resources committed to establishing protected areas have been allocated for *ad hoc* reasons (Pressey 1994), quantifiable, spatially-explicit techniques which identify candidate protected areas are increasingly applied to ensure efficient and effective conservation planning initiatives (Pressey 2002). The number of these spatial prioritisation techniques, as they are known, published in the peer-reviewed literature has grown exponentially since the early 1980s (Pressey 2002). Numerous sophisticated computer-based techniques have been developed (Margules & Pressey 2000) including exact optimization methods, heuristic and meta-heuristic algorithms, irreplaceability analysis, and statistical, phylogenetic and GIS techniques.

Despite the diversity of techniques applied to identifying protected area networks, spatial prioritizations have often employed biological and/or environmental data (hereafter 'ecological data') alone. An abundant literature on spatial prioritisation techniques provides a sound understanding of the limitations of applying ecological data (Knight et al. 2006a). Consensus has been generally reached on a suite of measures useful for describing the conservation value of ecological features, for example, richness, endemism, or irreplaceability, though there is some controversy surrounding which are the most effective (Mace et al. 2000; Possingham & Wilson 2005). There is a consistent call in the peer-reviewed literature for gathering ever-more ecological data (e.g., Balmford & Gaston 1999; Margules & Pressey 2000; Brooks et al. 2001; Meir et al. 2004).

However, non-ecological data (i.e., human, social and economic data) are not commonly (but are increasingly) included in spatial prioritisations (Williams et al. 2003). If applied, two types are most common. First, data on vulnerability – the likelihood or imminence of biodiversity loss to current or impending threatening processes (Pressey et al. 1996) – is being applied to complement ecological data to provide a measure of conservation priority (e.g., Pressey & Taffs 2001; Noss et al. 2002; see Wilson et al. 2005 for review). Second, data on the costs of implementation are being increasingly included (see Naidoo et al. 2006 for review) to improve the cost-effectiveness of spatial prioritisations (e.g., Ando et al. 1998; Balmford et al. 2000; Polasky et al. 2001, 2005; Moore et al. 2004; Wilson et al. 2006). These 'social data' influence target achievement, cost-efficiency and/or the spatial arrangement of areas important for achieving conservation goals (e.g., Polasky et al. 2001; Pressey & Taffs 2001; Knight et al., in prep. c).

However, the effectiveness of real-world processes for locating, establishing and managing protected areas is not determined by the valued nature sampled in these areas, and is not limited to the rate at which valued nature is being degraded or destroyed and/or the amount of funding available. Spatial prioritizations are often most effectively conducted at local- or regional-scales (Margules & Pressey 2000). Many regions are sub-divided into cadastres which are held by private land managers. Therefore, ultimately, effective conservation is determined by the choices made by individual people (Cowling & Pressey 2003), regarding both the human activities which degrade or destroy nature, and the resources and capacity which can be collectively mobilised to provide landscape-scale management (Ostrom 1990; Briggs 2001; Brunckhorst et al. 2002). Translating spatial prioritisation outputs into effective action therefore requires they grapple with the conflicting and often disparate values and land management goals of multiple land managers. Meeting this considerable challenge requires spatial prioritisations which do not simply inform us where conservation should be undertaken, but where specific actions can be undertaken most efficiently and effectively (Wilson et al. 2007). Currently, little consensus exists (in contrast to that for ecological data) on measures of social factors useful for describing the potential effectiveness of conservation action.

In response to both the push for gathering ever-more ecological data, and the growing recognition of the importance of understanding human, social and economic factors determining the effectiveness of conservation planning initiatives (e.g., Sunderland et al., in press; McShane and Wells, 2004; Williams et al. 2003; Knight & Cowling 2007; Cowling & Wilhelm-Rechmann 2007), calls have recently been made for conservation planners to map opportunities and constraints for effectively implementing conservation action (Cowling et al. 2004; Knight & Cowling 2007). Spatial prioritizations identifying the degree of opportunity for implementing effective conservation action move beyond simply 'where' and 'when' conservation action should occur towards 'how' it can effectively be undertaken (Knight & Cowling 2007).

We investigated the potential for gathering and mapping data on human and social factors hypothesized to influence the effectiveness of conservation actions implemented on-the-ground, which can be usefully applied to spatial prioritisations which map conservation opportunity. We applied a novel statistical approach to land manager interview data to develop indexes and scales for these factors, and aimed to identify a small subset of items (i.e., questions), which provide useful surrogate measures for land managers human and social characteristics, and thereby contribute towards the development of a rapid conservation opportunity assessment methodology.

METHODS

Planning Region

Our planning region comprised 301 cadastres (i.e., legal units of land ownership and transfer) within the Albany Centre of Plant Endemism, located within the Subtropical Thicket biome, one of South Africa's seven terrestrial biomes (Low & Rebelo 1998) which comprises the south-western portion of the Maputaland-Pondoland-Albany hotspot

(Steenkamp et al. 2005) (Figure 1). The planning region is recognised as important for ensuring the representation and persistence of the Subtropical Thicket biome (Rouget et al. 2006), and the focus of future conservation action in a strategy collaboratively developed by conservation and land management stakeholders (Knight et al. 2003, and in prep. a).

Defining Human and Social Dimensions of Conservation Opportunities

Mapping conservation opportunity may more effectively facilitate the translation of spatial prioritisations into on-ground action than approaches focused upon ecological data alone (Knight & Cowling 2007). We define conservation opportunities according to five dimensions: 1) conservation value, 2) vulnerability, 3) human capital, 4) social capital, and 5) economic costs of implementation. These factors are formulated in the context of an optimal mix of conservation instruments (Young et al. 1996) useful for securing candidate areas, and are collectively constituted as a Landscape Management Model (Knight et al. 2006a). These five dimensions will each be defined by multiple factors, for example, vulnerability may be comprised of exposure, intensity and impact (Wilson et al. 2005). Factors used to define each dimension will vary region-to-region, both according to differences in the regional characteristics, and the ability to gather this data, and so specific factors are best defined on a case-by-case basis. We aimed to evaluate potential factors comprising the human and social (i.e., land managers characteristics) dimensions of the concept of conservation opportunity. We did not investigate conservation value, vulnerability or the economic costs of implementation, as these are relatively well studied. The combined utility of all dimensions for scheduling conservation action will be investigated in future research. This is appropriate as the planning region is important for achieving regional conservation goals (Knight et al. 2003, and in prep. a; Rouget et al. 2006) so there is little practical purpose in re-assessing conservation value at the fine-scale. Land-use pressures are not significant as clearing of indigenous vegetation is almost non-existent, and commercial grazing is typically conducted at close to carrying capacity. The costs associated with establishing private land conservation instruments (e.g., voluntary conservation agreements, easements) are also relatively uniform compared to the variability of land purchase prices, as costs are not strongly a function of area.

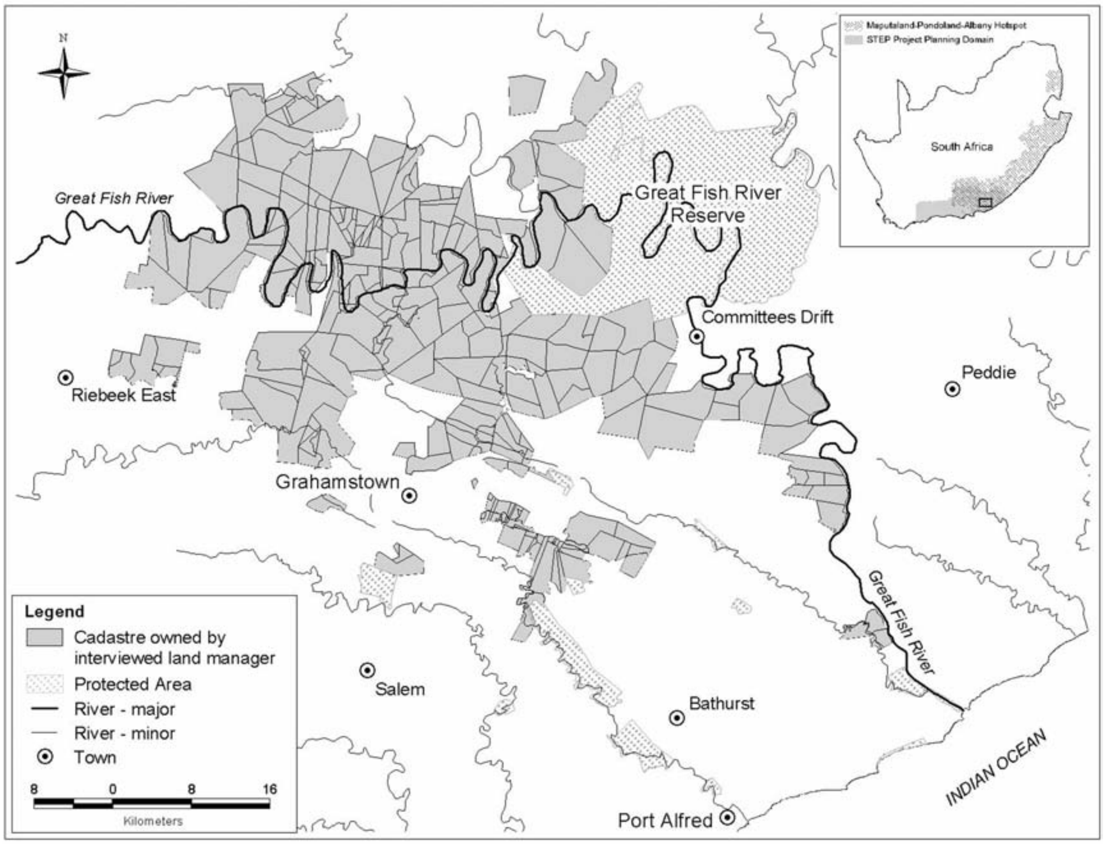


Figure 1 – The planning region comprises 301 cadastres owned by 48 land managers, and is located in the Albany District of the Eastern Cape, South Africa, an area dominated by Subtropical Thicket vegetation which forms part of the Maputaland-Pondoland-Albany hotspot (Steenkamp et al. 2005).

Landscape Management Model

A visioning process was collaboratively undertaken with stakeholders to develop a Landscape Management Model (i.e., Megaconservancy Networks; Rouget et al. 2006) which embodied their values and their perceived future desired landscape (Knight et al. 2003). It identified private land conservation instruments, not land acquisition, as the most favoured future land management scenario. These proactive activities were also complemented with a process for mainstreaming information on important areas for valued nature into reactive decision-making for development by local government (i.e., Pierce et al. 2003). In addition, a diverse range of potential conservation instruments were also examined through an interview survey.

Human Capital

The collective actions of individuals lie at the heart of the dilemma of the biodiversity crisis. Analysis of individual motives and values is critical to a solution (Ehrlich & Kennedy 2005), as the choices made by individual people determine the effectiveness of conservation planning initiatives (Cowling & Pressey 2003). We hypothesized that land manager characteristics influence the effectiveness of conservation actions specifically, conservation knowledge, conservation behaviour, entrepreneurial orientation, burnout potential, whether the land manager exhibited traits of a champion for potential conservation initiatives and was regarded by his/her peers as a local champion, was willing to participate in private land conservation initiatives, and/or was perhaps willing to sell their land to conservation interests (Table 1).

Social Capital

The landscapes of the planning region, as with many regions globally, has been subdivided into cadastres (legal units of land transfer) which are owned by private individuals. The size of cadastres is significantly smaller than the scale at which these landscapes function (Briggs 2001). Collective conservation action between land managers is therefore required to achieve conservation goals (Ostrom 1990; Briggs 2001; Brunckhorst 2002). We measured social capital as per Grootaert & van Bastelear (2001), which comprises measures of local sense of belonging, confidence in government, and local and broader networks. We complemented this with a measure of the willingness of land managers to collaborate with implementing organisations.

Criteria		Measure	Rationale / Assumptions
1. Human Capital			
1a	Conservation Knowledge	Knowledge of nature conservation and ecologically sustainable land management issues and processes	▪ Knowledge comprises the cognitive component of the tripartite model for describing attitudes (Bohner and Wanke 2002). ▪ Land managers with better knowledge of conservation theory and practice may be more likely to adopt conservation practices (Sanz & Grajal 1998; Rhodes et al. 2002; Holmes 2003; Steinmetz et al. 2006)
1b	Conservation Behaviour	Participation in conservation-friendly activities, such as alien invasive plant removal	▪ Behaviour comprises a component of the tripartite model for describing attitudes (Bohner and Wanke, 2002). ▪ Behaviour is a better reflection of values than attitudes, e.g., a strong stewardship ethic is not linked to increased adoption of best practice land management (Curtis & de Lacy 1998) ▪ Land managers already practicing conservation-friendly activities may require fewer incentives maintain these practices
1c	Entrepreneurial Orientation	Characteristics of entrepreneurship exhibited by land managers	▪ Skills and traits required to initiate a small business are probably useful to initiative private land conservation initiatives, for example an ability to recognise and seize opportunities, be self-motivated, innovative, and/or are prepared to take calculated business risks (Lumpkin & Dess 1996)
1d	Local Champion – Personal	Characteristics of leadership and drive exhibited by a land manager	▪ Champions are fundamental to leading private land conservation initiatives (Knight et al. 2003; ten Kate et al. 2004; Shanley 2006; van Wyk et al. 2007) and for mainstreaming conservation into other sectors (Cowling & Pressey 2003; Knight et al. 2006b)
1e	Local Champion – Peers	Land manager well-regarded by his/her peers	▪ A champion must be capable of building social capital and promoting collective action amongst his peers if landscape-level conservation is to be effective
1f	Willingness to Participate	Identifies the conservation instruments and incentives a land manager will and will not engage, and the level of reduced production they will accept	▪ Private land conservation initiatives are often voluntary and so rely on incentives and encouragement, rather than coercion or enforced involvement (Young et al. 1996; Byron & Curtis 2002), which requires we have a better understanding of the social and economic factors that underpin land managers willingness to engage land management initiatives (Curtis et al. 2001)

Criteria		Measure	Rationale / Assumptions
2. Social Capital			
2a	Local Sense of Belonging	Land managers level of trust and the strength of norms of reciprocity and sharing.	▪ Land managers who trust and have confidence in each other will probably work more effectively together, and will likely require less input to foster collective action.
2b	Confidence in Governance	Land managers level of trust in governance systems	▪ Civil and political liberties, political stability and the absence of political violence, and measures of contract enforcement, expropriation risk, corruption and the quality of government bureacracy impact upon economies (Grootaert & van Bastelear 2001). Land managers willingness to invest in a conservation initiative may reflect confidence in these components.
2c	Local Networks	Land managers level of involvement in community institutions and organisations, and his/her social networks.	▪ Effective private land conservation initiatives will probably require common property resource management, where multiple land managers manage their properties collectively (Ostrom 1990; Briggs 2001; Grootaert & van Bastelear 2001; Brunckhorst et al. 2002)
2d	Broader Networks	Land managers "connectedness" with regional, provincial, or national institutions and networks	▪ Local-scale conservation initiatives may derive significant benefits from people and resources found beyond the local area, whose access may be enhanced through a local contact
2e	Willingness to Collaborate	Identifies the agencies or organisations a land manager will and will not engage and their preparedness to work with them	▪ Collaboration is fundamental to effective conservation (Yaffee & Wondolleck. 2000).Some land managers are disillusioned with Government, and/or may have had negative experiences with other land management organisations and non-government organisations. To be effective, conservation inititaives must be sure with whom land managers are prepared to collaborate.
2f	Willingness to Sell	Identifies land manager to engage and agency or organisations	▪ Conservation agencies have funds available for land acquisition, however, land manager willingness to sell is know to be heterogeous (Tans 1974; Meir et al. 2004)

Table 1 – Preliminary criteria applied for defining local-scale "conservation opportunity" in the Albany District, Eastern Cape, South Africa. Criteria were identified from an extensive literature review, are context specific, and will probably differ between planning regions. For example, we measured 'Willingness to Participate' and 'Willingness to Sell' because although private land conservation initiatives (in which land managers participate) were of primary interest to land managers, local authorities also have funds for purchasing formally protected areas.

Data

Human and social factors defining the effectiveness of conservation action (Table 1) were identified, firstly, on face validity (i.e., the degree to which a factor matches commonly agreed mental models of a particular concept; Babbie 1989) from conservation planning (e.g., Soulé & Terborgh 1999; Gelderblom et al. 2003; Groves 2003), local-scale conservation initiatives (e.g., Yaffee & Wondolleck 2000), natural resource management (e.g., Briggs 2001; Schuett et al. 2001; Byron & Curtis 2002; Curtis et al. 2002; Sayer & Campbell 2004), community-based natural resource management (e.g., Fabricius et al. 2001; Fabricius & Collins 2008), bioregional planning (e.g., Miller 1996; Johnson et al. 1999; Brunckhorst 2000), and our own conservation planning experience (e.g., Cowling et al. 1999; Cowling & Pressey 2003; Knight 2006; Knight et al. 2006b).

Data were collected through semi-structured, face-to-face interviews of 48 land managers from June to November 2006 (see questionnaire in Appendix V at the end of this thesis). Draft questionnaires were initially reviewed by social researchers with extensive interview experience, and subsequently piloted and refined. *A priori* lack of contact details precluded stratification of land managers, who were identified from the telephone directory or through other land managers during interviews ('snowballing', *sensu* Goodman 1961). We monitored the spatial location of cadastres as interviews proceeded, targeting land managers who owned cadastres adjoining those of land managers already interviewed, improving the spatial contiguity of the final sample. Face-to-face interviews lasted between one and six hours, and were conducted generally in the land managers residence. The majority of land managers were small stock (i.e., goat, sheep) pastoralists who own, and whose income is primarily generated from, their properties. A significant number supplement income with small-scale eco-tourism ventures (e.g., hunting), or are exclusively eco-tourism. Despite the potential utility of information on land managers financial situation, such items were specifically avoided, as an earlier pilot indicated their sensitivity to this topic (Cumming 2007).

Data Analysis

Indexes and scales are similar, but distinctly different, ordinal (i.e., ranking) measures of factors composed of multiple items (i.e., questions) (Babbie 1989). Indexes are constructed through the simple accumulation of scores assigned to *individual* attributes. Scales are constructed through the assignment of scores to *patterns* of attributes, and have the advantage of accounting for differences in the intensity of responses to items (Babbie 1989). Our objectives were to 1) define a suite of indexes and scales, based on internally consistent and reliable subsets of items (i.e., questions), for factors hypothesised to influence the individual and collective conservation effectiveness of land managers (e.g., entrepreneurial orientation); and 2) identify and map clusters of land managers who represent conservation opportunities based upon their responses to measured factors.

Analyses were conducted using R, an open-source environment for statistical computation and graphics (R-core 2007). Specifically, the following add-on packages were used: 1) psych (Revelle 2007) for calculating three psychometric coefficients – Cronbach's α (Alpha), Revelle's β (Beta) and McDonald's ω_h (Omega) – and for the drawing of ICLUST plots, which also used Rgraphviz (Gentry et al. undated) and Graphviz; 2) subselect (Cerdeira et al. 2007) for calculating RV-coefficients to assist in selecting subsets of items; 3) stats (R-core 2007) for conducting cluster analyses; and 4) ade4 (Chessel et al. 2004) for drawing dendograms and associated table of values.

We calculated McDonald's ω_h (Omega) as it is regarded the most reliable coefficient (Zinbarg et al. 2005, 2006, 2007), but also report coefficients of Cronbach's α (Alpha) (Cronbach 1951) and Revelle's β (Beta) (Revelle 1979). Cronbach’s Alpha is the most widely applied, but least reliable, coefficient of internal consistency reported in the psychometric literature (Zinbarg et al. 2005). It may overestimate the proportion of variance due to general factors when indicators are multidimensional – a feature common to many datasets (Cronbach 1951; Revelle 1979). Furthermore, Cronbach’s Alpha and Revelle's Beta should be used together to judge scale quality and homogeneity, as both reflect important, but different, characteristics (Cooksey & Soutar 2006a and b). Equivalence between Cronbach’s Alpha and McDonald's Omega varies significantly, and holds only under a highly restrictive set of conditions (Zinbarg et al. 2005). Alternative combinations of subsets of items were trialled to explore coefficient values, balancing the compromise between reliability and the number of items. Reliability refers to the degree to which a subset of items (i.e., questions) of a factor captures the informational content of the full set of items.

The desired degree of internal consistency is a function of the purpose of the research, for example whether it is exploratory or applied (Nunnally, 1978). We are unaware of published direction on desirable values for Omega, but suggest values of 0.60 are low. Nunnally (1978) suggests, for fundamental research, reliabilities greater than 0.70 are sufficient for Cronbach's Alpha. Rossiter (2002) has more recently suggested that desirable values for Alpha and Beta would be 0.80 and 0.70 respectively. Beta values lower than 0.50 are considered to be low and to be indicative of the presence of subscales (Revelle 1979; Cooksey & Soutar 2006a).

Ultimately, we are interested in a relative ranking of land managers (there is no ultimate 'right' answer, as importance is limited by the resources available for implementation), as all land managers, in theory, could potentially be involved in private land conservation initiatives, and so internally consistent factors were identified by comparing Beta and Omega values. When identifying subsets of items for each factor, we confirmed they were representative (i.e., capture the informational content) of the full set of items for each factor, by calculating an RV-coefficient (Robert & Escoufier 1976). We believe the application of this technique in this context represents a statistical innovation when developing indexes and scales, as such "back-comparison" (i.e., checking the reliability of the subset at representing the informational content of the full set of questions) does not appear to be part of the standard psychometric approach. In identifying the 'best' subset of items, we traded-off the number of items comprising the subset against the RV-coefficient, but aimed for subsets of items which provided high coefficients for Omega and RV (see Table 2).

Scales and indexes were developed individually for different factors, depending upon the item structure for individual factors. Both measures were calculated to produce values between 0 and 1. Scales were developed where item responses were scored between 1 and 5, meaning identifying the internal consistency of subsets of items was appropriate. We identified the 'best' subset of items, scored and summed the values for each item, and dividing by the sum of the scores. In contrast, indexes were developed for factors calculating the sum of positive (i.e., 'Yes') responses to items (i.e., denoted with * in Table 2). The full set of items (not just the internally-consistent subset) was summed for indexes, and divided by the total number of items. The one exception was the Local Champion – Peers factor, which was calculated as the sum of the number of times a land manager was nominated by other interviewed land managers divided by the highest number of nominations (8). Several factors could potentially have been merged, as they measure

Factors (codes)	Items		Coefficients			
			Internal Consistency			Reliability
	n_s / n_t	Specific Items	$\dot{\alpha}$	β	$\dot{\omega}_h$	RV
Conservation knowledge (ck9)	4/11	2,4,8,9	0.71	0.55	0.66	0.71
Conservation behaviour (10)	4/8	1,2,3,7	0.62	0.50	0.62	0.75
Entrepreneurial orientation (eo11)	7/25	10,17,18,19,20,21,29	0.81	0.68	0.68	0.68
Local champion – Personal (15)	4/12	2,3,7,8	0.69	0.53	0.56	0.70
Local champion – Peers (lc15)	1/1*	~	~	~	~	~
Local sense of belonging (scb16)	3/10	8,9,11	0.77	0.58	0.81	0.73
Confidence in governance (scg18)	3/13	4,6,7	0.79	0.73	0.79	0.75
Local networks (scln17b)	6/25*	3,6,10,12,15,16	0.69	0.45	0.65	0.57
Broader networks (scbn19b)	3/11*	1,2,3	0.64	0.57	0.65	0.69
Willingness to participate (wp25i, wp25c, wp25r)	4/20*	7,16,17,18	0.85	0.72	0.78	0.73
Willingness to collaborate (wc13b)	4/24*	14,15,17,18	0.88	0.85	0.84	0.75
Willingness to sell (ws24)	2/5	1,5	0.90	0.90	ns	0.79
TOTALS	45/165					

Table 2 – Results of analyses for internal consistency and reliability for factors of conservation opportunity. * denotes factors calculated as an index (not a scale) using the full set if items (i.e., questions), rather than the subset of items to calculate a scale. n_s denotes the number of items which comprise the most internally consistent subset of items identified from the full set of items (n_t). 'Specific Items' refers to the item number in the interview questionnaire for items used to calculate the specific index or scale (see Supplementary Material). Measures of internal consistently are $\dot{\alpha}$ = Cronbach's alpha; β = Revelle's beta; $\dot{\omega}_h$ = McDonald's omega. The reliability coefficient is Robert and Escoufier's RV-coefficient and represents the degree to which the subset of items captures the informational content of the full set of items. ns = no solution. Factors in *italics* denote those excluded from the subsequent cluster analysis to identify land managers representing a conservation opportunity because their coefficients were low.

sub-factors of an apparently single factor, for example, the four social capital factors (Table 2; scb16, scln17b, scg18, scbn19b). These were not merged as the relationship between them is not understood (e.g., Maslach et al. 1996).

Effective private land conservation initiatives require collective action (Ehrlich & Kennedy 2005; Brunckhorst 2002), as landscapes are sub-divided and managed as cadastres at scales finer than those at which landscapes function (Briggs 2001). Furthermore, it is neither cost-effective nor operationally efficient to target individual land managers. We identified clusters (groups) of land managers with similar index and scale values for factors, trialling three different hierarchical clustering techniques which applied Horn-Morisita's index of dissimilarity: 1) single linkage, 2) complete linkage, and 3) Ward's minimum variance method of agglomeration. Clusters were then mapped in GIS.

RESULTS

Item Reduction

The identification of subsets of items (i.e., questions) for individual factors was highly effective, with a total of 165 items cut to 45, a 73 percent reduction in the number of items. Importantly, coinertia analysis of the complete and reduced set of items, following multiple correspondence analysis of each set, shows that most of the informational content of the full set is captured by the reduced set (RV-coefficient = 0.89). Internal consistency of the 12 factors was generally good (Table 2). Willingness to Sell ranked highest for Alpha and Beta coefficients (0.90), and although an Omega value was not calculatable, also had the highest RV-coefficient (0.79). It represented the most reliable factor. The Willingness to Collaborate factor had high coefficients. The coefficient for Confidence in Governance factor was also relative strong. Both measures of Local and Broader Networks ranked low (Omega 0.65), but were included as all items were to be summed to calculate the index, negating the importance of reliability. Both Conservation Knowledge and Entrepreneurial Orientation had moderately low, but acceptable, coefficients. It is worth noting that the Entrepreneurial Orientation factor had a low RV-coefficient, which may have resulted because we selected and structured the items as distinct sub-scales (see Hermansen-Kobulnicky & Moss 2004). Local Sense of Belonging had variable Beta and Omega coefficients, but was included as the reliability of the Omega coefficient was high. The Local Champion – Peers factor was included (despite no coefficient values) as internal consistency is assured because it comprises only one item and so is, by definition, internally consistent. The Willingness to Participate factor had relatively high values for Alpha, Beta and Omega coefficients, and a relatively high RV-coefficient. Two factors were excluded (Conservation Behaviour and Local Champion – Personal) both of which had relatively low Omega coefficients. No major sub-scales are apparent in the selected factors, which confirms the internal consistency of individual factors, though there is some relationship exhibited between Entrepreneurial Orientation and Local champion – Peers (Supplementary Material – Figure A).

Identifying Conservation Opportunities

Patterns between land managers for individual factors varied, sometimes markedly (Supplementary Material – Table A). Conservation Knowledge was generally low. In contrast, Entrepreneurial Orientation was high, perhaps because most land managers run their own business. Four land managers were prominent as being identified by their peers as Local Champions; (in rank order from highest) LM05, LM04, LM07 and LM18, suggesting some land managers are well-regarded by their community. The component factors of social capital were an interesting mix. Both Local Networks and Broader Network factors were low and very low, respectively, suggesting land managers are relatively isolated. Confidence in Governance was generally moderate (mode = 0.5333; median = 0.4667), notably with very poor confidence in local government, but reasonable confidence in national government. Local Sense of Belonging was relatively high, indicating an attachment to place. Willingness to Collaborate indexes varied markedly, from very low to very high, but were generally positive (mode = 0.608; median = 0.675). Willingness to Participate was assessed as three sub-scales – willingness to 1) adopt conservation instruments, 2) engage incentives, and 3) forgo production activities; all had relatively high values.

Of the three clustering methods trialled, Ward's minimum variance method of agglomeration was deemed most effective, as it best ensures the internal consistency of individual clusters (Revelle 2007). Nine distinct clusters were identified, which varied in the number of land managers they contained (Figure 2). The four primary factors influencing clustering were, in rank order, Willingness To Sell, Conservation Knowledge, Local Champion – Peers, and Broad Networks. The heterogeneity of index and scale scores between individual farmers varied within clusters. Removing Willingness To Sell and re-running the clustering analysis produced similar results. This was done 1) because

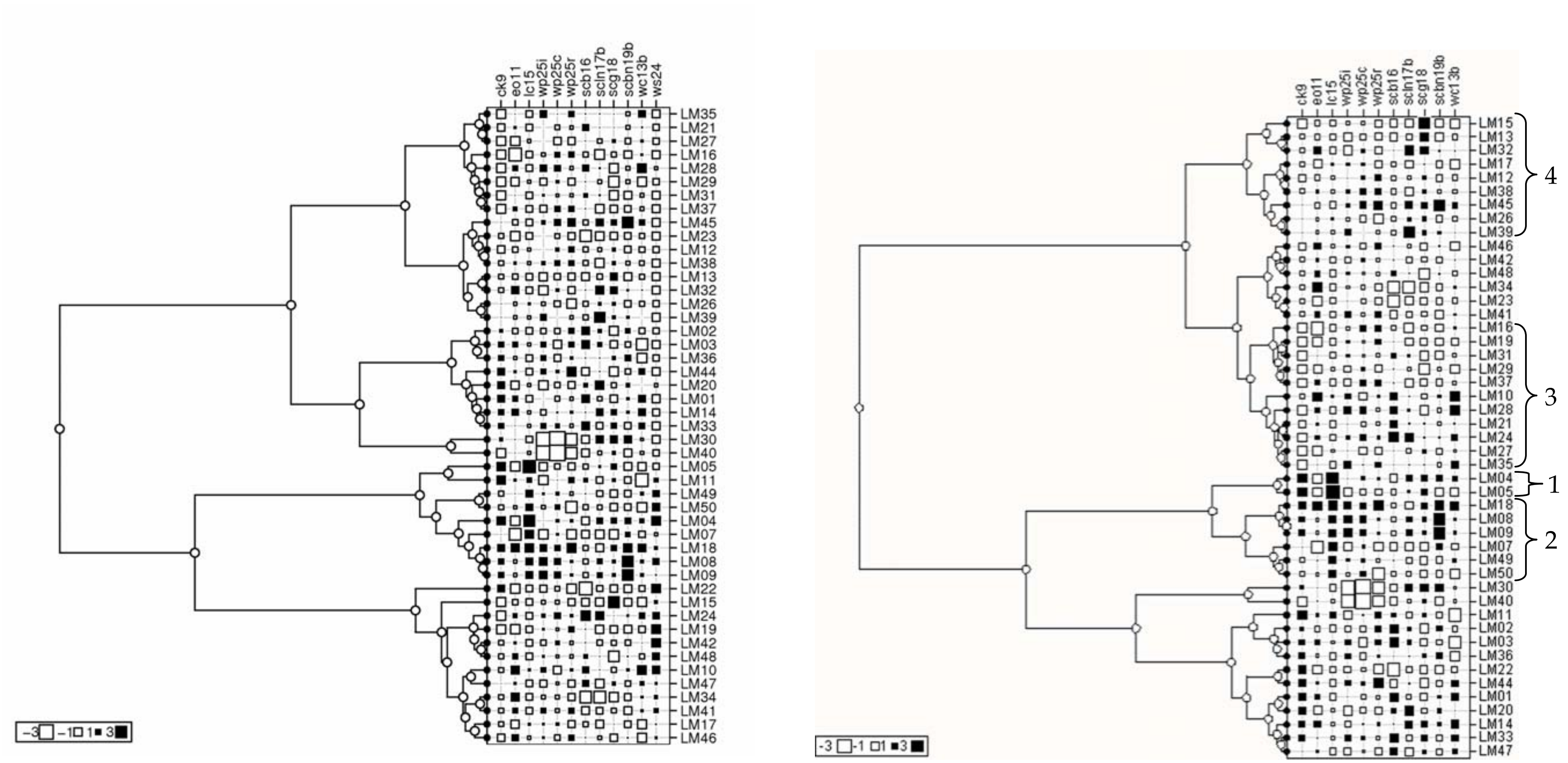


Figure 2- Hierarchical cluster analyses of land managers juxtaposed with a standardised table of item (i.e., question) responses. Horn-Morisita's index of dissimilarity was applied with Ward's minimum variance method of agglomeration. Figure 2a comprises the full set of factors of conservation opportunity, whilst Figure 2b has had the Willingness to Sell factor excluded.

land managers who are opportunities for private land conservation are not necessarily opportunities for land acquisition, and private land conservation was earlier identified as the most desirable Landscape Management Model, and 2) to investigate the influence of removing an influential factor.

DISCUSSION

Although widely agreed in theory that fusing the natural and social sciences is fundamental to effective conservation (Leopold 1935 in Meine & Knight 1999; Soulé 1986; Meffe 2001; Balmford & Cowling 2006; Hunter & Gibbs 2007), few spatial prioritisation techniques have pragmatically operationalized consilience – the fusion of knowledge traditions (Wilson 1998). We provide a preliminary attempt to begin quantifying and mapping factors comprising the human and social dimensions of conservation opportunity, which can then be combined with data on conservation value, vulnerability and economic costs of conservation action to map and schedule conservation opportunities. The concept of conservation opportunity represents a significant divergence from traditional approaches to allocating conservation resources – it assesses what action is possible cognoscente of constraints, rather than simply what nature is important. It moves beyond the limitations of solely using ecological data, which can only ever inform us 'where', but not 'how', conservation is most effectively undertaken. This study assesses people, the currency of conservation, for action, demonstrating the essential nature of understanding implementation opportunities and constraints (Cowling et al. 2004; Knight & Cowling 2007), not only the elements of nature that are most valued and most threatened, and the cost-effectiveness of alternative options.

The validity of indexes and scales refers to the extent to which an empirical measure adequately reflects the real meaning of the concept under consideration, and is assessed in several ways (Babbie 1989); overall, the validity of our approach is sound. Face validity (i.e., the degree to which a specific concept appears to be accurately represented by a quantifiable measure) is good, as the appropriateness of individual factors was subject to peer-review, and two factors with poor internal consistency removed. Greater attention paid to item selection and construction would perhaps have improved face validity. Content validity (the degree to which a scale or index covers the range of meanings included in a factor, e.g., the sub-scales of social capital) was addressed through a literature review to identify factors and their potential sub-indexes or sub-scales that other authors had successfully applied. Construct validity (the logical relationships among variables) was investigated statistically using the Omega coefficient, and compared against Cronbach's Alpha coefficient, for each factor, as well as back-checking with the RV-coefficient, and was confirmed by the ICLUST analysis.

Identifying environmental surrogates has been a major focus of conservation planning research but consistently robust surrogates have proven elusive (Rodrigues and Brooks 2007). Our search for a rapid assessment methodology adopts a surrogacy approach to social data. The effectiveness of our sub-sampling – a 73 percent reduction in the number of items coupled with very high reliability (RV-coefficient of 0.89) – suggests this method holds promise. Interviews with landholders could potentially be conducted relatively rapidly (i.e., 30-40 minutes compared to several hours). Meta-analysis of similar datasets (e.g., Winter et al. 2005; Cumming 2007) could assist the identification of a surrogate set of factors for rapidly assessing conservation opportunity across production landscapes throughout South Africa.

Ranking land managers for involvement in a private land conservation initiative is not a clear-cut process, and should not only be informed by the cluster analysis (Figure 2), but also the qualitative information gathered from the survey, as this provides essential context for the quantitative data. Land managers should also be mixed-and-matched according to the conservation instruments proposed, specifically, the spatial arrangement of 1) patterns of conservation opportunity, 2) vegetation types, and 3) existing protected areas. We suggest that two land managers (LM04, LM05; Figure 2b cluster 1) comprise a pilot programme, primarily because they clearly rate as the most prominent Local Champions, and have other positive factors (Figure 2b). This allows resources to be initially focused upon a small number of land managers, who, if the process is effective, will promote involvement of other land managers. Preliminary success could then signal the involvement of Cluster 2, who are strong in several factors, notably Willingness to Participate and Willingness to Collaborate. Clusters 3 and 4 could follow in due course. A large proportion of land managers rate as poor opportunities, which greatly facilitates ranking for implementation. These could be brought on-board once the initiative was running strongly, subject to implementing agencies ability to service and manage the conservation instruments implemented (e.g., von Hase et al. 2003). Our personal experience in South Africa and Australia indicates that failure to account for these factors leads to over-promising and under-delivering results, which in turn leads to disenchanted land managers and funders, and conservation planning initiatives which struggle to be effective. Strategic acquisition of lands could occur as funds allow.

There is little, if any, relationship between the patterns of vegetation types (our surrogate for conservation value) and conservation opportunity. There also appears to be little, if any, spatial pattern to the distribution of opportunities (Figure 3). Opportunities for both land acquisition and private land conservation are spatially fragmented. Implementation is therefore guaranteed to be far more complicated than suggested by our elegantly displayed hierarchical cluster analysis. The common assumptions prevalent in the peer-reviewed literature that 1) single protected areas can be readily expanded to larger protected areas, and 2) that private land conservation instruments can effectively be applied across multiple properties, is not simply unfounded, but denies the complexities of real-world implementation. However, land managers are highly complex entities whose values and behaviours are fluid, and which can be positively influenced through education (e.g., Sanz & Grajal 1998; Holmes 2003; Steinmetz et al. 2006), incentives (Young et al. 1996; Langpap 2006; Fabricius & Collins 2008), peer-pressure, and social marketing (McKenzie-Mohr 2000). This profoundly highlights the importance of shifting the focus of spatial prioritisations from simply identifying 'where', to 'how', conservation action should be implemented, with a major focus upon mainstreaming and enabling activities (Knight et al. 2006a). This highlights the importance of assessing conservation opportunity, not simply priority, for spatial prioritisations.

Gathering human and social data which define surrogates for fine-scale implementation opportunities requires conservation planners to engage social research techniques. This initial foray revealed technical issues. Face-to-face interviews can be time consuming, especially when large distances and difficult terrain separate land managers. Mail surveys may be more time and cost effective for gathering opportunity data (Curtis et al. 2001; Curtis et al. 2005), but will likely come at the expense of data quality. Cronbach's Alpha, the most widely applied coefficient of internal consistency in the psychometric literature, has questionable accuracy. Employing McDonald's Omega provides significantly more reliable results (Zinbarg et al. 2005). The apparent simplicity of combining multiple factors whose relationships are unknown into a single index of conservation opportunity can introduce inconsistency (e.g., Maslach et al. 1996); the hierarchical cluster analysis coupled

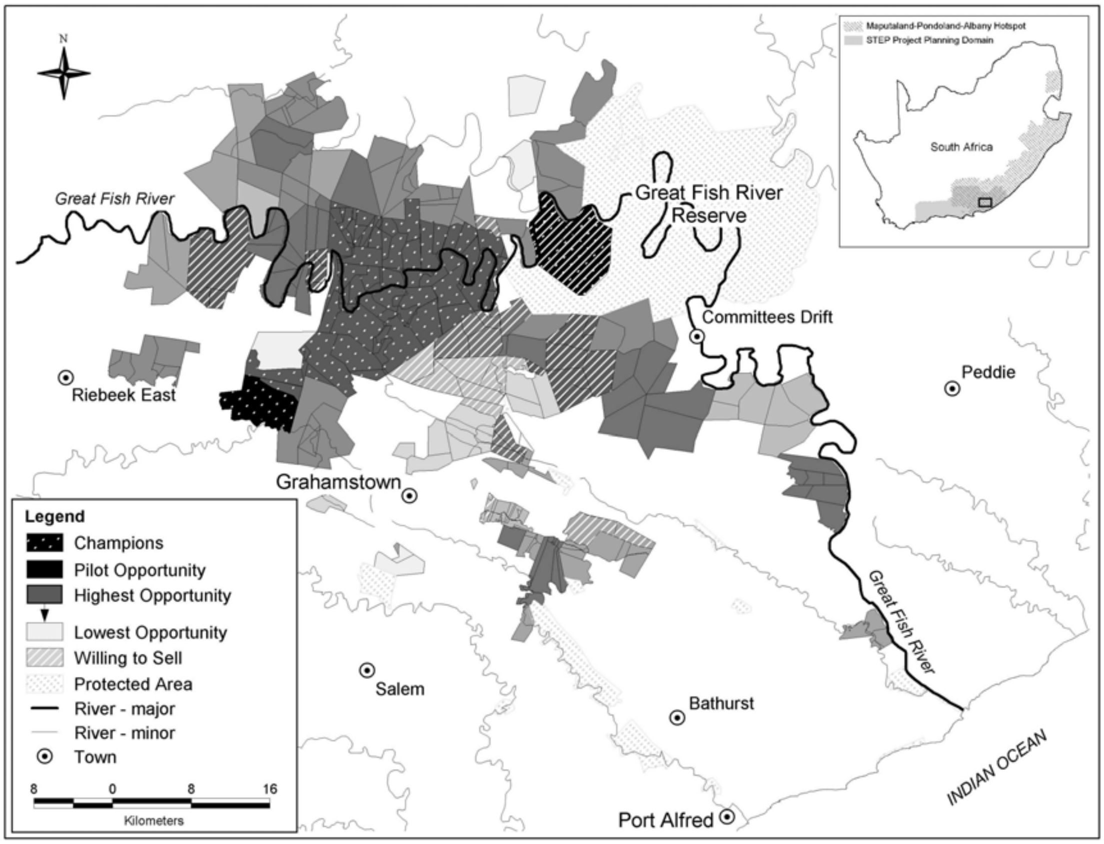


Figure 3 – Conservation opportunities mapped for the planning region. Champions are targeted to pilot implementation of private land conservation initiatives. High opportunity land managers are then potential priority candidates. Land managers willing to sell are denoted with hatching. Potential initiatives have been identified in the STEP Implementation Strategy (Knight et al. 2003, and in prep. a).

with a table of standardised factors not only avoids this problem but it's elegant display allows conservation planners to simply and rapidly assess the 1) relative weighting of factors, 2) homogeneity of clusters, and 3) relative appropriateness for different conservation instruments (e.g., acquisition, covenant). It is also simply explained to those unfamiliar with social research techniques. The 'back-checking' approach to reliability analysis is a novel, and useful, application for survey data.

Our approach could probably be improved in at least three ways. First, alternative factors may be more appropriate, notably in other planning regions. For example, land managers economic scope for involvement (as financial constraints limit land managers uptake of best-practice management; Curtis et al. 2001), emotional intelligence (which defines increased professional and collaboration success; Goleman 1998), or burnout (which can prompt land managers to exit voluntary conservation initiatives; Byron et al. 2001). A reliable measure of Conservation Behaviour (one of two factors we removed due to poor internal consistency) is also possibly a useful factor, being less ambiguous than measures of attitudes (McKenzie-Mohr 2000), and potentially a good indicator of land managers conservation commitment. Direct costs of involvement in conservation initiatives to land managers would also be useful; we excluded these as they were sensitive to discussing their finances (Cumming 2007). Second, our planning region is perhaps an atypical production landscape in that vulnerability is locally a non-issue. Complementing the human and social factors applied in this analysis with the more traditional measures of conservation value (e.g., irreplaceability) and vulnerability, and a measure of costs would provide a generally useful approach to scheduling conservation action in production landscapes. Third, removing the Willingness to Sell factor altered our clusters in a minor way, so it may prove useful to force the application of factors in the hierarchical cluster analysis in a ranked order, depending upon the landscape management model being applied. Future testing of the effects of removing or re-ordering factors would be useful.

Spatial prioritisations should *assist* people to make decisions, not provide complete answers (Sarkar et al. 2006). If they are to be translated into effective conservation action they are best viewed as but one, relatively small, stage in a broader conservation planning process (Knight et al. 2006a). Spatial prioritisations should be preceded by a social assessment (Cowling & Pressey 2003; Cowling & Wilhelm-Rechmann 2007). This is of supreme importance, as the effectiveness of conservation action is governed, ultimately, by the choices people make (Cowling & Pressey 2003). It is essential to establish an intimate understanding of social systems and their links with ecological systems (Berkes & Folke 1998; Brunckhorst 2000; Briggs 2001; Sayer and Campbell, 2004), comprehensive of people, their land uses, land management instruments and organizations (Knight et al. 2006b). This intimate knowledge can only be secured from direct contact with land managers, and is critical to identifying the face validity of factors used to define the human and social dimensions of conservation opportunity. It is also important to undertake a collaborative process for developing a landscape management model collectively with stakeholders. It should identify an optimal mix of conservation instruments and institutions (Young et al. 1996) and represent societal values for the structure and function of future landscapes (Knight et al. 2006a). It should guide the selection of the factors and the formulation of items for analysis. We applied the Megaconservancy Network as the landscape management model for our study (see Rouget et al. 2006).

Finally, mapping conservation opportunities provides a better alternative to spatial prioritisation techniques which solely use ecological data. First, conservation planning initiatives should not solely represent the values of academic conservation planners, but of society at large (Theobald et al. 2000). Spatial prioritisations are typically conducted in academic isolation (Knight et al., and in press a), which almost guarantees these approaches do not reflect societal values. Conservation opportunities represent societal values because they quantify land managers attitudes, not simply nature valued by conservation planners. Second, land managers likely to agree to participate, and to participate effectively, can be preferentially approached. This minimises slow progress and wasted resources consumed engaging less willing land managers, and improves the likelihood of effective long-term involvement by targeting land managers with desired characteristics (e.g., are least burnt-out, pro-conservation, entrepreneurial, and have strong social support networks). Third, influential land managers (i.e., champions), can be targeted for involvement for pilot programmes, as this lends credibility to initiatives, which may improve the rate of uptake, and level of commitment, by land managers subsequently approached to be involved in conservation initiatives. Rapid initial progress keeps funders happy and lends credibility with stakeholders, which promotes leverage of further funding and synergistic opportunities. Fourth, quantifying conservation opportunities requires conservation planners to interact with a planning regions inhabitants to gather data, which also provides a mechanism for informing and involving stakeholders. This produces a greater connection between 'researcher' and 'practitioner', a common short-coming of many conservation planning initiatives. Finally, we have quantified land managers attitudes specifically in the context of conservation opportunities, which better provides direction for implementation than using ecological data alone because it identifies land managers who display characteristics believed to be factors in effective conservation actions. This assists in more effectively bridging the research-implementation gap in conservation planning (Knight et al., in press a) by facilitating the translation of spatial prioritisations into local-scale action.

CONCLUSIONS

Representation and persistence are widely identified as the goals of conservation planning (Margules & Pressey 2000). Representation can be achieved using ecological data alone. The persistence of valued nature, however, is determined by social factors. The current preoccupation by conservation planners with the quality and quantity of ecological data is misplaced, as they are not always essential for spatial prioritisation; it depends on the context. Equal time and resources should be spent collecting and analysing social data to complement ecological data when assigning importance to areas for conservation action. Techniques for gathering and analysing social data are well-understood and available from the social sciences (e.g., Babbie 1989; Kitchin & Tate 2000). This shift in focus towards the non-environmental dimensions of conservation demands conservation planners move beyond simply generating hypotheses for the representation of valued nature (i.e., maps of candidate protected areas) towards formulating conservation problems in the context of opportunities to implement conservation actions founded upon an intimate understanding of entire social-ecological systems.

ACKNOWLEDGEMENTS

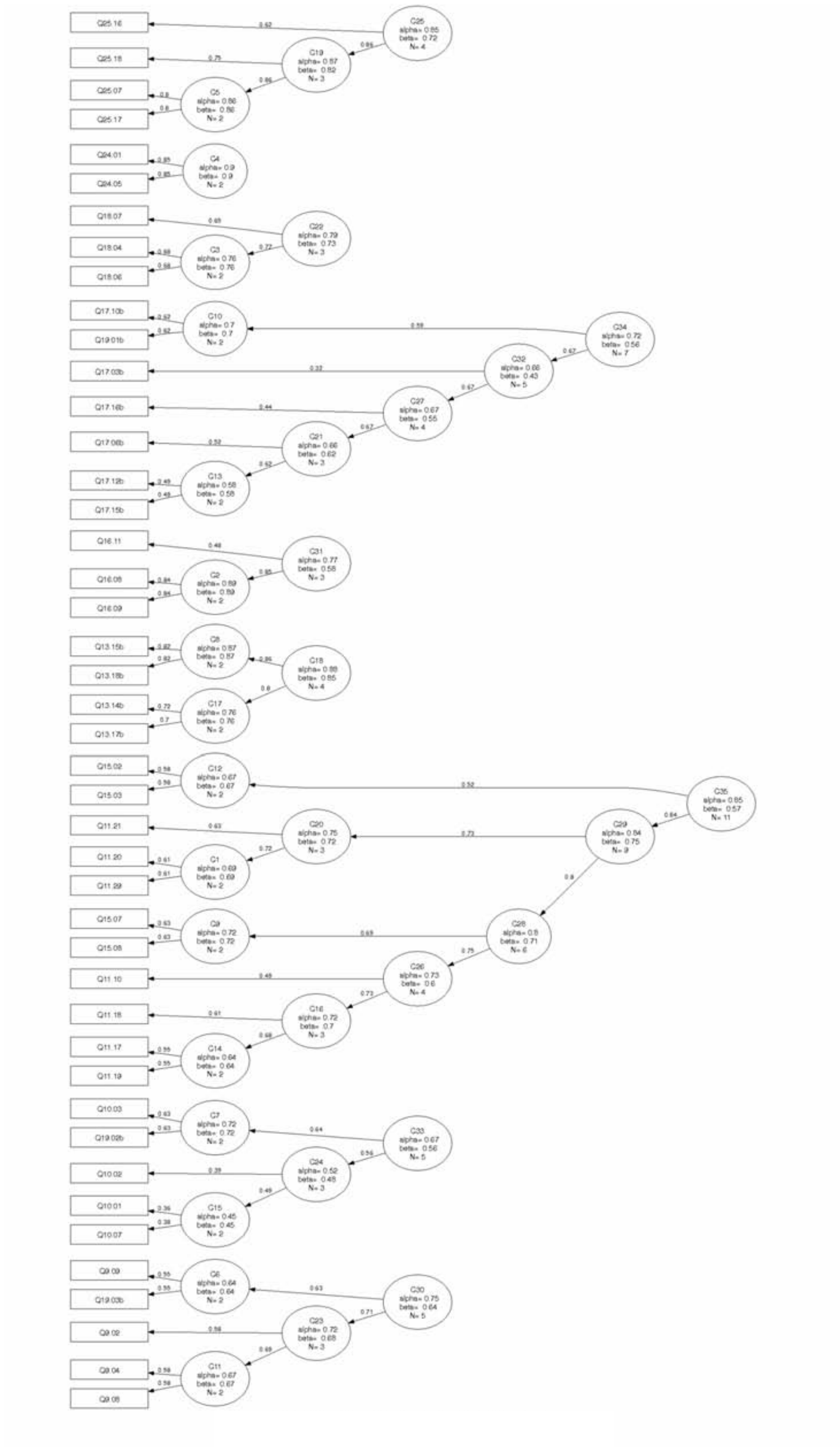
We thank those land managers who agreed to participate in our survey. The Global Environment Facility, World Bank, Department of Botany at the Nelson Mandela Metropolitan University, and Department of Environmental Science at Rhodes University provided funding and support. Input from Andrew Ainslie, Lorena Pasquini and Sheona Shackleton improved the interview approach. Gillian McGregor provided transport and cartographic input. Discussions with Simon Ferrier, Mandy Lombard, Mathieu Rouget, Theo Stephens and Susan Walker clarified our thinking.

SUPPLEMENTARY MATERIAL

Table A – Index and scale values for factors of conservation opportunity

	Factors of Opportunity											
	ck9	eo11	lc15	wp25i	wp25c	wp25r	scb16	scln17b	scg18	scbn19b	wc13b	ws24
LM01	0.75	0.914	0	0.767	0.764	0.733	0.933	0.168	0.333	0.109	0.9	0.156
LM02	0.5	0.771	0	0.7	0.745	0.867	0.933	0.232	0.267	0.145	0.608	0.267
LM03	0.625	0.914	0.125	0.867	0.655	0.867	0.933	0.24	0.333	0.036	0.383	0.156
LM04	0.875	0.686	0.875	0.767	0.891	0.8	0.6	0.264	0.6	0.164	0.8	1
LM05	0.875	0.686	1	0.633	0.745	0.667	0.667	0.216	0.6	0	0.525	0.256
LM07	0.375	0.6	0.625	0.6	0.873	0.6	0.6	0.112	0.267	0.145	0.583	0.378
LM08	0.625	0.8	0.5	0.967	1	0.8	0.667	0.256	0.533	0.309	0.758	0.778
LM09	0.625	0.8	0.5	0.967	1	0.8	0.667	0.256	0.533	0.309	0.758	0.478
LM10	0.25	1	0.25	0.867	0.673	0.8	0.867	0.2	0.4	0.109	1	0.9
LM11	0.875	0.857	0.375	0.6	0.836	0.867	0.8	0.144	0.533	0.018	0.317	0.633
LM12	0.125	0.771	0.125	0.767	0.909	0.867	0.667	0.176	0.533	0.018	0.608	0.256
LM13	0.25	0.771	0	0.633	0.727	0.667	0.6	0.16	0.667	0	0.625	0.156
LM14	0.625	0.943	0.125	0.7	0.855	0.8	0.733	0.288	0.6	0.109	0.917	0.211
LM15	0	0.771	0	0.733	0.782	0.667	0.6	0.12	0.867	0	0.492	0.578
LM16	0	0.571	0	0.733	0.964	0.867	0.667	0.088	0.4	0	0.733	0.156
LM17	0.25	0.714	0.25	0.8	0.891	0.667	0.667	0.128	0.467	0.018	0.5	0.478
LM18	0.75	1	0.625	0.933	0.982	1	0.667	0.128	0.6	0.236	0.933	0.578
LM19	0	0.686	0	0.8	0.8	0.867	0.733	0.12	0.333	0	0.583	1
LM20	0.75	0.714	0.125	0.6	0.746	0.667	0.8	0.328	0.4	0.127	0.692	0.378
LM21	0.125	0.857	0	0.767	0.764	0.733	0.867	0.2	0.467	0.055	0.717	0.256
LM22	0.75	0.686	0	0.667	0.764	0.6	0.4	0.152	0.333	0	0.6	1
LM23	0.25	0.686	0	0.767	0.764	0.667	0.467	0.112	0.333	0.018	0.617	0.156
LM24	0	0.886	0	0.833	1	0.8	1	0.312	0.467	0.073	0.85	0.8
LM26	0.375	0.8	0.25	0.733	0.727	0.6	0.667	0.224	0.533	0.018	0.625	0.256
LM27	0	0.686	0.125	0.767	0.691	0.667	0.733	0.168	0.533	0.036	0.675	0.256
LM28	0	0.914	0	0.933	1	0.733	0.867	0.208	0.267	0.055	1	0.378
LM29	0	0.714	0.125	0.667	0.891	0.667	0.733	0.176	0.2	0.055	0.492	0.256
LM30	0.5	0.829	0	0.4	0.24	0.53	0.6	0.296	0.667	0.2	0.667	0.156
LM31	0	0.829	0	0.8	0.8	0.733	0.8	0.208	0.267	0	0.65	0.156
LM32	0.25	0.971	0	0.6	0.891	0.667	0.733	0.32	0.667	0.073	0.708	0.156
LM33	0.625	0.829	0.125	0.867	0.927	0.733	0.933	0.144	0.6	0.018	0.858	0.156
LM34	0.25	1	0	0.733	0.782	0.667	0.467	0.04	0.267	0.018	0.742	0.578
LM35	0	0.829	0	0.933	0.836	0.867	0.733	0.2	0.467	0.055	0.892	0.156
LM36	0.625	0.8	0	0.867	0.709	0.8	0.733	0.2	0.533	0.164	0.467	0.256
LM37	0	0.886	0	0.667	0.982	0.867	0.733	0.112	0.333	0.018	0.65	0.156
LM38	0.25	0.857	0.125	0.833	0.964	0.867	0.667	0.104	0.533	0.055	0.633	0.156
LM39	0.375	0.8	0.125	0.9	0.818	0.733	0.667	0.376	0.533	0.109	0.692	0.156
LM40	0	0.829	0.125	0.4	0.236	0.533	0.6	0.176	0.533	0	0.658	0.256
LM41	0.25	0.914	0	0.867	0.782	0.867	0.6	0.144	0.4	0	0.675	0.633
LM42	0.25	0.857	0	0.7	0.927	0.733	0.733	0.16	0.4	0.036	0.7	1
LM44	0.75	0.857	0	0.867	0.891	1	0.6	0.2	0.267	0.036	0.858	0.156
LM45	0.375	0.771	0	0.833	1	0.933	0.667	0.296	0.6	0.309	0.833	0.156
LM46	0.125	0.943	0.125	0.8	0.745	0.867	0.733	0.176	0.333	0.091	0.492	0.533
LM47	0.375	0.857	0	0.667	0.8	0.667	0.867	0.112	0.533	0.036	0.783	0.533
LM48	0.25	0.914	0	0.8	0.8	0.733	0.8	0.2	0.2	0.091	0.625	0.844
LM49	0.25	0.829	0.5	0.8	0.891	0.733	0.733	0.152	0.333	0.018	0.767	0.789
LM50	0.25	0.8	0.5	0.733	0.945	0.533	0.667	0.168	0.333	0.018	0.475	0.9

Figure A – ICLUST Analysis



Discussion

Reflections on Learning By Doing: Towards Improving the Societal Relevance of Systematic Conservation Assessments

"Because contributions to knowledge echo the properties of human bodies and social systems, nearly all research reveals more about the researchers themselves and their assumptions than about the topics they study. The general effect is that research becomes ritualized pretence rather than a source of genuine contributions to knowledge."

William H. Starbuck
The Production of Knowledge:
The Challenge of Social Science Research, p.3
Oxford University Press, 2006

The research presented in this thesis explicitly aimed to move beyond simply generating scientific information for publication in peer-reviewed journals towards delivering useful improvements to theoretical and operational aspects of systematic conservation assessment. Specifically, the attempt was made investigate approaches to designing, undertaking, and implementing outputs from, systematic conservation assessments, so as to ensure societally relevant input into broader conservation planning initiatives. Specifically, this research set-out to investigate five specific questions:

1. Is the divide between research on systematic conservation assessment techniques and the application of their outputs (e.g., Prendergast et al. 1999) a real phenomenon?
2. What constitutes an effective conservation planning operational model? How are systematic conservation assessments effectively integrated into broader processes which lead to effective implementation? Are current conservation planning operational models effective?
3. Has the strong historical focus upon applying biological / environmental data for systematic conservation assessments provided less useful outputs than analysing a range human, social, economic data and biological and/or environmental data?
4. How do we best ensure that the information provided by systematic conservation assessments on 'where' conservation should be done is complemented with a process for 'how' effective conservation action is implemented?
5. What institutions are required to support the translation of systematic conservation assessments into action, how should they be structured, and what roles do they play in supporting conservation plans?

In attempting to provide answers to these questions, I adopted an action research approach focused upon social learning. Social learning can be defined as a process of iterative reflection which aims to improve useful knowledge that supports collective action and occurs through partnerships where we share our experiences, ideas and environments with others (Figure 1). I used my roles as the Implementation Specialist on the Subtropical Thicket Ecosystem Planning (STEP) Project, and a committee member and Chairperson of the Thicket Forum as contexts for learning how to improve the design and implementation of systematic conservation assessments. This was an attempt to situate myself *within* a 'real-world' conservation planning initiative so that my findings were the product of a 'learning-by-doing' process. Photographic examples of my 'learning-by-doing' experience are provided in *Appendix VI*.

The effectiveness of the outcomes of this research was measured in two ways:

1. The contribution this research makes towards providing improved techniques and approaches for the practice of pragmatic conservation planning, and,
2. The degree to which I have learnt, personally, to be a more effective conservation planner.

These outcomes are summarised in Table 1, and detailed further below. A synthesis of the outcomes of this learning process is also provided.

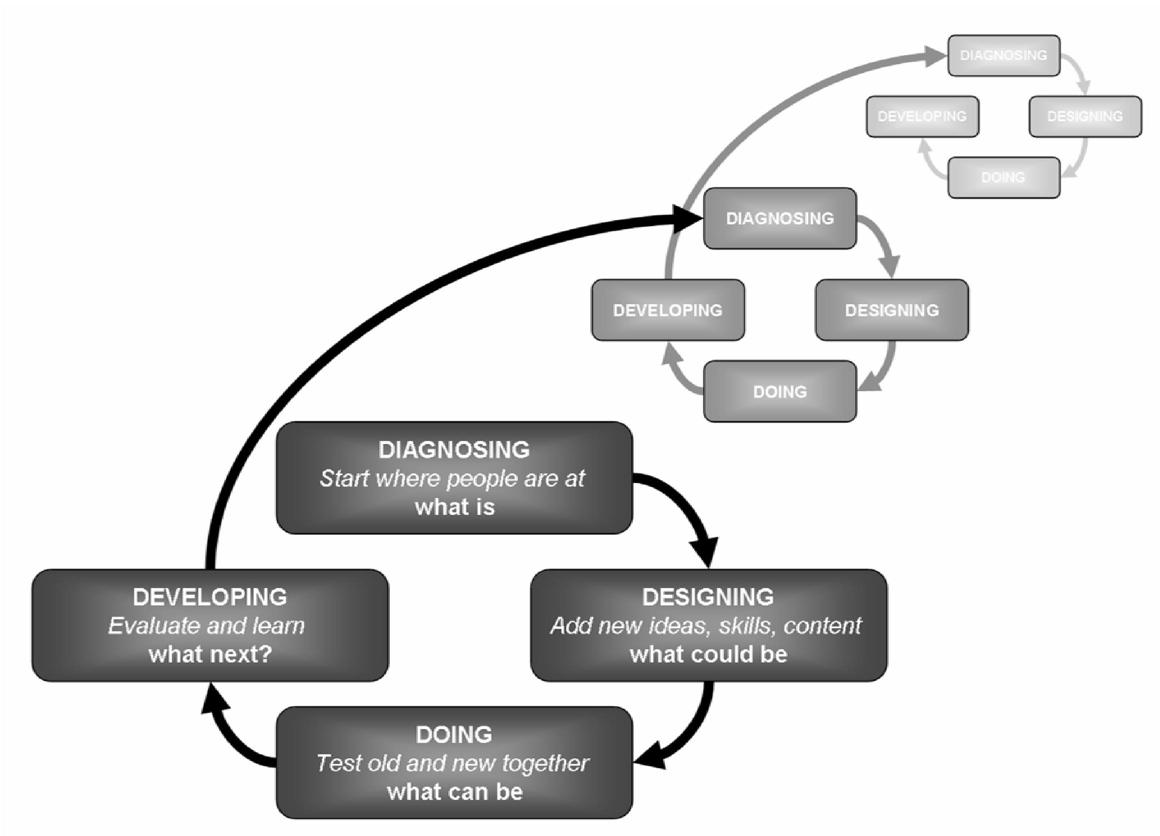


Figure 1 – Individual and social learning framework (after Keen et al. 2005).

Contributions of this thesis to…			
Conservation Science	**Conservation Practice**	**Personal Learning**	**Thesis Publications**
Research Question 1 – Research-implementation gap			
♦ Confirmation the majority of systematic conservation assessments published in the peer-reviewed literature are not implemented	♦ Recommendations for ensuring the science of systematic conservation assessment produces useful knowledge	♦ I was a practitioner; in doing this thesis I became a researcher. I under-estimated the difficulty of doing research which is societally-relevant. ♦ The importance of acknowledging and documenting failure in conservation planning	Prologue Paper I
Research Question 2 – Operational model			
♦ Highlighting the importance of situating the science of systematic conservation assessment in a broader operational context to ensure it is societally relevant ♦ Short-comings of existing operational models identified	♦ An operational context demonstrating how situate systematic conservation assessments to make them useful ♦ A more realistic approach to pragmatic conservation planning which is more -focused on implementing action ♦ A foundation for social learning and adaptive improvement in conservation planning	♦ The importance of designing individual stages in a conservation planning process so they integrate together effectively ♦ The relatively small role of systematic conservation assessments in a planning process for implementing effective conservation action	Paper II

Research Question 3 – Conservation opportunity			
♦ Promoting the importance of designing and situating systematic conservation assessments to engage opportunism ♦ Demonstrated importance of landowner willingness to sell in supporting decision-making for protected area expansion ♦ Demonstrated the potential utility of social research techniques	♦ A methodology for identifying the human and social dimensions of local-scale conservation opportunity	♦ Social research techniques (i.e., questionnaire design and analysis) ♦ How to use Marxan ♦ Importance of inter-disciplinary systematic conservation assessment teams	Paper V Paper VI Paper VII
Research Question 4 – Implementation strategy			
♦ Highlighting the importance of complementing systematic conservation assessments with a process for developing implementation strategies	♦ Lessons for improving the process for developing future implementation strategies ♦ An implementation strategy adopted by the Eastern Cape Implementation Committee	♦ That I enjoy and have an aptitude for group facilitation ♦ Collaboration is the foundation for effective conservation, but this is fraught with difficulties, some of which can't be overcome	Paper III
Research Question 5 – Institutions			
♦ Highlighting the importance of social learning institutions to support the outputs of systematic conservation assessments	♦ The establishment of Thicket Forum ♦ Research needs identified to support the implementation of the STEP Strategy	♦ Operational models for conservation planning should strive to establish social learning institutions, as these are the vehicle for ensuring the persistence of nature ♦ Conservation scientists are inadequately trained for the establishment of institutions	Paper IV

1. ***Is the much discussed divide between research on systematic conservation assessment techniques and the application of their outputs (e.g., Prendergast et al. 1999) a real phenomenon?***

The results from *Paper I* demonstrate clearly that the research-implementation gap in conservation planning is a real phenomenon, confirming earlier, published suggestions that systematic conservation assessment, as portrayed in the scientific literature, is largely a theoretical discipline. Almost universally, published studies open with a depressingly predictable paragraph lamenting the unprecedented decline of our environment, and conclude with a paragraph which makes recommendations as to what action should be taken. However, most authors of studies in the peer-reviewed literature had little or no intention of translating their studies into some form of conservation action. This finding is of considerable concern given, first, the claims by conservation scientists generally that they are participating in a mission-driven, crisis discipline, and second, the perception in some quarters that the science of systematic conservation assessment has made significant (pragmatic) achievements (see Conservation Biology 20th Anniversary Special Issue, Vol. 20). The science of systematic conservation assessment has become a displacement behaviour for academia (Whitten et al. 2001). It is little wonder, then, that practitioners see little value in adopting systematic conservation assessment techniques.

The finding that the science of systematic conservation assessment is not alone in facing the challenge of translating research into action is, paradoxically, both disturbing and cause for optimism. Disturbing, because numerous other applied disciplines charged with 'saving the world' – restoration ecology, ecosystem management, environmental psychology – are struck by the same paralysis. Cause for optimism, because disciplines such as the management and organizational sciences have recognised, and grappled with, the knowing-doing gap for several decades, and have insights into how to bridge the research-implementation gap (e.g., Senge et al. 1994; Pfeffer & Sutton 1999), if we care to look beyond our own knowledge. Conservation planners will require the courage to foray into the social sciences in the quest for solutions.

There is much discussion in the peer-reviewed literature of 'correct problem formulation' regarding systematic conservation assessment. The finding that the research-implementation gap is a real phenomenon sends a clear message that the way in which conservation problems are currently being formulated is missing the point. Formulating a problem for a systematic conservation assessment, and for a pragmatic on-ground need, are two very different processes with two explicitly different needs. Academic studies suffer because they invariably formulate their problems in a theoretical context without consideration of the real-world needs of implementers. Paper VI is a case-in-point – land availability is so fundamental to the expansion of protected area networks it is rather astonishing that this is the first study to examine landowners willingness to sell.

The results in *Paper I* highlight the need for a fundamental shift in the way that systematic conservation assessments are conceptually perceived, designed, undertaken, and implemented. A fundamental revisiting of the basic principles and practices of conducting systematic conservation assessments is urgently required (but for suggestions see Appendix IV; Groves 2003; Noss 2003). The adoption of action research and social learning approaches will be fundamental to the success of this process. Specifically, it highlights the importance of conservation planners being part of a network of people with complementary skills, and the essential nature of situating systematic conservation assessments in a broader operational model for conservation planning (*Paper II*).

2. ***What constitutes an effective conservation planning operational model? How are systematic conservation assessments effectively integrated into broader processes which lead to effective implementation? Are current conservation planning operational models effective?***

The six-year learning experience comprising my personal action research process has revealed systematic conservation assessments, alone, can never result in the implementation of conservation action. They simply provide information (not even knowledge) on where conservation investments can be most efficiently and effectively made. Ultimately, the effectiveness of systematic conservation assessments hinge upon the choices made by individual people, and whether they are willing to engage and implement the recommendations systematic conservation assessments offer (see *Paper III* and *Paper IV*).

If systematic conservation assessments are not integrated with other processes, then they will have no impact. Operational models outline the ways in which pragmatic conservation planning processes unfold, which calls for systematic conservation assessments to be situated in this broader context, if they are to be effective. However, the research-implementation gap is manifest in most existing operational models detailed in the peer-reviewed literature. Margules & Pressey (2000), the most widely-cited operational model for conservation planning, serves as a useful example, as it exhibits several significant shortcomings which makes the translation of systematic conservation assessments into action, more difficult .

First, the Margules & Pressey (2000) operational model is elaborated as a hybrid between a conceptual framework and an operational model. The theory (or conceptual basis) of the approach is entwined with the practice of running a conservation planning initiative. These are best kept separate, but linked, so that conservation planners can move back-and-forth between the two, promoting the adaptive refinement of both the conceptual framework and the operational model. Failure to separate them results, for example, in elements of the conceptual framework (i.e. principles, such as efficiency and flexibility) becoming too narrowly defined, shifting the focus back on systematic conservation assessment, rather than the implementation of conservation action.

Second, four of the six listed stages in the Margules & Pressey (2000) operational model are focused solely upon data issues, which have little, if any, impact upon processes implementing conservation action. Most of the focus is upon deciding 'where' conservation should be done, but not on 'how' it should be done. This denies the reality that conservation planning is inherently a normative social process which engages science to provide defensible information for decision-making, not a scientific process which engages society.

Third, this focus upon data at the expense of collaborating with stakeholders almost guarantees that systematic conservation assessments represents scientists values and goals, not those of society. It is not a scientists role to decide how landscapes should be designed and managed; they should, instead, press society to clearly articulate their values and goals so they can apply techniques to support decision-making processes for achieving these goals (Theobald et al. 2000).

Fourth, the fact that the operational procedure for undertaking and implementing systematic conservation assessments focuses so heavily upon data issues mistakenly gives the impression that the major research focus of the discipline should be upon technical (i.e., data) issues. It also manifests as an over-estimation of the contribution of conservation theory to pragmatic conservation planning (Prendergast et al. 1999), and implicitly perpetuates the research-implementation gap by down-playing the importance of the socio-economic dimension of conservation planning. This heavy focus upon data manifests in the peer-reviewed literature, as the majority of conservation planning studies are systematic conservation assessments, and not those dealing with other stages in the conservation planning operational model. This needs to change, and begins with developing and widely promoting operational models formulated from experiences of real-world conservation planning initiatives. *Paper II* is an attempt to present such an operational model, which is now being trialled in marine planning in South Africa and local government environment planning in Washington State, USA.

Finally, it is apparent that the science of systematic conservation assessment suffers from the lack of a clearly articulated conceptual framework. Other disciplines, notably restoration ecology, have recognised and grappled with establishing their conceptual framework (e.g., Hobbs & Harris 2001). As a result, it is a discipline more focused upon action (Young 2000). An explicitly-stated conceptual framework is essential for social learning and adaptive management, at the level of both the individual researcher and the discipline. This would also provide the benefit of operationalizing both multidisciplinarity and transdisciplinarity in conservation planning (see Max-Neef 2005). Much 'lip-service' is paid to conservation planning applying techniques from other disciplines – GIS, landscape ecology, politics, economics, statistics – yet truly multidisciplinary approaches do not typically happen in practice. It fails as an interdisciplinary and transdisciplinary science because biology defines its purpose.

3. ***Has the strong historical focus upon applying biological / environmental data for systematic conservation assessments provided less useful outputs than analysing a range human, social, economic data and biological and/or environmental data?***

The short review of the systematic conservation planning literature provided in *Paper VII* reveals that social data influence target achievement, cost-efficiency and/or the spatial arrangement of areas important for achieving conservation goals (e.g., Polasky et al. 2001; Pressey & Taffs 2001; Knight et al. in prep b). Whilst economic cost and vulnerability data are increasingly being applied in systematic conservation assessment, generally, non-ecological data on factors determining the effectiveness of potentially-implemented actions have been neglected. Economic cost and vulnerability data are indirect measures of the likelihood of valued nature persisting. However, human and social factors are important in determining the effectiveness of conservation actions, because ultimately, if these actions are to be effective they must be choices adopted by individual land managers and policy makers. It is difficult to understand why academic conservation planners have been so slow to recognise the necessity of including non-biological factors in systematic conservation assessments. Whilst the scoring approaches previously used in the 1960's and 1970's to identify areas important for nature conservation had significant technical shortcomings, they did typically apply multiple criteria inclusive of non-biological factors.

The formalisation of the concept of conservation opportunity presented and tested in *Paper V*, *Paper VI* and *Paper VII* represents a significant conceptual and operational advance in conservation assessment approaches, one which actively steers conservation planners towards understanding social systems and collecting human and social data for analysis. The results of *Paper VI* highlights that current, on-going calls for ever-more ecological data are misplaced, for in comparison, there is relatively little human and social data specifically gathered for systematic conservation assessments.

The science of systematic conservation assessment has suffered because it is historically rooted in the discipline of conservation biology. Conservation biology is zoological, descriptive and theoretical, and focused on population and genetic studies (Young 2000; Fazey et al. 2005), despite it's claims that it straddles both the natural and social sciences (e.g., Hunter & Gibbs 2007). Effective conservation planning, of which systematic conservation assessment is a component (Knight et al. 2006a), is normative, pragmatic, and focused upon mobilising the collective citizenry. Conservation biology is also rather negative in it's world perspective (Young 2000; Redford & Sanjayan 2003). The focus of conservation biology has probably influenced the (mis)direction of the science of systematic conservation assessment.

4. ***How do we best ensure that the information provided by systematic conservation assessments on 'where' conservation should be done is complemented with a process for 'how' effective conservation action is implemented?***

Systematic conservation assessments are very useful at providing information as to 'where' and 'when' conservation resources should be invested so as to ensure conservation action is as effective and efficient as possible. However, the implementation of conservation action is a process beyond data, which requires that specific activities be detailed as to 'how' conservation action is going to be rolled-out, and the forms it will take. Systematic conservation assessments are considered 'science', however, processes of implementation, whilst informed by science, are normative, messy, and unpredictable. For this reason, bridging the research-implementation gap requires that the areas important for achieving conservation goals identified by a systematic conservation assessment are complemented with a collaborative process for developing an implementation strategy.

The case study of the STEP Implementation Strategy development process documented in *Paper III* serves as an example of the complexity of this task. It requires skills that conservation scientists are rarely trained in – stakeholder identification, visioning, negotiation, facilitation, conflict resolution, landscape management model development, and project planning (Soulé 1986; Jacobson & McDuff 1998; Penn 2003). It is little wonder then that many conservation planning initiatives fail to be effectively implemented.

The importance of linking a systematic conservation assessment with a process for implementation strategy development, and ensuring both are translated into effective conservation action, is more effectively facilitated by employing systematic conservation assessments which identify conservation opportunity rather than simply measuring priorities (sensu Pressey 1997). The process of implementation strategy development aims to mobilise people towards collective action, which requires people to make a positive choice about their involvement. Systematic conservation assessments which measure conservation opportunity (inclusive of conservation value, vulnerability, economic cost, human and social factors determining the effectiveness of conservation actions – *Paper VI* and *Paper VII*) identify those stakeholders who are more likely to be effective participants, which improves the likelihood of implemented actions being effective.

5. What institutions are required to support the translation of systematic conservation assessments into action, how should they be structured, and what roles do they play in supporting conservation plans?

It is clear from my experience with the STEP Project, that successfully translating the outputs from systematic conservation assessments into conservation action requires support from a diverse range of organisations and institutional processes (*Paper III*). Although the STEP conservation planning products (see *Appendix III*) are being widely used for reactive land-use decision-making by local government and the consultants that support them, pro-active implementation of priority areas has languished, largely because 1) the Implementation Strategy has not been effectively mainstreamed into the day-to-day operation of primary land management organisations, and 2) has failed to secure the productive involvement of the most fundamental of stakeholders – rural land managers. A subtle but significant shift in the focus of the STEP Project from conducting a conservation assessment to providing information to implementers in the context of a social learning institution may have improved the outcome.

The Eastern Cape Implementation Committee (ECIC) – the institution charged with mainstreaming the STEP Implementation Strategy (*Paper III*) into the primary land management organisations – has been strategically situated, but appears to have chosen a direction which sidelines the STEP Strategy. It has proven relatively ineffective regarding the proactive implementation of actions identified in the STEP Strategy, but I would venture to suggest that the *way* it is run is the problem, and not the proposed aim and context of the institution which is proving limiting. Its objective of aligning the goals and activities of the primary land management organisations by targeting heads of agencies is appropriate.

Thicket Forum (*Paper IV*) has evolved significantly from its early roots, and I learnt much from my involvement as both a member of the organising committee and the Chairperson. It constitutes an essential institution for mainstreaming the goals of the STEP Project into the rural community, though it has a way to go before it can claim to be 'mainstreamed'. It aspires to link researchers, government officials and rural landowners, and the recent evolution in its structure and format away from academic presentations towards workshops and field trips has engaged greater numbers, though still too few, rural landowners. Thicket Forum will continue to be an on-going experiment for making systematic conservation assessments relevant to society. A recent grant – the first multi-year grant to any community-based forum – by the National Research Foundation of South Africa suggests it is headed in the right direction.

Whilst ultimately the design and establishment of social learning institutions is a fundamental foundation to effectively translating systematic conservation assessments into action, it proves exceedingly difficult to achieve in practice with multiple stakeholders exhibiting diverse values and goals. A significant shift in the quantity of research focused upon the intricacies of the data and algorithms employed for systematic conservation assessments, instead, to the development of institutions supporting the outputs of these techniques would probably provide large returns.

Lessons Learned

This research process has been a journey towards improving my personal effectiveness as a conservation planner, which hopefully makes a useful contribution towards the theory and practice of conservation planning generally, and systematic conservation assessment specifically. In summary, I have learnt several significant lessons, and wish to highlight the importance of:

Recognise the Limits of Conventional Conservation Science

Although science has a significant role to play in conservation planning, it will only ever be a supporting role. Science provides information to support decision-making (Lee 1993; Theobald et al. 2000), whilst conservation is a social process. The research process described in this thesis employed a diverse range of techniques for gathering, analysing and presenting information, the minority of which were strictly 'scientific'. This was necessary because conservation planning initiatives aim to alter the functioning of entire social-ecological systems, which are highly complex. Whilst the supposed 'objectivity' of science is of benefit in providing defensible information, it's ability to provide useful knowledge, as currently practiced, is limited. Refining the scientific approach to produce more useful knowledge requires two fundamental transformations. First, it must be conducted in the 'real-world' and involve people affected by its outcomes. Second, it must consistently and vigilantly document failures in it's application, and synthesize lessons which will improve future practice.

Transdisciplinarity Provides Integration

Transdisciplinarity is both a tool and a process, one which recognises multiple realities, practices consilience, and grapples with the complexity of social-ecological systems (Max-

Neef 2005). If we are to effectively link theory and practice we must move beyond our current inward-looking perspective and adopt a truly transdisciplinary approach, as conservation planning problems are not solved by systematic conservation assessments alone. This will require that conservation science be completely transformed, both at the level of individual researchers, and as a discipline. Conservation science must be linked to normative activities, such as land-use planning (Max-Neef 2005). Conservation problems must be defined in the context of an operational model, so that research and its outputs can be situated so as to deliver effective, user-useful and user-friendly solutions. The operation of land management organisations will also need to undergo a fundamental restructure of their operations. Teams of people with complementary skills must focus on common problems.

Pursue Holistic Understanding of Social-Ecological Systems

It is essential that we understand entire social-ecological systems, especially the links between social systems and ecological systems. These are our points of intervention. Typically this seems to require institutional solutions, supported by, but not limited to, systematic conservation assessments. To this end, the assessment of conservation opportunity, not simply priorities, is of significant benefit. Undertaking a social assessment of a planning region prior to conducting a systematic conservation assessment is essential (Cowling & Wilhelm-Rechmann 2007). We will be required to practice consilience – the fusion of knowledge traditions (Wilson 1998) – by engaging and capturing traditional and experiential knowledge, not simply scientific knowledge. Social research techniques, many of then non-quantitative, will be required.

Individual People Make the Difference

Ultimately, conservation planning, and so by definition systematic conservation assessment, is all about people. Systematic conservation assessments must represent societal values, not simply those of the scientists who undertake them. In this regard, it is essential that systematic conservation assessments not be viewed as products unto themselves, but instead, as only being of use if they are situated within a broader operational model (*Paper II*), preceded by a social assessment, informed by a collaboratively developed Landscape Management Model (*Paper II*), and complemented with an implementation strategy (*Paper II* and *Paper III*) and supporting institutions (Paper IV). Every aspect of conservation planning, inclusive of systematic conservation assessment, is enhanced by including a human and social dimension. For example, expert input improves vegetation and species maps (Mittermeier et al. 1995; Knight et al. 2006b; Knight & Cowling 2007), and stakeholder involvement validates implementation strategies (Paper III). Champions are essential for translating systematic conservation assessment outputs into effective conservation action, at political, organisational, and grass-roots levels (*Paper VII*).

Conservation Planners Are Participants

Finally, the role of the conservation planner must shift from being that of a supposedly objective expert who undertakes systematic conservation assessments hoping practitioners will spot them and adopt them, to that of an active facilitator who provides a needed service to practitioners. Conservation planners must portray humility, as it is the cornerstone of trust, without which collaboration, social learning and adaptive management is nought.

Future Research Directions

The research presented in this thesis provides a preliminary investigation into a number of aspects of conservation planning. Several future research directions are apparent. Specifically, the science of systematic conservation assessment would benefit from a focus on the following aspects of conservation planning:

- Testing of the operational model (Paper II) in other real-world contexts (it is currently being applied in three local government areas in Washington State, U.S.A., and has been adapted for ecosystem services planning [Cowling et al. in press])
- Further assessing the influence of social data upon conservation assessments, specifically which type of social data are most useful for identifying conservation opportunities which promote the implementation of effective conservation action
- Techniques for conducting visioning workshops which can be used for collaboratively developing landscape management models with stakeholders
- Techniques for identifying end-user needs to facilitate the development of user-useful and user-friendly conservation planning products
- Techniques for developing and mainstreaming implementation strategies, including ways of linking them to systematic conservation assessments to promote the implementation of effective conservation action

- Processes for social learning and adaptive refinement of both individual and organisational conservation planning processes

The current, overwhelming focus upon refining algorithms and testing surrogates for ecological data is providing little useful knowledge. Generally, far greater research is required into the social dimension of conservation planning. Significant practical gains are to be made from linking existing social research techniques to conservation assessment and planning. For example, questionnaire survey techniques for gathering human, social and economic data for inclusion into assessments of conservation opportunity (Paper VI and VII).

A significant absence from the conservation planning literature is that of case studies. An important research technique in the social sciences, case studies are not commonly published in the conservation literature, and appear to be shunned by natural scientists because they are a qualitative research technique. However, case studies are fundamental to conservation planning initiatives which adaptively improve, because a review of conservation planning experience is essential for social learning, and the complexity of the social-ecological systems which conservation planning initiative strive to influence defies quantification. In the words of Aldo Leopold:

> One of the anomalies of modern ecology is that it is the creation of two groups, each of which seems barely aware of the existence of the other. The one studies the human community as if it were a separate entity, and calls its findings sociology, economics and history. The other studies the plant and animal community and comfortably relegates the hodge-podge of politics to the liberal arts. The inevitable fusion of the two lines of thought will, perhaps, constitute the outstanding advance of the present century (Meine & Knight 1999).

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* This Bibliography comprises (as per NMMU regulations) a complete list of references from all the papers comprising this thesis, including the Introduction, the Prologue, Papers I to VII which comprise the body of the thesis, and the Discussion.

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Appendix I

Keeping People on the Land in Living Landscapes: A Co-operative Strategy for Conserving Landscapes and Enhancing Livelihoods in the Subtropical Thicket Biome. A report for partners of the Subtropical Thicket Ecosystem Planning (STEP) Project

Andrew T. Knight, André F. Boshoff, Richard M. Cowling and Sharon L. Wilson

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KEEPING PEOPLE ON THE LAND IN LIVING LANDSCAPES

A Co-operative Strategy for Conserving Landscapes and Enhancing Livelihoods in the Subtropical Thicket Biome, South Africa

October 2003

STEP

SUBTROPICAL THICKET ECOSYSTEM PLANNING

This Implementation Strategy is dedicated by those who have participated in STEP to the future generations of South Africans who will enjoy, love and depend upon the landscapes and resources of the Subtropical Thicket Biome

STEP is supported by the Global Environment Facility (GEF-MSP Grant 023504), implemented through the World Bank, and managed by the Terrestrial Ecology Research Unit at the University of Port Elizabeth, South Africa.

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Looking for STEP information, reports or spatial data ?

See the Conservation Planning Unit website http://cpu.uwc.ac.za

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Cover: *Aloe pluridens* in Sunday's Thicket (Photo: Jan Vlok) · Inset: STEP partners at work (Photo: Sharon Wilson)

FOREWORD

The tangled, dense and often spiny vegetation of the Subtropical Thicket Biome conceals a diverse abundance of rare and endemic plant species, with over 300, or 20%, of its plant species being found nowhere else on earth. It is also home to a diverse array of animals, including charismatic, rare, cryptic and ecologically vital species. Many economically essential industries exist throughout the biome, including pastoralism, cropping and the rapidly expanding eco-tourism and indigenous game-based industries. The people of the region are a special breed, representing a melting pot of Khoekhoen, San, Xhosa and European cultures.

Achieving a balance between industry and nature conservation to ensure ecologically sustainable land-use is a big challenge. The Subtropical Thicket Ecosystem Planning (STEP) project has been charged with laying a foundation for ensuring that this rich wealth of biological diversity, and the livelihoods of the communities in the biome, are conserved and enhanced, not only for future generations of South Africans, but for all humankind. This means maintaining the environmental processes on which natural and human systems depend. To achieve this, STEP has coupled sophisticated systematic conservation planning techniques with a strong focus upon relationships between partners, and upon implementation of conservation action.

STEP has provided a sound foundation for achieving ecologically sustainable land-use, by engaging and involving partners from local, regional, provincial and national government, non-government organisations, industry groups and private landowners, to catalyse a common vision through it's innovative ecologically sustainable land-use model of Megaconservancy Networks.

The livelihoods of hundreds of thousands of people depend upon Subtropical Thicket vegetation and it is therefore crucial that each one of us contributes to ensuring that this irreplaceable resource is protected and sustainably utilized. I invite you to accept this opportunity to become a partner in the challenging and exciting STEP initiative.

Mr Enoch Godongwana
Honourable Member of the Executive Council
Economic Affairs, Environment & Tourism
Province of the Eastern Cape
October 2003


ANDRE BOSHOFF


SANDI & MAZIZI


JAN VLOK


JAN VLOK


SHARON WILSON

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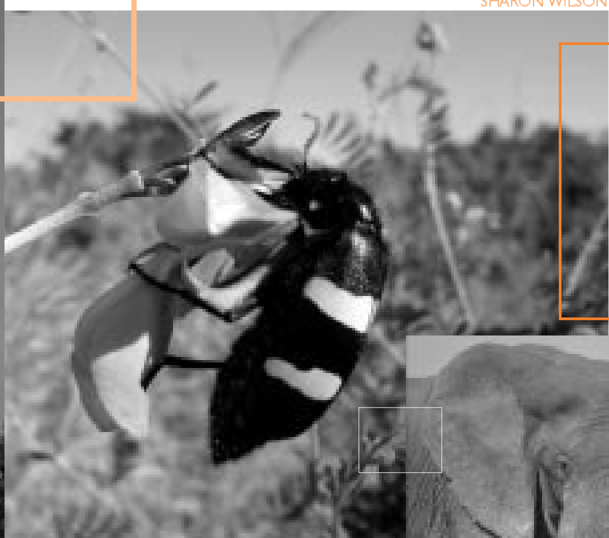
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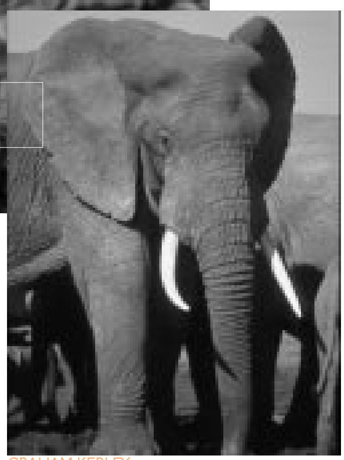

GRAHAM KERLEY

OUR COMMON VISION FOR LIVING LANDSCAPES

On the 15th and 16th April 2003 we partners of the Subtropical Thicket Ecosystem Planning (STEP) project, government officials, agency staff, non-government organisations and landowners, co-operatively developed a common Goal and a shared Vision of how ecologically sustainable land management could occur in our Subtropical Thicket Biome :

The people of the Thicket Biome take custodianship of their unique living landscapes and work together to conserve, enhance and use their natural resources to ensure sustainable ecological processes and livelihoods, now and in the future.

Our vision statement is centred on the concept of living landscapes. A living landscape is a large area of land which displays a patchwork of repeating patterns of ecosystems and land-uses, in which ecological, agricultural and social systems are managed so that they function sustainably, thereby ensuring that natural and cultural resources are available for future generations of people.

Our livelihoods benefit from a diverse range of industries dependent upon our landscapes:

- Angora and Boer goat pastoralism is our biggest industry.
- Game farming has become an important industry and is rapidly growing.
- Overseas tourists are increasingly visiting for eco-tourism and hunting.
- Our fertile valley flats produce an abundance of citrus, vegetables and chicory.
- Our Subtropical Thicket provides medicinal plants, wood for fuel and building, and food.

Unfortunately, our Subtropical Thicket Biome is in decline. Declining ecological systems erode the foundation of sustainable livelihoods, placing an already overwhelmingly poor regional community at great risk of further hardship and suffering. Clearly, we need towns, agriculture and development, but we must also maintain a healthy environment. After much scientific research and consultation with the community, we have identified priority areas that link existing nature reserves, river courses and nature-friendly land-use along corridors that connect the sea to the mountains, thereby ensuring both development and nature conservation.

We have named these priority areas Megaconservancy Networks, which is our agreed model for ecologically sustainable land management. They form an integral component of the Implementation Strategy detailed in this document, which is essential for aligning our goals and activities and detailing tasks to achieve our Vision.

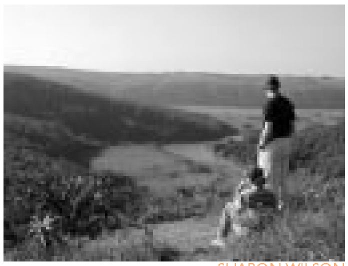

AMANDA YOUNGE

The challenge of achieving our Vision awaits us. We are proud of our biome and we want to be :

"Keeping People on the Land in Living Landscapes"

Xhosa Vision Statement

Abantu abanomdla kwimimandla yamatyholo entshinyano/ ashinyeneyo ngokukodwa, bathabatha uxanduva okunonophela ngokuzingca kulawulo lokwabelana kulondolozo lwemithombo yandalo enonxibelelwano esetyenziswa ngononophelo namhlanje nakwixesha elizayo ukwakhela sizukulwana esizayo.


SHARON WILSON

Afrikaans Vision Statement

Die mense van die Ruigtewoud-bioom neem eienaarskap van hul unieke lewende landskappe en werk saam om die natuurlike hulpbronne te bewaar, bevorder en benut om ekologies volhoubare prosesse en lewenswyses te verseker, nou en vir altyd.


AMANDA YOUNGE

THE WONDERS OF THE 'LOST' BIOME

The Subtropical Thicket, commonly known as valley bushveld or just thicket, is the 'lost' biome of South Africa, for it has only recently been recognised as a distinct biome. Confined largely to hillsides and valley lowlands of the coastal and immediate hinterland areas, Subtropical Thicket (as mapped by STEP) covers an area of some 48 000km^2, stretching from near Riversdale in the Western Cape Province to the Kei River in the Eastern Cape Province.

What are Biomes?

Biomes are ecologically distinct communities of similar groups of plants. South Africa's 7 biomes include Subtropical Thicket, the Nama Karoo and Succulent Karoo, Grassland, Fynbos, Forest and Savanna.

JAN VLOK

GRAHAM KERLEY

Subtropical Thicket comes in many different forms, and is most often a thorny, dense and impenetrable tangle of trees, shrubs and vines forming inter-connected or isolated bush-clumps. Often it resembles adjacent biomes, such as forest and savanna. The STEP mapping has revealed 112 different Subtropical Thicket vegetation types, comprised of 1558 plant species. A staggering 322 species (20%) are endemic, and are found nowhere else on earth. Many are localised endemics with highly restricted distributions. This globally significant level of plant diversity has been internationally recognised through the Albany Centre of Plant Diversity and Endemism and the Maputaland-Pondoland biodiversity 'hotspot'.

Subtropical Thicket is home to a diverse array of fauna, notably 48 species of medium- to large-sized mammals, including charismatic species such as the African elephant, the black rhinoceros and the Cape buffalo.

Intact Subtropical Thicket provides ecosystem 'services' critical for the survival of human communities, including clean water, clean air, soil retention, and the storage of carbon from the atmosphere to reduce global warming. Clearly, the Subtropical Thicket Biome is a region of global importance.

SHARON WILSON

JAN VLOK

RICHARD COWLING

MARIETJIE LANDMAN

LAND-USE AND OPPORTUNITIES FOR SUSTAINABLE MANAGEMENT

People have occupied the Subtropical Thicket Biome for at least 120 000 years, beginning with the San, then the Khoekhoen (Khoikhoi) and Bantu-speaking agro-pastoralists (ancestors of the Xhosa people), and most recently settlers of European descent who entered the region from the west in the mid-1700s.


GRAHAM KERLEY

Over the last 250 years extensive livestock pastoralism and bush-clearing for pastures has occurred throughout the Subtropical Thicket Biome, followed more recently by dryland and irrigated cropping and urban development. These activities are essential for ensuring the social and economic welfare of human communities. However, they have been largely conducted in an unsustainable manner. These intensive human land-uses have dramatically upset the delicate natural balance of environmental processes in some areas. This imbalance is evident through widespread land degradation.

STEP research indicates that Subtropical Thicket vegetation types have less than 50% of their original area in a pristine condition, and 13 types have endured extensive transformation. Many of these can be considered permanently destroyed as restoration is probably not feasible, and some areas now suffer from desertification. Noorsveld and Arid Spekboomveld are two of the broad vegetation types of greatest conservation concern. Overcrowding in communal lands, the result of historical inequalities, has produced generally high levels of degradation of Subtropical Thicket in these areas.

Economic Values of Subtropical Thicket

- *In 2000, mohair farming generated R192 million and 30000 direct and indirect jobs across the Eastern Cape.*
- *Tourism generated R4 billion in the Eastern Cape in 2002.*
- *Private nature reserves may generate up to R40 million and 240 jobs annually.*
- *Hunting generates R44 million annually, plus flow-on benefits.*
- *Trade in medicinal plants generates some R7 million annually.*
- *The aloe sap industry employs up to 6 000 sap tappers at any given time.*


GRAHAM KERLEY

The decline in natural systems imposes many costs on individual landowners and the broader community, including lower economic returns from declining farm productivity, foregone opportunities for diversification into eco-tourism related initiatives, restoration costs, and lost opportunities for clean air, clean water, and reducing global warming through the fixing of atmospheric carbon.


SHARON WILSON

The total extent of protected areas (e.g. national parks) has expanded rapidly in the recent past, with some 7% of the STEP planning region presently reserved. Expansion of the Greater Addo Elephant and Mountain Zebra National Parks, and of the Baviaanskloof and Gouritz Mega-reserves, offers great potential for the creation of living landscapes. The extent of private game reserves has also increased significantly, largely in response to the rapidly expanding foreign tourist industry, and offers significant employment opportunities. This trend, coupled with the slowing of national clearing rates, and the rapid transition of many pastoral ventures to wildlife-based tourism and game farming, potentially heralds a return to a more ecologically sustainable land management regime for the Subtropical Thicket Biome.

Capitalising upon this turn-around, so as to halt the extensive decline of natural systems and reduce the high levels of rural poverty, requires a strong commitment by all members of our communities to ecologically sustainable land management.

TAKING A POSITIVE STEP FORWARD
THE SUBTROPICAL THICKET ECOSYSTEM PLANNING PROJECT

In July 2000 the Subtropical Thicket Ecosystem Planning (STEP) Project was initiated in direct response to wide recognition by land managers and scientists of the rapid decline in the quality, extent and productivity of Subtropical Thicket vegetation due to unsustainable land-use practices. STEP aims to establish a foundation for the conservation and ecologically sustainable land management of Subtropical Thicket and the enhancement of the livelihoods of the people dependent upon it. The STEP planning region is depicted in Figure 1 (page 8).

SHARON WILSON

The goal of STEP is to :

"Conduct, together with key partners, a thorough conservation planning exercise in the Thicket Biome and to work closely with key partners to ensure the implementation of the outcomes of the planning exercise."

Key objectives considered essential for achieving this goal include :

- creation of an awareness of the value and plight of the Thicket Biome ;
- development of a Regional Conservation Planning Framework ;
- provision of a conservation priority map, supported by a capacity building service, for incorporation into land-use planning frameworks, especially within local government ;
- development of an implementation strategy for the conservation of Subtropical Thicket, which includes the identification and prioritisation of explicit conservation actions.

SHARON WILSON

The Regional Conservation Planning Framework provides the outline of the STEP approach, and is comprised of three integrated STEP activity themes known as Foundations :

SHARON WILSON

Foundation 1 - Empowering Individuals and Institutions

STEP has adopted a co-operative approach that aims to build relationships between, and the capacity of, key partners by aligning and consolidating common goals and demonstrating the power of relationship synergies.

Foundation 2 - Systematic Regional Conservation Assessment

A strong, defensible scientific approach to the systematic assessment of priority areas forms the cornerstone of sound conservation and land management decision-making. STEP has invested strongly in developing benchmark information, including the first region-wide map of Subtropical Thicket vegetation.

Foundation 3 - Implementation: Securing Conservation Action

Clear direction and strong relationships are critical to the implementation of action in priority areas. Instruments (e.g. Megaconservancy Networks) that not only ensure the conservation of environmental processes but which improve livelihoods, through promoting sustainable agriculture and water use, will be essential.

The STEP Regional Conservation Planning Framework can be accessed free-of-charge through the Conservation Planning Unit website at http://cpu.uwc.ac.za.

STEP OUTCOMES FOR IMPLEMENTING LIVING LANDSCAPES

STEP has strategically delivered a suite of outcomes and products that provide a strong basis for implementing living landscapes.

I. Empowered Individuals and Institutions

People are the key to successfully implementing living landscapes, and therefore STEP focused upon bringing together the diverse array of people involved in the wide range of land management related activities throughout the Subtropical Thicket, specifically :

- identifying and involving partners in many important issues, including developing a Vision, and this Implementation Strategy ;
- catalysing relationships between partners to better ensure that common goals are forged ; and
- providing training to partners in local government in the implementation of the STEP Conservation Priority Map to improve capacity to make wise land management decisions.

The STEP Handbook

A Handbook has been compiled by STEP to build capacity and meet the needs of Municipal-level decision-makers and their consultants. In particular, the STEP Conservation Priority Map, in association with the Handbook, has been developed specifically to incorporate biodiversity into land-use planning.

AMANDA YOUNGE

STEP embodies transparency and defensibility of its process and has continually informed partners through newsletters, presentations and discussions. Public involvement is a critical foundation of the STEP Implementation Strategy.

II. STEP Regional Conservation Planning Framework

Successfully implementing activities that promote living landscapes is a highly complex activity that requires a clear direction and sound organisation. The STEP Regional Conservation Planning Framework outlines the direction, context, tasks and methodologies for selected activities. It is focused upon implementation issues surrounding conservation action and management including: the translation of regional-scale notional priority conservation areas to local-scale action; instruments for implementing conservation; and the importance of partner involvement throughout the initiative. This focus upon implementation has been integrated throughout the STEP Framework, and incorporates the lessons learnt from several major regional conservation planning projects in South Africa and Australia, thereby avoiding the replication of mistakes from past initiatives. The STEP Framework should be useful in other agricultural regions.

III. Megaconservancy Networks

Megaconservancy Networks (Figures 2 and 3; pages 8 and 9) represent a concept model of ecologically sustainable land management that offers landowners opportunities to work together on biodiversity-based ventures, and to preserve the minimum extent of landscapes essential for ensuring the sustainability of natural and social river catchment systems. They consist of groups of adjacent properties of various tenures and land-uses whose owners are partners who share a common vision and who participate voluntarily, manage their lands in a co-ordinated, co-operative and integrated way, and are committed to halting the degradation and loss of indigenous plant and animal communities, and to improving their own livelihoods. Benefits include reducing costs by sharing expenditure for wildlife introductions and alien vegetation eradication; improving the foundation for eco-tourism; limiting environmental degradation and restoring landscapes to enhance ecosystem services; and conserving Subtropical Thicket landscapes for future generations of South Africans.

Ecologically sustainable land management *(ESLM)* *is the use, conservation and enhancement of the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be improved.*

IV. STEP Conservation Priority Map

STEP aims to provide spatially-explicit solutions to two critical conservation planning challenges. Firstly, ensuring the persistence of ecological and social systems requires not only that samples of biodiversity and landscape patterns are protected, but that the environmental processes essential for sustaining these systems are maintained. Megaconservancy Networks are our priority conservation areas. Secondly, achieving living landscapes also requires that areas outside Megaconservancy Networks are identified and managed to stem the degradation of landscapes through land-use planning processes, thereby ensuring the retention of Subtropical Thicket vegetation. The Conservation Priority Map (Figure 3; page 9) displays an index of Conservation Status that can be used to guide land-use planning decisions.

OUR STRATEGY FOR SECURING LIVING LANDSCAPES

What is an Implementation Strategy?

An Implementation Strategy is a common plan of action for partners which details the underlying principles, directions, and tasks for translating conservation planning products (e.g. the STEP Conservation Priority Map) into conservation action and management (e.g. conservation programmes, protected areas, and conservancies). It is an essential tool for monitoring partner progress towards achieving common goals.

During the STEP Strategy Workshop we partners identified a suite of eight broad issues essential for achieving the Vision. These issues group into four Key Themes:

- Key Theme 1 : Enhance Partner Involvement, Co-operation and Capacity
- Key Theme 2 : Support Planning for Conservation and Land-Use
- Key Theme 3 : Enhance the Effectiveness of the Protected Areas System
- Key Theme 4 : Promote and Realise Megaconservancy Networks

Each Key Theme comprises a suite of Critical Elements that are essential conditions for ensuring the long-term success of conservation action. Tasks essential to achieving the STEP Vision, here called Priority Actions, are also outlined. Every attempt has been made to retain the language and content provided by STEP partners at the strategy workshop, so as to ensure that this publication is truly representative of their views.


SHARON WILSON

The Implementation Strategy marks the start of the challenging road towards securing living landscapes throughout the Subtropical Thicket Biome.

KEY THEME 1

Enhance Partner Involvement, Co-operation and Capacity

Our human capital is perhaps our greatest resource for implementing conservation action - in short, people matter. Plentiful practical information, strong institutional systems and processes, productive partnerships, and co-operative governance are all essential ingredients. Enhancing the capacity of individuals and institutions to successfully undertake this work will further ensure the ecologically sustainable management of natural resources.

Strategic Key Theme Objective

Key partners and the broader community actively support the STEP Vision, based upon their sound understanding of the importance of conservation, the opportunities provided by ecologically sustainable land management for livelihood enhancement, and effective capacity to actively access, utilise and conserve knowledge and resources through participation in STEP aligned activities.


SHARON WILSON

Critical Elements

Key Partnerships

Strong partnerships are required between:

- all spheres of government, industry organisations, non-government organisations, educational institutions and landowners;
- government and NGO extension staff and researchers;
- extension staff (government and NGO) and rural landowners.

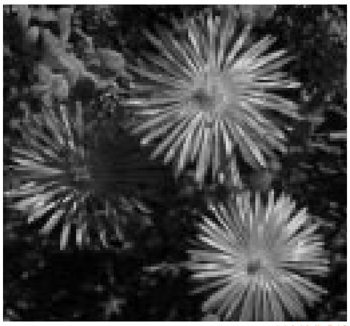
Capacity Improvements

- The ability of Local and District Municipalities and government departments (e.g. Departments of Agriculture) to design, deliver and manage land management programmes, especially regarding skills in: securing funding (e.g. writing and marketing skills); sound financial management, including effective spending of funds; developing and delivering effective environmental awareness and involvement programmes.
- Understanding of the functioning, management and utilisation of Subtropical Thicket social-ecological systems by land-use decision-makers and officials, and extension service staff.
- Programmes implemented by National Government to specifically support and develop capacity to achieve the STEP Vision.

SHARON WILSON

Funding Needs

- A dispersal system to co-ordinate the allocation of funds between conservation and land management agencies to optimise financial resources.
- Reliable and secure funding for activities with conditions that enhance the achievement of STEP goals.
- Funds for capacity building programmes, especially for Local and District Municipalities and government departments.
- Preliminary funding for a Bioregional Programme Co-ordinator.
- Funding targeted specifically for environmental awareness.



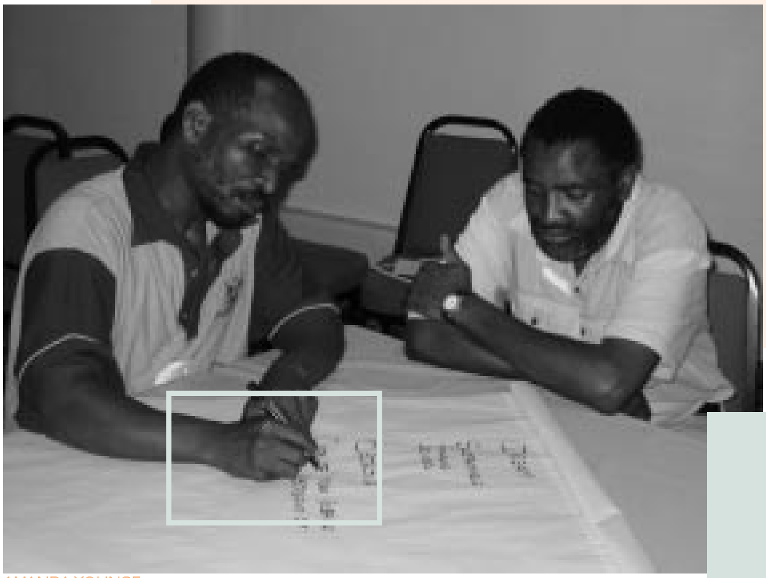
JAN VLOK

Legislative and Policy Support

- Formal recognition of our Constitutional 'duty of care' for the natural environment.

Information Needs

- Best-practice guidelines for public awareness, rural extension, and capacity building programmes, developed from past initiatives (including STEP) and presented in accessible language.
- Summaries (presented in simple language) of all existing legal responsibilities requiring enforcement by Local and District Municipalities, and government departments (esp. Departments of Agriculture, Water Affairs and Forestry, Land Affairs).
- An effective information feedback system to supply information between government departments and landowners for decision-making.



AMANDA YOUNGE

Strategic Research Directions

- Landowner goals and perceptions on nature conservation and land-use.
- Effectiveness of land management agencies in delivering required services.
- Potential opportunities for biodiversity-based economies.
- The values for, and uses of, natural resources by rural communities.

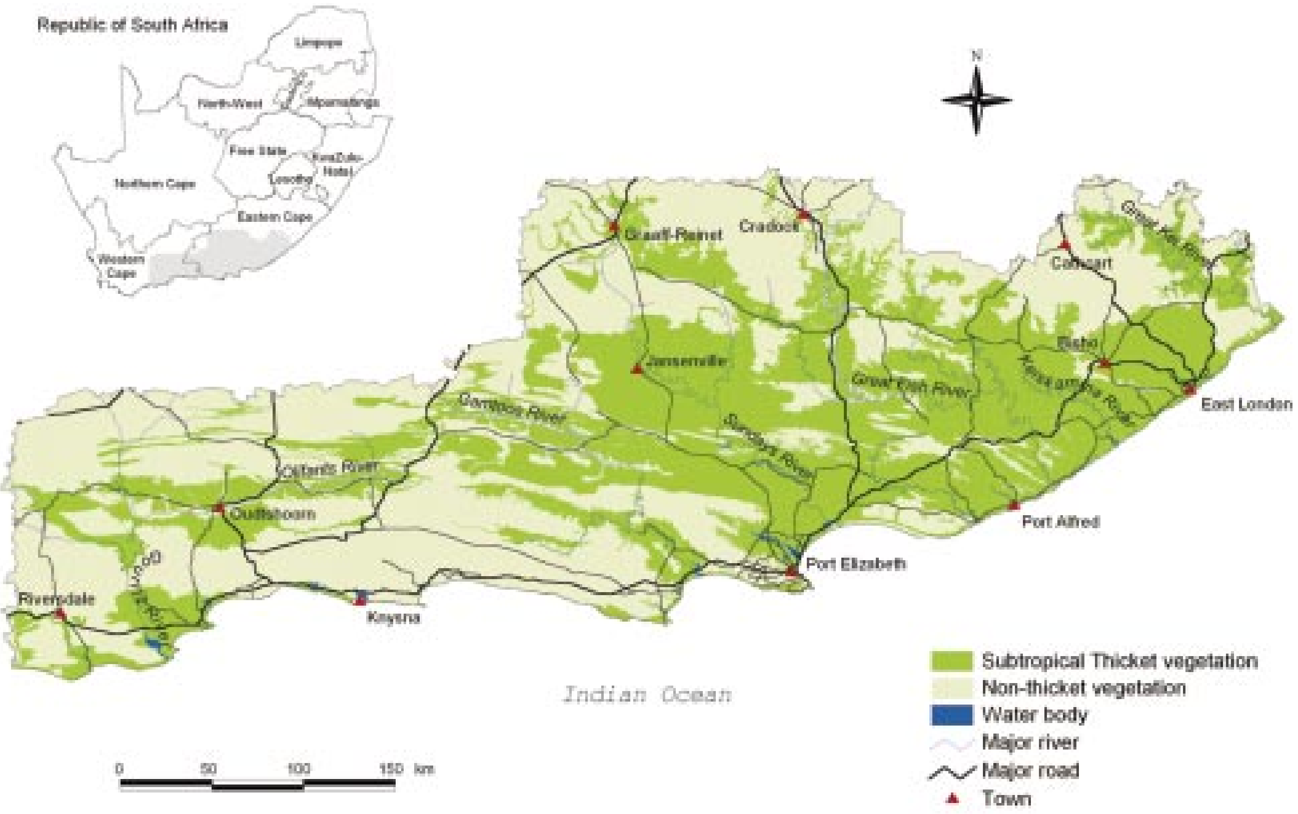


FIGURE 1 The STEP planning region, which covers an area of 105 454km^2, includes most of South Africa's Subtropical Thicket vegetation, and that part that holds globally significant plant diversity.

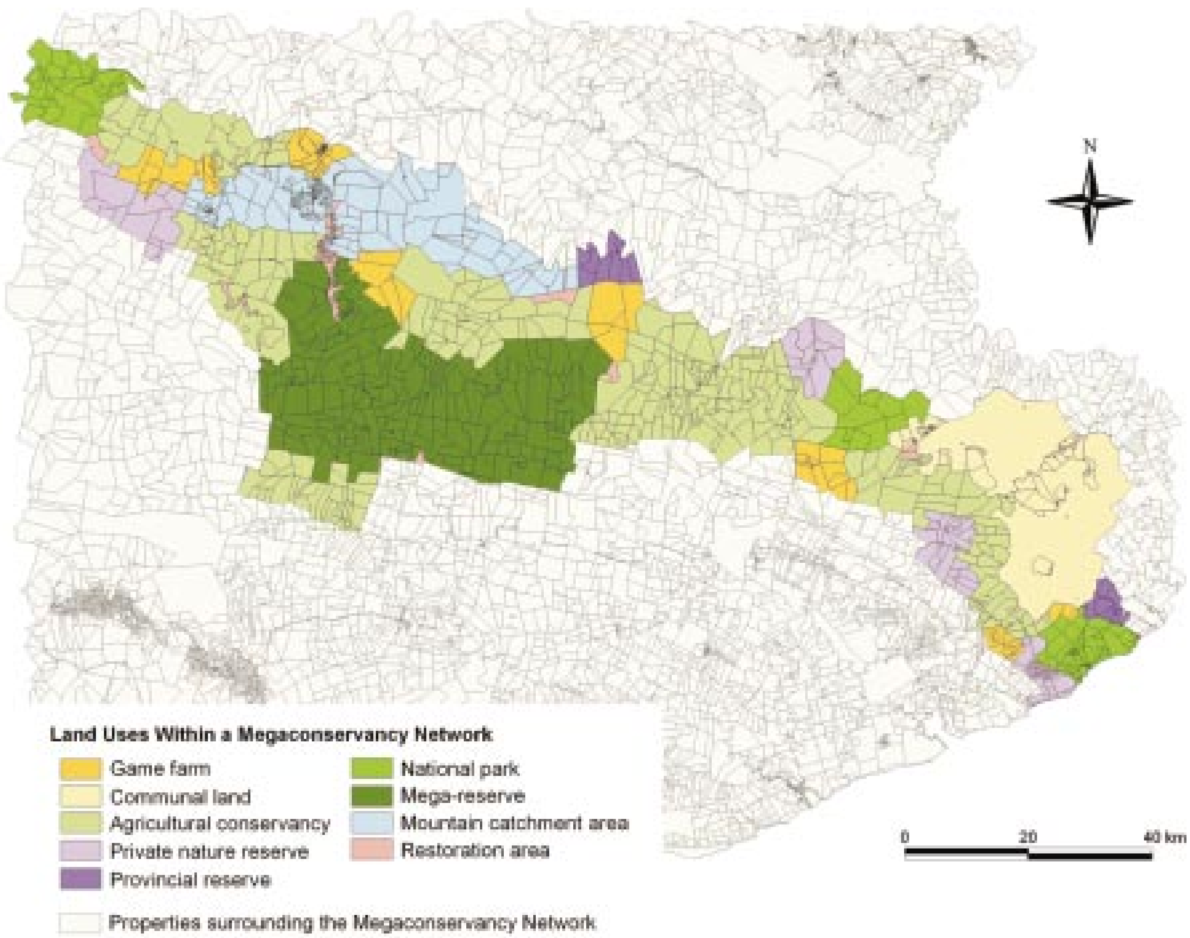


FIGURE 2 A hypothetical Megaconservancy Network (see pages 5 and 15), comprising a range of land-uses which might be included for their potential to support sustainable biodiversity-based economies. Refer to Knight and Cowling (2003) for greater detail

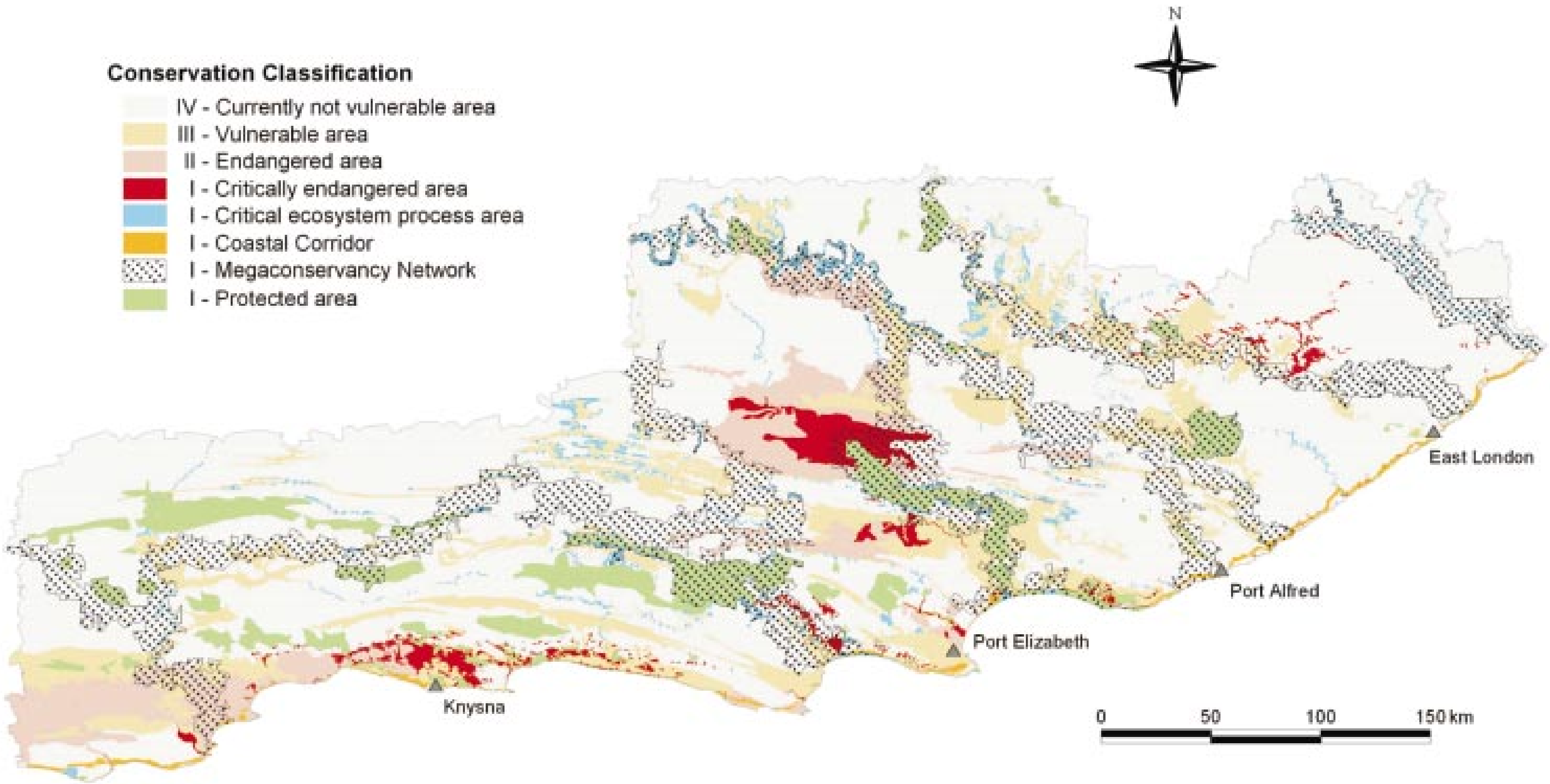


FIGURE 3 The STEP Conservation Priority Map (see page 5), which identifies and ranks areas important for conducting ecologically sustainable land-use practices (I = highest priority). Refer to Cowling *et al.* (2003) for research methodology, and to www.cpu.uwc.ac.za and Pierce (2003) for interpretation for general users and local government users, respectively.

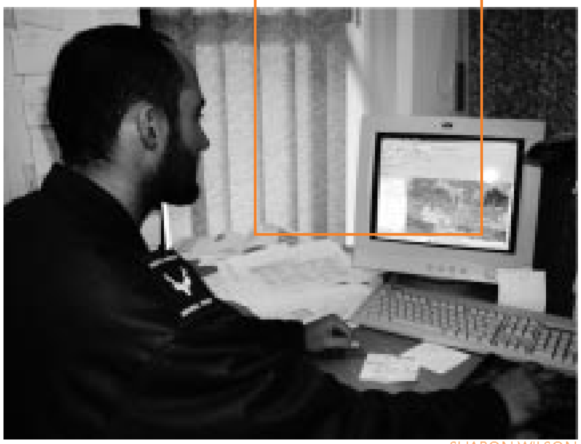
KEY THEME 2

Support Planning for Conservation and Land-Use

Conservation and livelihood enhancement activities must be integrated and have clear direction at the regional scale if they are to be sustainable and successful in the long term. Effective institutional systems for land-use and conservation planning are required. Information management and capacity building are key processes. The monitoring, evaluation and enforcement of land-use legislation and regulations are also critical factors. Aligning the goals of various land-use planning agencies is essential.

Strategic Key Theme Objective

To secure the effective integration of nature conservation information (i.e. the STEP Conservation Priority Map) into provincial and municipal land-use planning processes (e.g. Spatial Development Frameworks) and conservation planning processes (e.g. regional and local-scale conservation initiatives), through the tangible support of key partners.



SHARON WILSON

Critical Elements

Key Partnerships

- The Conservation Planning Unit (CPU) of the Western Cape Nature Conservation Board and the National Biodiversity Institute must have strong partnerships with Local and District Municipalities, consultants and environmental organisations.
- Environmental organisations and conservation projects that are developing conservation planning products (e.g. the STEP Conservation Priority Map) must foster strong partnerships with Local and District Municipalities to be able to effectively determine their needs.

SHARON WILSON

Capacity Improvements

- Strengthening of the ability of Local and District Municipalities and government departments to effectively deliver upon their obligations for Integrated Development Planning (IDP), upholding nature conservation through processing of Environmental Impact Assessments (EIAs) and clearing of virgin ground applications, and to efficiently manage and spend funding allocated for conservation and land management.
- Understanding by Local and District Municipalities and government agency officials and decision-makers of the utility and application of the STEP Conservation Priority Map.
- Monitoring, evaluation and enforcement of legislation at the grassroots level.

Funding Needs

- Integrated Development Planning funds secured by Local and District Municipalities for Integrated Environmental Management (IEM) and land-use planning activities.
- Funds for capacity building programmes for Local and District Municipalities and government departments.

Legislative and Policy Support

- Clear links between the range of natural resource management legislation and policies, e.g. the Biodiversity Bill and Integrated Development Planning.
- Support from officials knowledgeable in applying legislation
- Statutory recognition of the STEP Conservation Priority Map under the Biodiversity Bill to ensure integration of environmental information into development processes.

Information needs

- Research results must be made easily and widely accessible, especially the STEP Conservation Priority Map.
- Summaries (presented in simple language) of all existing legal responsibilities requiring enforcement by Local and District Municipalities, and government departments (esp. Agriculture, Water Affairs and Forestry, Land Affairs).

DANIEL BOSHOFF

Strategic Research Directions

- Determine localities, rates and extents of degradation of critically endangered types of Subtropical Thicket vegetation.
- Review of effectiveness of land-use planning instruments for conserving natural areas.

Priority Actions

- Ensure that the Conservation Planning Unit is sufficiently resourced to be able to effectively manage, distribute and update, where necessary, the data provided by STEP and other regional conservation planning projects, including knowledge of conservation planning research and land-use planning processes.

- Mainstream STEP conservation planning outputs and products into Integrated Development Planning and other sectoral plans in terms of their IDP requirements, facilitated by high-level indabas, Memoranda of Understanding, district level environmental forums, and the location of Champions within Local and District Municipality offices.

- Mainstream STEP conservation planning outputs and products into existing legal structures and land-use planning processes.

- Encourage Provincial and Municipal land-use decision-makers to develop, in consultation with other partners, new and innovative land-use planning instruments that enforce existing legislation in order to manage or limit human impacts on the Subtropical Thicket Biome.

- Lobby government to establish an environmental monitoring watchdog to monitor and enforce compliance with Strategic Development Frameworks (SDFs), and Strategic Environmental Assessments (SEAs).

ANDRE BOSHOFF

- Establish partnerships with land managers and decision-makers to educate them regarding the potential benefits of integrating the STEP Conservation Priority Map into their institutional decision-making processes.

- Secure the active commitment of National and Provincial government to capacity improvement.

KEY THEME 3

Enhance the Effectiveness of the Protected Areas System

Formally protected areas (i.e. those supported by legislation) are an essential instrument for securing priority conservation areas as they offer relative security to rare, sensitive or vulnerable landscapes, plants and animals. These areas can provide significant ecosystem services, including provision of clean water and air. As hubs for eco-tourism they also serve as a socio-economic engine that promotes livelihood enhancement opportunities for impoverished rural communities.

GRAHAM KERLEY

Strategic Key Theme Objective

To promote the establishment of a suite of Mega-reserves (including the Gouritz, Baviaanskloof and Greater Addo Elephant National Park Mega-reserves) along with a collection of smaller protected areas, which are effectively and efficiently managed in partnership with adjacent interests to achieve targets for ecological pattern and process, and to provide livelihood enhancement through employment.

Critical Elements

Key Partnerships

- Strong partnerships between protected area managers, neighbouring interests and tourism authorities.

Capacity Improvements

- Resourcing for national and provincial government and municipalities to enforce the security of protected areas.
- Interpretation within protected areas to improve environmental awareness standards.
- Enhanced on-reserve environmental monitoring systems.

Funding Needs

- Funding for effective management and enforcement for provincial and municipal reserves.
- Land acquisition funding.


SANDI & MAZIZI CONSULTING

Legislative and Policy Support

- Securing sufficient hydrological flows ('ecological in-flows') under the Water Act 1998.

Information Needs

- Clearly defined and defensible priority areas which are suitable for acquisition as protected areas.
- Best-practice guidelines for protected areas management.

Strategic Research Directions

- The social, economic and ecosystem service benefits of protected areas.
- The potential for job creation through eco-tourism in protected areas.
- Ecologically sustainable stocking rates of indigenous fauna.

GRAHAM KERLEY

Priority Actions

- Strategically plan the expansion of the Protected Areas System using best-practice, systematic conservation planning techniques.

- Expand the protected areas system in partnership with local communities to include rare, endemic, sensitive or vulnerable natural features, focusing upon the establishment of a small number of Mega-reserves, complemented by smaller reserves, so as to promote socio-economic development through eco-tourism.

- Build partnerships between protected area managers, neighbours and scientists, by establishing Megaconservancy Network Neighbourhood Committees that assist with the planning and management of protected areas, and their links with private and communal lands.

- Expand the use of contractual National Parks through the development of a co-ordinated programme as a means of building partnerships with neighbours, easing the financial costs of land acquisition, and equitably sharing the benefits derived from nature conservation activities.

- Ensure the development, evaluation and application of effective strategies for protected area management, including: management plans; environmental monitoring programmes; and financial management systems.

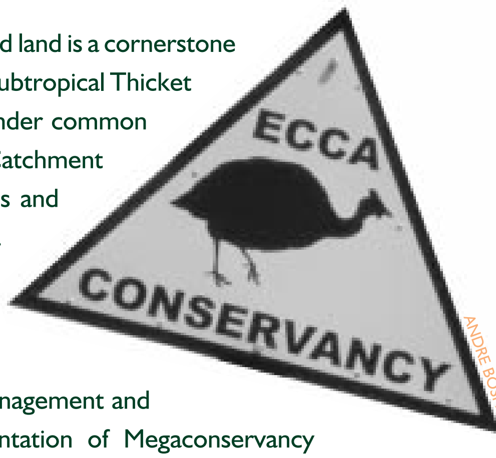
- Ensure that the information resource potential of all protected areas is realised and promotes environmental awareness through relevant and effective interpretation.

- Establish a programme of Honorary Conservators in protected areas to encourage societal participation and assist permanent protected areas staff, thereby increasing the efficiency of law enforcement programmes, capacity building and the fostering of environmental awareness throughout the broader community.

FRANCOIS DU PLESSIS

KEY THEME 4
Promote and Realise Megaconservancy Networks

Ecologically sustainable land management on privately- and communally-owned land is a cornerstone of regional-scale conservation initiatives in agricultural landscapes such as the Subtropical Thicket Biome. Megaconservancy Networks integrate a wide variety of land-uses under common goals, thereby enhancing mutual benefits and sharing costs. Integrated Catchment Management (ICM) promotes the opportunity to manage whole landscapes and balance the goals of nature conservation, agricultural production and water use.



ANDRE BOSHOFF

Strategic Key Theme Objective

To balance and achieve the goals of nature conservation, agricultural production and water use, thereby ensuring ecologically sustainable land management and the equitable disbursement of benefits and costs through the implementation of Megaconservancy Networks.

Critical Elements

Key Partnerships

- Strong relationships between protected area managers and private landowners, particularly conservancies, game farms and private nature reserves.
- Extension staff (non-government organisations and government land management agencies) and private landowners.
- Tourism authorities and Megaconservancy Network partners.
- Industry, private landowners and research institutions.
- Researchers and government and NGO extension staff.

Integrated Catchment Management (ICM)

is the co-ordinated and sustainable use and management of land, water and vegetation and other natural resources, on a water catchment basis, so as to balance resource utilization and conservation

Capacity Improvements

- Strong integrated multi-agency extension service.
- Enforcement of security of conservation values on private land, especially for partners receiving incentives.
- Resourcing for National Department of Agriculture to enforce security of virgin ground under the Conservation of Agricultural Resources Act.

Funding Needs

- Resourcing for extension staff.
- Financial support for new entrepreneurial ventures.
- Environmental levies to generate funds for the implementation of Megaconservancy Networks and sustainable resource utilisation, e.g. tourism levy, pollution levy (e.g. greenhouse gas emissions), and water levy.

Legislative and Policy Support

- Ability to place covenants upon property titles.
- Securing hydrological flows ('ecological in-flows') under the Water Act 1998.
- Enforcement of ecologically sustainable stocking rates.
- Effective assessment and policing by the Department of Agriculture of the Conservation of Agricultural Resources Act to prevent clearing of virgin ground.


RICHARD COWLING

Information Needs

- Accessible information that demonstrates the value of Integrated Catchment Management, protected areas as economic engines, and the opportunities and constraints of Megaconservancy Networks.
- Access for private landowners to data on ecologically sustainable stocking rates, game management, eco-tourism opportunities, and the benefits of conservancy membership.

Strategic Research Directions

- Benefits of, and potential for, cost-sharing and spin-off benefits of integrating land management and eco-tourism activities.
- Economics of game farming and protected areas.
- Ecological impacts of extra-limital (local or regional non-endemic) fauna species.

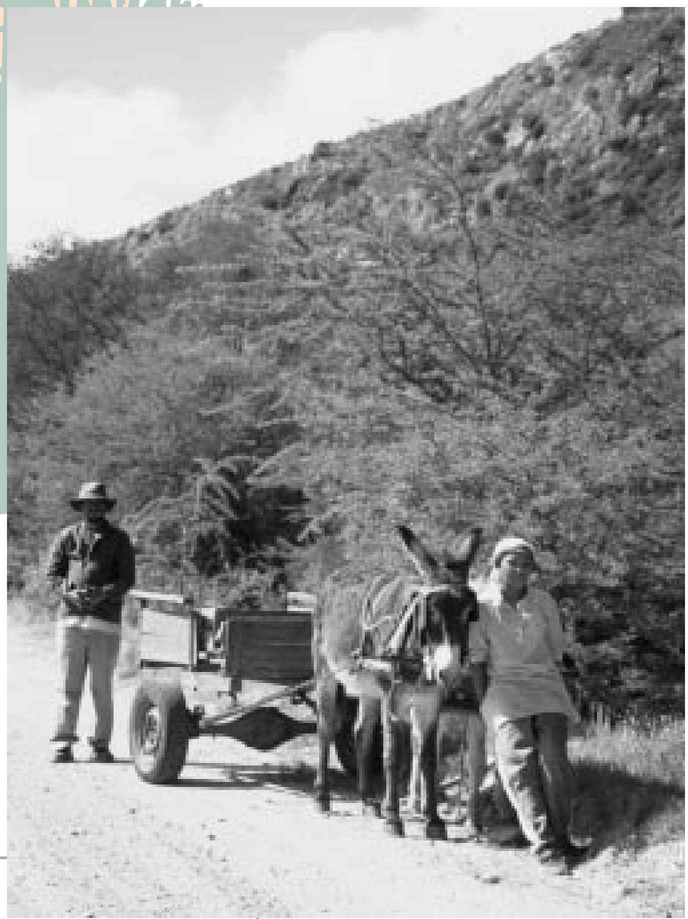
ANDRE BOSHOFF

Priority Actions

- Support and secure partnerships between owners/managers of adjoining lands within Megaconservancy Networks (e.g. South African National Parks, provincial and private reserves, conservancies and communal lands) through the establishment of informal working groups to align goals, and to identify the benefits associated with co-operative integrated management regimes.

- Land management agencies, industry organisations and research institutions to encourage ecologically sustainable land management practices, particularly: prescribed stocking rates for domestic and indigenous game; sustainable harvesting of indigenous plants; sustainable hunting of indigenous game; halting the introduction of alien and genetically modified plants and animals, and extra-limital game species; and reducing the use of pesticides, herbicides and other toxins.

- Develop and implement an effective incentives programme comprising a simple and appropriate suite of instruments targeting rural landowners (partners), and linking the level of incentives to the level of a partner's commitment and demonstrated conservation action.


SHARON WILSON

- Establish an integrated multi-agency extension service through the Department of Agriculture, South African National Parks, provincial conservation authorities and non-government organisations, which : 1) encourages an ethic of duty of care, stewardship, conservation and ecologically sustainable land management; 2) actively promotes the establishment of conservancies; 3) promotes prescribed stocking rates; and 4) promotes, negotiates, manages and enforces an incentives programme with landowners.

- Identify priority areas for ecological restoration, linked to job creation where possible, such as alien vegetation clearing or revegetation with spekboom (*Portulacaria afra*), which promotes the functioning of environmental processes (e.g. provision of clean air and water, and the storage of carbon from the atmosphere to reduce global warming) especially for highly vulnerable or degraded landscapes and habitats.

- Ensure adequate hydrological flows ('ecological in-flows') for rivers under the South African Water Act 1998 in consultation with water users.

- Develop co-operatively with partners a tourism strategy that is geographically based upon Megaconservancy Networks and which develops and promotes the economic and ecological benefits of ecologically sustainable tourism (eco-tourism) ventures, particularly for partners in the pastoral industry.

- Establish a certification programme (green branding) for, and in conjunction with, biodiversity-based industries.

- Document and promote : 1) model examples of successful partnerships which demonstrate the potential benefits of joining a Megaconservancy Network; and 2) lessons learnt from ecologically sustainable land management initiatives.

TOWARDS IMPLEMENTING OUR VISION

STEP has begun the process of catalysing partnerships, aligning partner goals, and developing and mainstreaming conservation planning products such as the Conservation Priority Map. The immediate challenge is for partners to support and implement the STEP Vision. Are **you** ready to accept this challenge?

COLIN URQUHART

Effective co-ordination is a critical factor in the successful implementation of our Vision. This begins with establishing mechanisms, such as formalised committees and institutional processes, which foster mutually beneficial partnerships and effective land management decision-making.

A Bioregional Programme Co-ordinator must focus upon maintaining the STEP profile, catalysing partnerships and aligning partner goals, mainstreaming the STEP conservation planning products, and securing funding for future work. To support this work, an Implementation Committee should be established to co-ordinate and align the institutional directions of land management agencies.

Supporting the Implementation Committee are two important organisations. The National Biodiversity Institute has been charged with co-ordinating the post-planning phase of regional conservation initiatives including STEP, CAPE and SKEP. Complementing this role is the Conservation Planning Unit of the Western Cape Nature Conservation Board, which houses, manages and serves information from bioregional planning initiatives. Together these two organisations strive to support the Implementation Committee and keep these plans as 'living plans'.

Supporting bioregional planning with strong environmental legislation is essential. Bioregional plans can now be recognised under the Biodiversity Bill, making the inclusion of the STEP Conservation Priority Map in land-use planning a statutory responsibility. Integrated Development Planning is also now underway, and the requirement to update these plans every five years provides an excellent opportunity for mainstreaming the STEP Conservation Priority Map into local government land-use planning, through their associated Spatial Development Frameworks.

A WORD ON OUR COMMON FUTURE

We do not inherit the earth from our ancestors,
we borrow it from our children.

SHARON WILSON

This old saying highlights our duty of care to the Subtropical Thicket Biome - for the benefit of the South African and global communities that come after us. As South Africans, we accept this responsibility for managing our natural resources wisely under the South African Constitution.

The international community has recognised the global significance of the Subtropical Thicket Biome by co-funding STEP. This initial investment has been wisely managed and used to catalyse the elements essential for establishing ecologically sustainable land management. The energy, enthusiasm and strong support of our partners has been a hallmark of the STEP process. Strengthening our partnerships will build a sustainable future for future generations of South Africans.

Our Implementation Strategy provides an innovative and challenging blueprint for achieving a sustainable future. Megaconservancy Networks offer opportunities for not only conserving natural resources but also for enhancing livelihoods. Won't you join us in making a difference?

ACKNOWLEDGMENTS TO STEP PERSONNEL & PARTNERS

The success of STEP has been built around the co-operation and commitment of a large number of people and institutions. The following people are gratefully acknowledged for their key roles :

Funders and Administrators

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SHARON WILSON

STEP Steering Committee

Mr Albert Mfenyana (Chair) - **Dept. of Economic Affairs, Environment & Tourism, Eastern Cape Government**
Mr Ben Gericke - **Dept. of Housing & Local Government, Eastern Cape Government**
Mr Nkosi Quvile - **Dept. of Water Affairs & Forestry, Eastern Cape**
Mr Mbuyisi Ramncwana - **Dept. of Agriculture, Eastern Cape Government**
Councillor Mankomo Pango and Mr Matthew Sompani - **Amatole District Municipality**
Mr Koos Jooste - **Cacadu District Municipality**
Mr Henry Hill - **Eden District Municipality**
Dr Geoff Cowan - **Department of Environmental Affairs & Tourism**
Dr Mike Knight / Dr Guy Castley - **South African National Parks**
Ms Khungeka Njobe / Dr Maureen Wolfson - **National Botanical Institute**

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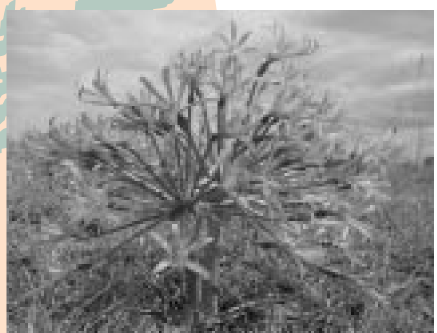
Dr Mathieu Rouget of the Institute for Plant Conservation, University of Cape Town
Vegetation Mapping :
Messrs Jan Vlok and Douglas Euston-Brown of Regalis Environmental Services
Land Cover Mapping :
Ms Wendy Lloyd, Ms Elna van den Berg, Dr Tony Palmer and Mr Terry Newby of the Agricultural Research Council
Public Participation Programme :
Ms Amanda Younge and Dr Dumisani Magadlela of Amanda Younge CC
Local Government Handbook :
Dr Shirley Pierce


JAN VLOK

Project Reviewers

Dr Brian van Wilgen of the Council for Scientific and Industrial Research (CSIR) Enviromentek
Dr Mike Cohen of CEN Integrated Environmental Management Unit

Partners

The collaboration and support of the wide range of partners from national and provincial government agencies, Local and District Municipalities, South African National Parks, the National Botanical Institute, the Botanical Society of South Africa and the private landowner sector has been critical to the success of the STEP Project, and is gratefully acknowledged.

USEFUL STEP REPORTS

Selected STEP reports are available from the CPU Website (http://cpu.uwc.ac.za) :

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Sims-Castley, R. 2002. A preliminary review of gross financial incomes generated by industries dependent on thicket vegetation. TERU Report No.37.

Vlok, J.H.J. and Euston-Brown, D.I.W. 2002. The patterns within, and the ecological processes that sustain, the subtropical thicket vegetation in the planning domain for the Subtropical Thicket Ecosystem Planning (STEP) project. TERU Report No.40.

Vlok, J.H.J., Euston-Brown, D.I.W. and Cowling, R.M. 2003. Acocks' Valley Bushveld 50 years on: new perspectives on the delimitation, characterisation and origin of thicket vegetation. South African Journal of Botany 69: 27-51.

GLOSSARY AND ABBREVIATIONS

alien - a species which exists, but does not naturally occur, in a specified area

biodiversity - the variety of all life in a nominated area, inclusive of genetic, species and ecosystem diversity and the processes through which they function

ANDRE BOSHOFF

CAPE - Cape Action for People and the Environment programme

conservation planning products - any form of information (e.g. spatial, image or textual) which is developed specifically for distribution to partners or end-users for the purposes of achieving conservation goals (e.g. decision-making, enhancing stakeholder relationships, or capacity building). Examples include maps of priority areas

community - the broad collection of individuals, groups, organisations and institutions

ecologically sustainable land management (ESLM) - the use, conservation and enhancement of the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be improved

endemic - a species which naturally occurs in a specified area

Implementation - the process of translating conservation planning products in both textual (e.g. strategies or action plans) and/or spatially-explicit (i.e. mapped priority conservation areas) forms into secure conservation areas through the development and establishment of instruments which encourage and ensure successful conservation management

Integrated Development Planning (IDP) - a South African government programme to ensure a balance between the myriad of land-use planning issues

living landscape - a large area of land which displays a patchwork of repeating patterns of ecosystems and land-uses, in which ecological, agricultural and social systems are managed so that they function sustainably, thereby ensuring that natural and cultural resources are available for future generations of people.

mainstreaming - the process of integrating information and actions from conservation planning activities into institutional programmes and processes so as to successfully enact conservation action and management

partner - an individual or institutions who participates or has an active interest in a conservation project or programme

partnership - a relationship between two or more stakeholders which is formed conciously so as to achieve an explicit goal

priority conservation areas - sites scheduled for early protective management because of their inherent values and exposure to imminent land-use pressures.

Spatial Development Framework (SDF) - a component of the Integrated Development Planning process which comprises a spatially-explicit (i.e. mapped) plan for a region

SKEP - the Succulent Karoo Ecosystem Planning project

STEP - the Subtropical Thicket Ecosystem Planning project

sustainable - the state of an action or activity whereby the long-term persistence of natural resources and the systems which are dependent upon them are assured

Vision - a statement of intent by a group of partners or stakeholders as to a hypothetical and usually ideal state of their world which serves as a goal for some form of action

For further information on STEP, or on the Megaconservancy Network concept, please see :

The Conservation Planning Unit website http://cpu.uwc.ac.za

or contact

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Design & Layout - Idea Corporation

Appendix II

Designing Large-scale Conservation Corridors for Pattern and Process

Mathieu Rouget, Richard M. Cowling, Amanda T. Lombard,
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Designing Large-Scale Conservation Corridors for Pattern and Process

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Abstract: *A major challenge for conservation assessments is to identify priority areas that incorporate biological patterns and processes. Because large-scale processes are mostly oriented along environmental gradients, we propose to accommodate them by designing regional-scale corridors to capture these gradients. Based on systematic conservation planning principles such as representation and persistence, we identified large tracts of untransformed land (i.e., conservation corridors) for conservation that would achieve biodiversity targets for pattern and process in the Subtropical Thicket Biome of South Africa. We combined least-cost path analysis with a target-driven algorithm to identify the best option for capturing key environmental gradients while considering biodiversity targets and conservation opportunities and constraints. We identified seven conservation corridors on the basis of subtropical thicket representation, habitat transformation and degradation, wildlife suitability, irreplaceability of vegetation types, protected area networks, and future land-use pressures. These conservation corridors covered 21.1% of the planning region (ranging from 600 to 5200 km^2) and successfully achieved targets for biological processes and to a lesser extent for vegetation types. The corridors we identified are intended to promote the persistence of ecological processes (gradients and fixed processes) and fulfill half of the biodiversity pattern target. We compared the conservation corridors with a simplified corridor design consisting of a fixed-width buffer along major rivers. Conservation corridors outperformed river buffers in seven out of eight criteria. Our corridor design can provide a tool for quantifying trade-offs between various criteria (biodiversity pattern and process, implementation constraints and opportunities). A land-use management model was developed to facilitate implementation of conservation actions within these corridors.*

Key Words: biological processes, conservation implementation, conservation planning, landscape connectivity, landscape linkages

Diseño de Corredores de Conservación de Gran Escala para Patrones y Procesos

Resumen: *La identificación de áreas prioritarias que incorporen patrones y procesos biológicos es uno de los mayores retos de las evaluaciones de acciones de conservación. Debido a que la mayoría de los procesos a gran escala están orientado a lo largos de gradientes ambientales, proponemos acomodarlos mediante el diseño de el diseño de corredores de escala regional para capturar esos gradientes. Con base en principios de planificación de conservación sistemáticos, tales como la representación y la persistencia, identificamos grandes extensiones de terrenos no transformados (i.e., corredores de conservación) para conservar patrones y procesos en el Bioma de Matorral Subtropical de África del Sur. Combinamos el análisis de la trayectoria de menor costo con un algoritmo dirigido a un objetivo para identificar la mejor opción para capturar gradientes*

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ambientales clave al mismo tiempo que se toman en cuenta objetivos de biodiversidad y oportunidades y restricciones de conservación. Identificamos siete corredores de conservación a partir de la representación del matorral subtropical, la transformación y degradación del hábitat, aptitud de la vida silvestre, no reemplazo de tipos de vegetación, redes de áreas protegidas y presiones de uso de suelo futuras. Estos corredores de conservación abarcaron 21.1% de la región de planificación (entre 600 y 5200 km^2) y alcanzaron objetivos para procesos biológicos con éxito y, en menor grado, para tipos de vegetación. Los corredores que identificamos tienen la intención de promover la persistencia de los procesos ecológicos (gradientes y proceso fijos) y cumplir con la mitad del patrón de biodiversidad. Comparamos los corredores de conservación con un diseño simple de corredor consistente en una franja de ancho fijo a lo largo de los ríos principales. Los corredores de conservación fueron mejores que los corredores ribereños en siete de ocho criterios. Nuestro diseño de corredores puede aportar una herramienta para la cuantificación de compensaciones entre diversos criterios (patrón y proceso de biodiversidad, constricciones y oportunidades de implementación). Desarrollamos un modelo de gestión de uso de suelo para facilitar la implementación de medidas de conservación dentro de estos corredores.

Palabras Clave: conectividad del paisaje, implementación de medidas de conservación, procesos biológicos, planificación de conservación, vínculos entre paisajes

Introduction

A major challenge for conservation assessments is to identify priority areas that incorporate biological and environmental patterns (species and land classes) and processes (e.g., migration). Incorporating processes into assessments invariably requires large tracts of the planning region (e.g., Noss et al. 2002; Cowling et al. 2003*a*) and is best approached at a landscape scale (e.g., Balmford et al. 1998; Terborgh & Soulé 1999; Noss 2003). Several approaches to incorporate processes have been suggested (Pressey et al. 2003), including incorporating spatial connectivity in target-driven algorithms (Possingham et al. 2000), targeting species persistence (Williams & Araujo 2000), accommodating processes associated with focal species, especially large mammals (Carroll et al. 2001; Kerley et al. 2003), and identifying spatial components of processes (Rouget et al. 2003). A problem with these approaches is that they do not always consider the achievement of large (landscape)-scale processes and pattern targets simultaneously (but see Noss et al. 2002; Cowling et al. 2003*a*). Generally, and usually implicitly, a trade-off between representation (sampling biodiversity pattern) and persistence (ensuring ecological functioning) ensues. In these cases, persistence is invariably relegated behind representation as a conservation goal (Carroll et al. 2001; Muruthi 2004).

Many large-scale processes such as biota movement (Laurance & Laurance 1999), geographic speciation (Cowling & Pressey 2001; Moritz 2002), or response to climate change (Midgley et al. 2003) are aligned along environmental gradients. All contain an element of direction and spatial linearity. These processes are therefore best accommodated by designing large-scale corridors (or landscape linkages) that capture the environmental gradients and facilitate biota movement and dispersal in relation to a range of spatial and temporal scales.

Corridors are most frequently conceptualized as areas of natural habitat that are contiguous or isolated (i.e., linkages or stepping stones) and enable particular plant and animal species dispersal and migration processes essential for their persistence in a landscape (Bennett 2003; Groves 2003). Significant controversy surrounds the design and efficacy of these features (Hobbs 1992; Simberloff et al. 1992; Dobson et al. 1999; Bennett 2003). Here we conceptualize corridors as regional-scale features that comprise extensive tracts of largely untransformed habitat aligned along major environmental gradients. The major role of these corridors is to ensure that regional-scale processes are integrated into the conservation assessment. These corridors should also achieve targets for pattern and process features and consider the opportunities and constraints for their implementation. Our concept is firmly rooted in the principles and practices of systematic conservation assessment where the overall goal is to achieve the representation and persistence of biodiversity (Cowling et al. 1999; Margules & Pressey 2000). Similar initiatives have and are being conducted by international nongovernmental organizations (e.g., Conservation International 2000; Dinerstein et al. 2000; Sanderson et al. 2002*a*; Muruthi 2004). These initiatives differ from our approach, however, in that they are not target-driven, systematic assessments.

We designed large-scale conservation corridors in the Subtropical Thicket Biome of South Africa as part of the Subtropical Thicket Ecosystem Planning (STEP) project (Knight et al. 2003*b*). Ours is the only account that we are aware of that describes the design of extensive conservation corridors based on the principles of systematic conservation planning while simultaneously being mindful of implementation issues. Our discussion of the outcomes emphasizes the problems associated with design based on multiple criteria and the opportunities and challenges for implementing conservation action.

Methods

Planning Context

The planning region for our study was centered on the Subtropical Thicket Biome (Low & Rebelo 1996); it covers 105,454 km^2 and straddles the Western and Eastern Cape Provinces of South Africa (Fig. 1). It was subdivided into six primary water catchments and a coastal region (hereafter referred to as catchments) (Fig. 1), encompassing the eight biogeographic subdivisions of the thicket biome (Vlok et al. 2003). Sixteen percent of the planning region has been transformed to agriculture, urbanization, afforestation, and alien invasive plants, and 12% has been severely degraded by overgrazing, leaving 72% of the habitat intact. Eight percent of the planning region is highly threatened by development pressures (urbanization, agriculture, or afforestation) that are likely to affect biodiversity negatively over the next 20 years (Cowling et al. 2003*b*). Almost half the region faces minimal land-use pressures over this time period. Areas of particular concern are mainly along the coastal belt. The semiarid interior of the planning region faces low-impact land-use pressures.

Subtropical thicket is composed of dense, spiny, and usually succulent thicket up to 3 m tall, which may occur in solid stands or as a mosaic of thicket clumps with other vegetation types (Vlok et al. 2003). Subtropical thicket has high plant species richness and endemism, most endemics being succulents and geophytes, and is associated with two globally recognized centers of succulent plant endemism: the Little Karoo Center of the Succulent Karoo in the west and Albany Center in the east (van Wyk & Smith 2001). The Subtropical Thicket Biome is contained in the southwestern sector of the Maputaland-Pondoland-Albany hotspot recognized by Conservation International (Steenkamp et al. 2005).

The fauna of the Subtropical Thicket Biome, although diverse, does not demonstrate the level of endemism of the flora. Mammal diversity is relatively high, with 48 species of large and medium-sized mammals. Unfortunately, many of these species have been extirpated, and all have undergone extensive reductions in their distribution. An important feature of the mammal fauna is the presence of two megaherbivores (African elephant [*Loxodonta Africana*] and black rhinoceros [*Diceros bicornis*]), which are recognized as keystone species in structuring subtropical thicket plant communities (Kerley et al. 2002). The avifauna is diverse, with 421 species of birds recorded within the planning region (no endemics). Ten "important bird areas" occur within the planning domain (Barnes 1998). The reptile fauna includes five tortoise species and relatively high endemism (13 species) among the lizards and snakes (Branch 1998). The amphibian

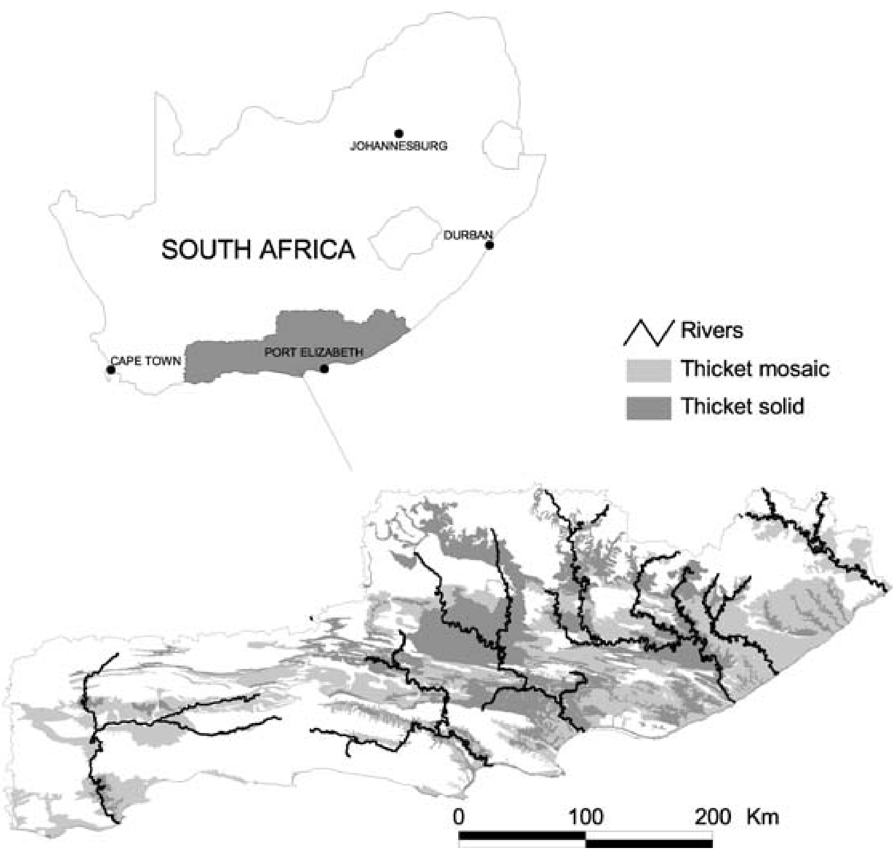

Figure 1. The location of the Subtropical Thicket Biome and the Subtropical Thicket Ecosystem Planning (STEP) planning domain. Subtropical thicket vegetation is classified as "solid" or "mosaic" (see text). Major rivers are indicated.

fauna includes at least five endemic species (Passmore & Carruthers 1995). Although the invertebrate diversity and endemism is probably high, little is known about this group.

The STEP project was a 4-year initiative (July 2000–June 2004) funded by the Global Environment Facility. The overall aims of STEP were to conduct a conservation assessment to identify priority areas that would ensure that the long-term conservation of the subtropical thicket biota and that the assessment outcomes were implemented through the policies and practices of public and private-sector agencies responsible for land-use planning and management of natural resources in the region (Cowling et al. 2003*b*; Knight et al. 2003*a*; Pierce 2003).

The need for such a conservation assessment resulted from (1) the high diversity and endemism of the subtropical thicket biota; (2) an existing biased protected area system; (3) an escalation in land-use pressures that threaten biodiversity in this area; (4) diminishing capacity of institutions responsible for land management; (5) a general lack of awareness of the importance, economic and otherwise, of subtropical thicket biodiversity; (6) opportunities associated with a shift to biodiversity-based rural economies, especially game farming and ecotourism; (7) current conservation initiatives (e.g., Greater Addo Elephant National Park); and (8) rapidly unfolding opportunities to mainstream the outcomes of this assessment into land-use legislation and policy.

Cowling et al. (2003*b*) provide a detailed description of the conservation assessment, including biodiversity features, biodiversity targets, land-use opportunities, and constraints. Here we provide a brief summary of the assessment.

The STEP conservation assessment, undertaken at the 1:100,000 scale, used as biodiversity features 169 vegetation types (of which 112 are thicket types), three wetland types, and five spatial surrogates (hereafter components) of ecological and evolutionary processes (Table 1). Models were used to determine the potential distribution and community-adjusted abundance of 48 species of large and medium-sized mammals (Boshoff et al. 2001). Here we used habitat suitability for the African elephant, a focal species in the subtropical thicket biome (Kerley et al. 2002), to enhance corridor design. We used a simple spreadsheet model to estimate the potential elephant density based on forage availability within the mammal habitats, partitioned within the herbivorous guilds, and the metabolic requirements of the mammals (see Boshoff et al. [2001] for more details). We rescaled elephant density from 0 to 100 to quantify habitat suitability for elephants.

We set conservation targets for all the biodiversity features we used in this study (Table 1). Vegetation-type targets, expressed as a percentage of the type's area before transformation, were set based on species-area data derived from phytosociological relevés (Desmet & Cowling 2004) and ranged from 10% to 26%. Targets for wetland and forest types were set at 100%, as required by South African legislation. Overall, vegetation-type targets are higher in the western part of the planning region and lower in the east, although for subtropical-thicket types, targets peak in the central parts. These target patterns reflect patterns of species rarity among vegetation types (Desmet & Cowling 2004): Local endemism is highest in the fynbos and succulent karoo vegetation in the west (Pressey et al. 2003) and lowest in grassland and savanna vegetation in the east, whereas in subtropical thicket, local endemism peaks in the central part of the planning region (Vlok et al. 2003).

C-Plan (New South Wales National Parks and Wildlife Services, Armidale, available from http://www.ozemail.com.au/~cplan), a conservation assessment software, was linked to ArcView (ESRI, Redlands, California) and used to calculate irreplaceability pattern (Ferrier et al. 2000) based on the biodiversity features and targets mentioned above. Irreplaceability measures the likelihood of selecting planning units for achieving representation targets. Irreplaceability values range from 0 (not needed) to 1 (irreplaceable, essential for achieving the set of targets) (Pressey et al. 1994). The units of selection for the assessment—the planning units—were based on cadastral data and included statutory protected areas.

Planning for Persistence

A key component of the STEP conservation assessment was planning for the persistence of biodiversity (Cowling

Table 1. Biodiversity features considered in the STEP conservation assessment to ensure biodiversity representation and persistence.

*Feature**	*Description*	*Target*	*Additional references*
Habitat types	169 vegetation and 3 wetland types mapped at 1:100,000	10–26% of original (pretransformation) area	Desmet & Cowling 2004
Wildlife suitability	habitat suitability for focal species (elephant)	1000 individuals in planning region	Boshoff et al. 2001; Kerley et al. 2003
Spatially fixed processes	biome interfaces, riverine corridors, and sand movement corridors	100% of extant area	Rouget et al. 2003
Spatially flexible processes	upland-lowland and macroclimatic gradients	at least one in each biogeographic region	

**Cowling et al. (2003*b*) provides details of each biodiversity feature.*

et al. 1999; Rouget et al. 2003). Spatially fixed processes were mapped and included in the irreplaceability analysis (see below), whereas spatially flexible processes (i.e., gradients) were captured by designing corridors. The most extensive ecological and evolutionary processes in the Subtropical Thicket Biome are aligned along several major biological gradients. These are largely nested within distinct biogeographic regions associated with the major (north-south aligned) river drainage systems of the planning region (Gouritz, Gamtoos, Sundays, Fish, Buffalo, and Kei rivers) but also are aligned along east-west trending climatic gradients (e.g., along the Great Escarpment, a major topographic feature running east and west in the northeastern part of the planning region) and the coastal dune systems (Vlok et al. 2003). Our overall aim in designing corridors was to represent these biological gradients (north-south upland-lowland and east-west macroclimatic gradients) within each biogeographically distinct water catchment. Corridor design, therefore, focused primarily on ensuring biodiversity persistence (i.e., the long-term maintenance of ecological and evolutionary processes), on which the conservation assessment is founded.

We translated the persistence goal into four key functions that the corridors must fulfill (in priority order): (1) maintain ecological processes (gradients) in subtropical thicket vegetation to enable movement of biota over ecological and evolutionary time scales; (2) ensure habitat retention and connectivity; (3) maximize wildlife habitat suitability; and (4) represent biodiversity pattern (to integrate biodiversity persistence and representation).

We used cost-distance analysis in a geographic information system (GIS) to design corridors. Cost-distance functions in ArcInfo (version 7.2, ESRI, Redlands, California) provide a spatially explicit framework that incorporates these criteria for identifying the least costly (or the most efficient) route to connect a landscape. Corridors were derived in three stages: stage 1, primarily driven by biological process considerations, identified the core area of the corridor (referred to as "conservation paths"); stage 2 expanded the core area to improve representation of habitats and the persistence of processes; and stage 3 further expanded corridors into areas of high irreplaceability value for biodiversity pattern (see below). We named conservation corridors and paths after their associated river catchments.

Identification of Conservation Paths (Stage 1)

Conservation paths aim to capture the processes associated with upland-lowland and climatic gradients operating at a macroscale. Although these macro-scale gradients could occur in various parts of the region, the functionality of such gradients relies on several ecological and human factors. Based on the first three key functions mentioned above, we hypothesized that maximum functionality would be achieved when gradients, in decreasing order of importance, (1) run through subtropical thicket vegetation types, (2) are not in transformed habitats (urban areas excluded from the analysis), (3) run through habitats highly suitable for wildlife, (4) encompass other process components (i.e., riverine corridors, biome interfaces, sand movement corridors), (5) link protected areas, and (6) are not in areas likely to be transformed in future.

We developed criteria to quantify the functionality of these gradients. These relate to (1) the presence of subtropical thicket vegetation and its condition, (2) the occurrence of process components, (3) the degree of suitability of wildlife habitat (with suitability of elephant habitat as a surrogate), (4) the location of protected areas, and (5) future land-use pressures (Table 2). Criteria relating to 4 and 5 illustrate how we incorporated implementation issues into the location of the paths. Table 2 indicates the relative importance of each criterion and the respective cost incurred. Given the cost values assigned, criteria of higher rank override lower rank criteria (i.e., intact habitat was always more suitable than transformed or degraded habitat irrespective of wildlife habitat suitability). The relative cost of each criterion reflects the priority order of the key functions mentioned above.

We developed a cost surface (referred to as a map of landscape suitability) that reflects the options for achieving upland-lowland and macroclimatic gradients by combining all these criteria. The cost surface was first derived at a 25-m resolution by adding all criteria (with their respective cost) and was then aggregated to 1000 m based on the mean cost value (Fig. 2). Thus low-cost areas represent the nearly optimal location for such ecological process components (gradients). In our case, protected areas of pristine subtropical thicket, which were also highly suitable for wildlife, were considered the best areas to achieve these gradients, whereas highly transformed habitat that was not subtropical thicket was considered least suitable.

We constrained the 1-km-wide conservation paths within single primary water catchments by anchoring them to major river mouths and ending them at the northern margin of subtropical thicket. River mouths were selected because of key ecological processes associated with their estuaries and wetlands (Heydorn & Tinley 1980). Based on the landscape suitability surface, least-cost surface analysis identified the best option to link start and end points. Urban areas, including rural settlements, were excluded (i.e., the paths could not traverse urban areas). This procedure selected conservation paths with the highest landscape suitability for the considered criteria.

Expanding Conservation Paths toward Corridors (Stage 2)

The 1-km-wide conservation paths represent a nearly optimal location and the bare minimum extent for conserving processes along upland-lowland and macroclimatic

Table 2. Criteria used to derive conservation paths in relation to the functionality of macroclimatic and upland-lowland gradients that the conservation paths aim to achieve.

Criteria	*Objective*	*Value*	*Change in cost*
Thicket biome	favor thicket biome	subtropical thicket vegetation	0
		nonthicket vegetation	+5000
Habitat transformation	avoid transformed areas	natural (untransformed)	0
		transformed	+4800
Habitat degradation	avoid degraded areas (including invaded areas)	intact	0
		moderately degraded	+1800
		severely degraded	+3200
Elephant suitability[a] (categorical)	favor suitable habitat for wildlife	high	0
		medium	+300
		low	+600
		not suitable	+900
Process component	include spatially fixed processes	process	0
		no process	+150
Protected areas	link protected areas	statutory protected areas[b]	0
		nonstatutory protected areas	+20
		outside protected areas	+80
Land-use pressures	avoid areas likely to be transformed	0 (no threat)	0
		1 (low threat)	+15
		2 (medium threat)	+30
		3 (high threat)	+45
Elephant suitability (continuous)	favor suitable habitat for wildlife	from 0 (high) to 14 (low)	0–14

[a] *Elephant suitability was first included as a categorical variable to ensure that highly suitable areas receive a lower cost than any area of medium suitability, irrespective of the values for the criteria below. The last criterion helps refine elephant suitability by assigning a range of values within each category.*
[b] *Statutory protected areas, which are underpinned by strong legislation and owned and run by national, provincial, or local authority agencies. Nonstatutory protected areas, underpinned by weak or nonexistent conservation legislation, comprise public or private land managed for conservation and other land uses. See Cowling et al. (2003*b*) for details.*

gradients. We expanded these paths to (1) buffer the conservation path, (2) include fixed process surrogates, (3) achieve targets for vegetation types, (4) select areas highly suitable for wildlife (with the African elephant as a surrogate species), and (5) incorporate existing protected areas. The expansion was adjusted to avoid areas threatened by future land-use pressures. In doing this, we identified large conservation corridors of contiguous, extant habitat that achieved conservation targets for process and pattern and considered implementation opportunities and constraints.

We identified criteria—similar to those for the conservation paths—to expand these paths into functional corridors. A new cost surface was required to consider areas of high irreplaceability for pattern targets (biodiversity pattern was not used to identify the conservation paths). This second cost surface was controlled by the extent of untransformed thicket, irreplaceability values for achieving vegetation type targets, wildlife habitat suitability (based on areas suitable for elephant), distribution of protected areas, and future land-use pressures. Figure 3a illustrates how we assigned a cost value to each criterion. Although

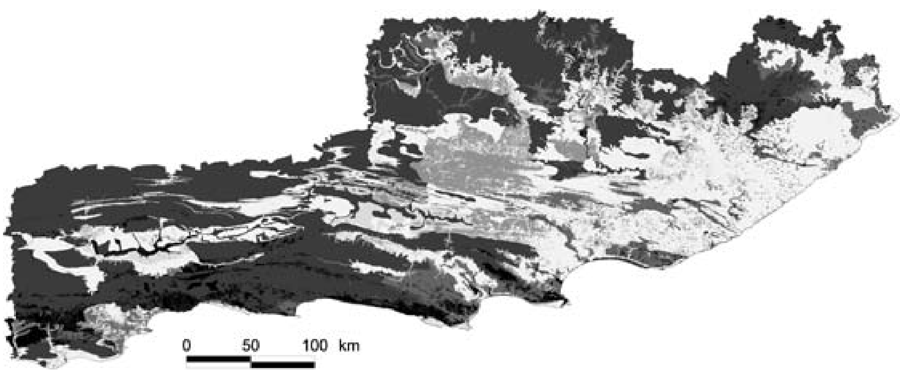

Figure 2. Landscape suitability surface showing the options for achieving upland-lowland and macroclimatic gradients based on the cost surface (see Table 2 for the list of criteria used). The shading relates to the landscape suitability (light shading means more suitable). Options for achieving the paths were greatest in the eastern part of the planning domain, where large tracts of untransformed subtropical thicket still occur.

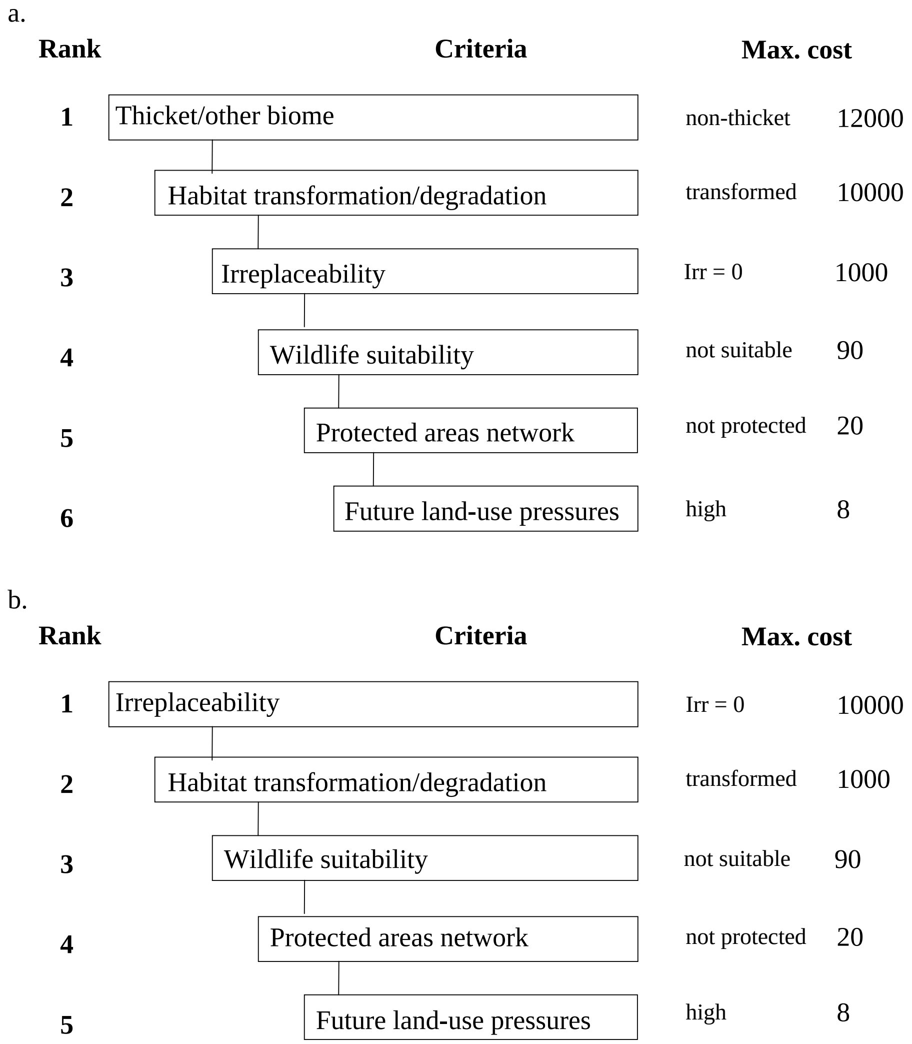

Figure 3. Criteria used for developing the cost surface which controls the expansion of conservation paths toward corridors in (a) intact subtropical thicket habitat and (b) areas of high pattern irreplaceability (Irr.). The relative cost of each criterion determines its importance and a maximum cost (Max. cost) was assigned to each. For example, intact subtropical thicket habitat that is highly suitable for wildlife habitat had the lowest cost (i.e., highest suitability for expanding the conservation paths), whereas transformed or degraded nonsubtropical thicket areas had the highest cost.

we put a high cost on habitat transformation and degradation to avoid transformed areas, preliminary analyses showed that maintaining large ratios of relative cost of each criterion had a greater influence on corridor design than small variations of the cost assigned to each criterion.

Using least-cost analysis, we identified the extent to which the conservation paths could be expanded based on the second cost surface (Fig. 3a). The expansion was controlled by calculating the incremental cost extending at a right angle from the conservation paths; the expansion was stopped when the cost of corridors reached 0.25% of the total cost (overall cost of all the 1-km^2 cells in the planning domain). This cutoff was arbitrarily set to control the maximum width of the conservation corridor. The actual width of the corridors varied according to the landscape suitability. The paths were most easily expanded in untransformed thicket vegetation of high irreplaceability. In hostile areas (i.e., transformed nonsubtropical thicket) the extent of the corridor was restricted to the 1-km-wide conservation path. We then adjusted the boundaries to planning units, with the exception of the Dune corridor, where the planning unit size was much larger than the width of available untransformed dune subtropical thicket vegetation, which is often confined to a very narrow strip immediately inland of the coast.

Expanding the Corridors into High Irreplaceability Areas (Stage 3)

Finally, we explored the extent to which corridors could be expanded to capture areas of high-irreplaceability for biodiversity. Irreplaceability values were recalculated in C-Plan for planning units, starting from the current configuration of corridors (from stage 2). We considered the contribution of corridors to targets for biodiversity features (Table 1), assuming that each of the corridors was afforded conservation management relatively consistent with that of protected areas. Spatially flexible processes were excluded because the corridors achieved them. The identified planning units were important for achieving remaining biodiversity targets. A new cost surface was required to update the irreplaceability pattern.

This third cost surface was controlled by irreplaceability values for achieving biodiversity targets, extent of untransformed areas (we no longer differentiated between subtropical thicket and nonsubtropical thicket vegetation types), wildlife habitat suitability (with African elephant suitability as a surrogate), distribution of protected areas, and future land-use pressures. Figure 3b illustrates how we assigned cost to each criterion. The lowest cost was allocated to intact habitat of high irreplaceability.

As in stage 2, we identified the extent to which the conservation paths could be expanded based on this new cost surface (Fig. 3b). The expansion stopped when the cost of corridors reached 0.25% of the total cost of the planning domain. The boundaries of the corridors were then adjusted to planning units except for the Dune corridor, where the size of the planning units was much larger than an appropriately sized corridor (see above).

Assessing Corridor Effectiveness

To test the adequacy of our approach, we compared the corridors identified here with a simple corridor designed to follow the courses of the major rivers (Fig. 1) and the dune coast. Such corridors, albeit simply designed, would nonetheless ensure biodiversity persistence by capturing the major east-west and north-south gradients. A similar design was used in the conservation assessment for the Cape Floristic Region (Cowling et al. 2003*a*). Our simple corridor design consisted of river buffers. We buffered the major rivers with a fixed width, which was adjusted to match the same area as the STEP corridors (2,225,000 ha). We compared both sets of corridors in relation to the criteria mentioned above: extent of natural area, thicket representation, elephant suitability, achievement of pattern targets (vegetation types), achievement of process targets, avoidance of land-use pressures (i.e., implementation constraints), and linkages to protected areas (implementation opportunities).

Results

Conservation Paths and Corridors

The identified paths represented the shortest and most suitable routes to achieve upland-lowland and macroclimatic gradients that pass through the major biogeographic subdivisions of the planning region (Fig. 4a). The Gouritz-Little Karoo and Gamtoos-Groot paths captured north-south upland-lowland gradients and east-west macroclimatic gradients. They were primarily constrained by subtropical thicket vegetation and habitat transformation at the mouth of the Gouritz and the Gamtoos rivers. The Sundays-Camdeboo and the Fish-Kowie paths captured north-south upland-lowland gradients and east-west macroclimatic gradients along the Great Escarpment. The Sundays-Camdeboo path was constrained by habitat degradation in the middle Sundays River valley. The Gqunube-Amatole path avoided rural settlements. The location of the Kei path was not seriously affected by habitat transformation. Finally, the Dune path, running along the entire coast, was interrupted by urban development throughout and alien plant infestation in the west.

Figure 4b shows the location of the seven corridors in the planning domain. Together they comprise 25% of the planning region. Other than the Gouritz-Little Karoo and Gamtoos-Groot corridors, which are surrounded by much nonsubtropical thicket vegetation, all encompassed >80% subtropical thicket vegetation (Appendix). Thicket condition was >80% intact in all but the Sundays-Camdeboo, Fish-Kowie, and Gqunube-Amatole corridors, where much habitat has been transformed by overgrazing by domestic livestock. Other forms of transformation were <10% in all corridors. Overall, the corridors were effective in incorporating the existing protected areas (Appendix). Statutory protected areas covered between 0% (Kei) and 27% (Sundays-Camdeboo) of the corridor area and nonstatutory protected areas between 1.8% (Kei) and 15.6% (Fish-Kowie). Only the Dune corridor encompassed a high proportion of high-threat area, largely owing to pressures from urbanization.

Corridor Assessment

Of the 169 vegetation and three wetland types in the planning domain, the corridors and existing statutory protected areas together achieved targets for 84 (48.8%) types. Another 30 vegetation types had >50% of their targets achieved in the corridors. The corridors, in combination with statutory protected areas, were reasonably effective in incorporating the spatially fixed process components. They incorporated some 56% of the extant area of both biome interfaces and riverine corridors and 86% of sand movement corridors.

Together with the statutory protected areas, the conservation corridors occupied almost a quarter of the planning domain. When comparing the effectiveness of these conservation corridors in achieving the design criteria, the conservation corridors outperformed the river buffers for seven of eight criteria (Table 3). They were better at capturing intact area, subtropical thicket habitat, elephant suitability, macroscale gradients, fixed processes, and protected areas and at minimizing threats. River buffers were slightly better at capturing biodiversity targets (50.9 vs. 48% target achieved).

Discussion

Our aim here was not to provide a comprehensive assessment of various planning approaches. Rather, we sought to highlight the key differences of corridors in relation

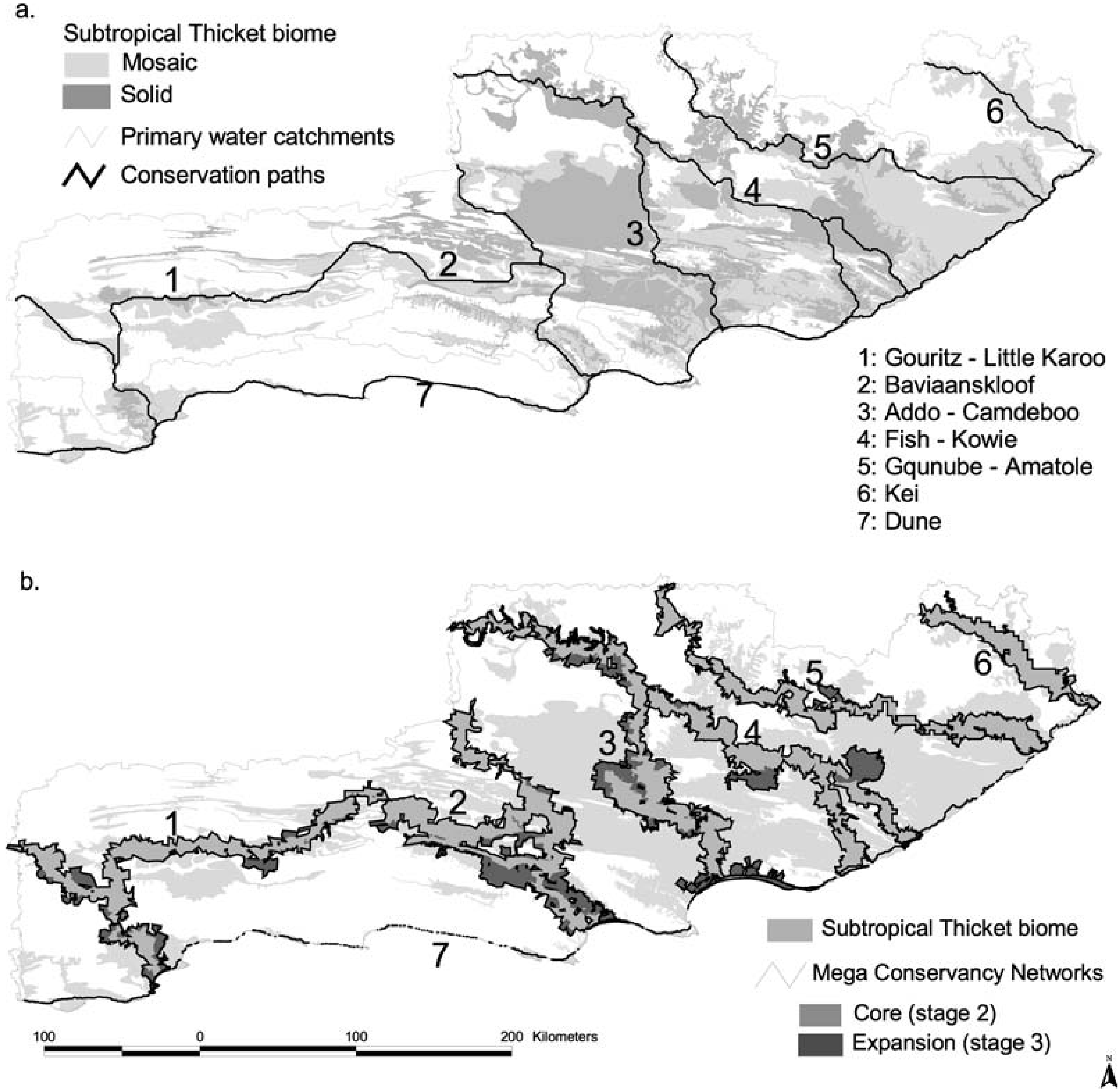

Figure 4. Identification of (a) conservation paths and (b) corridors for achieving upland-lowland and macroclimatic gradients. Each conservation path represents the most suitable route for capturing upland-lowland and macroclimatic gradients within each water catchment and along the dune coast. Corridors integrate biodiversity pattern and processes and avoid land-use pressures.

to other widely used approaches. Many researchers have used expert judgment to identify regional-scale corridors (e.g., Conservation International 2000; Dinerstein et al. 2000; Muruthi 2004). The drawback of this approach is that the achievement of pattern targets is often not considered. The same criticism may be leveled at approaches that rely entirely on identifying conservation areas that fulfill the requirements of focal species alone (Carroll et al. 2001; Sanderson et al. 2002*b*). An advantage of our approach is that we have combined elements of the systematic (target-driven) approach with the focal species (African elephant) requirement and accommodated, as far as possible, implementation opportunities and constraints. Expert knowledge was also used to identify the process components, as was the case for the conservation plan for the Cape Floristic Region (Cowling et al. 2003*a*), and to identify the cost assigned to each criterion used in the corridor design. The net result is a transparent and defensible system of corridors that ensures biodiversity persistence through large-scale processes, maximizes target

Table 3. Adequacy of STEP corridors and river buffers in terms of capturing intact habitat, subtropical thicket habitat, elephant suitability, processes, target achievement for vegetation types, inclusion of protected areas, and inclusion of areas subject to low land-use pressures.

	Statutory protected areas	*River buffers*	*STEP corridors*
Area (% of planning region)	7.3	21.1	21.1
Intact natural area (% of area)	95.8	83.3	85.3
Thicket biome (% of natural areas)	26.7	73.1	85
Elephant suitability (average value)	21.6	47.8	52.1
Gradients (%)	7.1	49.0	100.0
Fixed processes (%)	15.4	49.4	60.0
Pattern target achieved (%)*	13.6	50.9	48.0
Statutory protected areas (%)	100.0	27.5	47.7
Nonstatutory protected areas (%)	0.0	19.6	22.1
Low threat (%)	100.0	76.0	78.5

**The percentage of biodiversity features achieved includes the contribution of statutory reserves plus areas of corridors/buffers outside statutory reserves.*

achievement for spatially fixed processes and pattern features, and accommodates implementation opportunities.

Corridor Effectiveness

Achieving biodiversity pattern and process targets simultaneously is a challenging task few conservation assessments have attained (Noss et al. 2002; Cowling et al. 2003*a*). Our approach aimed to capture key biological processes (aligned along major environmental gradients) while representing as much biodiversity pattern as possible and facilitating implementation. The seven conservation corridors we identified capture all key environmental gradients, include a significant amount of other (spatially fixed) process components, and achieve targets for 48% of the pattern (vegetation type) features. Although conservation corridors did not perform better than simple river buffers in achieving vegetation type targets, they were more effective in achieving process targets (the primary objective of these corridors). Focusing on capturing key biological processes in the Subtropical Thicket Biome greatly enhances the prospects for ensuring biodiversity persistence (Cowling et al. 1999; Rouget et al. 2003). Furthermore, conservation corridors integrate well with existing conservation areas because they include almost 50% of the statutory protected areas. Conservation corridors were slightly more successful than the river buffers in avoiding future land-use pressures; this was the criterion with the lowest cost, however, and in many cases (especially along the dune coast) areas of high land-use pressure could not be avoided.

Other conservation instruments have been proposed in the planning region to ensure the retention of biodiversity features not included in the corridors. For example, guidelines have been developed that will enable local government, which is legally bound to incorporate biodiversity issues into their planning processes, to limit development in endangered habitats (defined as vegetation types for which the amount of remaining extent habitat is less than or marginally greater than the biodiversity target), in spatially fixed process components that are unreserved, and in the corridors themselves (Pierce 2003; Pierce et al. 2005). Therefore, when implemented, conservation corridors, together with this other conservation instrument, will ensure adequate conservation in the planning region of biodiversity targets for process and pattern. The implementation of both of these conservation instruments to date has been very encouraging (Pierce et al. 2005).

Corridor Design

Our approach for designing corridors is based on systematic conservation planning principles (Margules & Pressey 2000) that differ from previous corridor studies which rely mainly on expert judgment (Conservation International 2000; Dinerstein et al. 2000; Muruthi 2004). We set quantitative targets for biodiversity pattern and used the concept of irreplaceability to identify areas that are representative of the planning region's vegetation types. Irreplaceability, however, was not the only criterion we used. It was integrated with other criteria related to implementation opportunities (incorporating existing protected areas) and constraints (avoiding areas vulnerable to future land use pressures). By combining these criteria we managed to achieve simultaneously several potentially conflicting conservation goals. Although our approach is largely quantitative, expert knowledge played a crucial role in the identification of and cost assigned to each criterion used in the design. The approach is sufficiently general to be applied to other areas. The final configuration of the conservation corridors, however, depends mostly on the relative cost of each criterion. This design can provide a tool for quantifying trade-offs between various criteria (biodiversity pattern and process, implementation constraints and opportunities). Further sensitivity analysis (e.g., on the relative cost assigned to each criterion) would be required to fully understand these trade-offs. Future research should focus on the interplay between expert judgment and exploratory analyses in which criteria are interchanged and costs are varied in determining the most biological meaningful criteria and cost values.

We acknowledge that various existing conservation planning tools could partly address the issues covered here. Using conventional conservation planning approaches, based on target-driven algorithms embedded in C-Plan or Marxan, it is possible to set targets for pattern and process and to ensure spatial connectivity (Possingham et al. 2000). These approaches, however, cannot design corridors per se. Ours differs from these in that we consciously aligned our notional conservation system along environmental gradients and incorporated a wide array of design criteria in addition to connectivity. The focus was on explicit recognition of macroscale ecological processes and their appropriate design rather than connectivity of component sites to ensure larger reserves.

Designing corridors might not be appropriate in all planning regions. Given the large area of untransformed habitat still remaining in the planning region (72% of the planning domain), designing regional-scale corridors, which capture major environmental gradients across large distances, was still feasible. This might not be possible in other areas where transformation is more extensive. Under certain conditions increasing connectivity can even be harmful for biodiversity (Dobson et al. 1999). Planning approaches must be justified by the planning goal and the biological requirements of the area.

Planning for Implementation

Implementing conservation action requires more than just a systematic conservation assessment. An assessment must be coupled with stakeholder involvement and an implementation strategy (Knight et al. 2006). Our assessment was supported by a 4-year public participation process (Boshoff & Wilson 2004). An implementation strategy was also developed cooperatively with stakeholders (Knight et al. 2003). The entire process was integrated through an explicit conservation planning framework (Knight & Cowling 2003*a*). The conservation assessment is but one essential facet to solving the challenge of conserving and managing the Subtropical Thicket Biome.

The corridor design process outlined in our assessment was complemented, in practice, with the development of a model of ecologically sustainable land management called the Megaconservancy Network concept (Knight et al. 2003*b*). This model, developed with stakeholder input, was designed specifically for optimizing the socioecological conditions of the Subtropical Thicket Biome that provide opportunities for implementing conservation action. These opportunities include, for example, the rapid expansion of indigenous game ranching and indigenous game-based ecotourism and the high number of agricultural conservancies (private land-management agreements).

Each conservation corridor design represents a distinct megaconservancy network, each comprising a contiguous patchwork of properties of various tenures and land uses (e.g., privately owned land for stock farming, communal grazing land, ecotourism, and protected areas) that maximizes landscape heterogeneity (Forman 1995; Fabricius et al. 2003). It is proposed that properties (planning units) be managed in a coordinated, cooperative, and integrated way. A megaconservancy network is a mechanism (a network of people) for aligning visions for landscape futures (Brunckhorst 2000) and cooperatively managing capital flows (e.g., natural, financial, social) to better ensure the simultaneous achievement of agricultural production, water use, and nature conservation goals (Hobbs & Saunders 1991). For example, several landowners may establish a conservancy across diverse landscapes to maximize the benefits provided for their individual ecotourism ventures. Participants in a megaconservancy network are committed to halting the loss of indigenous biodiversity and improving their own livelihoods. The approach is one of conservation through stewardship rather than establishment of strict reserves. The motto for megaconservancy networks is “Keeping people on the land in living landscapes.”

Considerable progress has been made with fine-scale planning for implementing and achieving conservation action in three of the megaconservancy networks, namely Gouritz-Little Karoo, Baviaanskloof-Groot, and Sundays Camdeboo. Work has also begun in the Fish-Kowie Megaconservancy Network. Research at this scale requires a much better understanding of implementation opportunities and constraints, especially regarding issues such as landowner aspirations, institutional arrangements, capital and resource flows, and socioecological resilience (Brunckhorst 1998), than was required for this regional-scale study. Nonetheless, the approach adopted for this assessment, which was mindful of implementation issues, contributed greatly to the rapid implementation of conservation actions currently being undertaken in the planning region (Pierce et al. 2005).

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Appendix . Characteristics of conservation corridors in terms of the criteria used for deriving the landscape suitability surface.

	Gouritz-Little Karoo	*Gamtoos-Groot*	*Sundays-Camdeboo*	*Fish-Kowie*	*Gqunube-Amatole*	*Kei*	*Dune*	*PR*[a]
Area (km^2)	3939	5227	4960	3686	3039	1433	606	105,454
Stages 1–2 (%)[b]	79	72	68	79	95	100	100	na
Biome								
thicket (%)	66	66	80	90	78	79	98	45
Habitat degradation								
intact (%)	86	82	50	65	67	95	96	72
degraded (%)	5	15	48	31	27	1	4	24
Wildlife suitability[c]								
mean value	26	32	66	78	66	77	82	41
Irreplaceability[d]								
mean value	0.21	0.24	0.38	0.12	0.09	0.02	0.23	0.09
Protected areas								
statutory (%)	11	20	27	14	10	0	10	7
nonstatutory (%)	11	6	15	16	22	2	15	12
Land-use pressures								
low to none (%)	83	92	89	78	65	67	44	77

[a] *Entire planning region, including corridors; na, not applicable.*
[b] *Percentages are expressed in relation to the total area of each corridor.*
[c] *Elephant wildlife suitability ranges from 0 to 100 (most suitable).*
[d] *Values range from 0 to 1 (1, irreplaceable, essential for achieving biodiversity target).*

Appendix III

Systematic Conservation Planning Products for Land-use Planning: Interpretation for Implementation

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Systematic conservation planning products for land-use planning: Interpretation for implementation

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Abstract

There is an obvious need to incorporate biodiversity concerns into the policies and practices of sectors that operate outside protected areas, especially given the widespread devolution of power to local (municipal) authorities regarding land-use decision-making. Consequently, it is essential that we develop systematic (target-driven) conservation planning products that are both user-friendly and user-useful for local government officials, their consultants and the elected decision makers. Here, we describe a systematic conservation planning assessment for South Africa's Subtropical Thicket Biome that considered implementation opportunities and constraints from the outset by developing – with stakeholders – products (maps and guidelines) that could be readily used for local government land-use planning. The assessment, with concomitant stakeholder input, developed (i) Megaconservancy Networks, which are large-scale conservation corridors of multiple ownership that achieve targets principally for biodiversity processes; (ii) conservation status categories (critically endangered, endangered, vulnerable, currently not vulnerable) for all biodiversity features, identified on the basis of available extant habitat to achieve conservation targets, and (iii) a conservation priority map which integrates (i) and (ii). This map was further interpreted for municipal-level decision-makers by way of corresponding guidelines for land-use in each of the conservation status categories. To improve general awareness of the value of biodiversity and its services, a handbook was compiled, which also introduced new and impending environmental legislation. Within 18 months of the production of these products, evidence of the effective integration, or mainstreaming, of the map and its guidelines into land-use planning has been encouraging. However, more effort on increasing awareness of the value of biodiversity and its services among many stakeholder groups is still required. Nonetheless, our approach of planning for implementation by considering the needs and obligations of end users has already yielded positive outcomes. We conclude by providing suggestions for further improving our approach.

Keywords: Biodiversity persistence; Biodiversity representation; Implementation; Land-use planning; Mainstreaming; Systematic conservation planning

1. Introduction

While protected areas form the cornerstone of conservation strategies (Redford and Richter, 1999; Rodrigues et al., 2004), it is now widely accepted that strict protection will not secure the persistence of the world's biodiversity (Miller and Hobbs, 2002; Rosenzweig, 2003). The burden of conserving biodiversity will fall increasingly on sectors such as agriculture, forestry, mining and land-use planning (Burbidge and Wallace, 1995; Freemark et al., 2002; Hutton and Leader-Williams, 2003). In order for

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these sectors to play a constructive role in conservation, it is essential that biodiversity concerns be integrated or mainstreamed into their policies and practices (Cowling et al., 2002; Marzluff, 2004). Huntley et al. (in press) define mainstreaming biodiversity as the " the integration of values and goals relating to the conservation and sustainable use of biodiversity into economic sectors in order to achieve measurable conservation gains".

Over the past decade, great strides have been made in developing and refining methods of assessment for identifying priorities for conservation plans (Margules and Pressey, 2000; Groves, 2003). However, based on our collective experience in South Africa and Australia, we have come to believe that the most sophisticated methods of assessment will not achieve conservation goals if the needs of the implementing organizations and other inheritor stakeholders are not effectively considered during the planning process, and if the conservation planning products are not easily understood by these end users (Driver et al., 2003; Knight et al., in press; see also Theobald et al., 2000). This study forms part of a larger project (the Subtropical Thicket Ecosystem Planning Project) (Cowling et al., 2003) designed to overcome these two shortcomings by adopting the following approach. Firstly, those stakeholders who will ultimately inherit the plan, namely government officials associated with land-use planning, agriculture, nature conservation, water affairs and forestry, communal and freehold landowners, non-governmental organisations, tourism representatives and elected representatives, were identified (Boshoff and Wilson, 2004). Secondly, these stakeholders were invited to give input throughout the four-year development of the plan, from inception to the development of the final planning products (Knight et al., 2003). Thus, these inheritors developed a sense of ownership of the project. In this paper, we focus specifically on the products we developed to meet the needs of the land-use planning sector, a requirement widely recognised by others in the field of conservation planning (Theobald et al., 2000; Stoms, 2001; Marzluff, 2004). Agencies responsible for this sector routinely make decisions that result in the loss of irreplaceable biodiversity (Pressey, 1999; Groves, 2003). In the discipline of land-use planning (including landscape architecture) there is a long history of concern for biodiversity issues (e.g. McHarg, 1969; Steiner, 2000), though the focus has mainly been on the establishment of greenways (Fábos, 2003) and the maintenance of processes that provide services to urban and exurban communities (Beatley and Manning, 1997). Our study seeks to facilitate the integration of outcomes of systematic conservation planning into land-use planning policy and practice. These outcomes incorporate the spatial information on quantitative biodiversity targets (e.g. hectares of land classes or occurrences of species) for the long-term conservation and persistence of biodiversity features (Margules and Pressey, 2000).

In many parts of the world, land-use planning has been devolved to local government agencies that are expected to consult and involve a wide array of stakeholders from diverse sectors in identifying development options for their regions. Countries that are signatories to the Convention on Biological Diversity are compelled to adopt the principles embedded in Local Agenda 21, namely that local decision-making for integrated development planning (IDP) is democratic, and based on the goal of achieving social, economic and environmental sustainability (United Nations Conference on Environment and Development, 1992). South Africa is a signatory to the Convention, and has devolved all land-use decision making to some 284 local municipalities which encompass the entire country, and which are responsible for almost all land-use decisions. There are three major problems confronting the adoption and implementation of the environmental sustainability principle of Agenda 21: (i) among local government decision-makers there is a lack of awareness of the importance of planning specifically to protect priority areas identified through target-based conservation assessment; (ii) there is usually a disparity in objectives and, therefore, in structure and content between the scientific products generated by conservation assessments, and those required for land-use planning (Niämele, 1999; Theobald et al., 2000; Löfvenhaft et al., 2002), and (iii) many local government agencies responsible for land-use planning, especially in the developing world, lack the capacity to effectively integrate biodiversity into planning products (Wells and Brandon, 1993; Burbidge and Wallace, 1995; Infield and Adams, 1999; Groves, 2003) and would benefit from being provided with user-useful and user-friendly products (Driver et al., 2003).

Conservation biologists have made considerable progress in bridging the gap between conservation assessment and land-use planning (Saunders et al., 1995; ?, Pressey, 1998, 1999; Theobald et al., 2000; Ribaudo et al., 2001). However, systematic conservation assessment products, namely a spatially dispersed array of sites required to achieve targets (minimum sets) (e.g. Margules et al., 1988), maps of irreplaceability (e.g. Pressey, 1999), and imprecisely demarcated corridors required for the movement of specific biota (e.g. Rouget et al., 2003), are often not helpful to land-use planners who have to integrate the concerns of many sectors in a spatially explicit product. This is largely because most conservation planning assessments have neglected the instrument(s) required for the implementation process (Knight and Cowling, 2003a; Knight et al., in press), focussing instead upon the process of identifying priority areas for biodiversity. Furthermore, the use of arbitrary planning units (the spatially-explicit units used for displaying the results of conservation assessments) such as grid cells (a widespread feature of conservation assessments) makes integration even more difficult for land-use planners who usually require information for actual land management units, i.e. they work with cadasters. This paper describes a process aimed at overcoming these problems. The study is underpinned by two assumptions: (i) the conservation of biodiversity and its services forms the basis of environmental, social and economic sustainability (Orr, 2002a; Dawe and Ryan, 2003; Ekins et al., 2003), (ii) conservation priorities need to be identified using the principles of target-based representation and persistence (Margules and Pressey, 2000). Our chief contention is that the conservation priorities thus identified need to be interpreted in order to be integrated into land-use planning processes such as Integrated Development Plans (IDP) and Spatial Development Frameworks (SDFs) (Gelderblom et al., 2002; Cowling and Pressey, 2003; Marzluff, 2004).

The study was conducted in the Subtropical Thicket Biome of South Africa. Our targeted users were land-use planners and elected decision-makers in the region, which encompasses three district municipalities and 30 local municipalities. These stakeholders are responsible for all indicative planning (SDFs), hereafter referred to as forward planning, as well as reactive planning, involving decisions in response to applications from landowners for changes in land-usage. In addition to providing guidelines for these two forms of decision making, we also make recommendations regarding opportunities for sustainable development that makes optimal use of the natural environment and its biodiversity, e.g. wildlife ventures and ecotourism. We describe our approach involving the concurrent processes of systematic conservation assessment, which accounts for stakeholder needs and implementation issues, and the development of products, in particular a conservation priority map. With our initial focus on the municipal-level, we developed a Mapbook comprising a conservation priority map for each municipal area together with a set of guidelines. These guide both forward spatial planning and reactive decision making, and suggest opportunities for wise land-use. To complement the Mapbook, we compiled a Handbook for municipal decision makers aimed at enhancing understanding and awareness of the services provided by intact biodiversity, as well as relevant legislation, both existing and impending. Finally, we discuss the extent to which we have bridged the gap between conservation assessment and municipal-level land-use planning, describe the effectiveness of the interpretation for purposes of integrating this information into land-use planning, and provide a critique of our approach, so that others might learn from our experiences, especially with regard to extending the approach to other sectors.

2. A description of the planning region and planning context

2.1. Planning region

The planning region, which covers 105 454 km^2, is centred on the Subtropical Thicket Biome, and straddles the Western and Eastern Cape Provinces of South Africa (Fig. 1). Intact habitat covers 72% of the region, with 16% transformed by agriculture, urbanization, afforestation and alien invasive plants, and 12% has been severely degraded by overgrazing (Cowling et al., 2003). The principal form of land-use is the production of livestock from natural habitat on freehold farms; communal lands, where remittances from city dwellers are the major source of income, occupy less than 10% of the planning region. Approximately 7% of the planning region is included in formal (Type 1) protected areas, i.e. those underpinned by strong legislation and effective management (Cowling et al., 2003). Type 2 protected areas, i.e. those underpinned by weak or non-existent legislation, comprise 9% of the planning region. Eco-tourism and wildlife ventures (principally game harvesting for venison or trophies) on freehold land, are the fastest growing enterprises that are based on the region's natural resources (Cowling et al., 2003).

2.2. Biodiversity features of the Subtropical Thicket Biome

The biodiversity features of the Subtropical Thicket Biome are described in detail in Cowling et al. (2003) and Vlok et al. (2003). The region is associated with two globally recognized centres of plant endemism, namely the Little Karoo Centre of the Succulent Karoo in the west, and the Albany Centre in the east (Van Wyk and Smith, 2001). The Subtropical Thicket Biome comprises the south-western sector of the Maputaland-Pondoland-Albany hotspot recognised as a global biodiversity priority by Conservation International (Steenkamp et al., in press).

2.3. Planning context: The Subtropical Thicket Ecosystem Planning Project

The Subtropical Thicket Ecosystem Planning (STEP) Project was a four-year initiative (July 2000–June 2004) funded by the Global Environment Facility. The overall aims of the project were: (1) to conduct a systematic conservation assessment to identify priority areas that would ensure the long-term conservation of the subtropical thicket biota, and (2) to ensure that the assessment outcomes were implemented via integrating them into the policies and practices of private and public sector agencies responsible for land-use planning and the management and use of natural resources in the planning region. Details on the project are provided by

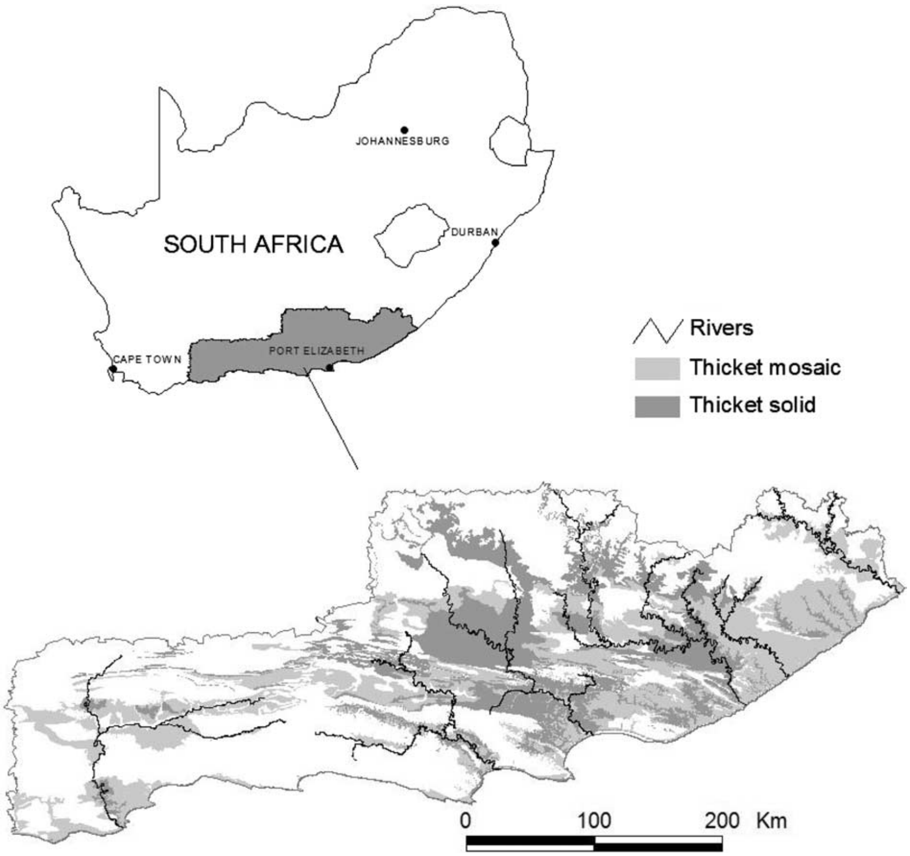

Fig. 1. The location of the Subtropical Thicket Biome and the Subtropical Thicket Ecosystem Planning (STEP) Project planning region in South Africa. Subtropical thicket vegetation is classified as "solid" and "mosaic" (see Vlok et al., 2003). Major rivers are shown.

Cowling et al. (2003), Knight et al. (2003) and Pierce (2003) (all available on http://cpu.uwc.ac.za).

2.4. Institutional and legal issues

There are two important pieces of legislation that have a bearing on the approach adopted for this study. The first is the Local Government Municipal Systems Act 32 of 2000. The spirit and deed of this act (Anon, 1998) are rooted in Local Agenda 21, a product of the 1992 Earth Summit, which identified local organizations and institutions as agents for development, and, along with social and economic issues, identified the conservation of the natural environment as a component of sustainable development. In terms of this legislation, local (municipal) government must undertake at least every five years, Integrated Development Plans and Spatial Development Frameworks. This process must be fully participatory and uphold the three foundations of social, economic and environmental sustainability. Retief and Sandham (2001) discuss how existing South African environmental legislation, geared mainly at national and provincial government, can be harnessed to ensure accommodation of environmental concerns at the local government level.

The second piece of legislation is the National Environmental Management: Biodiversity Act 10 of 2004. The aim of this act is to provide for the management and conservation of South Africa's biodiversity. Components of the act salient to this study are that (i) at the national and provincial sphere, there is provision for the listing of ecosystems that are threatened and in need of protection, and (ii) for listed ecosystems, the relevant municipalities must take into account the need for protecting such ecosystems in their Integrated Development Plans and Spatial Development Frameworks.

These pieces of legislation are progressive in: (i) recognising categories of endangerment at the ecosystem level, (ii) integrating biodiversity concerns into development planning, and (iii) the devolution of power to local-level organizations and institutions. However, at the local level, there are serious shortcomings in human capacity to implement this legislation. Prior to the 1994 democratic transition in South Africa, local government focused entirely on service delivery within urban areas, and biodiversity concerns were not their brief. Since that time, local municipalities have been newly demarcated to include various urban zones but always to encompass large areas of rural countryside that harbour much biodiversity, including many high-priority biodiversity features. Owing to the inequities of the apartheid era, all municipalities, but especially those in the racially designated former "homelands" comprising communally-owned land, have inherited a large backlog of essential services for the high number of impoverished inhabitants, operate on tight margins as a result of a small rates base, and have neither the capacity nor the resources to deal effectively with biodiversity issues. Certain products of this study, namely the guidelines associated with the maps, were designed and interpreted specifically to assist all municipal decision-makers in fulfilling their legal and moral responsibility for safeguarding biodiversity and its services, and to identify opportunities for sustainable development.

3. Conservation assessment for implementation

A STEP Project report provides a detailed description of the conservation assessment, including biodiversity features, biodiversity targets, land-use opportunities and constraints, and methods of analysis (Cowling et al., 2003). Rouget et al. (in press) provide additional information on the identification of conservation corridors as the spatial component of Megaconservancy Networks (see 3.4.1). Here, we provide a brief summary of the planning framework, methods and outcomes, highlighting how implementation considerations were integrated throughout.

3.1. Planning framework

The approach adopted for this study was guided by a conservation planning framework, developed by Knight and Cowling (2003a). This framework comprises three components, namely:

(i) empowering individuals and organizations, specifically the inheritor stakeholders and their associated implementing organizations mentioned above, through consultation about their needs and concerns, and accommodating these in the final assessment outcomes;
(ii) systematic conservation assessment;
(iii) securing conservation action through consultation with, and input from inheritor stakeholders.

Knight and Cowling (2003a) provide details on the components of the framework; here we wish to make only three points.

First, the approach to the conservation assessment was guided by the principles and practices of systematic conservation planning, as articulated in Margules and Pressey (2000).

Second, the framework added significantly to other systematic conservation planning protocols (e.g. Margules and Pressey, 2000; Groves, 2003), in that the systematic assessment was conceptually and operationally integrated into a broader planning framework focussed upon the implementation of conservation action. This increased the likelihood of establishing the prerequisite conditions essential for assessment outcomes being accepted by stakeholders and, therefore, the likelihood of successfully securing conservation action.

Third, the framework adopted the now widely endorsed ecologically sustainable land management or ecosystem approach (e.g. Bunch, 2003) to the conservation of landscapes and their component biodiversity (Knight and Cowling, 2003a). This approach aims to "keep people on the land in living landscapes", as opposed to the traditional approach of conservation, which removes people to create formal protected areas. In this way, it aims to ensure that not only are the landscapes and biodiversity of the Subtropical Thicket Biome conserved for future generations, but also that the social and economic systems of the region promote improved quality of life for its human inhabitants who are viewed as stewards for biodiversity.

3.2. Planning units

The planning region was subdivided into biogeographic divisions of the Subtropical Thicket Biome that are largely aligned with the region's major primary water catchments (Vlok et al., 2003) (Fig. 2). The units of selection for the conservation assessment, namely the planning units, were based on cadastral data, ecological and evolutionary process areas, and include Type 1 protected areas (i.e. protected areas underpinned by strong legislation and enforcement). The use of cadastres, as opposed to arbitrary planning units, enhanced implementation since these are the units that land-use planners routinely use when making land-use decisions.

3.3. Biodiversity features and targets

The STEP Project's conservation assessment, undertaken at the 1:100 000 scale, used as biodiversity features 169 vegetation types (of which 112 are thicket types), three wetland types, and five spatial surrogates (hereafter components) of ecological and evolutionary processes (Table 1). A model was used to determine the potential distribution and abundance of African elephant (*Loxodonta africana*) (Boshoff et al., 2001), a species used as a surrogate for the wildlife potential of the planning region (Rouget et al., in press). Conservation targets, which are central to the systematic approach to conservation planning (Margules and Pressey, 2000), were set for all biodiversity features used in this study (Table 1). Targets for vegetation types, expressed as a percentage of the type's pre-transformation area, were set using species-area data derived from phytosociological

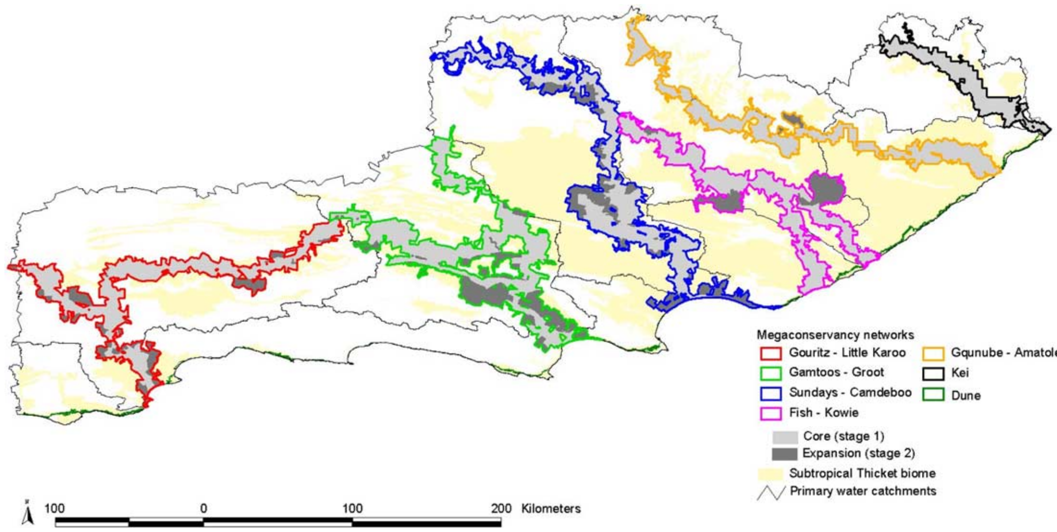

Fig. 2. Location of conservation corridors, or Megaconservancy Networks, in the STEP planning region. Each corridor represents the most suitable route for capturing upland-lowland and macroclimatic gradients within each major drainage basin, and along the dune coast. Corridors integrate biodiversity patterns and processes and incorporate protected areas, but also avoid land-use pressures. From Rouget et al. (in press).

Table 1
List of biodiversity features considered in the STEP conservation assessment

Feature	Description	Target	Additional references
Habitat types	169 vegetation and 3 wetland types mapped at 1:100 000	10–26% of original (pre-transformation) area	Desmet and Cowling (2004)
Wildlife suitability	Habitat suitability for focal species (elephant)	1000 individuals in planning region	Boshoff et al. (2002); Kerley et al. (2003)
Spatially-fixed processes	Biome interfaces, riverine corridors and sand movement corridors	100% of extant area	Rouget et al. (2003)
Spatially-flexible processes	Upland-lowland and macroclimatic gradients	At least one in each biogeographic region	

Details are provided in Cowling et al. (2003).

relevés (Desmet and Cowling, 2004), and ranged from 10% to 26% (Cowling et al., 2003). Targets for wetland and forest types were set as 100% of all remaining habitat, as required by South African legislation.

3.4. Conservation planning products

This study generated three conservation planning products, namely Megaconservancy Networks (MCNs) and conservation status categories, which were then combined into a conservation priority map for the region. The process of production is described below. Note that all products, at various stages of development, were presented for comment to a range of stakeholders, including municipal decision-makers, planners, nature conservation officials, planning and environmental consultants, and landowners at a series of workshops, where at least one of the authors was present at any given event. One-on-one interviews were held with key stakeholders in the land-use planning sector to refine the maps and guidelines. Significant time and effort was specifically invested in stakeholder collaboration for product structure, format and presentation, and this greatly improved the final utility of the product. Boshoff and Wilson (2004) provide information on the stakeholder engagement process in the workshops.

3.4.1. Conservation corridors as Megaconservancy Networks

Planning for the persistence of biodiversity (Cowling et al., 1999; Rouget et al., 2003) was a key component of the conservation assessment. We accommodated a persistence goal by identifying conservation corridors that incorporated major ecological and evolutionary processes, in particular those following major biological gradients, as well as a coastal corridor (for details, see Rouget et al., in press). The planning units used to populate the six inland and one coastal conservation corridors were selected on the basis of subtropical thicket representation, habitat transformation and degradation, wildlife suitability, irreplaceability of vegetation types (Pressey, 1999), existing protected area networks and future land-use pressures (Fig. 2). Thus, the expanded corridors accommodated implementation issues by avoiding areas already transformed and vulnerable to future transformation, and by incorporating areas that already enjoy some form of protection or are suitable for biodiversity-based tourism and wildlife ventures. These conservation corridors covered 24.9% of the planning region (ranging from 600 to 5200 km^2) and successfully achieved targets for biological processes and to a lesser extent for representation of vegetation types (Rouget et al., in press).

In order to provide an implementation mechanism for the expanded corridors, each was named as a specific Megaconservancy Network (Knight and Cowling, 2003b) (see Fig. 2). The implementation of ecologically sustainable land management in each of these would ensure simultaneously the achievement of biodiversity persistence targets, half of the biodiversity pattern (vegetation type) targets (Rouget et al., in press), and socio-economic goals (Knight and Cowling, 2003b). Hence, a Megaconservancy Network is a mechanism for achieving ecologically sustainable land management on a contiguous patchwork of properties of various tenures and land-uses, which maximizes landscape heterogeneity and the management of capital flows (e.g. natural, financial, social) (Knight and Cowling, 2003b). This can be achieved only if the component properties are managed in a co-ordinated, co-operative and integrated way.

3.4.2. Conservation status categories

The Megaconservancy Networks, together with Type 1 protected areas, do not achieve targets for all of the biodiversity features that we used in this study (Rouget et al., in press). Moreover, there is probably much undocumented and undescribed biodiversity in the 75% of the extant habitat of the planning region that falls outside of these Networks. Here, we present a procedure to deal with the areas that fall outside of both Megaconservancy Networks and existing protected areas. It was designed to ensure the retention of habitat associated with priority biodiversity features (in this case, vegetation types). In particular, it aimed to provide a region-wide categorisation of endangerment that would provide land-use decision makers with information enabling them to make decisions that would enhance instead of compromise the achievement of biodiversity targets.

Vegetation types were classified according to four categories of endangerment – critically endangered, endangered, and vulnerable ecosystems, as termed in the Biodiversity Act, as well as not currently vulnerable. The method of categorisation was purposely devised to be very simple: it was based on the area of each vegetation type required to achieve its biodiversity-based target, and the remaining area of its extant habitat, both expressed as a percentage of the original (pre-transformation) extent (Fig. 3). The conservation status of a vegetation type was determined by the difference between the target and extant habitat: where the target was ⩾ extant habitat, then the vegetation type fell into the critically endangered category; where the difference between the target and extant habitat was ⩾60% of the original extent of the vegetation type, it was categorised as currently not vulnerable. The cutoff of 60% selected those vegetation types that have a buffer of extant habitat >60% between themselves and the critically endangered category (i.e. the amount of extant habitat greatly exceeds the amount required for the target). The cutoff also selects only those vegetation types that have more than half of their habitat still extant. There is an extensive literature, mainly theory, which suggests that above a threshold of 50–70% of intact habitat, biodiversity is likely to persist, owing to the maintenance of ecosystem processes and viable populations of component species (e.g. Fahrig, 2001; Flather and Bevers, 2002; Desmet, 2004).

The other two categories (endangered and vulnerable) were determined by their positions above or below a parallel threshold line starting at 30% of extant habitat (Fig. 3). Research suggests that below a threshold of 20–40% of intact habitat remaining, biodiversity loss accelerates markedly (Andrén, 1994; Fahrig, 2001). The cutoff of 30% was half way between the two extreme categories of critically endangered, and currently not vulnerable. Vegetation types below the threshold had a buffer of less than or equal to 30% between themselves and the critically endangered category and were considered endangered, whereas vegetation types above the threshold had a buffer of between 30% and 60% between themselves and the critically endangered category and were considered vulnerable.

The results of the categorisation of the 172 vegetation types (including three wetland types) are shown in Fig. 3. Nine fell into the critically endangered category, of which seven were thus categorised because they have their targets set to all remaining extant habitat owing to national legislation: these are the three wetland types

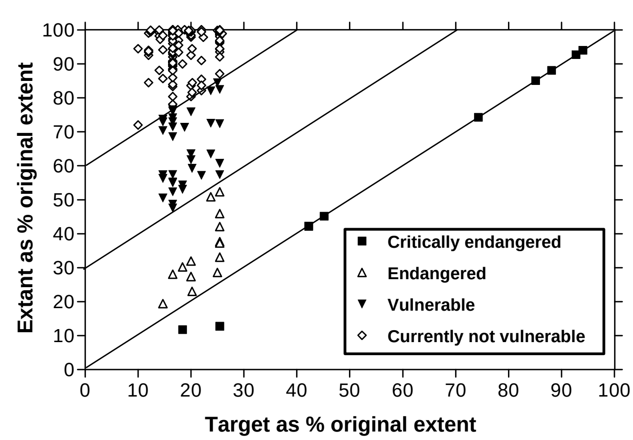

Fig. 3. Categorisation of the 169 vegetation types and three wetland types in the STEP planning region according to conservation status. The seven points on the bottom threshold line are the wetland and forest types for which targets were set at 100% of all extant habitat, as required by South African legislation.

Table 2
Area of extant (non-transformed[a]) habitat in categories of different conservation status in the STEP planning region

Land class	Symbol	km^2	% of planning region[b]
Type 1 protected areas		7222	8.1
Critically endangered[c]	I	17 931	20.2
Endangered	II	1388	1.6
Vulnerable	III	7388	8.3
Currently not vulnerable	IV	54 798	61.8

[a] That is, excluding areas transformed by urbanization, agriculture, afforestation and dense stands of invasive alien plants.
[b] Extant habitat only.
[c] Includes six vegetation types, three wetland types, spatially-fixed process components and the seven Megaconservancy Networks (MCNs).

and the four forest types. For the other two, targets could not be achieved owing to extensive transformation. Fourteen vegetation types fell into the endangered category. The vulnerable category included 35 vegetation types, and 114 vegetation types were categorised as currently not vulnerable.

We also categorised as critically endangered all extant habitat associated with the spatially fixed process components (Table 1) and the seven Megaconservancy Networks. The rationale for this was the need to retain all extant habitat associated with these features in order to ensure the long term persistence of biodiversity in the planning region (Cowling et al., 1999), and to contribute to targets for vegetation types through biodiversity-friendly management regimes. Overall, the critically endangered category (outside of Type 1 protected areas) comprised about 20% of the planning region (Table 2), of which 15 638 km^2 (87.5%) encompassed Megaconservancy Networks, 1206 km^2 (6.7%) the spatially fixed process components, and 1044 km^2 (5.9%) the nine vegetation types where the targets exceeded or equalled available habitat.

3.4.3. Conservation priority maps

The next challenge was to merge the Megaconservancy Networks and conservation status information into a single map that could be readily used by land-use decision-makers at all spheres of government (national, provincial and municipal), as well as by consultants, who regularly undertake work for government agencies.

Many assessments fail to be effectively implemented owing to poor or inappropriate product design (Theobald et al., 2000; Driver et al., 2003). Therefore, two of us (SMP and TW) devoted a great deal of effort, including workshop and one-on-one interactions with key stakeholders in the land-use planning sector, to identify the appropriate format and colour scheme for what we termed the "STEP conservation priority map".

Fig. 4 shows the conservation priority map for: (a) the entire planning region, and (b) a single municipality. Note that the maps include cadastral boundaries, rivers and all proclaimed roads (to facilitate site location by users), impacted or irreversibly transformed areas (to provide visual context for the endangerment categories), protected areas (Type 1 only), the location of Megaconservancy Networks (termed 'Network') and the spatial components of fixed processes (termed 'Process area'). Copies of these maps, along with the geographical information systems (GIS) data, for the entire planning region and for each of the region's 30 municipalities, can be downloaded from the website of the Conservation Planning Unit of Cape Nature, formerly the Western Cape Nature Conservation Board: http://cpu.uwc.ac.za.

3.5. Interpretation for municipal-level decision-makers

3.5.1. The STEP mapbook

We facilitated interpretation by twinning the conservation priority map with a corresponding set of guidelines designed specifically for municipal-level decision-makers (Table 3). We termed this product the STEP Mapbook, which was produced to assist municipalities in integrating biodiversity into land-use decisions (Pierce, 2003).

These guidelines provide, for each category of endangerment (Fig. 4), recommendations for reactive land-use decisions and for the forward planning required by Spatial Development Frameworks. The guidelines were developed by one of us (SMP) in wide consultation with conservation experts and key stakeholders in the land-use planning sector, by iterative refinement through one-on-one interviews and in workshops. Table 3 provides an example of the guidelines for the two extreme categories, namely currently not vulnerable and critically endangered. The complete set of guidelines can be downloaded from the website of the Conservation Planning Unit of Cape Nature: http://cpu.uwc.ac.za.

The guidelines are explicit and should ultimately be supported by regulations drafted for the Biodiversity Act. Thus, in critically endangered areas (including Megaconservancy Networks and Process areas), the recommendation is for no further loss of habitat and no impacts that would result in the loss of biodiversity (Table 3). These areas, however, also offer forward-planning opportunities, such as low-impact ecotourism. On the other hand, the guidelines recommend that high-impact activities or developments should be located in currently not vulnerable areas. Thus, the guidelines provide a basis for ensuring biodiversity-friendly development via both reactive and forward planning.

Each of the 30 local municipalities within the planning region was presented with a Mapbook, comprising a series of large-format maps (1:100 000) covering their area of jurisdiction, and a table of guidelines. The district municipalities received Mapbook compilations comprising all the local municipal areas within their domain.

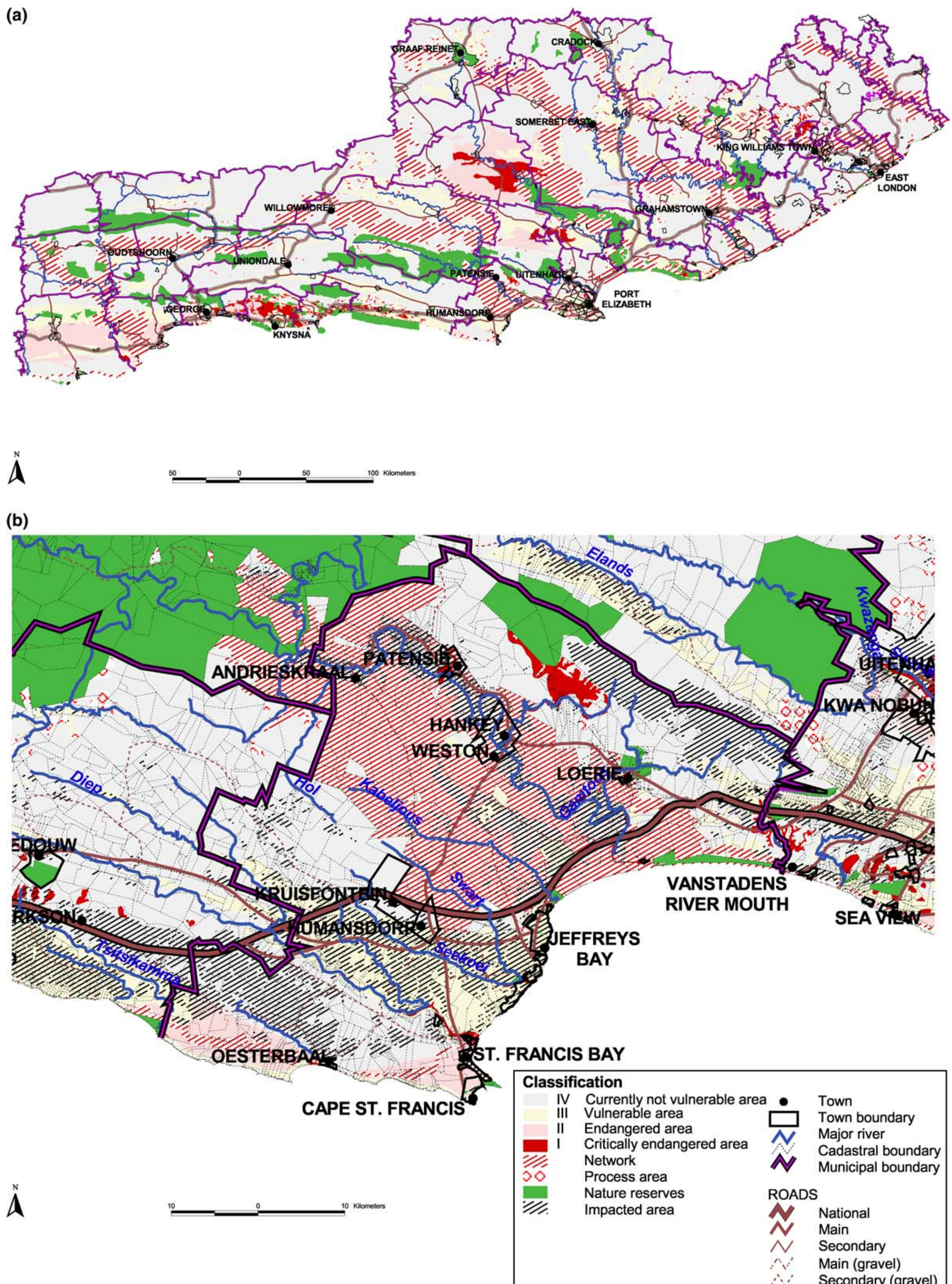

Fig. 4. Conservation priority maps of (a) the entire STEP planning region and (b) the Kouga Municipality.

3.5.2. The STEP Handbook

We believed that the outcomes of the conservation assessment in the planning region needed to be supported by additional interpretive material. Furthermore, with the enactment of more stringent municipal and environmental legislation, it became apparent that land-use

Table 3
Guidelines to assist municipal decision-makers and consultants in fulfilling their legal and other obligations to the natural environment

Category	Brief description	General rule	Procedures for municipalities (Reactive decisions)	Restrictions on activities (Forward spatial planning)	Opportunities for activities (Forward spatial planning)
Currently not vulnerable	Ecosystems which cover most of their original extent and which are mostly intact, healthy and functioning	Depending on other factors, this category can withstand loss of natural habitat	1. Proposed disturbance or developments should preferably take place on impacted areas.[a] 2. In response to an application for a non-listed activity which will have severe or large-scale disturbance on a relatively undisturbed site (non-impacted), the municipality should first seek the opinion of the local conservation organization. 3. For a proposed "listed activity", EIA[b] authorisation is required by law.	1. Proposed disturbance or developments should preferably take place on portions which have already undergone disturbance or impacts[a] rather than on portions that are undisturbed. 2. In general, this category can withstand loss of or disturbance to natural areas through human activities and developments.	Depending on constraints (such as avoidance of spoiling scenery or wilderness, or infra-structure limitations), this category can withstand loss of or disturbance to natural areas. Subject to these constraints, this category may be suitable for a wide range of activities (e.g. extensive urban development, cultivation, tourist accommodation, ecotourism, game faming).
Critically endangered	Ecosystems whose original extent has been so reduced that they are under threat of collapse or disappearance. Included here are special ecosystems such as wetlands and indigenous forests	Under no circumstances can this category withstand further loss of natural habitat	1. As a rule, no further loss of natural area and no further impacts[a] should be allowed. 2. The municipality should require an on-site investigation[c] to verify the site's condition relative to impacts[a] and its categorization. 2a. If the site has been severely impacted[a], and is assessed as critically endangered, then the municipality should recommend restoration[d] of the portion of land which will remain undeveloped, and its proclamation and management as a protected area.	No further loss of natural area and no further impacts should be allowed. Any disturbance of this category should be allowed only on condition that there are net gains for the natural environment (e.g. in the portion which will remain undeveloped), restoration[d] and proclamation and management as a protected area.	This category may be suitable for eco-friendly, nature-based activities with almost no impacts[a] such as responsible ecotourism (hiking trails, etc.). In those areas which have undergone severe impacts[a], there are opportunities for Integrated Development Planning (IDP) restoration[d] projects, via poverty relief funding.

	2b. If the site is relatively undisturbed, with medium to low impacts[a], and is verified as critically endangered, then the municipality should request a Special EIA.[e] 3. For a proposed "listed activity" that by law requires EIA[b] authorisation, the municipality should recommend a special EIA.[e]

Only two sample rows are given here; omitted are rows for vulnerable, endangered, Networks (MCNs), Process areas, protected areas and impacted (transformed) areas (adapted from Pierce, 2003).

[a] Impacts may be evaluated according to: (1) type of impact (e.g. urban development, cultivation, alien invasive plants, overgrazing); (2) extent of impact (degree of fragmentation); and (3) severity of impact (e.g. density of alien invasive plants, degree of overgrazing). Category (e.g. currently not vulnerable, Network, Process area) should be considered together with evaluation of impacts in order to make appropriate recommendation.

[b] EIA = environmental impact assessment. The law requires that before municipal decision-makers may allow certain "listed activities" in their area, they must first receive the necessary EIA authorisation from the relevant government department, which has to be arranged by the applicant. See Pierce (2003) (Appendix 1, Annexure 2) for further details on EIAs and "listed activities".

[c] On-site investigation should involve firstly an evaluation of impacts[a] and then, depending on these findings, further assessment by a conservation official or specialist consultant of the site's vegetation type/s and categorisation (e.g. critically endangered, Network). This verification is recommended because of the broad-scale (1:100 000) feature mapping used in the STEP Project.

[d] Restoration can involve the permanent removal of invasive alien plants, wetland restoration, and replanting of degraded areas. See Pierce (2003) (Chapter 3, section 1.2) for financing opportunities.

[e] Special EIA here means an EIA which also takes into account: (1) a vegetation survey and categorisation of area according to the definitions of the STEP Handbook (Appendix 2); (2) evaluation of impacts[a]; (3) permission only for development appropriate to category (e.g. critically endangered, Network); (4) if area is impacted and development is allowed, then recommendations for a net gain for the ecosystem (i.e. restoration[d] of the portion of land which will not be developed, and its proclamation and management as a protected area).

decision-makers at the municipal-level needed assistance in fulfilling their legal obligations regarding biodiversity conservation and environmental sustainability.

Therefore, the STEP Handbook (Pierce, 2003) was compiled to provide further information to enable land-use decision-makers and private-sector consultants (acting on behalf of public or private sector agents) to make development decisions and recommendations, respectively, that do not violate the biodiversity conservation and environmental sustainability principles embodied in the Biodiversity and Municipal Acts.

The Handbook also provides an explanation of the conservation assessment in lay terms; information on the value of biodiversity as a prerequisite for sustainability; legal obligations regarding biodiversity and sustainability; land reform and biodiversity; a guide to environmental legislation and Environmental Impact Assessment regulations from a planning perspective; and information on the recognition of biodiversity features for specialist consultants. Information on the value of biodiversity was illustrated by case studies describing in brief the economic importance of plants and animals, the role of the indigenous pollinator fauna in sustaining the fruit export industry, water supply and quality, indigenous knowledge, ecotourism, beach sand replenishment and carbon capture, as well as socio-cultural heritage value.

The STEP Handbook can be downloaded from the website of the Conservation Planning Unit of Cape Nature: http://cpu.uwc.ac.za.

4. Response of land-use decision-makers to the STEP products

The conservation priority map has been generally well received by representatives of national, provincial and district municipal spheres, and by private consultants working for local municipalities. Owing to funding delays, the program to guide municipal decision-makers in the use of the STEP Handbook and Mapbooks has only recently been initiated (October 2004). Acceptance of the Megaconservancy Network concept has also been favourable. Below we present an anecdotal account of the extent to which the study's conservation assessment products, hereafter referred to as STEP products, have been incorporated into land-use decision-making thus far (see also Boshoff and Wilson, 2004).

4.1. National government and parastatals

The STEP products have been incorporated into the National Biodiversity and Action Plan of the national Department of Environmental Affairs and Tourism and endorsed by the South Africa National Biodiversity Institute (formerly the National Botanical Institute) which has undertaken to catalyse and facilitate the implementation of the STEP Project and its products in the Eastern Cape Province. Furthermore, the STEP products are being used by South African National Parks in the spatial planning for the expansion of the Addo Elephant and Mountain Zebra national parks; by the Department of Water Affairs and Forestry to inform their planning activities; and by the Electricity Supply Commission, South Africa's parastatal power utility company, to inform the location of a major powerline across the planning region. The Development Bank of South Africa, which provides institutional and other support to municipalities, has made compliance with the STEP Project's conservation plan mandatory for the successful disbursement of loans and grants.

4.2. Provincial governments

The STEP products have been adopted by provincial-level planners for both the Western Cape and Eastern Cape Provinces for identifying the boundaries of, and permissible impacts within, the evolving Gouritz and Baviaanskloof mega-reserves, two of the Megaconservancy Networks identified by the assessment (Fig. 2). Cape Nature, the conservation organisation for the Western Cape Province, has endorsed the use of the STEP products and has made compliance with these a default in the compilation of their Spatial Development Frameworks for district and local municipalities within the planning region. The Department of Economic Affairs, Environment and Tourism: Eastern Cape Province, the organisation responsible for conservation outside of Type 1 protected areas, has used the STEP products in compiling the provincial conservation plan, which will ultimately inform the forthcoming Provincial Growth and Development Plan; this plan will, in turn, provide a spatially-explicit development guidelines for all government sectors in that part of the planning region that falls within the province. The products were incorporated into the Eastern Cape Province's Strategic Assessment of Biodiversity of 2003 and its State of the Environment report of 2004.

Little success, however, has been achieved in engaging the formal agriculture sector, especially at provincial government level, despite involvement of relevant officials in the process. However, rural landowners have viewed the Megaconservancy Network concept with interest and enthusiasm.

4.3. Local government

The planning region includes a metropolitan municipality (the Nelson Mandela Metro comprising three large urban centres) and three district municipalities, each of which includes a number of local municipal areas. Officials, planners and their consultants are using the STEP products to inform their spatial planning, but to varying degrees. Two district municipalities of the Eastern Cape have formally requested their local municipalities to comply with the planning guidelines in the compilation of their Spatial Development Frameworks. Stewart et al. (2004) produced a fine-scale (1:10 000) assessment for the Nelson Mandela Metro that used the STEP Project's approach to produce a conservation priority map and the same associated guidelines. This product has been integrated into land-use decision-making for the metro.

STEP products are also being integrated into planning for the municipality of the region's second largest city. Several of the smaller municipalities are using the products, although this is happening not through the involvement of municipal officials, but instead via consultants who are employed by municipalities to prepare their Spatial Development Frameworks. Feedback from these consultants has been very positive and all regard the products as user-useful and user-friendly. We know of at least two cases where frameworks that used the STEP products, have directed development away from priority areas.

At this stage, an evaluation of the extent to which of the products have been effectively integrated or mainstreamed into municipal decision-making is premature, and must await the completion of the recently initiated capacity building and training project based on the Handbook and Mapbook.

5. General discussion

Here, we first evaluate the conservation assessment approach and its products, next we assess the extent to which we have been successful in making these products useful, and finally we provide a general critique of our study and make suggestions for improving future initiatives.

5.1. Evaluation of the conservation assessment for implementation

The implementation of conservation action is a normative process, guided by human values and the consequent choices that people make (Callicott et al., 1999; Freyfogle and Newton, 2002). Therefore, in order to influence conservation decisions, conservation biologists need to confront and comprehend the messy world of institutions, policies and politics (Meffe, 1998), and reach beyond the biological sciences into economics, sociology, education and law (Robertson and Hull, 2001; Orr, 2002b; Mascia et al., 2003). The discipline of "conservation planning" is a case in point: overwhelming effort has been devoted to refining the scientific and technological aspects of the systematic assessment component of what is, overall, a complex social planning process (Knight et al., in press). Equal effort is now required in designing products for implementers, illustrated by, for example, the development of the conservation priority map, the Handbook and Mapbook (Pierce, 2003), as well as developing an implementation strategy. The development of the implementation strategy (Knight et al., 2003) took the same amount of time as the systematic assessment, and was fraught with greater challenges.

The approach adopted for the assessment is significantly different from the approach used for most other systematic conservation assessments. Notably, we considered implementation issues from the outset. Of particular importance were the lessons that we learnt from participating in the assessment for the Cape Action Plan for the Environment Project (Cowling and Pressey, 2003), namely: (i) municipal-level decision-makers are a key stakeholder group since it is they who are empowered to make far-reaching decisions regarding biodiversity, and (ii) assessment products must be both user-friendly and user-useful: products based on arbitrary planning units and dynamic and often cryptic biodiversity values (e.g. maps of irreplaceability) are not comprehensible to most stakeholders working in the land-use planning sector (Driver et al., 2003).

Other factors that influenced our approach for this assessment and developing its products were the promulgation of the Municipal and Biodiversity Acts. These two pieces of legislation provide the principal instruments for ensuring that our assessment products are being integrated into municipal-level decision-making. They dictate the sphere of governance that we targeted and underpin the conservation status categories that were identified for different land classes. Another influence on our approach is the growing armoury of municipal-level incentives for conservation on private land, currently being developed to facilitate the retention of natural habitat in priority areas (Botha, 2001). Finally, successfully implementing ecologically sustainable land management on freehold land requires an optimal mix of complementary conservation and land-use instruments (Young et al., 1996). This led us to formulate an explicit land management model, namely the Megaconservancy Network concept (Knight and Cowling, 2003a).

5.2. Evaluation of conservation status categories

While there have been other attempts to allocate land class features to categories of endangerment (e.g. Noss et al., 1995; Reyers et al., 2001), this study is the first attempt to use, in addition to habitat loss, an explicit and defensible biodiversity target in identifying these categories. Obvious problems with the method are the somewhat arbitrary cutoffs between categories and lack of consideration of habitat fragmentation status of extant features. Thus, a feature in the currently not vulnerable category could have a high level of anthropogenic habitat fragmentation and might better be located in the vulnerable category. However, similar overall levels and configurations of habitat fragmentation may affect different components of the biota differently (Collinge, 2001). Until a clearer picture has emerged on the impacts of different habitat fragmentation patterns on different biodiversity components, we believe it would be unwise to change this system. We do note, however, that any amount of fine-tuning is unlikely to change the status of critically endangered and endangered features (unpublished data), these being the ones where habitat retention is most critical. These thresholds can be reviewed periodically, as provided for by the Biodiversity Act.

5.3. Evaluation of the conservation priority map

A major advantage of the conservation priority map is that it provides information on the priority status of features (i.e. vegetation types and ecological and evolutionary process surrogates), as opposed to individual planning units (e.g. grid squares), for the entire planning region. Furthermore, the endangerment status categories are relatively stable over time, unlike in the case of minimum set analyses (Margules et al., 1994). The latter deliver spatially dispersed arrays of priority planning units that achieve biodiversity targets but provide no information on the remainder of the planning region. Moreover, any given minimum set solution is only one of a host of different spatial options for target achievement (Balmford, 1998); land-use planners would require the appropriate data and software in order to assess the likely impacts of habitat loss on biodiversity conservation. While maps of irreplaceability do have the advantage of providing region-wide information on conservation value (Pressey, 1999), their information is provided for planning units and relatively small changes in the status of particular planning units may result in quite large changes in the irreplaceability patterns. As is the case of minimum set analysis, irreplaceability analysis is dynamic and requires capacitated personnel to effectively use these tools for land-use planning. Our experience from earlier conservation assessments such as the Cape Action Plan for the Environment Project (Cowling and Pressey, 2003) indicates land-use planners and other stakeholders had great difficulties in comprehending dynamic products (Driver et al., 2003).

5.4. Bridging the gap

While many have made the plea for improved integration of systematic conservation assessment and land-use planning approaches and products (Niämele, 1999; Pressey, 1999; Theobald et al., 2000; Stoms, 2001; Löfvenhaft et al., 2002; Groves, 2003; Marzluff, 2004), we know of no published examples that have sought, explicitly, to bridge the gap between these two sectors. This gap is symptomatic of the pervasive gap that exists between the production of scientific information and its provision in forms useful to those who need it for implementation (Hulse et al., 2004). Clearly, if this gap is to be bridged at a much wider scale, the current academic focus upon systematic assessment methodologies must be re-focussed upon implementation issues (Knight et al., in press).

This study has connected the outcomes of a systematic conservation assessment with the needs of land-use planners, resulting in the products that have been endorsed by planning officials and consultants working in this sector. In particular, they have appreciated the region-wide depiction of conservation values, the stability of the products (at least over the five-year planning processes required by the Municipal Act), and the lack of requirement for GIS and other software capacity for routine use. We are quite confident that our products have achieved simultaneously the goals of systematic conservation planning (representation and persistence) in a format that is comprehensible and useful for municipal-level decision-making. However, additional training support will be required in poorly capacitated municipalities.

5.5. Adoption of the products

In just eighteen months since their publication, the products have been surprisingly well integrated or mainstreamed into land-use decision-making across the planning region, but especially in those organizations that fulfil the prerequisites of adequate organizational and institutional capacity, effective non-governmental organisation involvement, and awareness of the significance of biodiversity (Cowling et al., 2002). Thus, the adoption of the products has been most effective in the Nelson Mandela Metro (Stewart et al., 2004), in the municipality of the region's second largest city (Buffalo City), and in the better-capacitated district municipalities (especially in the Western Cape Province), in national and provincial organizations, and amongst consultants.

The major constraints for effective adoption at the municipal level are a lack of awareness of the significance of biodiversity for social and economic sustainability, and poor governance and capacity in municipal organizations. Because of the high levels of poverty and unemployment in our planning region, much greater emphasis is given to the social and economic pillars of sustainability; generally, biodiversity and the natural environment concerns are associated with the wealthy elite (see Turpie, 2003) and not regarded as a priority. Envisaging a healthy biosphere as the foundation for economic and social well being (Orr, 2002a; Dawe and Ryan, 2003), or even as one of the three equally important pillars of sustainability, is certainly not a widely held view amongst municipal officials in the planning region. However, when expressed in terms of clean water, sufficient forage for livestock, and a supply of wild plants for food and medicine, biodiversity and the environment have much more meaning for the rural poor, as revealed in meetings between one of us (SMP) and officials and councillors from impoverished and poorly capacitated municipalities. More effort is required to clarify the significance of biodiversity to human well-being in these municipalities.

Along with a lack of awareness of biodiversity issues, a lack of capacity and poor governance in many municipalities in the planning region, there are a number of characteristics which are also hindrances to effective integration or mainstreaming of biodiversity concerns into land-use planning (Smith et al., 2003). The amalgamation of small neighbouring urban municipalities, a skills exodus, large backlogs for social delivery to the very poor, and the additional burden of servicing expanded rural areas, have placed a huge strain on the new municipal structures (Retief and Sandham, 2001). In most municipalities, ecosystem services are poorly understood, under supported and not co-ordinated, and capacity for environmental conservation is mostly non-existent. A weak non-governmental organization sector (at least in conservation) greatly hinders opportunities for effective partnerships for achieving environmental sustainability (Wells and Brandon, 1993; Steiner et al., 2003).

In order for widespread adoption of the products to occur throughout the planning region, much more attention needs to be given to creating more effective and accountable governmental and non-governmental organizations and institutions at the local scale (Burbidge and Wallace, 1995; Brunckhorst, 1998). Hopefully, an increasing awareness and appreciation of the value of biodiversity to material and spiritual well being (Orr, 2002b) will be achieved by the capacity building project for training municipal officials and councilors in the use of the STEP Handbook and Mapbook. The project also intends to expand the guidelines to incorporate all provincial and national government sectors that influence land-use decision-making.

5.6. General critique and suggestions for improvement

The overall approach we have adopted for this study has many shortcomings. Fortunately, planning is an ongoing activity and Spatial Development Frameworks must, by law, be repeated every five years. Therefore, there are many opportunities to improve the conservation assessment products to enable stronger integration into municipal land-use planning. Below we provide some suggestions.

While the Handbook was aimed at increasing awareness of the value of biodiversity for the range of services it provides, our conservation planning assessment used biodiversity features that emphasized existence rather than use values. Nonetheless, many of the features that we have targeted are of great value to other sectors with which alliances should be formed (Johns, 2003), namely tourism (e.g. sand movement corridors for beach replenishment, natural scenery and wildlife), water (mountain catchments, riverine corridors and wetlands) and agriculture (habitat for pollinators, grazing resources, cut flowers). The conservation of priority natural habitat adjacent to urban areas involves high opportunity costs. However, the retention of such areas provides an opportunity to re-connect the urban poor to biodiversity (Pyle, 2003) and maintain unbroken the heritage of indigenous knowledge and biodiversity-based tradition that exists amongst rural migrants who now live in urban centres (e.g. Cocks and Wiersum, 2003).

The features that support the services described above can be envisaged as critical natural capital, defined by Ekins et al. (2003) as "natural capital which is responsible for important environmental functions and which cannot be substituted in the provision of these functions by manufactured capital". We propose that stakeholders be involved in identifying and mapping different forms of critical natural capital, and also in communicating its importance for sustainability to government and civil society. While economic assessments of the value of this capital would be welcome, we believe that impassioned narratives (Johns, 2003), fierce lobbying, effective social marketing and other normative actions are likely to be more effective than often dubious monetary values (Chiesura and De Groot, 2003) in integrating the conservation of these features into land-use planning. Once the features associated with critical natural capital have been mapped, it will be possible to assess the extent to which they have achieved the biodiversity-based conservation targets. Assuming the establishment of effective lobby groups to protect the natural capital features, the responsibilities of the conservation sector may shrink significantly as a greater slice of the citizenry is marshalled to protect biodiversity. Moreover, a greater overall portion of intact habitat may be included in the protection sphere, since the maintenance of some services may require habitat for which biodiversity targets have already been achieved.

This brings us to the second major shortcoming of our approach. Other than the Megaconservancy Networks where connectivity for the maintenance of ecological processes is central, in cases where spatial options still exist, our approach is very silent on exactly where natural habitat should be retained. We recommend (Table 3) that down to a certain threshold, loss of habitat can be tolerated in areas categorized as currently not vulnerable. Two problems arise. Firstly, this contradicts the land-use planners' perception towards avoiding development in currently "wild" areas; secondly, we are mute regarding the configuration of habitat loss and the impacts of progressive habitat fragmentation on the persistence of biodiversity (Theobald et al., 1997; Fahrig, 2001; Flather and Bevers, 2002; Desmet, 2004; see Section 5.2). These problems are overcome to a certain extent by mapping the spatial components of processes required for the maintenance of biodiversity. Mapping of critical natural capital may also ensure the retention of tracts of landscape that are larger than areas required by the biodiversity targets alone. However, in a perpetual growth economy, development and, hence, habitat fragmentation, have to occur somewhere. Our recommendation is to locate new development in areas where considerable options remain to achieve targets. We do acknowledge that more attention must be given to the configuration of habitat required for target achievement and biodiversity persistence.

Finally, the process of uptake and application of these products by land-use planners requires monitoring. No such programme is yet in place, although this will form part of the training project discussed above. We support the assertion of Theobald et al. (2000) that the ability of implementers to describe the goals of programmes such as the STEP Project, is an (at least) equally important measure of success of conservation programmes as are measures of biodiversity features under conservation management. People are, after all, not only the cause of the need for conservation efforts, but also the solution.

Ours is a tentative step to bridge the gap between systematic conservation assessment and land-use planning, and to ensure the integration of our products into land-use decision-making. It is much too early to say whether we have been successful, although the products are already being used as inputs for land-use planning. Given that ongoing habitat loss is the greatest pressure facing biodiversity, our approach represents an attempt to turn the tide by persuading land-use planners to focus development away from the areas most in need of conservation. The land-use guidelines given in the Mapbook enable biologically informed decisions to be made regarding retention of habitat and its loss to development, and highlight opportunities for biodiversity-friendly development in priority areas. Thus, they embody a less conflict-ridden and crisis-centred approach to conservation than is commonly the case (Redford and Sanjayan, 2003). It is still early in the day, but we believe this will be good news not only for biodiversity conservation, but also for the people who depend upon it.

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Appendix IV

Designing Systematic Conservation Assessments that Promote Effective Implementation: Best Practice from South Africa

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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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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.

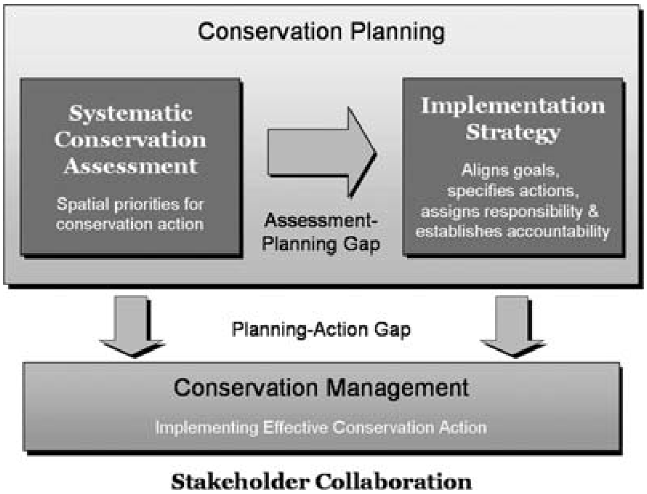

*Figure 1. A systematic conservation assessment is only one component of a conservation planning process and should be complemented with a process for developing an implementation strategy in the context of stakeholder collaboration. The "knowing-doing gaps" (Pfeffer & Sutton 1999), composed of the assessment-planning 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*).

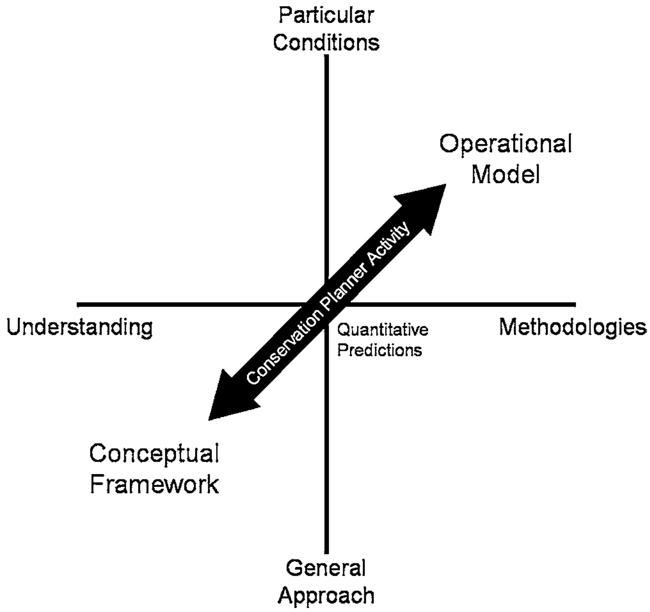

Figure 2. An effective conservation planner moves between a conceptual framework that aims to provide a general understanding of social-ecological systems and the role and approach of conservation planning processes and an operational model that aims to provide methodologies on how to "do" conservation 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 produces 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 literature 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.

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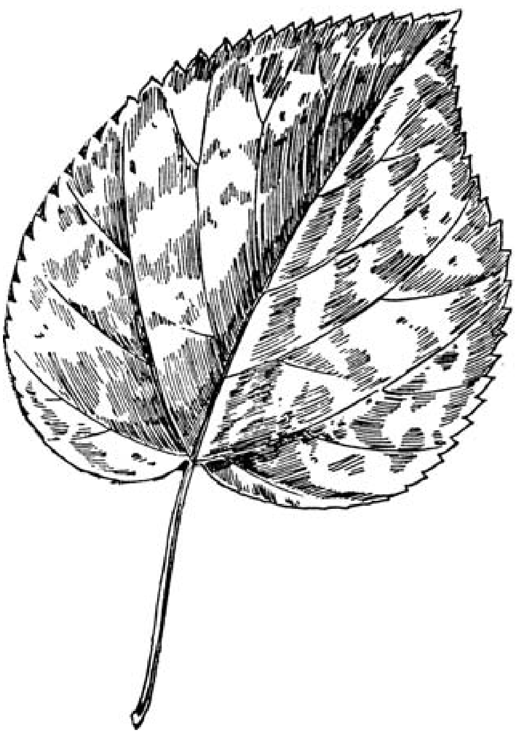

Appendix V – Interview Survey Questionnaire

Land-Use & Livelihoods Project
Landowner Questionnaire

Designed by Andrew Knight with review from
Dr. Andrew Ainslie, Lorena Pasquini, and Dr. Sheona Shackleton

Interviews conducted with landowners and managers
June to November 2006, Albany District, Eastern Cape, South Africa

Interview Code: ________ Date of interview ________ Interview location ___________________

Interviewee Personal and Farm Information

Landowner Name – ____

Property Name(s) – ____

FKMCN Sub-region – North / Central / Southern

Show landowner the wall map

1.01) Can you identify your property on this map?

1.02) How many years have you lived on this property? ______years

1.03) How many years have you owned this property? ______years

1.04) How many generations has this property been in your family? ______generations

1.05) How many years have you been farming? ______years

1.06) How many hours do you work a week? ______hours

1.07) Does the bulk of your income derive from on-farm or off-farm activities?

1.08) Land uses (rank by largest area)

sheep grazing	angora grazing	goats grazing	cattle grazing	game – venison	game – eco-tourism	cropping (list types)	Other

1.09) From which activity does your largest income derive from? (rank by largest proportion of income)

sheep grazing	angora grazing	goats grazing	cattle grazing	game – venison	game – eco-tourism	cropping (list types)	Other

<u>Conservation Knowledge (9)</u>

		No	Yes	Sort of
9.01	Were you aware, prior to this interview, that Valley Bushveld forms part of a globally important "hotspot" for plants and animals?	0	2	1
9.02	Can you tell me why "hotspots" are regarded as important?	0	2	1
9.03	Do you read books on ecology, the environment, valley bushveld?	0	2	1
9.04	Do you know what the "IUCN Red Data List" is?	0	2	1
9.05	Do you know that landowners have a legal obligation to clear invasive alien plants from their properties?	0	2	1
9.06	Were you aware, prior to this interview, a permit is required to clear or plough virgin land?	0	2	1
9.07	Do you know which government department or person you can contact should you wish to obtain such a permit?	0	2	1
9.08	Do you know what the responsibility of the Eastern Cape Parks Board is?	0	2	1
9.09	Have you heard of the STEP Project?	0	2	1
9.10	Do you know that there are government prescribed stocking rates?	0	2	1
9.11	Do you know what the government prescribed stocking rates are for your farm?	0	2	1
9.12	Do you adhere to these government prescribed stocking rates? If not, why not?	0	2	1

Conservation Behaviour (10)

		No	Yes	Sort of
10.01	Have you removed any alien plants from your property in the last 2 years?	0	2	1
10.02	Have you undertaken any soil conservation measures for reducing soil erosion in the last 2 years?	0	2	1
10.03	Have you undertaken any nature conservation activities for any plants in the last 2 years (e.g., surveys, restoration)?	0	2	1
10.04	Have you undertaken any nature conservation activities for any animals in the last 2 years (e.g., surveys, re-introductions)?	0	2	1
10.05	If bush encroachment is occurring on your property, do you actively attempt to manage it?	0	2	1
10.06	Do you formally monitor veld condition using a recognised method?	0	2	1
10.07	Do you run any ecotourism activities on your farm?	0	2	1
10.08	Have you attended any STEP Project workshops or meetings?	0	2	1

Entrepreneurship (11)

Need for achievement		Strongly disagree	Disagree	Neutral / unsure	Agree	Strongly Agree
11.01	I want to make my mark in the farming profession	1	2	3	4	5
11.02	I am driven by the desire to succeed at farming	1	2	3	4	5
11.03	My professional success is an important legacy for my children	1	2	3	4	5

Need for autonomy – desire to work for self		Strongly disagree	Disagree	Neutral / unsure	Agree	Strongly Agree
11.04	I enjoy being self-employed	1	2	3	4	5
11.05	By being self-employed I can achieve things I wouldn't otherwise be able to achieve	1	2	3	4	5
11.06	I am more professionally satisfied being my own boss than working for somebody else	1	2	3	4	5

Need for autonomy – willingness to listen to advice and guidance of others		Strongly disagree	Disagree	Neutral / unsure	Agree	Strongly Agree
11.07	I believe that other farmers can provide me with useful advice regarding my business	1	2	3	4	5
11.08	I would benefit from doing a business course at a Technicon, college or university	1	2	3	4	5
11.09	Whilst I know a lot about how to be a successful farmer, I don't know everything	1	2	3	4	5

Centre of control		Strongly disagree	Disagree	Neutral / unsure	Agree	Strongly Agree
11.10	The course of my life is determined by my own actions	1	2	3	4	5
11.11	I do not require the assistance of anyone else to achieve the goals I set for myself	1	2	3	4	5
11.12	The actions of others do not over-ride my control of the direction of my life	1	2	3	4	5

Opportunistic		Strongly disagree	Disagree	Neutral / unsure	Agree	Strongly Agree
11.13	I believe that I have the ability to identify emerging new business opportunities	1	2	3	4	5
11.14	I believe that I have the ability to adjust my farming business to capitalise on emerging opportunities	1	2	3	4	5
11.15	I actively seek opportunities for improving my farming business	1	2	3	4	5

11.16) Are you hampered by any circumstances which inhibit your ability to capitalise on opportunities?

___

___

___

Creativity and innovativeness		Strongly disagree	Disagree	Neutral / unsure	Agree	Strongly Agree
11.17	I want to be known as an innovator amongst my colleagues	1	2	3	4	5
11.18	I believe I have what it takes to be an innovative farmer	1	2	3	4	5
11.19	I have a feeling of success or pride when I do something innovative	1	2	3	4	5

Calculated risk taking – awareness of risk		Strongly disagree	Disagree	Neutral / unsure	Agree	Strongly Agree
11.20	Successful farmers are likely to have taken some chances along the way	1	2	3	4	5
11.21	I am a risk-taker compared to most other farmers I know	1	2	3	4	5
11.22	I am prepared to take significant risks if the returns are large enough	1	2	3	4	5

Calculated risk taking – strategy for dealing with risk		Strongly disagree	Disagree	Neutral / unsure	Agree	Strongly Agree
11.23	I put measures in place to cover myself against the business risks I take	1	2	3	4	5
11.24	I believe that diverse businesses are more resilient businesses	1	2	3	4	5
11.25	It is important to have a strategy in place for dealing with risk	1	2	3	4	5

11.26) What measures do you put in place, if any, to offset any business risks?

___

___

___

Entrepreneurial Behaviour		Strongly disagree	Disagree	Neutral / unsure	Agree	Strongly Agree
11.27	I have taken practical steps to diversify my business	1	2	3	4	5
11.28	I investigate new ways of doing things	1	2	3	4	5
11.29	I have taken chances in an attempt to achieve my business goals	1	2	3	4	5

11.30) Have you attempted to diversify your business in the last 5 years? If so, how?

___

___

Burn-out Potential – How Are You Doing? (12)

How Often:	0	1	2	3	4	5	6
	Never	A few times a year or less	Once a month or less	A few times a month	Once a week	A few times a week	Every day

	How Often: 0-6	Statements
12.01		I feel emotionally drained from my work.
12.02		I feel used up at the end of the work day.
12.03		I feel fatigued when I get up in the morning and have to face another day working.
12.04		I can easily understand how my staff feel about things.
12.05		I feel I treat some staff as if they were impersonal objects.
12.06		Working with people all day is really a strain for me.
12.07		I deal very effectively with the problems of my staff.
12.08		I feel burned out from my work.
12.09		I feel I'm positively influencing other people's lives through my work.
12.10		I've become more callous toward people since I took this job.
12.11		I worry that this job is hardening me emotionally.
12.12		I feel very energetic.
12.13		I feel frustrated by my job.
12.14		I feel I'm working too hard on my job.
12.15		I don't really care what happens to some staff.
12.16		Working with people directly puts too much stress on me.
12.17		I can easily create a relaxed atmosphere with my staff.
12.18		I feel exhilarated after working closely with my staff.
12.19		I have accomplished many worthwhile things in this job.
12.20		I feel like I'm at the end of my rope.
12.21		In my work, I deal with emotional problems very calmly.
12.22		I feel staff blame me for some of their problems.

Collaboration Willingness Index (13)

	Agency	Willing to work with them?			Rate your willingness to work with each agency you answered "Yes" to work with				
	National Government	**No**	**Yes**	**Not sure**	**Very Low**	**Low**	**Mod.**	**High**	**Very High**
13.01	Dept. Agriculture	0	2	1					
13.02	Dept. Environmental Affairs	0	2	1					
13.03	Dept. Land Affairs	0	2	1					
13.04	Dept. Water Affairs & Forestry	0	2	1					
13.05	South African National Parks	0	2	1					
13.06	South African Police Service	0	2	1					
13.07	South African National Biodiversity Institute	0	2	1					
	Provincial / Local Government			1					
13.08	Eastern Cape Parks Board	0	2	1					
13.09	Dept. Econ. Affairs, Environment & Tourism	0	2	1					
13.10	Local Municipality	0	2	1					
13.11	District Municipality	0	2	1					
	Non-Government Organisations								
13.12	Wildlife & Environment Society of South Africa	0	2	1					
13.13	Botanical Society of South Africa	0	2	1					
13.14	Wilderness Foundation	0	2	1					
13.15	Landmark Foundation	0	2	1					
	Research Organisations								
13.16	Agricultural Research Council	0	2	1					
13.17	Rhodes University	0	2	1					
13.18	Nelson Mandela Metropolitan University (formerly University of Port Elizabeth)	0	2	1					
13.19	University of Fort hare	0	2	1					
	Private Organisations								
13.20	Your Conservancy	0	2	1					
13.21	A neighbouring Conservancy	0	2	1					
13.22	Your Farmers Association	0	2	1					
13.23	A neighbouring Farmers Association	0	2	1					
13.24	Your Industry group (please name it)	0	2	1					
13.25	Private consultant	0	2	1					
13.26	Other (please specify)	0	2	1					

Willingness to be Involved in Nature Conservation (13)

		Strongly disagree	Disagree	Neutral / unsure	Agree	Strongly Agree
13.27	Nature conservation activities are compatible with running an agricultural or game-based business	1	2	3	4	5
13.28	It is possible for me to consider conserving land that is useful for agricultural production	1	2	3	4	5
13.29	Protecting intact areas of vegetation on my farm offers me significant advantages	1	2	3	4	5
13.30	Problem animals can be managed in ways other than culling	1	2	3	4	5
13.31	I am passionate about the conservation of nature and wildlife	1	2	3	4	5
13.32	If my livelihood could be assured, I would reduce my production activities to undertake nature conservation activities	1	2	3	4	5

Institutions and Networks (Social Capital)

Local sense of belonging (16)

Show landowner the wall map

16.01) Can you draw a line around 'your community' on this map?

		Strongly disagree	Disagree	Neutral / unsure	Agree	Strongly Agree
16.02	I feel a sense of belonging to my community	1	2	3	4	5
16.03	Generally speaking, most people in my community can be trusted	1	2	3	4	5
16.04	I do not worry that my home will be broken into	1	2	3	4	5
16.05	I do not worry that my stock, game or produce will be stolen	1	2	3	4	5
16.06	I was keen to vote in the recent Municipal elections	1	2	3	4	5
16.07	If I have a problem, or something is worrying me, I have people outside my family that I can turn to	1	2	3	4	5
16.08	If I assist a neighbour in some way, I anticipate that he/she will assist me in the future	1	2	3	4	5
16.09	If a neighbour assists me in some way, he/she anticipates that I will assist him/her in the future	1	2	3	4	5

		once a year or less	once in six months	once a month	once a fortnight	once a week or more
16.10	My neighbours and I help each other with work-related matters (e.g., fencing) :	1	2	3	4	5
16.11	My neighbours and I loan each other resources, equipment or staff :	1	2	3	4	5

Local Networks (17)

Are you a member of any local farming / business organisations?					How often are you involved (on average) in activities with this group?				
		No	Yes	Was once	once a year or less	once in six months	once a quarter	once a month	once a week or more
17.01	Farm Watch / Commandoes	0	2	1	1	2	3	4	5
17.02	Conservancy	0	2	1	1	2	3	4	5
17.03	Farmers Association	0	2	1	1	2	3	4	5
17.04	Landcare group	0	2	1	1	2	3	4	5
17.05	Holistic Farming group	0	2	1	1	2	3	4	5
17.06	Industry co-operative	0	2	1	1	2	3	4	5
17.07	Local Business Council	0	2	1	1	2	3	4	5
17.08	Reserve m'gement committee	0	2	1	1	2	3	4	5
17.09	ECGMA	0	2	1	1	2	3	4	5
17.10	Local industry group (1)	0	2	1	1	2	3	4	5
17.11	Local industry group (2)	0	2	1	1	2	3	4	5
17.12	Local industry group (3)	0	2	1	1	2	3	4	5
17.13	Other (please specify)	0	2	1	1	2	3	4	5
17.14	Other (please specify)	0	2	1	1	2	3	4	5

Are you a member of any local social organisations?					How often are you involved in activities?				
		No	Yes	Was once	once a year or less	once in six months	once a quarter	once a month	once a week or more
17.15	Tennis club	0	2	1	1	2	3	4	5
17.16	Cricket club	0	2	1	1	2	3	4	5
17.17	Golf club	0	2	1	1	2	3	4	5
17.18	Hunting club	0	2	1	1	2	3	4	5
17.19	Rugby club	0	2	1	1	2	3	4	5
17.20	Botanical Society of SA	0	2	1	1	2	3	4	5
17.21	Children's school group	0	2	1	1	2	3	4	5
17.22	I phone my neighbours:	0	2	1	1	2	3	4	5
17.23	I socialise with people in my community :	0	2	1	1	2	3	4	5
17.24	I attend Agricultural Shows, etc:	0	2	1	1	2	3	4	5
17.25	I am involved in voluntary local community service activities:	0	2	1	1	2	3	4	5
17.26	Church or religious group	0	2	1	1	2	3	4	5
17.27	Other (please specify)	0	2	1	1	2	3	4	5

17.18) On this map could you describe your relationship with each of your neighbours, using the following categories Show landowner the local map:

1	2	3	4	5
No relationship	Poor relationship	Reasonable relationship	Good relationship	Excellent relationship

Broader Networks (19)

Are you a member of any regional or national organisations?					How often are you involved (on average) in activities with this group?				
		No	Yes	Did once	once a year or less	once in six months	once a month	once a fortnight	once a week or more
19.01	I have a working relationship with a researcher. WHO?	0	2	1	1	2	3	4	5
19.02	I have a working relationship with an NGO (e.g., WESSA) WHO?	0	2	1	1	2	3	4	5
19.03	I attended STEP programme meetings over the last five years	0	2	1	1	2	3	4	5
19.04	I am a member of the Botanical Society of S Africa	0	2	1	1	2	3	4	5
19.05	I attend meetings of the local municipality	0	2	1	1	2	3	4	5
19.06	I attend meetings of the provincial government	0	2	1	1	2	3	4	5
19.07	I attend meetings of the national government	0	2	1	1	2	3	4	5
19.08	Indalo	0	2	1	1	2	3	4	5
19.09	EC Game Man. Assoc.	0	2	1	1	2	3	4	5
19.10	Thicket Forum	0	2	1	1	2	3	4	5
19.11	Regional industry group (1)	0	2	1	1	2	3	4	5
19.12	National industry group (1)	0	2	1	1	2	3	4	5
19.13	Other (please specify)	0	2	1	1	2	3	4	5

19.14) How many times in 2005 did you receive support from an extension officer? Which agency / organisation?

	Rating	Agency(s)
1	Never	
2	One time	
3	Two times	
4	Three times	
5	Four times	
6	More than four times	

19.15) How would you rate the quality of the support?

0	1	2	3	4	5
No visit from extension staff	Poor	Satisfactory	Reasonable	Good	Excellent

<u>Confidence in Government (18)</u>

18.01) What issues regarding government, at any level, concern you the most?

____
____
____
____
____

		Strongly disagree	Disagree	Neutral / unsure	Agree	Strongly Agree
18.02	My **local municipality** is doing a good job at meeting it's responsibilities to the people in our community	1	2	3	4	5
18.03	My **provincial government** is doing a good job at meeting it's responsibilities to the people in our province	1	2	3	4	5
18.04	My **national government** is doing a good job at meeting it's responsibilities to South African people	1	2	3	4	5
18.05	My **local police force** is doing a good job at meeting it's responsibilities to the people in our community	1	2	3	4	5
18.06	I feel that me and other farmers are strongly supported by Government	1	2	3	4	5
18.07	I believe that government listens to me if I speak	1	2	3	4	5
18.08	I believe that I can influence decisions affecting my community	1	2	3	4	5
18.09	By working together, people in my community can influence decisions that affect our community	1	2	3	4	5
18.10	My opinion of government has improved over the last 10 years	1	2	3	4	5
18.11	If I have a concern regarding a local issue, my local municipality will listen and act upon my concern	1	2	3	4	5
18.12	The money I pay through income tax is generally being well spent	1	2	3	4	5
18.13	It is important to vote in national and provincial elections	1	2	3	4	5
18.14	I am concerned about the direction of the land reform process	1	2	3	4	5

Who Are Your Local Champions? (15)

15.01) Do you hold any leadership positions in any local groups, e.g. Farmers Association, conservancy, industry group, or local sporting organisation?

____
____
____
____
____

		Strongly disagree	Disagree	Neutral / unsure	Agree	Strongly Agree
15.02	I enjoy being in leadership roles	1	2	3	4	5
15.03	I enjoy working with people towards a common goal	1	2	3	4	5
15.04	I'm committed to making my local community a better place to live	1	2	3	4	5
15.05	It is important that I attend meetings of local organisations	1	2	3	4	5
15.06	I keep myself informed with 'goings-ons' in my community and the region	1	2	3	4	5
15.07	I would describe myself as "self-motivated"	1	2	3	4	5
15.08	I would describe myself as "someone who gets things done"	1	2	3	4	5
15.09	I generally have very good relations with my neighbours	1	2	3	4	5
15.10	I am passionate about nature conservation	1	2	3	4	5
15.11	I am passionate about farmers rights and welfare	1	2	3	4	5
15.12	I believe in facilitating good communication	1	2	3	4	5
15.13	Once I set my mind on a task I will see it through to the end	1	2	3	4	5

15.14	Can you identify any influential, well-respected people in your community?	Does this person hold any leadership positions?	Contact details
1			
2			
3			

<u>Willingness To Be Involved</u> (25)

SHOW LANDOWNER LIST OF INSTRUMENTS – Explain to landowners about the suite of instruments, how binding & voluntary conservation agreements differ, what we're keen to understand about them, and how incentives work as a trade-off against production

	Instruments	Strongly disagree	Disagree	Neutral / unsure	Agree	Strongly Agree
25.01	I believe that my farming venture would benefit if I became a partner to one of the conservation incentives outlined	1	2	3	4	5
25.02	I would be interested in possibly becoming a partner in a **voluntary conservation agreement** for my property, even without receiving incentives	1	2	3	4	5
25.03	I would be interested in possibly becoming a partner in a **binding conservation agreement** for my property, even without receiving incentives	1	2	3	4	5
25.04	I would be interested in possibly becoming a partner in a **Landcare group**, even without receiving incentives	1	2	3	4	5
25.05	I would be interested in possibly becoming a partner in a **carbon banking programme**, even without receiving incentives	1	2	3	4	5
25.06	I would be interested in possibly becoming a partner in a **common property resource management agreement**, even without receiving incentives	1	2	3	4	5
25.07	I would be interested in possibly becoming a partner in an **extension service programme**, even without receiving incentives	1	2	3	4	5

25.08) What incentives would be useful in encouraging you to join a voluntary conservation agreement?

How interested would you be to receive each *incentive*?		25.23) Rank best incentive for you	Not at all interested	Possibly interested	Neutral / unsure	Interested	Very interested
25.09	Tax rebate		1	2	3	4	5
25.10	Rates rebate		1	2	3	4	5
25.11	Vegetation fencing subsidy		1	2	3	4	5
25.12	Soil erosion works subsidy		1	2	3	4	5
25.13	Financial payment (direct payment)		1	2	3	4	5
25.14	Targeted alien plant removal by Working for Water		1	2	3	4	5
25.15	Access to a support network of like-minded landowners		1	2	3	4	5
25.16	Signage for voluntary conservation agreement membership		1	2	3	4	5
25.17	Extension officer support		1	2	3	4	5
25.18	Access to scientific information and support		1	2	3	4	5
25.19	Access to eco-tourism support		1	2	3	4	5
25.20	Other		1	2	3	4	5

	Reduced production	Strongly disagree	Disagree	Neutral / unsure	Agree	Strongly Agree
25.21	I would consider reducing my production activities (e.g., stocking rates) even if I wasn't offered incentives which offset my losses from reduced production	1	2	3	4	5
25.22	I would consider reducing my production activities (e.g., stocking rates) if offered appropriate incentives which offset my losses from reduced production	1	2	3	4	5

Section 2. Land-Use Pressures

Intention to clear (7)

Show the landowner the map of land management units, and explain what LMUs are

7.01) You have ______ land management units on your property(s) ______________________. These are:

	Land management units	
LMU No.	**Property**	**Vegetation type**
01		
02		
03		

		Strongly disagree	Disagree	Neutral / unsure	Agree	Strongly Agree
7.02	All the different LMUs on my property are equally valuable for my farming enterprise	1	2	3	4	5
7.03	LMU01 is essential for my farming enterprise	1	2	3	4	5
7.04	LMU02 is essential for my farming enterprise	1	2	3	4	5
7.05	LMU03 is essential for my farming enterprise	1	2	3	4	5

Please rate your current intention to clear each land management unit:

	Land management units	Already cleared Yes / No	Currently clearing or have submitted clearing application	Strongly thinking of clearing	Unsure if to clear or not	Unlikely to clear	Will never clear
7.06	LMU01		1	2	3	4	5
7.07	LMU02		1	2	3	4	5
7.08	LMU03		1	2	3	4	5

Conservation Instruments

Likelihood of selling property (24)

Explain to landowners about the suite of instruments and what we're keen to understand about them

		Strongly disagree	Disagree	Neutral / unsure	Agree	Strongly Agree
24.01	I am currently thinking of selling my property	1	2	3	4	5
24.02	I would never sell my property, but intend to pass it on to my immediate family or relatives	1	2	3	4	5
24.03	My family has made arrangements (e.g. a succession plan) for the transfer of my property to the next generation	1	2	3	4	5
24.04	I would preferentially sell my property to a nature conservation organisation (e.g., SANP, ECPB) than any other private buyer	1	2	3	4	5

24.05	I am thinking of selling my property…	Never	This year	Next year	3-5 years	6-10 years	11-20 years	21-30 years	31-40 years

Interviewee Personal Information

e-mail: ________________________________ Tel: _______________

1.10) Landowner gender: Female / Male 1.17) Age: ______

1.11) Landowner race:

(White) English	(White) Afrikaans	Xhosa	Coloured	Other

1.12) What language do you primarily use at home?

English	Afrikaans	Xhosa	Zulu	Other

1.13) What language is primarily used with farm staff?

English	Afrikaans	Xhosa	Zulu	Other

1.14) Marital status

Single	Married	Divorced	Widowed	Other (please specify)

1.15) Gender and ages of children: 1)________________________ 5)________________________
2)________________________ 6)________________________
3)________________________ 7)________________________
4)________________________ 8)________________________

1.16) Level of education completed:

Junior school	High school	Diploma	Did some University	Full degree	MSc degree	PhD degree	Other (please specify)

Appendix VI – Pictorial

Images of Activities and Experiences

A selection of images to capture the 'learning-by-doing' experience

1a. Classic Albany Spekboomveld, with many locally endemic plant species, e.g. *Euphorbia tetragona*

1b. The Groot Rivier Poort in the heart of the Subtropical Thicket biome

2a. Visioning at the STEP Strategy Workshop, Seaview 2003

2b. Break-away group at STEP Strategy Workshop Seaview 2003

3a. Presenting at the East London STEP Handbook Workshop June 2003

3b. Discussing STEP Conservation Priority Mapping, East London STEP Handbook Training Workshop June 2003

4a. Opening Thicket Forum 2006, trialling the 'new' workshop format

4b. Thicket Forum fieldtrip to 'Radway Green' owned by Leonie and Rodney Yendall 2006

5. Filming for 50/50 television show in 2003

6. Grahamstown Land-Use & Livelihoods Project meeting for agency staff, May 2004

7. STEP Project display at the Kirkwood Wildlife Festival 2004

8. Interviewing Albany farmer John Sparks, Koonap Post Remainder 2006