The role and use of experts and expert knowledge in spatial conservation prioritization

by

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English abstract

Decision-making in conservation should be efficient and effective as time and resources are typically limited. Conservation planning is one process by which stakeholders collaboratively make decisions when attempting to ensure the persistence of biodiversity. Spatial prioritization is the activity of applying quantitative data to spatial analysis to select locations for conservation investment and is a distinct process within conservation planning.

The use of experts in spatial prioritization, and more generally in conservation planning, is widely accepted and advocated, but there is no general operational model for how best to involve them. Acceptable standards of practice in selecting experts and in applying specific techniques for eliciting expert knowledge need to be developed and tested in different contexts to ensure robust and defensible results of spatial prioritization processes.

Although experts and expert knowledge have limitations, including them in spatial prioritization can produce many benefits, such as increased robustness of decisions and time and cost savings. Timeous, decisive, cost-efficient and robust decision-making is essential when attempting to stem the continued loss of biodiversity across the world. Although widely used, very little research has been conducted into the role of experts in spatial prioritization processes.

In this research, the role and use of experts and expert knowledge in spatial prioritization was explored through the following processes:

1) a review of the peer-reviewed literature examining the role, and different types, of experts included in spatial prioritization studies (Chapter 2) to identify the patterns of their involvement;

2) a study examining the process and the differences between individual and group expert outputs and outcomes produced from a typical spatial prioritization workshop to provide a baseline against which experts might be identified for future involvement (Chapter 3); and

3) a study examining the knowledge of local community and land management experts and their ability to predict private landowners self-reported attitudes towards conservation, willingness to partner with organizations and behavior relating to conservation, aimed to test if expert knowledge might replace interviews when mapping conservation opportunity (Chapter 4).

The main findings of this research are, firstly, that experts primarily contributed to spatial prioritization through mapping of species, habitats and ecosystems (that can be input into spatial prioritization analyses), and specifically also the selection of areas important for implementing conservation action (e.g., priority conservation areas).

Secondly, individual experts contributed different expertise to the spatial prioritization processes in which they were involved, sometimes despite being considered experts in the same field. Individual experts differed to each other in the knowledge they contributed, decisions they made, and in the information content and its spatial representation. Groups of experts collaborating to produce the same information were more effective at capturing expert knowledge than individuals.

Thirdly, when seeking to map human and social data to inform the mapping of conservation opportunity, experts were unable to reliably score private landowner's attitudes towards conservation, willingness to partner with organizations and behavior relating to conservation. Experts were able though, to provide accurate knowledge on the general attitudes of landowners, the context of the area in which the research was conducted, and the challenges that landowners in the area face.

Collectively, this research can be used to inform the development of standards of best practice to ensure the most effective and cost efficient approach to integrating spatial prioritization software with expert knowledge.

Afrikaans abstract

Besluitneming in bewaring moet doeltreffend en effektief wees omdat tyd en hulpbronne skaars is. Bewaringsbeplanning is een proses waardeur aandeelhouers gesamentlik besluite kan neem wanneer hul poog om die voortbestaan van biodiversiteit te verseker. Ruimtelike prioritisering verwys na die proses waar kwantitatiewe data toegepas word op ruimtelike analise om areas vir bewaringsbelegging te selekteer. Dit is ’n afsonderlike proses binne bewaringsbeplanning.

Die gebruik van deskundiges in die bepaling van ruimtelike prioritisering en meer algemene bewaringsbeplanning word wyd aanvaar en bepleit maar daar is geen algemene operationele model wat bepaal hoe om hul ten beste in te sluit nie. Aanvaarbare standaarde in die praktyk van die seleksie van kundiges en die aanwending van spesifieke tegnieke om kundige kennisstelsels uit te lok moet ontwikkel en getoets word in verskillende kontekste om robuuste en verdedigbare resultate te verseker.

Daar is baie voordele verbonde aan die gebruik van deskundiges en kundige kennisstelsels, ten spyte van hul beperkings. Voordele sluit onder andere tyd- en kostebesparings in. Tydige, beslissende, koste-effektiewe en robuuste besluitneming is noodsaaklik wanneer daar gepoog word om die voortdurende wêreldwye verlies aan biodiversiteit te stuit. Al word hul algemeen gebruik is daar nog baie min navorsing gedoen oor die rol van kundiges tydens die proses van ruimtelike prioritisering.

Die rol en gebruik van kundiges en kundige kennisstelsels in die bepaling van ruimtelike prioritisering is deur die volgende prosesse ondersoek:

1) ’n Oorsig van portuurbeoordeelde literatuur wat die rol van en verskillende tipes kuniges wat in ruimtelike prioritisering studies ingesluit word, bestudeer (Hoofstuk 2) ten einde die patrone van hul betrokkenheid te identifiseer;

2) 'n studie wat die proses en verskille tussen die insette en uitkomste van individuele en groepe kundiges, soos geproduseer by 'n tipiese ruimtelike prioritisering werkwinkel, bestudeer ten einde 'n grondlyn daar te stel waarteen kundiges vir toekomstige betrokkenheid geïdentifiseer kan word (Hoostuk 3); en

3) ’n bestudering van die kennis van plaaslike gemeenskaps- en grondbestuur kundiges en hul vermoë om privaat grondeienaars se selfgerapporteerde houdings teenoor bewaring, hul bereidwilligheid om met organisasies saam te werk en gedrag wat verband hou met bewaring te voorspel om te toets of kundige kennis onderhoude sal kan vervang tydens die kartering van bewaringsmoontlikhede (Hoofstuk 4).

Die vernaamste bevindinge van hierdie navorsing is, ten eerste, dat kundiges se primêre bydrae tot ruimtelike prioritisering plaasvind deur die kartering van spesies, habitats en ekosisteme (wat alles in ruimtelike prioritisering analise vervat kan word), en meer bepaald die seleksie van areas wat belangrik is vir die implementering van bewaringsaksie (bv. prioriteit bewaringsareas).

Tweedens, individuele kundiges se bydrae tot die ruimtelike prioritisering prosesse waar hul betrokke was, het verskil, selfs waar hul as kundiges in dieselfde veld beskou word. Individuele kundiges het van mekaar verskil ten opsigte van die kennis wat hul bygedra het, die besluite wat hul geneem het, die inhoud van inligting en die ruimtelike voorstelling daarvan. Groepe kundiges wat saamwerk om dieselfde inligting op te lewer was meer effektief in die vaslegging van kundige kennis as individuele kundiges.

Derdens, tydens die soeke na menslike en maatskaplike data om die kartering van bewaringsmoontlikhede in te lig was kundiges nie in staat is om 'n betroubare skatting van privaat grondeienaars se houdings teenoor bewaring, bereidwilligheid om saam met organisasies te werk en gedrag wat verband hou met bewaring te maak nie. Deskundiges kon egter akkurate kennis meedeel ten opsigte van die algemene houdings van grondeienaars, die konteks van die area van navorsing en die uitdagings wat grondeienaars in die spesifieke areas in die gesig staar.

Hierdie navorsing kan gesamentlik gebruik word om die ontwikkeling van standaarde van beste praktyk vas te stel om die mees doeltreffende en koste-effektiewe benadering tot die integrasie van ruimtelike prioritisering sagteware met deskundige kennis te verseker.

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Chapter 1: Introduction

Decision-making in conservation

Decision-making in conservation is challenging due to a combination of factors: resources and data are invariably limited, time frames in which to make decisions are often short, the complexity and dynamism of natural systems and processes tends to be very high, collaboration should involve multiple stakeholders who typically have divergent values and ideas on how to implement conservation actions, and the uncertainty of how natural and social systems will respond to management without any immediate feedback from decisions that have been made (Knight & Cowling 2007; Lombard et al. 2010; Burgman et al. 2011; Runge et al. 2011). Faced with the increasing loss of genes, species, ecosystems and ecosystem services throughout the world (Pimm & Raven 2000; Dirzo & Raven 2003), and taking into account these challenges, it has become increasingly important to make strategic conservation decisions that result in effective and efficient action.

Decisions in conservation can be made and informed in several different ways, including (perhaps most commonly) the intuition of managers (e.g. Sutherland et al. 2004; Roux et al. 2006), soliciting expert knowledge (e.g. Olivieri et al. 1995; Groves 2002; Cowling et al. 2003; Knight et al. 2006b; Conservation Measures Partnership 2007; Morrison et al. 2009), and the application of software based models, (e.g. Onal & Briers 2002; Sarkar et al. 2006). These may, or may not, be evidence based (Sutherland et al. 2004). Experts have, or continue to be, used in conservation planning, and specifically spatial prioritization processes (Cowling et al. 2003), but very little research has been conducted on the reliability (e.g., the thresholds of uncertainty) of their knowledge (Burgman et al. 2011) and/or how to involve them most effectively in conservation activities.

Experts, expert knowledge and spatial prioritization

Conservation planning, which integrates the processes of collaboration between stakeholders, spatial prioritization to identify regionally or locally areas important for implementing conservation actions and a process for developing an implementation strategy, forms a common basis for decision-making and the implementation of conservation action (Knight et al. 2006a; Margules and Sarkar 2007).

Spatial prioritization is the process of identifying areas, through the application of quantitative data to spatial analysis, important for implementing effective and cost-efficient conservation actions that achieve conservation targets (Knight et al. 2006a; Wilson et al. 2009). It forms part of the broader conservation planning process (Knight et al. 2006a; Margules and Sarkar 2007).

The activity of spatial prioritization has historically applied two different, but sometimes integrated methods. The first method promotes the use of expert knowledge (Cowling et al. 2003), which can be collected in various ways, for example, during workshops (e.g. Olivieri et al. 1995; Hannah et al. 1998; Dinerstein et al. 2000; Bojorquez-Tapia et al. 2003; Game et al. 2011), where a group of experts come together to provide data, make decisions and collaborate on a specific process (Olivieri et al. 1995), or through questionnaires (e.g. Maddock & Samways 2000), asking experts to draw areas important for species, habitats, ecosystems and/or their services using tools such as hard copy maps or geographic information systems (e.g. Thorbjarnarson et al. 2006), and consulting expert's one-on-one to provide specific data, insight and knowledge (Jongman 1995; Grantham et al. 2010). The second, and more recently developed, method advocates a systematic process of collecting data and using, typically, computer based algorithms to solve problems of regional protected area selection and design (e.g. Kirkpatrick 1983; Margules et al. 1988; Pressey & Nicholls 1989).

Experts are people who have specialist knowledge, insight and wisdom relating to a specific field or context which has been gained through life experience and/or formal training or education and/or immersing themselves in the specific field or context (Nowotny et al. 2001; Collins & Evans 2007; Kuhnert et al. 2010). There are different types of experts and expert knowledge (see Collins & Evans 2007 'The Periodic Table of Expertise'). Specialist tacit knowledge, comprising of interactional and contributory expertise, is wisdom or competence derived from being immersed in a certain practice, culture or society to a point where the expert is viewed as well-informed in that specific context (Nowotny et al. 2001; Collins & Evans 2007). Ubiquitous tacit knowledge is possessed by everyone, to a greater or lesser extent, depending on the extent of social immersion of the individual in the specific context (Collins & Evans 2007). The knowledge that indigenous people and cultures have of their immediate environment, known as local ecological knowledge (Steele & Shackleton 2010), can be either general or specialist, depending on individual's exposure and experience, as well as the extent of their knowledge (Chalmers & Fabricius 2007). Expert knowledge is most defensible, and reliable, if it is developed in a stable, predictable environment where the expert has the opportunity to continuously learn from these regularities and the feedback received from observations and decisions (Kahneman 2011).

The involvement of experts in spatial prioritization, and more generally in conservation planning processes, ensures better contextualized and effectively implementable plans (Cowling et al. 2003; Knight et al. 2006b). The most effective outcomes result when systematically gathered data plus expert knowledge are integrated through a process that applies computer-based algorithms to identify areas important for implementing conservation action and complementing this with expertise that better ensures the practical implementation of the plan (Dinerstein et al. 2000; Pressey & Cowling 2001; Cowling et al. 2003; Knight et al. 2006b). Experts can contribute by guiding the planning process, providing spatial information about species, habitat and ecosystem locations and distributions, especially in areas with no or poor data, and by providing context to research and planning to produce more scientifically and socially robust conservation planning processes (Dinerstein et al. 2000; Nowotny et al. 2001; Cowling et al. 2003; Conservation Measures Partnership 2007).

Although the biases involved in incorporating expert knowledge into spatial prioritization have been subject to preliminary investigation (Maddock & Samways 2000; Cowling et al. 2003), the degree of reliability of expert knowledge defined by levels of precision, accuracy and uncertainty, are rarely discussed or quantified (Burgman et al. 2011). Some of the limitations that have been identified include: 1) spatial bias; 2) thematic bias; 3) incomplete knowledge; and 4) expert knowledge does not always fill the gaps in available data as it may provide what is already known (Maddock & Samways 2000; Cowling et al. 2003).

Despite wide application, precisely what characteristics comprise a useful and reliable expert have not been defined for spatial prioritization, nor more generally for conservation planning. This includes an absence of understanding of how similar or contrasting individual experts and their knowledge are to one other. In the peer reviewed literature, the utility of expert knowledge is rarely discussed and best practice techniques for eliciting expert knowledge and integrating experts into spatial prioritization processes have not been formalized.

Aims of thesis

The topics covered by this thesis will probably be familiar to conservation practitioners involving experts in spatial prioritizations (e.g. Olivieri et al. 1995; Dinerstein et al. 2000; Wheeler et al. 2008; Didier et al. 2009).

This research aimed to examine the role and use of experts and expert knowledge in spatial prioritization through three complementary studies. The first aimed to explore where and how experts and their knowledge have been historically applied for spatial prioritization. This was done in order to identify patterns of expert involvement. The second study aimed to quantify the differences between three potential approaches of involving experts: 1) differences between individual experts, 2) differences between groups of experts, and 3) differences between individuals and groups. This was done by examining the process of, and experts experience with, mapping important areas for plant conservation as individuals and in groups during a workshop. The aim was to provide a baseline against which experts might be identified for future involvement. The third study examined the knowledge of local community and land management experts and their ability to predict private landowners self-reported attitudes towards conservation, willingness to partner with organizations and behavior relating to conservation. It aimed to test whether experts can replace interviews when mapping the social dimensions of conservation opportunity.

This thesis aimed to provide insights into how to improve the efficiency and effectiveness of spatial prioritizations involving experts. Through looking at the historical use, studying current processes of elicitation of experts, following the process of identifying experts in different contexts to be used in different aspects of the spatial prioritization and exploring the use of experts in identifying areas of conservation opportunity, the research aimed to discover optimal ways of selecting and involving experts in spatial prioritization.

Experts play a role in conservation decision-making, at various stages of the planning process, and therefore the influence they have in this process, and the limits and extent of their knowledge and involvement requires exploration and assessment (Nowotny et al. 2001; Cowling et al. 2003).

Thesis outline

This thesis consists of five chapters, three of which are presented as individual manuscripts planned for submission to international peer-reviewed journals. The first and last (fifth) chapters comprise an Introduction and a Conclusion. The introduction introduces and explores the questions which are being addressed through this research, providing context for the three main chapters. This body of research is synthesized, along with personal reflections of the lessons learnt, in the concluding chapter (Chapter 5).

The three manuscripts (Chapters 2, 3 and 4) stand alone and so some repetition, particularly in the introductions, is present due to the need to provide context separately for each paper. Although there are three independent manuscripts, they are designed to be complementary and so represent a coherent body of research into the role of experts in spatial prioritization.

The first manuscript, Chapter 2, comprises a review of the peer-reviewed literature on spatial prioritization, examining the use and role of experts in these processes. Various experts and expert knowledge has been included.

The second manuscript, Chapter 3, examines the process of, and the results from, a spatial prioritization workshop. An expert spatial prioritization was held to map important areas for plant conservation in the Nelson Mandela Bay Metropole in order to study the process and outputs from such a workshop.

The third paper, Chapter 4, compares human and social data, self-reported by private landowners on their attitudes, willingness to partner with organizations and behavior relating to conservation, to equivalent data collected from relevant experts. This was done through carrying out interviews with both landowners and experts, exploring the human and social factors relating to mapping conservation opportunity on private land.

Chapter 2: The use of experts and expert knowledge in spatial conservation prioritization: A literature review

Abstract

Experts and expert knowledge are used in spatial prioritization processes, but the extent and the manner in which it is incorporated has not been explicitly researched. This study aimed to explore when, how and what experts had been used in papers, published in the peer-reviewed literature, which carry out spatial prioritization between 1984 and 2010. A total of 394 papers were identified, of which 109 (27.7%) had included experts or expert knowledge in the spatial prioritization process. Ecological experts and species specific experts were predominantly used to map species localities and habitats and/or in selecting priority areas. In papers where the lead author was affiliated to a NGO or private research institution experts and expert knowledge were used significantly more than in papers where the lead author was affiliated to a university. Although experts are used in spatial prioritization, how they are selected and used, who they are and how many experts are used is not often explicitly stated. This makes the regulation and use of experts and expert knowledge challenging. In order to more effectively utilize and incorporate experts and expert knowledge in spatial prioritization processes further research needs to go into understanding experts, how they are selected to take part in spatial prioritization, the defensibility of the knowledge they provide and how best to elicit expert knowledge.

Key words

Experts; expert knowledge; spatial prioritization; literature review

Introduction

Conservation planning (Knight et al. 2006b; Margules & Sarkar 2007) has evolved to become a basis of conservation and land use management as well as planning (Balmford 2003; Pierce et al. 2005). The planning process is integral in selecting effective protected areas which are representative of the biodiversity in a specific area (Margules & Pressey 2000). The systematic conservation planning process consists of three main parts: 1) the social process of collaborating with relevant stakeholders, 2) spatial conservation prioritization and, 3) the development of conservation strategies, which result in implementation of conservation actions (Knight et al. 2006a; Margules and Sarkar 2007).

Spatial conservation prioritization is the activity of applying quantitative data to spatial analysis to select locations for conservation investment (Wilson et al. 2009). It aims to identify where specific instruments and incentives (i.e. actions) are to deliver effective and cost efficient conservation action. In this way it fits within the process of conservation planning (Margules and Sarkar 2007).

Early spatial prioritization processes were driven by ad hoc processes (Pressey 1994) and ecological principles such as the theory of island biogeography (Diamond 1976). Both quantitative conservation indices (Götmark et al. 1986) and spatial prioritization techniques, a systematic process of gathering relevant biological and socio-economic data specific to a planning region (Margules & Pressey 2000; Cowling & Pressey 2003; Knight et al. 2006b), developed in response to the ad hoc nature of selecting protected areas (Sarkar et al. 2006). Quantitative indices developed in response to the need to provide empirical evidence for valuing and comparing areas. This process was established to inform conservation on land use planning by allowing for areas to be assigned a direct conservation value (Goldsmith 1975; Ferrier et al. 2000).

The activity of spatial prioritization has historically applied two different methods. The first method promotes the use of expert knowledge (Cowling et al. 2003), which can be collected in various ways, for example during workshops, which involve a wide range of experts relevant to the area where prioritization is being done, deciding on priority areas according to their knowledge and experience (e.g. Olivieri et al. 1995; Dinerstein et al. 2000; Sanderson et al. 2002; Thorbjarnarson et al. 2006; Wheeler et al. 2008; Didier et al. 2009; Game et al. 2011). Questionnaires can be used to collect the knowledge which experts can provide (e.g. Maddock & Samways 2000). The second, and more recently developed, method advocates a systematic process of collecting data and using, typically, computer based algorithms to solve problems of regional protected area design (e.g. Kirkpatrick 1983; Margules et al. 1988; Pressey & Nicholls 1989). Experts may be used to simply identify (e.g. list) candidate areas for conservation, or to qualitatively rank criteria used to score areas for comparison (e.g. Tubbs & Blackwood 1971; Goldsmith 1975). Although the expert method is referred to as the earlier method, there is not a lot of literature describing it, whereas the development of algorithms is well documented in the literature.

Ad hoc approaches were generally expert driven where experts, typically biologists and/or ecologists, are asked to inform where protected areas should be established (e.g. Soulé 1985; Olivieri et al. 1995). Two of the largest areas selected had never even been explored by the experts, but they made an informed prediction that the area would possess a large amount of biodiversity (Soulé 1985). This type of ad hoc selection has been disputed over the years (Sarkar et al. 2006), but the lack of systematically collected data encourages such an approach. The use of algorithms in selecting priority conservation areas emerged in response to this ad hoc approach (Sarkar et al. 2006) but the most effective set of protected areas was still not being identified as this algorithm approach also had its limitations (Pressey 1999).

Experts are regarded as being biased to specific geographic areas and taxa (Maddock & Samways 2000), and their knowledge is not regarded as comprehensive (Kress et al. 1998). With the increasing ability to travel to further extremities of the earth and therefore an ability to collect larger amounts of data in more areas, the type of decision referred to by Soulé (1985) is decreasingly necessary. Systematic approaches to designing protected area networks allow for the process to be defensible and repeatable (Noss et al. 1997; Pressey & Cowling 2001). ‘Real world' conservation plans often rely on experts to provide data not captured in accessible databases (Knight et al. 2006b). These systematic analyses typically use maps of biological or ecological data, some of which may have been developed by experts (e.g. a vegetation map). This expert data can be captured much more rapidly and cost effectively than data which has been systematically gathered.

“An expert is someone who has knowledge of the subject of interest gained through their life experience, education or training” (Kuhnert et al. 2010).The pool of experts in any one specific field may, in practice, be very small, comprising people with overlapping skills, knowledge and experience (Burgman et al. 2011). This definition of experts often excludes a number of experts who might not have official qualifications or skills, but rather from experience, have specialist knowledge on the topic being explored (Collins & Evans 2007; Burgman et al. 2011).

Specialist expert knowledge, comprising of interactional and contributory expertise (specialist tacit knowledge, see Collins & Evans 2007 ‘The Periodic Table of Expertise’), is possessed by certain people who have a wisdom or competence based knowledge derived from being immersed in a certain practice, culture or society to a point where they are viewed as well-informed in that specific context (Nowotny et al. 2001; Collins & Evans 2007). Universal or ubiquitous tacit knowledge, including general knowledge or popular understanding of topics and primary sources of knowledge, is possessed to a greater or lesser extent by everyone, depending on the social immersion in the topics context (Collins & Evans 2007). Local knowledge, the knowledge that indigenous people and cultures have of their immediate environment (Steele & Shackleton 2010), can be both general or specialist, also depending on the immersion of an individual (Chalmers & Fabricius 2007). The process of gathering expert knowledge is social and therefore difficult to define, but the outcome of understanding and being able to do things that the expert could not before is real (Collins & Evans 2007). Expert knowledge is best justified if it is developed in a regular, predictable environment and the expert has opportunity to continuously learn from these regularities (Kahneman 2011).

Debate has ensued in the conservation planning literature as to the relative utility and defensibility of expert versus systematic data and analyses (Pressey & Nicholls 1989; Dinerstein et al. 2000; Sanderson et al. 2002; Didier et al. 2009). There is now a general consensus that integrating expert and systematically gathered data provide the most effective results (Pressey & Cowling 2001; Cowling et al. 2003; Knight et al. 2006b). This is done in several ways including using algorithms and systematically gathered data to determine priority areas and using expert knowledge to ensure the practical implementation of the plan (Cowling et al. 2003).

Expert knowledge and experience has been used in selecting priority conservation areas by various organizations (Cowling et al*.* 2003; Conservation Measures Partnership 2007; Morrison et al. 2009). Dinerstein et al. (2000); Conservation Measures Partnership (2007) and Morrison et al. (2009) strongly advocated the use of experts throughout the conservation planning process, both in guiding the process and contributing spatial information about species distribution. Dinerstein et al. (2000) especially place value on expert contributions in areas where there is no or poor data available in the published literature (see Knight et al. 2006b). Experts also provide context to the conservation planning process and the more contextualized the research is the more socially robust and practical the knowledge gained from the process will be (Nowotny et al. 2001).

Experts do not necessarily have to be limited to conservation professionals. Knowledgeable members of the local community can also be useful in the selection of candidate conservation areas (Rivers-Moore et al. 2007; Von Hase et al. 2010; Bryan et al. 2011; Game et al. 2011). For science to become more effective in the 'real world' data gathering needs to move away from being a segregated model of interaction to being more integrated within the social context of research (Nowotny et al. 2001). "The direct dialogue with the public should move from being an optional add-on to science-based policy-making and to the activities of research organizations and learned institutions, and should become a normal and integral part of the process." (House of Lords 2000)

There are limitations to expert knowledge and the incorporation of expertise in any decision making process, most notably the potential bias and incompleteness of expert knowledge (Cowling et al. 2003). There are also many benefits, for example, significant cost and time savings that using expert derived data can deliver. In order for it to be used most effectively the outcomes of the expertise have to be "correct, reliable and socially robust, regardless of their origins and processes" (Nowotny et al. 2001). It is important, therefore, that expertise, its uses and the power it has within decision making processes be assessed (Nowotny et al. 2001).

Experts have been used extensively in conservation planning, and especially in the spatial prioritization process, for many years. We suggest that the debate between systematic and expert approaches was necessary, but initially polarized the views of the different camps. It would appear that the advances in systematic approaches have overshadowed the importance of experts.

The question remains, when and how is expert data best elicited and then applied (Kuhnert et al. 2010)? There have been very few studies which have looked at differences between experts and systematic approaches. It is important to the further development of the conservation planning process, especially with regard to merging expert and systematic approaches (Cowling et al. 2003), that we understand how best to incorporate the extensive and useful knowledge that experts have into the process. This paper explores where and how experts and their knowledge have been used.

Methods

We collected and assessed the international peer-reviewed literature that presented spatial prioritization.

Literature was sourced through ISI Thompsons Web of Science, and limited to English language peer-reviewed papers with one or more of the following terms in the tittle, keywords or abstracts: conservation assessments, conservation planning, conservation plan, conservation evaluation, conservation value, reserve selection, area selection, area identification, priority area, bioregional conservation, bioregional planning, ecoregional assessment, ecoregional conservation, integrated conservation and natural areas identification. The research was not limited to any specific start date, but concluded with papers from 2010.

This filter identified 4194 papers which were refined by reading abstracts to identify relevant papers. This was a multi-phased process, where publications were first identified as relevant, and then refined according to the ease with which papers could be identified as relevant (see Supplementary Material: Table 2.9). Where necessary the entire paper was read to determine its relevance. This reduced the number of papers to 394. We do recognize that approaches to spatial prioritization have been written about in the grey literature, especially which includes experts, but this was not included in the scope of this study due to the difficulties associated with systematically searching for grey literature.

All 394 papers were searched with Adobe Reader, for the terms “expert” and “specialist”. Where it was not possible to search for specific terms the entire paper was read. Papers that included experts were then identified. This resulted in 109 spatial prioritization papers that mentioned experts. The country of origin of the lead author, the country in which the study was conducted (based on the World Bank 2011), whether the study was conducted in the country where the lead author is from, the affiliation of the lead author (see Supplementary Material: Table 2.10) and the date of publication were determined. The relationship between whether the study was conducted in the same country as the country of residence of the lead author was looked at for the country of residence (according to income bracket) of the lead author, the country the study was conducted in (according to income bracket), as well as the affiliation of the lead author. This provided insight into whether there was any link between these factors and where lead authors were conducting spatial prioritizations.

The publications which included the use of experts were further searched for how experts had been used (see Supplementary Material: Table 2.11), what experts had been used (see Supplementary Material: Table 2.12), whether experts had been used exclusively and whether expert reliability had been tested. This was also done using the search function in Adobe Reader and where not possible by reading through the paper.

All the data was compiled and basic statistical analysis done in Microsoft Excel 2010. Pearson’s Chi-squared tests were conducted in Statistica 10 to test for relationships between various factors.

Results

A total of 394 papers were identified in the review. Since 1984 27.7% (109) spatial prioritization papers have included experts and/or expert knowledge to inform analysis, which is an average of 4.04 (±6.15) papers per year. There has been a steady increase in the use, and explicit mention of, experts in spatial prioritization papers (Figure 2.1). None of the papers in this review from before 1995 mentioned the use of experts or expert knowledge.

There is no significant link between the lead author’s country of residence or the country the study was conducted in and the use of experts (Table 2.1 & 2.2). The very large majority (80.5%) of spatial prioritization papers are authored by authors residing in High Income countries (Table 2.1). Although the majority of the papers (59.4%) are studies carried out in High Income countries, it is a much broader spread over countries from all income brackets than where the lead authors reside. There was a significant relationship (Table 2.3) between the affiliation of lead author and the use of experts ($p=0.00014$, Pearson Chi Square Test), with authors from NGO’s and private research organizations more inclined to use experts than authors from Universities. Experts are predominantly used to map species localities and habitats (37.3%) and/or in selecting priority areas (18.6%). Table 2.4 shows the other ways in which experts have been used in spatial prioritization studies. The majority of experts were specific ecological experts (32.1%), species experts (27.6%) and general ecological experts (26.1%), along with various other experts (14.1%) (Table 2.5; see Supplementary material: Table 2.12 for definitions). Experts were used exclusively in six of the 109 publications which included the use of experts. In seven of the 109 publications the reliability of the data or knowledge provided by experts was tested with some other reliable data or knowledge.

Of the 109 papers which included experts and/or expert knowledge, 50.5% were conducted in a different country to the lead author, whereas of the 285 papers that did not include experts or expert data 42.5% were conducted in a different country to that of where the lead author is from, although there is no significant relationship. Just over half, 53.3%, of papers where the lead author resides in a high income country are not conducted in the same country as where the lead author is from. This differs significantly to the majority, 89.4%, of papers where the lead author resides in a country in the upper middle income bracket and the prioritization was done in the same country as where the lead author is from (Table 2.6; Pearson Chi-square $p < 0.0001$).

Just over half, 56.8%, of spatial prioritizations done by lead authors affiliated with universities are conducted in the same country as the lead author resides, whereas 75% and 70% of spatial prioritizations done by lead authors affiliated to NGO's and private research institutions respectively, did not take place in the same the lead author resides (Table 2.7; Pearson Chi-square test $p = 0.00122$).

In countries of a high (63.3%) and upper middle (67.1%) income bracket there is a greater number of spatial prioritizations done in the same country as where the lead author resides, than not. In countries of a lower middle (30.4%) and low (30.8%) income bracket the opposite is true (Table 2.8; Pearson Chi-square $p < 0.0001$).

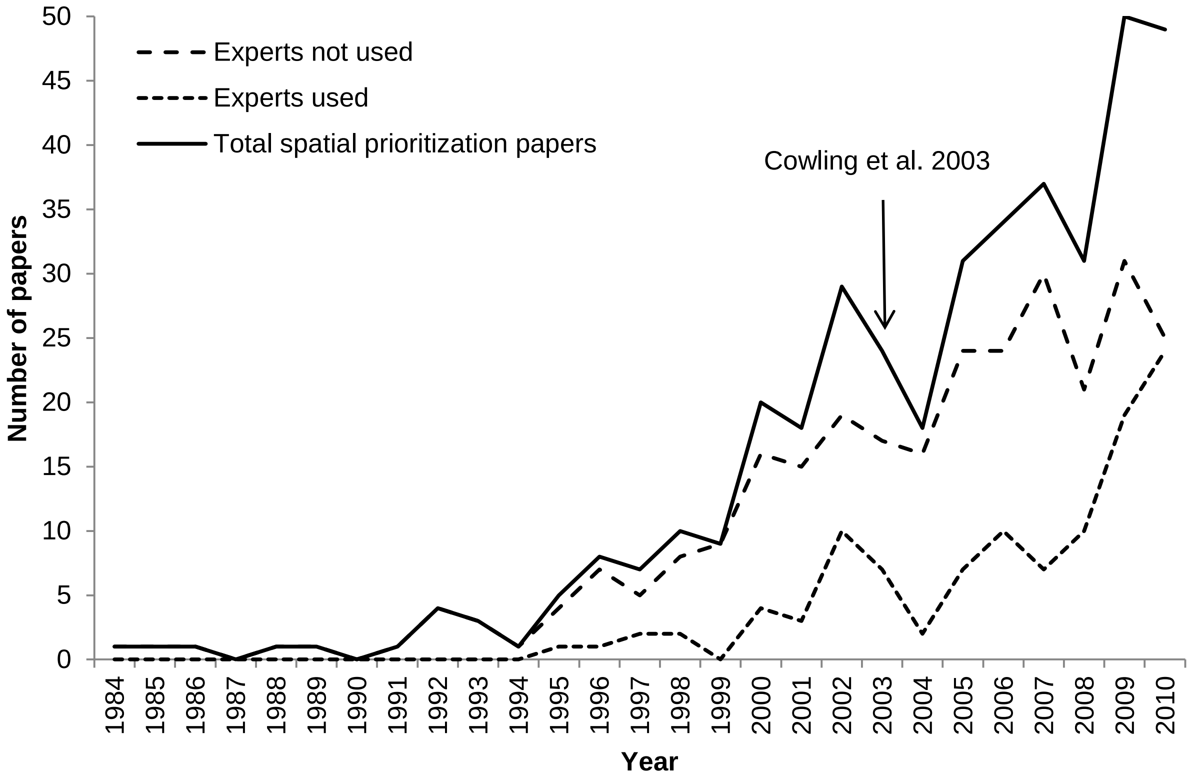

Figure 2.1: Spatial prioritization papers from the peer-reviewed literature between 1984 and 2010

Table 2.1: The proportion of papers representing the country of residence of the lead author. Note: The 'percentage of country of residence' for 'yes' and 'no' in that particular income bracket add up to 100%

Have experts been used?	Country of residence of lead author High Income	Upper Middle Income	Lower Middle Income	Low Income	Totals
Yes	85	22	1	1	109
% of country of residence	26.8	33.3	14.3	25.0	
% of 'Yes' papers	78.0	20.2	0.9	0.9	100.0
No	232	44	6	3	285
% of country of residence	73.2	66.7	85.7	75.0	
% of 'No' papers	81.4	15.4	2.1	1.1	100.0
Total	317	66	7	4	394
Total %	80.5	16.8	1.8	1.0	100.0

Table 1.2: The proportion of papers representing the study the country was conducted in. Note: The 'percentage of country income bracket' for 'yes' and 'no' in that particular income bracket add up to 100%

Have experts been used?	Country income bracket High Income	Upper Middle Income	Lower Middle Income	Low Income	Mixed	Totals
Yes	58	28	9	5	9	109
% of country income bracket	24.8	31.8	39.1	38.5	25.0	
% of 'Yes' papers	53.2	25.7	8.3	4.6	8.3	100.0
No	176	60	14	8	27	285
% of country income bracket	75.2	68.2	60.9	61.5	75.0	
% of 'No' papers	61.8	21.1	4.9	2.8	9.5	100.0
Total	234	88	23	13	36	394
Total %	59.4	22.3	5.8	3.3	9.1	100.0

Table 2.3: The proportion of papers representing the affiliation of lead authors. Note: The 'percentage of affiliation of lead author' for 'yes' and 'no' in that particular income bracket add up to 100%

Have experts been used?	Affiliation of lead author				Totals
	University	NGO	Private research	Government research	
Yes	71	15	7	16	109
% of affiliation of lead author	24.9	53.6	70.0	22.5	
% of 'Yes' papers	65.1	13.8	6.4	14.7	100.0
No	214	13	3	55	285
% of affiliation of lead author	75.1	46.4	30.0	77.5	
% of 'No' papers	75.1	4.6	1.1	19.3	100.0
Totals	285	28	10	71	394
% of total papers	72.3	7.1	2.5	18.0	100.0

Table 2.4: Types of expert input to spatial prioritization papers between 1984 and 2010 (n=109 papers). The total value differs to Table 2.5 because times mentioned is a total count not relative to the amount of papers

Categories	Times mentioned	% of times mentioned
Mapping species and habitats	60	37.3
Selection of priority areas	30	18.6
Review	22	13.7
Providing species specific data	15	9.3
Assigning targets	18	11.2
General ecological expertise	11	6.8
Mainstreaming	3	1.9
Identifying threats	2	1.2
Total	161	100.0

Table 2.5: Types of experts used in spatial prioritization papers between 1984 and 2010 (n=109 papers) The total value differs to Table 2.4 because times mentioned is a total count not relative to the amount of papers

Categories	Times mentioned	% of times mentioned
Specific ecological experts	43	32.1
Species experts	37	27.6
General ecological experts	35	26.1
Local experts	15	11.2
Conservation planning experts	3	2.2
Non-ecological experts	1	0.7
Total	134	100.0

Table 2.6: Relationship between whether the spatial prioritization was conducted in the same country as the country of residence of the lead author and the country of residence lead author

Study conducted in same country as where lead author resides?	Country of residence of lead author				Totals
	High Income	Upper middle income	Lower middle income	Low income	
No	169	7	0	0	176
% of papers	53.3	10.6	0.0	0.0	
% of 'No' papers	96.0	4.0	0.0	0.0	100.0
Yes	148	59	4	7	218
% of papers	46.7	89.4	100.0	100.0	
% of 'Yes' papers	67.9	27.1	1.8	3.2	100.0
Totals	317	66	4	7	394
Total %	80.5	16.8	1.0	1.8	100.0

Table 2.7: Relationship between whether the spatial prioritization was conducted in the same country as the country of residence of the lead author and the country the study was conducted in

Study conducted in same country as where lead author resides?	Country study was conducted in High income	 Upper middle income	 Lower middle income	 Low income	 Mixed	Totals
No	86	29	16	9	36	176
% of papers	36.8	33.0	69.6	69.2	100.0	
% of 'No' papers	48.9	16.5	9.1	5.1	20.5	100.0
Yes	148	59	7	4	0	218
% of papers	63.3	67.1	30.4	30.8	0.0	
% of 'Yes' papers	67.9	27.1	3.2	1.8	0.0	100.0
Totals	234	88	23	13	36	394
Total %	59.4	22.3	5.8	3.3	9.1	100.0

Table 2.8: Relationship between whether the spatial prioritization was conducted in the same country as the country of residence of the lead author and the affiliation of the lead author

Study conducted in same country as where lead author resides?	Affiliation of lead author: University	 NGO	 Private research	 Government research	Totals
No	123	21	7	25	176
% of total papers	43.2	75.0	70.0	35.2	
% of 'No' papers	69.9	11.9	4.0	14.2	100.0
Yes	162	7	3	46	218
% of total papers	56.8	25.0	30.0	64.8	
% of 'Yes' papers	74.3	3.2	1.4	21.1	100.0
Totals	285	28	10	71	394
Total %	72.3	7.1	2.5	18.0	100.0

Discussion

The use of experts in spatial prioritization

There has been a steady increase in the number of papers conducting spatial prioritization processes between 1984 and 2010 (see also Pressey 2002). The literature on spatial prioritization has heavily focused on systematic prioritization, which reflects the response that systematic conservation planning was to ad hoc approaches of protected area selection (Sarkar et al. 2006). We recognize that the ad hoc processes of spatial prioritization (Pressey 1994), mostly took place before 1984, which is not reflected in the results. Since 1994 there has been a steady increase in the number of papers recording the use of experts and/or expert knowledge during spatial prioritization processes. The use of experts in spatial prioritization has been recognized and mentioned extensively (Dinerstein et al. 2000; Pressey & Cowling 2001; Cowling et al. 2003; Knight et al. 2006b), but we believe this is the first time it has been represented explicitly.

There is little information provided in papers about the experts used, e.g. what their specific field of expertise was, the time they had spent in the field as an expert and who/how they were identified as experts. This is poor practice as all these factors affect the quality of the study. Differences between experts can be significant (see Chapter 3 of this thesis), much as differences between statistical techniques applied to the same data can give significantly different results (comparison between two statistical methods, Cronbach's α and McDonald's ω_H, on the same data can be seen in Chapter 4 of this thesis and in Knight et al. 2010). For this reason authors should be explicitly stating the numbers of experts, the expertise of each and the levels of uncertainty of their knowledge. A clear method for selecting, eliciting and reporting on expert's involvement in spatial prioritization is lacking, whereas such methods are being studied and developed for other areas of conservation (Burgman et al. 2011; Martin et al. 2012).

The absence of a relationship between the use of experts and the country of residence of the lead author, as well as the income bracket of the country in which the study was conducted, is interesting as one might expect that experts would be used in lower income countries, due to the lack of development (e.g. the lack of large species databases). We suspected there would be a link between low income countries and the use of experts, as experts are often used to fill in gaps in data which is not captured in any specific database (Knight et al. 2006b). The reason could be that there is an equal lack of experts in lower income countries, due to lack of capacity and training (McNeely 1993; Chalmers & Fabricius 2007), or that data gaps are ubiquitous (see Cowling et al. 2010) resulting in the need for experts to fill data gaps in most countries. Local ecological knowledge is being used to inform decision making in some of these areas though (e.g. Chalmers & Fabricius 2007; Tang & Gavin 2010; Gandiwa 2012).

There was a significant relationship, though, between the use of experts and authors affiliated with non-governmental organizations (NGO's) and private research institutions, and the non-use of experts with authors affiliated with universities and government research institutions. This is perhaps because spatial prioritization software was primarily adopted by academics, whilst NGO's and private research institutions have mainstreamed this software more recently. Knight et al. (2008) point out that few conservation plans that are published in peer reviewed literature result in conservation action. The majority of papers in this study were by lead authors affiliated with universities whose primary incentive is to publish papers. The majority of lead authors associated with universities do not use experts in the spatial prioritization process. We hypothesize that these papers do not include experts, because these papers aim to do studies with data that is as comprehensive as possible and/or because 'real-world' studies have perhaps one opportunity to conduct and implement their plan and cover data gaps using experts, as more knowledge may be in experts heads (tacit knowledge) than in databases (Knight et al. 2006b). Cowling et al. (2003) advocated incorporating experts and expert knowledge into the systematic conservation planning process, as this would provide insight into pragmatic management and implementation issues.

A large diversity of experts has been used in various ways to inform spatial prioritization. The majority of what experts are providing is spatially specific species data as well as informing decision making (selection of priority areas and review of data and decisions). Very few studies rely solely on expert data (6, 5.5%), but very few of the studies which use expert data actually test or review the data provided by the experts (7, 6.4%). The irony is that many papers use experts to fill data gaps to increase the certainty of their outputs but do not quantify the degree of uncertainty surrounding this data (Burgman et al. 2011).

Experts are used more often in studies conducted in countries where the lead author is not resident, although this relationship is not statistically significant. This is possibly because foreign authors may not have the expertise of local experts. In lower income countries, spatial prioritization studies were conducted predominantly by foreign researchers and some local researchers who only conducted studies in their home country. This could be the result of authors from higher income countries having greater funding to do studies outside of their home country, or that local conservation professionals from lower income countries do not have sufficient education, capacity and/or expertise to carry out spatial prioritizations and so outsource these studies.

Understanding the role of experts

Experts are widely endorsed by practitioners (Olivieri et al. 1995; Groves 2003; Conservation Measures Partnership 2007) and advocated for conservation planning (Dinerstein et al. 2000; Ferrier 2002; Cowling et al. 2003; Knight et al. 2006b; Sarkar et al. 2006) and in other areas of conservation (Oliver 2002; Kuhnert et al. 2010; Burgman et al. 2011). Experts are valuable for numerous reasons for spatial prioritization in providing data where there are gaps in the recorded datasets, in informing ‘real world’ decision making, in providing context, in engaging all the stakeholders viewpoints in decision making and the consideration of socio-economic factors in conservation planning (although our results suggests this rarely occurs). The use of experts has been advocated and demonstrated within the structure of systematic conservation planning (Cowling et al. 2003; Knight et al. 2006b). It is obvious from this study this this has been happening, but not to the extent that is advocated. A wide range of experts are providing a wide range of valuable data, but only in 27.7% of the 394 papers included in this study. Many short comings in using experts to inform conservation have been pointed out though. Experts are biased towards specific areas which they know, they favour certain species over others, they have gaps in their knowledge and expert based decision making is very subjective (Maddock & Samways 2000; Cowling et al. 2003; Regan et al. 2004). These limitations are known but rarely quantified. Quantifying the limitations of, and uncertainty surrounding, expert knowledge should be promoted.

Experts are used mapping species and habitats, selecting priority areas for conservation, reviewing data collected, providing specific data about species, assigning targets for conservation planning, providing general ecological insight, helping to mainstream conservation plans into conservation action and identifying threats to natural areas. This data ranges from specific, spatial identification of certain species and habitats which are inputted into systematic conservation planning processes, to general informing of decision making and providing overarching insight into conservation planning and decision making. This is all very valuable and immediately available information that is being accessed by only a few studies.

The elicitation of expert knowledge needs to be carried out according to structured protocols in order to counteract the limitations that experts and expert knowledge have (McBride et al. 2012). Understanding different types of expert knowledge, how experts are utilized in decision-making and how to choose experts is widely studied (Nowotny et al. 2001; Collins & Evans 2007; Kahneman 2011). These criteria and conditions ensure the ability to trust expert judgments: 1) when experts developed their expertise in “an environment that is sufficiently regular to be predictable” and 2) when experts had the “opportunity to learn these regularities through prolonged practice" (Kahneman 2011). Methods for eliciting expert knowledge for formal modeling and incorporating expert knowledge into rule-based systems have been explored extensively in various fields (Wright & Ayton 1987; Ford & Sterman 1998). Improving expertise, elicitation of expert knowledge, selecting the correct experts has been studied specifically in conservation management and decision-making as well (Yamada et al. 2003; Burgman et al. 2006; Kuhnert et al. 2010; Burgman et al. 2011; Martin et al. 2012; McBride et al. 2012).

This study shows that experts have been used in spatial prioritization, but a general philosophy and framework for involving experts is lacking. Systematic conservation planning needs to explore quantifying the limitations and uncertainty of expert knowledge for: 1) identifying experts, 2) eliciting expert knowledge from disciplines such as conservation management, and 3) for integrating expert knowledge into the planning process, especially in terms of spatial prioritization of areas for conservation action. Nowotny et al. (2001) identified that the power experts have in decision making processes needs to be explored, which has been done to some extents in conservation planning (Dinerstein et al. 2000; Maddock & Samways 2000; Cowling et al. 2003; Knight et al. 2006b). Didier et al. (2009) suggested systematic conservation planning as a long and challenging activity that requires large amounts of data, therefore not many conservation organizations, focused on action, are actually carrying them out. The Conservation Measures Partnership (2007) lays out a project management process for the implementation of conservation action of which identifying biodiversity targets, which would involve spatial prioritization, is a part, but the emphasis of the process is on building relationships with stakeholders, identifying opportunities and remaining flexible. This process has elements of a systematic conservation plan (Margules & Pressey 2000), but is not as long or data intensive. Didier et al. (2009) carried out a conservation prioritization based solely on expert data. Although they acknowledged and identified their process as an incomplete process, it resulted in some conservation action. Whether a study is expert or systematic possibly does not influence its adoption by stakeholders, but more likely the rigor of its decision-making.

Expert knowledge is not comprehensive, especially in areas of high species turn over where species diversity is immense, but it is readily available and relatively quick, although not always easy, to elicit. We have to assume that knowledge will grow over time if an investment is made, for example citizen science programs such as Custodians of Rare and Endangered Wildflowers, CREW (CREW Operation Manual 2008). Cowling et al. (2010) still leave the question, though, of whether we just ignore biological data and simply map the human and social dimensions of conservation opportunity? We believe that if expert knowledge can effectively be incorporated into the systematic conservation planning structure, it is not necessary to throw this process out, it will enable the process to be more relevant, quicker, cheaper and therefore more effective for implementation (Cowling et al. 2003). Cowling et al. (2010) stated that it could be wise to focus conservation efforts on action rather than further inventory of species within the systematic conservation planning process.

In order to ensure that reserve selection does not just fall back into the pre-systematic planning ad hoc methodology, where experts where used, but not within a systematic framework, current conservation planning practices should to be built on to include: 1) experts and expert knowledge effectively, 2) methodology which can be carried out by conservation managers not specifically trained in systematic conservation planning, 3) not requiring excessive amounts of data, and 4) informing actual conservation implementation and management practices while still maintaining the important elements of systematic conservation planning which ensure the repeatability and defensibility of the plan.

Limitations

No papers were included in the study from before 1984, which was not due to any exclusion by the methods procedure, there were just no papers which were identified during the search and were relevant to the study from before 1984. This could be due to the difference in terminology or the functioning of Web of Science. We recognize that papers including spatial prioritization had been published before 1984, for example the seminal work by Kirkpatrick (1983) and others, such as Tubbs & Blackwood (1971) and Goldsmith (1975).

The fact that grey literature was excluded from this review may have caused a bias in the results against work done by many NGO's and spatial prioritizations carried out in lower income countries, where authors are probably less likely to publish their studies in peer reviewed literature.

We acknowledge that the results of this study do not necessarily show the complete picture of how experts have been used in practical conservation planning, but it does show to what extent the use of experts has been written about. An observation that we made was that some of the papers never mention the use of experts, but they use current databases of species, which could or could not have been built up using expert knowledge and input. For example, the IUCN Standards and Petitions Working Group (2008) refer to the inclusion of experts in informing the classification of Red List species. Simaika & Samways (2009) refer to the IUCN Red Listing process as being expert based. Some papers that not mention experts, but used the IUCN Red List in the spatial prioritization process (e.g. Larsen & Rahbek 2005; Cardillo et al. 2006; Fiorella et al. 2010; Jenkins et al. 2010). The authors, whose level of expertise varies, sometimes apply their own expertise or insight to decision-making, especially in terms of methodology, and spatial prioritization decisions. This inclusion of experts and expert knowledge is often overlooked, as it is not stated as expertise in papers.

Future research

The integration of experts into systematic conservation plans is not happening extensively, so it would be interesting to note whether these ‘plans’ written about are actually being implemented. It was not possible to explore this in this study though, so it would be interesting future research.

The patterns found in this study are specific to spatial prioritization studies written about and published in the peer reviewed literature. The work could be replicated, including the grey literature in order to give a more comprehensive picture of the patterns.

Further research needs to look at understanding experts, the contribution they and the knowledge they provide to spatial prioritization, and to conservation planning and how this can be better incorporated. Eliciting expert knowledge and the manner in which expert knowledge can be included in the systematic conservation planning process needs to be explored further. This would include examining the process of expert workshops, e.g. to map priority areas. Whether experts can actually be used to identify biological priorities in places without the need for systematic conservation assessment also needs to be explored. This research would lead to the development of a framework for including expert knowledge in these processes.

It would also be important, in the light of Cowling et al. (2010) findings, to explore how experts can contribute to identifying conservation opportunity. Can experts contribute to social assessments? Do experts have insight into the social context of areas which would help inform conservation action? There needs to be an understanding developed of the difference between various types of data for identifying important areas for conservation action.

There are various types of knowledge which can be loosely grouped into tacit knowledge and scientific knowledge. Tacit knowledge includes general, working and specialist knowledge. In order to better understand experts and expert knowledge it is important to explore how these different types of knowledge are valued, identified and elicited.

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Supplementary material

Table 2.9: The criteria applied when selecting papers for inclusion in the review process

Criteria for including papers
Papers presenting a spatial conservation prioritization inclusive of algorithms, specialist software or a particular recognized process
Tests of surrogacy comparing representation when conducting a spatial conservation prioritization
Species prioritizations that identify focal, keystone, umbrella or threatened species where species were prioritized and subsequently used to select areas
Gap analyses of current protected areas where this approach was used to specifically identify areas for conservation action (e.g. Strittholt & Boerner 1995; Root et al. 2003)
Criteria for excluding papers
Studies which develop a methodology for prioritizing species or populations and theoretically could be used for identifying areas of conservation importance but do not do so
Models applying theoretical data which does not identify specific locations
Biogeographic analyses, (e.g. mapping patterns of species richness or rarity), which could theoretically be used in selecting priority conservation areas have been excluded, even when the authors state the study had the potential to be applied
Gap analyses of current protected areas

Table 2.10: The affiliation of the leader author was identified and classified according to the following categories

Category	Description
Universities	All academic institutions
Government research	All the government research institutions, including para-statal and other research institutions which receive funding from government, also including public research institutions
Private research	All private research institutions or companies
NGO	All non-profit organizations

Table 2.11: How experts had been used was classified as follows

Category	Description
Providing species specific data	Experts provided specific data about species that is their particular field of expertise
Mapping species and habitats	Experts classified and mapped certain values, habitats, ecological networks or distributions of species
Assigning targets	Experts assigned conservation targets in order to ensure conservation action is successful
Selection of priority areas	Experts selected the priority areas for conservation
Review	Scientific experts reviewed or confirmed work done through systematic research, often confirming mapped data to be correct, or approving plans
Mainstreaming	Experts were used to ensure the practical implementation of the conservation plan
General ecological expertise	Experts provided insight and helped make decisions based on their general ecological knowledge
Identifying threats	Experts identified threats to specific species, habitats, ecological processes or biomes

Table 2.12: What experts had been used was classified as followed

Category	Description
Species experts	Experts who provided information about or contributed to the mapping of specific species
General ecological experts	Experts who provided information or contributed to mapping, selection of priority areas about general ecological principles, such as ecological processes and interaction of species
Conservation planning experts	Experts in the process of conservation planning
Local experts	Experts who contribute by providing local knowledge
Specific ecological experts	Experts who were used according to a specific, broader than species, expertise. This relates to either geographic or biome specifics
Non-ecological experts	Experts who provided knowledge and insights that were not specifically ecologically based

Chapter 3: The contribution of individual and group expertise to spatial conservation prioritization workshops

Abstract

Expert workshops are used as a method to elicit expert knowledge, data and judgments for spatial prioritization. Although this is a widely used accepted practice there has not been much research done on the differences between individuals and groups of experts and studying workshop processes and techniques. This study aimed to quantify the differences between individual experts and groups of experts in order to identify an effective and efficient workshop approach for integrating experts into spatial prioritization processes. This was done by holding and examining an expert workshop process where individuals and groups of experts mapped important areas for plant conservation in the Nelson Mandela Bay Metropole. Individual experts differed greatly between each other, individuals differed to groups of experts and groups of experts differed to each other. Experts enjoyed the group mapping exercise more than the individual mapping exercise and believed that they produced a more comprehensive map during the group mapping exercise. It is important that experts to be included in spatial prioritization processes are selected according to standard guidelines, which need to be developed. Experts are valuable to spatial prioritization, but guidelines for the running of spatial prioritization workshops should be developed, in order to ensure structured, repeatable and defensible elicitation of expert knowledge. This will result in experts and expert knowledge being incorporated and utilized effectively and efficiently in spatial prioritization.

Key words

Experts; spatial prioritization; workshop; individuals and groups; decision-making

Introduction

The conservation planning process involves collaboration with relevant stakeholders, development of strategy and then implementation of these as conservation actions (Knight et al. 2006a; Margules and Sarkar 2007). Conservation planning has become increasingly important due to increasing loss of biodiversity throughout the world (Dirzo & Raven 2003).

Conservation planning comprises three main processes: 1) Collaboration, which is the social process of involving all the stakeholders in carrying out conservation management actions, 2) implementation strategy, which provides the how and what of carrying out the actions, 3) spatial prioritization, which is “the process of using spatial analysis of quantitative data to identify locations for conservation investment” (Wilson et al. 2009, p. 16) and provides data to inform the strategy development process (Cowling & Pressey 2003; Knight et al. 2006a; Margules & Sarkar 2007). All established operational models for conservation planning identify spatial prioritization as one activity in the complete conservation planning process (Cowling & Pressey 2003; Groves 2003; Knight et al. 2006a; Margules and Sarkar 2007; Pressey & Bottrill 2008).

Spatial prioritization is the process of identifying areas important for implementing conservation actions that achieve conservation targets (Margules and Sarkar 2007; Wilson et al. 2009). Kirkpatrick (1983) published the first spatial conservation prioritization that applied complementarity to be published in the peer reviewed literature, who noted that this iterative process evolved beyond the non-systematic manner of previous processes that ranked areas of importance for conservation. Spatial conservation prioritization techniques evolved in response to ad hoc processes for identifying important sites for conservation action (Pressey 1994).

An expert can be defined as a person who has specialist knowledge, insight and wisdom into a particular subject which has been gained through life experience and/or formal training or education and/or immersing themselves in a specific context (Nowotny et al. 2001; Collins & Evans 2007; Kuhnert et al. 2010). Experts are usually identified according to this experience, by other people involved in the same field or are recognized by their formal education or training (Collins & Evans 2007). Experts and expert knowledge is not limited to formally educated, trained or experienced individuals, it also extends to local tacit knowledge (Nowotny et al. 2001; Collins & Evans 2007; Burgman et al. 2011). Any group of experts in a specific field is in practice very small (Burgman et al. 2011).

Experts have been involved in spatial conservation prioritization analyses in various ways (Cowling et al. 2003; Chapter 2). Early spatial prioritization relied on expert driven ad hoc processes of identifying suitable land for conservation (Pressey 1994). Significant expertise in conservation values was not typically required or applied as protected areas were gazetted often because land was worthless for other uses (Pressey 1994; Norton 2000). Opportunity was the driving factor for acquiring land for conservation, along with factors unrelated to representing biodiversity (Pressey 1994). Scoring processes, where experts applied, typically, a quantitative ranking system to identify the relative importance of areas (e.g. Tubbs & Blackwood 1971; Van der Ploeg & Vlijm 1978). Conservation organizations subsequently used experts for spatial prioritization, especially in the form of expert workshops (e.g. Olivieri et al. 1995; Sanderson et al. 2002; Morrison et al. 2009). Spatial prioritization now uses computer-based techniques augmented with expert knowledge (e.g. Groves 2002; Cowling et al. 2003; Knight et al. 2006b; Conservation Measures Partnership

2007; Morrison et al. 2009). The experts used include: ecological experts, species specific experts, locally knowledgeable experts, conservation planning experts and even non-ecological experts (Chapter 2)

Experts have been used to fill in gaps in data and to provide practical experience and expertise to drive the spatial prioritization process (Jarman 1986; Pressey et al. 2000; Knight et al. 2006b). It is assumed, although rarely explicitly stated, that experts use their expertise in deciding what land would be designated for conservation, notably when data is not available (e.g. Hannah et al. 1998; Dinerstein et al. 2000; Pressey & Cowling 2001) and relevant and useful information solely comprises expert knowledge. Expert spatial prioritization workshops have been run extensively throughout the world, with a wide variety of experts, to contribute to conservation planning processes (e.g. Hannah et al. 1998; Hoctor et al. 2000; Allnutt et al. 2002; Smith et al. 2006; Wheeler et al. 2008; Amis et al. 2009; Didier et al. 2009; Geselbracht et al. 2009; Zerger et al. 2011). Expert knowledge has been captured in various ways, for example: selecting priority areas by combining expert knowledge with technical scientific information, engaging local stakeholders to identify priority areas during interviews, synthesizing various expert provided data on priorities during group workshops and setting conservation targets based on land cover maps and group discussions (Hannah et al. 1998; Smith et al. 2006), although the limitations and uncertainty surrounding expert knowledge is rarely discussed or quantified.

Experts have been used in conservation planning to map species and habitats, in the selection of priority areas, reviewing data and plans, providing species specific data and assigning targets for conservation, providing general ecological expertise, providing local knowledge, mainstreaming conservation plans and identifying threats to biodiversity (Chapter 2). Approximately 28% of spatial prioritization studies in the peer-review literature have incorporated experts, with 5.5% of those using experts alone for area selection (Chapter 2).

Expert and systematic approaches have been historically considered separate approaches to spatial prioritization (Cowling et al. 2003; and see Pressey & Nicholls 1989; Dinerstein et al. 2000), and identify a philosophical disagreement between factions as to the most effective approach. Recently it has become widely agreed that integrating expert and systematic approaches is the most effective (Groves 2002; Cowling et al. 2003; Knight et al. 2006b; Conservation Measures Partnership 2007; Pressey & Bottrill 2008), however little has been written in the peer reviewed literature regarding how best to integrate expert and systematic approaches.

Expert knowledge has been gathered in different ways. Traditionally the most common method is during expert workshops, where a group of experts is brought together to provide insight and knowledge for a specific process (Olivieri et al. 1995; e.g. Hannah et al. 1998; Sanderson et al. 2002; Bojorquez-Tapia et al. 2003). Expert knowledge has been elicited through questionnaire surveys (Madock & Samways 2000), sending experts the necessary tools, maps, data forms and instructions, and asking them to draw priority areas (Thorbjarnarson et al. 2006), consulting with experts to provide specific data, insight and knowledge (Jongman 1995; Grantham et al. 2010).

More generally the application of expertise to conservation has been explored in two ways. Firstly, by researching how to elicit typically academic expert judgment to reduce uncertainty in conservation decision-making usually regarding species locations, population sizes and dynamics, conservation management options, synthesizing information and providing solutions (Burgman et al. 2006; Kuhnert et al. 2010; Speirs-Bridge et al. 2010; Burgman et al. 2011; Martin et al. 2012; McBride et al. 2012). Secondly, through the inclusion of citizen scientists for data gathering and education (Bonney et al. 2009; Wright 2011). Questions regarding the identification of the most effective set of experts and how best to verify expert judgment remain unanswered (Burgman et al. 2011).

Experts inform conservation decision making as individuals and as groups. Maddock & Samways (2000) mailed questionnaires to individual experts to provide data. Hannah et al. (1998) brought together a group of experts to inform conservation decision making in Madagascar. Theobald et al. (2000) examined ways to include ecological experts in decision making for local government, groups of farmers in the community, or the individual landowner. Individual and group decision-making, and the relative merits of each, have been extensively studied (Hill 1982; Miner 1984).

Individuals' decision-making and behavior comprises two general types – reasoned action and stressed response (Keinan 1987), and is affected by various factors (Fishbein & Ajzen 2010). Stressed response is not discussed further here, as it is not relevant to the context of the paper. Reasoned action has been conceptualized in various ways and is a complex concept, as many factors influence action (Fishbein & Ajzen 2010). A widely accepted model which explains human behavior is the Theory of Planned Behavior (Ajzen 1991). This model describes three factors influencing behavior: 1) attitude towards the behavior, 2) subjective norm, which relates to the extent which an individual is influenced by peer and social pressures, and 3) perceived behavioral control, which is the extent to which an individual believes they have the ability to perform the actual behavior (Ajzen 1991; Fishbein & Ajzen 2010). When individuals are presented with a decision they are presented with the option to choose between two or more alternatives, with the assumption being that they will decide on the option which maximizes the outcome of the decision, but these decisions are also affected by the risks involved as well as the individual's personal preference (Edwards 1954). We hypothesize that this reasoned behavior, taking into account all the options, risk and personal preference, influences how experts contribute to decision making in conservation planning and management.

Hill (1982) proposes that the old adage of 'two heads are better than one' is commonly accepted, with groups making better decisions than individuals. Groups of experts tend to pool their varying knowledge with individual experts being are able to correct errors of others immediately (Hill 1982). However, groups are not necessarily always more effective. Groups will be less effective where: 1) there is a specific individual who is very knowledgeable (Hill 1982; Miner 1984) or 2) a less knowledgeable but assertive group member exerts influence over a group and its decisions, not allowing each group member to contribute their complete expertise and knowledge (Kameda et al. 1997). Groups will be most effective when the strengths of individual group members are identified and utilized most effectively within the group (Kerr & Tindale 2004).Unified and well organized groups will be most effective in decision making, although groups tend to not utilize information which is not widely shared by most of the individuals in the group (Kerr & Tindale 2004).

Group expert workshops have the ability to serve as a great platform for this integration and exchange of various forms of multi-disciplinary knowledge to take place (Knight et al. 2006b; Fazey et al. 2012). Most conservation decision-making involves multiple stakeholders, including experts (e.g. Miller & Hobbs 2002; Knight et al. 2008; Morrison et al. 2009) and so understanding group dynamics can improve decision-making.

Steele et al. (2007) pointed out that decision-makers and experts in conservation management are very diverse in many ways, therefore each can have a valuable and varied input in any decision-making process. By placing people together in a group does not automatically mean the group is the sum total of the knowledge, experience and expertise of the individuals. The group often brings about a very different dynamic (Steele et al. 2007) as individuals can be influenced by other members (Kameda et al. 1997).

Raymond et al. (2010) identified, providing examples, the importance of integrating both scientific and local knowledge into environmental management and decision making. Decision making and research will also have a greater social, economic and environmental impact if knowledge exchange takes place between stakeholders (Fazey et al. 2012). When this exchange and integration of knowledge happens across various different disciplines, relating to the complex problems around environmental conservation, the resulting knowledge and research will be more applicable to practical implementation (Evely et al. 2010).

Regional and local scale conservation planning, inclusive of spatial prioritization, has formed a very important part of conserving South Africa's biodiversity since the 1980s, and has been driven through the application of innovative analyses to real-world problems (Balmford 2003). The earliest known application of an area selection algorithm is by Chris Burgers, a planner with CapeNature in the Western Cape Province, who used an iterative approach similar to Kirkpatrick (1983) to assess additions to De Hoop Nature Reserve on the South Africa's southern coast (Pressey 2002). Subsequent work in the 1990's by Rebelo & Siegfried (1990), Rebelo & Siegfried (1992) and Rebelo (1994) examined iterative, spatial prioritization analyses for selecting candidate protected areas which would best protect rare and unprotected Fynbos species. Further pragmatic applications in South Africa include Cowling's (1999) work designing reserves in the Succulent Karoo biodiversity hotspot; Pressey & Cowling (2001) in the Cape Floristic Region (CFR), a comprehensive conservation planning initiative in the CFR (see: Cowling & Pressey 2003). Spatial prioritizations formed the basis for plans designed with the intention of mainstreaming maps of conservation priorities into government decision making and into land management processes (Balmford 2003). All of this has led to the country-wide application of spatial prioritizations through national, provincial and municipal plans (e.g. Berliner & Desmet 2007; Ferrar & Lötter 2007; Driver et al. 2012) following the mainstreaming of spatial prioritization into the National Environmental Management: Biodiversity Act (2004), which stipulates spatial prioritization maps for local municipal planning. South Africa also has a complete National Biodiversity (spatial prioritization) Assessment including terrestrial, marine and freshwater components (Driver et al. 2012). Seven of the nine provinces of South Africa have comprehensive, although of varying levels of spatial prioritization, plans designed to inform conservation action.

Experts have been used extensively in the formulation of conservation plans in South Africa (e.g. Cowling & Pressey 2003; Berliner & Desmet 2007; Ferrar & Lötter 2007). Knight et al. (2006b) states the importance of experts to eight of these plans. Driver et al. (2003) used experts to: identify threats to conservation, identify areas of conservation opportunity, make decisions for conservation, provide technical expertise and to review decisions. The primary inclusion of experts and expert knowledge, though, in all of the above processes was to fill in gaps where data was lacking, which informed spatial prioritizations (Cowling & Pressey 2003). Dinerstein et al. (2000) also advocates the use of experts in areas where there is poor data available.

This research aimed to quantify the differences between three potential approaches of involving experts in a spatial prioritization expert workshop. Firstly, we examine the differences between individual experts. Secondly, we examine the differences between groups of experts. Thirdly, we examine the differences between individual experts and groups. This was done by examining the process of and experts experience with mapping important areas for plant conservation (IAPC) as individuals and in groups. The IAPC process based on experts input was compared, and expert's opinions of the effectiveness of the process were also examined. Our goal was to use the results of this study to identify an effective approach for integrating experts into a spatial conservation prioritization process. The results of the workshop plan to be used by the Nelson Mandela Bay Municipality (http://www.nelsonmandelabay.gov.za/) to inform the updating of their bioregional plan, expansion of their important plant database, and targeting of citizen scientists search activities through the Custodians of Rare and Endangered Wildflowers (CREW) program.

Methods

The planning region

Nelson Mandela Bay Metropole (NMBM) comprises of the city of Port Elizabeth and the towns of Uitenhage, Despatch and surrounds. Although it is a largely urban area, it contains significant biodiversity. Five of South Africa's seven biomes are present in Nelson Mandela Bay: Forest, Fynbos, Grassland, Nama Karoo and Subtropical Thicket (Low & Rebelo 1998; Mucina & Rutherford 2006; SRK Consulting 2007). NMBM is situated within both the Cape Floristic Region (CFR) and the Albany Centre of Plant Endemism portion of the Maputoland-Pondoland-Albany biodiversity hotspots (Myers et al. 2000; Mittermeier et al. 2004). NMBM has 58 different vegetation types, containing many important areas for ecological patterns and processes, as well as many species of special concern (SRK Consulting 2007). Substantial pressures exist in the remaining natural vegetation in the area through residential, commercial and industrial development, agriculture, mining, alien plant infestation and others (SRK Consulting 2007). The Eastern Cape Province has high levels of unemployment and poverty, with very little skills and capacity for excellent governance, especially with regard to conservation (Wilhelm-Rechman & Cowling 2011).

Experts

Experts in plant species, vegetation and conservation in the Nelson Mandela Bay Metropolitan area were invited to attend a one-day workshop at the Nelson Mandela Metropolitan University in Port Elizabeth, Eastern Cape, South Africa. Experts were asked to map important plant conservation areas within the metropolitan.

Experts were identified through a snow-balling approach (Goodman 1961). Known experts were initially approached by the authors and also asked to identify other experts. Of the 24 experts invited, 11 were able to attend the workshop.

Workshop procedure

Experts were requested to participate in an individual mapping exercise and a group mapping exercise. All of the experts attending the workshop were briefed about the purpose of the workshop at the start of the day (Appendix 1.1). This briefing was not extensive with regard to instructions for the workshop as the design of our approach was consciously simple so as to test the effect the absence of specifications and tools would have and what specifications and tools experts identified should be included. The program for the workshop is laid out in Appendix 1.2.

For the individual mapping each of the experts were provided a laminated 1:90 000 topographic map of the NMBM and were asked to identify IAPC using polygons. Each individual was provided with 4 pens of different colors, which they could use to mark different types of areas. They were requested to label each polygon and explain why they had identified each IAPC, and their level of confidence in the spatial and thematic accuracy of each polygon. This was done by filling in a table provided (Instructions included in Appendix 1.3). Each individual was given the freedom to interpret how and why they defined and selected identified IAPC's. There was no stipulation of how many areas, or what total area each IAPC should comprise. No biodiversity targets were provided to assist individuals. A reflection exercise was held after the session to discuss the exercise.

The individual mapping session was followed by a group mapping session. Experts were divided into two groups of five and six. Group 1 consisted of conservation professionals who had experience with conservation planning, whereas Group 2 consisted of people whose expertise was more purely botanical, mostly academics and amateur botanists. The same maps and methodology was used for the group mapping as for the individual.

Each of the individual and group maps was scanned. The digital images were then geo-referenced in ESRI ArcGis version 10 and each polygon was digitized on-screen in ArcGIS. The number of polygons, size of polygons, circularity and compactness of polygons and total area mapped data was tested for normality, and was non-normal therefore Spearman's rank correlation coefficient and Kruskal–Wallis one-way analysis of variance tests were done on the relevant data in Statistica 10. A multidimensional scaling analysis was also done comparing the polygon spatial distribution and overlap data of the individual experts in Statistica 10. The factors used in this analyses were the percentage of overlap between the expert's mapped areas. This resulted in two factors, as the percentage of overlap is relative to both experts being compared.

Understanding experts' experiences

Three questionnaires were designed for the experts to answer before the workshop (Appendix 1.4), after the individual mapping session (Appendix 1.5) and after the group mapping session (Appendix 1.6). Each questionnaire was filled out by the experts individually.

The questionnaires were designed to gain an understanding of: 1) general demographic, work related, expertise and education of individual experts, 2) individuals motivation for attending the workshop, 3) experiences and insight into the individual mapping exercise, 4) experiences and insight into the group mapping exercise, 5) insight into the differences and preferences between the individual and group exercises and, 6) insight into the general workshop.

The questionnaire data was analyzed in Microsoft Excel 2010.

Feedback to participants

All of the participants were e-mailed and asked if they would like a copy of the spatial data from their individual mapping exercise as well as the spatial data from their group's map. Six of the eleven experts requested this data.

Each of the experts will also be provided a copy of this paper, and all of the data and the paper will also be provided to the Nelson Mandela Bay Municipality.

Results

Demographics

A total of 11 experts attended the workshop, eight men and three women. There were nine experts whose first language was English and two Afrikaans. All experts were white South Africans. The average age of the experts was 45 years, ranging from 26 to 67 years of age. Four of the experts were academics, four conservation professionals, two were retired from non-conservation related jobs and one of the experts worked for local government in environmental management.

Attendance motivations

All experts variously attended the workshop to assist conservation, to learn from the experience, and/or because they were interested in the research. All experts indicated that they would have attended the workshop even if they were not compensated for their travel expenses. Some, 27% (3), of the experts indicated they would have attended the workshop if it had run over two days, 55% (6) indicated maybe and 18% (2) that they would definitely not have attended if it had been over two days.

Sources of expertise

Experts indicated they developed knowledge of plants and vegetation of the NMBM over an average of 19.45 year, ranging between 4 and 46 years. Six of the eleven expert's personal perception of their own expertise differed to that of other experts. All described themselves as having less, and more specific, expertise than identified by other experts. Interaction with other professionals was cited by all 11 as the most important way in which they had gained their knowledge, with working on in their jobs and recreational activities also being identified as important. Magazines and seminars during undergraduate studies were identified as the least important sources of knowledge (Table 3.1).

Mapping procedure

Almost half, 45% (5), of experts had been previously involved in a similar mapping exercise. All experts said that they derived some benefit from attending the workshop. Experts enjoyed both the individual and group mapping exercises, but found it quite challenging to try and identify all the important plant areas they felt they should know. The base map provided was generally deemed not be ideal for the exercises due to the small scale and difficulty in reading some of the labels on the map, but was large and clear enough to still allow the experts to satisfactorily identify IAPC's. The map was also outdated in terms of the location of some protected areas, as pointed out by a few of the experts in the individual mapping questionnaire. The methodology, information provided and requirements presented before the individual mapping exercise were sufficient, but not entirely satisfactory, as was predicted due to the nature of the design of the exercise. There was some uncertainty amongst experts as to whether they lacked knowledge, expertise and experience for identifying IAPC's. More than half, 55% (6), of the experts disagreed that the exercise could have been more effective if the maps, layers and GIS data had been e-mailed to them in advance of the workshop and they had been allowed to do the mapping in their own time, whereas 18% (2) said it would have been better and 27% (3) were unsure.

A positive dynamic was perceived in both groups during the group mapping exercises, with all experts feeling that they were freely able to contribute within the group and that their suggestions were acknowledged by the group. The majority, 64% (7), of experts enjoyed the group mapping exercise more than the individual exercise, with 36% (4) saying both were equally enjoyable. Almost all experts, 82% (9), stated that the group exercise produced the most comprehensive map and was the best use of time, whereas one expert said the individual exercise was best and one that the exercises were equally comprehensive. All experts said the group exercise most actively encouraged learning. Just over half, 55% (6), of the experts said the individual exercise allowed them to map their knowledge most effectively, whereas 36% (4) said the group exercise was most effective and 9% (1) that they equally allowed them to map their knowledge effectively (Table 3.2).

No logistical arrangements of the workshop were perceived as decreasing experts' ability to easily and accurately provide information.

Table 3.1: Reported sources of knowledge. Percentage values were calculated by adding all the scores given for each source, out of 10, (0 if it was not selected at all) and dividing by the highest possible total

Source	%
Interaction with other professionals	86
On the job	71
Recreational activities	56
Websites	52
Scientific journal articles	49
Textbooks	44
Research study for masters	40
Research study for PhD	35
Fieldwork for undergrads	19
Seminars for undergrads	14
Magazines	11

Table 3.2: Experts responses to questions relating to the group and individual mapping exercises. [a]n=5; [b]n=6

Between the individual and group prioritizing sessions which:	Group 1[a]			Group 2[b]		
	Individual	Group	Equal	Individual	Group	Equal
Was the most enjoyable	3	2	0	0	5	1
Produced the most comprehensive map	1	3	1	0	6	0
Made the best use of time	1	3	1	0	6	0
Actively encouraged learning	0	5	0	0	6	0
Allowed me to best map my knowledge effectively	5	0	0	1	4	1

Mapping IAPC's

Experts mapped IAPC's for varying reasons, (Figure 3.1) including important vegetation (43), species of special concern (116), ecosystem services (8) and various combinations of these: important vegetation/species of special concern/ecosystem services (4), important vegetation/species of special concern (82), important vegetation/ecosystem services (6), species of special concern/ecosystem services (4). Most experts (8) rated their uncertainty in the accuracy of polygon themes (i.e. "thematic" in Figure 3.2) more highly than the spatial location and dimension of polygons. A pattern which was observed in both the spatial and thematic results was that where there is a large standard deviation in an individual's level of confidence, the first polygons they drew had a higher level of self-reports confidence, and then decreased in confidence during the exercise.

The total area mapped (Kruskal-Wallis test: H (1, N= 11) = 5.633333 p = 0.0176) and average size of polygons (Kruskal-Wallis test: H (1, N= 11) =4.800000 p =0.0285) were significantly different between Group 1 and Group 2.

There was a significant difference between the average of the individual maps of experts in Group 2 and the group map in terms of total area (p = 0.000136), number of polygons (p = 0.001269) and the total area as a percentage of the NMBM (p = 0.000136).

In total area mapped (Kruskal-Wallis test: H (10, N= 250) =43.50000) experts 7 and 8, respectively, were significantly different to 9 (p = 0.020269; p = 0.019168), 2 (p = 0.012128; p = 0.013491) and 3 (p = 0.007358; p = 0.020611). Expert 5 was different solely to 7 (p = 0.038815). In circularity (Kruskal-Wallis test: H (10, N= 250)) and compactness (Kruskal-Wallis test: H (10, N= 250)) index respectively expert 2 differed significantly to experts 7 (p = 0.016514; p = 0.016514), 8 (p = 0.002061; p = 0.002061), 10 (p = 0.001374; p = 0.001374), 3 (p = 0.020017; p = 0.020017) and 5 (p = 0.000501; p = 0.000501). Experts 4 and 5 (p = 0.039997; p = 0.039997) also differed significantly. No other significant differences in spatial data between experts were found.

There was great variation in polygons chosen by individual experts (Figure 3.3), but interestingly all experts working as conservation professionals are located on the left side of the plot and all academics and retired experts are on the right.

Group 1's total mapped area overlapped with Group 2's by 44% and Group 2's overlapped with Group 1's total mapped area by 47% (Figure 3.4). Individual experts can be substantially different in the size and location of the polygons they map. Expert's 2 and 9 had no overlap in the areas mapped (Figure 3.5).

There were no significant relationships between any of the demographic information (occupation, level of education, age and number of years over which expertise was developed) and compactness, circularity, average polygon size and total area mapped as a percentage of the NMBM (Table 3.3). A significant relationship existed between age and number of polygons, with younger experts identifying more polygons (Spearman R = -0.625302; p = 0.039648).

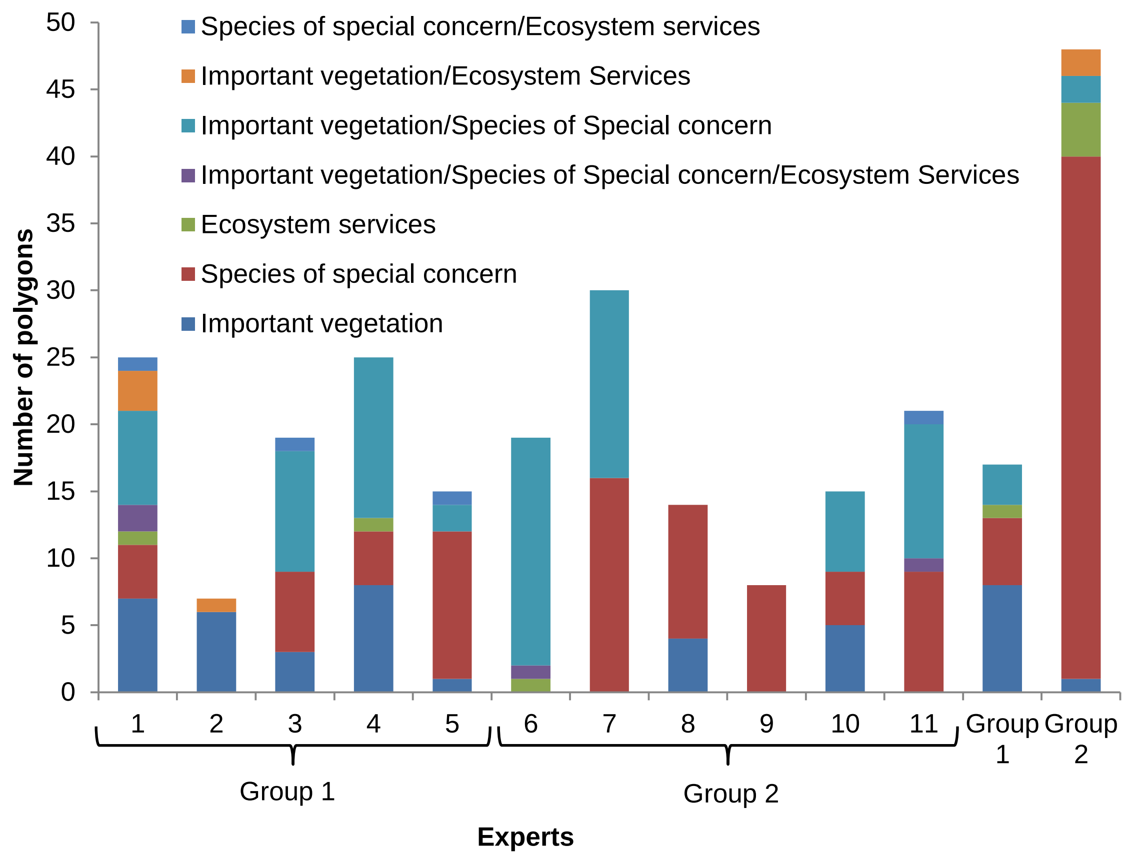

Figure 3.1: Number of times each polygon type mentioned by experts and groups

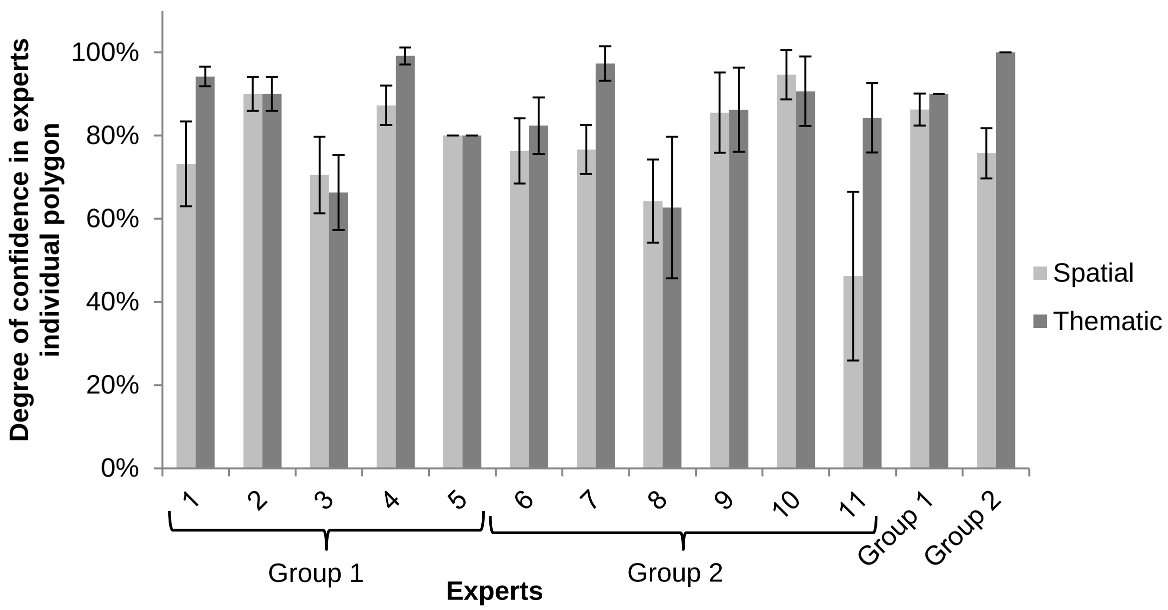

Figure 3.2: Average confidence level of the polygons drawn by individual experts and groups, expressed by spatial and thematic aspects of individual polygons, with Standard Deviation bars

Table 3.3: Polygon mapping data from each individual expert as well as the 2 Groups, with standard deviations in brackets where applicable (Note: The number of polygons value in Table 3 differs to supposedly corresponding values in Figure 1. The values in Figure 1 relate to what the experts filled in on their data sheets, why they mapped certain polygons. Table 3 data is from ArcGIS, a count of the number of actual polygons experts drew)

Expert	Total Area (km²)	Number of Polygons	Average per Polygon (km²)	Total area of NMBM (%)	Average Circularity index	Average Compactness Index
1	120.98	25	4.84 (7.56)	6.19	0.19 (0.10)	0.73 (0.23)
2	75.05	10	7.50 (6.13)	3.84	0.09 (0.05)	0.52 (0.14)
3	190.57	31	6.15 (9.26)	9.75	0.21 (0.10)	0.77 (0.22)
4	323.94	25	12.96 (19.48)	16.58	0.17 (0.09)	0.69 (0.20)
5	303.15	34	8.92 (32.70)	15.51	0.24 (0.08)	0.85 (0.17)
6	36.90	19	1.94 (3.25)	1.89	0.19 (0.09)	0.73 (0.22)
7	68.96	40	1.72 (3.39)	3.53	0.21 (0.08)	0.80 (0.17)
8	21.60	18	1.20 (2.11)	1.11	0.23 (0.08)	0.84 (0.18)
9	49.90	8	6.24 (3.81)	2.55	0.19 (0.06)	0.77 (0.13)
10	34.51	14	2.46 (3.10)	1.77	0.26 (0.01)	0.90 (0.02)
11	143.69	25	5.75 (11.09)	7.35	0.20 (0.07)	0.77 (0.17)
All individuals - average	145.08 (105.40)	25.31 (11.47)	5.66 (3.27)	7.42 (5.4)	0.19 (0.04)	0.75 (0.09)
Group 1 - total	267.65	30	8.92 (15.36)	13.70	0.16 (0.11)	0.67 (0.25)
Group 1 - average	202.74 (109.44)	25 (9.25)	8.07 (3.12)	10.37 (5.60)	0.18 (0.05)	0.71 (0.12)
Group 2 - total	249.12	50	4.98 (10.25)	12.75	0.19 (0.08)	0.75 (0.17)
Group 2 - average	59.26 (44.36)	20 (11.02)	3.22 (2.19)	3.03 (0.02)	0.21 (0.03)	0.80 (0.06)

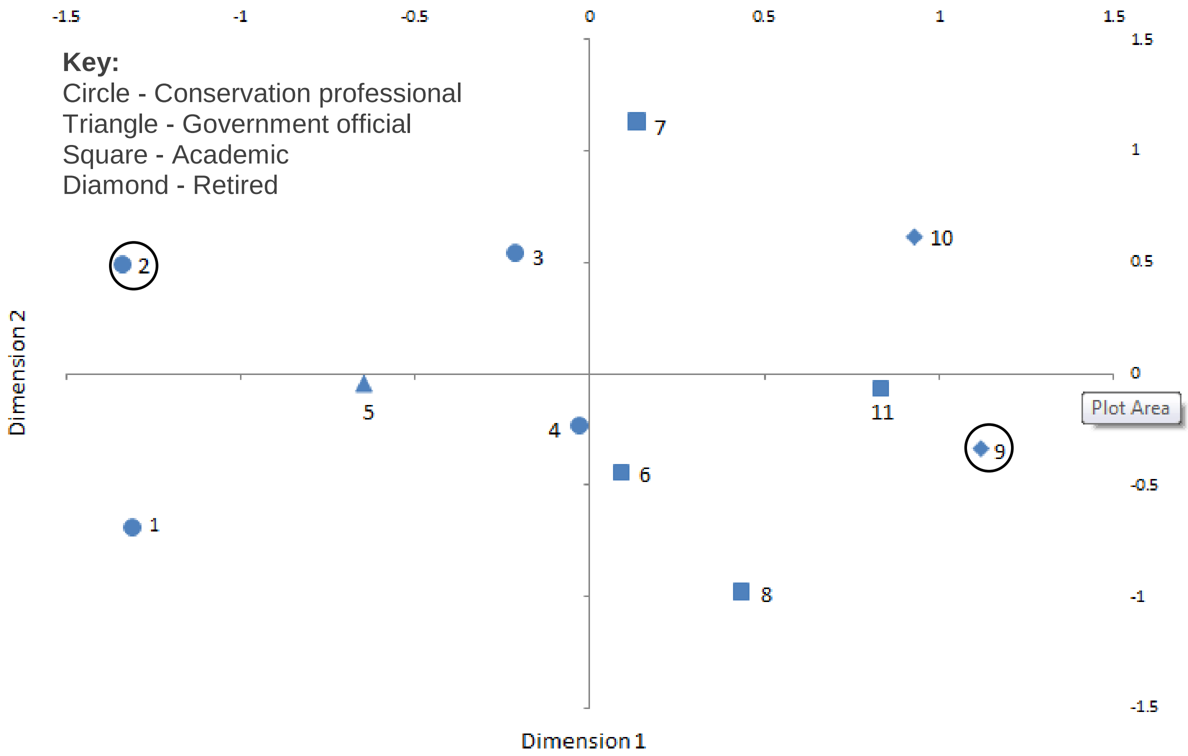

Figure 3.3: Multidimensional scaling analysis of the percentage of spatial overlap in polygons of individual experts. Experts 2 and 9 (circled) are displayed in Figure 5

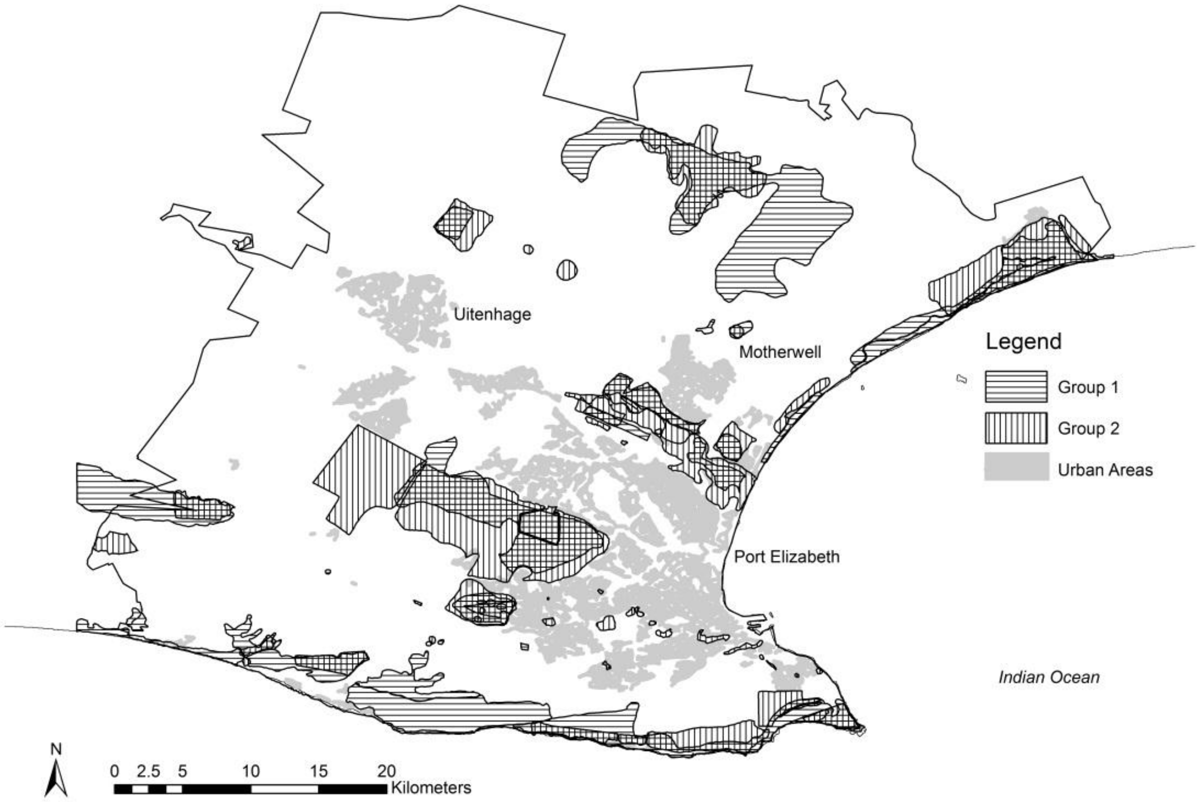

Figure 3.4: Polygons mapped by Groups 1 and 2. Group 1 total mapped area overlaps Group 2's by 44%. Group 2 total mapped area overlaps Group 1's by 47%

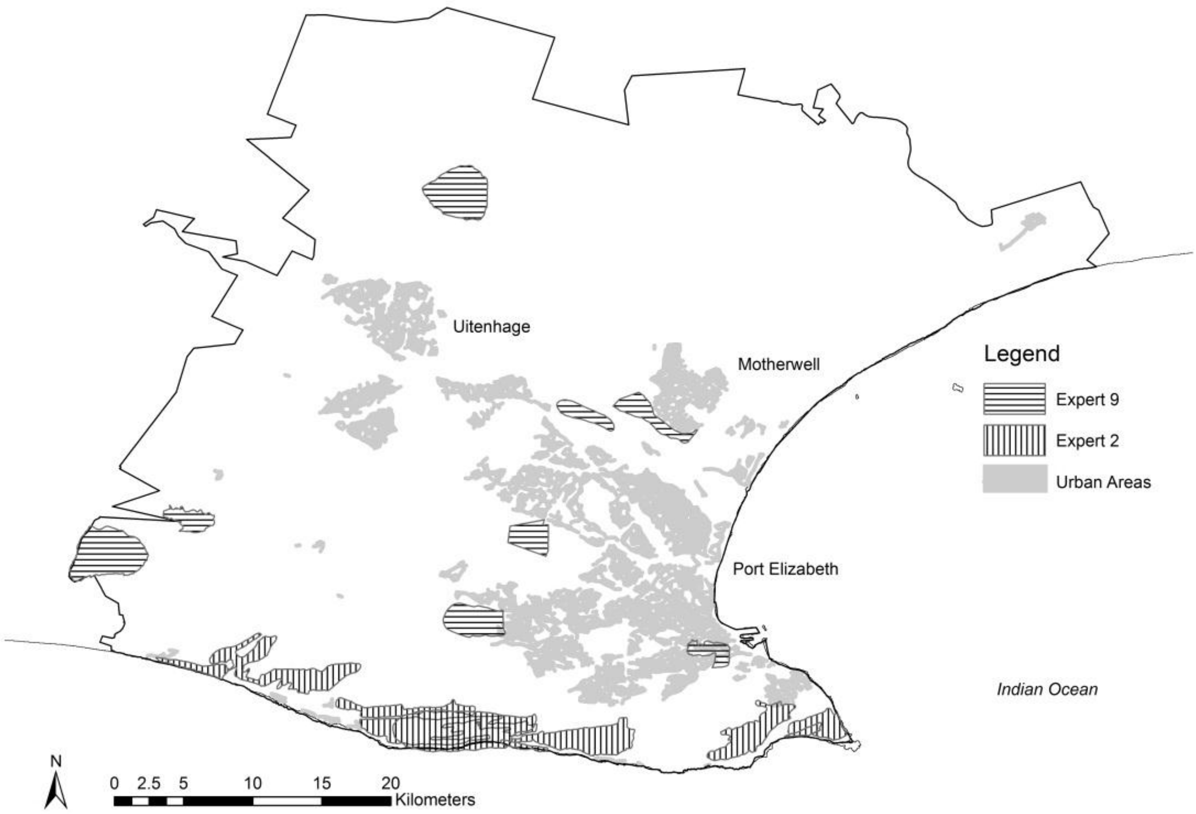

Figure 3.5: Polygons mapped by a conservation professional (Expert 2), and a retiree and amateur botanist (Expert 9)

Discussion

Experts and spatial prioritization

Although the biases involved in incorporating expert knowledge into spatial prioritization have been subject to preliminary investigation (Maddock & Samways 2000; Cowling et al. 2003)., the extent of expert knowledge and the levels of precision, accuracy and uncertainty are rarely quantified (Burgman et al. 2011). We can only really trust experts and expert judgments when they are acquired according to the following conditions: 1) “an environment that is sufficiently regular to be predictable” and 2) “an opportunity to learn these regularities through prolonged practice” (Kahneman 2011).

Little, if any, research has been conducted that quantifies differences between individual experts, group and individual decision-making, or the individual, contextual or group dynamic factors that explain these differences . One of the challenges for conservation experts, relating to Kahneman’s (2011) stipulations for reducing the uncertainty of expertise is when systems are in place that promotes reflection and feedback. Without feedback experts cannot learn to improve their judgments. There is a difference, though, between expert judgments, according to intuition, as referred to in Kahneman (2011), and supplying knowledge or data that is known to an expert. The use of the term expert though seems to imply the ability to go beyond basic knowledge production, to linking this knowledge to decision making and action (Nowotny et al. 2001).

The absence of research in spatial prioritization, and conservation planning more generally, into how individual people and groups make decisions is alarming given the prominence of the use of experts by practitioners (e.g. NGO’s). This stands in contrast to other disciplines, both conservation related (e.g. Kaplowitz & Hoehn 2001; Oliver 2002; Steele et al. 2007; Kuhnert et al. 2010; Speirs-Bridge et al. 2010; Burgman et al. 2011) and many others, including engineering, reliability and safety analysis, systems development & operations (e.g. Kaplan 1992; Sandri et al. 1995; Ford & Sterman 1998; Faraj & Sproull 2000).

Conservation planners have invested immense time and effort developing decision-support software to complement expert decision-makers but rarely done similar for experts. This resulted in one source of uncertainty in spatial prioritization going un-quantified. There is a need to ensure the defensibility of expertise and this requires, firstly, understanding of the scope of expert knowledge and its precision, accuracy and uncertainty, and secondly, a process that can best guarantee the robustness of expert knowledge. We explored this in a preliminary manner.

Expertise

Expertise is a widely used, common, well studied, and misunderstood concept across many disciplines (Collins and Evans 2007; Kahneman 2011). Expertise is developed through extensively doing a specific task multiple times, which is an intricate and slow process (Kahneman 2011). This leads to different levels of expertise, especially according to level of exposure (Collins & Evans 2007). Experts are widely used in spatial prioritization, especially in pragmatic, real-world conservation planning initiatives (Chapter 2).

This study demonstrated experts perceive their own expertise as being less comprehensive than other experts do. Although integration of expert and systematic approaches is now considered best practice (Cowling et al. 2003; Knight et al. 2006b) and experts are included in many conservation plans (Chapter 2).

Although all eleven individuals that attended the workshop were identified by their peers as experts in the vegetation of Nelson Mandela Bay Municipality they had greatly varying years building their expertise. Expertise is most often identified according to experience, education and training (Kuhnert et al. 2010). This definition can often limit the total pool of expertise (Collins & Evans 2007), as demonstrated by this research. The pool of experts have developed expertise over a varied time period and have varying levels of education, with two of the retired experts never having studied or worked in any field related to conservation, ecology or botany. They have gained their expertise through their hobbies and general interest, mostly through Custodians of Rare and Endangered Wildflowers (CREW). These two individuals mapped larger individual polygons than the educated botanical experts, who are also part of CREW, indicating that the experts with a formal education were more precise in identifying areas, although the two retired experts did not have a low level of self-reported confidence, spatial or thematic, in the polygons they identified. Further research is required to determine the accuracy of expert’s predictions.

Most experts do not view themselves as experts to the extent that others view them as experts. Experts under-state, or other experts over-state, levels and ranges of expertise. Our experience with this workshop was that experts were not willing to draw polygons in areas where they were not confident, or else they indicated their uncertainty. It is commonly accepted that experts are generally overconfident in their judgments and decisions (Speirs-Bridge et al. 2010). Experts tend more to be overconfident and to stray outside of their particular field of expertise (Burgman et al. 2011). This differs to what we found in this workshop.

All of the experts identified interaction with other professionals as the most important way that they have gained expertise (Table 3.1). This indicates the importance of knowledge sharing through forums such as conferences and seminars, and especially social learning institutions which allow experts to network and share ideas (Knight et al. 2006b). Although experts cited learning from peer-reviewed journal papers and textbooks contributed to developing their knowledge and expertise, they indicated that practically associated activities, such as working on the job and recreational activities, were more important (Table 3.1). It must be noted though that half of the experts at this workshop are members of Custodians of Rare and Endangered Wildflowers, CREW, (CREW Operations Manual 2008), and therefore the recreational activities mentioned greatly relate to this citizen science program.

Although differences were noted between individuals and groups, there was nothing conclusive linking any particular aspects, such as education, length of work experience, age, profession and other predictors of expertise that could be used in future to select experts. What makes an expert, an expert is not a simple concept (Collins & Evans 2007; Burgman et al. 2011), and we predict that there could be many other personality traits that should be factored into understanding this expertise, such as the amount of time experts have spent in the field and extent of interaction with other experts.

Individual versus group decision-making

The experts stated that the group mapping exercise was the most effective, produced the most comprehensive map and was the most enjoyable, with the exception of one individual (Table 3.2). The importance of human interaction and the dynamic of consensus are powerful ingredients to promote learning (Knight et al. 2006b; Reed et al. 2010), as are people feeling confident that they produced the more comprehensive map, while also having an enjoyable experience. This process also contributed to all experts reporting they learnt something during the workshop, which promotes their expertise. It is important to realize that these workshop need to be designed not only as an avenue for one way flow of information, but more importantly as a social learning experience.

There was a noticeable difference in opinions between Group 1, primarily private conservation practitioners and a government official, who knew each other, but did not necessarily work together, and Group 2 comprising academics and two retired people, but who are all members of CREW, therefore they all knew each other and have worked together. This difference in group dynamics could have contributed to the difference in opinions, especially with regard to which mapping exercise best allowed individuals to map their own knowledge. People seem more comfortable and able to work effectively with people they know well and have worked with before.

It is important to note that often very different information is captured from individuals than from the same individuals in a group (Kaplowitz & Hoehn 2001). This can be seen in the difference between individuals and groups. These differences are both spatial and thematic (Figures 3.1 & 3.2; Table 3.3). The absence of patterns in significant differences makes it difficult to conclude what could bring about these differences, but it advocates the use of a diverse group of experts, in order to cover the diversity of what experts can offer (Evely et al. 2010; Raymond et al. 2010). Knowledge does not appear to be related to age, work experience or education. The younger experts possibly drew more polygons due to having more energy, working more quickly or because all the younger experts were actively researching in the NMBM and were part of CREW, thereby spending substantial time in the field. The individual mapping process may allow individuals to summarize and collate their knowledge, which then allows them to contribute more effectively and accurately to the group. This process should be considered when designing expert workshops.

The experts in Group 1 mapped a greater variety of types of polygons. As conservation professionals and a government official they may have been involved in more pragmatic conservation activities than the academics and retirees in Group 2. The individual experts in Group 2 mapped more species of special concern. When working as a group, Group 2 mapped more categories than Group 1, but the majority of Group 2's polygons were species of special concern and Group 1's important vegetation. This perhaps demonstrates a difference in how experts with different involvement in conservation view important plant areas.

Group 1 generally mapped larger polygons, and mapped a larger area than Group 2, who had smaller polygons, which were more precise. This relates again to the themes mapped by Group 2 which were specifically species of special concern, whereas Group 1 was more focused on complete areas of important vegetation. These two different focuses both have benefits to spatial prioritization with regard to scale. It is important to identify areas important for conservation at both coarse and fine scales (Rouget 2003). Identifying larger areas, which represent whole, functioning ecosystems results in the prioritization of the entire system, which would result in it being more likely to survive and maintain species, whereas the identification of specific areas where species of special concern occur is beneficial in order to ensure the conservation and therefore survival of rare, endangered, irreplaceable and under-represented species (Poiani et al. 2000). This approach is consistent with the coarse and fine filter approaches commonly applied in pragmatic spatial prioritization (Rouget 2003). It might prove enlightening to redo the process by mixing up the groups.

The process of assessing self-reported spatial and thematic levels of confidence that experts had in each polygon they drew was very valuable. It showed to what extent experts trusted their own judgments and made them think specifically about what they are mapping, where they are mapping it and how certain they are of the location of specific features. The process of reducing expert overconfidence was explored by Spiers-Bridge et al. (2010) who advocated having experts explicitly express their confidence in their judgments to reduce overconfidence. It also allows whoever is utilizing the data to know what sites they might have to visit and confirm, as opposed to others where the expert is confident of their knowledge. Standard techniques for comparing measures of uncertainty are required to ensure consistent evaluation.

Translating theory into action

When thinking about implementing these results it is important to consider the context of the research. This study was conducted in South Africa, and specifically the NMBM. Conservation planning, and spatial prioritization more specifically, is integral to conservation action in South Africa through its National Environmental Management: Biodiversity Act No. 10 of 2004 (Driver et al. 2012) and has a relatively long history of application (Knight et al. 2006b). Each local municipality, as determined by the Minister of Environmental Affairs in a province, must publish a Bioregional Plan which contains “the components of biodiversity in the region”, “measures for the effective management of biodiversity” and must “provide for monitoring of the plan” (National Environmental Management: Biodiversity Act No. 10 of 2004). NMBM has a draft of such a Bioregional Plan, which is based on spatial prioritization (SRK Consulting 2007). Some decision-makers have substantial expertise in spatial prioritization, while others have little understanding of the techniques (Wilhelm-Rechman & Cowling 2011). Preceding spatial prioritization with a problem orientation, inclusive of a stakeholder analysis, will assist conservation planners to design spatial prioritization workshops and analysis more effectively.

Updating and renewing these plans is an expensive process and requires substantial time and resources. Due to the legalities of spatial prioritization, including five-yearly updates, and the implications it has to development, which can often be contentious (Noss et al. 1997), it is critically important that bioregional plans are scientifically and legally defensible. This requires the process of informing and updating the plans to be consistent and guided by an explicitly-stated, structured process. Knowledge for the area is consistently increasing, especially due to the work done by CREW. Data is accruing faster than the five year review period of the Bioregional Plans, largely through CREW survey and reports (CREW Operations Manual 2008). This is surprising given the extraordinary plant species diversity of

South Africa, which necessitates long-term systems to collect species data (e.g. Cowling et al. 2010). Such systems should be aware of the declining return on investment of species surveys for spatial prioritization (Grantham et al. 2008). South Africa generally, and the NMBM specifically, has many experts available to contribute to the updating of bioregional plans. Experts are valuable in providing insights which makes plans more relevant and effective to specific contexts, therefore making plans more practically implementable (Knight et al. 2006b).

There are two ways in which the research in this paper can be translated into action: 2) Use the data gained from the questionnaires, expert feedback and observation during the workshop to design better, more effective workshops, and 2) use the data which was captured during the workshop process to inform conservation action in the NMBM.

The question remains though, to what extent can we just take what experts say as absolute truth and base legal documents on this type of exercise? Further research is required into the empirical differences between expert tacit knowledge of, for example, plant species locations, and its accuracy and precision.

Recommendations for future priority setting workshops

Selecting experts

In selecting experts to attend a spatial prioritization workshop the following criteria should be considered:

- Experts should be identified by peers
- Experts should confirm that they are confident in their expertise
- Experts who are not academics or conservation professionals should not be overlooked (see Low et al.2009; Cowling et al. 2010; Raymond et al. 2010)
- An optimal mix of different types of experts need to be included in a workshop so as to have comprehensive coverage of all the related aspects of spatial prioritization, but this is a very difficult thing to define and to identify

Workshop process

The following should be considered during an expert spatial prioritization workshop:

- The management of time and workshop fatigue is integral in eliciting the best and most accurate possible data from the experts
- It is important to explicitly and precisely identify: 1) what are the goals and, 2) what are the desired outputs of the workshop

- Important plant areas should be defined according to the goals of the workshop, determining what should and should not be included in the specific process, allowing experts to direct their efforts providing applicable data
- Experts should be encouraged to bring tools, such as maps, textbooks and field notes, to the workshop, equipping their decision-making
- It is important to supply experts with comprehensive and detailed maps
- Experts' communicating their level of confidence allows decision-makers to have some basis for knowing how certain they should be in selecting areas
- Both the individual and group mapping exercises provided valuable data, but if time was very limited, we would suggest only doing a group mapping exercise
- We suggest that experts be mixed and not grouped according to any common characteristic

Use of data gained at workshop

Data and decisions from expert spatial prioritization workshops can be used as follows:

- Expert spatial prioritization workshops could be used to formally inform the Bioregional Planning process
- In some cases, human and social data may be more effective than biological data, which may not even be required (Cowling et al. 2010)
- Citizen science programs, such as CREW and the Second South African Bird Atlas Project (see Wright 2011) can be used, through expert spatial prioritization workshops, to provide current data on species, vegetation, ecological processes and ecosystem services to inform Bioregional Planning processes
- Bioregional Plans should ideally be updated in an on-going fashion, as opposed to one-off spatial prioritization events, using a spatial conservation planning database located within a land management organization responsible for land-use decision-making (see Theobold et al. 2000) This is already happening in KwaZulu-Natal province (Goodman 2003)
- It is important that data is gathered for spatial prioritization according to specific targets and contexts. Problems and challenges need to be identified, which inform data that is needed to approach and solve the problem, ensuring spatial prioritization, and conservation plans, are more relevant and understandable for decision-makers and stakeholders (Knight et al. 2006b)

Expert spatial prioritization workshops can greatly contribute to practical conservation planning by providing a space for the following:

- Structured elicitation, gathering and recording of expert knowledge
- Experts can engage on current conservation issues and decide on what is currently relevant
- Experts can provide data to constantly review and update the Bioregional Plans
- Provide a platform for sharing of ideas and knowledge, which allows experts to learn from each other and collaborate more on research and implementation projects, i.e. knowledge exchange
- Provincial government and municipal decision-makers can be invited to attend workshops and engage with experts on conservation issues and how they relate to economic and rural development

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Chapter 4: Can experts replace interviews when mapping the social dimensions of conservation opportunity?

Abstract

Global conservation efforts have been predominantly focused on identifying protected areas, which exclude human activity. Most of the remaining biodiversity currently occurs on private land though, therefore conservation efforts need to focus on how to conserve this biodiversity. Effective conservation action needs to take into account assessing and mapping conservation opportunity. Human and social data needs to be collected in the spatial prioritization process in order to develop an understanding of the socio-economic context of areas. This research is time consuming and expensive to carry out. We carried out landowner interviews in order to assess conservation opportunity measures in the Joubertina area of the Eastern Cape, South Africa. We then compared this data to equivalent data about the landowners collected through expert interviews, in order to assess whether the process can be simplified and shortened, to be more time and cost effective. The experts were not specifically conservation experts, but rather people who had a relationship with the landowners and had insight into landowners' attitudes and actions. Experts were not able to accurately predict and score conservation opportunity related measures for individual landowners, but were able to provide accurate insight into the general attitudes of landowners and the challenges the landowners face. Experts play a valuable role in spatial prioritization processes, but were shown to be inaccurate in providing specific human and social data for individual landowners. Further research needs to go into studying how experts can be effectively utilized in the process of mapping conservation opportunity.

Key words

Experts, conservation opportunity, spatial prioritization, decision-making, landowners

Introduction

Conservation planning is a process where stakeholders collaboratively develop strategies for implementing effective conservation actions at locations identified by a spatial conservation prioritization (Sarkar et al. 2006; Margules & Sarkar 2007; Wilson et al. 2009). These conservation actions have traditionally been largely focused on identifying and designating formally protected areas (i.e. IUCN categories I-IV) which exclude human activity (Miller & Hobbs 2002; Brockington et al. 2006; Dowie 2009), or do not nominate specific types of actions for implementation (Wilson et al. 2007). However, most of the remaining globally important biodiversity is located on privately-owned land (Knight 1999; Theobald & Hobbs

2002; Bond et al. 2004). Formally protected areas are often too small to support viable populations of species, ecosystems and social and ecological processes (Simberloff 1988; Newmark 1995), and are becoming increasingly isolated as landscapes are fragmented by human activities (Saunders et al. 1991). Protected area networks are also often biased towards areas of low production value, which could not be used for any other purpose (Pressey 1994; Norton 2000), and so fail to protect a representative sample of biodiversity that is also likely to persist (Ferrier et al. 2002; Rodrigues et al. 2004). Conservation actions on private land can play a critically important role in expanding protected area networks (Newmark 1995; Knight 1999; Langholz & Lassoie 2001; Parker 2004; Winter et al. 2007; Fishburn et al. 2009; Gallo et al. 2009).

Spatial conservation prioritization is the activity of applying quantitative data to spatial analysis to select locations for conservation investment (Wilson et al. 2009), although the majority of studies published in the peer-reviewed literature do not directly promote conservation action (Knight et al. 2008). Spatial prioritization is one part of the greater conservation planning process (Sarkar et al. 2006; Margules & Sarkar 2007). Measures of conservation priority have historically been used to identify networks of candidate areas that represented valued natural features to target levels. The vulnerability and conservation value (e.g. species richness, endemism or irreplaceability) of biodiversity have been commonly used (Pressey 1999; Margules & Pressey 2000; Noss et al. 2002), with economic costs more recently also being included in spatial prioritization (Naidoo et al. 2006). Knight et al. (2006a) identified the need to incorporate the assessment of the social dimensions of social-ecological systems into spatial prioritizations. The social dimensions of a social-ecological system can be identified as the characteristics of individual people (e.g. their attitudes and behavior) and groups (i.e. institutions and organizations). An understanding of the social context of an area is of utmost importance during the conservation planning decision-making process the perceptions, attitudes and willingness of local people and landowners greatly influences where and how conservation action can be implemented (Cowling & Wilhelm-Rechmann 2007; Polasky 2008; Knight et al. 2010).

The selection of protected areas for conservation has developed from early ad hoc, opportunity based, selections to systematic conservation planning processes, which takes into account relevant, systematically gathered, biological and socio-economic data specific to a planning region (Pressey 1994; Sarkar et al. 2006). Although the importance of carrying out systematic data collection and applying conservation planning principles is recognized as a valuable process to select protected areas (Margules & Pressey 2000; Cowling & Pressey 2003; Knight et al. 2006b), it has been recognized that in order for conservation action to be effectively implemented, opportunities should be utilized wherever they arise (Knight &

Cowling 2007; Cowling et al. 2010). This is especially true when we consider the diminishing return on investing time into gathering biodiversity data (Grantham et al. 2008) and that investment for conservation action should be made into opportunities and not on only doing extensive biodiversity surveys (Cowling et al. 2010).

There has been some debate surrounding the use of conservation opportunity to inform the implementation of conservation action, a reflection of the recent emergence of this concept (Knight & Cowling 2007; Pressey & Bottrill 2008; Knight & Cowling 2008). Conservation opportunity is defined by the social, economic and political factors of a specific context and dictates the practical implementation of conservation action by controlling the ability to acquire land as well as actual ability to implement the required actions (Knight & Cowling 2007).

Regardless of this debate, it is widely agreed that understanding people and the need to engage and collaborate with both individuals and society is essential for effective conservation planning (Mascia et al. 2003; Ehrlich & Kennedy 2005; Brooks 2010). Especially with regard to the influences they have on conservation planning and action. Knight et al. (2010) identified various social factors which should be incorporated into the conservation planning process. Raymond & Brown (2011) also used socio-economic and human behavioral dimensions, along with spatial aspects, to assess conservation opportunity in Australia.

Understanding human behavior is a complex task, but which has been studied extensively in sociology, anthropology and psychology. One of the models used to understand and predict behavior is the Theory of Planned Behavior (Ajzen 1991). This theory predicts human behavior by looking at three things: 1) attitude toward the behavior, 2) subjective norms (i.e. to what extent people's decisions are affected by the opinions of those around them), and 3) perceived behavioral control. Bamberg & Möser (2007) explain the use of the Theory of Planned Behavior as it has been used in environmental psychology. The Theory of Planned Behavior has been used to explore landowners' decision-making and conservation behavior (Beedell & Rehman 1999) and Steg & Vlek (2009) supported it as a successful method to explain environmental behavior.

"An expert is someone who has knowledge of the subject of interest gained through their life experience, education or training" (Kuhnert et al. 2010). Experts are not only limited to people who have official qualifications or skills, but also includes people who have developed specialist knowledge from experience (Collins & Evans 2007; Burgman et al. 2011). Although experts are difficult to identify and expert knowledge difficult to define, experts provide real and valuable insight and knowledge to decision-making processes (Collins & Evans 2007).

Experts and expert knowledge has been used in spatial prioritization process by various conservation organizations (Cowling et al. 2003; Morrison et al. 2009), most extensively by NGO's (Chapter 2). Experts are used in spatial prioritization to: provide spatial and thematic information about species and habitats, especially where there is limited data, provide context to research, review data and plans, assign targets for conservation, provide local knowledge, mainstream conservation plans, identify threats to biodiversity and generally inform decision-making (Dinerstein et al. 2000; Nowotny et al. 2001; Cowling et al. 2003; Chapter 2).

The utility of experts in conservation generally has been widely debated (Burgman et al. 2006; Kuhnert et al. 2010; Martin et al. 2012), and more specifically regarding spatial prioritisation analyses (Pressey & Nicholls 1989; Dinerstein et al. 2000; Sanderson et al. 2002; Didier et al. 2009). Although experts have been used, there are some limitations. Experts show biases towards specific geographic areas and/or biomes and/or species where they have predominantly worked or carried out research (Kress et al. 1998; Maddock & Samways 2000). Expert knowledge is also often incomplete (Cowling et al. 2003), but experts tend to be overconfident in their judgements (Burgman et al. 2011). These shortcomings and biases of experts, in terms of biodiversity data, could present greater when providing insight on social data, which could be considered as more subjective.

Experts have also been seen as valuable because they better ensure more relevant and practically implementable plans (Dinerstein et al. 2000; Nowotny et al. 2001; Cowling et al. 2003). Expert knowledge can be best utilized where there are gaps in current data, and/or when systematic data collection is impractical, i.e. is expensive, time constrained and/or there are no practical sampling methods (Pressey & Bottrill 2009; Kuhnert et al. 2010). Experts also provide insight into the local context and can provide an avenue or platform for interaction between local stakeholders and conservation professionals (Pressey & Bottrill 2009). Although there are many reservations about using experts to provide empirical data, experts can be very valuable to decision-making processes (Burgman et al. 2011; Martin et al. 2012). Experts can provide immediate data, which is valuable where prolonged data gathering will 1) exclude capitalising on windows of opportunity that emerge (e.g., availability of funding, a favourable change in government policy), and/or 2) the rapid pace of pressures on valued species, ecosystems and social and ecological processes compromises conservation goals (Pressey et al. 2004), and/or 3) reduce the return-on-investment for conservation (Grantham et al. 2008).

Knowledgeable local community members have been involved in spatial prioritization to provide biodiversity data as well as an understanding of socio-economic contexts (Chalmers & Fabricius 2007; Ban et al. 2008; Weeks et al. 2010; Game et al 2011). When relevant stakeholders and the local community are involved in informing the conservation planning and decision-making process greater commitment can be achieved, making implementation of effective conservation action more likely (Game et al. 2011). To our knowledge, experts have not been used to contribute empirical data to assessing the social dimensions of conservation opportunity (Knight et al. 2010).

Techniques for assessing the social dimensions of conservation opportunity typically consist of surveying or interviewing landowners to measure their attitudes towards conservation, their conservation behavior, their willingness and capacity to engage specific conservation instruments, incentives and institutions, and other socio-economic factors (e.g. Ban et al. 2008; Knight et al. 2010; Raymond & Brown 2011). This process of mapping social data is relatively time consuming and expensive.

We hypothesize that interviewing a small number of local experts can short-cut the extensive, time consuming and elaborate process involved in interviewing the typically numerous landowners required to collect data useful for mapping the social dimensions of conservation opportunity. We test whether local experts are able to provide comparable data on landowners self-reported attitudes, behavior, willingness, capacity and other socio-economic factors (Knight et al. 2010; Raymond & Brown 2011). This research aims to investigate the possibilities for providing a shortcut to the social and human conservation opportunity assessment process.

Methods

We used both the currently popular and accepted methodology of systematically interviewing landowners, using an interview protocol, to elicit social data. We then identified relevant experts who supposedly knew the landowners which we interviewed and asked them to provide similar data about each landowner that was interviewed and that they knew.

Study area

The study was conducted in the Kouga Mountains and Heights areas around Joubertina within the Kouga River catchment which is located in the South-Western Eastern Cape, South Africa (Figure 4.1). The Kouga River and its catchment area are important in supplying water to Port Elizabeth, a large city on the East coast of South Africa (McConnachie & Cowling 2012). The vegetation consists of predominantly Fynbos with elements of Subtropical Thicket and Succulent Karoo (Mucina & Rutherford 2006). Land-uses in this area include commercial fruit, vegetables, livestock (sheep, cattle and ostrich) and Honeybush tea farming and eco-tourism. Some of the land is also used for lifestyle farmers, i.e. those not conducting commercial agriculture, which do not necessarily then have a specific agricultural land-use.

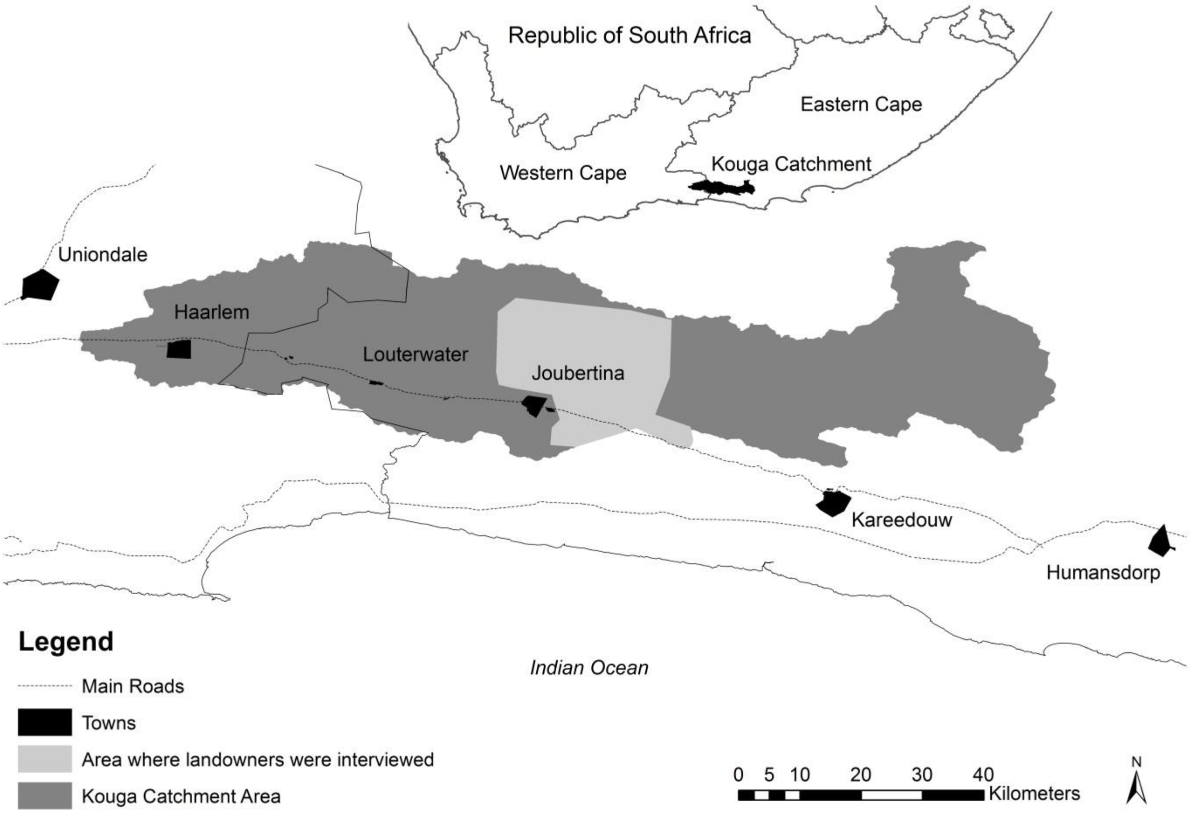

Figure 4.1: The study area within the Kouga Catchment, near Joubertina in the Eastern Cape of South Africa

Landowner interviews

Twenty three landowners were interviewed by the primary author at their homes or in the town of Joubertina during May and August 2012. One interview was conducted telephonically. Landowners were identified using the snowballing technique (Goodman 1961) through discussions with an agricultural extension officer, staff from a local non-profit organization, a local Church Minister and landowners. These 23 landowners were selected as they own land in the immediate area surrounding Joubertina. The landowners interviewed were limited to those that had livestock and were in the geographical area of the study. The only landowners fitting this profile who were not interviewed were those that do not permanently live in the area.

The interviews were arranged by telephone and took between 40 minutes and four hours to complete. The interview protocol was is based on prior work done by Knight et al. (2010) and McClure (2010) and consisted of open-ended questions, Likert statements and yes or no questions (Babbie 1989). This structure aimed to provide qualitative, for understanding the subtlety of the local context, and quantitative data which could be statistically analyzed.

Interview factors included: 1) historical context and background information about landowner and land, 2) conservation context, 3) attitude towards conservation behavior, 4) perceived subjective norms, 5) perceived behavioral control, 6) willingness-to-collaborate with organizations, 7) willingness-to-participate in organized conservation meetings and actions, 8) willingness-to-sell property, 9) champions, 10) conservation behavior, and 11) landowner personal information (Appendix 2.1).

Factors 1 and 2 provided background information on the landowner, their family's history of land ownership, the land uses, the landowners general attitude to living in the area, their relationship with their land, general attitudes towards conservation and the challenges they face. Factors 3, 4 and 5 were based on the Theory of Planned Behavior (Ajzen 1991; Fishbein & Ajzen 2010) to explore dimensions of landowners' potential future conservation behavior. Factors 6 and 7 explored the landowner's willingness to participate and collaborate with various conservation organizations. Factor 8 explored landowner's willingness to sell their property and what they intended to do with their property long term. Factor 9 explored the social relationships between landowners in the area, identifying the respected and liked landowners. Factor 10 assessed the landowner's self-reported conservation behavior. Factor 11 gathered all the relevant personal information of the landowner.

Expert interviews

The aim of the expert interviews was to assess the extent and accuracy of the experts' knowledge of the various factors which the landowners' who were interviewed, were questioned about. This was in order to assess whether expert interviews could replace landowner interviews in assessing conservation opportunity in an area.

"An expert is someone who has knowledge of the subject of interest gained through their life experience, education or training" (Kuhnert et al. 2010). Experts are people who have knowledge of a specific subject of interest gained through their experience and/or education and/or training (Kuhnert et al. 2010). In this context experts were identified as people who knew the landowners well enough to provide insight as to the information landowners provided about themselves in the landowner interviews. . Experts were identified through landowner interviews (not directly, but by taking note of any professionals that landowners mentioned), and snowballing with other experts and people in positions working closely with landowners. Four of the five identified experts were interviewed at their work places and one telephonically. Interviews were conducted during August 2012, and lasted between one and four hours. Experts were not limited to conservation professionals.

The expert interview protocol comprised open ended and closed ended questions. It was designed to mirror the landowner interview protocol and comprised six factors: 1) background information about the experts including job description and experience, 2) interaction with landowners relating to how well the experts know each landowner (experts were asked to classify how well they knew landowners: don't know; know about; know; know well), how often they interact and what they speak about when they do, 3) conservation related factors including landowners' attitude towards conservation behavior, perceived subjective norms, perceived behavioral control, willingness to collaborate with organizations, willingness to sell their property and actual conservation behavior, 4) landowner specific information relating to the land-uses on their land and other business interests as well as scores relating to how respected and influential each landowner is believed to be in the community, 5) community context and, 6) personal information about the experts (Appendix 2.2).

Experts were asked to score landowners they had met according to their (i.e. the experts) understanding of landowners attitudes and behavior. There was also one case where the expert only interacts with landowners about one specific factor relating to conservation and he/she was only willing to score the landowners about this factor.

Information not specifically gathered but that emerged through the open-ended questions were recorded.

Data analyses

Descriptive statistics

Only descriptive statistics was done on the data from factor 1 and 11 from the landowner interviews and factor 1 and 6 from the expert interviews in order to report on and describe demographic information about the landowners and experts. Descriptive statistics was carried out on data from factor 2 from the landowner interviews and factor 5 from the expert interviews by counting the number of times the landowners and experts mentioned various things. These counts when then compared to find similarities in the data provided by landowners and experts.

Scale development

Scales were developed to represent summaries of factors which had multiple questions (Babbie 1989). Factors 3, 4, 5, 8 and 10 from the landowner interviews that comprised Likert statements were tested for internal consistency using Cronbach's α (Alpha), in Statistica 10, and McDonald's ω_H (Omega), in R. Cronbach's α is the more widely applied test of internal consistency, but it overestimates the proportion of variance for interview protocols where the factor being measured has multiple dimensions (Zinbarg et al. 2005). McDonald's ω_H is a more reliable measure of internal consistency in this context and therefore (Zinbarg et al. 2005).

Scales were developed for each factor using McDonald's ω_H by removing items that decreased the internal consistency of individual scales, and then summing the scores for individual items and dividing them by the highest possible total for each factor to produce a value between zero and one. The higher the scale value, the more likely a landowner would display positive conservation behavior. A total of five scales were developed for each landowner.

Identifying differences between landowners and experts

The scales developed for the different sections, as well as direct responses from landowners, were compared to corresponding responses from experts relating to the same concepts. The percentage difference between landowner and expert responses for each question was calculated. All of the scores for landowner and expert responses were adjusted to reflect a relative value out of 10, depending on how responses from different factors in the interview protocols were scored. The percentage difference was then calculated by subtracting the difference between the expert and landowner scores for linked questions, where the questions were directly comparable, and then between the scores experts provided to the general question and the equivalent scale values developed for individual landowners. These differences for each equivalent response were added together and the total difference divided by the largest possible difference between the expert and landowners responses according to the number of questions answered, and specific to, individual landowners. This resulted in a percentage difference score, which is directly comparable between the five experts and the individual landowners for individual questions.

Wilcoxon Matched Pairs Tests were used to compare the direct responses between, and the equivalent responses from individual landowners.

A T-test was conducted to identify any difference between the percentage difference scores and how well the experts reported that they knew landowners. All data was collated in Microsoft Excel 2010, and analyzed in Statistica 10.

Results

Landowner demographics

Of all the landowners interviewed, 20 were male and 3 female. The majority, 21, was white, Afrikaans-speaking South Africans and 2 were white, English-speaking South Africans, but all 23 landowners spoke Afrikaans with their laborers. The average age of the landowners was 56 (range: 25-76). The average length of time that the land had been owned by the landowners families was 72 (range: 1-200) years, with the average length of time that the landowners had been living/farming on their land being 19 (range: 1-60) years.

Landowners were predominantly engaged in livestock pastoralism, or fruit and vegetable cropping, or lifestyle farming. 16 of the landowners were commercial farmers, 4 were a combination of small scale commercial and lifestyle farming, and 3 landowners were lifestyle farmers,. Most of the landowners, 17, predominantly farmed livestock, 2 fruit and one predominantly vegetables. All 20 of the commercial landowners had livestock on their land. With regard to level of education, 2 of the landowners had a primary school education, 12 had completed high school, 3 had diplomas and 6 had completed university degrees.

Expert demographics

The experts interviewed included an agricultural advisor and researcher at the Eastern Cape Department of Rural Development and Agrarian Reform; an environmental officer at the Eastern Cape Department of Economic Development, Environmental Affairs and Tourism; a Stewardship Program manager for the Eastern Cape Parks and Tourism Board; an extension officer for a local non-profit organization; a Dutch Reformed Church Minister. Most, 4, of the experts interviewed were male and 1 female, with 3 being white, Afrikaans-speaking South Africans and 2 white, English-speaking South Africans. They had an average age of 52 years (range: 37-64), with an average of 17 years working in the area (range: 1.5-32). 4 had a full university degree with honours and 1 had a diploma.

Internal consistency

There are notable differences between the two different tests for internal consistency, Cronbach's α and McDonald's ω (Table 4.1). We used the set of questions as indicated by the highest possible McDonald's ω_H to create indices for each factor. The index for Conservation behavior has the lowest internal consistency. The scales for the various factors were calculated using the refined set of questions, therefore for factor 3 two questions were removed, for factor 4 one question was removed, for factor 5 three questions were removed, for factor 8 one question was removed and for factor 10 one question was removed when the scale was calculated. The minimum threshold for ω values was 0.6, as used by Knight et al. (2010), but in some cases a higher ω was preferred. The scales for the individual landowners for the factors in Table 4.1 are included in the Supplementary material: Table 4.8.

Comparing landowner and expert responses

There was a difference in the number of landowners that each expert knew and was willing to score, as well as in the number of total questions that the experts answered in their interview protocol. This was due to some experts not feeling that they could answer for certain areas that they had no knowledge, or experience in. This resulted in it being impossible to do any direct statistical analysis to all the data in the same manor.

The experts scored high percentage differences between their responses and those of the landowners. On average, experts' responses were most similar to responses from Landowner 04's (14.2% difference) and most different to Landowner 02's and Landowner 17's responses (both 45.7% difference). Experts' responses about individual landowners differed, on average, by 33.4(±5.6) % to the corresponding responses of the landowners (Table 4.2).

Table 4.1: Measures of internal consistency of factors describing land owner behavior, using Cronbach's Alpha and McDonald's Omega. 'Full set' values represent a calculation for all items in the scale. 'Refined set' values represent calculations with low scoring items removed. Values in brackets denote the number of items

	Cronbach's α		McDonald's ω_H	
Factor	Full set	Refined set	Full set	Refined set
3. Attitude towards conservation behavior	0.54 (12)	0.60 (8)	0.46 (12)	0.75 (10)
4. Perceived subjective norms	0.85 (15)	0.85 (15)	0.42 (15)	0.82 (14)
5. Perceived behavioral control	0.41 (15)	0.61 (12)	0.61(15)	0.77 (12)
8. Willingness to sell property	0.86 (6)	0.86 (6)	0.70 (6)	0.87 (5)
10. Conservation behavior	0.70 (15)	0.76 (12)	0.34 (15)	0.73 (14)

Table 4.2: The difference (%) between responses from landowners and experts, reported per each landowner by each expert for all questions and relevant scales.
Note: Data absences result from non-responses by experts where individual landowners were unknown to them

	Experts (%)						
Landowner	E1	E2	E3	E4	E5	Average per landowner	Standard deviation
L01	47.1	41.0			42.2	43.5	2.6
L02	37.8	50.7			48.6	45.7	5.7
L03	42.8	32.1				37.5	5.3
L04	10.4	12.1	23.4	16.3	8.8	14.2	5.2
L05	29.1	31.9				30.5	1.4
L06	36.1	41.7			27.4	35.1	5.9
L07	27.5	39.9			33.1	33.5	5.1
L08	34.6	52.5				43.5	9.0
L09	36.0	39.4	22.8	41.2	57.7	39.5	11.2
L10	34.1	42.6			33.2	36.6	4.2
L11	25.7	25.5				25.6	0.1
L12		28.7				28.7	0.0
L13	30.0	34.8				32.4	2.4
L14	30.7	21.7				26.2	4.5
L15	43.9	35.4	59.1		28.6	41.7	11.4
L16	30.8	34.1			28.5	31.1	2.3
L17	28.1	36.7	72.3			45.7	19.1
L18	28.8	28.5	52.6			36.6	11.3
L19	25.4	24.8				25.1	0.3
L20	27.6	33.6	38.9		29.0	32.3	4.4
L21	30.0	36.8			33.2	33.3	2.8
L22	18.1	25.2				21.7	3.6
L23	27.3	27.3			30.0	28.2	1.3
Average per expert	31.0	33.8	44.9	28.8	33.4	33.4	5.6
Number of landowners known by expert	22	23	6	2	12	13	8.4

Experts responded most accurately to question 3.1.1 (Please fill in the following table relating to landowners' attitudes towards conservation behavior: The killing of vermin such as lynx and leopard that eat livestock). There was no significant difference between the expert responses and corresponding landowner responses (Table 4.4: $p>0.05$ for all experts) and there was an average difference of 20.2(±2.3) % total responses (Table 4.3). The most inaccurately answered question was 3.5.1 which had significant differences between the responses of experts and landowners (Table 4.4: $p<0.05$ for all experts) and there was an average difference of 57.7(±11.3) % between landowner and expert responses (Table 4.3). Only Experts 1, 2 and 3 provided responses to more than 12 landowners. Of the 23 questions answered by Expert 1, 5 were not significantly different to the corresponding landowner responses. Expert 2 had 6 which were not significantly different of the 23 questions answered. Expert 3 answered 15 questions, of which 3 did not show significant difference between the expert and the landowner's answers (Table 4.4).

There is no significant relationship between the average difference in responses between landowners and experts and the level of familiarity between individual landowners and individual experts ($p=0.293373$) (Table 4.5). The only expert that showed a significant *p*-value for this relationship is E3 ($p=0.035286$), but this expert knew only 6 landowners. The standard deviations of the percentage difference for all the experts as a group and the individual experts is higher where the experts only know landowners as opposed to lower standard deviations where the experts know landowners well.

Table 4.3: The difference (%) between responses from landowners and experts, reported by individual experts per specific questions. Note: Data absences result from non-responses by experts where individual landowners were unknown to them. (For detailed questions see Supplementary material: Table 7)

	Experts (%)						
Question number	E1	E2	E3	E4	E5	Average per question	Standard Deviation
3.1.1	18.7	20.3	22.2	16.7	23.1	20.2	2.3
3.1.2	19.2	40.1	48.1	16.7		31.0	13.4
3.1.3	30.8	41.1	66.7	22.2		40.2	16.7
3.1.4	22.2	29.2	54.3	8.5	22.8	27.4	15.0
3.2.1	22.2	33.3	13.9	38.9	23.1	26.3	8.8
3.2.2	36.9	37.7	19.4	38.9		33.2	8.0
3.2.3	25.8	27.1	19.4	38.9		27.8	7.0
3.2.4	22.8	21.0	17.5	38.9	31.2	26.3	7.8
3.3.1	32.3	30.9	59.3	27.8	22.2	34.5	12.9
3.3.2	34.3	31.4	70.4	16.7		38.2	19.8
3.3.3	42.9	33.3	55.6	5.6		34.3	18.4
3.3.4	29.4	21.7	58.0	19.4	38.4	33.4	14.0
3.4.1	40.7	41.9	76.4	45.8	76.4	56.2	16.5
3.4.2	38.5	39.1	61.1	50.0	27.5	43.2	11.4
3.4.3	40.4	32.9	33.3	38.9	69.4	43.0	13.5
3.4.4	30.4	28.7	45.7	11.1	71.4	37.4	20.2
3.4.5	35.2	37.9	50.0	22.2	44.3	37.9	9.4
3.4.6	36.8	34.0	49.1	39.6	13.0	34.5	11.9
3.5.1	53.1	47.1	54.1	54.4	79.6	57.7	11.3
3.6.1	28.3	28.5	7.4	16.7	38.0	23.8	10.6
3.6.2	38.9	44.0	29.6	27.8		35.1	6.7
3.6.3	36.4	41.1	33.3	72.2		45.7	15.5
3.6.4	17.9	22.4	19.0	19.8	27.9	21.4	3.6
Average:	31.9	33.2	41.9	29.9	40.6	35.2	4.8
No. landowners known by experts	22	23	6	2	12	13	8.4

Table 4.4: The significance of differences (p-value) between experts (who knew more than 12 landowners) and landowner responses to individual questions. p-value * denotes p-values displaying a significant difference between landowners responses and experts responds for individual questions. Note: The gaps in the data are where Expert 5 did not respond to the questions as the expert did not believe they had insight into those specific questions (For detailed questions see Supplementary material: Table 7)

	E1	E2	E5
Question		p-value s	
3.1.1	0.559549	0.286828	0.328066
3.1.2	*0.016609	*0.000734	
3.1.3	*0.000089	*0.000027	
3.1.4	*0.001325	*0.000027	*0.003346
3.2.1	0.308788	*0.001658	0.07119
3.2.2	0.658009	0.414041	
3.2.3	0.687374	0.9679	
3.2.4	0.095244	*0.037213	*0.028057
3.3.1	*0.030366	0.649456	0.37426
3.3.2	*0.001658	0.070701	
3.3.3	*0.000098	*0.000321	
3.3.4	*0.000086	*0.00006	*0.018604
3.4.1	*0.000061	*0.000027	*0.002874
3.4.2	*0.00006	*0.00006	*0.037634
3.4.3	*0.002282	*0.024224	*0.00604
3.4.4	*0.033341	*0.002961	*0.003346
3.4.5	*0.00004	*0.000046	*0.003346
3.4.6	*0.000053	*0.000027	*0.049861
3.5.1	*0.000281	*0.000195	*0.002218
3.6.1	*0.016609	0.390534	*0.003346
3.6.2	*0.000089	*0.000153	
3.6.3	*0.00004	*0.000027	
3.6.4	*0.003133	*0.000105	*0.002874

Table 4.5: T-test of the average difference in response between expert and landowner (as a percentage) and the familiarity level between the expert and landowner, as indicated by the expert. Note: E4 was not included individually, as he/she only knew two landowners, but E4 was included in the all experts test

	All experts	E1	E2	E3	E5
Average (%) - Know	35.2	30.3	32.2	55.7	32.1
Average (%) - Know well	32.2	31.7	33.2	23.1	34.0
p-value	0.293373	0.709401	0.828135	0.035286	0.805581
Number of landowners expert knows	24	11	5	4	4
Number of landowners expert knows well	40	11	17	2	8
Standard deviation (%) - Know	15.5	10.5	14.7	13.9	17.6
Standard deviation (%) - Know well	7.4	5.4	6.2	0.4	9.9

Qualitative data

Most, 20 of the 23, landowners made some mention of the peace and beauty of nature and their love for the land as reasons why they enjoy living in the study area and why they enjoy farming in the study area. All experts mentioned landowner's connection to their land and appreciation of nature, especially because it is what underpins their livelihoods. 20 of the 23 landowners also mentioned that they have a responsibility to manage their land sustainably when asked what their relationship is with the land they own. All of the experts alluded to this deep appreciation and responsibility that the landowners feel they have towards their land.

The landowners generally expressed mixed feelings when asked about what their perception was of "conservationists". This ranged from a great appreciation and respect for the work they do, to an extreme irritation towards "greenies", who most landowners feel do not have a balanced view of conservation versus production, and who do not understand landowners perspectives of having to make a living from the land. These mixed feelings towards "conservationists", by landowners were identified by all experts.

The experts identified all but two of the 10 challenges that landowners said they faced as farmers in South Africa. The two that the experts did not mention were the two least mentioned by the landowners (Table 4.6).

Table 4.6: Challenges facing landowners and farmers in South Africa as identified by landowners and by experts. This is for 23 landowners and 5 experts

Challenges	Number of landowners who mentioned the challenge	Number of experts who mentioned the challenge
Lack of government support	10	3
Restrictive and prescriptive labour laws	9	5
Bad roads	8	1
Politics resulting in uncertainty and instability	8	2
Problem animals which cause damage to livestock	7	3
Climate change	5	4
High prices of products used for farming	4	3
Difficult and uncertain market for produce	3	2
Alien invasive plants	2	0
Safety and security	2	0

Discussion

Expert knowledge of landowner attitudes and behavior

This study was undertaken with a very homogeneous group of landowners (predominantly white, Afrikaans and long-term residents), which would be reasonably assumed to make it easier for experts to accurately provide data on landowners. However, the experts in this study were unable to accurately provide specific information regarding landowners' attitudes and behavior compared to landowners' self-reported information (Tables 4.2, 4.3 and 4.4). Only in three items from a total of 23 did experts not have significantly different responses to landowners (Table 4.4). It must be noted that there is a possibility that the experts might be correct in their responses and that the landowners might not have responded truthfully, however, this is unlikely as several experts explicitly stated the large degree of uncertainty of some of their knowledge.

Although experts have been widely used in spatial prioritization to provide ecological data on the location and abundance of species and ecosystem types (e.g. Knight et al. 2006b) when mapping conservation priority, it would seem experts are generally less reliable at providing reliable data on individuals attitudes and behavior when mapping conservation opportunity.

A big challenge in this research was that landowners and conservation or other experts could have different standards between what is perceived as conservation friendly behavior (Beedell & Rehman 1999). This results in a very subjective scoring process throughout, from the landowners of themselves to the experts of the landowners. There is not a real baseline which defines where one or other attitude or behavior falls on the pro-conservation scale. This is solely based on each person's perception. This factor was known beforehand, but we wanted to see what effect this would have on the results. It has made it difficult to justify the accuracy or relevance of data provided by experts about landowners, but we still believe that the experts provided insight and information that would be valuable to any real world conservation planning process.

There were also differences between the five experts and their responses about landowners. Although it was not possible to do statistical tests due to the uneven number of responses and the nature of the data, therefore not providing any proof of significant difference, these differences should still be noted. Experts in conservation are diverse and have varying input which can contribute valuably to decision-making (Steele et al. 2007).

Experts' knowledge would seem to be more reliable in the case of atypical landowners. Experts' knowledge regarding Landowner 04 was similar to his/her self-reported information (Table 3). Landowner 04 is not well-known by most of the experts, but is more outspoken than the majority of landowners about issues relating to conservation. It seems reasonable to suggest that experts will more accurately estimate the attitudes and behavior of individual landowners who express their views and interests more openly.

Factors that would intuitively be thought to produce more reliable expert knowledge of landowners appear not to be useful predictors of expert reliability. Expert 1 has worked directly on agriculture and conservation factors with all but one landowner for 32 years. Assuming Expert 1 to have extensive insight into landowners' attitudes and behavior would appear a reasonable assumption. However, the reliability of Expert 1 was similar to all other experts (Tables 4.3 and 4.4). When interviewed, Expert 1 recounted a great numbers of stories, examples and interactions with landowners to support his scores. Self-nominated experts should be treated with caution. The knowledge of individual experts should be empirically tested to quantify reliability. Ironically, this will require interviewing landowners, which is the very activity that expert knowledge is supposed to circumvent to inform the mapping of conservation opportunity.

Expertise is developed over a long period of time by carrying out a task multiple times, leading to different levels of expertise (Collins & Evans 2007; Kahneman 2011). Collins & Evans (2007) refer to people who have specialist tacit knowledge as having wisdom which is practical. This type of practical knowledge results from a person being fully integrated in a community so as to become well-informed in that context (Nowotny et al. 2001; Collins & Evans 2007). This type of contextual, practical knowledge and insight is very important in carrying out a social assessment of conservation opportunity in an area, but it is very difficult to measure. However, in the present study, there was no significant difference in scoring accuracy relating to how well the experts knew the landowners (Table 4.5). This result not only counters the general findings of studies of expertise and is also counter intuitive, as one could reasonably expect social proximity to produce greater understanding. Explaining this phenomenon, both in this specific study area and more generally, will be essential for identifying the factors that define reliable experts for spatial prioritization. However, the standard deviation of the percentage difference was substantially lower, although not statistically different, for landowners that experts knew well. This could indicate that experts have a better general understanding of individual landowners they know very well, but are unable estimate specific attitudes or behavior.

The degree to which the findings of this study can be extrapolated to other contexts remains uncertain. We are unaware of other studies testing the reliability of expert's knowledge of the social factors defining conservation opportunity. Results examining the differences between experts from other fields appear mixed. Research in the field of business management has shown that manager's perceptions of the organizations they work for and the environment in which they work differ not only from each other, but also to systematically gathered data (Mezais & Starbuck 2003). The accuracy and reliability of experts has also been extensively studied in the legal profession, as experts (e.g. doctors, law enforcement officers) are used in trials to provide testimony, but is often hearsay (Seaman 2007).

However, in contrast, cases exist of the reliability of expert knowledge. The managers of a restoration program, the Working for Water program in South Africa (Macdonald 2004), showed substantially greater reliability than the experts in this present study regarding the degree to which alien plants were successfully cleared in two catchments (McConnachie & Cowling, submitted). Managers more directly involved in a specific project were found to be able to describe the effectiveness of a project more accurately. The knowledge of novice and professional ecologists has been shown to be comparable regarding the location of plant species of high conservation value (Chapter 3). The local ecological knowledge of indigenous people living on the Wild Coast of South Africa was consistent with that of scientists and even added to understanding the ecology of the area (Chalmers & Fabricius 2007).

Despite experts inability, in this present study, to accurately predict precise values for landowners self-reported attitude towards conservation, their subjective norms, behavioral control, willingness to collaborate, willingness to sell and their conservation behavior, the experts did provide useful insights for a social assessment of the study area (sensu Cowling & Wilhelm-Rechmann 2011). Qualitative data showed that, when giving insight into the general context of the study area and the attitudes of landowners, the experts were able to provide this with reasonable accuracy. For example, experts identified all but the two least mentioned challenges that the landowners face in South Africa (Table 4.6). This finding is supported by the use of experts in defining the problem orientation of policy challenges (e.g. Clark 2002).

The results of this present study, and others, where experts were unable to score landowners attitudes and behavior relating to conservation, raises a question widely recognized in social research (Babbie 1989) - are data self-reported by landowners true reflections of their attitudes and behavior? It is possible that experts are providing a more accurate judgment. The methods employed by this study were chosen to replicate methods commonly used for measuring the social dimensions of conservation opportunity (e.g. Ban et al. 2008; Knight et al. 2010; Raymond & Brown 2011) and is limited regarding the inability to remove the uncertainty around landowners self-reported conservation attitudes and behavior. Self-reported behavior is probably always inaccurate to some degree (Babbie

1989; St. John et al. 2010), and therefore should be treated with a level of uncertainty (Steg & Vlek 2009; St. John et al. 2010). Landowners may over report their attitudes and behavior of conservation actions for numerous reasons (Babbie 1989). Mezais & Starbuck (2003) pointed out that it is difficult to compare manager's perceptions to data gathered by academics due to the different ways in which managers, who are working professionals, and academics, view situations and approach problems. In the present study, the experts know the landowners and work with them in various contexts, but have never before had to think about or consider the landowner's specific attitudes, views and actions towards conservation. Determining the accuracy of landowners' responses in this present context would require a long-term study that monitors landowners' behavior, preferably without their knowledge. This presents logistical and ethical challenges. Developing an ability to predict future landowner behavior would be a very useful research direction, and will require in-depth, long-term research founded upon a model of reasoned human behavior, such as the Theory of Planned Behavior (Fishbein & Ajzen 2010).

It has been common practice to interview landowners in order to assess social aspects related to conservation planning, especially with regard to assessing conservation opportunity (Knight et al. 2010; Raymond & Brown 2011). With this research we found that it is very difficult to assign any specific, objective score on any of these elements. The varying and supposedly inaccurate responses of experts has caused us to question the extent to which landowners can objectively assess their own attitudes and actions, so as to be comparable to each other and what an expert might say. We do not in any way say that the information gained from landowners is a lie, or that it is not valuable. It is extremely valuable, but we must not overestimate the extent to which this data is relevant. It is important in providing insight into how landowners think, what their views, attitudes and actions relating to conservation are, but only within their own context.

Implications for spatial prioritization and conservation opportunity

Social data on the attitudes and behavior of individuals and groups within a planning region is important for conservation planning (Dinerstein et al*.* 2000; Nowotny et al*.* 2001; Cowling et al. 2003; Mascia et al. 2003), and particularly for spatial prioritization when mapping conservation opportunity (Knight & Cowling 2007; Knight et al. 2010). Such data is time consuming and expensive to gather, and may be difficult to complete over large areas with diverse land uses. The results of this study suggest that experts cannot replace systematic interviews when data is required on individual landowners. However, practical applications of spatial prioritization (e.g. Dinerstein et al 2000; Knight et al. 2006b; Conservation Measures Partnership 2007; Morrison et al. 2009) suggest that simple or limited data is a preferable to no data at all. In this context, we recommend the following for addressing the limitations of expert knowledge so as to improve the utility of spatial prioritizations when conservation planning:

1. *Acknowledge an appropriate role for experts* – Experts have important roles to play in informing the context of research, which landowners to approach to promote implementation, in which order landowners should be approached and what factors should be included for interviews or interview protocols and how to frame them. Experts can also be used to introduce researchers to landowners.
2. *Quantify the uncertainty of expert knowledge* – Overconfidence in expert judgments and knowledge can be reduced by asking the expert to quantify the uncertainty of the knowledge they are providing (Burgman et al. 2006; Speirs-Bridge et al. 2010)
3. *Recognize conservation opportunity manifests in multiple ways* – 1) Opportunity may exist but be unrecognized, 2) it may emerge spontaneously, or 3) it can be created through conservation action. Accordingly, it may not always be necessary to map the social dimensions of conservation opportunity.
4. *Develop long term collaborations* – This informs conservation opportunity by practitioners interacting with landowners. It also builds trust through the establishment of a relationship between conservation practitioners and landowners, which results in more effective implementation of conservation action. Landowners are more likely to learn, seek advice and listen to someone they trust and who shows a long term interest in their land and personal well-being (Knight et al. 2006a; Knight et al. 2011).
5. *Consider reverse auctions* – A useful conservation instrument that obviates the need for a detailed understanding of individual landowner's attitudes and behavior defining the social dimensions of conservation opportunity. This is where landowners name a price that they will be willing to accept in order to conserve a certain piece of land, or ensure the continuation of certain ecosystem services on their land, in response to a tender (Coggan & Whitten 2005; Tovey 2008; e.g. Hill et al. 2011). The landowner knows what cost it will have to their production, which the government, or other agency willing to pay to protect it, does not know. Therefore a willing buyer, willing seller approach is used to facilitate conservation that covers landowner losses in productivity (Coggan & Whitten 2005).
6. *Investigate the utility of quantitative generalization* – Quantitative generalization is a technique derived from Anthropology and could contribute to conservation (Williams 2000; Fairweather & Rinne 2011). By interviewing a small number of carefully

selected individuals that can offer general insights which would inform and direct conservation action, time and money would be saved in decision-making.

Predictive models of landowner behavior potentially have utility (e.g. Guerrero et al. 2010) if they can be applied across different regions, but this is problematic in that planning regions differ significantly in the factors determining landowners behavior, and require the very landowner interviews we seek to avoid so as to reduce the time and financial costs of interviews.

Future research

Some of the practices that are queried in the interview protocol are sensitive, therefore if landowners respond positively they could be admitting to illegal or frowned upon behavior. An example from South Africa is the killing of problem animals, such as Leopard which are an endangered species, is illegal without the relevant permits (National Environmental Management Act: Biodiversity Act 2004; Henschel et al. 2008). Due to the sensitive nature of this information landowners could tend to answer inaccurately, or rather give answers they believe the interviewer would want to hear. This results in inaccuracies, especially when wanting to compare the landowners' responses with the experts' responses. St. John et al. (2010) proposes a methodology that can be used to elicit sensitive information with regard to conservation issues, while maintaining the respondents' anonymity and facilitating a space where they can be more open and honest.

Although we found that expert and landowner data differed, we believe that the experts are not necessarily wrong. Rather that the scoring does not add up because of such differing views on conservation and conservation action between experts and landowners. Experts are synthesizing various factors in their decision-making, which would be almost impossible to quantify, but then how do we justify trusting and using expert opinions and knowledge in this process? These are questions that, if answered through future research, will contribute greatly to the process.

Another observation that was made during the research, which relates to future social research, is that interviewing an individual can be a transformative experience. Getting an expert opinion is not. Through the process of being interviewed and questioned on factors relating to conservation landowners are challenged to re-evaluate where they are at and what they believe and think. We must remember that social research is only about gathering data, but also about building relationships. If we only approach experts to provide data we lose the valuable process of engaging with landowners. We believe this should be kept in mind when designing future research relating to social assessments and gathering of social data for conservation planning.

Future research needs to be done on how best to elicit expert knowledge that is relevant to social and human data, which can inform conservation opportunity. This research showed that the methodology used here was not effective, but that experts do have knowledge that can contribute significantly to conservation. Further research should be focused on understanding experts, reducing uncertainty and how to identify and select relevant experts for research relating to mapping conservation opportunity.

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Supplementary material

Table 4.7: Factors asked during the expert interview

Number	Factor	Specific questions
3.1	Landowners' attitudes towards conservation behavior	1. The killing of vermin such as lynx and leopard that eat livestock 2. The importance of farmers clearing alien vegetation on their farms 3. The implementation of measures to stop soil erosion on farmers' property 4. General attitude toward conservation behavior
3.2	Landowners' perceived subjective norms	1. The killing of vermin such as lynx and leopard that eat livestock 2. The importance of farmers clearing alien vegetation on their farms 3. The implementation of measures to stop soil erosion on farmers' property 4. General perceived subjective norm
3.3	Landowners' perceived behavioral control	1. The killing of vermin such as lynx and leopard that eat livestock 2. The importance of farmers clearing alien vegetation on their farms 3. The implementation of measures to stop soil erosion on farmers' property 4. General perceived behavioral control
3.4	Landowners' willingness to collaborate with organizations	1. National government 2. Provincial government 3. Local government 4. Non-profit organizations 5. Universities 6. General willingness to collaborate
3.5	Landowners' willingness to sell their property	1. General willingness to sell property
3.6	Landowners' actual conservation behavior	1. The killing of vermin such as lynx and leopard that eat livestock 2. The importance of farmers clearing alien vegetation on their farms 3. The implementation of measures to stop soil erosion on farmers' property 4. General conservation behavior

Table 4.8: Scores for scales of specific factors for individual landowners

Landowner	Factors				
	3. Attitudes towards conservation behavior	4. Perceived subjective norms	5. Perceived behavioral control	8. Willingness to sell property	10. Conservation Behavior
L01	0.94	0.60	0.85	0.96	0.73
L02	0.94	0.69	0.88	0.60	0.87
L03	0.82	0.36	0.80	0.48	0.70
L04	1.00	0.26	0.90	0.88	0.99
L05	0.85	0.27	0.70	1.00	0.73
L06	0.88	0.29	0.90	1.00	0.71
L07	0.91	0.57	0.88	1.00	0.91
L08	0.95	0.59	0.93	0.80	0.79
L09	0.95	0.26	0.75	1.00	0.87
L10	0.91	0.57	0.88	1.00	0.91
L11	0.92	0.23	0.83	0.96	0.73
L12	0.94	0.37	0.88	0.96	0.79
L13	0.94	0.41	0.80	0.64	0.76
L14	1.00	0.66	0.95	1.00	0.93
L15	0.89	0.63	0.82	0.32	0.73
L16	0.85	0.39	0.87	0.28	0.77
L17	0.86	0.36	0.77	0.48	0.74
L18	0.75	0.31	0.72	0.84	0.73
L19	0.91	0.27	0.90	0.88	0.84
L20	0.88	0.40	0.82	1.00	0.73
L21	0.83	0.47	0.88	1.00	0.61
L22	0.94	0.74	0.80	0.68	0.77
L23	0.89	0.44	0.68	0.76	0.64
Average	0.90	0.44	0.83	0.81	0.78

Chapter 5: Conclusion

The role and use of experts and expert knowledge in spatial conservation prioritization

This research provides a general picture of how experts have been used in spatial prioritization, insight into the most common process for including experts (i.e., workshops) and the difference between individual experts and groups of experts as well as exploring how the use of experts can be expanded to identifying areas of conservation opportunity.

The role and use of experts and expert knowledge in spatial prioritization was explored through three different research processes which made up Chapters 2, 3 and 4 in this thesis. Chapter 2 consisted of a review of the peer-reviewed literature, studying how and what experts have been included in papers carrying out spatial prioritizations processes. Chapter 3 studied the process of and the results from an expert spatial prioritization workshop, where individual and group mapping exercises were carried out to identify important areas for plant conservation. Chapter 4 compared human and social data, of private landowners' attitudes towards conservation, willingness to partner with organizations and behavior relating to conservation, collected directly from the landowners, to equivalent data collected from relevant experts.

Experts are people who have specialist knowledge, insight and wisdom relating to a specific field or context which has been gained through life experience and/or formal training or education and/or immersing themselves in the specific field or context (Nowotny et al. 2001; Collins & Evans 2007; Kuhnert et al. 2010). There are various types of experts and expert knowledge, and it is not limited to people who have formal education and/or training, but also includes local knowledge and specialist tacit knowledge which is gained through being immersed in a certain practice, culture or society to a point where the expert is viewed as well-informed in that specific context (Nowotny et al. 2001; Collins & Evans 2007).

Review of the peer-reviewed literature showed experts and expert knowledge have been widely used in spatial prioritization process, mostly by NGO's and private research institutions, whose main focus is the implementation of conservation actions, in contrast to research done by authors affiliated to universities and government research institutions (Chapter 2). Experts contribute in the following different ways within the spatial prioritization process: mapping species and habitats, selection of priority areas, review, providing species specific data, assigning targets, general ecological expertise, mainstreaming and identifying threats (Chapter 2). Different experts bring different expertise, even if they are supposed experts in the same field (Chapter 2; Chapter 3). The following different types of experts have been used in spatial prioritization process: specific ecological experts, species experts, general ecological experts, local experts, conservation planning experts and non-ecological experts (Chapter 2).

Through the processes of carrying out an expert spatial prioritization workshop and interviewing experts to score landowners on social data relating to conservation opportunity, certain of these trends of types of experts used were expressed through this research as well. Experts mapped species and habitats, selected priority areas, provided species data and identified threats to biodiversity during the workshop (Chapter 3) and experts provided raw data for mapping human and social data (Chapter 4), which did not show up in the literature review. There were some similarities between the experts involved in the research in Chapters 3 and 4. Both provided raw data for mapping important areas for conservation, although in Chapter 3 it was vegetation related data and Chapter 4 human and social data. In both cases experts were not limited to conservation professionals, the group of experts in both studies consisted of diverse people, with diverse jobs and diverse insight into the subjects. In both chapters the group of experts involved was identified as experts by their peers. The experts in Chapter 3 were divided into conservation professionals and academics/botanical experts. In Chapter 4 the majority of experts were also conservation professionals. These experts are involved in day-to-day decision-making relating to conservation, mainstreaming of conservation actions, identifying threats to biodiversity and selecting priority areas for conservation action.

Individual experts, identified by peers as experts in the same field and in the same geographic area, differed in the knowledge they expressed, the decisions they made, the data they provided, both spatially and thematically and the insight they provided (Chapter 3; Chapter 4). These individual differences could not be found to be linked to any obvious demographic factors such as age, years working in the field or level of education (Chapter 3; Chapter 4), but experts working in similar fields/jobs expressed their knowledge most similarly (Chapter 3). Group activities of eliciting expert knowledge were better at capturing expert knowledge, as shown by both the results of the knowledge and data produced, and decision-making, as well as that expressed by experts involved in the group and individual mapping activities (Chapter 3). The greatest sources of developing expertise, as identified by experts themselves, were interaction with other professionals/experts and time spent on the job (Chapter 3). Formal education seems no replacement for real-world experience.

Experts were not able to accurately score private landowner's attitudes towards conservation, willingness to partner with organizations and behavior relating to conservation. This was compared to similar, relative scores elicited directly from the landowners themselves (Chapter 4). Experts were able to provide accurate, insightful and elaborate knowledge and data on the general attitudes of landowners, the context of the area in which the research was done and the challenges that landowners in the area face (Chapter 4).

General consensus has been established that integrating expert knowledge in a process using algorithms and systematically gathered data to determine priority conservation areas is the most effective for implementing conservation action (Dinerstein et al. 2000; Cowling et al. 2003). This offsets the effect that limitations of experts and expert knowledge have, such as biases towards certain geographic areas, biomes, vegetation types and/or species, and the incompleteness of expert knowledge (Maddock & Samways 2000; Cowling et al. 2003). These limitations were noted during both the expert workshop (Chapter 3) and using experts to map conservation opportunity (Chapter 4), but it is possible to mitigate the limitations by asking experts to express their level of uncertainty and therefore self-regulate the data they provide. Although these limitations have been noted and preliminarily investigated, the extent of expert knowledge and the levels of precision, accuracy and uncertainty are rarely discussed or quantified (Burgman et al. 2011). The results of this thesis show that more research needs to be devoted to investigating these aspects of experts and expert knowledge.

Using experts and expert knowledge in spatial prioritization has many benefits, such as time and cost savings (Knight et al. 2006b). This was observed when comparing the time taken to complete data collection for Chapter 3, which was purely an expert workshop, and took only a day to complete, as opposed to the systematically gathered data in Chapter 4, which took two months. These saving are important as quick, decisive and cost effective decision-making is becoming more and more important due to continued loss of biodiversity throughout the world (Pimm & Raven 2000; Dirzo & Raven 2003). Good, reliable and accurate decision-making is also imperative to biodiversity conservation. It is therefore important that the knowledge, judgments and decisions made by experts are “correct, reliable and socially robust” (Nowotny et al. 2001). How experts are selected, who constitutes as experts, which experts are included in research and decision-making, how expert knowledge is elicited and how reliable expert knowledge is, needs to be studied and understood in order for their effective involvement in spatial prioritization, and conservation planning processes.

Although none of these results will be surprising to people and organizations that carry out spatial prioritizations which are aimed at implementation of conservation actions, I believe it is the first time that the use of experts in spatial prioritization has been explicitly studied and quantified. The use of experts in spatial prioritization, and more generally conservation planning, is widely accepted and advocated (Olivieri et al. 1995; Dinerstein et al. 2000; Cowling et al. 2003; Conservation Measures Partnership 2007; Morrison et al. 2009), but there is no general operational model for how best to include them in spatial prioritization studies.

Quantifying the accuracy, precision and uncertainty of expert knowledge is almost never undertaken. It is surprising, given that expert's decisions have potentially far reaching, long-term implications (Nowotny et al. 2001) and the absence of quantified empirical measures of accuracy, precision and uncertainty makes decision making based on expert knowledge less defensible. This can be problematic in contexts where it is challenged, especially perhaps in legal processes (Noss et al. 1997).

Techniques for eliciting expert knowledge in spatial prioritization need to be improved and built on, using the work done by Burgman et al. (2011), Martin et al. (2012) and McBride et al. (2012) as a basis. Acceptable standards of practice in applying specific techniques for eliciting expert knowledge need to be developed and tested in different contexts to ensure robust and defensible results.

The major contributions of this research are as follows:

1. A historical overview of the use of experts in spatial prioritization, providing insight into how current practices can be improved and developed to incorporate experts and expert knowledge into systematic (e.g. software driven) processes
2. Preliminary data on how best to select experts and how to structure expert workshops, emphasizing that caution should be exercised when selecting experts (i.e. experts cannot just be selected randomly because someone thinks them to be an expert in a specific field). A thorough recruitment process should be conducted when selecting experts
3. Expert data on human and social dimensions of conservation opportunity should probably be treated with caution. Until further research is done in this regard, and to avoid uncertainty human and social dimensions of conservation opportunity should probably be collected through interviews with the landowners, and not rely solely on expert data
4. The importance of collaboration for conservation planning is again highlighted. It is common knowledge among pragmatic conservation planners, but this work confirms this as well as earlier research
5. Provides a baseline for future research, especially to inform the development of a framework for the use of experts, including how experts are selected, who constitutes

an expert, how to elicit expert knowledge using different methods relevant to spatial prioritization (e.g. expert workshops, surveys) and how to quantify precision, accuracy and uncertainty in expert knowledge

In order to utilize experts and expert knowledge in real world conservation planning it is important that the process of selecting experts is justified and consistent. The limitations surrounding experts and expert knowledge need to be understood and accounted for in each context that they are included. Experts need to be provided the opportunity to express their uncertainty of the data they provide or the decisions they make. Structured processes of expert elicitation need to be followed, and should be developed based on evidence (such as the research presented in this thesis). Experts should only be asked to provide knowledge or make decisions in the specific field, geographic and thematic, of their expertise. Following these guidelines will result in more effective, efficient, defensible and accurate use of experts in spatial prioritization, and more generally, conservation planning processes.

Personal reflection and lessons learnt

During the last two years I have learnt that the process of doing a master's degree is so much more valuable than just the knowledge which you gain in the particular field you are studying. I have learnt about life, about conservation, about people, about project planning, professionalism and communication, self-discipline and self-motivation. It has been exciting, draining, interesting and mind-numbing, an all-round great experience of growth and self-discovery.

One of the biggest lessons I learnt, with regards to science in general, was that science is not perfect, it does not have all the answers and people's egos often get in the way of practical problem solving through science. One of the big problems I have observed is that the context-specific nature of research is not always recognized or explicitly stated and overarching claims are sometimes made, seemingly providing "one-size-fits-all" solutions to extremely complex problems. This was challenging to learn, and to then take into account, when reading, processing and trying to understand copious quantities of literature. I was especially challenged to apply this that I learnt to my own research. There are times where I would have liked to make all-encompassing statements about experts, or landowners, but what I found is not necessarily applicable to other contexts. This was a valuable lesson.

Arriving at accurate and precise understanding of concepts and how I view and understand them, and just developing a general understanding of conservation planning and spatial prioritization was a challenge. This was greatly helped by attending the Biodiversity Planning Forum in 2011 and 2012, as well as through numerous conversations with my supervisor. This gave me insight to the practical implications of the research I was doing. Through gaining this bigger picture context on my research I was much more motivated to do my work excellently so as to try and contribute to conservation planning.

I learnt that you have to have an open, enquiring mind, but that you also have to be able to critically engage with ideas, evaluating the merits, especially taking into account the differences in contexts between the research you are doing and what others have done. This ensures that you can learn from other people, even when the work they did does not directly relate to one’s own.

Through organizing the expert workshop I learnt a lot about communication, how to address people with varying levels of professional qualifications and how to effectively organize an event, especially seeing as though it was in a city 1000km from where I lived. I thoroughly enjoyed the interaction with the experts, and gained valuable insight into diverse jobs in the conservation field in South Africa.

One of my favourite parts of my master’s research was interviewing landowners. The large majority of the people I interviewed were very open, friendly and interested in my research. I drank a lot of coffee, ate a lot of biscuits and even had a few meals thrown in. It was refreshing to be in a completely different environment than what I had been living in for the last six years. The area where I did the interviews was also a beautiful place, which was an added bonus. Everywhere I went, I was welcomed with a smile and it was great to just experience that hospitality.

Another valuable lesson from the interview process was learning how to best go about interviewing people, how to make them feel comfortable to express their views honestly and openly. I learnt a lot about farmers, their challenges, perceptions and general attitude towards conservation that was not really possible to record or communicate through the research, but will help to inform how I interact with farmers for the rest of my career. This is all on top of me having grown up on a farm in the Eastern Cape myself.

I was very struck by the passion that farmers have for their land, their animals and the natural environment. Farmers are often pointed too as the people who are messing up the environment through their agricultural management practices, but I found that in the cases where that is true, it is mostly just from a lack of knowledge, and definitely not from a lack of caring about the natural environment.

Through the process of carrying out a literature review I learnt to pay attention to detail and a great deal of patience. It was a very challenging, time consuming process, but was valuable in providing an overview of the use of experts in spatial prioritization. I would never want to do that again though!

Although I have gained extensive knowledge about conservation planning, spatial prioritization, experts and expert knowledge, decision-making and the dynamics of how people perceive and interact with nature, conservation and environmental issues, the most valuable skills I have learnt are how to gather and process information, and how to critically engage with a problem in order to find the best contextualized solution, which is informed by previous research. I truly believe that these are the most valuable skills that I have learnt that will stand me in good stead in the working environment.

One of the very pleasant things that I experienced and learnt is that people are very willing to help and offer advice to students. I was very fortunate to have numerous conversations and meetings with people that gave me advice, helped me to understand concepts, gave insight into different contexts, especially in terms of the realities of conservation planning in South Africa and who were just generally willing to assist with my research. I learnt that if you are willing to listen to people they are willing to offer their wisdom, support and general assistance.

I appreciate the opportunity that I have had to complete my master's studies under the supervision of an excellent supervisor who is very knowledgeable, was very understanding and gave me great encouragement, always motivating me to do better. It has been a valuable learning experience and I believe that I have grown both 'academically' and personally.

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Appendix 1

These are the documents from the expert spatial prioritization workshop done and written about in Chapter 3. They consist of the following:

1. Expert workshop briefing
2. Expert workshop program
3. Instructions for expert mapping
4. Expert pre-workshop questionnaire
5. Questionnaire – Individual Mapping
6. Questionnaire – Group Mapping

Mapping Important Plant Conservation Areas in the Nelson Mandela Bay Metropolitan area

Expert Workshop Briefing
Nelson Mandela Metropolitan University
1st November 2011

Thank you for your participation in this workshop. The data gathered today will be used, firstly, to advise continued conservation action in the Nelson Mandela Bay Municipality, and secondly, as part of my Master's thesis which aims to better understand the use of expert knowledge in conservation planning. Through this workshop I am hoping to learn more about how expert's contribute data towards the conservation planning process, as well as gain insight into the dynamics of individual and group mapping of important plant conservation areas. The workshop will be facilitated by myself, Craig Galloway, and my supervisor and Andrew Knight from the Department of Conservation Ecology and Entomology at Stellenbosch University.

Background:
Experts are used extensively in conservation planning – the activity of deciding when, when and how conservation action should be implemented. Data from experts is used in mapping vegetation, species diversity, species-habitat relationships, priority conservation areas, ecological processes and other things. Experts are involved both as individuals and in groups (expert workshops) in conservation planning, but there has never been a study comparing how these two methods of gathering expert data differ. Does it make a difference how the data is collected?

Expert data is accepted as irrefutable in most cases of conservation planning, with many areas being included as important plant conservation areas because experts identified them. Is the data that expert's provide sufficient to compile a complete critical biodiversity area map?

Objectives:
This workshop, further research and analyses aim to address the following questions:

- What is the difference between data gathered individually from experts and data from group expert workshops?
- What are the relative merits and limitations of expert derived versus systematically gathered data for systematic conservation planning?
- Will there be potential cost and time savings to systematic conservation plans by applying expert derived data?

These questions have immense relevance to conservation planning initiatives throughout the world and have yet to be addressed in the peer-reviewed literature. Once addressed, they will assist in improving conservation planning initiatives.

Thank you!

Craig

Craig Galloway

Mapping Important Plant Conservation Areas in the Nelson Mandela Bay Metropolitan area

Expert Workshop Program
Nelson Mandela Metropolitan University
1st November 2011

Facilitators:	Craig Galloway and Andrew Knight, Department of Conservation Ecology and Entomology, Stellenbosch University
Host:	The Department of Botany, Nelson Mandela Metropolitan University
Venue:	Umvelani Room in Madibaz (staff/student canteen)
Attendees:	Experts in vegetation, plant species and conservation identified by their peers

Schedule:

08h30-09h00:	Arrival, welcome and tea	Craig Galloway
09h00-09h30:	Background briefing and introductions	Craig Galloway and Andrew Knight
09h30-10h00:	Experts complete first questionnaire	Attendees work individually
10h00-11h00:	Individual expert mapping	Attendees work individually
11h00-11h30:	Reflection session	Craig Galloway and Andrew Knight
11h30-12h30:	Group expert mapping	Craig Galloway and Andrew Knight
12h30-13h30:	Lunch with group reflection and discussion	Craig Galloway and Andrew Knight
13h30-14h00	Debriefing, thanks and conclusion	Craig Galloway

Mapping Important Plant Conservation Areas in the Nelson Mandela Bay Metropolitan area

Instructions for Expert Mapping
Nelson Mandela Metropolitan University
1st November 2011

Instructions for individual expert mapping:

We would like you to identify important plant areas that warrant conservation action by drawing them on the map provided. We will ask you to do this, firstly, as individual experts, and secondly, in groups of experts.

Specifically, can you please:

- Draw polygons/circles around important plant conservation areas
- Number each polygon individually on the map, e.g. 1, 2, 3
- Log these numbers and a description of why individual polygons are important in the key provided
- Use a different coloured marker for identifying different types of area as you see fit
- Collections of polygons (i.e. meta-populations of a species in close proximity) can be numbered as 1A, 1B, etc...
- Whole communities may be marked off, but again please use a different colour
- If an area is marked which contains numerous different species please could you list the species on the key
- Do not discuss your identification of important plant areas with other experts

Instructions for group expert mapping:

The same criteria and specific requests apply as above, but in this process consensus should be reached within the group in identifying important areas for plant which warrant conservation action. It is up to the group to decide how their group will complete this activity.

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Expert Pre-Workshop Questionnaire

ConsEnt

Instructions

Please fill in all the questions as precisely and comprehensively as possible.

Thank you,

Craig

Craig Galloway

1. Demographic Information

1.1) Name: ______________________________

1.2) Gender: Male ☐ Female ☐

1.3) Home language: ______________________________

1.4) Work language: ______________________________

1.5) Cultural group: ______________________________

1.6) Town of residence: ______________________________

1.7) Date of birth: ______________________________

1.8) E-mail address: ______________________________

1.9) Telephone numbers: work - ____________ cell - ____________

2. Work

2.1) a. What organisation do you work for?

____

b. What section in this organisation do you work in?

____

c. What is your position title?

____

2.2) Please could you describe your work. What are your key responsibilities?

____

____

____

____

2.3) How many years have you worked in this specific field?

____

3. Expertise

Definition of an expert: A person who is very knowledgeable about or skilful in a particular area (Oxford Dictionary); Experts are people with overlapping skills, knowledge and experience in a particular field (Burgman, M., Carr, A., Godden, L., Gregory, R., McBride, M., Flander, R. & Maguire, L. 2010. Redefining expertise and improving ecological judgment. In press.)

3.1) What field do you consider yourself to be an expert in?

____

3.2) What field do you think your peers consider you to be an expert in?

____

3.3) To what extent do you feel have expertise in:

a. Taxa (e.g. birds, plants, mammals) - __________________________________

Could you also please name __________________________________

specific species __________________________________

c. Geographic area/region - __________________________________

3.4) How did you gain your knowledge and expertise? (please tick the ones which apply to you) Could you also please rank the importance of these sources of knowledge.

	Knowledge:	Importance:
a. Websites	______	______
b. Seminars for undergrad	______	______
c. Fieldwork for undergrad	______	______
d. Research study for masters	______	______
e. Research study for PhD	______	______
f. Scientific journal articles	______	______
g. Magazines	______	______
h. Textbooks	______	______
i. Interaction with other professionals	______	______
j. On the job	______	______
k. Recreational activities	______	______
l. Other (please specify)	__________________	______
	__________________	______
	__________________	______

3.6) Over what period of time have you developed this knowledge?

____

3.7) Could you name other leading experts with deep knowledge of biodiversity in the Nelson Mandela Bay Area?

a. Plants: ____
____

b. Ecological processes: ____
____

c. Animals: ____
____

d. Conservation: ____
____

4. Education

4.1) Please can you fill in the following details about your tertiary education:

a. Undergraduate:

a.1. Degree - ____________________________________

a.2. University and Department – ____________________________________
____

a.3. Year completed - ____________________________________

b. Masters:

b.1. Degree – ____________________________________

b.2. University and Department – ____________________________________
____

b.3. Research topic – ____________________________________

____

____

b.4. Supervisors – ______________________________

____

b.5. Year completed - ______________________________

c. PhD:

c.1. Degree – ______________________________

c.2. University and Department – ______________________________

____

c.3. Research topic – ______________________________

____

____

c.4. Supervisors – ______________________________

____

c.5. Year completed - ______________________________

d. Any other diploma or certificate:

d.1. Diploma/certificate - ______________________________

d.2. Institution - ______________________________

d.3. Year completed - ______________________________

e. Any other diploma or certificate:

d.1. Diploma/certificate - ______________________________

d.2. Institution - ______________________________

d.3. Year completed - ______________________________

5. Motivation

5.1) What reasons motivated you to attend this workshop today?

____

____

Please fill in the following Likert statements relating to your reasons for attending the workshop:

Motivations for attending workshop		Strongly disagree	Disagree	Neutral/ unsure	Agree	Strongly Agree
a.	I am attending the workshop to assist in conservation					
b.	I am attending the workshop to learn					
c.	I am attending the workshop to assist a student in getting a degree					
d.	I am attending the workshop as a personal favour to Craig Galloway or Andrew Knight					
e.	I am attending the workshop because I am interested in the research					

5.2) What is your personal goal for today's workshop?

____

____

5.3) Would you still have come to the workshop if your travel costs were not covered?

Yes ☐ Maybe ☐ No ☐ N/A ☐

5.4) Would you have still come to the workshop if it was over two days?

Yes ☐ Maybe ☐ No ☐

Questionnaire – Individual Mapping

Instructions

Please fill in all the questions as precisely and comprehensively as possible.

Thank you,

Craig

Craig Galloway

1.1) Name: ____

1.2) Please fill in the following Likert statements relating to the individual mapping exercise:

Statements:		Strongly disagree	Disagree	Neutral/ unsure	Agree	Strongly Agree
a.	I really enjoyed the exercise					
b.	I found the exercise to be very frustrating					
c.	The map provided allowed me to easily identify important plant conservation areas					
d.	There were sufficient different coloured pens to allow me to effectively map priority areas					
e.	The methodology and requirements presented for me to identify important plant conservation areas were effective					
f.	I felt as if I lacked in terms of knowledge, expertise and experience when identifying important plant conservation areas					
g.	There should have been more information provided to me in order to facilitate better decision making when identifying important plant conservation areas					
h.	It would have been simpler and more effective to do the mapping digitally, on GIS					

1.3) Please explain in detail, if necessary, any of your responses above relating to:

a. Your enjoyment of the exercise

____

____

____

b. Your frustration with the exercise

____

____

____

c. The map provided

____

____

____

d. The pens provided

____

____

____

e. The methodology and requirements presented

____

____

____

f. Your perceived lack of knowledge, expertise and experience

____

____

____

g. The information provided

____

____

____

h. The idea of rather doing digital mapping

____

____

____

1.4) Do you think this exercise could have been more effective if we had e-mailed you the maps, layers, GIS data and allowed you to do the mapping in your own time?

Yes ☐ No ☐ Unsure ☐

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Questionnaire – Group Mapping

ConsEnt

Instructions

Please fill in all the questions as precisely and comprehensively as possible.

Thank you,

Craig

Craig Galloway

1.1) Name: ____

1.2) Please fill in the following Likert statements relating to the group mapping exercise:

Statements:		Strongly disagree	Disagree	Neutral/ unsure	Agree	Strongly Agree
a.	I really enjoyed the exercise					
b.	I found the exercise to be very frustrating					
c.	The map provided allowed me to easily identify important plant conservation areas					
d.	There were sufficient different coloured pens to allow me to effectively map priority areas					
e.	The methodology and requirements presented for me to identify important plant conservation areas were effective					
f.	I was limited in my ability to make effective decisions					
g.	More information was required prior to me attending the workshop which would have resulted in the group coming to a more effective decision on important plant conservation areas					
h.	It would have been simpler and more effective to do the mapping digitally, on GIS					

1.3) Please explain in detail, if necessary, any of your responses above relating to:

a. Your enjoyment of the exercise

____

____

____

b. Your frustration with the exercise

____

____

____

c. The map provided

____

____

____

d. The pens provided

____

____

____

e. The methodology and requirements presented

____

____

____

f. Your perceived lack of ability to make decisions

____

____

____

g. The information provided

____

____

____

h. The idea of rather doing digital mapping

____

____

____

1.4) Please fill in the following Likert statements relating to the group dynamic during the exercise:

	Statements:	Strongly disagree	Disagree	Neutral/ unsure	Agree	Strongly Agree
a.	I felt I was freely able to contribute within the group					
b.	My suggestions were not acknowledged or listened to within the group					
c.	One member of the group completely dominated the process					
d.	I did not feel like an expert on vegetation in the Nelson Mandela Bay Municipality within this group					
e.	The process could have been improved by active facilitation by an outside facilitator					

1.5) Please explain in detail, if necessary, any of your responses above relating to:

a. Your ability to freely contribute within the group

____

____

____

b. The fact that you felt your suggestions were not acknowledged or listened to by the group

____

____

____

c. The dominance of one member of the group

____

____

____

d. Your perceived lack of expertise within the group context

____

____

____

e. The additional value an outside facilitator could provide

____

____

____

1.6) How could the group session be improved?

____

____

____

____

____

____

1.7) Between the individual and group prioritising sessions which:

Was the most enjoyable – Individual ☐ Group ☐ Equal ☐

Produced the most comprehensive map -Individual ☐ Group ☐ Equal ☐

Made the best use of time - Individual ☐ Group ☐ Equal ☐

Actively encouraged learning - Individual ☐ Group ☐ Equal ☐

Allowed me to best map my knowledge effectively - Individual ☐ Group ☐ Equal ☐

1.8) Is there anything you would change about the whole workshop in terms of:

a. The manner in which it was run – please elaborate

____

____

b. The information that was provided in helping with decision making – please elaborate

____

____

c. The manner of facilitating the group decision making process – please elaborate

____

____

d. Other?

____

____

1.9) Have you been involved in such a conservation priority setting activity before?

Yes ☐ No ☐

If yes, for which project(s)?

____

1.10) Did you derive any benefit from attending this workshop?

Yes ☐ No ☐

Please comment

____

____

1.11) Please fill in the following Likert statements relating to the venue:

In terms of the venue:		Strongly disagree	Disagree	Neutral/ unsure	Agree	Strongly Agree
a.	There was enough available work space					
b.	The temperature in the room was too cold					
c.	The temperature in the room was to hot					
d.	The lighting in the room was poor					
e.	The room was too bright					

1.12) Please fill in the following Likert statements relating to the food:

In terms of the food:		Strongly disagree	Disagree	Neutral/ unsure	Agree	Strongly Agree
a.	The food was of a good standard and quality					
b.	There was sufficient food					
c.	Lunch was served too early					
d.	Lunch was served too late					
e.	There were sufficient tea eats					

1.13) Please fill in the following Likert statements relating to the time:

In terms of the time:		Strongly disagree	Disagree	Neutral/ unsure	Agree	Strongly Agree
a.	The day was too long					
b.	The day was too short and rushed					
c.	There should have been more breaks					
d.	There should have been less breaks					

1.12) Would you like to receive information about the results of the study? ______________

Appendix 2

These are the questionnaires from the interviews with landowners and experts done and written about in Chapter 4. They consist of the following:

1. Landowner interview survey
2. Expert interview survey

Landowner Interview Survey

Interviewee: ______________________________

Interview location: ______________________________

Date and Time: ______________________________

1. BACKGROUND INFORMATION

1.1. What different types of land uses do you have on your farm?

____

____

____

1.2. What is the dominant land-use on your farm?

____

1.3. For how many years have your family owned this farm?

____

1.4. For how many years have you been farming this farm?

____

1.5. For how many years have you been farming?

____

1.6. What type of farmer are you: (explain these differences if necessary)

Commercial ☐

Subsistence ☐

Lifestyle ☐

1.7. What is/are your farm(s) name? Could you please identify your farm(s) on this map?

____

2. CONSERVATION CONTEXT

2.1. What do you like about living here?

2.2. What do you like about being a farmer?

2.3. How would you describe your relationship with the land you own? (prompt – how do you interact with it, what do you get out of it, how do you feel about it)

2.4. Have you ever had experiences which negatively affected your view of nature conservation? Please specify these experiences

2.5. Have you ever had experiences which positively affected your view of nature conservation? Please specify these experiences.

2.6. What is your perception of conservationists (a person who works in the industry of nature conservation and has the aim to preserve the natural environment)?

2.7. What challenges do you face as a farmer in South Africa?

3. ATTITUDE TOWARDS CONSERVATION BEHAVIOR

Conservation behavior: Actions which are dictated by an understanding of the value of the natural environment and the effect that farming can have on these values. It is when a landowner acts out of a desire to conserve the natural environment on their farm.

3.1. It is important for farmers to know their farm's carrying capacity and base their stocking rate and other grazing decisions on this information

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

3.2. Fences stop the movement of wild animals between areas of natural land, which is a bad thing

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

3.3. Jackal, leopards, lynx and other wild animals which kill livestock are vermin and need to be exterminated

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

3.4. Soil erosion is a real problem and we as farmers should implement measures to ensure it does not happen on our land

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

3.5. Ecotourism can be a good business for farmers who wish to minimise their impact on the environment

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

3.6. Farmers are wasting their time and effort if they attempt to recycle as much waste as possible

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

3.7. It is important for farmers to be creative with methods to save electricity

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

3.8. I do not value speaking to and learning from other farmers about sustainable agriculture and other conservation related matters

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

3.9. The local farming community should be keeping each other accountable when it comes to blatantly anti-conservation and anti-sustainable farming practices

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

3.10. It is not important that farmers monitor and manage the veld condition on their farms

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

3.11. It is important for farmers to clear alien vegetation on their farms

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

3.12. It is important for farmers to consider the implications burning veld has on the plants and animals on the farm

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

3.13. Farmers should pay special attention to how they manage rivers, river banks and wetlands, especially in terms of ploughing and burning

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

3.14. Knowing what type of vegetation is have on a farm is important in informing how a farmer manages the veld

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

3.15. It is important that farmers know of any rare or endangered animals or plants on their farm

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

4. PERCIEVED SUBJECTIVE NORMS

4.1. I make sure I manage my stocking rates according to the carrying capacity of my farm, otherwise other farmers in the community comment negatively about my farming methods

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

4.2. I ensure that my fences are in a good condition so as to not have any issues with my neighbours

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

4.3. I kill jackal, leopards, lynx and other vermin which kill livestock because that is the common practice in our community

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

4.4. Soil erosion is a perceived by farmers in my area as a real problem and for this reason I implement measures to ensure it does not happen on my farm

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

4.5. I will only consider going into ecotourism if other farmers in our area think it is a good idea

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

4.6. Farmers in our area don’t care about recycling, therefore I don’t really worry about it either

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

4.7. The farmers in our area are conscious about saving electricity, which is why I make sure I use as little as possible

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

4.8. Farmers in our area speak regularly about sustainable agriculture and other conservation related matters, therefore I have to be informed about it

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

4.9. Our farming community keeps each other accountable when it comes to blatantly anti-conservation and anti-sustainable farming practices, which ensures that I farm accordingly

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

4.10. The farmers in our community monitor and manage the veld condition on their farms, therefore I do the same

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

4.11. Most of the farmers in our community clear alien vegetation on their farms, and so I also clear alien vegetation on my farm

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

4.12. The farmers in our area are aware of the implications that burning veld has on the native plant on their farms, therefore I make sure I take it into account when I burn as well

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

4.13. There is great value placed on the rivers, their banks and wetlands in our area, therefore I pay special attention in how I manage these areas on my farm, especially in terms of ploughing and burning

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

4.14. All the farmers in our area know what type of vegetation they have on their farms, which caused me to find out about the vegetation on my farm and to manage accordingly

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

4.15. I make sure I know what rare and endangered species I have on my farm, because all the other farmers know what is on their farm

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

5. PERCIEVED BEHARIOURVAL CONTROL

5.1. I can easily control whether overgrazing happens on my farm

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

5.2. I can decide when and where to put up or take down fences on my farm

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

5.3. I feel it is essential that I kill jackal, leopards, lynx and other vermin which kill livestock on my farm

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

5.4. I can readily implement measures to ensure soil erosion does not happen on my farm

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

5.5. I can develop ecotourism on my farm if I want to

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

5.6. It is possible for me to recycle waste from my farm

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

5.7. I can easily use less electricity on my farm

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

5.8. I can ensure that the topic of sustainable agriculture and other conservation-related matters come up in conversation within our farming community

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

5.9. It is possible for me to keep other farmers in our community accountable when it comes to blatantly anti-conservation and anti-sustainable farming practices

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

5.10. I can easily monitor and manage the veld condition on my farm

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

5.11. I can readily remove alien vegetation on my farm

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

5.12. I can afford to take the well-being of native plants into account when I burn my veld

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

5.13. I have the freedom to take into account the ecological value of rivers, river banks and wetlands in how I manage them, especially in terms of ploughing and burning

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

5.14. I can easily find out what type of vegetation I have on my farm and make management decisions accordingly

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

5.15. I can easily find out what rare and endangered species I have on my farm

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

6. WILINGNESS-TO-COLLABORATE

I am willing to collaborate with the following organisations:

	Organisation	Rank the top 3 you would be willing to work with	Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly	Never heard of it
	National Government:							
6.1	Department of Agriculture, Forestry and Fisheries							
6.2	Department of Environmental Affairs							
6.3	Department of Water Affairs (example: irrigation boards)							
6.4	Department of Tourism							
6.5	South African National Parks							
6.6	Working for Water							
6.7	Working for Wetlands							
6.8	Department of Rural Development and Land Reform							
	Provincial Government:							
6.9	EC Department of Economic Development and Environmental Affairs							
6.10	EC Parks and Tourism							
6.11	EC Department of Agriculture and Rural Development							
6.12	WC Department of Local Government, Environmental Affairs and Development Planning							
6.13	CapeNature							
6.14	WC Department of Agriculture							
6.15	*Local Municipality*							
	Para-Statal Organisations:							
6.16	South African National Biodiversity Institute							

	Organisation	Rank the top 3 you would be willing to work with	Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly	
	Non Profit Organisations:							
6.17	WWF – World Wide Fund for Nature							
6.18	Eden to Addo Initiative							
6.19	Endangered Wildlife Trust							
6.20	Living Lands							
6.21	Landmark Foundation							
6.22	Wilderness Foundation							
	Cooperative Groups:							
6.23	East Cape Agricultural Co-op							
6.24	AgriMark							
6.25	Cooperative buying groups – Name yours							
6.26	Farmers' association – Name yours							
6.27	Local conservancies – Name yours							
6.28	Sub-Tropical Thicket Restoration Program							
6.29	R3G (Mike Powell)							
	Universities:							
6.30	Stellenbosch University							
6.31	UCT							
6.32	NMMU (formerly UPE)							
6.33	Rhodes University							
6.34	University of Fort Hare							
6.35	University of the Transkei							
	Private:							
6.36	Companies							
6.37	Consultants							

7. WILLINGNESS-TO-PARTICIPATE

7.1. I would be willing to be involved in a learning group for conservation friendly farming

- 7.1.1. If it means that I will learn to conserve more biodiversity on my farm
- 7.1.2. Only if the methods contributed to my farming productivity
- 7.1.3. Only if I was forced by some sort of law
- 7.1.4. Other reasons ____

7.2. I would be willing to be involved in a learning group for conservation friendly farming

- 7.2.1. Even if my travel and time costs were not covered
- 7.2.2. Even if the cost of the time I sacrificed was not covered
- 7.2.3. Only if all my costs, both time and travel were covered
- 7.2.4. Other reasons ____

7.3. I would be willing to implement conservation friendly farming methods on my farm

- 7.3.1. If it means I will make a contribution to conservation in SA
- 7.3.2. Only if my farm productivity did not decrease
- 7.3.3. Only if I was forced to by law
- 7.3.4. If I was provided monetary (cash) incentive to cover my loss in productivity (eg – sheep that are killed by predators)
- 7.3.5. Other reasons ____

7.4. I would be interested in entering into a voluntary, with no legal ties, conservation agreement for my farm (*explain the existing voluntary provincial agreements*)

- 7.4.1. Only if it is between the other farmers in my area
- 7.4.2. If it was between the farmers in our area and an NGO
- 7.4.3. If it was between me and the local municipality
- 7.4.4. If it was between me and provincial government
- 7.4.5. If it was between me and national government

7.4.6. Other organisations ____

7.5. I would be interested in entering into a legally binding conservation agreement for my farm (*explain the existing legally binding provincial agreements*)

7.5.1. Only if it is between the other farmers in my area

7.5.2. If it was between the farmers in our area and an NGO

7.5.3. If it was between me and the local municipality

7.5.4. If it was between me and provincial government

7.5.5. If it was between me and national government

7.5.6. Other organisations ____

7.6. I would be interested in entering into a conservation agreement for my farm (do these answers depend on voluntary or binding)

7.6.1. Even if I am not compensated at all for any loss in productivity

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

7.6.2. Only if I am compensated via tax breaks or rates rebates

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

7.6.3. Only if I am given a cash payment

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

7.6.4. If I am offered support on my farm for the clearing of alien plants

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

7.6.5. Other reasons ____

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

8. WILLINGNESS-TO-SELL PROPERTY

8.1. I will never sell my property

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

8.2. I would sell my property if I was offered the going market rate

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

8.3. I would sell my property if I was offered 50% more than the market rate

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

8.4. I would sell my property if I was offered double the market rate

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

8.5. I will not sell my property but will pass it on to my child/children

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

8.6. If I had to sell my property, I would rather sell it to a conservation related organisation than a commercial farmer

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

9. CHAMPIONS

9.1. Who are the two most respected and influential, in ranked order, individuals in your community?

1) ____

2) ____

9.2. Can you name any other respected individuals?

____

____

9.3. I feel very attached to, and want to be, an integral member of my community

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

10.CONSERVATION BEHAVIOR

10.1. I never stock beyond the government-stated carrying capacity of my farm

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

10.2. I take down all fences where they limit movement of wildlife on my farm and between other farms

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

10.3. I regularly shoot, poison and trap jackal, leopards, lynx and other vermin which kill livestock

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

10.4. I implement measures to stop soil erosion on my farm

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

10.5. I have developed ecotourism on my farm

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

10.6. I always recycle waste from my farm and household

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

10.7. I have implemented electricity reduction initiatives on my farm and in my household

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

10.8. I pay to have my personal carbon footprint offset

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

10.9. I regularly speak to and learn from other farmers about sustainable agriculture and other conservation friendly farming methods

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

10.10. I confront members of the local farming community who blatantly behave in ways that are anti-conservation and anti-sustainable farming practices

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

10.11. I have an explicit system to monitor and manage the veld condition on my farm

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

10.12. I regularly clear alien vegetation on my farm – note how often:

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

10.13. I always consider the plant biodiversity on my farm when I burn?

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

10.14. I never plough or burn on river banks or on wetlands

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

10.15. I have taken specific measures to be sure I know precisely what type of vegetation I have on my farm and I make management decisions accordingly

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

10.16. I know all the rare and endangered species which are present on my farm

Agree strongly	Agree slightly	Neutral	Disagree slightly	Disagree strongly

10.17. Do you manage your farm to conserve any specific species?

____

____

____

10.18. Do you use any species as indicators of veld condition on your farm?

____

____

____

11. INTERVIEWEE PERSONAL INFORMATION

11.1. E-mail address

____

11.2. Telephone numbers

Home: ________________________ Cell: ________________________

11.3. Gender

____

11.4. Year born

____

11.5. Cultural group

White (English)	White (Afrikaans)	Xhosa	Coloured	Other

11.6. Home language

English	Afrikaans	Xhosa	Other

11.7. Language used primarily with staff

English	Afrikaans	Xhosa	Other

11.8. Marital status

Married	Single	Divorced	Widowed

11.9. Highest level of education completed

None	Primary school	High school	Diploma	Some university	Full degree	Masters degree	PhD degree

Expert Interview Survey

Interviewee: ______________________________

Interview location: ______________________________

Date and Time: ______________________________

1. Background

1.1. How long have you lived in the Langkloof valley?

____

1.2. What is your occupation?

____

1.3. Job description

1.3.1. What is your official title?

____

1.3.2. What are your responsibilities?

____

____

____

____

____

1.4. How many years have you worked in this job?

____

1.5. Did you work in this area before this job? If so in what and for how long?

____

____

____

2. Interaction with landowners

2.1. Please fill in the table below relating to how well you know each landowner and how often you interact

	Familiarity				Relationship (where do you interact)						
	Don't know (never heard of)	Know About (never met)	Know (have met)	Know Well	Social comings & goings	Know through children	Work	Sport	Friend	Family	Other
Andries Gerber											
Barry du Plessis											
Bremer Pauw											
Carol Blumenthal											
Chris Kolesky											
Ewald Gerber											
Frans Gerber											
Garry Krauspe											
George Ferreira											
Heinie Gerber											
Jan Herselman											
Jeannette Swart											
Manie Kleyn											
Martin Wessels											
Michael Ferreira											
Nico Ferreira											
Niel Hopkins											
Pierre Oelofsen											
Riana Martinson											
Stefaan Gerber (Son of Fanie)											
Stefan Gerber											
Thys Henzen											
Tienie Kritzinger											
Wilhelm Gerber (Son of Danie)											

2.2. When you do interact, what do you speak about?

	Polite greeting	Local events, gossip	Business talk (markets, official)	Farming (general)	Environmental issues	Recreational Talk (sport, hobbies, share a beer, kids)	Personal & Family	Other
Andries Gerber								
Barry du Plessis								
Bremer Pauw								
Carol Blumenthal								
Chris Kolesky								
Ewald Gerber								
Frans Gerber								
Garry Krauspe								
George Ferreira								
Heinie Gerber								
Jan Herselman								
Jeannette Swart								
Manie Kleyn								
Martin Wessels								
Michael Ferreira								
Nico Ferreira								
Niel Hopkins								
Pierre Oelofsen								
Riana Martinson								
Stefaan Gerber (Son of Fanie)								
Stefan Gerber								
Thys Henzen								
Tienie Kritzinger								
Wilhelm Gerber (Son of Danie)								

3. Conservation specifics

3.1. Please fill in the following table relating to landowners' attitudes towards conservation behavior (please give each landowner a mark out of 10 for each column)

	1.The killing of vermin such as lynx and leopard that eat livestock	2. The importance of farmers clearing alien vegetation on their farms	3. The implementation of measures to stop soil erosion on farmers' property	4. General attitude toward conservation behavior
Andries Gerber				
Barry du Plessis				
Bremer Pauw				
Carol Blumenthal				
Chris Kolesky				
Ewald Gerber				
Frans Gerber				
Garry Krauspe				
George Ferreira				
Heinie Gerber				
Jan Herselman				
Jeannette Swart				
Manie Kleyn				
Martin Wessels				
Michael Ferreira				
Nico Ferreira				
Niel Hopkins				
Pierre Oelofsen				
Riana Martinson				
Stefaan Gerber (Son of Fanie)				
Stefan Gerber				
Thys Henzen				
Tienie Kritzinger				
Wilhelm Gerber (Son of Danie)				

3.2. Please fill in the following table relating to landowners' perceived subjective norms, i.e. to what extent they are effected in their decision making by the opinions of others (please give each landowner a mark out of 10 for each column)

	1. The killing of vermin such as lynx and leopard that eat livestock	2. The importance of farmers clearing alien vegetation on their farms	3. The implementation of measures to stop soil erosion on farmers' property	4. General perceived subjective norm
Andries Gerber				
Barry du Plessis				
Bremer Pauw				
Carol Blumenthal				
Chris Kolesky				
Ewald Gerber				
Frans Gerber				
Garry Krauspe				
George Ferreira				
Heinie Gerber				
Jan Herselman				
Jeannette Swart				
Manie Kleyn				
Martin Wessels				
Michael Ferreira				
Nico Ferreira				
Niel Hopkins				
Pierre Oelofsen				
Riana Martinson				
Stefaan Gerber (Son of Fanie)				
Stefan Gerber				
Thys Henzen				
Tienie Kritzinger				
Wilhelm Gerber (Son of Danie)				

3.3. Please fill in the following table relating to landowners' perceived behavioral control, i.e. to what extent landowners have control over their behaviors (please give each landowner a mark out of 10 for each column)

	1. The killing of vermin such as lynx and leopard that eat livestock	2. The importance of farmers clearing alien vegetation on their farms	3. The implementation of measures to stop soil erosion on farmers' property	4. General perceived behavioral control
Andries Gerber				
Barry du Plessis				
Bremer Pauw				
Carol Blumenthal				
Chris Kolesky				
Ewald Gerber				
Frans Gerber				
Garry Krauspe				
George Ferreira				
Heinie Gerber				
Jan Herselman				
Jeannette Swart				
Manie Kleyn				
Martin Wessels				
Michael Ferreira				
Nico Ferreira				
Niel Hopkins				
Pierre Oelofsen				
Riana Martinson				
Stefaan Gerber (Son of Fanie)				
Stefan Gerber				
Thys Henzen				
Tienie Kritzinger				
Wilhelm Gerber (Son of Danie)				

3.4. Please fill in the following table relating to landowners' willingness to collaborate with organisations (please give each landowner a mark out of 10 for each column)

	1. National government	2. Provincial government	3. Local municipality	4. Non-profit organisations	5. Universities	6. General willingness to collaborate
Andries Gerber						
Barry du Plessis						
Bremer Pauw						
Carol Blumenthal						
Chris Kolesky						
Ewald Gerber						
Frans Gerber						
Garry Krauspe						
George Ferreira						
Heinie Gerber						
Jan Herselman						
Jeannette Swart						
Manie Kleyn						
Martin Wessels						
Michael Ferreira						
Nico Ferreira						
Niel Hopkins						
Pierre Oelofsen						
Riana Martinson						
Stefaan Gerber (Son of Fanie)						
Stefan Gerber						
Thys Henzen						
Tienie Kritzinger						
Wilhelm Gerber (Son of Danie)						

3.5. Please fill in the following table relating to landowners' willingness to sell their property (please give each landowner a mark out of 10 for each column)

	1. Will they pass their farm on to their children	2. General willingness to sell property
Andries Gerber		
Barry du Plessis		
Bremer Pauw		
Carol Blumenthal		
Chris Kolesky		
Ewald Gerber		
Frans Gerber		
Garry Krauspe		
George Ferreira		
Heinie Gerber		
Jan Herselman		
Jeannette Swart		
Manie Kleyn		
Martin Wessels		
Michael Ferreira		
Nico Ferreira		
Niel Hopkins		
Pierre Oelofsen		
Riana Martinson		
Stefaan Gerber (Son of Fanie)		
Stefan Gerber		
Thys Henzen		
Tienie Kritzinger		
Wilhelm Gerber (Son of Danie)		

3.6. Please fill in the following table relating to landowners' actual conservation behavior (please give each landowner a mark out of 10 for each column)

	1. The killing of vermin such as lynx and leopard that eat livestock	2. The importance of farmers clearing alien vegetation on their farms	3. The implementation of measures to stop soil erosion on farmers' property	4. General conservation behavior
Andries Gerber				
Barry du Plessis				
Bremer Pauw				
Carol Blumenthal				
Chris Kolesky				
Ewald Gerber				
Frans Gerber				
Garry Krauspe				
George Ferreira				
Heinie Gerber				
Jan Herselman				
Jeannette Swart				
Manie Kleyn				
Martin Wessels				
Michael Ferreira				
Nico Ferreira				
Niel Hopkins				
Pierre Oelofsen				
Riana Martinson				
Stefaan Gerber (Son of Fanie)				
Stefan Gerber				
Thys Henzen				
Tienie Kritzinger				
Wilhelm Gerber (Son of Danie)				

4. Landowner specific information

4.1. Please fill in the table below relating to the landowners' land-uses and other business interests

	What type of farmer are they? (commercial – C; lifestyle – L)	What different land-uses do they have on their land	Do they have any other business interests
Andries Gerber			
Barry du Plessis			
Bremer Pauw			
Carol Blumenthal			
Chris Kolesky			
Ewald Gerber			
Frans Gerber			
Garry Krauspe			
George Ferreira			
Heinie Gerber			
Jan Herselman			
Jeannette Swart			
Manie Kleyn			
Martin Wessels			
Michael Ferreira			
Nico Ferreira			
Niel Hopkins			
Pierre Oelofsen			
Riana Martinson			
Stefaan Gerber (Son of Fanie)			
Stefan Gerber			
Thys Henzen			
Tienie Kritzinger			
Wilhelm Gerber (Son of Danie)			

4.2. Please fill in the table below relating to how respected and influential each landowner is. Please give a score out of 10 for each landowner. This relates specifically to the perceptions of the farming community

	How respected and influential are they
Andries Gerber	
Barry du Plessis	
Bremer Pauw	
Carol Blumenthal	
Chris Kolesky	
Ewald Gerber	
Frans Gerber	
Garry Krauspe	
George Ferreira	
Heinie Gerber	
Jan Herselman	
Jeannette Swart	
Manie Kleyn	
Martin Wessels	
Michael Ferreira	
Nico Ferreira	
Niel Hopkins	
Pierre Oelofsen	
Riana Martinson	
Stefaan Gerber (Son of Fanie)	
Stefan Gerber	
Thys Henzen	
Tienie Kritzinger	
Wilhelm Gerber (Son of Danie)	

5. Community context

5.1. How do the landowners feel (how do they view the land, what do they get out of it, what is their responsibility towards the land) about the land which they own?

5.2. What are the challenges that the local farming community faces?

5.3. What is the landowners' general perception of conservation and conservationists?

6. Demographic factors

6.1. E-mail address

____

6.2. Telephone numbers

Home: ________________________ Cell: ________________________

6.3. Gender

____

6.4. Year born

____

6.5. Cultural group

White (English)	White (Afrikaans)	Xhosa	Coloured	Other

6.6. Home language

English	Afrikaans	Xhosa	Other

6.7. Languages spoken at work

English	Afrikaans	Xhosa	Other

6.8. Highest level of education completed, please specify in what

None	Primary school	High school	Diploma	Some university	Full degree	Masters degree	PhD degree

Specify: ____