Putting people back in the picture:
a social research agenda for
a social-ecological approach to
conservation planning

Rebecca Marion Jarvis

A thesis submitted to Auckland University of Technology
in fulfilment of the requirements for the degree of
Doctor of Philosophy (PhD)

2015

Institute for Applied Ecology New Zealand

School of Applied Sciences

Faculty of Health & Environmental Sciences

Abstract

The implementation of successful conservation actions is often limited by the inadequate consideration of the social systems within which conservation is embedded. As such, understanding the enabling social factors of effective implementation is a central goal of conservation. By identifying and accounting for these social factors, planners can develop a social-ecological approach to conservation that better accounts for the dynamic interactions between people and nature. Such an approach is particularly important for understanding the complex multi-actor, multi-priority systems increasingly common in conservation. Furthermore, a social-ecological approach can highlight contextual information that can better link regional planning with local action.

In this thesis, I develop a social research agenda for a social-ecological approach to conservation planning. First, I ran a workshop bringing together conservation researchers and practitioners to better understand the implementation gap. The workshop highlighted how the implementation gap is still very real in conservation, and the importance of considering conservation planning from a social-ecological perspective. Second, using a seascape in New Zealand as a case study, I developed a social research agenda for a social-ecological approach to conservation planning. The social research agenda consists of three key stages to identify and involve stakeholders: (1) map knowledge exchange in the conservation network to understand the governance system; (2) crowdsource spatial values to understand actors and identify place-based conservation opportunities; and (3) integrate citizen science to include local knowledge in planning processes. This agenda demonstrates how social network analysis, crowdsourced social mapping surveys, and citizen science can strengthen conservation planning by identifying the enabling social factors for successful implementation. Finally, I describe how this social research agenda could be integrated in conservation planning to understand and account for the social systems within which conservation is embedded. While broadly applicable to conservation around the world, this agenda remains flexible for local and regional contexts.

This thesis addresses a critical gap in conservation theory and practice by defining a social research agenda for planning processes. As such, this agenda will provide explicit guidance to conservation researchers, planners, and practitioners on how to undertake conservation planning from a social-ecological perspective. By identifying the enabling social conditions for feasible conservation actions, this social research agenda can increase the likelihood of achieving successful conservation outcomes.

Table of contents

List of figures

List of tables

Attestation of authorship

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.

Rebecca M. Jarvis

Date: 24/03/2016

Co-authored works

Chapters 3-6 of this thesis represent four separate studies that have been submitted to peer-reviewed journals for consideration for publication. All co-authors have approved the inclusion of the joint work in this doctoral thesis.

Study 1

Conservation, mismatch, and the research-implementation gap.
Chapter 3 in thesis.
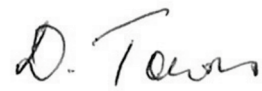
Contribution: Rebecca Jarvis conceived the idea, co-led the workshop, and wrote the manuscript (80% contribution). Stephanie Borrelle helped conceive the idea, co-led the workshop, and contributed to writing the manuscript (18%). Barbara Bollard Breen and Dave Towns both reviewed and provided feedback on the manuscript (1% each).

Stephanie Borrelle	Dr. Barbara Bollard Breen	Assoc. Prof. Dave Towns

Study 2

Assessing the transformative potential of local organisations in complex conservation landscapes.
Chapter 4 in thesis.

Contribution: Rebecca Jarvis conceived the idea, developed the study, analysed the data, and wrote the manuscript (80% contribution). Barbara Bollard Breen supervised the study and edited the manuscript (10%). Christian Krägeloh and Rex Billington both reviewed and provided feedback on the manuscript (5% each).

Dr. Barbara Bollard Breen	Assoc. Prof. Christian Krägeloh	Prof. Rex Billington

Study 3

Identifying diverse conservation values for place-based spatial planning using crowdsourced voluntary geographic information.

Chapter 5 in thesis.

Contribution: Rebecca Jarvis conceived the idea, developed the study, analysed the data, and wrote the manuscript (80% contribution). Barbara Bollard Breen supervised the study and edited the manuscript (10%). Christian Krägeloh and Rex Billington both reviewed and provided feedback on the manuscript (5% each).

Dr. Barbara Bollard Breen   Assoc. Prof. Christian Krägeloh   Prof. Rex Billington

Study 4

Citizen science and the power of public participation in marine spatial planning.

Chapter 6 in thesis.

Contribution: Rebecca Jarvis conceived the idea, developed the study, analysed the data, and wrote the manuscript (80% contribution). Barbara Bollard Breen supervised the study and edited the manuscript (10%). Christian Krägeloh and Rex Billington both reviewed and provided feedback on the manuscript (5% each).

Dr. Barbara Bollard Breen   Assoc. Prof. Christian Krägeloh   Prof. Rex Billington

Publications and conference presentations associated with this thesis

Peer-reviewed journal publications

Jarvis, R. M., Bollard Breen, B., Krägeloh, C. U., & Billington, D. R. (2016). Identifying diverse conservation values for place-based spatial planning using crowdsourced voluntary geographic information. *Society & Natural Resources*, *29*(5), 603-616.

Jarvis, R. M., Bollard Breen, B., Krägeloh, C. U., & Billington, D. R. (2015). Citizen science and the power of public participation in marine spatial planning. *Marine Policy, 57*, 21–26.

Jarvis, R. M., Borrelle, S. B., Bollard Breen, B., & Towns, D. R. (2015). Conservation, mismatch, and the research-implementation gap. *Pacific Conservation Biology*, *21*(2), 105–107.

Manuscripts in review

Jarvis, R. M., Bollard Breen, B., Krägeloh, C. U., & Billington, D. R. (in review). Assessing the transformative potential of local organisations in complex conservation landscapes. *Ecology and Society*.

Conference workshop

Jarvis, R. M., & Borrelle, S. B. (2014, July). *Bridging the research-implementation gap*. Workshop conducted at the meeting of the Society for Conservation Biology Oceania: Resilient Island Ecosystems and Communities, Suva, Fiji.

Conference symposium

Towns, D. R., Bollard Breen, B., & Jarvis, R. M. (2013, November). *Understanding social-ecological systems for effective conservation.* Symposium conducted at the meeting of EcoTas13: The 5th joint conference of New Zealand Ecological Society (NZES) and Ecological Society of Australia (ESA), Auckland, New Zealand.

Conference presentations

Jarvis, R. M., Bollard Breen, B., Krägeloh, C.U., & Billington, D. R. (2014, July). Public participation for marine spatial planning. In Anderson-Lederer, R. (Chair), *Integrating science with participatory conservation.* Symposium conducted at the meeting of the Society for Conservation Biology Oceania: Resilient Island Ecosystems and Communities, Suva, Fiji. **Award: Best Student Paper and One of Three Top Student Presentations**.

Jarvis, R. M., Bollard Breen, B., Krägeloh, C.U., & Billington, D. R. (2014, May). Conservation governance networks: Is the tail wagging the dog? In Andrachuk, M., & Alexander, S. (Chairs), *Understanding collaboration in governance arrangements through network analysis.* Symposium conducted at the meeting of Resilience 2014: Mobilising for Transformation, Montpellier, France.

Jarvis, R. M., Bollard Breen, B., Krägeloh, C.U., & Billington, D. R. (2013, November). Social network analysis: How do social and institutional characteristics affect conservation outcomes? In Towns, D. R. (Chair), *Understanding social-ecological systems for effective conservation.* Symposium conducted at the meeting of EcoTas13: The 5th joint conference of New Zealand Ecological Society (NZES) and Ecological Society of Australia (ESA), Auckland, New Zealand.

Jarvis, R. M., Bollard Breen, B., Krägeloh, C.U., & Billington, D. R. (2013, September). Collective action in conservation: Thresholds and peer effects. In Mumaw, L. (Chair), *Integrating human dimensions in to conservation planning and participation.* Symposium conducted at the meeting of the Australian Research Council (ARC) Centre of Excellence for Environmental Decisions (CEED), Brisbane, Australia.

Jarvis, R. M., Bollard Breen, B., Krägeloh, C.U., & Billington, D. R. (2013, January). *Understanding social-ecological systems.* Paper presented at the Student Conference on Conservation Science (SCCS), Brisbane, Australia.

Other publications and conference presentations generated during candidature

Peer-reviewed journal publications

Pearson, S., Windupranata, W., Pranowo, S. W., Putri, A., Yingjie, M., Vila-Concejo, A., Fernández, E., Méndez, G., Banks, J., Knights, A., Firth, L., Bollard Breen, B., Jarvis, R. M., Chen, S., Nicholas, A., Smith, H., & Aguirre, J. D. (in review). Conflict solving the World's Harbours: Case studies of how conflicts are managed and a plan for shared learning. *Ocean & Coastal Management*.

Aguirre, J. D., Bollard Breen, B. Cameron, M., Constantine, R., Duffy, C., Dunphy, B., Hart, K., Hewitt, J. E., Jarvis, R. M., Jeffs, A., Kahui-McConnell, R., Kawharu, M., Liggins, L., Lohrer, A. M., Middleton, I., Oldman, J., Sewell, M., Smith, A., Thomas, D. B., Tuckey, B., Vaughn, M. & Wilson, R. (accepted). Loved to pieces: Toward sustainable management of the Waitemātā Harbour and Hauraki Gulf. *Regional Studies in Marine Science*.

Conference presentation

Pearson, S., Windupranata, W., Pranowo, S. W., Putri, A., Yingjie, M., Vila-Concejo, A., Fernández, E., Méndez, G., Banks, J., Knights, A., Firth, L., Bollard Breen, B., Jarvis, R. M., Chen, S., Nicholas, A., Smith, H., & Aguirre, J. D. (2015, June). *How conflicts are managed in the World's Harbours; Sharing what has been learnt.* Paper presented at the meeting of the Centre for Maritime Research (MARE) People and the Sea VIII Conference, Amsterdam, Netherlands.

Acknowledgements

Ethical approval

The research conducted in this thesis was approved by the AUT University Ethics Committee (AUTEC 12/221) on 22 November 2012 and the AUT University Faculty of Health and Environmental Sciences Māori Research Facilitation Committee on 23 November 2012.

Chapter 1

Introduction

1.1 Background

Conservation science is often described as a crisis- or mission-driven discipline. Yet as conservation research continues to increase, biodiversity decline and environmental degradation continue to accelerate (Knight et al., 2008). To mitigate this loss, 193 parties to the Convention on Biological Diversity developed 20 critical conservation targets in 2010 (CBD, 2010). These targets include protecting 17% of terrestrial and 10% of marine areas around the world by 2020. However, a recent review of the targets found national and global shortfalls in achieving these conservation goals (Butchart et al., 2015; World Parks Congress, 2014). For example, only 15% of terrestrial and 3% of marine areas are currently protected. Of those areas, up to 68% of ecoregions, 78% of important sites for biodiversity, and 57% of species have inadequate coverage (Butchart et al., 2015). Furthermore, management of the protected areas that do exist varies in effectiveness, with 40% likely to have major management deficiencies and 14% lacking the basic requirements to operate (Leverington, Costa, Pavese, Lisle, & Hockings, 2010).

Systematic conservation planning has expanded rapidly in recent years to optimise the investment of limited time and resources, and enhance the effectiveness of protection and management (Margules & Pressey, 2000; Pressey & Bottrill, 2009). Systematic planning ensures equitable and representative coverage of biodiversity, ecosystem types, and processes across the planning region. As such, systematic planning can contribute to the identification of new protected areas to achieve conservation targets while maximising biodiversity objectives. The systematic planning framework is now the main planning paradigm and is used widely around the world, influencing conservation priorities (Sanderson, Redford, Vedder, Coppolillo, & Ward, 2002) and guiding policy decision-making (Airamé et al., 2003; Bottrill & Pressey, 2012). However, despite some notable successes (e.g., McCook et al., 2010), few of these plans have been implemented on the ground. In reality, many remain "paper plans" for "paper parks" (Knight et al., 2008). The main reason for this lack of implementation is the inadequate consideration of the social systems within which conservation is embedded (Ban et al., 2013). As such, understanding

the enabling social factors of effective implementation has become a central goal of conservation.

While the systematic conservation planning framework was expanded to encourage stakeholder involvement in planning processes (Pressey & Bottrill, 2009), involvement is commonly overlooked or oversimplified in practice. Socio-economic data, where included, is often integrated with biodiversity data in the later stages of planning as a proxy to meaningful stakeholder involvement. As a result, the final plan is often delivered to stakeholders without engagement or consultation. Such a process can cause conflict where stakeholders do not feel their views and values are adequately incorporated in the plan (Bengston, 1994). Furthermore, these plans are not often supported by the stakeholders, limiting the likelihood of successful implementation. While conservation planning is typically ecologically-focused, developing a social-ecological approach to conservation also accounts for the social factors that may constrain or facilitate successful conservation (McGinnis & Ostrom, 2014; Ostrom, 2007, 2009).

In this thesis, I use the Hauraki Gulf Marine Park (HGMP), New Zealand, as a case study seascape. Previous management plans have remained unimplemented in the HGMP due to the inadequate consideration of the social systems that influence the likelihood of conservation success. For this reason, I investigate how to better account for social complexity in systematic conservation planning. I use social network analysis to understand the governance system, and an online social survey to understand actors and crowdsource social values data. I demonstrate how diverse local values can be used to identify conservation opportunities across the planning region. In addition, I utilise citizen science to demonstrate the importance of including local knowledge and citizen concerns in planning. I use the insights from this thesis to develop a social research agenda for a social-ecological approach to conservation. This agenda provides explicit guidance to conservation researchers, planners, and practitioners on how to undertake conservation planning from a social-ecological perspective. By identifying the enabling social conditions for feasible conservation actions, this social research agenda can increase the likelihood of achieving successful conservation outcomes. My research was used to inform Sea Change—Tai Timu

Tai Pari, a spatial planning process currently underway in the HGMP. The final plan for the HGMP will be delivered by the end of 2016.

1.2   Thesis aim and objectives

The aim of this thesis is to develop a social research agenda for a social-ecological approach to conservation planning. To achieve this aim, I have four research objectives.

Objective 1:   *Identify the implementation gap and the role of knowledge exchange in achieving conservation outcomes*

Objective 2:   *Understand conservation governance in a complex multi-actor, multi-priority, multi-scale seascape*

Objective 3:   *Understand conservation actors across diverse values to identify place-based conservation opportunity*

Objective 4:   *Evaluate the role of citizen science in conservation planning*

I will achieve each of these four objectives in Chapters 3 to 6, respectively. First, I will describe the outcomes of a workshop bringing together conservation researchers and practitioners to identify the implementation gap and role of knowledge exchange in conservation systems (Objective 1). The outcomes of the workshop will provide the context for developing a social research agenda to overcome the implementation gap. Second, I will develop a social research agenda using a seascape in New Zealand as a case study. The social research agenda will consist of three key stages: (1) mapping knowledge exchange in a conservation network to understand the governance system (Objective 2); (2) crowdsourcing spatially-referenced social values to understand actors and identify place-based conservation opportunities (Objective 3); and (3) integrate citizen science in planning processes to include local knowledge in decision-making (Objective 4). This agenda will identify the enabling social factors for successful implementation. Finally, in the

Discussion, I will describe how this social research agenda can be integrated in conservation planning to develop a social-ecological approach to conservation.

1.3   Originality of thesis

This thesis addresses a critical gap in conservation theory and practice by defining a social research agenda for planning processes. As such, this agenda will provide explicit guidance to conservation researchers, planners, and practitioners on how to undertake conservation planning from a social-ecological perspective. By identifying the enabling social conditions for feasible conservation action, this social research agenda can increase the likelihood of achieving successful conservation outcomes.

In Chapter 3, I will demonstrate how the implementation gap is still very real in Oceania, and identify how mismatches between conservation research and practice continue to limit conservation outcomes. I demonstrate the importance of bringing together researchers and practitioners to promote knowledge exchange, and highlight seven ways to overcome the implementation gap. In Chapter 4, I map knowledge exchange between conservation organisations in the HGMP. The mapped network of organisations was previously unknown and provides insight into how plans may have remained unimplemented in the past. I make recommendations on how to shift the governance systems towards more inclusive multi-scale governance to achieve successful conservation outcomes.

In Chapters 5 and 6, I analyse the results of a social survey designed within an online mapping tool to: (1) understand actors and identify place-based conservation opportunities; and (2) investigate the role of citizen science in spatial planning. The survey was the first of its kind designed within the mapping tool, SeaSketch, also being used to develop a marine spatial plan in the region. In Chapter 5, I provide insights into broadening participation and support for feasible conservation actions. The social survey was one of the first to crowdsource spatially-referenced social data to identify conservation opportunities for planning processes. In Chapter 6, I investigate how citizen science can enhance citizen contributions to planning, while integrating local knowledge in decision making. This

study was one of the first to examine the role of citizen science in marine conservation planning. The results from Chapters 5 and 6 were used to inform the Sea Change—Tai Timu Tai Pari conservation planning process. In addition, my research was presented back to working groups and roundtables to encourage knowledge exchange and inform broader participatory processes.

While social network analysis, social values mapping, and citizen science have all been investigated in conservation science, no other known research project combines the insights from these three methods to develop a social research agenda. By outlining and integrating such a social research agenda within an ongoing conservation planning process, I demonstrate how conservation can be undertaken using a social-ecological approach. In doing so, I strengthen the effectiveness of systematic conservation planning in delivering conservation outcomes.

All of my four study chapters have been submitted to international peer-reviewed journals. Three have been accepted, and one is in review.

1.4   Rationale for research design

The social research agenda in this thesis was developed using the Hauraki Gulf Marine Park in New Zealand as a case study. I chose to use the Hauraki Gulf Marine Park as a case study as I had the opportunity to collaborate with Sea Change—Tai Timu Tai Pari, and develop my social research agenda to inform the planning process. As such, the agenda was designed to offer guidance and support to planners, while identifying the enabling social factors for effective implementation. Furthermore, this agenda was designed to enhance public participation in planning from the outset, and inform broader participation processes. The opportunity to contribute to Sea Change—Tai Timu Tai Pari provided a valuable learning experience that improved my knowledge and understanding of conservation planning in complex systems. In addition, I hoped to encourage thinking around how social research could be integrated in conservation.

However, it is important to acknowledge the strengths and weaknesses of case study research. Most notably, case study research often seeks to answer focused questions that can be used to improve decision-making in a particular context. As a result, critics of case study research often highlight the limited generalisability of research undertaken using a single case study system (Flyvbjerg, 2006). However, Flyvbjerg (2006) also note that a carefully chosen case study that is not case-specific can also contribute to generalisability. While my methods did provide context-specific insights, the methods themselves have been used across diverse conservation scenarios (e.g., Alexander & Armitage, 2015; Bonney et al., 2014; Brown & Kyttä, 2014). In addition, the social research agenda was developed within the systematic conservation planning framework (Margules & Pressey, 2000; Pressey & Bottrill, 2009), the leading conservation planning paradigm used around the world. Consequently, the methods and the social research agenda developed in this thesis could be broadly generalizable to different conservation systems while providing context-relevant insights. As a result, I was able to develop a social research agenda that made a direct contribution to conservation planning in New Zealand, while also addressing a critical gap in conservation theory and practice.

1.5 Thesis organisation

This thesis is organised into seven chapters (Table 1). In Chapter 1, this chapter, I have introduced the thesis and outlined the thesis aim and objectives. In Chapter 2, I will establish the context of my research through a literature review. Chapters 3 to 6 are my study chapters developed from peer-reviewed manuscripts. In Chapter 7, the Discussion, I being together the main findings of this thesis and discuss how these findings achieve the thesis aim.

Table 1. Thesis organisation by chapter, outlining purpose, and methods used.

Chapter	Purpose	Methods
1 Introduction	• Describe research problem • Outline thesis aim and research objectives • Identify originality of thesis • Describe thesis organisation	• Literature review
2 Literature review	• Establish context of the research • Introduce relevant literature • Highlight current knowledge gaps	• Literature review
3 Knowledge exchange	• Study 1 to achieve Objective 1 • Bring together conservation researchers and practitioners from across Oceania to discuss their work • Identify the implementation gap • Identify the role of knowledge exchange for achieving successful conservation outcomes	• Literature review • Workshop
4 Governance	• Study 2 to achieve Objective 2 • Map knowledge exchange between conservation organisations in the HGMP • Identify the limitations of the current governance system in the HGMP • Highlight pathways to improved governance	• Literature review • Organisational network analysis (ONA) survey • Social network analysis
5 Actors	• Study 3 to achieve Objective 3 • Increase public awareness of the Sea Change—Tai Timu Tai Pari spatial planning process • Highlight how diverse values can be better incorporated in conservation planning • Discuss social acceptability and feasibility of different conservation actions • Identify and involve actors in the planning process	• Literature review • SeaSketch survey • Voluntary geographic information (VGI) • Spatial analyses
6 Citizen science	• Study 4 to achieve Objective 4 • Highlight citizen concerns about the state of the environment in the HGMP • Provide fine-resolution environmental data across the planning region • Discuss the role of public participation and citizen science in conservation planning • Highlight how mapped local knowledge can be used to inform planning	• Literature review • SeaSketch survey • Citizen science • Spatial analyses
7 Discussion	• Summarise the main findings of the thesis and how they relate to the thesis aim • Describe implications of this research • Demonstrate original contributions • Describe remaining knowledge gaps • Identify future research questions	• Literature review • Critique of work • Self-reflection

Chapter 2

Literature review

2.1 Overview

This literature review will introduce relevant research, highlight current knowledge gaps, and establish the context of my research. First, I discuss conservation planning and the systematic conservation planning framework. In particular, I highlight how this framework has recently been expanded to better include social considerations in planning, and evaluate how well these considerations have been accounted for in practice. Second, I outline current knowledge and research on the enabling social factors for effective conservation implementation. These social factors are becoming increasingly recognised as key for linking regional planning with local action. Third, I establish the importance of incorporating these social factors in conservation planning to develop a social-ecological approach. I discuss how conservation has been largely ecologically-focused to date, and highlight the importance of developing a social-ecological approach to conservation planning. Fourth, I outline the case study seascape used to develop a social research agenda in this thesis; the Hauraki Gulf Marine Park, New Zealand. Finally, I summarise the key points of my literature review and discuss how they relate to my thesis aim and objectives.

2.2 Conservation planning

2.2.1 Protected areas

Protected areas have become the foremost conservation strategy for protecting biodiversity and mitigating environmental degradation. The world database of protected areas (WDPA) shows that marine and terrestrial protected area coverage has been expanding around the world (IUCN & UNEP, 2011). As a result, protected areas are predicted to increase, through conventions such as the Convention on Biological Diversity (CBD), to include 17% of terrestrial and 10% of marine areas by 2020 (CBD, 2010; Juffe-Bignoli et al., 2014). Nevertheless, a recent review of the CBD targets found national and global shortfalls in achieving these conservation goals (Butchart et al., 2015; World Parks Congress, 2014). Furthermore, a number of established protected areas are undergoing downgrading, downsizing, and degazettement (PADDD; Mascia et al., 2014). Indeed, 543

instances of PADDD have been observed across 57 countries, affecting over 503,591 km².
PADDD therefore highlights the impermanence of conservation interventions. Given the common assumption that protected areas will remain protected for centuries, or indefinitely, it is important to reconceptualise conservation planning to view protected areas as dynamic, rather than permanent. In achieving our conservation targets we must therefore ensure adequate monitoring and evaluation of existing protected areas, in addition to expanding area coverage.

However, we must not rely on expanding protected area coverage alone. Conservation must be wary of favouring ease of establishment over value of protection. There is a risk that new protected areas are likely to be designated in remote areas with low human density that are seen as relatively easy to implement, or in areas that are not otherwise valued for extractive or development purposes (Devillers et al., 2014). Indeed, critics have described the recent rise in the establishment of large-scale marine protected areas (MPAs) as "low hanging fruits" in meeting international conservation targets (Agardy, di Sciara, & Christie, 2010; Leenhardt, Cazalet, Salvat, Claudet, & Feral, 2013). For example, since 2004, ten large-scale MPAs have been established, representing more than 80% of global marine protected area coverage (Leenhardt et al., 2013). Yet many of these designations are in remote places where protected areas are easier to establish. As a result, these designations may increase protected area coverage, but may provide limited protection to species and ecosystems under threat. For example, up to 68% of ecoregions, 78% of important sites for biodiversity, and 57% of species have inadequate coverage in protected areas (Butchart et al., 2015). Furthermore, management is often more effective nearer areas of high human density (Geldmann et al., 2015). As a result, these large remote protected areas in regions of low human density also risk increased chances of ineffective management. Indeed, of the protected areas that do exist, 40% are likely to have major management deficiencies and 14% are lacking the basic requirements to operate (Leverington et al., 2010). Conservation efforts must therefore account for representativeness of conservation features and management effectiveness, rather than relying on increasing the percentage area protected alone. Without adequate representativeness, the establishment of new protected areas will risk prioritising quantity over quality. Without adequate management, the species and

ecosystems within these protected areas may not be protected, and may remain under threat.

Furthermore, while a number of large-scale MPAs are well meaning, many have disregarded the social dimensions of these conservation interventions, raising concerns over environmental justice and social equity (De Santo, 2013). In particular, the development of exclusionary "no-take" designations depriving local fishers from marine resources, and the eviction of local peoples from these areas (e.g., De Santo, Jones, & Miller, 2011; De Santo, 2013; Leenhardt et al., 2013). Such interventions have risked depriving local people from the resources upon which their livelihoods and wellbeing depend. Furthermore, such protected areas undermine the access and benefit sharing provisions of the CBD. In particular, undermining obligations to "respect, preserve, and maintain knowledge, innovations and practices of indigenous and local communities… and encourage equitable sharing of the benefits" in Article 8, and to "integrate consideration of the conservation and sustainable use of biological resources in national decision-making" in Article 10 (CBD, 2010; De Santo et al., 2011). Therefore, conservation planning must adequately incorporate local people in planning to ensure representative protection secures benefits for both people and nature.

The Great Barrier Reef Marine Park (GBRMP) in Australia and the Papahanaumokuakea Marine Nation Monument (PMNM) are internationally recognised as marine protected areas that achieve representative protected while including local and indigenous peoples in conservation management (Leenhardt et al., 2013). The governance and planning systems of these large-scale MPAs have enabled different agencies, organisations, and communities to manage the planning region together. For example, since rezoning the GBRMP in 2004 (McCook et al., 2010), no-take zones have been increased from 4.6% to 33.3%, covering at least 20% of each of 70 different bioregions (Day, 2008; Devillers et al., 2014; Fernandes et al., 2005). The five-year rezoning process included numerous rounds of public consultation and involved local stakeholders. The resulting plan protected minimum amounts of known habitats and unique sites, while minimising opportunity costs to local people. Instead of designating the entire area as exclusionary no-take, the GBRMP is zoned

for multiple use, achieving conservation targets while incorporating the social considerations of local people.

2.2.2 Systematic conservation planning

The systematic conservation planning framework was established to ensure representative coverage of biodiversity, ecosystem types, and processes in conservation prioritisation (Margules & Pressey, 2000; Pressey & Bottrill, 2009). By enhancing representation, the framework enhances the effectiveness of protection and management. Furthermore, systematically planning conservation actions can ensure that limited time and resources are spent to maximise biodiversity objectives and achieve conservation targets. As a consequence, the framework has become the leading conservation planning paradigm, and is used widely around the world. Considering the benefits of such an approach, the framework has been used to influence conservation priorities (Sanderson et al., 2002) and guide policy decision-making (Airamé et al., 2003; Bottrill & Pressey, 2012).

In 2009, the framework expanded from six to eleven steps to better involve stakeholders in conservation processes and integrate social considerations in planning (Pressey & Bottrill, 2009). In particular, highlighting the importance of identifying stakeholders early (Step 2) and involving them throughout the planning process (Arrow A in Figure 1). Step 5 was also an important new addition to the framework, identifying the need to incorporate key social data with biodiversity data in conservation prioritisation (Step 9). Integrating social and biodiversity data provides a means for achieving conservation targets through adequate representation, while minimising opportunity costs for local people. This spatial prioritisation is therefore a key component of conservation planning. Similar guidelines for spatial planning have also been developed, including marine spatial planning (Ehler & Douvere, 2009), and integrated coastal management (White, Christie, D'Agnes, Lowry, & Milne, 2005).
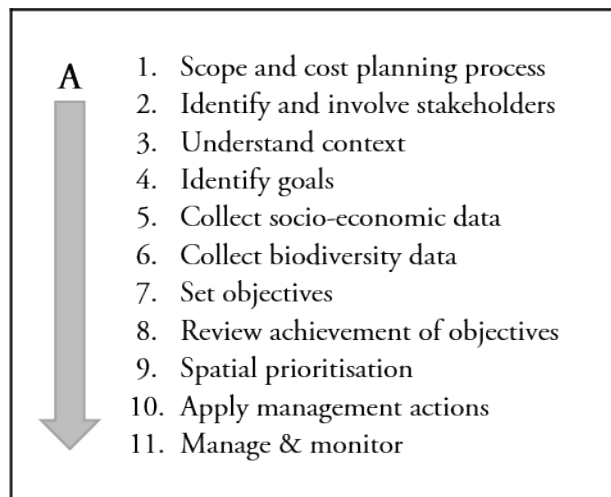
Figure 1. The systematic conservation planning framework adapted from Margules & Pressey (2000) and Pressey & Bottrill (2009). Eleven steps of the conservation planning process. Arrow A indicates the identification of stakeholders in the initial steps and involvement throughout the planning process.

However, much of the social data integrated in conservation planning has been modelled as a cost or threat to conservation (Ban et al., 2013; Naidoo et al., 2006). Modelling social data as a cost or threat assumes stakeholder support for conservation actions will be encouraged where these actions are at a distance from people. As a result, the inclusion of social data as a cost often frames nature conservation as being pursued "despite people" (e.g., Mace, 2014). Furthermore, this approach is likely to identify new protected areas in remote places with low human density that are seen as relatively easy to implement, and in areas not valued for other purposes. This approach therefore risks favouring ease of establishment over need for protection (e.g., Devillers et al., 2014). In other words, this approach risks favouring quantity over quality.

In contrast, there has been a recent rise in interest of alternative social data which can be used to identify new and existing conservation opportunities (e.g., Ives et al., 2015; Gurney et al., 2015; Whitehead et al., 2014). For example, a recent study by Whitehead et al. (2014) demonstrated the value of integrating spatially-referenced social values with biodiversity data in spatial prioritisation. The study demonstrated that integrated social and biodiversity data can identify socially supported and ecologically valuable conservation actions. In addition, these actions were more likely to be feasible through social support, increasing the likelihood of successful implementation, while identifying areas of equivalent

biodiversity value to a conservation prioritisation based on biodiversity data alone. Such an approach is likely to contribute towards achieving the biodiversity targets without undermining the access and benefit sharing provisions of the CBD. While this approach is still in its infancy, further work exploring the role of social data to identify conservation opportunities is likely to increase effective implementation while achieving both social and ecological objectives.

Furthermore, the systematic conservation planning framework was designed to be adaptive and dynamic (Pressey & Bottrill, 2009). An adaptive approach encourages iterative updates to fine-tune the original plan as understanding improves, new information becomes available, threats change, conservation interventions are evaluated, and feedback loops become apparent in the system (Mills et al., 2015; Pressey, Mills, Weeks, & Day, 2013). In addition, an adaptive planning approach acknowledges that protection is impermanent (e.g., Mascia et al., 2014), and that the effectiveness of management can be variable (Geldmann et al., 2015; Leverington et al., 2010). Given the urgency of addressing conservation problems, the systematic conservation planning framework provides a powerful adaptive approach that delivers representative and cost-effective solutions for achieving our conservation goals.

2.2.3   Planning for impact

Despite becoming the dominant paradigm for conservation planning, the systematic conservation planning framework suffers a fundamental flaw in practice; planners often miss key steps in the framework that deliver conservation impact. Most notably, despite the updated framework highlighting the importance of involving stakeholders in planning, this step is often overlooked. Indeed, the "implementation gap" has become a common phenomenon in conservation, whereby few conservation plans are implemented on the ground (Knight et al., 2008; Knight, Cowling, & Campbell, 2006). As a result, many conservation plans remain "paper plans" for "paper parks" (Knight et al., 2008). The main reason for this lack of implementation is due to the inadequate consideration of the social systems within which conservation is embedded (Ban et al., 2013). As such, understanding

the enabling social factors of effective implementation has become a central goal of conservation.

There appear to be two main reasons for this lack of stakeholder involvement: (1) limited time and resources; and (2) uncertainty about how to involve stakeholders in a meaningful and productive way. First, it is important to recognise that almost all conservation planning processes are undertaken under limited time and resources. As a result, many planners disregard stakeholder involvement, widely recognised as a time- and resource-intensive process. Moreover, time dedicated to broad, unfocused stakeholder workshops may actually be counter-productive to planning efforts (Knight et al., 2006). For example, where such workshops risk increasing planning fatigue or frustration between planners and stakeholders without solving a conservation issue or building consensus. Second, the strength of the systematic planning framework is its flexibility and broad applicability around the world. However, this flexibility may have left planners unsure how to meaningfully involve stakeholders. Indeed, few planners have experience with stakeholder-based processes themselves, and there is little consensus or clarity over the appropriate approach (Reed et al., 2009). Without further guidance on how to involve stakeholders in planning processes, planners will tend to ignore or overlook this critical step. It is likely that this confusion also contributes to stakeholder involvement being disregarded for time reasons, especially where planners will first have to identify the appropriate approach before then involving stakeholders.

In contrast, planners tend to focus on plan-making (Mills et al., 2015). Indeed, there were over 245 studies published between 1980 and 2000 utilising mathematical algorithms to select reserves and prioritise areas for conservation (Pressey, 2002). This focus often ignores stakeholder involvement in the early stages of planning, limiting the feasibility of later implementation. Furthermore, delivering the prioritisation as the final planning outcome neglects to translate this plan into an implementation strategy for action (Mills et al., 2015; Morrison, McAlpine, Rhodes, Peterson, & Schmidt, 2010). While prioritisation is an integral part of the planning process, few prioritisations achieve conservation outcomes alone (Cowling et al., 2004). For plans to be implemented, planners also need to identify

the actions associated with these prioritisations (Brown et al., 2015; Game, Kareiva, & Possingham, 2013). For these actions to be feasible, stakeholders need to be involved in the process. Therefore, new methods and approaches are required that provide explicit guidance to planners on how to involve stakeholders in planning processes, and identify the enabling social factors for effective implementation.

2.3   Social factors for effective conservation

Broadly, there are three social factors that have been identified as key to effective conservation planning: (1) the governance system; (2) indicators of likely support and feasibility; and (3) local knowledge. I will discuss each in the context of conservation planning in the following sections.

2.3.1   Governance and social network analysis

The governance system is the decision-space where knowledge is produced, shared, and used, and within which conservation planning is undertaken. Therefore, understanding conservation governance can provide important insights in to who makes conservation decisions, who will implement these decisions, and who these decisions are likely to affect (Bennett, 2015). Governance research has expanded rapidly in recent years to provide important insights into broader social, institutional, and political processes that can limit the effectiveness of conservation (Bennett & Dearden, 2014b; Bennett, 2015; Lockwood, 2010).

Social network analysis (SNA) has emerged as a key method for understanding conservation governance systems (Alexander & Armitage, 2015; Ives et al., 2015). Social networks include the number, type, direction, and strength of the interactions between individuals or organisations. Therefore, SNA is valuable for understanding these interactions, and how these interactions affect the efficacy of conservation governance. As such, SNA is increasingly used for a number of conservation applications, including: (1) identifying key individuals or organisations in the conservation system (Österblom et al., 2015); (2)

identifying existing interactions and cooperation (Vance-Borland & Holley, 2011); (3) mapping the network to ensure individuals or groups are not marginalised from conservation processes (Prell, Hubacek, & Reed, 2009); (4) understanding how network structures emerge from patterns of interactions (Borgatti & Foster, 2003); (5) understanding how these patterns affect social processes such as cooperation, knowledge exchange, and social learning (Bodin & Crona, 2009; Conley & Udry, 2001); and (6) determining how network structures affect capacity for adaptive planning and management (Newig, Günther, & Pahl-Wostl, 2010; Sandström & Rova, 2009).

Governance research has essentially moved through three key concepts: from the Tragedy of the Commons (Hardin, 1968), to community-based management (e.g., Hegarty, 1997; Pomeroy & Carlos, 1997; Rivera & Newkirk, 1997), to complex systems thinking (e.g., Armitage et al., 2007, 2009; Berkes, 2007). Research addressing the Tragedy of the Commons tended to focus on the sustainable management of a common-pool resource system, such as a forestry or fisheries. Much of this literature suggested that stakeholders could not manage these resources sustainably, and therefore advocated stronger top-down management of these systems (Hardin, 1968). In rebuttal, research in community-based management began to emerge from the literature advocating bottom-up approaches to conservation. These approaches suggested that local communities often have the capacity and ability to manage their own resources (Hegarty, 1997; Pomeroy & Carlos, 1997; Rivera & Newkirk, 1997). In reality, there are strengths and limitations to both of these approaches. While top-down steering is unlikely to achieve conservation actions alone (Hajer et al., 2015), bottom-up approaches are likely to be *ad hoc* and unrepresentative of important conservation features across a planning region (Margules & Pressey, 2000).

In theory, bottom-up actions can merge to form regional networks that achieve both local and regional conservation goals (Chomitz, 2007). However, in practice, linking regional systematic planning with local action is complicated. Indeed, navigating the dynamic space between regional planning and local action has become the critical debate in marine conservation planning over the past few years (Bennett & Dearden, 2014a; Mills et al., 2014; Pressey et al., 2013; Seddon et al., 2010; Weeks, 2010). Conservation often occurs in

complex systems with multiple stakeholders and multiple priorities, operating at multiple scales. As a result, different actors are likely to have scale-specific knowledge relevant for effective governance (Ernstson, Barthel, Andersson, & Borgström, 2010). Consequently, achieving successful conservation outcomes often relies on establishing the appropriate multi-scale links in the governance system. Given the need to understand these multi-scale links, SNA can provide important insights on how to achieve effective conservation governance.

2.3.2   Social values and conservation opportunity

A conservation opportunity is defined as "an advantageous combination of circumstances that allows goals to be achieved" (Moon et al., 2014, p.1484). Conservation opportunities, therefore, include the identification of the social factors necessary to implement conservation actions and the inclusion of these factors in conservation planning (Knight & Cowling, 2007; Knight et al., 2010). As such, conservation scientists are increasingly recognising the role of conservation opportunity in bridging the implementation gap in conservation (Game et al., 2011; Pressey & Bottrill, 2009). However, work done to understand and define conservation opportunity is still in its infancy, and there is limited understanding of the enabling social factors for effective implementation (Moon et al., 2014).

Indicators of likely support for conservation include social values, place attachment, demographic characteristics, preferences, knowledge of the area, and perceived risk (Brown & Kyttä, 2014; Ives et al., 2015; Pannell et al., 2006; Raymond & Brown, 2011). Of these indicators, increasing interest has emerged in the role of social values for identifying conservation opportunity. In particular, the values assigned to different places within a planning region (Bryan, Raymond, Crossman, & King, 2011; Seymour, Curtis, & Pannell, 2010). Clusters of these values can be used to indicate social acceptability and the likely support of different conservation actions in different areas (Brown & Reed, 2012; Brown & Raymond, 2014). In addition, these values have been shown to shape pro-environmental and conservation behaviours (Seymour et al., 2010). Moreover, by identifying where place-

based values align with areas important for biodiversity, planners can design implementation strategies where social acceptability can enhance the feasibility of conservation actions while achieving biodiversity goals (e.g., Whitehead et al., 2014).

However, building a conservation project where all stakeholders are involved is complicated (Day, Paxinos, Emmett, Wright, & Goecker, 2008; Douvere, Maes, Vanhulle, & Schrijvers, 2007; Ehler, 2008; Guenette & Alder, 2007). As a result, where stakeholder involvement has been undertaken by planners, involvement has often been limited to a small number of stakeholder groups or individuals (Raymond, Kenter, Plieninger, Turner, & Alexander, 2014). Yet successful conservation will depend on identifying conservation opportunity and gaining social support across the planning region. In conservation regions with high human density it is therefore important to expand the definition of stakeholders to "actors" to also include any individuals, groups, or organisations that are likely to affect, or be affected by, conservation (Olsson, Folke, & Hahn, 2004; Olsson, Folke, & Hughes, 2008; Österblom & Folke, 2013; Schultz, Folke, Österblom, & Olsson, 2015). As such, actors may also include any residents, citizens, and members of the public who live in, use, or value any area included in the conservation plan. For this reason, I will refer to stakeholders within the broader definition of "actors" in this thesis.

Interestingly, with the rise of internet-based tools there has been increasing appeal in the application of online participatory mapping. These tools allow the public to map their social values online, crowdsourcing spatially-referenced social values across a wide range of actors in a planning region. Furthermore, online mapping can be relatively quick and inexpensive to develop (Brown & Kyttä, 2014), providing a cost- and time-effective means to broaden involvement of actors in conservation processes. As such, participatory mapping can be used to better account for, and include, actors in planning processes. This data can be used to identify conservation opportunities early in the planning process, and inform broader participatory approaches. For example, a crowdsourced social values survey could be used to raise awareness of planning in the early stages of the planning process. The conservation opportunities identified could be used to drive broader participation processes that identify how to translate these opportunities into effective action on the ground.

Crowdsourced participatory mapping therefore offers a valuable approach to more adequately include actors in conservation planning.

2.3.3   Local knowledge and citizen science

While conservation is grounded in evidence-based reasoning to evolve our knowledge and decision-making, we are currently undergoing a paradigm shift as to what constitutes "knowledge" in conservation. In addition to knowledge derived from the scientific method, other diverse forms of knowledge are increasingly being recognised as key to effective conservation. For example, local ecological knowledge and indigenous knowledge systems are increasingly being integrated in conservation research and practice (Brook & McLachlan, 2008; Huntington, 2000). Furthermore, triangulation across different local and scientific knowledge sources may provide a more comprehensive and holistic understanding of the system to be managed (Fazey et al., 2014; Johnson, Lilja, Ashby, & Garcia, 2004; Reed, 2008). Such an integrated approach has been described as more robust than relying on scientific or local knowledge alone (Armitage, Berkes, Dale, Kocho-Schellenberg, & Patton, 2011; Reed, Fraser, & Dougill, 2006; Stringer & Reed, 2007), and has been identified as important for adaptive planning and management processes (Armitage et al., 2009). Given that the support of conservation by local communities is crucial for conservation success (Beltran, 2000; Lockwood & Kothari, 2006; McNeely, Lockwood, & Chapman, 2006; Nepal, 2000), integrated approaches to planning and management are likely to provide important long-term ecological and social outcomes.

For example, Weeks et al. (2014) found the integration of local knowledge and Western science to be critical in the design of a marine protected area network in the Coral Triangle. Here, local knowledge was used to build local capacity and identify multiple-use zoning patterns that balanced competing objectives. In addition, the integration of local knowledge enhanced the involvement of actors in the planning process. The study found MPA networks based on the integration of scientific information and local knowledge were more likely to have successful management outcomes as a result of improved design and increased social support. In particular, incorporating community visions for the environment in MPA

design was seen as key for successful implementation (Weeks et al., 2014). As a result, the MPA networks in the study could be used to deliver a region-wide MPA network that is comprehensive and ecologically representative, while also achieving social goals for livelihood benefits, sustainable use, and food security.

As local knowledge has been increasingly integrated in conservation, new approaches have been suggested for enhancing public participation. For example, citizen science is expanding rapidly in conservation research, particularly in the Western world. Following recent calls to rethink planning processes to encourage public participation and incorporate local knowledge (Caldow et al., 2015; Sbrocchi, 2014; Shucksmith, Gray, Kelly, & Tweddle, 2014; Shucksmith & Kelly, 2014), citizen science has gained momentum in the conservation community. Indeed, citizen science became one of the dominant themes of the recent 27th International Congress for Conservation Biology (ICCB, 2015). Moreover, many conservation agencies are increasingly turning to citizen science to overcome the limitations of restricted time and resources for data collection (Dickinson, Zuckerberg, & Bonter, 2010). In addition to providing data collected by citizens, citizen science has been shown to provide a number of further benefits. In particular, enhancing cooperation between researchers, planners, practitioners, and citizens (Newman et al., 2012), identifying community-driven questions (Bonney, Shirk, Phillips, & Wiggins, 2014), promoting environmental stewardship (Cooper, Dickinson, Phillips, & Bonney, 2007; Dickinson et al., 2012), and bridging regional planning with local efforts and interests (Newman et al., 2012). As a result, citizen science can also be used to enhance social support of conservation actions and the feasibility of successful implementation.

Furthermore, participatory mapping of citizen science could provide spatially-referenced local knowledge that could be integrated in spatial prioritisation. It follows, that with adequate research design, spatially mapped citizen science could provide a novel method for integrating local knowledge in systematic conservation planning. In addition, citizen science could be used to provide fine-resolution environmental data across large planning regions difficult to achieve by other means. While not a substitute for broader stakeholder involvement, citizen science could provide a worthwhile approach for integrating local

22

knowledge in spatial prioritisation while identifying community concerns. Similar to the spatially-referenced social values data discussed in section 2.3.2 above, citizen science can also be used to raise awareness of planning processes and broaden public participation.

2.4   Towards a social-ecological approach to conservation

2.4.1   A social-ecological approach

Conservation occurs within social-ecological systems (SES; Ostrom, 2009). Yet conservation planning has remained ecologically-focused to date. While the systematic conservation planning framework was recently expanded to better account for the social considerations of conservation systems (Pressey & Bottrill, 2009), these key steps are frequently ignored, overlooked, or oversimplified. As a result, few conservation plans are implemented due to the inadequate consideration of the social systems within which conservation is embedded (Ban et al., 2013). In section 2.3, I discussed three main social factors relevant to effective conservation planning and implementation. However, much of the research on these social factors has been undertaken separately. Having identified the benefits of understanding all three factors, I therefore recommend a new approach be developed to integrate social network analysis, social values mapping, and citizen science in conservation processes. This thesis will integrate these three factors to develop a social research agenda that can be used to develop a social-ecological approach to conservation planning.

This social research agenda will provide explicit guidance for planners to better understand the social systems that facilitate and constrain effective conservation. For example, understanding governance can highlight how decisions are made, who they affect, and who are most likely to implement actions on the ground. In addition, place-based conservation opportunities and local knowledge can be used to identify citizen concerns and social support for different conservation actions in different areas. Furthermore, this information can be used to develop preliminary versions of the plan – or prototypes – to develop broader participatory processes throughout planning. By using planning prototypes,

planners can take action on priorities identified early, while continuing to collect data and improve the plan (Mills et al., 2015). Such an approach is more likely to achieve successful conservation outcomes than waiting for the final plan to be delivered before taking any action, especially where planning processes take a number of years. Furthermore, these prototypes can be used to clarify and negotiate conservation goals across a wide range of actors through the planning process. While it is important to avoid broad, unfocused workshops that risk increasing fatigue and frustration between participants and planners (Knight et al., 2006), these prototypes could be used to identify socially-supported conservation opportunities and build consensus. As a consequence, such workshops could be contextual and relevant to stakeholder needs and values. Contextual workshops could be used to build meaningfully collaborative processes, and identify socially supported and ecologically valuable actions that can be implemented on the ground (Knight et al., 2006).

A social-ecological approach to conservation therefore emphasises the importance of understanding human-environment interactions, how people use and value the environment, how their actions affect the environment, and how conservation planning affects people (Ban et al., 2013; Miller, Caplow, & Leslie, 2012). Further, incorporating social factors in conservation decision-making is likely to increase social acceptability and support for conservation actions, thus increasing feasibility of implementation and the likelihood of conservation success (Ives & Kendal, 2014; Ives et al., 2015; Whitehead et al., 2014). Embedding a social research agenda in the initial stages of an ecologically-focused conservation planning framework will therefore provide the groundwork for developing social-ecological approach throughout the planning process. As such, this thesis helps to lay the social foundation upon which future social-ecological research and planning can be developed.

2.4.2 An adaptive conservation process

Systematic conservation planning is often undertaken with data that have been collected opportunistically across the planning region, potentially demonstrating large geographic sampling bias (e.g., Fourcade et al., 2014). For example, research undertaken at several study sites in the region may detect a particular threat or identify a particular conservation feature. Unfortunately, where these data are integrated in systematic planning, these regions may be prioritised for action, while areas where no research was undertaken will be assumed to have no threat or feature of interest. As a consequence, systematic conservation planning can hide biases in the data and sampling effort across the region (Game et al., 2013). Yet the systematic conservation planning framework was not designed to deliver a static prioritisation; the framework was designed to facilitate an iterative and adaptive process that would be updated as new information becomes available (Margules & Pressey, 2000; Pressey & Bottrill, 2009). Such an approach was designed to fine-tune the plan to context and feasibility of conservation priorities identified, to correct for mistakes in the data, and to improve decision-making as more and better data becomes available (Mills et al., 2015; Pressey et al., 2013).

While incorporating iterative updates and revisions to planning processes can be intimidating, such actions are necessary to maximise the likelihood of successful conservation outcomes. To become adaptive, we must therefore shift the intellectual culture of planning towards an adaptive process, rather than focusing on improving the prioritisation alone (Grantham et al., 2010; Mills et al., 2015; Pressey et al., 2013). By incorporating prototypes in the planning process, adaptive planning can be encouraged. Indeed, prototypes can be developed in the early stages of planning processes, and therefore require iterative refinement as the process develops (Mills et al., 2015). For example, public consultation and broader participatory processes could be a useful tool for evaluating the accuracy and representativeness of social data collected (Ives et al., 2015). These prototypes can be used to drive collaboration with stakeholders through the planning process to identify new priorities as more social and ecological data becomes available (Game et al., 2011). Moreover, the likelihood of implementing adaptive planning increases with

development of a shared understanding, the use of a prototyping approach, and engagement with actors at multiple levels (Mills et al., 2015). As a consequence, successful adaptive planning and governance processes often require an understanding of conservation as a complex social-ecological system (Cvitanovic, Hobday, van Kerkhoff, Wilson, et al., 2015), an aim of this thesis.

2.5   Case study: Hauraki Gulf Marine Park, New Zealand

2.5.1   Location and context

The Hauraki Gulf Marine Park (HGMP), also known as Tāmaki Makaurau and Te Moananui ā Toi, is located on the North Island of New Zealand (Figure 2). The HGMP includes 1.3 million hectares of marine, coastal, island and catchment systems, and is home to over 1 million people. Many of these people live in Auckland city, which has been the centre for human activity in New Zealand for nearly 1000 years (Department of Conservation, 2006; Hauraki Gulf Forum, 2014). The HGMP is considered a national taonga (treasure) and an iconic kainga (home).
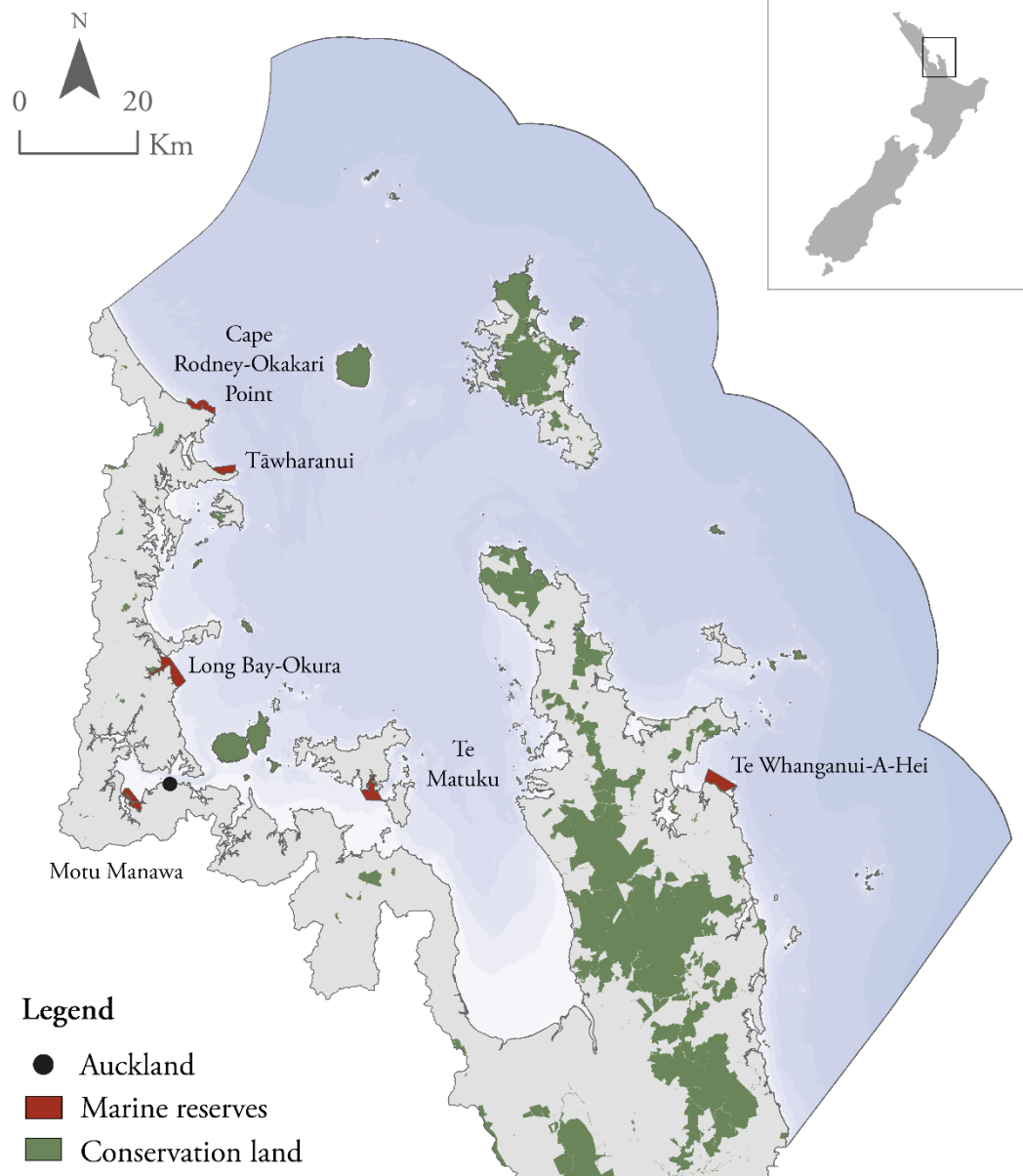
Figure 2. Map of the Hauraki Gulf Marine Park, New Zealand, indicating the names and locations of six marine reserves (orange), the location of Auckland city (dark grey point marker), and the extent of conservation land within the park boundary (green).

Māori are the tangata whenua (original people) of New Zealand, and have a long history of occupation in the HGMP. There are 13 iwi (tribes) that lay claim to the lands in the HGMP, with rich and complex relationships with the land and sea. In New Zealand, all conservation and development projects require consultation with local iwi to safeguard their indigenous sovereignty, traditional knowledge, cultural practices and sacred sites (D'Arcy, 2009; Leenhardt et al., 2013; Waitangi-Tribunal, 1985). All planning efforts in

the HGMP consult with iwi to recognise the special relationships of mana whenua to Tāmaki Makaurau.

In 2000, the HGMP was established under the Hauraki Gulf Marine Park Act (2000) to recognise the national significance of the Hauraki Gulf and enhance protection of biodiversity across the region. The Act also established the Hauraki Gulf Forum (HGF) as a statutory body to monitor the environment and improve management of the HGMP. The HGF consists of representatives from local and regional councils, mana whenua, and the Ministers of Māori Affairs, of Conservation, and of Primary Industries. However, despite the establishment of the HGMP and HGF, there is no legal requirement to give effect to the Act (Hauraki Gulf Forum, 2014). Furthermore, proposed changes to the Resource Management Act (1991) suggest easing environmental regulations related to active land management in the HGMP, while encouraging urban and infrastructure development. The Marine Protected Areas Policy and Implementation Plan (2005) was developed ten years ago to identify and establish new protected areas (Department of Conservation & Ministry of Fisheries, 2005). However, no new fully protected areas have been created in the HGMP since the policy was developed. Previous management plans were designed for the HGMP, but have remained unimplemented due to the inadequate consideration of the social systems that influence the likelihood of conservation success.

2.5.3   State of the Gulf

The HGF produce a "State of the Gulf" report every three years to examine issues related to the management and protection of the HGMP (e.g., Hauraki Gulf Forum, 2011, 2014). In 2011, the State of the Gulf report highlighted the rapid transformation of the HGMP "over two human lifespans… with most environmental indicators showing negative trends or remaining at levels which are indicative of poor environmental condition" (Hauraki Gulf Forum, 2011, p.7). The 2014 update suggested the continued "suppression of environmental values at low levels, and progressive environmental decline" (Hauraki Gulf Forum, 2014, p.16). The key environmental indicators identified by the reports included fishing, toxic chemicals, nutrients, microbiological contamination, sediment loading,

introduced marine species, harmful algae and pathogens, litter, coastal development, and the maintenance and recovery of biodiversity (Hauraki Gulf Forum, 2011, 2014). The key threats identified included a lack of protected areas, inadequate fisheries management, coastal development, and inputs of nutrients, sediments, and contaminants from land use.

However, despite the declining state of the environment in the HGMP, a number of islands have become critical sanctuaries for endangered native and endemic biodiversity. There are over 30 major island groups in the HGMP, with over six restored to over 80% native forest cover. Following their success, a number of other islands are currently undergoing re-vegetation. Mammalian pests have been eradicated from 36 of the islands in the HGMP, and a number of vulnerable endemic birds, reptiles, and insects have been translocated to islands for protection and to encourage population growth (Department of Conservation, 2011). As a result, these islands are commonly known and referred to as "treasure islands" (www.treasureislands.co.nz). For example, Tiritiri Matangi was one of the first conservation programmes to actively restore native species and habitats in the world, and is considered a model of international conservation significance (Rimmer, 2009). In addition, the HGMP is in the process of becoming recognised as an internationally Important Bird Area (IBA) for seabirds who rely on many of these islands as important nesting sites (Gaskin & Rayner, 2013).

There are six no-take marine reserves in the HGMP (Hauraki Gulf Forum, 2014). Most notably, the Cape Rodney-Okakari Point Marine Reserve was the first reserve established in New Zealand in 1975 and one of the first no-take marine reserves established in the world (Babcock, 2013). The environmental recovery of this reserve led to another five marine reserves being designated since 1993. However, each reserve is between 5 and 9km², with the six reserves protecting only 0.3% of the marine environment in the HGMP (Hauraki Gulf Forum, 2014). As a consequence, one of the primary aims of conservation planning in the HGMP region is to identify new areas for marine protection.

Both "State of the Gulf" reports identify a lack of stakeholder involvement in planning, weak governance and ineffective management as the cause of ongoing environmental

decline (Hauraki Gulf Forum, 2011, 2014). Indeed, while regional management plans have been developed to mitigate key threats in the HGMP, they have never been implemented. In contrast, many successful restoration projects in the HGMP have been local and community-led (Hauraki Gulf Forum, 2014). Indeed, thousands of volunteer hours have been spent on restoring and revegetating offshore islands, while new community trusts are emerging to restore marine and terrestrial environments and advocate for diverse environmental issues. Moreover, two of the six marine reserves that now exist in the HGMP were first proposed by academic researchers or community trusts. As a result, the reports recognise how "the activities and behaviours of stakeholders… have a significant influence on environmental outcomes" in the HGMP (Hauraki Gulf Forum, 2014, p. 171), and emphasise how future efforts should focus on building strong stakeholder and citizen involvement. Such involvement was identified as critical if future planning efforts in the HGMP are to achieve their conservation goals. Therefore, if the HGMP is to extend protection and mitigate environmental threats, a new social-ecological approach to conservation is required.

2.5.4   Sea Change—Tai Timu Tai Pari

Sea Change—Tai Timu Tai Pari is currently being developed as the new conservation planning process in the HGMP (Sea Change—Tai Timu Tai Pari, 2014c). In contrast to previous planning efforts in the HGMP, the Sea Change—Tai Timu Tai Pari process is being driven by stakeholders in partnership with mana whenua. The Stakeholder Working Group (SWG) was appointed in December 2013 to manage the planning process and deliver a final plan by the end of 2016. Such an approach was developed to recognise that "the knowledge and capability to solve pressing ecological problems already exists in communities – it just needs to be brought together, in a way that doesn't allow one voice or agenda to dominate" (Sea Change—Tai Timu Tai Pari, 2014, p.1). Sea Change—Tai Timu Tai Pari is further supported by its sponsoring agencies, including the Hauraki Gulf Forum, Department of Conservation, Auckland Council, Waikato Regional Council and Ministry of Primary Industries, in partnership with mana whenua. While the final plan will

be non-statutory and therefore not legally mandated, these agencies have agreed to adopt the plan and support its implementation.

In addition, the SWG has established seven issues-based roundtables to provide additional investigations into each topic and feedback their results to the SWG for inclusion in the plan. The seven roundtables include: water quality and catchments, fish stocks, biodiversity and biosecurity, infrastructure for the economy and communities of the Gulf, aquaculture, an accessible gulf, and Mātauranga Māori (Sea Change—Tai Timu Tai Pari, 2014b). Each roundtable comprises several SWG members, several key stakeholders, plus other invited participants considered to have specific knowledge and experience in each roundtable topic. In addition to this, the SWG have invited a number of researchers, experts, and local organisations to present their work and knowledge on the HGMP for consideration in the plan.

During the initial stages of my PhD research, I presented the results of my social network analysis (Chapter 4) to several of the Sea Change—Tai Timu Tai Pari sponsoring agencies. As a result, I was invited to provide additional social research to inform the planning process. With support of Sea Change—Tai Timu Tai Pari, I developed the social survey analysed in Chapters 5 and 6 of this thesis within the online collaborative mapping tool, SeaSketch (www.seasketch.org). The survey was undertaken during the early scoping stages of the planning process, designed to raise public awareness and participation in planning. In addition, the survey provided spatially-referenced social values and local knowledge in the same format as over 60 other ecological and economic data layers to be used in spatial prioritisation in the later stages of the process. This survey facilitated broad and inclusive involvement of actors in the initial stages of the planning process while identifying enabling social factors for effective implementation. This data were used to identify place-based conservation opportunities for feasible conservation action that could be combined with ecological data to achieve both social and ecological objectives in the HGMP. Furthermore, this research identified citizen concerns and the value of integrating local knowledge in conservation planning. This opportunity provided me with the knowledge and experience to develop the social research agenda presented in this thesis.

2.6 Summary

The implementation of successful conservation actions is often limited by the inadequate consideration of the social systems within which conservation is embedded. As such, understanding the enabling social factors of effective implementation is a central goal of conservation. By identifying and accounting for these social factors, planners can develop a social-ecological approach to conservation that better accounts for the dynamic interactions between people and nature. Such an approach is particularly important for understanding the complex multi-actor, multi-priority systems increasingly common in conservation. Furthermore, a social-ecological approach can highlight contextual information that can better link regional planning with local action.

In this thesis I will develop a social research agenda for a social-ecological approach to conservation planning. As such, this agenda will provide explicit guidance to conservation researchers, planners, and practitioners on how to undertake conservation planning from a social-ecological perspective. By identifying the enabling social conditions for feasible conservation actions, this social research agenda can increase the likelihood of achieving successful conservation outcomes. This thesis therefore addresses a critical gap in conservation theory and practice by defining a social research agenda for conservation planning processes.

My research was used to inform the Sea Change—Tai Timu Tai Pari planning process in the HGMP. The final plan will be delivered by the end of 2016.

Chapter 3

Knowledge exchange

In this chapter, I will examine knowledge exchange and the impact of the implementation gap to achieve my first research objective:

Objective 1:   *Identify the implementation gap and the role of knowledge exchange in achieving conservation outcomes*

To achieve this objective I will describe and assess the outcomes of a workshop bringing together conservation researchers and practitioners at the Society for Conservation Biology Oceania Conference in Fiji. Workshop participants identified five mismatches between conservation research and practice that contribute to the implementation gap in Oceania. The workshop highlighted the importance of creating opportunities for knowledge exchange to overcome these mismatches. Both researchers and practitioners emphasised the importance of considering conservation from a social-ecological perspective, and identified seven ways to overcome the implementation gap. Consequently, this chapter helps establish the context for developing a social research agenda for a social-ecological approach to conservation planning (Chapters 4 to 6).

A version of this chapter has been published as Jarvis R. M., Borrelle, S. B., Bollard Breen, B., & Towns, D. R. (2015). Conservation, mismatch, and the research-implementation gap. *Pacific Conservation Biology, 21*(2), 105-107.

3.1 Abstract

Despite calls to better link research and practice, the implementation gap continues to limit conservation success. In this chapter, I report on the outcomes from a workshop at the Society for Conservation Biology Oceania Conference in Fiji on bridging the implementation gap. The workshop highlighted how the implementation gap is still very real in conservation, and the importance of bringing together researchers and practitioners to discuss their work. Workshop participants discussed how the implementation gap limits conservation effectiveness, identified five key mismatches between research and practice, and recommended seven ways to overcome the gap.

3.2 Introduction

Conservation has long been established as a mission-driven discipline (Soulé, 1985), and yet two-thirds of conservation assessments published in peer-reviewed literature do not plan for action (Knight et al., 2008). As a result, the implementation gap has become prevalent in conservation, whereby little conservation knowledge is translated into outcomes on the ground (Knight et al., 2008; Knight, Cowling, & Campbell, 2006). Despite calls to better link research and practice beginning decades ago (e.g., Saunders & Burbidge, 1988), the gap between knowing and doing is still widely acknowledged in conservation. Therefore, we need to better understand how to bridge this gap in order to achieve the substantial improvements in conservation outcomes that are required.

Knowledge can transform how we think, make decisions, and act. Yet limited knowledge exchange between researchers and practitioners can reinforce the implementation gap in conservation. Indeed, as our conservation knowledge continues to increase, biodiversity loss and environmental degradation continue to accelerate around the world (Knight et al., 2008). In other words, we are knowing more while losing even more (e.g., White, Kates, & Burton, 2001). There are a number of reasons for a lack of research achieving effective conservation outcomes, including, most notably: (1) most research is never designed with action in mind (Knight et al., 2008); (2) planners cannot often access or understand

research (Fuller, Lee, & Watson, 2014); and (3) scale mismatch (Guerrero, McAllister, Corcoran, & Wilson, 2013). First, most conservation research is undertaken to improve our knowledge for publication in the international peer reviewed literature. As a consequence, research is often developed based on the likelihood of publication, rather than relevancy to practitioners on the ground. Second, even where research is relevant, practitioners often have limited access to the literature. Indeed, a recent paper by Fuller, Lee, & Watson (2014) found that only 9% of conservation papers were open access, with only 4% allowing material to be reused. Third, scale mismatch occurs where research is undertaken at a different scale to the conservation issue, or the likely scale of action. For example, scale mismatch can occur where research focuses on identifying a conservation action at a scale larger or smaller than the appropriate scale for effective implementation (Guerrero et al., 2013).

Therefore, for researchers to design research that informs practice, they will first need to identify the research questions, at the relevant scale, that will assist practitioners in improving action. For practitioners to implement this knowledge, they will require access to the research. Indeed, the effectiveness of conservation will depend on how well this knowledge is exchanged between researchers, planners, and practitioners. As a result, both researchers and practitioners have called for new integrated forms of planning and governance that enhance knowledge exchange processes between them (Cvitanovic et al., 2015). Knowledge exchange has therefore become a rapidly expanding area of conservation research, and the foremost approach for linking research, planning, and action (Cvitanovic et al., 2015). Furthermore, effective knowledge exchange processes can be used to build long-term trusting relationships between researchers and practitioners (Reed, Stringer, Fazey, Evely, & Kruijsen, 2014), identified as key to delivering conservation outcomes (Fazey et al., 2013). These long-term processes are therefore crucial for aligning research and practice to achieve our conservation goals.

However, researchers and practitioners are often seen as distinct groups in conventional conservation processes. As a result, the roles of researchers and practitioners tend to develop separately. Following, researchers are often seen as the knowledge producers while

practitioners are the users of this knowledge (Mitton, Adair, McKenzie, Patten, & Waye-Perry, 2007). Yet, if we broaden the definition of knowledge beyond that knowledge produced by researchers using the scientific method, we can also include practitioners' knowledge of the conservation area they manage. For example, practitioners often have practical and experiential knowledge of the new and emerging priorities within their conservation landscape, and the successes and failures of previous conservation actions. By extension, alternative knowledge exchange processes could be developed bringing together researchers and practitioners to each share their own experiences and knowledge. Such an approach could be used to identify common goals for research and action by aligning the work of researchers and practitioners from the outset (Nel et al., 2015). Consequently, research would be designed with action in mind, while practitioners would have an established relationship with researchers and access to their work. Furthermore, bringing together different knowledge sources can develop a more holistic and systems-oriented understanding of the conservation issue (Armitage et al., 2011; Reed et al., 2006; Stringer & Reed, 2007). Such an integrated approach to conservation will be key for overcoming mismatch between research and practice to bridge the implementation gap.

In this chapter, I report on the outcomes of a workshop developed to identify conservation mismatches between research and practice in Oceania, enhance knowledge exchange, and identify recommendations for how to overcome the implementation gap.

3.3 Methods

Workshop participants identified themselves as either a researcher or practitioner based on whether they believed their work focused more strongly on research or implementation. The approach of the workshop was designed to encourage discussion and knowledge exchange between researchers and practitioners through three activities. First, each participant wrote their core conservation objective on a post-it note. All objectives were anonymous, although the post-it notes were colour coded to identify researcher and practitioner objectives for later discussion. Participants were then asked to attach their post-it note to a board at the front of the room to identify the main scale at which they operated

while carrying out their objective: local, regional, national, or international. Group discussion was structured to identify mismatches between the scale at which researchers and practitioners worked.

Second, I wrote the objectives on a separate sheet of A3 paper in random order. Researchers and practitioners were given three stickers each, again colour coded to indicate their different roles. Each participant was asked to indicate the research objectives they felt were most important for conservation in Oceania. They were asked to indicate their preference by the stickers they placed next to each objective. Again, all voting was anonymous. Group discussion was then facilitated to examine the objectives that received the greatest number of votes, and consider the differences between researcher and practitioner objectives.

Third, I brought together the main points raised in the workshop for open discussion. Participants discussed scale mismatch which had become apparent during the first workshop activity, and priority mismatch which had been identified in the second activity. Through discussion about the workshop and broader experiences, researchers and practitioners identified three further mismatches limiting conservation effectiveness: temporal, communication, and institutional mismatch.

3.4 Results

The eleven participating researchers were mostly early- to mid-career academics joined by several scientists employed by conservation organisations. The five practitioners included conservation professionals working in stakeholder engagement, network science, and natural resource management. Experience of individuals in either group ranged from several years to more than a decade. Researchers and practitioners identified five mismatches between conservation research and practice: scale, temporal, priority, communication, and institutional mismatch. The key points identified about each of the five mismatches are discussed in more detail below.

Scale mismatch

Practitioners at the workshop were more likely to work at a local scale as they felt they were better able to integrate local knowledge into decision-making and increase the involvement of communities in decision-making for more effective conservation outcomes. In contrast, researchers worked from local to global scales, with many working on the latter. The global scope was thought to be more common due to the broader scope of grants and funding available for projects designed at this scale, and the improved prospects for publication. Both researchers and practitioners highlighted how one of the main difficulties in conservation is the ability to translate conservation goals designed at broad scales to actions specific to local areas. All participants highlighted the need for greater multi-scale thinking in the future.

Temporal mismatch

Practitioners and researchers appeared to work within different time frames. Practitioners were more adaptive and focused on resolving emerging local issues so that they did not negatively impact communities or the environment in the future. Alternatively, researchers were mainly observational, often developing methods to resolve existing knowledge gaps that had been identified within the scientific literature. Researchers and practitioners agreed that conservation science needed to more effectively combine information from past and present, while looking to the future. Such an approach can be used to ensure actions are evidence-based and grounded in theory, while being as proactive as possible in the field.

Priority mismatch

Researchers' objectives typically focused on ecosystem dynamics and threats to species, while practitioners focused on how best to work within local and social systems for more effective action. When rating all anonymous participant objectives for importance, both researchers and practitioners agreed the following three objectives were key for successful conservation outcomes: (1) building and supporting community capacity for local action; (2) training, education, and awareness to implement research recommendations; and (3)

understanding the social and ecological factors that best support communities and conservation. Both environmental and social objectives were considered important, but both researchers and practitioners highlighted that a key priority of future conservation efforts should be to focus on developing a social-ecological approach to better implement research and deliver action on the ground.

Communication mismatch

Researchers noted that they often had no knowledge of what projects the practitioners were implementing or what actions had been successful or unsuccessful in the past. Practitioners emphasised that they often had limited access to research findings due to their organisations not being able to afford the subscription rates of academic journals. Both researchers and practitioners stressed the need for better knowledge exchange and access to each other's work. Participants highlighted that greater shared knowledge would ensure that new efforts did not duplicate work that has already been done. Furthermore, improved knowledge exchange could be used to identify new opportunities for collaboration, and ensure conservation is informed by the experiences of both research and practice.

Institutional mismatch

Both researchers and practitioners agreed that institutions and their funding sources affected the type of work that they carried out. Practitioners highlighted how their organisations often had much less funding or resources than academic institutions. As a result, practitioners felt they did not have as many opportunities to learn new skills or stay up to date with emerging research methods. Conversely, researchers felt they were not allocated enough time to implement or action their research, instead feeling pressure from their own research institutions to publish their findings and move on to the next research project. Further, researchers stressed that while they felt there was a real need to implement their work, taking time to do so could leave them at a career disadvantage in an institutional system that rewards publication outputs over action. As a result, attempts made to implement their research may hinder their future conservation efforts where they are measured against other researchers who have focused their time on delivering

publication outputs only. Workshop participants stressed that the priorities of the different institutions were often divergent, despite researchers and practitioners wanting to foster greater collaboration. Therefore, new practices need to be developed so that their work can become aligned and well resourced.

Recommendations for overcoming mismatch

Participants proposed five recommendations to specifically address the mismatches identified by the workshop, highlighting how researchers and practitioners should aim to: (1) develop multi-scale projects coordinating broader goals with local actions; (2) ensure that action is adaptive and future-oriented, while being grounded in theory; (3) design research with action in mind; (4) develop an international open-access resource of existing and proposed projects; and (5) find ways for institutions to provide adequate time and resources to encourage collaboration, skill development, knowledge exchange, and action. Further, participants also suggested that: (6) academic students should be co-supervised by researchers and practitioners to ensure they develop complementary skills in research and implementation; and (7) a role should be developed for connectors to identify the most valuable links between researchers, practitioners, and projects.

3.5   Discussion

The workshop highlighted how the implementation gap is still very real in conservation and the importance of bringing together researchers and practitioners to discuss their work. The workshop was designed to facilitate knowledge exchange and learning between conservation researchers and practitioners. However, while useful, the workshop was a singular opportunity to share knowledge for those attending the conference. For conservation to be effective, long-term knowledge exchange is required to align research and practice throughout conservation. Furthermore, knowledge exchange opportunities should be embedded in conservation planning from the outset to ensure research informs planning, and planning informs action. Indeed, such opportunities can build trust between researchers and practitioners to develop long-term two-way communication and create opportunities for collaboration and learning (Reed, Stringer, Fazey, Evely, & Kruijsen,

2014). Conservation planning must therefore shift towards practices that enhance knowledge exchange and opportunities for learning if we are to achieve our social and ecological goals (e.g., Armitage et al., 2011).

Nevertheless, the mismatches identified in the workshop highlight a number of barriers to effective long-term knowledge exchange. For example, while participants stressed the importance of working towards the recommendations identified in the workshop, many felt unsupported pursuing this type of work. While researchers and practitioners identified a strong personal desire to bridge the mismatches identified in the workshop, many felt there was little they could do without institutional change. Indeed, institutions do not often recognise such activities as important, further reinforcing mismatches between research and practice while limiting effective knowledge exchange (Acheson, 2006; Briggs, 2006; Cvitanovic et al., 2015; Shanley & Lopez, 2009). In contrast, the mismatches identified by participants highlighted the need to build a collaborative infrastructure between funding sources, research institutions, planning agencies, and practitioners. Until institutions rethink the criteria by which they measure success and allocate funding, they will continue to reinforce mismatches that contribute to the implementation gap. Real conservation progress can only be possible if institutions begin to prioritise and support the recommendations outlined by the workshop.

Furthermore, both practitioners and researchers highlighted the importance of developing a social-ecological approach to conservation. Indeed, the most important objectives identified were building local capacity for action, training to implement research, and understanding social and ecological factors that support communities in conservation. A social-ecological approach to conservation highlights the importance of framing conservation as a complex social process from the outset (Biggs et al., 2011), understanding the dynamic interactions between human and natural systems (Ostrom, 2007, 2009), enhancing knowledge exchange (Nel et al., 2015), and identifying the pathways for translating knowledge into action for successful conservation outcomes (McGinnis & Ostrom, 2014). Arguably, therefore, mainstreaming a social-ecological approach to conservation will help achieve the key objectives identified by the workshop.

Overcoming the implementation gap will only be possible if we develop social-ecological approaches to conservation that enhance knowledge exchange. Such approaches could be further improved beyond the scope of the workshop by bringing together researchers, practitioners, planners, and actors to build consensus and identify common goals in conservation. New models of conservation planning are therefore required. Ultimately, the success of conservation depends on overcoming the implementation gap to ensure conservation is evidence-based, effective, and actionable.

3.6 Conclusion

In this chapter, I described the outcomes of a workshop bringing together conservation researchers and practitioners to identify the mismatches contributing to the implementation gap. Workshop participants identified five mismatches between conservation research and practice: scale, temporal, priority, communication, and institutional mismatch. Participants also recommended seven ways to bridge these mismatches and overcome the implementation gap. The workshop highlighted the critical role of knowledge exchange in conservation processes to align research and action. In addition, my findings highlighted the importance of considering conservation from a social-ecological perspective. This chapter therefore establishes the context for developing a social agenda for a social-ecological approach in Chapters 4 to 6 in this thesis. This social-ecological approach can be used to enhance knowledge exchange in conservation planning to overcome the implementation gap.

Chapter 4

Governance

In this chapter, I will map the governance system in a complex seascape to achieve my second research objective:

Objective 2:   *Understand conservation governance in a complex multi-actor, multi-priority, multi-scale seascape*

To achieve this objective I use social network analysis to map knowledge exchange between conservation organisations in a complex conservation system. My study suggests the conventional top-down structure of this governance system has limited the successful implementation of previous management plans developed for the HGMP. In contrast, much of the conservation action undertaken in the region has been community-led. Yet these local organisations are often on the periphery of the governance system with few connections to other organisations and limited knowledge exchange. My study suggested that more successful governance could be developed by transitioning from a top-down to multi-scale approach. Multi-scale governance could be developed by identifying the productive links between organisations with similar priorities across scales, while better linking regional planning with local action. I conclude that multi-scale governance is required to shift the HGMP towards more successful conservation outcomes. As such, I highlight the value of a social network approach for understanding conservation governance. Such an approach is particularly important for understanding the complex multi-actor, multi-priority systems increasingly common in conservation.

A version of this chapter has been submitted as Jarvis R. M., Bollard Breen, B., Krägeloh, C.U., & Billington, D.R. Assessing the transformative potential of local organisations in complex conservation landscapes. *Ecology and Society* (in review).

4.1 Abstract

Conservation often occurs in complex systems with multiple actors and multiple priorities, operating at multiple scales. Yet governance research accounting for this complexity has been limited to date. In this chapter, I apply social network analysis to identify conservation organisations in the HGMP and map the governance system. The structure and function of the governance system was previously unknown. For this reason, I use social network analysis (SNA) to characterise the existing governance system and make recommendations on how to shift the system to more effective conservation outcomes. I demonstrate that a conventional top-down approach has limited the implementation of previous management plans in the HGMP, and note that many successful conservation actions have been community-led. However, the contributions of local organisations have not been included in conservation planning. I therefore recommend that the HGMP encourages the involvement of local organisations in conservation governance, recognising their contributions as key to conservation success. I conclude that incorporating these local organisations in governance processes is vital for shifting the governance system from a centralised top-down structure to a multi-scale structure better linking regional planning with local action. By developing a more inclusive approach to conservation governance, planners can enhance the likelihood of successful conservation outcomes across the planning region. This study therefore demonstrates the value of using SNA to understand conservation governance in a complex multi-actor, multi-priority seascape.

4.2 Introduction

Without good and effective governance, conservation is unlikely to succeed (Bennett & Dearden, 2014b; Bennett, 2015). As a consequence, governance research has expanded rapidly in recent years to provide important insights into the broader social, institutional, and political processes that constrain or facilitate successful conservation (Bennett & Dearden, 2014b; Bennett, 2015; Lockwood, 2010). Furthermore, social network analysis (SNA) has emerged as a leading approach for better understanding conservation governance (Alexander & Armitage, 2015; Armitage, de Loë, & Plummer, 2012; Cohen, Evans, &

Mills, 2012). By identifying the actors, organisations, and the patterns of the collaboration between them, SNA can provide valuable insights for improving conservation outcomes.

Multi-scale governance has emerged as the most suitable approach in complex conservation systems with multiple actors operating at multiple scales (Armitage et al., 2009; Carlsson & Berkes, 2005; Folke, Hahn, Olsson, & Norberg, 2005; McGinnis & Ostrom, 2014; Per Olsson, Folke, & Berkes, 2004; Ostrom & Cox, 2010). Such an approach integrates local organisations into planning and governance while accounting for the existing relationships these organisations have with local places and contexts (Ernoul & Wardell-Johnson, 2013). Indeed, local organisations often possess sophisticated local ecological knowledge valuable for governance (Becker & Ghimire, 2003; Johannes, 1998; Tengö, Brondizio, Elmqvist, Malmer, & Spierenburg, 2014), and are more likely to be sources of novel information and innovation in the system (Bodin & Crona, 2009; Granovetter, 1973; Mills et al., 2014). Furthermore, local organisations often reflect the feasibility of local people to achieve a conservation action, the capacity for implementation, and their willingness to act (e.g., Bodin & Crona, 2009; Cowling & Wilhelm-Rechmann, 2007; Mills et al., 2014). Accordingly, it is important to integrate local organisations in governance processes to achieve successful conservation outcomes.

However, conventional top-down governance continues to dominate in many conservation systems. As a result, the efficacy of conservation planning and governance remains limited. Indeed, top-down steering is unlikely to achieve conservation outcomes alone (Hajer et al., 2015), especially where this approach risks marginalising those actors and organisations that are less well connected in the network (Bodin & Crona, 2009). Similarly, top-down approaches can cause unnecessary conflicts in the system where actors and organisations feel their priorities are ignored, raising questions on the legitimacy and equity of governance processes (Bennett & Dearden, 2014b; Sandström, Crona, & Bodin, 2014). Therefore, SNA may provide important insights valuable for developing effective and inclusive governance, especially in governance systems that are poorly understood. In particular, through the identification of previously unknown organisations and governance structures in large-scale networks. Furthermore, SNA can be used to identify those organisations that

are less well connected and are therefore at greater risk of marginalisation in an unknown system. Such an approach is especially valuable in complex systems, with multiple actors and multiple priorities, operating at multiple scales: a governance system increasingly common in conservation.

In a recent review of SNA research, Alexander & Armitage (2015) identified three conceptual approaches commonly used to better understand governance in conservation systems: (1) binary metaphorical; (2) descriptive; and (3) structurally explicit. First, a binary approach identifies the presence or absence of networks as a binary variable. Indeed, the majority of SNA studies in marine conservation identify the presence or absence of a network, while overlooking the implications of the structure of the network and the relationships between actors (Alexander & Armitage, 2015). Second, a descriptive approach focuses on the identification of links, or actors, within the network (Bodin & Prell, 2011). For example, identifying the role of bridging organisations, or bridging links between two organisations. Yet this description rarely includes any mention of network structure or function (Alexander & Armitage, 2015). Third, a structurally explicit approach focuses on the social structure of the network. For example, mapping the links between actors representing collaboration or knowledge exchange (Cohen et al., 2012). While most SNA has been largely binary or descriptive, a structurally explicit approach can provide valuable insights on patterns of knowledge exchange between actors and organisations in complex systems (Alexander & Armitage, 2015). Such an approach can therefore be used to identify the social factors that constrain or facilitate successful conservation outcomes. As such, I focus on a structurally explicit approach to SNA in this study.

In addition, a structurally explicit approach highlights the contextual nature of conservation planning and governance. For example, several studies have suggested that a strong core-periphery structure can enhance the likelihood of achieving successful conservation outcomes (e.g., Alexander, Armitage, & Charles, 2015), while others have suggested that such a structure may constrain effective collaborative management (e.g., Ernstson, Sörlin, & Elmqvist, 2009). Indeed, a core-periphery structure may be better suited for coordinating action across a limited number of actors to achieve a simple task or single

conservation priority (Leavitt, 1951), but is much less well suited for complex conservation systems (Ernstson et al., 2009). In contrast, more decentralised networks are likely to be better for solving more complex tasks, where different parts of the network can generate different knowledge and actions matched to the context and scale of the issue (Bodin, Crona, & Ernstson, 2006). It is important to note, therefore, that a core-periphery structure can both constrain and facilitate effective conservation processes (Diani, 2003; Ernstson et al., 2009). Indeed, there is no ideal network structure across all governance systems, and the efficacy of the network will depend on context (Alexander et al., 2015; Bodin & Crona, 2009). Given the need to take context into account, a structurally explicit approach to SNA will provide important insights on developing effective conservation planning and governance in complex systems.

In this chapter, I will use SNA to understand the governance system in the HGMP. Previous conservation planning in the HGMP has been developed by two organisations, Auckland Council and the Department of Conservation. Yet previous plans have remained unimplemented, while most of the successful conservation action in the HGMP has been community-led (Hauraki Gulf Forum, 2014). Importantly, both "State of the Gulf" reports have identified a lack of stakeholder involvement, weak governance, and ineffective management as the cause for ongoing environmental decline (Hauraki Gulf Forum, 2011, 2014). In contrast, the reports highlight how "the activities and behaviours of stakeholders… have a significant influence on environmental outcomes" in the HGMP (Hauraki Gulf Forum, 2014, p. 171) and emphasise how future efforts should focus on building strong stakeholder and citizen involvement. Yet the structure and function of the governance system was poorly understood. In this study, I will apply SNA to map the governance system influencing the effectiveness of conservation planning in the HGMP. I will first plot knowledge exchange in the governance system between different types of organisations involved in conservation in the HGMP. I will then map the governance network in relation to individual organisations and the knowledge exchange between them. I will examine knowledge exchange in the governance system, and demonstrate how social network analysis can be used to provide new insights into how this system can constrain or facilitate successful conservation outcomes.

4.3 Methods

The survey design and data collection were conducted as per Blanchet and James (2012), adapted for conservation governance in the HGMP. A list of conservation actors was developed from a detailed review of conservation organisations operating in the HGMP from the establishment of the Hauraki Gulf Forum (2000) to present through an online search of websites, publications, planning documents, and grey literature. Actors were defined as individuals representing any organisation that had an active role in shaping conservation action, governance, or decision-making in the HGMP. Each actor was contacted via email and asked to complete a short online survey using the Organisational Network Analysis Survey Tool (www.onasurveys.com). Actors were asked to identify each individual they received information from, and sent information to, relating to conservation in the HGMP. Knowledge exchange was therefore defined as any information useful for assisting in everyday tasks and/or achieving long-term conservation goals. Actors not previously identified in the original list were also contacted via a snowball sampling methodology to ensure maximum participation of HGMP actors in the survey (Atkinson & Flint, 2004). Two rounds of email reminders were sent to non-respondents who had not yet completed the survey. The survey was open between 3 June and 2 August 2013, until no new individuals were identified and SNA response was considered to be saturated.

To map the governance network, I grouped responses to organisation level where links represented knowledge exchange within and between organisations. By asking individuals to map other individuals in the network, I established genuine patterns between individuals who could name each other, rather than between an individual and an organisation identified more broadly. Such links are considered to reflect routine, long-term, stable patterns of interaction (Ernstson et al., 2009; Marsden, 1990), rather than a temporary or brief interaction with an organisation where an individual contact cannot be named. Participants were encouraged to name all individuals within their own organisation, in addition to those individuals in other organisations, with whom they exchanged knowledge on conservation in the HGMP. This approach also provided a means to map knowledge

exchange within each organisation, in addition to between organisations, in the governance network.

Organisations were coded by type: (1) council; (2) government; (3) Māori; (4) local; (5) NGOs; (6) research; (7) education; and (8) legal (definitions and examples in Table 2). Knowledge exchange between and within organisations was visualised via a modified circular plot using the *circlize* package (Gu, Gu, Ellis, Schlesner, & Brors, 2014) in RStudio v.0.99.467 (RStudio Team, 2015). Social network analysis and visualisation was conducted in Gephi v.0.8.2-beta (Bastian, Heymann, & Jacomy, 2009) where layer assignment was based on degree (the number of connections each node has to other nodes). Network metrics were calculated using Gephi and the *igraph* package in RStudio (Csardi & Nepusz, 2006).

Table 2. Type of organisation, definition, and an example.

Organisation	Definition	Example
Council	Councils and council-controlled organisations. Councils are responsible for developing regional strategies and plans, including conservation planning in the HGMP. Council-controlled organisations are responsible for the delivery of a service or activity on behalf of a council organisation.	Auckland Council
Government	Government agencies, including public and state services that operate in respect of the Government of New Zealand.	Department of Conservation
Māori	Iwi, and Māori groups established to build iwi aspirations and articulate iwi visions for the environment.	Ngāti Paoa Iwi Trust
Local	Local, voluntary, and community-led organisations established to address a certain issue within the borders of the HGMP. Includes trusts, "friends of", and "supporters" groups.	Motuihe Island Restoration Trust
NGOs	National and international NGOs that were established to address issues beyond the scope and scale of the HGMP, but also contribute to work within the HGMP.	World Wildlife Fund (WWF)
Research	Universities and research institutes.	Auckland University of Technology
Education	Organisations offering environmental education opportunities in the HGMP.	Motutapu Outdoor Education Camp
Legal	Legal entities concerned with legal disputes, appeals, and accordance with the rule of law.	Courts of New Zealand

4.4 Results

The survey was completed by 330 actors across 101 organisations (57.69% response rate). As a result, 548 weighted links were identified between and within organisations (4044 total weight). The network was relatively sparse, with less than 6% of all possible links present (network density = 0.054). The governance system included 38 local organisations, 16 NGOs, 14 research institutions, 13 Māori groups, 7 education organisations, 6 government agencies, 4 council organisations, and 3 legal entities. Knowledge exchange occurred within and between all seven types of organisation in the HGMP governance network (Figure 3). The circular plot demonstrates how the majority of knowledge exchange passes within and between research, government, council, and local organisations. Interestingly, research, government, and local organisations demonstrate notable knowledge exchange within the same type of organisation, as indicated by the size of the knowledge exchange feedback loop on the far right of the plot for each type of organisation.

Visualising the conservation network layered by degree demonstrates the top-down, core-periphery nature of the HGMP governance system (Figure 4). For example, two organisations are the largest nodes and are located at the top of the network, indicating their centrality. These organisations are a council organisation, Auckland Council, and a government organisation, the Department of Conservation. The grey arrows between nodes are also widest at the top of the network indicating the greatest knowledge exchange occurring between several organisations in the core. Moreover, both Auckland Council and the Department of Conservation demonstrate relatively high levels of knowledge exchange within the same organisation, as is indicated by the size of the grey circles behind each of the nodes. In contrast, many of the local organisations in the network are relatively small and located near the bottom of the network, in the network periphery. Their small relative size indicates few connections to other organisations in the network and limited knowledge exchange.
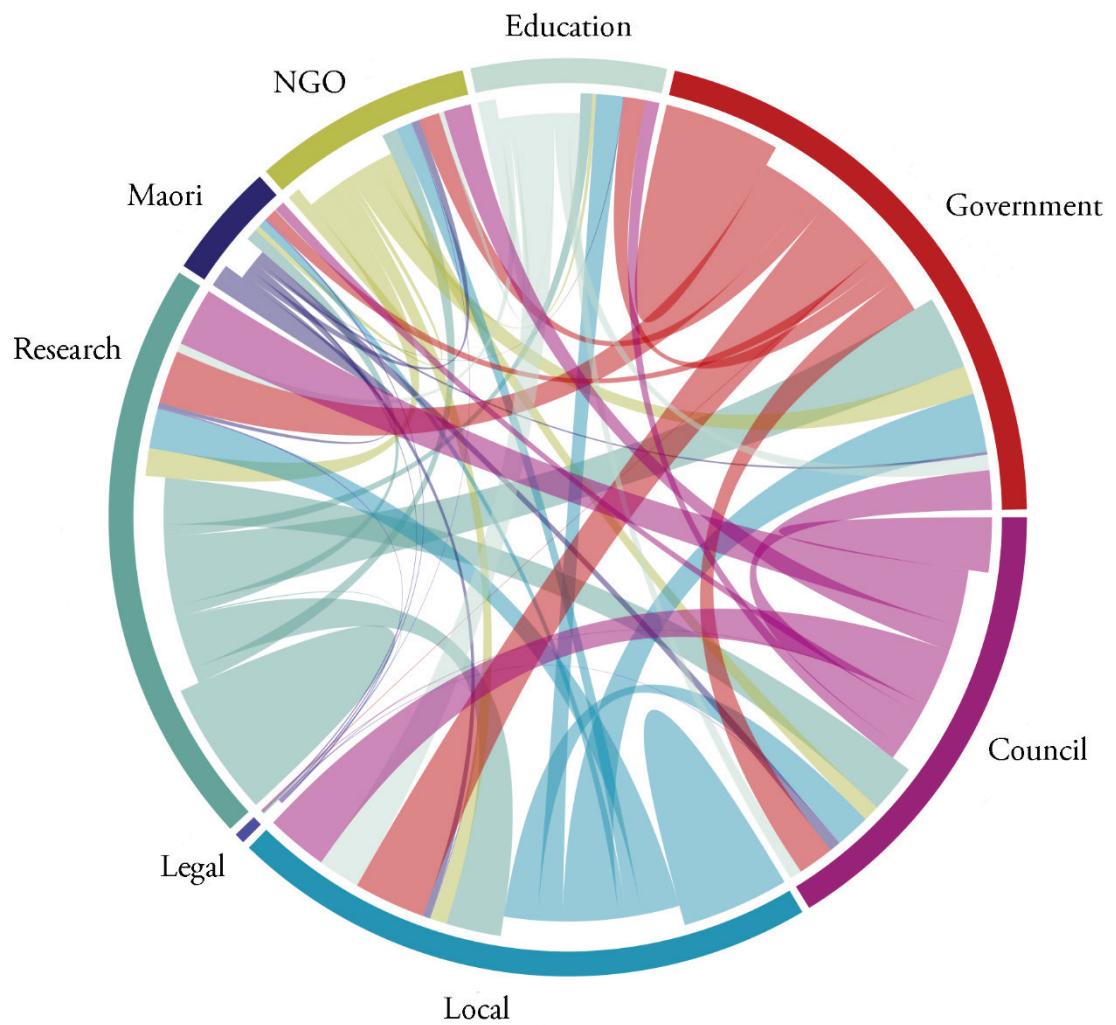
Figure 3. Knowledge exchange between and within types of organisation, where outgoing information is indicated by bars moving out from the coloured type of organisation, and incoming information is indicated by the different colours received from other types of organisation.
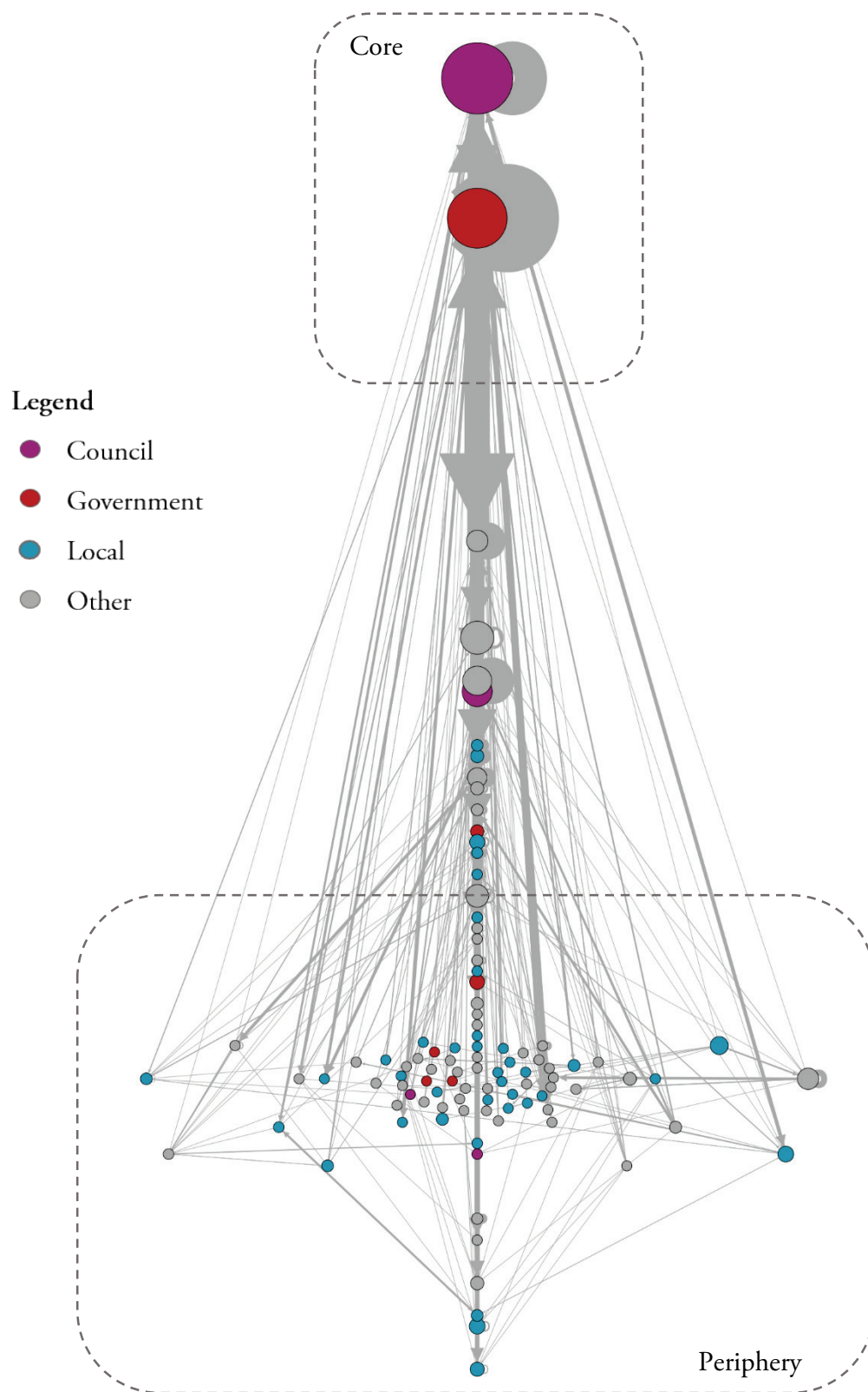
Figure 4. Conservation governance network of the HGMP layered by degree (number of connections each node has to other nodes in the network). The larger the node, and the higher the node in the network, the more connections that node has to other organisations. The wider the links and arrows between organisations, the greater the knowledge exchange between them. The larger the grey circle behind the node, the greater the knowledge exchange within that organisation.

In addition, a simplified version of the governance system illustrates how over half of the knowledge exchanged in the HGMP never reaches the two central planning organisations (Figure 5). Indeed, 57.52% of knowledge in the HGMP is exchanged within and between other organisations in the network, while only 24.23% reaches the planning organisations at the core. In contrast, these planning organisations provide other organisations in the network around half the knowledge they receive (11.45%), while 6.80% of the knowledge in the network is exchanged between planners.
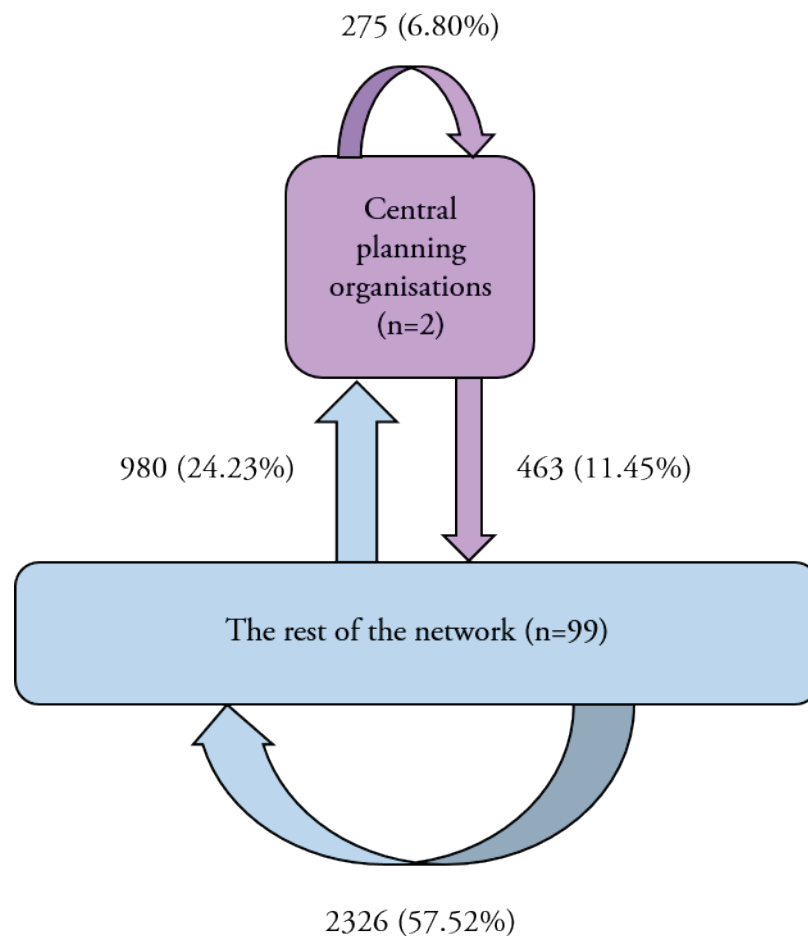
Figure 5. The HGMP governance system demonstrating knowledge exchange within and between the two central planning organisations, and the rest of the network. The arrows demonstrate the direction of knowledge exchange. The values indicate the sum of weighted links represented by each arrow and (%) represents the percentage of total knowledge exchange.

4.5 Discussion

The circular plot demonstrated the complexity of knowledge exchange and governance in the HGMP. In addition, the diversity of organisations and knowledge exchange patterns in the plot suggests a wide range of values and interests found within the governance system. Interestingly, the plot identified greater knowledge exchange within and between four types of organisations: research, local, government, and council. However, the plot also revealed a notably greater knowledge exchange feedback loop within the same type of organisation for government, local, and research organisations. While this could indicate greater collaboration between colleagues within these types of organisations, this could also suggest that research, planning, and action are undertaken relatively separately in the HGMP.

Furthermore, the mapped governance network identified the core-periphery structure of the HGMP governance system. Indeed, SNA highlighted that the majority of knowledge exchange in the HGMP moves within and between two organisations: Auckland Council, a council organisation, and the Department of Conservation, a government organisation. These two organisations have led previous conservation planning in the HGMP. However, these plans remained unimplemented and the health of the environment has continued to decline (Hauraki Gulf Forum, 2011, 2014). Despite previous planning efforts being unsuccessful, this top-down hierarchy is still apparent, with the majority of knowledge exchange occurring within and between these two organisations in the core of the network. In contrast, many of the successful conservation actions in the HGMP have been community-led. Yet the majority of local organisations are located on the periphery of the network with few connections to others and limited knowledge exchange. Furthermore, the simplified governance system demonstrated how nearly 60% of all knowledge exchange in the HGMP never reaches planners. This suggests that the framing conservation governance continues to be driven by these central organisations through their position in the network (e.g., Ernstson et al., 2009), despite being unsuccessful in the past. Furthermore, core-periphery structures tend to reinforce and reproduce the same structure over time (Diani, 2003; Ernstson et al., 2009). In the HGMP, this core-periphery structure therefore risks reinforcing governance structures that have been ineffective at mitigating ongoing

environmental degradation, while overlooking the local knowledge and values key to conservation success.

It is important to note that different actors are likely to have scale-specific knowledge relevant for effective governance (Ernstson et al., 2010). Indeed, local organisations often possess sophisticated local ecological knowledge valuable for governance (Becker & Ghimire, 2003; Johannes, 1998; Tengö et al., 2014), and are more likely to be sources of novel information and innovation in the system (Bodin & Crona, 2009; Granovetter, 1973; Mills et al., 2014). Furthermore, these local groups have developed reflecting local values and priorities, the feasibility of local people to achieve a conservation action, the capacity for implementation, and their willingness to act (e.g., Bodin & Crona, 2009; Cowling & Wilhelm-Rechmann, 2007; Mills et al., 2014). As a consequence, understanding the agency and the collective action of local organisations will provide valuable insights for transforming the governance system towards more successful conservation outcomes (Folke, Carpenter, Walker, Scheffer, & Chapin, 2010; Folke et al., 2005; Walker, Holling, Carpenter, & Kinzig, 2004; Westley et al., 2013). Yet the contributions of local organisations have not been included in conservation planning.

I therefore recommend that the HGMP encourages the involvement of local organisations in conservation governance, and recognises their contributions as key to success. Such a shift will require challenging the efficacy of the current governance and planning processes, the inclusion of a diverse set of actors and priorities, and the decentralisation of responsibility and action (Game, Meijaard, Sheil, & McDonald-Madden, 2014). Yet a multi-scale approach is more likely to achieve successful conservation action in complex multi-actor, multi-priority systems (Ernstson et al., 2009), where different parts of the network can generate different knowledge and actions matched to different conservation priorities (Bodin, Crona, & Ernstson, 2006). Incorporating these local organisations in governance processes is vital for shifting the governance system from a centralised top-down structure to a multi-scale structure. In addition, acknowledging the contributions of local organisations in conservation governance may provide a means to link regional planning with local action (Mills et al., 2014; Pressey et al., 2013). By developing a more inclusive

multi-scale approach to conservation governance, planners can enhance the likelihood of successful conservation outcomes across the planning region.

However, identifying the links between organisations that are most likely to achieve successful conservation outcomes remains a challenge (Alexander & Armitage, 2015; Bodin & Crona, 2009). Therefore, new approaches to conservation planning and governance are required to shift the system towards successful conservation outcomes. Recognising the importance of increasing inclusion in the HGMP, Sea Change—Tai Timu Tai Pari initiated a stakeholder-driven planning process in December 2013. The process was developed to recognise that "the knowledge and capability to solve pressing ecological problems already exists in communities – it just needs to be brought together, in a way that doesn't allow one voice or agenda to dominate" (Sea Change—Tai Timu Tai Pari, 2014, p.1). In Chapters 5 and 6 of this thesis, I identify place-based values and local knowledge used to inform the Sea Change—Tai Timu Tai Pari planning process and increase social support for successful implementation. Such an approach is designed to identify valuable multi-level links between actors and organisations across scales and better link regional planning with local values and action. The plan will be delivered by the end of 2016.

While the SNA in this study provided important insights into the governance and planning processes in the HGMP, there are some limitations to using this method in isolation. For example, there are likely to be a small number of local organisations that were not identified in this analysis because they were not connected to the existing governance network. Furthermore, SNA did not adequately identify or characterise mātauranga Māori (Māori knowledge) in the HGMP. While the SNA did identify 13 Māori groups, these groups do not adequately represent the broad range of iwi values and interests in the HGMP. Furthermore, the SNA did not account for iwi representatives within various other types of conservation organisations. SNA could therefore be accused of being inadequate at identifying or characterising iwi knowledge, priorities, and values in the HGMP.

It is important to note that Bodin & Prell (2011) suggest that up to 20% missing data as acceptable in conservation SNA research. More than 20% missing data is likely to have considerable impact on the network structure, especially where this network is being

mapped as links between individuals. However, a response rate of over 80% is typically achieved through face-to-face interviews (e.g., Crona & Bodin, 2006; Enqvist et al., 2014). In contrast, an online survey was developed in this study due to the size and scope of the HGMP. While face-to-face interviewing typically offers higher response rates than an online survey (Curasi, 2001), this approach was unfeasible given the time-limitations and scope of this study. Notably, however, the response rate of this study was likely to be higher than the 57% reported here. The original list of actors was collected between the establishment of the Hauraki Gulf Forum (2000) and the start of the survey to maximise potential reach over a poorly understood system. As a result, a number of email contacts were likely to be out of date. For example, I received 3 separate emails from individuals to clarify that they no longer worked in conservation in the HGMP. It can be assumed that there were likely to be a number of other individuals who were no longer active in the HGMP that did not respond to the survey at all, skewing the response rate reported. Furthermore, the final SNA was presented back to the planning organisations in the core, and several NGOs and local organisations, who confirmed the structure around their organisation. As a result, I am confident the SNA sufficiently captured the structure of the governance system in the HGMP. However, I would recommend that future SNA be complimented by additional qualitative methods to fully capture the different types of knowledge within the governance system.

4.6 Conclusion

I conclude that inclusive multi-scale governance is required to shift the HGMP towards successful conservation outcomes. Previous top-down processes have remained unimplemented in the past. In contrast, successful conservation action in the HGMP has been mainly community-led at a local scale. Yet these local organisations are often on the periphery of the governance system with few connections to other organisations and limited knowledge exchange. Therefore, I suggest that more successful governance could be developed by transitioning from a top-down to a multi-scale approach. Multi-scale governance could be developed by identifying the productive links between organisations with similar priorities across scales, while better linking regional planning with local action.

I conclude that inclusive multi-scale governance is required to shift the HGMP towards more successful conservation outcomes. Such an approach is particularly important for achieving the outcomes required in the complex multi-actor, multi-priority systems increasingly common in conservation.

Chapter 5

Actors

In this chapter, I will describe how spatially-referenced social values data can be used to achieve my third research objective:

Objective 3: *Understand conservation actors across diverse values to identify place-based conservation opportunity*

To achieve this objective I will describe a social survey developed inside the online collaborative mapping tool, SeaSketch. The survey was crowdsourced through multiple online, news, and print media to increase participation rates while raising public awareness of the broader Sea Change—Tai Timu Tai Pari spatial planning process. The survey provides spatially-referenced social data on citizen values across the HGMP region. I show that spatial consensus of these values could be used to identify place-based conservation opportunities across the planning region. In addition, my study suggests that regional planning could incorporate diverse *anthropocentric* and *biocentric* conservation values by identifying different places valued for different reasons. The study demonstrates the importance of embracing diverse conservation values across the *anthropocentric-biocentric* spectrum to broaden participation and social support for conservation. I predict that developing conservation actions relevant to different social values in different areas would enhance the social support of these actions, and consequently, feasibility of implementation. I conclude that understanding how citizens value different areas across a planning region could reveal new and existing opportunities for conservation action, and consequently, enhance the likelihood of success. My study suggests that these place-based opportunities could be used to better link regional planning with local action to overcome the implementation gap in the HGMP.

5.1 Abstract

The values of conservationists and planners will affect their decisions, tools, and practice, while the values of the public will affect the social acceptability of different management actions and, consequently, the likely success of implementation. This study investigates how voluntary geographic systems (VGI) can be used to identify areas important for *anthropocentric* and *biocentric* values across a spatial planning region to inform place-based conservation planning. The study also identified *anthropocentric-biocentric* areas where both *anthropocentric* and *biocentric* values were assigned to the same location. Differences in number of visits were observed between value orientations. Differences in distance to marine reserves, conservation land, and residential areas were also observed. The study highlighted how VGI can be a useful tool to encourage awareness and engagement in the initial stages of the planning cycle while providing spatial data to identify place-based conservation opportunities across diverse conservation values.

5.2 Introduction

While our values guide our judgement of the world around us, affect the decisions we make, and the actions we support, they are still rarely acknowledged or incorporated into conservation planning (Ives & Kendal, 2014). However, it is becoming increasingly recognised that conservation issues are often social issues (Moon & Blackman, 2014), and conservation planning is a social process (Biggs et al., 2011). As such, there has been increasing interest in the role of social values for achieving successful conservation outcomes.

Recent debate in the literature highlights ongoing tensions between conservationists championing either *anthropocentric* or *biocentric* values for conservation (Hunter, Redford, & Lindenmayer, 2014). According to conservationists with *anthropocentric* values, conservation is for the wellbeing of humanity and the benefits the environment can provide to society. In contrast, conservationists with *biocentric* values argue that conservation is for the sake of the environment and the species that live there, considering humans to be no more intrinsically important than other species. These different value orientations provide

different conservation discourses in management with *anthropocentrists* framing conservation as "nature for people", and *biocentrists* framing conservation as "nature for itself" (Mace, 2014). Ultimately, the framing will affect how conservation is conducted, because the key ideas and scientific underpinnings of these different framings will influence the tools and techniques used by conservationists, and how they measure positive conservation outcomes (Mace, 2014).

However, Hunter and colleagues (Hunter et al., 2014) also highlight that while different conservationists may identify more strongly with an *anthropocentric* or *biocentric* framing for conservation, few are entirely *anthropocentric* or *biocentric*. Instead, the authors argue that conservationists' values exist at different points across a continuous *anthropocentric-biocentric* spectrum. Regardless of their position on the spectrum, all conservationists ultimately wish to minimise or reverse harm to nature, albeit for different reasons. Contention over polarised values can limit conservation progress (Tallis & Lubchenco, 2014) and these values should be seen as complementary, with plenty of room to accommodate the entire *anthropocentric-biocentric* spectrum in conservation (Hunter et al., 2014). Incorporating diverse values in conservation can facilitate conservation progress by focusing on identifying the effectiveness of different actions in different contexts, while also developing multiple pathways to conservation success (Game et al., 2014; Mace, 2014; Tallis & Lubchenco, 2014).

The public also hold diverse *anthropocentric* and *biocentric* values for conservation across the *anthropocentric-biocentric* spectrum. These values have been shown to be good predictors of pro-environmental attitudes and people's views on different management decisions (Ives & Kendal, 2014; Schultz, 2001; Stern, Kalof, Dietz, & Guagnano, 1995; Thompson & Barton, 1994). Further, the values people hold for conservation relate to place-specific values they assign to different locations, and the management actions they support in these areas (Ives & Kendal, 2013, 2014; Kaltenborn & Bjerke, 2002; Van Riper & Kyle, 2014). It is therefore important to consider not only how values affect the decisions conservationists make, but also how different values influence the public's views and support for these decisions. Conservation efforts focused on *anthropocentrism* or *biocentrism* alone can risk marginalising those with different values (Hunter et al., 2014), and can even

lead to conflict (Bengston, 1994). Including diverse conservation values in spatial planning can minimise conflict and identify where mutually compatible values exist (Brown & Reed, 2012; Van Riper & Kyle, 2014). In locations where values are compatible, planners can align values and actions to increase public support and the likelihood of conservation success (Ives & Kendal, 2014; Whitehead et al., 2014). New methods are required to identify value diversity that can be used to inform conservation planning and account for the different ways nature is valued across conservationists, planners, and the public.

Three geospatial technologies are becoming increasingly used to map public values and increase non-expert participation in spatial processes: public participation geographic information systems (PPGIS), participatory geographic information systems (PGIS), and voluntary geographic information systems (VGI). While there are similarities between these approaches, key differences are determined by the definition and purpose of participation (Brown & Kyttä, 2014). PPGIS is more commonly used to enhance public involvement in developed countries, while PGIS tends to be used in developing countries to build social capital and community empowerment. VGI has been used in developed and developing countries, aimed at encouraging citizens to act as voluntary sensors to increase the volume and extent of spatial data (for a review of the three approaches, see Brown & Kyttä, 2014).

Unfortunately, survey response rates have been declining across all survey approaches (Brown & Kyttä, 2014; Couper & Miller, 2008). Declining response provides a data sufficiency issue across larger study areas where there are not enough data to identify patterns and features with confidence (Brown & Kyttä, 2014). As a result, increasing participation rates have been identified as a key priority for all geospatial participation processes (Brown & Kyttä, 2014). Advances in technology have provided opportunities for researchers to investigate alternatives to more traditional paper-based surveys, and many are increasingly designing surveys online (Brown, Weber, Zanan, & de Bie, 2012). While internet surveys may have lower response rates than mail surveys, internet technology may reduce spatial error by providing "zoom" capability between multiple scales and resolutions, and by eliminating the potential for human error in translating mail responses to GIS software for analysis (Brown et al., 2012). Where time and resources are limited, internet

surveys may also be preferred for their lower costs and shorter processing times (Brown et al., 2012).

As a consequence, VGI is becoming increasingly used to crowdsource voluntary participants by reaching a larger number of respondents that may not have otherwise been included (Brown & Kyttä, 2014). However, there are concerns about how the motivations of voluntary participation may differ from a random household sample, and whom the increased data would represent (Brown, Kelly, & Whitall, 2014; Brown & Kyttä, 2014). For example, increased preferences for *biocentric* conservation and preservation values have been observed in crowdsourced VGI (Brown, Weber, & Bie, 2015). As a result, VGI data cannot be broadly generalised to the public. However, there are additional benefits to crowdsourcing voluntary participation. Participatory processes that encourage public awareness and engagement in planning have been shown to increase trust and support of the planning process, while also increasing the likelihood of cooperation and compliance (Brown et al., 2015). It is therefore important to consider the role of the spatial data, and the participatory process itself, in the planning cycle (Brown & Kyttä, 2014). VGI data may be better suited to diagnostic and scoping activities during the initial phases of the planning cycle that can still be used to inform broader participatory processes (Brown & Kyttä, 2014).

The Department of Conservation (DOC) have recently adopted a place-based approach to conservation in New Zealand (Brown & Weber, 2013). Acknowledging the implementation gap, this place-based approach calls for the identification of places in the planning region that are relevant and comprehensible to actors, planners, and practitioners. In doing so, planners can develop relevant and workable actions relevant to spatially demarcated places across a planning region (e.g., Young et al., 2007). However, planners must ensure that the identification of places is undertaken using a defensible process that adequately integrates actors. By involving actors in place-identification, planners can ensure conservation actions in these areas are likely to have public support, increasing the likelihood of successful implementation (Ives & Kendal, 2014; Whitehead et al., 2014).

Such an approach will be valuable for linking regional planning with feasible local action to achieve successful conservation outcomes.

In this study, I investigate whether VGI can be used to identify areas important for *anthropocentric* and *biocentric* values across a spatial planning region. I examine how these values compare to: (1) the number of times participants visited the areas they identified; (2) distance to marine reserves; and (3) distance to conservation land. I conclude by discussing the benefits and limitations of using VGI to identify diverse place-based conservation opportunities to better link regional planning with local action.

5.3   Methods

5.3.1   Study design

The survey was open to the public for seven weeks between 3 March and 21 April 2014. Participants were recruited through crowdsourcing via print, online, and news media across the HGMP region, including newspaper features, Sea Change—Tai Timu Tai Pari promotional activities and mailing lists, social media promotion, and a television interview on a national news station. A VGI approach was selected to collect fine-resolution data across the HGMP while increasing public awareness of the broader marine spatial planning process. The survey consisted of a landing page on the Sea Change—Tai Timu Tai Pari website (www.seachange.co.nz) that led to an informed consent screen, then to the survey designed within the online collaborative mapping tool, SeaSketch (www.seasketch.org). A Geographx basemap was used to highlight the survey area in colour as it was considered familiar to the public through its use in DOC maps, signposts, and printed literature, in addition to New Zealand magazines, and trail-walking guides (Geographx, 2014). A red line was used to delimit the HGMP boundary, with areas outside the boundary in greyscale for context only. Screen-caps of the HGMP region in SeaSketch can be found in Appendix D.

In contrast to other geospatial studies where participants were asked to use separate markers for different values, this study asked participants to use markers to identify places important to them before identifying as many values as they felt accurately represented that location. Fourteen values were available for selection at each marker added to the map, adapted from previous studies conducted by Brown and colleagues (Brown & Donovan, 2014; Brown & Weber, 2013). The list of values was further modified by internal review across representatives from the Sea Change—Tai Timu Tai Pari partner organisations and a pilot study of a random sample of 218 participants (81 completed the survey; 37% response rate) recruited via the Auckland Council People's Panel (Auckland Council, 2014). Participants were also asked to identify how many days they had visited the location in the past year (up to 365 days). Participants were also asked to contribute their local knowledge of the area under the marker by rating current environmental health (*very poor, poor, ok/average, good, very good*) and change in environmental health in the past five years (*improved, stayed the same, degraded*). The results of these last two questions are analysed and discussed in Chapter 6. Adults 18 years and above were invited to participate in the survey as per the ethical guidelines of our research institution (AUTEC 12:221). A copy of the questionnaire can be found in Appendix E.

5.3.2   Identification of anthropocentric and biocentric areas

The 4,495 points were coded as being either *anthropocentric, biocentric*, or *anthropocentric-biocentric* dependent on the value orientations that had been identified at that point. Points were reclassified as *anthropocentric* or *biocentric* as per recent discussions in the literature (Hunter et al., 2014; Mace, 2014; Tallis & Lubchenco, 2014), previous studies (Ives & Kendal, 2014; Thompson & Barton, 1994), and common use and understanding within the HGMP. *Anthropocentric* values included *community, cultural, employment, historical, home, identity, recreation, scenic, spiritual* and *tourism,* and *biocentric* values included *conservation, native species, research* and *wilderness* (Table 3). Points where *anthropocentric* and *biocentric* values had both been selected were reclassified as *anthropocentric-biocentric*.

Table 3. Value orientation, value, and definition of value used in the VGI survey: anthropocentric orientation defined as conserving nature "for people", including human wellbeing, use, and benefits to an individual or society; biocentric orientation defined as conserving nature "for itself", the species that live there, and intrinsic or existence value (as per Hunter et al., 2014; Mace, 2014; Tallis & Lubchenco, 2014).

Value Orientation	Value	Definition
Anthropocentric	Recreation	Recreation or leisure
	Tourism	Tourism, travel, or sightseeing
	Community	My community
	Historical	Historical significance
	Identity	My identity
	Home	Because it is my home and I live here
	Cultural	My culture or heritage
	Employment	Work, income, or employment
	Scenic	Attractive scenery and views, sights, smells, or sounds
	Spiritual	Spiritual significance
Biocentric	Conservation	Environmental conservation
	Native species	Native animals, plants, or trees
	Wilderness	Being wild, uninhabited, or untouched by human activity
	Research	Scientific research

Anthropocentric, biocentric, and *anthropocentric-biocentric* point data were then mapped via kernel density analyses (ESRI, 2014c) to produce heatmaps where point data in each cluster were concentrated (hereafter referred to as *anthropocentric, biocentric* and *anthropocentric-biocentric* hotspots). Value point data has been shown to cluster between 3 and 6 km (Nielsen-Pincus, 2011), so a circular search radius and fixed distance band of 5 km were used for the analyses (as per Alessa, Kliskey, & Brown, 2008; Brown & Donovan, 2014). Each density analysis was standardised by subtracting the mean grid density and dividing by the grid standard deviation (as per Brown & Donovan, 2014; Brown & Weber, 2013). Densities were visualised in three bands (top third, middle third, bottom third) excluding

standardised kernel densities less than one to highlight value hotspots. Point density grids were analysed using a 20m grid cell size in ArcGIS 10.2.2 (ESRI, 2011).

5.3.2 Data analyses

Current environmental health and change in environmental health were recoded in three intervals to provide a negative (-1), neutral (0) and positive rating (1) for analysis. Spatial data delineating DOC marine reserves and public conservation areas were sourced from Koordinates (www.koordinates.com), and spatial data delineating New Zealand residential areas was sourced from Land Information New Zealand (LINZ; data.link.govt.nz). Conservation land was identified by removing marine reserves from the public conservation areas layer. Near analysis (ESRI, 2014d) was used to calculate the distance between each point added by participants and the nearest marine reserve, conservation land, and residential area in kilometres (km). Significant differences between value orientations in number of visits and distance to marine reserves, conservation land, and residential areas were analysed using Kruskal Wallis one-way analysis of variance and pairwise Wilcoxon rank sum tests in RStudio v.0.98.994 (RStudio Team, 2015).

5.4 Results

5.4.1 Anthropocentric, biocentric, and anthropocentric-biocentric areas

In total, 4,495 points were added to the map by the 1,491 participants who completed the survey (participant demographics are listed in Appendix F). The mean and median number of points added per participant was three points, with nearly three quarters of participants adding between one and three points (1,089 = 73% of points) and almost all participants added ten points or less (1,441 = 97%). Participants selected 16,652 values across the points added to the map, with the majority of participants adding between one and five values at each point (3,645 = 81%). Of the 16,652 values added, three quarters were *anthropocentric* (12,256 = 74% of values), while one quarter were *biocentric* (4,396 = 26%). Accounting for multiple values added at each point, of the 4,495 points added, 2,287 (51%

of points) were identified as being of only *anthropocentric* value, 70 (2%) were identified as being of only *biocentric* value, and 2,138 (47%) points were identified as being of both *anthropocentric* and *biocentric* value.

Mapping value hotspots demonstrated remarkable spatial variation between *anthropocentric* and *biocentric* hotspots (Fig. 6 and 7). While *anthropocentric* values were commonly identified near Auckland city in the south west of the HGMP, *biocentric* values were most commonly identified on offshore islands. *Biocentric* hotspots were typically located at several existing terrestrial conservation or restoration projects, including Te Huaturu-o-Toi (Little Barrier Island), Tiritiri Matangi Island, Miranda Shorebird Centre, and the Rangitoto and Motutapu Islands restoration project. Cape Rodney-Okakari Point Marine Reserve was also identified as a *biocentric* hotspot within the HGMP.

As expected, a*nthropocentric-biocentric* hotspots showed substantial overlap with *anthropocentric* and *biocentric* hotspots, while also identifying several new areas identified as important for both *anthropocentric* and *biocentric* values (Figures 6 to 8). The spatial variation between *anthropocentric* and *biocentric* hotspots identifies different areas valued by the public for *anthropocentric* or *biocentric* reasons across the HGMP. The areas identified as *anthropocentric-biocentric* hotspots highlight areas valued by the public for both *anthropocentric* and *biocentric* reasons.
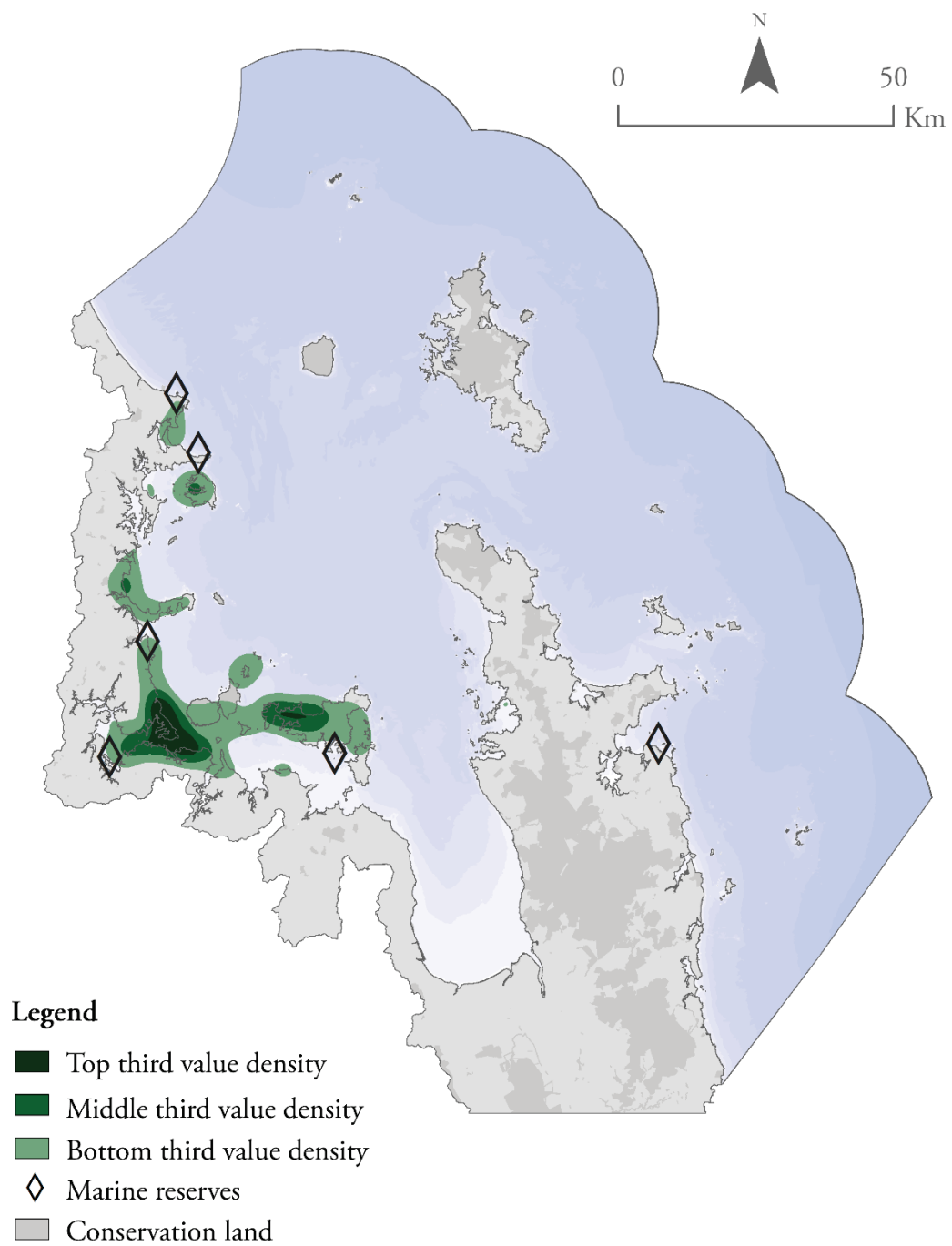
Figure 6. Anthropocentric value hotspots
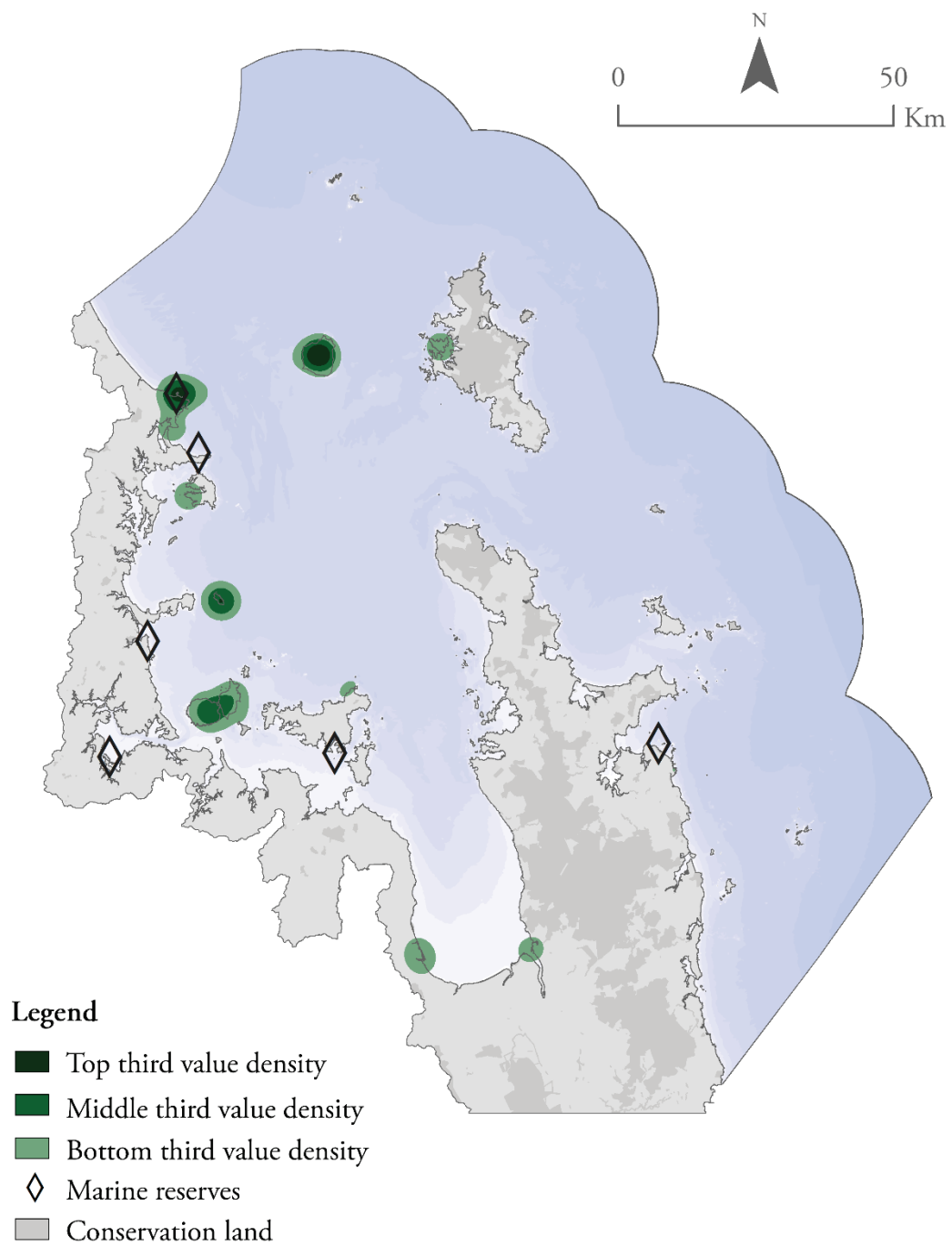
Figure 7. Biocentric value hotspots
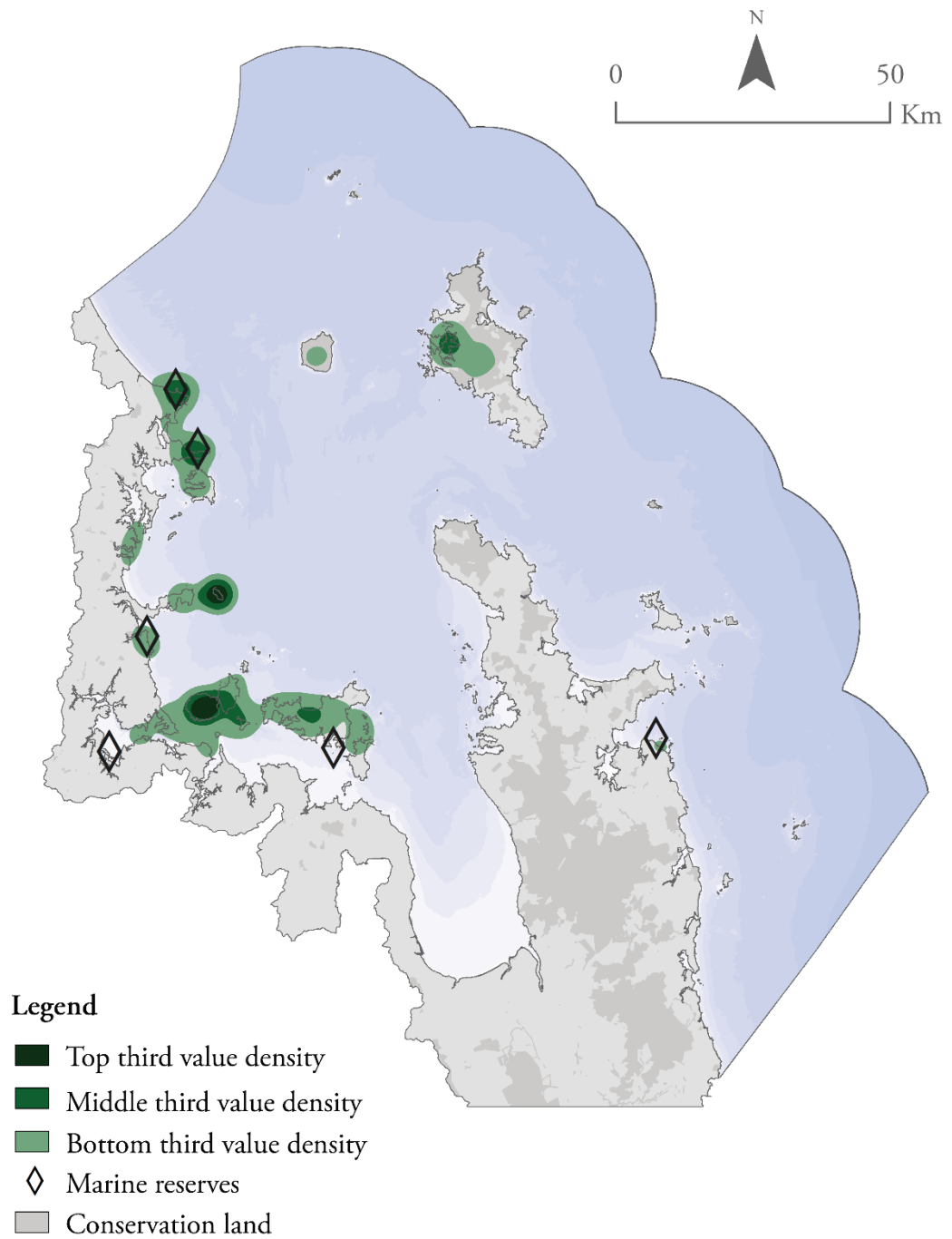
Figure 8. Anthropocentric-biocentric value hotspots

5.4.2   Comparison to other information and features

The number of visits and distance from marine reserves, conservation land, and residential areas, were all significantly different across *anthropocentric*, *biocentric* and *anthropocentric-biocentric* value orientations (Table 4). The number of visits estimated was significantly different between the three value orientations. Areas identified for *anthropocentric* value were visited most often (34 days per year), followed by *anthropocentric-biocentric* locations (29 days), and finally *biocentric* locations (7 days). The distance from conservation land was significantly different among all three value orientations (Table 4 and 5). *Biocentric* locations identified closest to conservation land (1.6 km), followed by *anthropocentric-biocentric* locations (1.7 km), with *anthropocentric* locations furthest from conservation land (1.9 km). Locations identified for *anthropocentric* value were significantly closer to marine reserves (12.9 km) than *anthropocentric-biocentric* locations (17.0 km) and *biocentric* locations (19.0 km). Distance from residential areas was significantly different between all three value orientations, with *anthropocentric* locations identified closest to residential areas (4.6 km), followed by *anthropocentric-biocentric* locations (11.0 km), and *biocentric* locations (14.2 km).

Table 4. Profile of locations identified as anthropocentric, anthropocentric-biocentric and biocentric value: mean (confidence interval) for value orientations, response range, and Kruskal Wallis one-way analysis of variance test statistic (*p<0.001).

		Anthropocentric	Anthropocentric-biocentric	Biocentric	Range	
Visits (days)	Visits in past year	33.58 (3.17)	29.36 (3.30)	7.10 (4.15)	0 to 365	$X^2 = 92.58^*$
Distance to features (km)	Conservation land	1.89 (0.08)	1.67 (0.10)	1.61 (0.70)	0 to 20.33	$X^2 = 100.49^*$
	Marine reserves	12.93 (0.46)	17.00 (0.65)	19.01 (3.53)	0 to 66.38	$X^2 = 60.81^*$
	Residential areas	4.56 (0.38)	10.99 (0.67)	14.17 (3.51)	0 to 66.65	$X^2 = 445.58^*$

Table 5. Pairwise comparisons between value orientations: p-values reported from pairwise Wilcoxon rank sum tests.

		Visits in past year	Distance to conservation land	Distance to marine reserves	Distance to residential areas
Anthropocentric	Anthropocentric-biocentric	<0.001	<0.001	<0.001	<0.001
Anthropocentric	Biocentric	<0.001	<0.001	<0.001	<0.001
Anthropocentric-biocentric	Biocentric	<0.01	<0.05	0.38	<0.01

5.5 Discussion

5.5.1 Anthropocentric areas

Anthropocentric areas were identified closest to residential areas, highlighting *anthropocentric* hotspots around Auckland city. However, areas identified for *anthropocentric* value were also within several kilometres of conservation land. While conservation land near residential areas is smaller and more fragmented than land further from the city, it may also be of value to those who live nearby. Further, high densities of *anthropocentric* values in residential areas such as Auckland city may also reflect the value of urban green space to local residents. Around half of the points added were identified for *anthropocentric* value, highlighting the importance of "nature for people" to participants. Conservation planning in the HGMP has tended to focus on *biocentric* communication strategies in the past, and it is important that planners also take *anthropocentric* values into account. A more traditional *biocentric* approach may not be as effective in areas identified for *anthropocentric* value, while conservation efforts aligned to *anthropocentric* values will increase the likelihood of public support in these areas and, consequently, conservation success (Bengston, 1994; Ives & Kendal, 2014).

Conservation efforts and communication strategies in areas identified for *anthropocentric* value may consider the ecosystem services important to people in these areas, with environment quality and access key priorities. Access to conservation land and urban green space has been shown to enhance human wellbeing (Fuller, Irvine, Devine-Wright, Warren, & Gaston, 2007; Maas, Verheij, Groenewegen, de Vries, & Spreeuwenberg, 2006), and may play an important role in enhancing broader environmental attitudes while connecting people to nature (Brown et al., 2015). At a regional scale, it is important to include *anthropocentric* values and broaden more traditional *biocentric* conservation communication strategies to include framing conservation as "nature for people" as well as "nature for itself" (Mace, 2014).

5.5.2   Biocentric areas

Biocentric hotspots were identified at existing conservation and restoration projects on offshore islands, and the Cape Rodney-Okakari Point Marine Reserve. While the environmental health of the HGMP has been described as in decline at a regional scale, these projects have often been as identified as conservation successes. The projects focus on native and threatened species management and the development of wildlife sanctuaries. Members of the public can volunteer to reforest several of the islands for a day at a time, accessing the island on a day return ticket via ferry. Established as a wildlife sanctuary in 1895, Te Huaturu-o-Toi (Little Barrier Island) has been described as the most intact native ecosystem in New Zealand and an invaluable refuge for endangered species (Department of Conservation, 2015). Despite visits being strictly regulated, the island was identified as a *biocentric* hotspot in this survey.

The *biocentric* values identified by participants suggest *biocentric* conservation efforts and communication strategies focused on "nature for itself" have worked well in these areas to garner social support and conservation success. However, further work is required to understand whether the *biocentric* values added to the map reflect the personal value of these areas to survey participants, or whether the participant is expressing knowledge about these areas being important for conservation regardless of their own personal value (e.g., Brown et al. 2015). In contrast, no *biocentric* hotspots were identified by participants on the Coromandel Peninsula, despite there being relatively large areas of conservation land towards the centre and south of the HGMP. Areas identified for *biocentric* values were the most distant from residential areas, and it would be interesting for further work to identify if the accessibility of the Coromandel Peninsula limits the identification of *biocentric* values such as wilderness. Future strategies may focus greater efforts on conservation land in areas of the HGMP that were not identified for *biocentric* value in this survey to increase public awareness and conservation action in these areas. Understanding whether *biocentric* values added to the map reflect personal values, or external knowledge about existing conservation projects, will be important for planners to understand the effectiveness of previous conservation efforts and communication strategies.

While there are six marine reserves in the HGMP, only one was identified as a *biocentric* hotspot. Cape Rodney-Okakari Point Marine Reserve was the first reserve established in New Zealand in 1975 and is recognised as a conservation success due to the diversity and abundance of fish now present within the reserve. More than 200,000 visitors visit the reserve each year, and it is a popular place for people to snorkel and scuba-dive (Enderby & Enderby, 2006). In contrast, the other five reserves in the HGMP were established between 1993 and 2011, with the majority of visitors staying on the beach above the water. These results suggest underwater experiences of successful marine conservation may help foster greater *biocentric* values for marine reserves, and it would be important to explore this further at each site.

5.5.3 Anthropocentric-biocentric areas

While only 2 per cent of points added were identified for *biocentric* value, half were identified for *anthropocentric* value, and around half identified as *anthropocentric-biocentric* value. The prevalence of *anthropocentric-biocentric* areas identified by participants emphasises the importance of accounting for place-based value diversity in these areas, and more broadly across the spatial plan.

Mapping value densities identified Cape Rodney-Okakari Point Marine Reserve and Tāwharanui Marine Reserve as having some clustered *anthropocentric-biocentric* value. However, four of the marine reserves had little or no value point density across the three value orientations. Average point distances from marine reserves were between 12.9 and 19.0 km across value orientations, suggesting that while some points clustered at marine reserves, the majority of points were elsewhere. Considering one of the goals of the marine spatial plan is to identify additional areas for marine protection, it will be a key priority for planners to expand participatory processes to better understand how the public view and value marine reserves. If marine reserves are not seen as a value or priority in the HGMP, social support for the allocation of additional protected areas may be limited. By developing an *anthropocentric-biocentric* communication strategy at marine reserves, planners and

conservationists can better understand how these areas may be viewed for both the benefit of marine biodiversity underwater and the people who visit these areas.

Anthropocentric-biocentric areas may benefit from conservation strategies developed through a social-ecological systems framework to develop better outcomes for people and nature (e.g., Ban et al., 2013; Ostrom, 2009). Place-based conservation in these areas, and broader conservation communications at a regional scale, risk conflict where they focus on one value orientation alone (Bengston, 1994), potentially marginalising those with different values (Hunter et al., 2014). It is important to remember that *biocentric* and *anthropocentric* values can be seen as complimentary, with planners, conservationists and the public sitting at different points across the spectrum.

5.5.4   Voluntary geographic information systems

The main limitation of VGI is that crowdsourced voluntary data cannot be generalised to the broader public. Brown and Kyttä (2014) caution that VGI may provide a means for interest groups to bias the results in their favour. However, studies have also suggested a bias toward *biocentric* conservation and preservation values in voluntary data that was not observed in this study (e.g., Brown et al., 2015). It is likely that the motivations of a voluntary sample would be different to those of a random household sample and it would be interesting to compare these approaches. It would also be useful for future surveys to ask how participants had heard of the opportunity to participate to determine different levels of recruitment through print, online, and news media.

While acknowledging the limitations of a VGI approach, a recent study investigating the use of crowdsourced data in planning questions how accurate and complete VGI data must be to be useful (Brown et al., 2015). VGI can also be used to fulfil multiple planning objectives, including raising stakeholder awareness and engagement in the planning process, while encouraging trust, cooperation, and compliance (Brown et al., 2015). By using VGI data to identify social values in the early stages of the spatial plan, place-based communication and conservation strategies can be developed that are aligned to diverse

conservation values. While there are limitations to VGI, the survey process could be seen as one tool in the participatory toolbox. Voluntary data are well suited for scoping spatial information in the initial steps of planning, and can be used to inform broader participatory processes (Brown & Kyttä, 2014).

This survey was one of the first of its kind requiring participants to first identify areas important to them, before identifying as many values as they felt adequately represented that location. While a novel approach to geospatial participatory data collection, this method allowed us to identify multiple values each location for analysis and collect further information on local knowledge and the number of times the survey participant had visited that location. Comparing differences in this data between different value orientations provided useful insight that can be used to inform further participatory processes and develop value-relevant place-based conservation and communication strategies. By encouraging participants to first identify areas important to them before identifying values I was able to account for value diversity across *anthropocentric, biocentric* and *anthropocentric-biocentric* value orientations at each point.

While *anthropocentric* values being identified closer to residential areas and *biocentric* values being identified at existing conservation projects may not be novel, areas not identified will likely be of most use to planners. Although there are large areas of conservation land in the Coromandel, these areas were not identified across any value orientation. Despite one of the key priorities of the marine spatial plan including the identification of additional areas for marine protection, value hotspots were not identified at several existing reserves. Further work to identify why these areas were not valued, and how values and social support may be encouraged, will be of great use to planners.

5.6 Conclusion

This study provided a means for collecting participatory data useful for spatial planning while providing answers to our six research questions. The study demonstrated how voluntary geographic information systems (VGI) can be used to identify areas important

for *anthropocentric* and *biocentric* values across a spatial planning region, as long as the benefits and limitations of VGI are carefully considered and taken into account. VGI also identified areas important for *anthropocentric-biocentric* values where both value orientations were identified by survey participants. In addition, the number of visits and distance to marine reserves, conservation land, and residential areas varied across value orientations.

While crowdsourcing voluntary participation may limit the generalisation of results to the broader public, the data can still be useful for scoping the region in the initial stages of the planning cycle. This study demonstrated how VGI can be used to identify diverse conservation values to develop place-based conservation planning. The study highlighted how VGI can be a useful tool within the participatory toolbox, encouraging public awareness and engagement in broader participatory processes while providing spatial data on conservation values to inform spatial planning. By incorporating diverse conservation values in spatial planning, planners can broaden social support for different place-based conservation actions, while also developing multiple pathways to conservation success (Game et al., 2014; Mace, 2014; Tallis & Lubchenco, 2014).

Chapter 6

Citizen science

In this chapter, I will assess the role of citizen science in conservation planning to achieve my fourth research objective:

Objective 4:   Evaluate the role of citizen science in conservation planning

To achieve this objective I will investigate the role of citizen science in conservation planning. I find that citizen science can be used to collect fine-resolution environmental health observations across broad planning regions difficult to collect otherwise. I assess the role of citizen science as a broad scoping tool at the beginning of conservation planning processes. Data gaps can be filled through online citizen science while encouraging a supportive space to facilitate trust and learning in conservation processes. I also show that citizen science could be useful as a cost- and time-effective monitoring tool to encourage ongoing monitoring and evaluation. I demonstrate the role of spatially-referenced local knowledge to facilitate knowledge exchange between planners and citizens, while also informing planning processes. I recommend that citizen science could be used to determine citizen concerns and priorities in the spatial planning region. I note that citizen science can fulfil multiple social and ecological objectives beyond data collection through increased environmental awareness, education, recreation, knowledge, and discovering unexpected information and events. I therefore recommend that planning processes intregrate citizen science to better link local knowledge, research, planning and action.

A version of this chapter has been published as Jarvis R. M., Bollard Breen, B., Krägeloh, C.U., & Billington, D.R. (2015). Citizen science and the power of public participation in marine spatial planning. *Marine Policy, 57*, 21-26.

6.1 Abstract

Systematic conservation planning is becoming increasingly used in the sustainable management of marine and coastal ecosystems. However, limitations on time and resources often restrict the data available for conservation planning, and limit public engagement and participation in the planning process. While citizen science is being increasingly used to provide fine-resolution environmental data across large terrestrial planning areas, there has been little uptake in marine systems or conservation planning to date. This paper demonstrates how consistent citizen observations can be used to identify hotspots of *good* and *poor* environmental health across a planning region, and where environmental health has *improved* or *degraded* in the past five years; information that is difficult to obtain by other means. The study demonstrates how citizen science provides valuable insight into environmental health across a conservation planning region, while fostering a supportive space for the public to contribute their own observations and participate in the planning process.

6.2 Introduction

Marine actors are an important source of information on local environmental conditions, and their involvement is thus considered crucial for the effective planning and implementation (Shucksmith & Kelly, 2014). However, while it is common for conservation processes to advocate stakeholder engagement, many resort to a top-down, or deficit model, of consultation. Few conservation processes encourage participation through two-way knowledge exchange, and new methods are needed to account for different types of local knowledge (Voyer, Gladstone, & Goodall, 2015). As a result, there has been a recent call to rethink conservation processes to encourage public participation and incorporate local environmental knowledge (Caldow et al., 2015; Sbrocchi, 2014; Shucksmith et al., 2014; Shucksmith & Kelly, 2014).

Citizen science is becoming increasingly prevalent in terrestrial monitoring programs, with voluntary observations from the public used to inform academic and environmental

research (Tulloch et al., 2013). Citizen science engages millions of people around the world, contributing valuable information that can be used by researchers, practitioners, planners and the public (Bonney et al., 2014). However, despite its successes, citizen science is not widely accepted as a valid scientific method due to concerns about data quality (Bonney et al., 2014; Sbrocchi, 2014). Much of this scepticism relates to potential biases in survey effort, errors in records, issues of scale, and inconsistencies over time (Tulloch et al., 2013). To counter these issues, new technologies are being developed to improve data collection, management, and quality control (Newman et al., 2012). For example, a new statistical technique has been developed to identify signals of change in noisy ecological data collected by citizen scientists (Isaac, van Strien, August, de Zeeuw, & Roy, 2014). Studies have demonstrated that data collected by citizen scientists can be of equal quality to data collected by experienced researchers, provided that citizen scientists are given proper training and appropriate protocols are used (Danielsen et al., 2014; Szabo, Fuller, & Possingham, 2012). As a consequence, environmental agencies are increasingly using citizen science to overcome limitations of time and resources for data collection (Dickinson et al., 2010). By crowdsourcing data collection, citizen science can provide fine-resolution environmental information over large geographic regions that would be difficult to achieve otherwise (Tulloch et al., 2013).

Citizen science also provides additional benefits beyond the collection of ecological data. Citizen science broadens engagement and inclusion in ecological research while building a cooperative space for planners, practitioners, researchers, and participants to work together (Newman et al., 2012). Incorporating diverse local knowledge provides a means to address community-driven questions (Bonney et al., 2014), and bridges management planning with local efforts and interests (Newman et al., 2012). Furthermore, citizen science has been described as a public good itself, as it increases the scientific knowledge held by the public while also promoting environmental stewardship (Cooper et al., 2007; Dickinson et al., 2012). A recent review regarding the full potential of citizen science identified eight benefits for nature conservation, including advantages for management, awareness, education, recreation, social and economic research, increasing ecological knowledge, improving methods of monitoring and evaluation, and discovering unexpected information

or events (Tulloch et al., 2013). As a result, citizen science provides key outcomes for science, for the individuals taking part, and for broader society (Sbrocchi, 2014). There may still be some issues of data quality in citizen science, but no dataset are perfect (Szabo et al., 2012), and arguably the positives outweigh the negatives (Tulloch et al., 2013). Consequently, many conservation agencies are increasingly turning to citizen science as a cost-effective method of collecting large environmental data sets while fulfilling multiple ecological and social objectives (Tulloch et al., 2013).

This chapter demonstrates how citizen science can also be used to provide fine-resolution environmental health data across large marine regions to inform conservation planning processes. The environmental health of the HGMP has been reported to have been in decline for a number of years (Hauraki Gulf Forum, 2011, 2014). However, limitations to time and resources have restricted the number of sites studied, and much of the data used in the reports has been collected at selected sites and extrapolated to a regional scale. As a consequence, these reports often describe declining environmental health across the entire planning region (Hauraki Gulf Forum, 2011, 2014). In this chapter I demonstrate how citizen science can be used to collect fine-resolution environmental health data across the entire planning region. In addition, I show that this citizen science can also be used to determine local trends in the HGMP through consistent citizen observations.

6.3 Methods

Citizen science data were collected at the end of the survey described in Chapter 5. At each point participants were asked to rate the health of the environment at that location (*very good, good, ok/average, poor, very poor*), and to identify how the health of the environment at that location had changed over the past five years (*improved, stayed the same, degraded*). Participants could also respond to indicate that they did not know how to rate the environmental health, or could not determine how the health had changed, at each location. The term 'environmental health' was used in this study as the term is commonly used by environmental and council agencies in New Zealand in their public

communication and engagement strategies, and so was considered a familiar term to the general public (Hauraki Gulf Forum, 2011, 2014).

Point data were mapped to provide fine-resolution data of current environmental health, and change in environmental health, across the HGMP. Environmental health data were coded as 1=*very good* and *good*, 2=*ok/average*, 3=*poor* and *very poor*, and change in environmental health was coded as 1=*improved*, 2=*stayed the same*, and 3=*degraded*. Points that were rated as 'I don't know' or 'could not determine' were excluded from the hotspot analyses. Hotspot analyses (ESRI, 2014a) were used to identify point data that were significantly correlated (p<0.05) around low and high values for each question. Heatmaps of correlated point data were produced using kernel density analyses (ESRI, 2014c) to visualise hotspots of consistently rated *good* or *poor*, and *improving* or *degrading*, environmental health. The heatmaps of *good* and *poor*, and *improved* and *degraded* hotspots were then converted to polygons. Intersect analyses were used to identify areas where polygons of *good* and *poor* health corresponded with polygons of *improved* and *degraded* health (ESRI, 2014b). Intersecting areas were reclassified as areas of *good* and *improved*, *good* but *degraded*, *poor* but *improved*, and *poor* and *degraded* environmental health.

Point data added to the maps by the public have been shown to accumulate between 3 and 6 km (Nielsen-Pincus, 2011), so a circular search radius and fixed distance band of 5 km were used for the analyses in this paper (as per Alessa et al., 2008; Brown & Donovan, 2014). Kernel densities are influenced by the number of points added, so density analyses were standardised by subtracting the mean grid density and dividing by the grid standard deviation (as per Brown & Weber 2013; Brown & Donovan 2014). Kernel densities were plotted in 3 equal interval bands (top third, middle third and bottom third value density) for the hotspot heatmaps, where standardised kernel density was greater than zero. Point density grids were determined with a 20m grid cell size, and all analyses were performed in ArcGIS 10.2.2 (ESRI, 2011).

6.4 Results

Of the 4495 points dropped on the spatial map by participants, environmental health was rated at 4281 points (95% of total points), and change in health over the past five years was rated at 3383 points (75%). Environmental health was rated *very good* at 1248 points (28% of total points), *good* at 1734 points (39%), *ok/average* at 1012 points (23%), *poor* at 235 points (5%) and *very poor* at 52 points (1%). Point data show that environmental health was rated *good* or *very good* across most of the region, while most points rated *poor* or v*ery poor* were located around the south west coast (Figure 9a). Hotspots confirm health was consistently rated as *poor* in the south west and several other areas around the south coast of the planning region, also demonstrating many coastal areas and offshore islands that were consistently rated as having *good* environmental health (Figure 9b). Three marine reserves were shown to be within the *good* environmental health hotspots, one reserve was in *poor* environmental health, and two reserves were outside either *good* or *poor* hotspots.
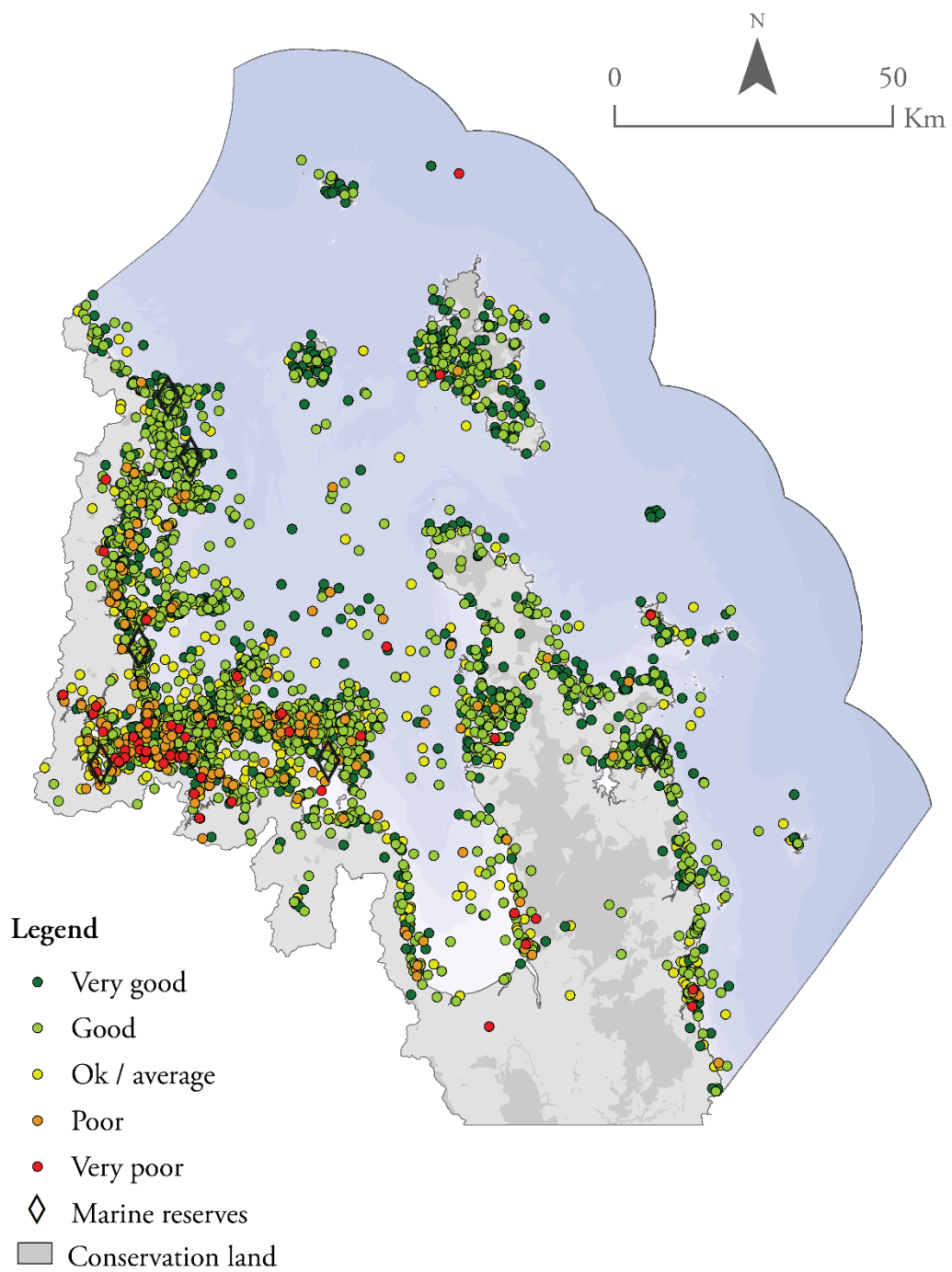
Figure 9a. Point data for environmental health (very good, good, ok/ average, poor, very poor).
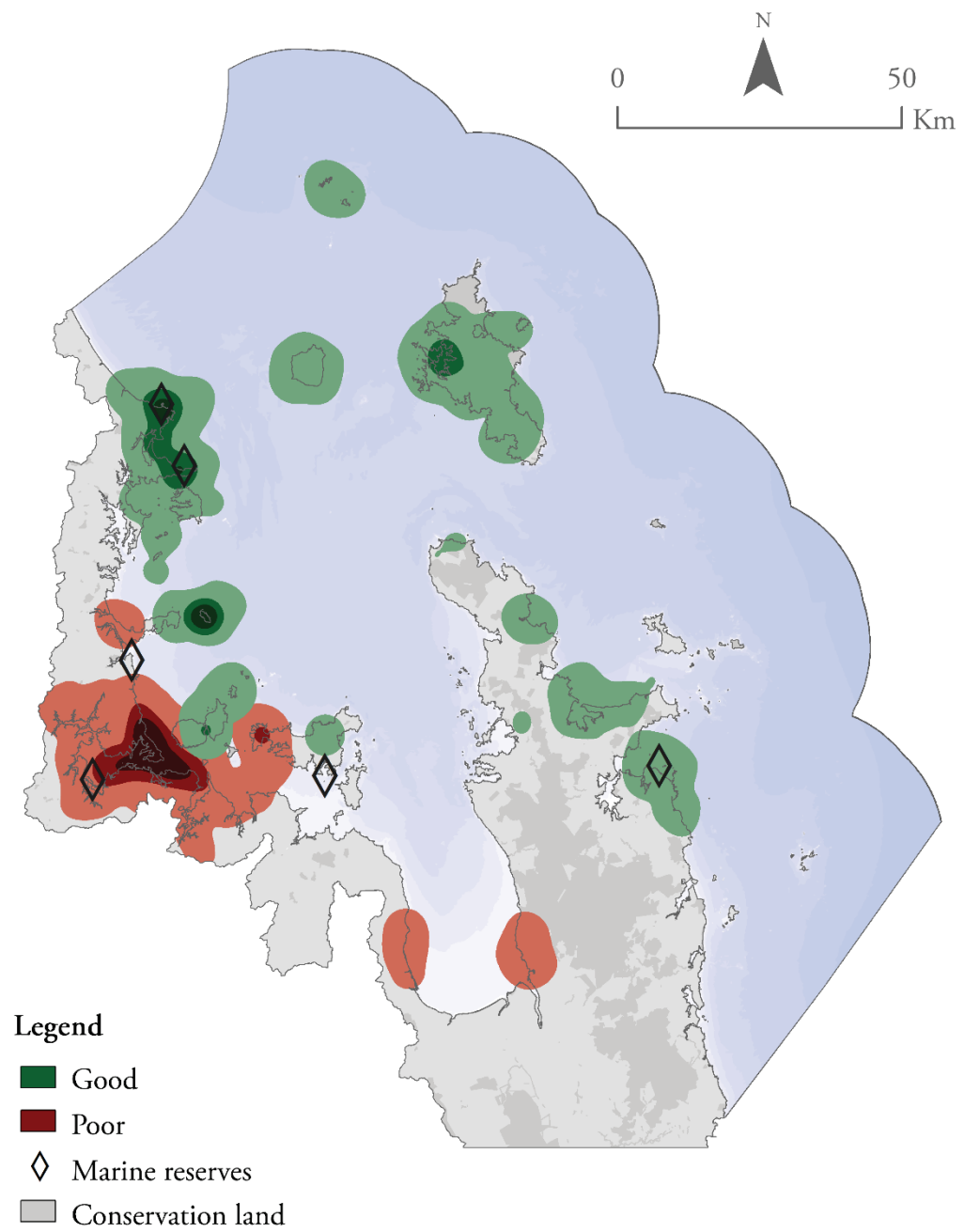
Figure 9b. Hotspots of good and poor environmental health.
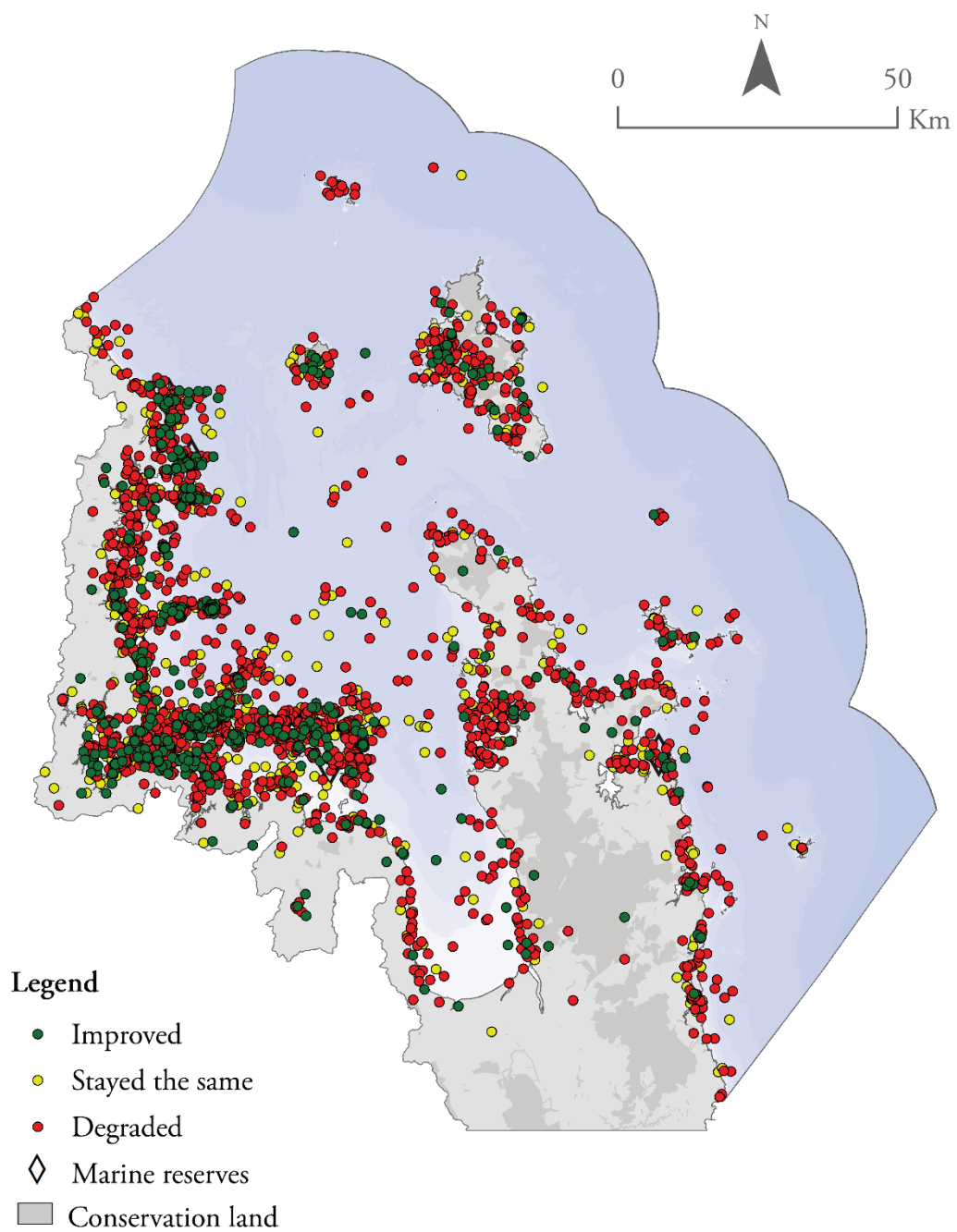
Figure 10a. Point data for change in environmental health over the past five years (improved, stayed the same, degraded).
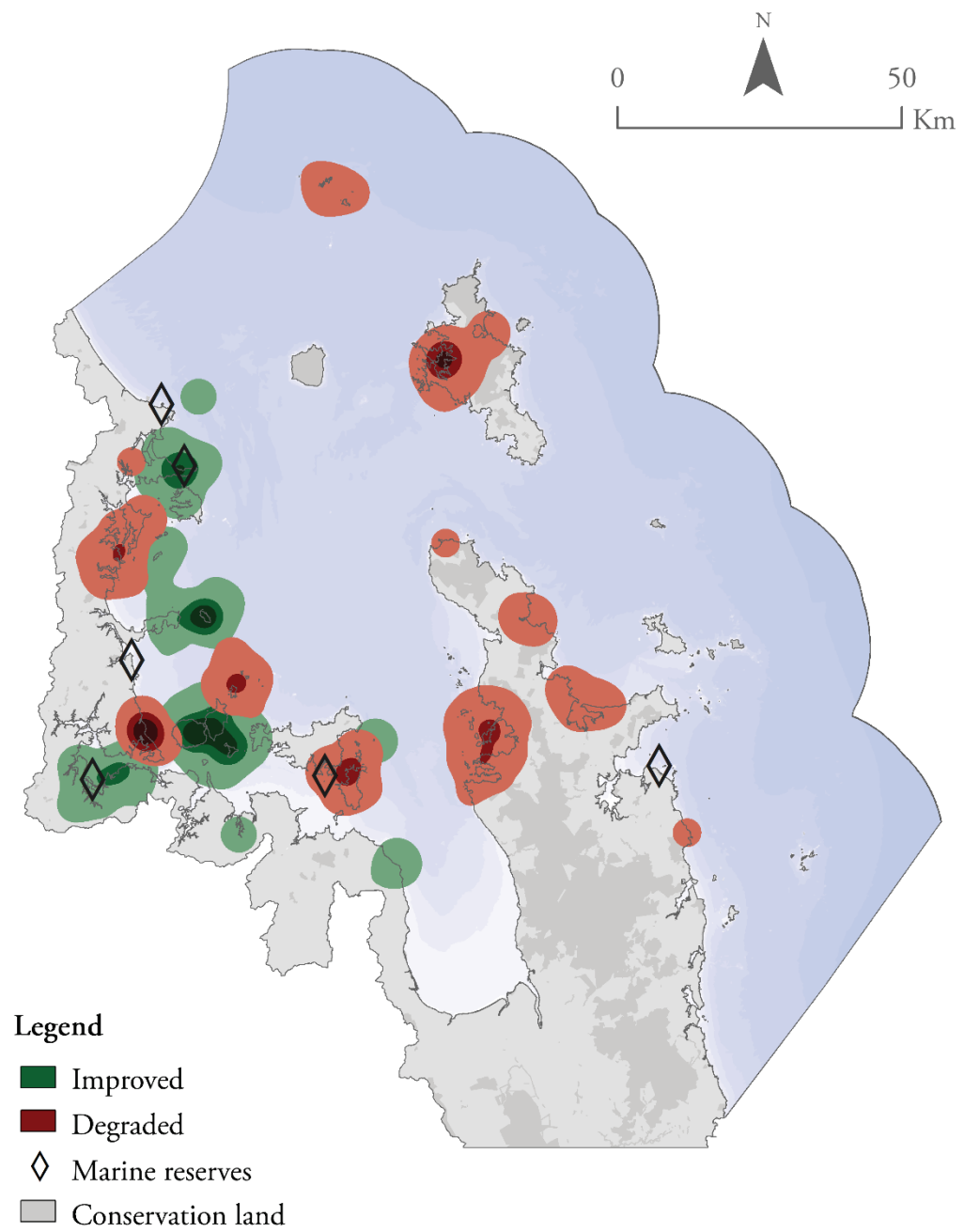
Figure 10b. Hotspots of improved and degraded environmental health.

Legend

- Improved
- Degraded
- ◇ Marine reserves
- Conservation land

Change in environmental health in the past five years was rated as *improved* at 553 points (12% of total responses), *stayed the same* at 720 points (16%), and *degraded* at 2110 points (47%) (Figure 10a). Hotspots confirmed environmental health was consistently rated as having *degraded* over the past five years at several areas around the coast and offshore islands, while other sections of coast and islands were consistently rated as having *improved* environmental health over the past five years (Figure 10b). Two marine reserves were within the *improved* environmental health hotspots, one was within the *degraded* health hotspots, and three reserves were outside the *improved* or *degraded* hotspots.

Overlaying *good* and *poor* hotspots (Figure 9b) with *improved* and *degraded* hotspots (Figure 10b) identified where these hotspots corresponded. Intersect analyses identified areas around the west coast and several offshore islands that were in *good* environmental health and had *improved* over the past five years, and areas on the east and west coast and offshore islands that were in *good* environmental health but had *degraded* over the past five years (Figure 11). The analyses also identified areas that were in *poor* environmental health and had *degraded* in the past five years on the south west coast of the planning region, surrounded by areas in *poor* environmental health that had improved. Combining the spatial analyses in this way identified trends in the data spatially consistent across citizen science observations. Of the six marine reserves in the HGMP, one was identified as having *good* and *improved* environmental health, one was identified as having *poor* but *improved* environmental health, and four marine reserves were identified as outside this trend data.
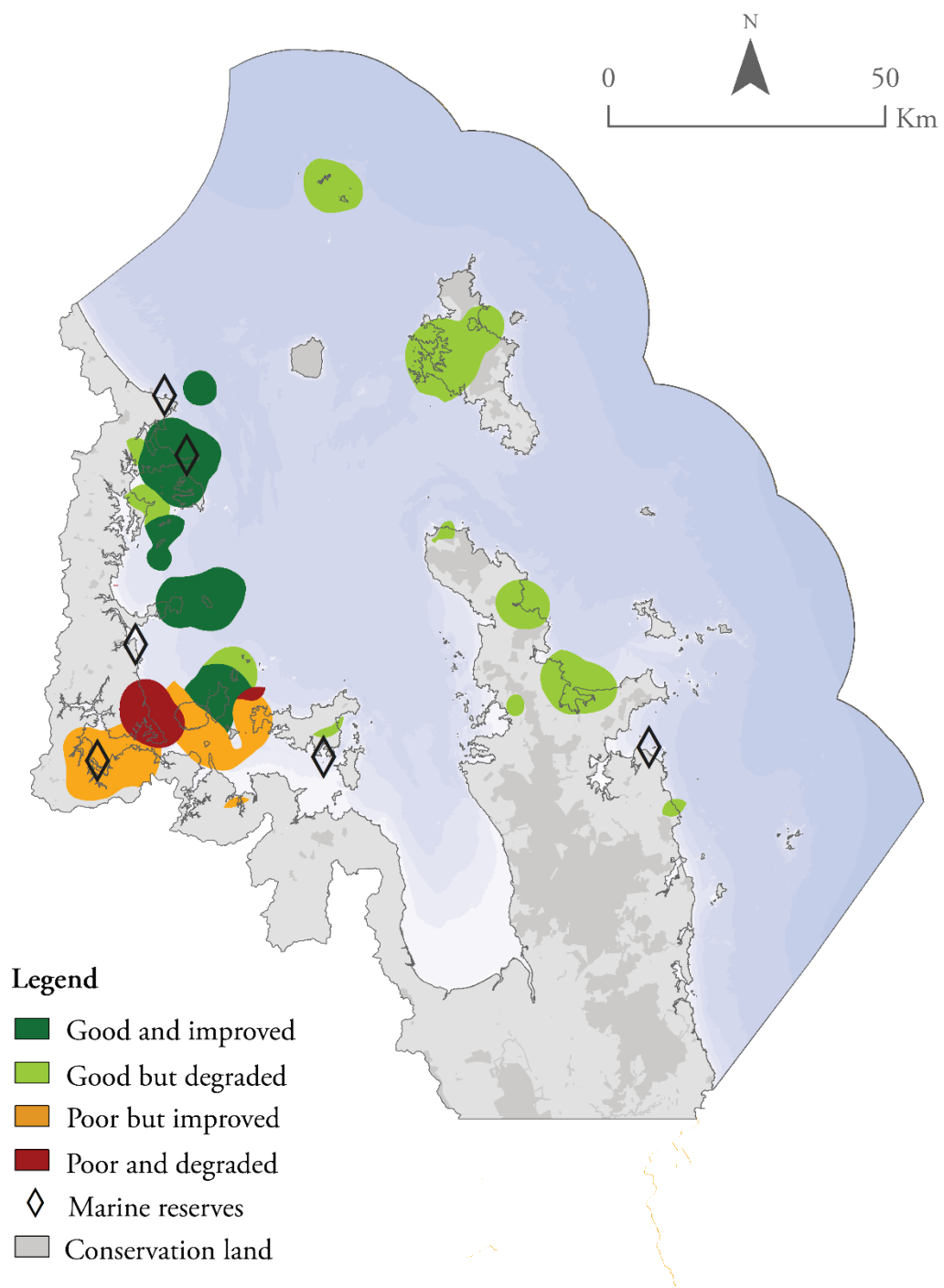
Figure 11. Areas of good and improved, good but degraded, poor but improved, and poor and degraded environmental health.

6.5 Discussion

In this chapter, I demonstrate how citizen science can be used to provide thousands of fine-resolution environmental observations on current and recent trends in environmental health across a planning region. The study also demonstrates how hotspot analyses can be used to determine areas rated similarly across citizen science observations to identify hotspots of *good* or *poor*, and *improved* or *degraded*, environmental health. By comparing hotspots of current and changing environmental health across consistent citizen science data, areas can be identified as being in *good* and *improved*, *good* but *degraded*, *poor* but *improving*, and *poor* and *degrading*, environmental health. By identifying statistically significant point data rated similarly by different respondents the study overcame potential limitations regarding variations in accuracy and data quality. Differences in survey effort were controlled for by standardising hotspot data so that the number of responses would not affect the hotspots identified by density analyses.

In particular, the survey demonstrated that the majority of the ratings of *poor* and *very poor* environmental health were located in the south west of the HGMP, around Auckland city. As the most heavily used and most populated area in the HGMP, these results may be unsurprising, but they do provide insight into areas the public feel need increased attention by planners. Combining current health data with change over the past five years suggested that some of the areas in and around Auckland have been *improving*. Understanding where areas have been *improving* is valuable for planners so that they can better understand what actions have been successful in the past. However, the results also indicate that increased efforts should be dedicated to these areas to improve environmental health around Auckland city, which, whether *improving* or *degrading*, was consistently rated to be an area of *poor* or *very poor* environmental health by the public. While reports have extrapolated environmental data in previous surveys to suggest environmental health is declining across the entire region, public observations suggest there are a number of areas also in *good* condition. Some of these locations are also *improving* and it may be useful for planners to communicate these areas as success stories in the HGMP, and investigate what actions may have led to successful management and *good* health to inform and improve

future planning actions. It is also important to note that a number of sites were rated *good* but *degrading*, and these sites will require more focused attention in the future to identify key threats and to mitigate against decline.

Interestingly, Tāwharanui Marine Reserve was the only reserve of the six in the HGMP that was collectively identified as being in *good* and *improving* environmental health. While Cape Rodney-Okakari Point and Te Whanganui-A-Hei marine reserves were observed to be in *good* environmental health, neither were identified as *improving* or *degrading*. Further work could clarify what actions or communication strategies at Tāwharanui have led to citizen observations to view the environment as continuing to improve. These lessons could then be applied more broadly at other marine reserves in the HGMP. In addition, Motu Manawa was observed to be in *poor* environmental health, while the marine reserve was also identified as *improving*. Clarification of successful actions in Motu Manawa could therefore be applied more broadly to other areas of *poor* health in the HGMP to improve environmental quality across the region. Long Bay-Okura marine reserve was not identified by either hotspot analysis, and further work is required to determine environmental health in this location. Notably, Te Matuku was identified as being in neither *good* nor *poor* environmental health, although the health was identified as *degrading*. Therefore urgent actions are required to identify threats contributing to the degrading environmental health on the ground so that this degredation can be mitigated. The results of this study suggest high variability in the environmental health across the six marine reserves of the HGMP. In addition, the study has identified *degrading* environmental health at Te Matuku which will require ground-truthing and further work to identify potential threats to the area. If *degrading* health is confirmed at this site, urgent action can be taken to mitigate this trend. Citizen science therefore provided important insight into the environmental health at the six marine reserves that can inform future research and management actions. In addition, long-term citizen science projects could be used to monitor the ongoing health in these areas, and any new protected areas identified.

However, several issues still need to be considered when using citizen science observations. As the point data covered most of the coast and offshore islands, any area not identified as a

hotspot in Figure 9b and Figure 10b was either given a consistently neutral rating (*ok/average* or *stayed the same*, respectively), or there was too much variability in the data to determine a consistent trend. This highlights a potential issue as the analyses do not allow us to distinguish between neutral ratings and data with high variability in these areas. This is particularly evident where several marine reserves were not identified in the hotspot or trend analysis despite having citizen observations at each location. However, this study only identified hotspots at a regional level and further research should be undertaken to unravel fine-resolution data within each marine reserve. It is important to note that the spatial accuracy of citizen data points may be an issue in this analysis due to the marine reserves being so small in comparison to the rest of the HGMP. Alternatively, specific citizen science projects could also be developed on site at each reserve to monitor trends in environmental health more directly. I therefore recommend further work to determine why citizen observations are so variable at the marine reserves that were not identified in this analysis. This work could include further analysis to identify whether environmental health at these sites was highly variable, potentially due to particular environmental events, or whether these reserves are seen as in neither *good* or *bad* health, nor *improving* or degrading. Moreover, it is also important to note that while hotspots identify areas of consistent ratings across citizen science observations, it is still unclear as to whether this reflects the health of the environment itself or public perceptions of the environment at these locations. For example, areas consistently rated as being in *good* or *improved* health by the public may be a reflection of the health of the environment or a result of positive public perceptions of local conservation efforts. Similarly, areas consistently rated as being in *poor* or *degraded* health may reflect the environment or may be negative public perceptions related to recent development proposals, or a damaging newspaper article or opinion piece.

Another limitation of citizen science is the potential bias of the participant sample, and it would be useful to compare the results of the study to a representative sample of the public. Underrepresented groups could then be targeted in future efforts to ensure public participation and local environmental knowledge is representative of the population. I recommend triangulating data from a range of sources including workshops and focus groups, qualitative fieldwork, media analysis, and a review of local events that may have

affected public opinion, to provide a greater understanding of the results of the study. It is also recommended that future research efforts sample across the region to compare observations of experienced researchers to the citizen science observations contributed by the public. While additional steps in the citizen science process, understanding whether consistent citizen observations represent local environmental health, or reflect a public response to social influences, local media, or communication strategies, will be of value to both planners and the public.

Despite the limitations identified in this study, I believe citizen science provided valuable insight on how the public view environmental health across the planning region. Citizen science provided fine-resolution environmental observations across the area that would be difficult to achieve by other methods, or the time and resource limitations faced by environmental agencies and planning organisations. Identifying hotspots of *good* and *poor*, and *improved* and *degraded*, environmental health across consistent citizen science observations provides valuable information for planners, researchers, practitioners and the public. Further, recognising where these hotspots overlap provides insight into trends beyond hotspot analysis, characterising areas rated as *good* and *improved, good* but *degraded, poor* but *improved,* and *poor* and *degraded* environmental health. Although citizen science data may receive scepticism over issues regarding data quality (Bonney et al., 2014; Tulloch et al., 2013), identifying hotspots across thousands of observations demonstrates consistent data in these areas. Coupling hotspots of current health with hotspots of how health has changed in the past five years demonstrates a method for determining trends across the planning region as defined by citizen science. Although analyses from thousands of observations are likely to be representative of environmental trends, further work is required to disentangle whether consistent public ratings are influenced by other social factors. If consistency is reflective of trends in environmental health, planners can use these data to target areas undergoing different trends to identify new threats to environmental health and monitor the effectiveness of different management actions. If consistency is also influenced by other social factors affecting how the public rates the environment in these areas, planners can use this information to determine the positive and negative influence of communication strategies, management actions, and public media. Where environmental

assessments may diverge from public assessments they still remain valuable in providing insight into unexpected information or events (Tulloch et al., 2013), and indirect influences of other environmental and social factors. Focusing future management efforts in areas where citizen observations match and diverge from environmental health will build trust, respect, and a collaborative working environment between managers and the public to better understand the HGMP. This study provides valuable data which can be used to develop a framework for more intensive research to better understand how environmental and social influences affect assessments of environmental health.

6.6   Conclusion

While increasingly used in terrestrial monitoring programs, there has been a lack of uptake of citizen science in marine conservation planning to date. By crowdsourcing data collection, citizen science provides fine-resolution environmental data across a marine planning region, overcoming the limitations of time and resources usually faced by decision makers and environmental agencies. Citizen science can also be used to enhance public participation in conservation planning by broadening engagement and inclusion in environmental research and monitoring. Hotspots identified across thousands of citizen science observations identified trends in environmental health that would be difficult to achieve by other methods. Understanding where environmental assessments converge or diverge from citizen science observations is of value to planners in the region, and to future research and management efforts. Further, incorporating diverse local environmental knowledge through public participation fulfils multiple ecological and social objectives of conservation planning and management. The study also contributed to developing a supportive and cooperative space for the public to become involved in research that contributes knowledge useful to the plan being developed in the region. By incorporating local knowledge into the plan, citizen science can make an important contribution to increasing awareness, inclusion, and management of the HGMP.

Chapter 7

Discussion

In this thesis, I aimed to develop a social research agenda for a social-ecological approach to conservation planning. To achieve this aim, I had four research objectives:

Objective 1:   *Identify the implementation gap and the role of knowledge exchange in achieving conservation outcomes*

Objective 2:   *Understand conservation governance in a complex multi-actor, multi-priority, multi-scale seascape*

Objective 3:   *Understand conservation actors across diverse values to identify place-based conservation opportunity*

Objective 4:   *Evaluate the role of citizen science in conservation planning*

In this chapter, I review the main findings of my thesis, evaluate each objective, and highlight key challenges in understanding social complexity. I also provide a social research agenda for a social-ecological approach to conservation planning.

7.1 Summary of research contributions

This thesis addresses a critical gap in conservation science by defining a social research agenda for conservation planning processes. A social research agenda provides explicit guidance to conservation researchers, planners, and practitioners on how to undertake conservation planning from a social-ecological perspective. Social-ecological research is increasingly recognised as key for conservation planning that delivers outcomes on the ground (Ban et al., 2013; Cowling & Wilhelm-Rechmann, 2007; McGinnis & Ostrom, 2014). By identifying the enabling social conditions for feasible conservation action, a social research agenda can assist in developing a social-ecological approach to conservation planning. Characterising a social research agenda can therefore provide important insights to improve the effectiveness of social-ecological conservation.

In Chapter 3, I described and assessed the outcomes of a workshop bringing together conservation researchers and practitioners at the Society for Conservation Biology Oceania Conference in Fiji. Workshop participants identified five mismatches between conservation research and practice that contribute to the implementation gap in Oceania. The workshop highlighted the role of knowledge exchange in overcoming these mismatches, identifying seven ways to overcome the implementation gap in conservation. In addition, both researchers and practitioners emphasised the importance of considering conservation from a social-ecological perspective. Consequently, the study helped establish the context for developing a social research agenda for a social-ecological approach to conservation.

In Chapters 4 to 6, I undertook three studies to inform the development of a social research agenda. The social research agenda, and the research undertaken in these three chapters, were developed using the Hauraki Gulf Marine Park (HGMP), New Zealand, as a case study. Previous management plans in the HGMP have remained unimplemented due to the inadequate consideration of the social systems within which conservation is embedded. A new planning process, Sea Change—Tai Timu Tai Pari, was developed for the HGMP during my candidature to better account for these social systems to ensure the new conservation plan would be successfully implemented. My research was developed with the

support of Sea Change—Tai Timu Tai Pari. My results were used to better understand the social systems in the HGMP to inform the planning process. The final plan for the HGMP will be delivered by the end of 2016.

In Chapter 4, I mapped knowledge exchange in a complex conservation system using social network analysis. My study suggested that the conventional top-down structure of this governance system had limited the successful implementation of past management plans developed for the region. I highlighted how much of the conservation action undertaken in the region had been mainly implemented by local community-led groups and organisations on the periphery of the network. In addition, my study suggested that more successful governance could be developed by transitioning from a top-down to multi-scale approach. Multi-scale governance would identify productive links between organisations with similar priorities across scales, while better linking regional planning with local action. I concluded that multi-scale governance was required to shift the HGMP towards successful conservation outcomes.

In Chapter 5, I described a social survey developed using the online collaborative mapping tool, SeaSketch. The survey was crowdsourced through multiple online, news, and print media to increase participation rates while raising public awareness of the broader Sea Change—Tai Timu Tai Pari planning process. The survey provided spatially-referenced social data on citizen values across the HGMP. I showed that the collective spatial consensus of these values could be used to identify place-based conservation opportunities across the planning region. In addition, my study suggested that regional planning could incorporate diverse *anthropocentric* and *biocentric* conservation values by identifying different places valued for different reasons. The study demonstrated the importance of embracing diverse conservation values across the *anthropocentric-biocentric* spectrum to broaden participation and social support for conservation. I predicted that developing conservation actions relevant to different social values in different areas would enhance social support for these actions, and consequently, feasibility of implementation. I concluded that understanding how citizens value different areas across a planning region could reveal new and existing opportunities for feasible conservation action, and

consequently, increase the likelihood of conservation success. My study suggested that these place-based opportunities could be used to better link regional planning with local action to overcome the implementation gap in the HGMP.

In Chapter 6, I investigated the role of citizen science in conservation planning. I found that citizen science could be used to collect fine-resolution environmental health observations across broad planning regions difficult to collect otherwise. I assessed the role of citizen science as a broad scoping tool at the beginning of conservation planning processes. Data gaps can be filled through online citizen science while encouraging a supportive space to facilitate trust and learning in conservation processes. I also showed that citizen science could be useful as a cost- and time-effective monitoring tool to encourage ongoing monitoring and evaluation. I demonstrated the role of spatially-referenced local knowledge to facilitate knowledge exchange between planners and citizens, while also informing planning processes. I recommended that citizen science should be used to determine citizen concerns and priorities in the spatial planning region. I noted that citizen science can fulfil multiple social and ecological objectives beyond data collection through increased environmental awareness, education, recreation, knowledge, and discovering unexpected information and events (e.g., Tulloch et al., 2013). I therefore recommend that conservation planning processes also incorporate citizen science in planning to integrate local knowledge in planning and action.

7.2   Think process, not product

Objective 1:   Identify the implementation gap and the role of knowledge exchange in achieving conservation outcomes

Knowledge can transform how we think, make decisions, and act. However, the implementation gap has become a common phenomenon in conservation, whereby few conservation plans are implemented on the ground (Knight et al., 2008; Knight, Cowling, & Campbell, 2006). As a result, conservation research is expanding to deliver more and better conservation knowledge, while biodiversity loss and environmental degradation continue to accelerate around the world (Knight et al., 2008). Essentially, we are knowing

more while losing even more (e.g., White, Kates, & Burton, 2001). We must therefore enhance knowledge exchange to ensure research informs planning, and planning delivers action.

The systematic conservation planning framework was designed to be an adaptive and iterative process (Margules & Pressey, 2000; Pressey & Bottrill, 2009). However, despite being widely applied around the world, many of the eleven steps in the framework are ignored, overlooked, or oversimplified. As a result, planners typically focus on plan-making, and often deliver a prioritisation as the final product of conservation planning (Mills et al., 2015). While prioritisation is an integral part of the planning process, few prioritisations achieve conservation outcomes alone (Cowling et al., 2004). Indeed, planners will also need to identify the actions associated with these prioritisations (Brown et al., 2015; Game et al., 2013). Furthermore, for these actions to be feasible, conservation actors will need to be involved in planning from the outset. While incorporating iterative updates and revisions to planning processes can be intimidating, they are necessary to maximise the likelihood of successful conservation outcomes. To become adaptive, we must therefore shift the intellectual culture of planning towards an adaptive process, rather than focusing on improving the prioritisation alone (Grantham et al., 2010; Mills et al., 2015; Pressey et al., 2013).

In Chapter 3, I discussed the outcomes from a workshop bringing together conservation researchers and practitioners. Workshop participants identified how the implementation gap limits the effectiveness of research and practice in achieving conservation goals. I predicted that long-term knowledge exchange was critical for linking research and practice, and creating effective and adaptive conservation processes. For example, knowledge exchange could identify research opportunities that could directly inform and improve conservation practice. In addition, practitioners could increase their access and understanding of research through direct knowledge exchange with researchers. I note that knowledge exchange could be further improved by bringing researchers, practitioners, planners, and actors together to identify common goals in planning. I believe a process-based approach to conservation planning that enhances knowledge exchange is crucial to

overcoming the implementation gap and achieving our conservation goals. The likelihood of implementing adaptive planning increases with development of a shared understanding, the use of a prototyping approach, and engagement with actors at multiple levels (Mills et al., 2015). Therefore adaptive planning processes should integrate knowledge exchange opportunities from the outset to align research, planning, and practice.

Limitations

Explicitly incorporating iterative adaptation in conservation planning processes can be intimidating (Pressey et al., 2013). Conservation professionals often have little knowledge or experience linking research, planning, and action. In addition, I found that divergent institutional priorities can further limit knowledge exchange, even where researchers and practitioners are committed to aligning their work. Despite articulating mismatch and identifying recommendations for overcoming the implementation gap, both researchers and practitioners felt unsupported pursuing this type of work. Indeed, institutions do not often recognise that such activities are important, further reinforcing mismatches between research and practice, while undermining effective knowledge exchange and collaboration (Acheson, 2006; Briggs, 2006; Cvitanovic, Hobday, van Kerkhoff, & Marshall, 2015; Shanley & Lopez, 2009). As a consequence, researchers, planners, and practitioners often face institutional barriers that prevent knowledge exchange from occurring. I believe institutions need to rethink the criteria by which they measure success and allocate funding to foster effective knowledge exchange processes. Such processes are likely to be more effective where conservation professionals have the time and support to pursue activities that better align research, planning, and practice. Therefore, the main constraints to developing an adaptive conservation process are the institutional and governance contexts that do not support this type of work. While incorporating iterative updates and enhancing knowledge exchange processes can be intimidating, such actions are necessary to maximise the likelihood of achieving our conservation goals.

Future work

There is a need to enhance and facilitate knowledge exchange processes in conservation. However, successful knowledge exchange processes are understudied and not well understood. While knowledge exchange is a rapidly expanding area in conservation science (Cvitanovic et al., 2015), greater clarity is required on defining and facilitating effective knowledge exchange. Further work could explore different approaches to monitor and reflect on knowledge exchange throughout conservation planning. It would be of particular interest to understand how knowledge exchange can enhance planning processes and lead to successful conservation action. In addition, it would be useful to document how the involvement of actors in planning processes can influence knowledge exchange and planning outcomes. For example, regular workshops between researchers, practitioners, planners, and actors could be used to document how knowledge exchange influences outcomes in the stakeholder-driven Sea Change—Tai Timu Tai Pari planning process. Regular workshops could also be used to identify continued mismatches between knowledge and action, and determine new approaches for overcoming the implementation gap.

I recommend further work to explore how momentum can be maintained, and effectiveness monitored, after the Sea Change—Tai Timu Tai Pari plan is released later this year. A strategy for action will also be required to implement the released plan on the ground. In addition, monitoring and evaluation of these conservation actions will be required to ensure the plan remains adaptive and up-to-date. Therefore, further work could also be undertaken to identify and support adaptive planning processes, and reflect on institutional and governance settings that limit or facilitate successful conservation (e.g., Mills et al. 2015).

7.3   Understanding governance

Objective 2:   *Understand conservation governance in a complex multi-actor, multi-priority, multi-scale seascape*

The governance system is the decision-space where knowledge is produced, shared, and used, within which conservation planning is undertaken. Understanding conservation governance can therefore provide important insight into who makes conservation decisions, how knowledge is exchanged, who will implement these decisions, and who these decisions are likely to affect (Bennett, 2015). As such, governance research has expanded rapidly in recent years to provide important insights into broader social, institutional, and political processes that can constrain or facilitate successful conservation (Bennett & Dearden, 2014b; Bennett, 2015; Lockwood, 2010). By identifying the actors, organisations, and the patterns of the collaboration between them, SNA can provide valuable insights for improving conservation outcomes.

In Chapter 4, I mapped knowledge exchange between conservation organisations in a complex conservation system using a structurally explicit approach to SNA. The governance structure, and number of conservation organisations in the HGMP, was poorly understood. Therefore, the study provided important insights into the conservation system. Furthermore, my study suggested the conventional top-down structure of the governance system had limited the successful implementation of previous management plans. In contrast, many of the successful conservation actions in the HGMP had been local and community-led. Yet these local organisations were often located on the periphery of the governance system with few connections to other organisations and limited knowledge exchange. I recommended acknowledging and integrating these local organisations in conservation governance to improve conservation outcomes in the planning region. I suggested that more successful conservation governance could therefore be developed by transitioning from a top-down to a multi-scale approach. By identifying the productive and valuable links between organisations with similar priorities across scales, the system can develop multi-scale links that better connect regional planning and local action. Developing

an inclusive multi-scale governance is necessary for shifting the HGMP towards more successful conservation outcomes.

Furthermore, Chapter 4 demonstrated how a structurally explicit approach to SNA can provide important insights for improving conservation governance. For example, several studies have suggested that a strong core-periphery structure can enhance the likelihood of achieving successful conservation outcomes (e.g., Alexander, Armitage, & Charles, 2015), while others have suggested that such a structure may constrain effective collaborative management (e.g., Ernstson, Sörlin, & Elmqvist, 2009). Indeed, a core-periphery structure can both constrain and facilitate effective conservation processes depending on the context of the system (Diani, 2003; Ernstson et al., 2009). Yet the study in Chapter 4 demonstrated that the core-periphery structure of the governance system had been limiting the effectiveness of achieving successful conservation outcomes. Given the need to take context into account, a structurally explicit approach to SNA provides important insights on developing effective conservation planning and governance in complex systems. Such an approach is particularly important for understanding the complex multi-actor, multi-priority systems increasingly common in conservation.

Limitations

The study in Chapter 4 focused on network structure at an organisational level. I recommended that local organisations be better integrated in planning processes. However, local organisations only identify where collective action has already emerged from the system, and what conservation actions are already being undertaken. While it is important to integrate local organisations in planning and governance, it is also important to account for actors more broadly in the system. SNA is limited by how you bound the system, and the research in Chapter 4 was bounded to an organisational level. Recognising this limitation, in Chapters 5 and 6 I investigated how a crowdsourced survey could be used to identify conservation opportunities and citizen concerns.

As SNA research increases, it is important to note that conservation governance cannot be understood through a network lens alone. I used SNA to provide important insights into

the governance structure limiting the effective implementation of previous conservation plans. I recommended the network to link regional planning and local action by transitioning to multi-scale governance. However, I was unable to identify the specific links in the network that could shift the governance system to more successful conservation outcomes. SNA could be used to identify the links between organisations that would enhance network connectivity, improve network metrics, and shift the network towards a multi-scale structure. However, only using SNA to identify these links overlooks the social complexity of real-world relationships. For example, all cooperation carries a transaction cost where time and effort must be dedicated to building and maintaining a mutually productive relationship (Bode, Probert, Turner, Wilson, & Venter, 2011). This relationship will only be maintained if both parties build trust and are able to assist each other in reaching common goals. Therefore, identifying a specific connection to improve the network metrics or network structure is unlikely to account for the complexity of cooperation.

Nevertheless, SNA is useful for characterising the governance system, identifying organisations and actors, and understanding patterns of knowledge exchange. As such, SNA can provide valuable understanding of the governance system in the context of successful or unsuccessful conservation processes. However, to improve conservation governance in the HGMP, we must first improve conservation processes. Indeed, "good governance" has been shown to develop from conservation processes that include legitimacy, direction, performance, accountability, and active and fair engagement (Lockwood, 2010). Therefore, we need new conservation processes that incorporate actors and local organisations in a fair and legitimate way. While developing a conservation process that includes a wide range of actors is challenging, such an approach is necessary for achieving the conservation outcomes that are required. Crowdsourcing a social survey to identify place-based conservation opportunities and citizen concerns across a planning region could be one such approach.

Future work

Future work could focus on mapping how the governance system has changed over the Sea Change—Tai Timu Tai Pari process. The analysis in this paper identified the governance

system before the current planning process was initiated. By developing a stakeholder-driven planning approach, Sea Change—Tai Timu Tai Pari is likely to shift towards a multi-scale governance structure. For example, by identifying conservation opportunities and citizen concerns, planning can better link regional planning and local action. By developing an inclusive approach to conservation planning, Sea Change—Tai Timu Tai Pari can identify the productive links between organisations with similar priorities across scales. Furthermore, by integrating actors in the planning process conservation actions can be identified that are more likely to be implemented, increasing the likelihood of successful conservation action. Mapping how the governance system changes through the stakeholder-driven planning process could provide valuable insights as to how a top-down system transforms into more effective multi-level governance.

I propose that SNA research could further be developed to: (1) map the evolution of the network over time (e.g., Garcia-Amado et al., 2012); (2) explore fit between governance systems, ecological processes, and the conservation opportunities and citizen concerns identified in this thesis; (3) provide insights for coordinating effective governance processes across multiple jurisdictions (e.g., Treml, Fidelman, Kininmonth, Ekstrom, & Bodin, 2015); (4) combine the structurally explicit approach to SNA with qualitative interviews to determine how the governance structure has formed, and how it may successfully transition over time; and (5) apply SNA to existing protected areas to determine how well they are achieving the access and benefit sharing provisions of the CBD and their management effectiveness. I note that SNA is a valuable tool for providing important insights into conservation governance and the social factors that influence the effectiveness of conservation planning. In addition, I recommend that a structurally explicit approach to SNA be more broadly applied to better account for local and regional contexts in conservation governance.

Given the limited number of empirical examples, SNA could be used to identify the structure of governance systems already achieving their goals. Developing a portfolio of successful governance examples will address limitations in our knowledge and understanding of "good governance" in complex conservation systems. It is important to

note that there is no optimal network structure across all scenarios (Bodin & Crona, 2009), and successful governance will be context-specific (Alexander & Armitage, 2015). That said, a portfolio may provide the opportunity to identify common characteristics of successful governance using a structural network perspective. Extending this portfolio to include multi-scale examples in complex systems would be especially useful for characterising governance efficacy. In particular, in navigating the multi-scale links that effectively link regional planning and local action. Once this portfolio is available, modelling could be used to better explore the structure and function of successful governance across multiple case studies. For example, agent-based modelling could provide important insights into the effects of different network structures on achieving conservation outcomes in complex systems.

7.4   Understanding actors

Objective 3:   Understand conservation actors across diverse values to identify place-based conservation opportunity

Stakeholder engagement is widely acknowledged as key for conservation success. Involving stakeholders in planning can help identify common goals that are socially acceptable, increasing the feasibility of successful implementation. However, few conservation processes meaningfully engage or involve stakeholders. While "identify and involve stakeholders" is the second step of the eleven step systematic planning framework (Margules & Pressey, 2000; Pressey & Bottrill, 2009), this step is often overlooked or oversimplified. Instead, planning increasingly collects socio-economic data alongside biodiversity data as a proxy for stakeholder involvement. Where included, socio-economic data are often analysed as a cost or threat to conservation (Ban et al., 2013; Naidoo et al., 2006). As a result, the inclusion of socio-economic data often frames nature conservation as being pursued "despite people" (e.g., Mace, 2014). Inclusion of socio-economic data as a cost or threat will only identify conservation priorities at a distance from people, rather than identifying feasible opportunities across the planning region. These prioritisations are often delivered as the final planning outcomes.

Several studies are beginning to consider including social values data to identify conservation opportunities where action is more feasible (e.g., Ives et al., 2015; Mills et al., 2013; Tulloch, Tulloch, Evans, & Mills, 2014; Whitehead et al., 2014). These studies identify the enabling social conditions for conservation action, while developing biodiversity priorities that are socially acceptable and environmentally valuable. For example, Whitehead et al. (2014) identified socially acceptable conservation priorities that had biodiversity outcomes equivalent of using biodiversity data alone. By identifying socially acceptable and environmentally valuable priorities, conservation actions were more feasible to implement, therefore increasing the likelihood of achieving successful conservation outcomes.

Furthermore, I recommend expanding the definition of stakeholders to "actors", as in this thesis. There are many different definitions of stakeholders in planning, and where stakeholder involvement has been included, this involvement typically focuses on a small number of key stakeholder groups or individuals (Raymond, Kenter, Plieninger, Turner, & Alexander, 2014). By expanding the definition to actors, I broaden stakeholder involvement to include any individuals, groups, or organisations that are likely to affect, or be affected by conservation (Olsson et al., 2004, 2008; Österblom & Folke, 2013; Schultz et al., 2015). Actors, therefore, may also include local residents, citizens, and members of the public, as in this thesis. Similarly, we need to understand conservation opportunities across a wide set of diverse actors, rather than a few key stakeholders, if we are to enhance feasibility of conservation actions. I therefore recommend using this broader definition of actors where identifying the enabling social conditions for effective conservation planning.

In Chapter 5, I crowdsourced social values across the planning region. I identified conservation opportunities across the planning region. The data layers were delivered to Sea Change—Tai Timu Tai Pari for inclusion with over 60 other ecological and economic data layers for co-mapping projects within their online mapping tool. In addition, the maps were of interest for enhancing knowledge exchange between planners, practitioners, researchers, and actors while informing broader participatory processes in conservation planning. While I did not translate these opportunities into an implementation strategy

myself, I delivered these opportunities to Sea Change—Tai Timu Tai Pari to establish an implementation strategy with actors as part of their broader participation process. By scoping these opportunities in the initial stages of the planning process, subsequent versions of the plan can take better account of the enabling social factors that will enhance feasibility. My study suggested that these place-based opportunities could be used to better link regional planning with local action. I suggest the conservation opportunities identified in the social values study be considered a preliminary version of the plan, or prototype, in the scoping stage of the planning process (e.g., Mills et al., 2015). Prototypes can be updated as understanding improves and as more social, economic, and biodiversity data becomes available in later planning stages. For example, I provided the spatial social values data to inform the Sea Change—Tai Timu Tai Pari participation processes, while also ensuring the data were in the same format as other ecological and economic data for scenario mapping later in the planning process. In addition, a prototype approach has been identified as important for facilitative adaptive conservation planning processes (Mills et al., 2015; Pressey et al., 2013). Providing a planning prototype of place-based conservation opportunity early in the planning process can therefore provide direction for broader participation processes, and build social support for subsequent versions of the plan. Instead of predicting the distribution of conservation priorities through the integration of socio-economic and biodiversity data in later stages of the plan, planning tools can be used to drive collaboration with actors through the planning process and identify new conservation solutions (Game et al., 2011).

In this thesis, I expanded the characterisation of conservation opportunity to include opportunities across the *anthropocentric-biocentric* spectrum. I used spatially-referenced social values to identify a spatial consensus of place-based values in different areas of the planning region. I reasoned that different people value conservation for different reasons, and conservation debates about why we conserve have limited conservation progress (Tallis & Lubchenco, 2014). I suggested that *anthropocentric* conservation was likely to marginalise and alienate those with *biocentric* values, and vice versa. Instead, I called for conservation planning to include both *anthropocentric* and *biocentric* values in planning efforts. Participants identified *anthropocentric* and *biocentric* hotspots in different regions of the

plan where conservation communication strategies and action could be designed relevant to local values. I found that the majority of place-based values were both *anthropocentric* and *biocentric* so that conservation planning narratives would have to embrace "for nature", "for people", and "for nature and people" framings (e.g., Mace, 2014). Arguing about why we should conserve nature reduces complexity to a single dichotomy, limiting conservation progress. My finding implies local areas are likely to be valued for different reasons, and that regional planning can incorporate the whole *anthropocentric-biocentric* spectrum. I therefore recommend creating inclusive and diverse planning processes that welcome as many voices as possible. I highlight that more inclusive conservation is integral to identifying the actions we need to achieve our conservation goals. By expanding the characterisation of conservation opportunities across the *anthropocentric-biocentric* spectrum, conservation can move beyond restrictive and marginalising debates about why we conserve nature, to focus our efforts on *how* to conserve nature. By identifying different areas in the plan valued for different reasons, planners can develop multiple place-based implementation strategies relevant to diverse local values. I conclude that the values maps provided to Sea Change—Tai Timu Tai Pari could therefore be used to develop multiple place-based and context-relevant pathways to conservation success.

Limitations

There are two main limitations to the values maps produced in Chapter 5: (1) they only highlight conservation opportunities; and (2) they are not representative of the broader population. First, despite criticising other studies for delivering a map of priorities or opportunities without identifying conservation actions, Chapter 5 did just that. However, my study was not designed to be the final product of the planning process. My study was designed to develop additional social data layers to be incorporated back in to the SeaSketch planning tool to develop a plan and associated strategy for implementation. My study was designed to collect baseline social data for spatial planning, while increasing public awareness of the planning process. Social data were collected in the same format as over 60 other ecological and economic data layers being used in the planning process. I delivered my social data to Sea Change—Tai Timu Tai Pari so that interactive and online mapping, and the development of alternative planning scenarios in the subsequent

planning stages, would report social outcomes and feasibility along with economic and ecological outcomes. I also delivered these maps to the Stakeholder Working Group and Accessible Gulf Roundtable to inform broader public participation processes that were ongoing throughout the planning process. Developing the final plan, and identifying the associated conservation actions, is currently being undertaken by Sea Change—Tai Timu Tai Pari, and was therefore beyond the scope of this thesis.

In addition, the study was designed to increase knowledge exchange across diverse needs and values, while expanding the framings of conservation in the HGMP to include the entire *anthropocentric-biocentric* spectrum. Broad, unfocused workshops can be counter-productive to planning efforts (Knight et al., 2006). I therefore delivered the maps in Chapter 5 to Sea Change—Tai Timu Tai Pari to develop workshops contextual and relevant to the needs and values of actors in the HGMP. For example, a workshop can discuss a particular value hotspot identified on the map and work to identify place-based conservation actions aligned with local values and priorities. In doing so, I hoped to demonstrate that place-based opportunities could be used to foster meaningful collaboration aimed at better linking regional planning with local action to overcome the implementation gap in the HGMP. These value maps were not meant to be the final product of the planning process. Rather, I provided these maps to drive collaboration and knowledge exchange in subsequent meetings, focus groups, and broader participation processes being undertaken by Sea Change—Tai Timu Tai Pari.

Second, the crowdsourced nature of the survey meant that the results were not representative of the broader population. Given that response rates have been declining across all recruitment methods (Brown & Kyttä, 2014; Couper & Miller, 2008; Galea & Tracy, 2007), increasing participation rates has been identified as a key priority for all geospatial participation processes (Brown & Kyttä, 2014). As a consequence, discussions with planners led to the identification of crowdsourcing as the preferred survey approach. While results could not be generalised to the broader population, crowdsourcing did increase response rates to provide values data across the HGMP region. In addition, crowdsourcing the survey provided the opportunity to integrate citizen science into the

survey (as discussed in Chapter 6 and section 7.5 below). I could then use the data to identify hotspots of collective spatial consensus across different participants. I recommended that the data could be used to drive future knowledge exchange in workshops, and provide social insight combined with ecological and economic data in SeaSketch. The caveat was that while the data could drive understanding of social complexity, and facilitate actor and citizen involvement, the data were not a representative sample. I recommend that future knowledge exchange work could focus on where the survey results aligned or diverged from the values and priorities of underrepresented groups.

As a consequence, there was inadequate representation of Māori values and knowledge in the social data and resulting maps. The online survey may have been inappropriate, or the crowdsourced nature of the survey may have led to other demographics becoming dominant. For example, some cultural values and knowledge are distinctly aspatial or are difficult to translate into spatial data (Ban et al., 2013). Therefore, alternative participation approaches and focused workshops are still required to enhance knowledge exchange. Recognising the importance of mana whenua and mātauranga Māori in conservation planning, co-governance arrangements have already been established within Sea Change—Tai Timu Tai Pari (Hauraki Gulf Forum, 2014). There is also a specialist "Mātauranga Māori" roundtable, with representatives on the Stakeholder Working Group driving the planning process (Sea Change—Tai Timu Tai Pari, 2014a, 2014b).

Future work

Sea Change—Tai Timu Tai Pari now has over 60 ecological, economic, and social data layers in the online spatial planning tool, SeaSketch (Sea Change—Tai Timu Tai Pari, 2014a). Sketching tools within SeaSketch will enable different actors to draw and modify different planning zones for different management scenarios and their associated actions. The reporting tools of the SeaSketch software can then be used to analyse ecological integrity, human well-being, social values, and potential governance issues relating to different sketched zones and across prospective planning scenarios (SeaSketch, 2015). As such, SeaSketch provides a useful interactive tool for developing and communicating spatial ideas for the future management of the HGMP. However, little is known about the

potential of online co-mapping projects in enhancing knowledge exchange processes. As such, I would recommend evaluating the role of online co-mapping tools, such as SeaSketch, for enhancing knowledge exchange. For example, future work could analyse planning scenarios sketched by researchers, planners, practitioners, and actors in comparison to the final plan when it is released at the end of 2016, and in comparison to plans that were released in the past but were never implemented. In addition, I would also recommend investigating how enhanced knowledge exchange through online mapping processes may influence the likelihood of achieving ecological, economic, and social outcomes. Given the need for adaptive planning processes, I urge future work to evaluate how online co-mapping tools can be used to enhance monitoring and evaluation to deliver iterative planning updates.

In addition to providing social data for SeaSketch, I found my social values maps to be of direct interest to working groups and issues-based roundtables. Further work could evaluate the use of values maps, and identified conservation opportunities, for steering qualitative workshop environments. I believe the place-based opportunities identified by these maps could be used to drive contextual workshops relevant to local values. These workshops can focus on how representative these maps are of the broader population, encourage social learning, identify common goals, and develop a strategy for implementation. As such, I recommend comparing and evaluating the role of social values data in online mapping and workshop environments. In particular, evaluating the role of workshops in highlighting additional aspatial knowledge, values, and priorities that could not be captured by the spatial survey. Additional work will also be required to identify alternative approaches to enhance the participation for otherwise underrepresented groups. I conclude that, while further work is necessary, crowdsourcing social data in the early scoping stages of planning provides key social insights to guide broader participation processes. I predict crowdsourcing will become used much more frequently in planning processes as technology improves and the scope of online tools develops. I believe work of this kind can be used to demonstrate the value of understanding social complexity in the early stages of planning processes, and to inform subsequent planning priorities

Furthermore, I recommend exploring the potential role of a citizen jury in the HGMP. Citizen juries have recently begun to emerge in conservation, where a group of citizens are brought together to study conservation issues for a number of days, drawing upon witnesses and information from multiple points of view (Crosby & Hottinger, 2011). For example, a citizen jury for the management of Dogger Bank in the North Sea provided the opportunity for citizens to cross-question experts from research, fisheries, energy, and NGO perspectives (Delaney et al., 2013; Hattam, 2015). The goal of the workshop was not to reach consensus, but to facilitate a process in which different perspectives were shared, and potential conflicts and trade-offs discussed (Delaney et al., 2013). Further research would be required to understand how citizen juries could compliment other participatory approaches in the HGMP, such as focus groups and workshops. I recommend that future work could evaluate the role of a citizen jury in providing further direction to citizen participation, and in evaluating alternative planning scenarios in the later stages of planning processes.

7.5 Integrating citizen science

Objective 4: Evaluate the role of citizen science in conservation planning

This thesis has identified how citizen science can provide five key roles where it is integrated in conservation planning processes: (1) early scoping and integration of local knowledge; (2) democratising knowledge production; (3) enhancing knowledge exchange; (4) as a monitoring tool; and (5) as a social good.

First, I found that citizen science can provide fine-resolution environmental health data across broad planning regions difficult to achieve otherwise. In Chapter 6, I demonstrated how citizen science provided valuable insights to inform planning processes while developing a supportive space for citizens to contribute their own local knowledge. I investigated how consistent citizen science observations could be used to identify current and recent trends in environmental health across the planning region. I found that while environmental agencies were increasingly using citizen science to overcome limitations of time and resources for data collection, there had been little uptake in marine conservation

to date. Indeed, where citizen science has been used to underpin research, most have been terrestrial projects (Hyder, Townhill, Anderson, Delany, & Pinnegar, 2015), with only 14% undertaken in marine systems (Roy et al., 2012). My study suggested that citizen science could also be used to provide key insights for marine conservation planning efforts.

Second, I demonstrated that citizen science can be used to democratise knowledge production and enhance citizen participation in planning. While researchers are typically considered the knowledge producers in conventional planning processes, citizen science can be used to blur the lines around knowledge production, sharing, and use. I noted that much of the environmental data in the HGMP have been collected by conservation researchers at a restricted number of sites. In some cases, this restricted data had been extrapolated to a regional scale to predict environmental trends. I found that citizen science could provide fine-resolution data across the entire region while also providing regional scale insights. While the State of the Gulf reports suggest the health of the Gulf is broadly declining (Hauraki Gulf Forum, 2011, 2014), citizen science also identified places within the HGMP that were in good health or improving. I therefore recommend citizen science for broadly scoping environmental health data and conservation research for planning processes.

Third, citizen science may be key for facilitating knowledge exchange in conservation planning processes. Increasingly, citizen involvement is advocated as key for achieving future science and policy outcomes across disciplines and around the world (Bell, Pena, & Prem, 2013; Cundill, Roux, & Parker, 2015; Reed et al., 2014). As such, conservation is moving beyond disciplinary silos, and new transdisciplinary approaches are emerging to encourage citizen integration in planning processes. My study suggested that citizen science can provide an important means to integrate citizens and their local knowledge in planning. I concluded that spatially-referenced local knowledge may have an important role in facilitating knowledge exchange between science and society, while also informing planning processes.

Fourth, I noted that citizen science could provide additional benefits as a time- and cost-effective monitoring tool. Effective adaptive conservation planning requires planning,

122

implementation, monitoring, and evaluation (Plummer, 2009). However, few planning processes conduct monitoring or evaluation (Bottrill & Pressey, 2012). As such, few plans are implemented and many plans become rapidly out of date (Bottrill, Mills, Pressey, Game, & Groves, 2012; Knight, Cowling, Boshoff, Wilson, & Pierce, 2011). Further, without monitoring, planners will not be able to identify successful and unsuccessful conservation actions to improve further efforts. I believe citizen science could therefore provide a novel tool for ongoing monitoring to enhance adaptive processes.

Fifth, I found that citizen science could also be described as a social good (e.g., Dickinson et al., 2012). Citizen science can provide advantages for planning, while also increasing the scientific and environmental knowledge held by the public. In addition, citizen science can promote environmental stewardship, increase recreation, improve environmental and social research, improve methods of monitoring and evaluation, and discover unexpected information and events (Tulloch et al., 2013). My study also demonstrated the role in identifying citizen concerns, and integrating these concerns in planning. As such, citizen science provides key outcomes for science, for the individuals taking part, and for broader society (Sbrocchi, 2014).

While there are a number of issues around data quality in citizen science, no data are perfect (Szabo et al., 2012; Tulloch et al., 2013). In addition, a number of studies have demonstrated that citizen science can be of equal quality to data collected by experienced researchers (Danielsen et al., 2014; Szabo et al., 2012; Tulloch et al., 2013). Consequently, I believe the positives of integrating citizen science in conservation planning processes far outweigh the negatives. I believe citizen science could be used more widely in marine and terrestrial conservation to inform conservation research and planning. In particular, the inclusion of local knowledge may provide additional benefits in identifying community-driven questions to better link regional planning with local action. Integrating the local knowledge in online co-mapping and scenario planning will provide a means to incorporate citizen concerns. Delivering citizen science maps to ongoing participatory processes will integrate local knowledge in knowledge exchange processes. I believe citizen science provides an important means to deliver fine-resolution data across broad planning regions while encouraging a supportive space to build trust and develop social learning. As such,

including local knowledge in conservation planning through citizen science will achieve multiple social and ecological outcomes. It is therefore important to recognise citizen science as critical to future conservation planning.

Limitations

Citizen science was undertaken as part of the social values survey analysed in Chapter 5 and section 7.4 above. Consequently, the citizen science data were produced by the same survey participants and so is also not representative of the broader population. Citizen science is typically opportunistic to improve environmental insights, and is not usually generalised to the broader public. However, if citizen science was used as the only method of integrating local knowledge in planning, the unrepresentative sample would likely be an issue. Broader knowledge exchange processes, such as those in Sea Change—Tai Timu Tai Pari, are therefore recommended in addition to citizen science.

In Chapter 6, I determined environmental health priorities and trends from collective citizen observations. Differences in survey effort were controlled for by standardising the data so the number of responses in different areas would not bias the hotspots identified by the density analysis. However, a number of areas on the HGMP region were not identified. It was difficult to determine where unidentified areas were due to consistently neutral health ratings (e.g., *ok/average* health, or health has *stayed the same*), or high variability in the data. It is also important to note that, while density analyses can identify areas of consistent citizen science observations, it is unclear whether this consistency reflects the health of the environment in these locations, or public perceptions of health at these locations.

Future work

I recommend that future work ground-truth citizen observations by comparing citizen observations to professional observations. Given the breadth and scope of the data, it is important to determine whether consistent ratings are reflective of the environment, or other social factors. For example, areas consistently rated as *good* or *improved* health by

citizens may be a reflection of the environmental health at these locations, or a result of positive public perceptions of local conservation efforts. Similarly, areas consistently rated in *poor* or *degrading* health may reflect the environment, or may be negative public perceptions related to recent development proposals, or a damaging newspaper article or opinion piece. My study suggested triangulating data from a range of sources to provide a greater understanding of the results. I believe understanding whether consistent citizen observations represent local environmental health, or reflect a public response to social influences, local media, or conservation communication strategies, will be of value to both planners and citizens. I also recommend future work compare the citizen science observations obtained in this study to those of a representative sample of the broader HGMP population. Underrepresented groups could then be targeted in future efforts to ensure the local knowledge provided to inform planning is representative.

In this thesis, I have demonstrated how valuable citizen science can be for marine conservation planning efforts. As citizen science is increasingly used in conservation research, I predict novel methods and approaches will be developed to better integrate citizen science into planning. Further work could investigate how citizen science can better integrate local knowledge in knowledge exchange processes, and how this may affect conservation outcomes. Moreover, citizen science could be used to develop new tools and a broader user community to identify and improve social and ecological outcomes in conservation. For example, a broader community could be developed by including statisticians, data administrators, local organisations, NGOs, teachers, and students in citizen science projects (e.g., Sullivan et al., 2014). In addition, involving students in citizen science could provide additional educational outcomes, while enhancing student engagement in civil issues near where they live (Cooper, 2012).

I note that the citizen science in this thesis followed a contributory citizen science model (see Hyder et al., 2015) with the resulting data used to inform knowledge exchange and the planning process. Further work could investigate the potential for integrating different citizen science models in conservation planning. For example, examining how collaborative or co-created citizen science (Bonney et al., 2009) or independent citizen science projects

(Hyder et al., 2015) could provide important insights for achieving conservation outcomes. Future work could also draw on the lessons learned by citizen science projects from a variety of different systems. For example, terrestrial participatory monitoring has been shown to improve the efficacy of decision-making and the speed of implementation (Danielsen, Burgess, Jensen, & Pirhofer-Walzl, 2010). Furthermore, terrestrial participatory monitoring has also been shown to be important for identifying new conservation interventions that local people can undertake to tackle biodiviersity threats with limited external support (Danielsen et al., 2005). Such participatory approaches could be tested in marine systems to identify new methods for navigating the space between regional planning and local action. In addition, with the expansion of big data, further work could explore the role of citizen science in delivering big data across time, scales, and transnational boundaries. I believe citizen science will become widely used to influence conservation planning and policy. I recommend further work focuses on identifying opportunities where citizen science can improve conservation efforts, influence planning and policy, and facilitate conservation outcomes.

7.6   A social research agenda for social-ecological conservation planning

Thesis aim: *Develop a social research agenda for a social-ecological approach to conservation planning*

This thesis addresses a critical gap in conservation science by defining a social research agenda for conservation planning processes (Box B in Figure 12). I believe this agenda will provide explicit guidance to conservation researchers, planners, and practitioners on how to undertake conservation planning from a social-ecological perspective. By identifying the enabling social conditions for feasible conservation action, this social research agenda can increase the likelihood of achieving successful conservation outcomes.
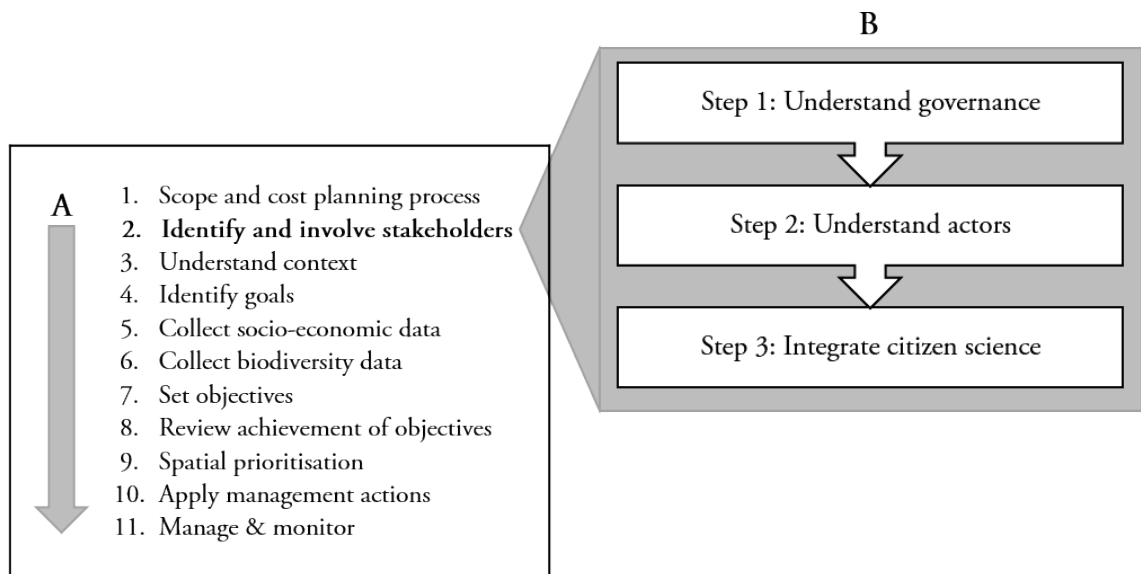
Figure 12. Conservation planning as a social-ecological process adapted and expanded from Margules & Pressey (2000) and Pressey & Bottrill (2009), where A indicates the importance of involving stakeholders throughout the process, and B indicates the social research agenda developed in this thesis.

The social research agenda developed in this thesis consists of three key steps: (1) map knowledge exchange in the conservation network to understand governance; (2) crowdsource spatial values from citizens to understand actors and identify conservation opportunities; and (3) integrate citizen science to incorporate local knowledge and citizen concerns. These three steps follow the research undertaken in Chapters 4 to 6, respectively. I recommend using social network analysis to map knowledge exchange and better understand conservation governance (Step 1). I suggest crowdsourcing a social survey to identify place-based conservation opportunities across diverse conservation values (Step 2), while also mapping local knowledge to integrate citizen science (Step 3). Both Steps 2 and 3 could be completed in the same mapping tool, SeaSketch, as used in this thesis. Alternatively, Google maps (e.g., Brown et al., 2014) or cloud-based ArcGIS Online (ESRI, 2015) could also be used. As technology continues to expand and improve, opportunities to collect spatially referenced social data will continue to increase, while becoming cheaper to develop and apply.

Conservation is widely criticised for not meaningfully identifying, involving, or engaging with stakeholders. While conservation planning processes have been expanded in recent years to "identify and involve stakeholders" (e.g., Pressey & Bottrill, 2009), few processes

identify and involve stakeholders in practice. Planners may skip this step to deliver a conservation prioritisation under limited time and resources. Alternatively, the flexibility and broad applicability of the systematic planning framework may have left researchers, planners, and practitioners unsure how to meaningfully involve stakeholders. If the former, I recommend revisiting stakeholder involvement to ensure this becomes a priority, even where time and resources are limited. If the latter, this confusion may be due to "stakeholder involvement" being considered to be described too generally by planners for practical application. Stakeholder involvement is further complicated by expanding this definition to actors, to broadly include residents, users, and citizens who will affect, and be affected by conservation actions. However, such an approach is necessary to include the diverse range of people who will affect feasibility and the likelihood of successful implementation. In developing a social research agenda, this thesis provides the explicit guidance necessary on how to involve actors in conservation processes. As such, the social research agenda in this thesis can be used to identify the enabling social factors across a broad range of actors that will lead to the conservation outcomes required.

In addition, identifying the enabling social factors of conservation may facilitate adaptive conservation processes. While the systematic conservation planning framework was designed to be iterative and adaptive (Margules & Pressey, 2000; Pressey & Bottrill, 2009), it is rarely used to develop an adaptive process. The likelihood of implementing adaptive planning increases with development of a shared understanding, the use of a prototyping approach, development of capacity for adaptive processes, and engagement with actors at multiple levels (Mills et al., 2015). As such, adaptive planning will depend on the identification of the enabling social factors that will facilitate inclusive planning processes and enhance the feasibility of conservation actions. I believe the social research agenda in this thesis is the first step to identifying and understanding the social factors that facilitate the social learning processes necessary for adaptive conservation planning. I recommend broad application of the social research agenda to assist in understanding the enabling social conditions for feasible conservation action, therefore increasing the likelihood of conservation success.

Limitations

I recognise that shifting to a process-based approach in conservation planning is likely to require greater time and resources. Therefore, challenging the efficacy of current institutional and governance processes may become the main hurdle in shifting to a process-based approach. Arguably, however, biodiversity loss and environmental degradation continue to accelerate and new approaches are required to achieve our conservation goals. Therefore, I suggest that such a shift is necessary if we are to translate our knowledge into action to achieve effective conservation outcomes on the ground. I note that while Sea Change—Tai Timu Tai Pari provided the license for my access to SeaSketch, other free online mapping tools are also available (e.g., Googlemaps, ArcGIS online) which could significantly reduce time and costs associated with developing a spatially-referenced social survey. Further, the recent escalation in citizen science suggests new time- and cost-effective data collection and monitoring techniques. I predict that as technology continues to improve, new tools and approaches will be developed to further facilitate adaptive conservation planning processes. However, challenges will remain in convincing time- and resource-limited planning projects to embrace an adaptive planning approach.

Due to time limitations I was only able to develop a social research agenda for the early stages of the planning, rather than develop a social-ecological approach to conservation throughout the planning process. Therefore, the broader conservation planning process is outside of the scope of a PhD thesis. Similarly, the social research agenda developed here does not translate social insights into feasible actions. However, the development of an implementation strategy is being undertaken by the broader Sea Change—Tai Timu Tai Pari planning process and is also beyond the scope of this thesis. I am grateful for the opportunity to contribute social insights that informed the Sea Change—Tai Timu Tai Pari process. This opportunity also provided a valuable learning experience that improved my knowledge and understanding of conservation planning in complex systems.

Future work

The stakeholder-driven Sea Change—Tai Timu Tai Pari planning process (Sea Change—Tai Timu Tai Pari, 2014a) is likely to shift the governance system and planning process of the HGMP. I would recommend further work to map how the integration of local knowledge, values, and citizen concerns alters the planning process and governance system. By identifying these shifts, future work could evaluate how the social research agenda has influenced the conservation process. In addition, the application of the social research agenda in different conservation contexts could also improve insights into the social dynamics that facilitate or enable successful conservation action in different situations. To address limitations in our knowledge and understanding, it would be interesting to explore how a social research agenda influences conservation outcomes through a social-ecological approach.

Social-ecological systems thinking has increased understanding of the interconnected nature of human and environmental systems, improved collaboration across disciplines, and enhanced decision-making processes across science and society (Fischer et al., 2015). However, social-ecological systems work is still in its infancy, and further work is required for a social-ecological approach to become mainstream in conservation. Key knowledge gaps still exist in social-ecosystems research, including: (1) understanding transboundary governance across regions and scales; (2) how to develop stronger science-society and science-policy interfaces; and (3) identifying how power relations, justice, and stewardship affect, and are affected by, conservation processes (Fischer et al., 2015). I therefore recommend future work explore how these knowledge gaps affect the success of conservation outcomes in complex social-ecological systems.

The natural sciences alone cannot, and have not, solved conservation problems (Bennett & Roth, 2015). Overcoming conservation challenges will require greater understanding of the intertwined social and ecological systems within which conservation is embedded. I therefore recommend encouraging the establishment of social-ecological communities of practice including planners, practitioners, and researchers across multiple disciplines. Understanding conservation issues and opportunities across different disciplinary lenses will

strengthen insight and innovation. In addition, these communities of practice should also include citizens to assist in characterising and solving conservation problems. Nurturing these communities of practice will encourage knowledge exchange and learning processes across diverse groups of people to identify common goals and translate knowledge to action. As interactions between people and nature continue to increase in scale and intensity, mainstreaming a social-ecological approach has never been more important to the future of conservation.

7.7 Conclusion

In this thesis, I identified the role of the governance system, actors, and citizen science in conservation planning. I showed that conservation planning consistently overlooks or underrepresents social considerations that determine conservation feasibility. I developed a social research agenda to provide explicit guidance on how social complexity can be identified and integrated in conservation planning. I believe this social research agenda could be used more widely in conservation to develop a social-ecological approach to conservation planning. This social-ecological approach would better link research, planning, and action to increase the likelihood of achieving successful conservation outcomes.

References

Acheson, J. M. (2006). Institutional failure in resource management. *Annual Review of Anthropology, 35*, 117–134. doi:10.1146/annurev.anthro.35.081705.123238

Agardy, T., di Sciara, G. N., & Christie, P. (2010). Mind the gap: Addressing the shortcomings of marine protected areas through large scale marine spatial planning. *Marine Policy, 35*(2), 226–232. doi:10.1016/j.marpol.2010.10.006

Airamé, S., Dugan, J. E., Lafferty, K. D., Leslie, H., McArdle, D. A., & Warner, R. R. (2003). Applying ecological criteria to marine reserve design: A case study from the California Channel Islands. *Ecological Applications, 13,* 170–184. doi:10.1890/1051-0761(2003)013[0170:AECTMR]2.0.CO;2

Alessa, L. N., Kliskey, A. A., & Brown, G. (2008). Social–ecological hotspots mapping: A spatial approach for identifying coupled social–ecological space. *Landscape and Urban Planning, 85*(1), 27–39. doi:10.1016/j.landurbplan.2007.09.007

Alexander, S., Armitage, D., & Charles, T. (2015). Social networks and transitions to co-management in three marine reserves in Jamaica. *Global Environmental Change, 35*, 213–225. doi:10.1016/j.gloenvcha.2015.09.001

Alexander, S. M., & Armitage, D. (2015). A social relational network perspective for MPA science. *Conservation Letters, 8*(1), 1–13. doi:10.1111/conl.12090

Armitage, D., Berkes, F., Dale, A., Kocho-Schellenberg, E., & Patton, E. (2011). Co-management and the co-production of knowledge: Learning to adapt in Canada's Arctic. Global Environmental Change, 21(3), 995–1004. doi:10.1016/j.gloenvcha.2011.04.006

Armitage, D., Berkes, F., & Doubleday, N. (2007). *Adaptive co-management: collaboration, learning and multi-level governance.* Vancouver, Canada: University of British Columbia Press.

Armitage, D., de Loë, R., & Plummer, R. (2012). Environmental governance and its implications for conservation practice. *Conservation Letters, 5*(4), 245–255. doi:10.1111/j.1755-263X.2012.00238.x

Armitage, D., Plummer, R., Berkes, F., Arthur, R. I., Charles, A. T., Davidson-Hunt, I. J., … Wollenberg, E. K. (2009). Adaptive co-management for social–ecological complexity. *Frontiers in Ecology and the Environment, 7*(2), 95–102. doi:10.1890/070089

Atkinson, R., & Flint, J. (2004). Snowball sampling. In M. S. Lewis-Beck, A. Bryman, & T. F. Liao (Eds.), *Encyclopedia of Social Science Research Methods* (pp. 1044–1045). Thousand Oaks, CA: SAGE Publications, Inc.

Auckland Council. (2014). People's Panel. *People's Panel.* Retrieved November, 23, 2014, from http://www.aucklandcouncil.govt.nz/EN/AboutCouncil/HaveYourSay/Pages/Peoples

Panel.aspx?utm_source=shorturl&utm_medium=print&utm_campaign=Peoples_Pan
el

Babcock, R. C. (2013). Leigh Marine Laboratory contributions to marine conservation. *New Zealand Journal of Marine and Freshwater Research*, *47*(3), 360–373. doi:10.1080/00288330.2013.810160

Ban, N. C., Mills, M., Tam, J., Hicks, C. C., Klain, S., Stoeckl, N., … Chan, K. M. A. (2013). A social-ecological approach to conservation planning: Embedding social considerations. *Frontiers in Ecology and the Environment.* doi:10.1890/110205

Bastian, M., Heymann, S., & Jacomy, M. (2009). Gephi: An open source software for exploring and manipulating networks. *International AAAI Conference on Weblogs and Social Media.* Washington DC: George Washington University.

Becker, C. D., & Ghimire, K. (2003). Synergy between traditional ecological knowledge and conservation science supports forest preservation in Ecuador. *Ecology and Society*, *8*(1), [online] URL: http://www.consecol.org/vol8/iss1/art1/

Bell, S., Pena, A. C., & Prem, M. (2013). Imagine coastal sustainability. *Ocean & Coastal Management*, *83*, 39–51. doi:10.1016/j.ocecoaman.2013.02.016

Beltran, J. (2000). *Indigenous and traditional peoples and protected areas: Principles, guidelines and case studies.* Retrieved from https://portals.iucn.org/library/efiles/documents/PAG-004.pdf

Bengston, D. N. (1994). Changing forest values and ecosystem management. *Society & Natural Resources*, *7*(6), 515–533. doi:10.1080/08941929409380885

Bennett, N. J. (2015). Governing marine protected areas in an interconnected and changing world. *Conservation Biology*, *29*(1), 303–306. doi:10.1111/cobi.12458

Bennett, N. J., & Dearden, P. (2014a). From measuring outcomes to providing inputs: Governance, management, and local development for more effective marine protected areas. *Marine Policy*, *50*, 96–110. doi:10.1016/j.marpol.2014.05.005

Bennett, N. J., & Dearden, P. (2014b). Why local people do not support conservation: Community perceptions of marine protected area livelihood impacts, governance, and management in Thailand. *Marine Policy*, *44*, 107–116. doi:10.1016/j.marpol.2013.08.017

Bennett, N., & Roth, R. (2015). *The conservation social sciences: What?, how? and why?* Vancouver, BC: Canadian Wildlife Federation and Institute for Resources, Environment, and Sustainability, University of British Columbia.

Berkes, F. (2007). Community-based conservation in a globalized world. *PNAS: Proceedings of the National Academy of Sciences of the United States of America*, *104*(39), 15188–15193. doi: 10.1073/pnas.0702098104

Biggs, D., Abel, N., Knight, A. T., Leitch, A., Langston, A., & Ban, N. C. (2011). The implementation crisis in conservation planning: Could "mental models" help? *Conservation Letters*, *4*(3), 169–183. doi:10.1111/j.1755-263X.2011.00170.x

Bode, M., Probert, W., Turner, W. R., Wilson, K. A., & Venter, O. (2011). Conservation planning with multiple organizations and objectives. *Conservation Biology*, *25*(2), 295–304. doi:10.1111/j.1523-1739.2010.01610.x

Bodin, Ö., & Crona, B. I. (2009). The role of social networks in natural resource governance: What relational patterns make a difference? *Global Environmental Change*, *19*(3), 366–374. doi:10.1016/j.gloenvcha.2009.05.002

Bodin, Ö., Crona, B., & Ernstson, H. (2006). Social networks in natural resource management: What is there to learn from a structural perspective? *Ecology And Society*, *11*(2), r2. Retrieved from http://www.ecologyandsociety.org/vol11/iss2/resp2/

Bodin, Ö., & Prell, C. (2011). *Social networks and natural resource management: Uncovering the social fabric of environmental governance*. Cambridge, United Kingdom: Cambridge University Press.

Bonney, R., Ballard, H., Jordan, R., McCallie, E., Phillips, T., Shirk, J., & Wilderman, C. (2009). *Public participation in scientific research: Defining the field and assessing its potential for informal science education.* Retrieved from http://files.eric.ed.gov/fulltext/ED519688.pdf

Bonney, R., Shirk, J. L., Phillips, T. B., Wiggins, A., Ballard, H. L., Miller-Rushing, A. J., & Parrish, J. K. (2014). Next steps for citizen science. *Science*, *343*(6178), 1436–1437. doi:10.1126/science.1251554

Borgatti, S. P., & Foster, P. C. (2003). The network paradigm in organizational research: A review and typology. *Journal of Management*, *29*(6), 991–1013. doi: 10.1016/S0149-2063(03)00087-4

Bottrill, M. C., Mills, M., Pressey, R. L., Game, E. T., & Groves, C. (2012). Evaluating perceived benefits of ecoregional assessments. *Conservation Biology*, *26*(5), 851–861. doi:10.1111/j.1523-1739.2012.01898.x

Bottrill, M. C., & Pressey, R. L. (2012). The effectiveness and evaluation of conservation planning. *Conservation Letters*, *5*(6), 407–420. doi:10.1111/j.1755-263X.2012.00268.x

Briggs, S. V. (2006). Integrating policy and science in natural resources: Why so difficult? *Ecological Management & Restoration*, *7*(1), 37–39. doi:10.1111/j.1442-8903.2006.00245.x

Brook, R. K., & McLachlan, S. M. (2008). Trends and prospects for local knowledge in ecological and conservation research and monitoring. *Biodiversity and Conservation*, *17*(14), 3501–3512. doi:10.1007/s10531-008-9445-x

Brown, C. J., Bode, M., Venter, O., Barnes, M. D., McGowan, J., Runge, C. A., … Possingham, H. P. (2015). Effective conservation requires clear objectives and prioritizing actions, not places or species. *PNAS: Proceedings of the National Academy of Sciences of the United States of America, 112*(32), E4342. doi:10.1073/pnas.1509189112

Brown, G., & Donovan, S. (2014). Measuring change in place values for environmental and natural resource planning using Public Participation GIS (PPGIS): Results and challenges for longitudinal research. *Society & Natural Resources, 27*(1), 36–54. doi:10.1080/08941920.2013.840023

Brown, G., Kelly, M., & Whitall, D. (2014). Which "public"? Sampling effects in public participation GIS (PPGIS) and volunteered geographic information (VGI) systems for public lands management. *Journal of Environmental Planning and Management, 57*(2), 190-214. doi:10.1080/09640568.2012.741045

Brown, G., & Kyttä, M. (2014). Key issues and research priorities for public participation GIS (PPGIS): A synthesis based on empirical research. *Applied Geography, 46*, 122–136. doi:10.1016/j.apgeog.2013.11.004

Brown, G., & Reed, P. (2012). Values compatibility analysis: Using public participation geographic information systems (PPGIS) for decision support in national forest management. *Applied Spatial Analysis and Policy, 5*(4), 317–332. doi:10.1007/s12061-011-9072-x

Brown, G., & Weber, D. (2012). Measuring change in place values using public participation GIS (PPGIS). *Applied Geography, 34*, 316–324. doi:10.1016/j.apgeog.2011.12.007

Brown, G., & Kyttä, M. (2014). Key issues and research priorities for public participation GIS (PPGIS): A synthesis based on empirical research. *Applied Geography, 46*, 122–136. doi:10.1016/j.apgeog.2013.11.004

Brown, G., & Raymond, C. M. (2014). Methods for identifying land use conflict potential using participatory mapping. Landscape and Urban Planning, 122, 196–208. doi:10.1016/j.landurbplan.2013.11.007

Brown, G., & Weber, D. (2013). A place-based approach to conservation management using public participation GIS (PPGIS). *Journal of Environmental Planning and Management, 56*(4), 455–473. doi:10.1080/09640568.2012.685628

Brown, G., Weber, D., & de Bie, K. (2015). Is PPGIS good enough ? An empirical evaluation of the quality of PPGIS crowd-sourced spatial data for conservation planning. *Land Use Policy, 43*, 228–238. doi:10.1016/j.landusepol.2014.11.014

Brown, G., Weber, D., Zanan, D., & de Bie, K. (2012). Evaluation of an online panel for Public Participation Geographic Information Systems (PPGIS) surveys. *International Journal of Public Opinion Research*, 1–12. doi:10.1093/ijpor/eds001

Bryan, B. A., Raymond, C. M., Crossman, N. D., & King, D. (2011). Comparing spatially explicit ecological and social values for natural areas to identify effective conservation strategies. *Conservation Biology*, *25*(1), 172–181.

Butchart, S. H. M., Clarke, M., Smith, R. J., Sykes, R. E., Scharlemann, J. P. W., Harfoot, M., … Burgess, N. D. (2015). Shortfalls and solutions for meeting national and global conservation area targets. *Conservation Letters*. doi:10.1111/conl.12158

Caldow, C., Monaco, M. E., Pittman, S. J., Kendall, M. S., Goedeke, T. L., Menza, C., … Costa, B. M. (2015). Biogeographic assessments: A framework for information synthesis in marine spatial planning. *Marine Policy*, *51*, 423–432. doi:10.1016/j.marpol.2014.07.023

Carlsson, L., & Berkes, F. (2005). Co-management: Concepts and methodological implications. *Journal of Environmental Management*, *75*(1), 65–76. doi:10.1016/j.jenvman.2004.11.008

CBD. (2010). COP Decision X/2. Strategic plan for biodiversity 2011-2020. Retrieved June, 12, 2015 from http://www.cbd.int/decision/cop/?id=12268.

Chomitz, K. M. (2007). *At loggerheads?: Agricultural expansion, poverty reduction, and environment in the tropical forests.* Washington, DC, USA: World Bank Publications.

Cohen, P. J., Evans, L. S., & Mills, M. (2012). Social networks supporting governance of coastal ecosystems in Solomon Islands. *Conservation Letters*, *5*(5), 376–386. doi:10.1111/j.1755-263X.2012.00255.x

Conley, T., & Udry, C. (2001). Social learning through networks: The adoption of new agricultural technologies in Ghana. *American Journal of Agricultural Economics*, *83*(3), 668–673.

Cooper, C. B. (2012). Links and distinctions among citizenship, science, and citizen science. A response to "The future of citizen science". *Democracy and Education*, *20*(2), 1–4. Retrieved from http://democracyeducationjournal.org/home/vol20/iss2/13

Cooper, C. B., Dickinson, J., Phillips, T., & Bonney, R. (2007). Citizen science as a tool for conservation in residential ecosystems. *Ecology and Society*, *12*(2), 11. Retrieved from http://www.ecologyandsociety.org/vol12/iss2/art11/

Couper, M. P., & Miller, P. V. (2008). Web survey methods. *Public Opinion Quarterly*, *72*(5), 831–835. doi:10.1093/poq/nfn066

Cowling, R. M., Knight, A. T., Faith, D. P., Ferrier, S., Lombard, A. T., Driver, A., … Desmet, P. G. (2004). Nature conservation requires more than a passion for species. *Conservation Biology*, *18*(6), 1674–1676. doi:10.1111/j.1523-1739.2004.00296.x

Cowling, R. M., & Wilhelm-Rechmann, A. (2007). Social assessment as a key to conservation success. *Oryx*, *41*, 135–136.

Crona, B., & Bodin, Ö. (2006). What you know is who you know? Communication patterns among resource users as a prerequisite for co-management. *Ecology and Society*, *11*(2), 7. Retrieved from http://www.ecologyandsociety.org/vol11/iss2/art7/

Crosby, B. N., & Hottinger, J. C. (2011). The Citizens Jury Process. *Book of the States*, 321–325. Retrieved from http://knowledgecenter.csg.org/drupal/system/files/Crosby2011.pdf

Csardi, G., & Nepusz, T. (2006). The igraph software package for complex network research. *InterJournal, Complex Systems*. Retrieved from http://igraph.org

Cundill, G., Roux, D. J., & Parker, J. N. (2015). Nurturing communities of practice for transdisciplinary research, *Ecology and Society, 20*(2), 22. doi:10.5751/ES-07580-200222

Curasi, F. C. (2001). A critical exploration of face-to-face interviewing vs. computer-mediated interviewing. *International Journal of Market Research*, *43*(4), 361–375.

Cvitanovic, C., Hobday, A. J., van Kerkhoff, L., Wilson, S. K., Dobbs, K., & Marshall, N. A. (2015). Improving knowledge exchange among scientists and decision-makers to facilitate the adaptive governance of marine resources: A review of knowledge and research needs. *Ocean & Coastal Management, 112*, 25–35. doi:10.1016/j.ocecoaman.2015.05.002

Cvitanovic, C., Hobday, A. J., van Kerkhoff, L., & Marshall, N. A. (2015). Overcoming barriers to knowledge exchange for adaptive resource management; the perspectives of Australian marine scientists. *Marine Policy, 52*, 38–44. doi:10.1016/j.marpol.2014.10.026

D'Arcy, P. (2009). Variable rights and disminishing control: The evolution of indigenous maritime sovereignty in Oceania. In D. Ghosh, H. Goodall, & S. Hemelryk Donald (Eds.), *Water, sovereignty, and borders in Asia and Oceania* (pp. 20-38). Abingdon & New York, NY: Routledge.

Danielsen, F., Burgess, N. D., & Alviola, P. A., Balete, D. S., Mendoza, M., Custodio, D., & Enghoff, M. (2005). Does monitoring matter? A quantitative assessment of management decisions from locally-based monitoring of protected areas. *Biodiversity & Conservation, 14*, 2633–2652. doi:10.1007/s10531-005-8392-z

Danielsen, F., Burgess, N. D., Jensen, P. M., & Pirhofer-Walzl, K. (2010). Environmental monitoring: The scale and speed of implementation varies according to the degree of

peoples involvement. *Journal of Applied Ecology, 47*(6), 1671–1705. doi:10.1111/j.1365-2664.2010.01874.x

Danielsen, F., Jensen, P. M., Burgess, N. D., Altamirano, R., Alviola, P. A., Andrianandrasana, H., … Young, R. (2014). A multicountry assessment of tropical resource monitoring by local communities. *BioScience, 64*(3), 236–251. doi:10.1093/biosci/biu001

Day, J. (2008). The need and practice of monitoring, evaluating and adapting marine planning and management – lessons from the Great Barrier Reef. *Marine Policy, 32*(5), 823–831. doi:10.1016/j.marpol.2008.03.023

Day, V., Paxinos, R., Emmett, J., Wright, A., & Goecker, M. (2008). The Marine Planning Framework for South Australia: a new ecosystem-based zoning policy for marine management. *Marine Policy, 32*(4), 535–43. doi:10.1016/j.marpol.2007.10.009

De Santo, E. M. (2013). Missing marine protected area (MPA) targets: How the push for quantity over quality undermines sustainability and social justice. *Journal of Environmental Management, 124*, 137–146. doi:10.1016/j.jenvman.2013.01.033

De Santo, E. M., Jones, P. J. S., & Miller, A. M. M. (2011). Fortress conservation at sea: A commentary on the Chagos marine protected area. *Marine Policy, 35*(2), 258–260. doi:10.1016/j.marpol.2010.09.004

Delaney, A., Degnbol, D., Hadjimichael, M., Hattam, C., Borger, T., Austen, M., … Burdon, D. (2013). *Citizen workshop: The Dogger Bank, for whom and for what?* Paper presented at the In VECTORS Annual Meeting, Athens, Greece.

Department of Conservation. (2006). *Hauraki Gulf Marine Park and its conservation islands.* Christchurch. Retrieved from http://www.doc.govt.nz/documents/about-doc/concessions-and-permits/conservation-revealed/hauraki-gulf-marine-park-lowres.pdf

Department of Conservation. (2011). *Islands of the Hauraki Gulf Marine Park.* Retrieved from http://www.doc.govt.nz/documents/parks-and-recreation/places-to-visit/auckland/islands-of-the-hauraki-gulf-marine-park.pdf

Department of Conservation. (2015). *Te Hauturu-o-Toi/Little Barrier Island Nature Reserve.* Retrieved March 1, 2015, from http://www.doc.govt.nz/parks-and-recreation/places-to-go/auckland/places/little-barrier-island-nature-reserve-hauturu-o-toi/nature-and-conservation/

Department of Conservation & Ministry of Fisheries. (2005). Marine Protected Areas Policy and Implementation Plan. Wellington, New Zealand.

Devillers, R., Pressey, R. L., Grech, A., Kittinger, J. N., Edgar, G. J., Ward, T., & Watson, R. (2014). Reinventing residual reserves in the sea: Are we favouring ease of

establishment over need for protection? *Aquatic Conservation: Marine and Freshwater Ecosystems*, *25*, 480-504. doi:10.1002/aqc.2445

Dickinson, J. L., Shirk, J., Bonter, D., Bonney, R., Crain, R. L., Martin, J., … Purcell, K. (2012). The current state of citizen science as a tool for ecological research and public engagement. *Frontiers in Ecology and the Environment*, *10*(6), 291–297. doi:10.1890/110236

Dickinson, J. L., Zuckerberg, B., & Bonter, D. N. (2010). Citizen science as an ecological research tool: Challenges and benefits. *Annual Review of Ecology, Evolution, and Systematics*, *41*(1), 149–172. doi:10.1146/annurev-ecolsys-102209-144636

Douvere, F., Maes, F., Vanhulle, A., & Schrijvers, J. (2007). The role of marine spatial planning in sea use management: The Belgian case. *Marine Policy*, *31*(2), 182–91. doi:10.1016/j.marpol.2006.07.003

Ehler, C. (2008). Conclusions: Benefits, lessons learned, and future challenges of marine spatial planning. *Marine Policy*, *32*(5), 840–843. doi:10.1016/j.marpol.2008.03.014

Ehler, C., & Douvere, F. (2009). *Marine spatial planning: a step by step approach towards ecosystem-based management*. Intergovernmental Oceanographic Commission and Man and the Biosphere Programme. IOC Manual and Guides No. 53, ICAM Dossier No. 6. Paris: UNESCO.

Enderby, J., & Enderby, T. (2006). *A guide to New Zealand's marine reserves*. New Zealand: New Holland Publishers.

Enqvist, J., Tengö, M., & Bodin, Ö. (2014). Citizen networks in the Garden City: Protecting urban ecosystems in rapid urbanization. *Landscape and Urban Planning*, *130*, 24–35. doi:10.1016/j.landurbplan.2014.06.007

Ernoul, L., & Wardell-Johnson, A. (2013). Governance in integrated coastal zone management: a social networks analysis of cross-scale collaboration. *Environmental Conservation*, *40*(3), 231–240. doi:10.1017/S0376892913000106

Ernstson, H., Barthel, S., Andersson, E., & Borgström, S. T. (2010). Scale-crossing brokers and network governance of urban ecosystem services: The case of Stockholm. *Ecology and Society*, *15*(4), 28. Retrieved from http://www.ecologyandsociety.org/vol15/iss4/art28/

Ernstson, H., Sörlin, S., & Elmqvist, T. (2009). Social movements and ecosystem services—the role of social network structure in protecting and managing urban green areas in Stockholm. *Ecology And Society*, *13*(2), 39. Retrieved from http://www.ecologyandsociety.org/vol13/iss2/art39/

ESRI. (2011). ArcGIS Desktop: Release 10.2.2. Redlands, CA: Environmental Systems Research Institute.

ESRI. (2014a). Hot Spot Analysis (Getis-Ord Gi*). *ArcGIS Resource Center*. Retrieved November, 28, 2014 from http://resources.arcgis.com/en/help/main/10.1/index.html#//005p00000010000000

ESRI. (2014b). Intersect Analysis. *ArcGIS Resource Center*. Retrieved November, 28, 2014 from http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html#/Intersect/00080000000p000000/

ESRI. (2014c). Kernel Density Analysis. *ArcGIS Resource Center*. Retrieved November, 28, 2014 from http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html#//009z0000000s000000.htm

ESRI. (2014d). Near Analysis. *ArcGIS Resource Center*. Retrieved November, 28, 2014 from http://resources.arcgis.com/en/help/main/10.1/index.html#//00080000001q000000

ESRI. (2015). ArcGIS Online. Retrieved August 18, 2015, from http://blogs.esri.com/esri/esri-insider/2011/08/30/future-cloud-based-gis-analysis-arcgis-online/

Fazey, I., Bunse, L., Msika, J., Pinke, M., Preedy, K., Evely, A. C., … Reed, M. S. (2014). Evaluating knowledge exchange in interdisciplinary and multi-stakeholder research. *Global Environmental Change. 25*, 204-220. doi:10.1016/j.gloenvcha.2013.12.012

Fazey, I., Evely, A. C., Reed, M. S., Stringer, L. C., Kruijsen, J., White, P. C. L., … Trevitt, C. (2013). Knowledge exchange: A review and research agenda for environmental management. *Environ. Conserv.*, *40*(1), 19–36. doi:10.1017/S037689291200029X

Fernandes, L., Day, J., Lewis, A., Slegers, S., Kerrigan, B., Breen, D., … Stapleton, K. (2005). Establishing representative no-take areas in the Great Barrier Reef: Large-scale implementation of theory on marine protected areas. *Conservation Biology*, *19*(6), 1733–1744. doi:10.1111/j.1523-1739.2005.00302.x

Fischer, J., Gardner, T. A, Bennett, E. M., Balvanera, P., Biggs, R., Carpenter, S., … Tenhunen, J. (2015). Advancing sustainability through mainstreaming a social–ecological systems perspective. *Current Opinion in Environmental Sustainability*, *14*, 144–149. doi:10.1016/j.cosust.2015.06.002

Flyvbjerg, B. (2006). Five misunderstandings about case-study research. *Qualitative Inquiry, 12*(2), 219–245. doi:10.1177/1077800405284363

Folke, C., Carpenter, S. R., Walker, B., Scheffer, M., & Chapin, T. (2010). Resilience thinking: Integrating resilience, adaptability, and transformability. *Ecology and Society*, *15*(4), 20. Retrieved from http:// www.ecologyandsociety.org/vol15/iss4/art20/

Folke, C., Hahn, T., Olsson, P., & Norberg, J. (2005a). Adaptive governance of social-ecological systems. *Annual Review of Environment and Resources*, *30*(1), 441–473. doi:10.1146/annurev.energy.30.050504.144511

Fourcade, Y., Engler, J. O., Rödder, D., & Secondi, J. (2014). Mapping species distributions with MAXENT using a geographically biased sample of presence data: A performance assessment of methods for correcting sampling bias. *PLoS ONE*, *9*(5), 1–13. doi:10.1371/journal.pone.0097122

Fuller, R. A., Irvine, K. N., Devine-Wright, P., Warren, P. H., & Gaston, K. J. (2007). Psychological benefits of greenspace increase with biodiversity. *Biology Letters*, *3*(4), 390–394. doi:10.1098/rsbl.2007.0149

Fuller, R. A., Lee, J. R., & Watson, J. E. M. (2014). Achieving open access to conservation science. *Conservation Biology, 28*(6), 1550–1557. doi:10.1111/cobi.12346

Galea, S., & Tracy, M. (2007). Participation rates in epidemiologic studies. *Annals of Epidemiology*, *17*(9), 643–653. doi:10.1016/j.annepidem.2007.03.013

Game, E. T., Kareiva, P., & Possingham, H. P. (2013). Six common mistakes in conservation priority setting. *Conservation Biology*, *27*(3), 480–485. doi:10.1111/cobi.12051

Game, E. T., Lipsett-Moore, G., Hamilton, R., Peterson, N., Kereseka, J., Atu, W., … Possingham, H. P. (2011). Informed opportunism for conservation planning in the Solomon Islands. *Conservation Letters*, *4*(1), 38–46. doi:10.1111/j.1755-263X.2010.00140.x

Game, E. T., Meijaard, E., Sheil, D., & McDonald-Madden, E. (2014). Conservation in a wicked complex world; challenges and solutions. *Conservation Letters*, *7*(3), 271–277. doi:10.1111/conl.12050

Garcia-Amado, L. R., Perez, M. R., Iniesta-Arandia, I., Dahringer, G., Reyes, F., & Barrasa, S. (2012). Building ties: Social capital network analysis of a forest community in a biosphere reserve in Chiapas, Mexico. *Ecology and Society*, *17*(3), 3. doi:10.5751/ES-04855-170303

Gaskin, C. P., & Rayner, M. J. (2013). *Seabirds of the Hauraki Gulf: Natural history, research, and conservation.* Retrieved from http://www.aucklandcouncil.govt.nz/EN/AboutCouncil/representativesbodies/haurakigulfforum/Documents/haurakigulfseabirdmanagementplanmar2013.pdf

Geldmann, J., Coad, L., Barnes, M., Craigie, I. D., Hockings, M., Knights, K., … Burgess, N. D. (2015). Changes in protected area management effectiveness over time: A global analysis. *Biological Conservation*, *191*, 692–699. doi:10.1016/j.biocon.2015.08.029

Geographx. (2014). Geographx. Retrieved March, 25, 2015, from
     http://geographx.co.nz/portfolio/

Granovetter, M. S. (1973). The strength of weak ties. *American Journal of Sociology*, *78*(6),
     1360–1380.

Grantham, H. S., Bode, M., McDonald-Madden, E., Game, E. T., Knight, A. T., &
     Possingham, H. P. (2010). Effective conservation planning requires learning and
     adaptation. *Frontiers in Ecology and the Environment*, *8*, 431–437.
     doi:10.1890/080151

Gu, Z., Gu, L., Ellis, R., Schlesner, M., & Brors, B. (2014). Circlize implements and
     enhances 343 circular visualization in R. *Bioinformatics*, *30*.
     doi:10.1093/bioinformatics/btu393

Guenette, S., & Alder, J. (2007). Lessons from marine protected areas and integrated ocean
     management initiatives in Canada. Coastal Management, 35(1), 51–78.
     doi:10.1080/10.1080/08920750600970578

Guerrero, A. M., McAllister, R. R. J., Corcoran, J., & Wilson, K. A. (2013). Scale
     mismatches, conservation planning, and the value of social-network analyses.
     Conservation Biology, 27(1), 35-44. doi:10.1111/j.1523-1739.2012.01964.x

Gurney, G. G., Pressey, R. L., Ban, N. C., Álvarez-Romero, J. G., Jupiter, S. & Adams, V.
     M. (2015). Efficient and equitable design of marine protected areas in Fiji through
     inclusion of stakeholder-specific objectives in conservation planning. *Conservation
     Biology, 29*, 1378-1389. doi: 10.1111/cobi.12514

Hajer, M., Nilsson, M., Raworth, K., Bakker, P., Berkhout, F., de Boer, Y., … Kok, M.
     (2015). Beyond cockpit-ism: Four insights to enhance the transformative potential of
     the sustainable development goals. *Sustainability*, *7*(2), 1651–1660.
     doi:10.3390/su7021651

Hardin, G. (1968). The tragedy of the commons. *Science, 162*(3859), 1243–1248.
     doi:10.1126/science.162.3859.1243

Hattam, C. (2015). *Use of citizen's jury to assess value of Dogger Bank Special Area of
     Conservation.* Paper presented at the meeting of *11th International Conference of the
     European Society for Ecological Economics (ESEE)*, Leeds, UK.

Hauraki Gulf Forum. (2000). Hauraki Gulf Marine Park Act. Retrieved from
     http://www.legislation.govt.nz/act/public/2000/0001/latest/DLM52558.html

Hauraki Gulf Forum. (2011). *State of our gulf: Hauraki Gulf—Tikapa Moana/ Te
     Moananui a Toi State of the Environment Report 2011.* New Zealand. Retrieved from
     http://www.aucklandcouncil.govt.nz/EN/AboutCouncil/representativesbodies/hauraki
     gulfforum/Documents/hgfstateoftheenvreport2011.pdf

Hauraki Gulf Forum. (2014). *State of our gulf: Hauraki Gulf—Tikapa Moana/ Te Moananui a Toi State of the Environment Report 2014.* Retrieved from http://www.aucklandcouncil.govt.nz/EN/environmentwaste/coastalmarine/Document s/stateofourgulf2014.pdf

Hegarty, A. (1997). Start with what the people know: A community based approach to integrated coastal zone management. *Ocean & Coastal Management*, *36*(1-3), 167–203. doi:10.1016/S0964-5691(97)00015-X

Hunter, M. L., Redford, K. H., & Lindenmayer, D. B. (2014). The complementary niches of anthropocentric and biocentric conservationists. *Conservation Biology*, *28*(3), 641–645. doi:10.1111/cobi.12296

Huntington, H. P. (2000). Using traditional ecological knowledge in science: Methods and applications. *Ecological Applications*, *10*(5), 1270–1274. doi:10.1890/1051-0761(2000)010[1270:UTEKIS]2.0.CO;2

Hyder, K., Townhill, B., Anderson, L. G., Delany, J., & Pinnegar, J. K. (2015). Can citizen science contribute to the evidence-base that underpins marine policy? *Marine Policy*, *59*, 112–120. doi:10.1016/j.marpol.2015.04.022

ICCB. (2015). 27th International Congress for Conservation Biology & 4th European Congress for Conservation Biology, Montpellier, France.

Isaac, N. J. B., van Strien, A. J., August, T. A., de Zeeuw, M. P., & Roy, D. B. (2014). Statistics for citizen science: Extracting signals of change from noisy ecological data. *Methods in Ecology and Evolution*, *5*(10), 1052-1060. doi:10.1111/2041-210X.12254

IUCN & UNEP. (2011). The World Database on Protected Areas (WDPA). Cambridge, UK.

Ives, C. D., Biggs, D., Hardy, M. J., Lechner, A. M., Wolnicki, M., & Raymond, C. M. (2015). Using social data in strategic environmental assessment to conserve biodiversity. *Land Use Policy*, *47*, 332–341. doi:10.1016/j.landusepol.2015.04.002

Ives, C. D., & Kendal, D. (2013). Values and attitudes of the urban public towards peri-urban agricultural land. *Land Use Policy*, *34*, 80–90. doi:10.1016/j.landusepol.2013.02.003

Ives, C. D., & Kendal, D. (2014). The role of social values in the management of ecological systems. *Journal of Environmental Management*, *144*, 67–72. doi:10.1016/j.jenvman.2014.05.013

Johannes, R. (1998). The case for data-less marine resource management: examples from tropical nearshore finfisheries. *Trends in Ecology and Evolution*, *13*(6), 243–246.

Johnson, N., Lilja, N., Ashby, J. A., & Garcia, J. A. (2004). The practice of participatory research and gender analysis in natural resource management. *Natural Resources Forum*, *28*(3), 189–200. doi:10.1111/j.1477-8947.2004.00088.x

Juffe-Bignoli, D., Burgess, N., Bingham, H., Ems, E. M. S., de Lima, M. G., Deguignet, M., … Kingston, N. (2014). Protected Planet Report 2014. Cambridge, United Kingdom:UNEP-WCMC.

Kaltenborn, B. P., & Bjerke, T. (2002). Associations between environmental value orientations and landscape preferences. *Landscape and Urban Planning*, *59*(1), 1-11. doi:10.1016/S0169-2046(01)00243-2

Knight, A. T., Cowling, R. M., Boshoff, A. F., Wilson, S. L., & Pierce, S. M. (2011). Walking in STEP: Lessons for linking spatial prioritisations to implementation strategies. *Biological Conservation*, *144*, 202–211. doi:10.1016/j.biocon.2010.08.017

Knight, A. T., Cowling, R. M., & Campbell, B. M. (2006). An operational model for implementing conservation action. *Conservation Biology*, *20*(2), 408–419. doi:10.1111/j.1523-1739.2006.00305.x

Knight, A. T., Cowling, R. M., Rouget, M., Balmford, A., Lombard, A. T., & Campbell, B. M. (2008). Knowing but not doing: Selecting priority conservation areas and the research-implementation gap. *Conservation Biology*, *22*(3), 610–617. doi:10.1111/j.1523-1739.2008.00914.x

Knight, A. T., Driver, A., Cowling, R. M., Maze, K., Desmet, P. G., Lombard, A. T., … von Hase, A. (2006). Designing systematic conservation assessments that promote effective implementation: Best practice from South Africa. *Conservation Biology*, *20*(3), 739–750. doi:10.1111/j.1523-1739.2006.00452.x

Leavitt, H. (1951). Some effects of certain communication patterns on group performance. *Journal of Abnormal and Social Psychology*, *46*(1), 38–50.

Leenhardt, P., Cazalet, B., Salvat, B., Claudet, J., & Feral, F. (2013). The rise of large-scale marine protected areas: Conservation or geopolitics? *Ocean and Coastal Management*, *85*, 112–118. doi:10.1016/j.ocecoaman.2013.08.013

Leverington, F., Costa, K. L., Pavese, H., Lisle, A., & Hockings, M. (2010). A global analysis of protected area management effectiveness. *Environmental Management*, *46*(5), 685–698. doi:10.1007/s00267-010-9564-5

Lockwood, M. (2010). Good governance for terrestrial protected areas: A framework, principles and performance outcomes. *Journal of Environmental Management*, *91*(3), 754–766. doi:10.1016/j.jenvman.2009.10.005

Lockwood, M., & Kothari, A. (2006). Social context. In M. Lockwood, G. L. Worboys, & A. Kothari (Eds.), *Managing protected areas: A global guide* (pp. 41–72). London, UK: Earthscan.

Maas, J., Verheij, R. A., Groenewegen, P. P., de Vries, S., & Spreeuwenberg, P. (2006). Green space, urbanity, and health: how strong is the relation? *Journal of Epidemiology and Community Health*, *60*(7), 587–592. doi:10.1136/jech.2005.043125

Mace, G. M. (2014). Whose conservation? *Science*, *345*(6204), 1558–1560. doi:10.1126/science.1254704

Margules, C. R., & Pressey, R. L. (2000). Systematic conservation planning. *Nature*, *405*(6783), 243–253. doi:10.1038/35012251

Marsden, P. V. (1990). Network data and measurement. *Annual Review of Sociology*, *16*, 435– 463.

Marín, A., & Berkes, F. (2010). Network approach for understanding small-scale fisheries governance: The case of the Chilean coastal co-management system. *Marine Policy*, *34*(5), 851–858. doi:10.1016/j.marpol.2010.01.007

Mascia, M. B., Pailler, S., Krithivasan, R., Roshchanka, V., Burns, D., Mlotha, M. J., … Peng, N. (2014). Protected area downgrading, downsizing, and degazettement (PADDD) in Africa, Asia, and Latin America, and the Caribbean, 1900-2010. *Biological Conservation*, *169*, 355–361. doi:10.1016/j.biocon.2013.11.021

McCook, L. J., Ayling, T., Cappo, M., Choat, J. H., Evans, R. D., De Freitas, D. M., … Williamson, D. H. (2010). Adaptive management of the Great Barrier Reef: a globally significant demonstration of the benefits of networks of marine reserves. *PNAS: Proceedings of the National Academy of Sciences of the United States of America*, *107*(43), 18278–18285. doi:10.1073/pnas.0909335107

McGinnis, M. D., & Ostrom, E. (2014). Social-ecological system framework: Initial changes and continuing challenges. *Ecology and Society*, *19*(2), 30. doi:10.5751/ES-06387-190230

McNeely, J., Lockwood, M., & Chapman, J. (2006). Building support for protected areas. In M. Lockwood, G. L. Worboys, & A. Kothari (Eds.), *Managing protected areas: A global guide* (pp. 656–676). London, UK: Earthscan.

Miller, B. W., Caplow, S. C., & Leslie, P. W. (2012). Feedbacks between conservation and social-ecological systems. *Conservation Biology*, *26*(2), 218–227. doi:10.1111/j.1523-1739.2012.01823.x

Mills, M., Álvarez-Romero, J. G., Vance-Borland, K., Cohen, P., Pressey, R. L., Guerrero, A. M., & Ernstson, H. (2014). Linking regional planning and local action: towards using social network analysis in systematic conservation planning. *Biological Conservation*, *169*, 6–13. doi:10.1016/j.biocon.2013.10.015

Mills, M., Pressey, R. L., Ban, N. C., Foale, S., Aswani, S., & Knight, A. T. (2013). Understanding characteristics that define the feasibility of conservation actions in a

common pool marine resource governance system. *Conservation Letters*, 6(6), 418–429. doi:10.1111/conl.12025

Mills, M., Weeks, R., Pressey, R. L., Gleason, M. G., Eisma-Osorio, R. L., Lombard, A. T., … Morrison, T. H. (2015). Real-world progress in overcoming the challenges of adaptive spatial planning. *Biological Conservation*, 181, 54–63. doi:10.1016/j.biocon.2014.10.028

Ministry for the Environment. (1991). Resource Management Act 1991. Retrieved from http://www.legislation.govt.nz/act/public/1991/0069/latest/DLM230265.html

Mitton, C., Adair, C. E., McKenzie, E., Patten, S. B., & Waye-Perry, B. (2007). Knowledge transfer and exchange: review and synthesis of the literature. *Milbank Q*, 85(4), 729–768.

Moon, K., Adams, V. M., Januchowski-Hartley, S. R., Polyakov, M., Mills, M., Biggs, D., … Raymond, C. M. (2014). A multidisciplinary conceptualization of conservation opportunity. *Conservation Biology*, 28(6), 1484–1496. doi:10.1111/cobi.12408

Moon, K., & Blackman, D. (2014). A guide to understanding social science research for natural scientists. *Conservation Biology*, 28(5), 1167–1177. doi:10.1111/cobi.12326

Morrison, T. H., McAlpine, C., Rhodes, J. R., Peterson, A., & Schmidt, P. (2010). Back to the future? Planning for environmental outcomes and the new Caring for our Country program. *Australian Geographer*, 41(4), 521–538. doi:10.1080/00049182.2010.519763

Naidoo, R., Balmford, A., Ferraro, P. J., Polasky, S., Ricketts, T. H., & Rouget, M. (2006). Integrating economic costs into conservation planning. *Trends in Ecology & Evolution*, 21(12), 681–7. doi:10.1016/j.tree.2006.10.003

Nel, J. L., Roux, D. J., Driver, A., Hill, L., Maherry, A. C., Snaddon, K., … Reyers, B. (2015). Knowledge co-production and boudnary work to promote implementation of conservation plans. *Conservation Biology*. doi:10.1111/cobi.12560

Nepal, S. K. (2000). Tourism, national parks, and local communities. In R. Butler & S. W. Boyd (Eds.), *Tourism and national parks: Issues and implications* (pp. 73–94). New York: John Wiley & Sons.

Newig, J., Günther, D., & Pahl-Wostl, C. (2010). Synapses in the network. Learning in governance networks in the context of environmental management. *Ecology and Society*, 15(4), 24. Retrieved from http://www.ecologyandsociety.org/vol15/iss4/art24/

Newman, G., Wiggins, A., Crall, A., Graham, E., Newman, S., & Crowston, K. (2012). The future of citizen science: Emerging technologies and shifting paradigms. *Frontiers in Ecology and the Environment*, 10(6), 298–304. doi:10.1890/110294

Nielsen-Pincus, M. (2011). Mapping a values typology in three counties of the interior Northwest, USA: Scale, geographic associations among values, and the use of intensity weights. *Society & Natural Resources*, *24*(6), 535–552. doi:10.1080/08941920903140972

Olsson, P., Folke, C., & Berkes, F. (2004). Adaptive comanagement for building resilience in social–ecological systems. *Environmental Management*, *34*(1), 75–90. doi:10.1007/s00267-003-0101-7

Olsson, P., Folke, C., & Hahn, T. (2004). Social-ecological transformation for ecosystem management: the development of adaptive co-management of a wetland landscape in southern Sweden. *Ecology and Society*, *9*(4), 2. Retrieved from http://www.ecologyandsociety.org/vol9/iss4/art2/

Olsson, P., Folke, C., & Hughes, T. P. (2008). Navigating the transition to ecosystem-based management of the Great Barrier Reef, Australia. *PNAS: Proceedings of the National Academy of Sciences of the United States of America*, *105*(28), 9489–9494. doi:10.1073/pnas.0706905105

Österblom, H., & Folke, C. (2013). Emergence of global adaptive governance for stewardship of regional marine resources. *Ecology and Society*, *18*(2), 4. doi:10.5751/ES-05373-180204

Österblom, H., Jouffray, J.-B., Folke, C., Crona, B., Troell, M., Merrie, A., & Rockström, J. (2015). Transnational corporations as "keystone actors" in marine ecosystems. *PLoS ONE, 10*(5), e0127533. doi:10.1371/journal.pone.0127533

Ostrom, E. (2007). A diagnostic approach for going beyond panaceas. *PNAS: Proceedings of the National Academy of Sciences*, *104*(39), 15181-15187. doi:10.1073/pnas.0702288104

Ostrom, E. (2009). A general framework for analyzing sustainability of social-ecological systems. *Science*, *325*(5939), 419–422. doi:10.1126/science.1172133

Ostrom, E., & Cox, M. (2010). Moving beyond panaceas: A multi-tiered diagnostic approach for social-ecological analysis. *Environmental Conservation*, *37*(4), 451–463. doi:10.1017/S0376892910000834

Pannell, D. J., Marshall, G. R., Barr, N., Curtis, A., Vanclay, F., & Wilkinson, R. (2006). Understanding and promoting adoption of conservation practices by rural landholders. *Australian Journal of Experimental Agriculture*, *46*(11), 1407–1424. doi:10.1071/EA05037

Plummer, R. (2009). The adaptive co-management process: An initial synthesis of representative models and influential variables. *Ecology and Society*, *14*(2), 24. Retrieved from http://www.ecologyandsociety.org/vol14/iss2/art24/

Pomeroy, R. S., & Carlos, M. B. (1997). Community-based coastal resource management in the Philippines: A review and evaluation of programs and projects, 1984–1994. *Marine Policy*, *21*(5), 445–464. doi:10.1016/S0308-597X(97)00016-X

Prell, C., Hubacek, K., & Reed, M. (2009). Stakeholder analysis and social network analysis in natural resource management. *Society & Natural Resources*, *22*(6), 501–518. doi:10.1080/08941920802199202

Pressey, R. L. (2002). The first reserve selection algorithm—a retrospective on Jamie Kirkpatrick's 1983 paper. *Progress in Physical Geography*, *26(3),* 434–441.

Pressey, R. L., & Bottrill, M. C. (2009). Approaches to landscape- and seascape-scale conservation planning: Convergence, contrasts and challenges. *Oryx*, *43*(4), 464-475. doi:10.1017/S0030605309990500

Pressey, R. L., Mills, M., Weeks, R., & Day, J. C. (2013). The plan of the day: Managing the dynamic transition from regional conservation designs to local conservation actions. *Biological Conservation*, *166*, 155–169. doi:10.1016/j.biocon.2013.06.025

R Development Core Team. (2005). R: A language and environment for statistical computing, reference index version 2.x.x. R Foundation for Statistical Computing, Vienna, Austria. Retrieved from http://www.r-project.org

Raymond, C. M., & Brown, G. (2011). Assessing conservation opportunity on private land: Socio-economic, behavioral, and spatial dimensions. *Journal of Environmental Management*, *92*(10), 2513–2523. doi:10.1016/j.jenvman.2011.05.015

Raymond, C. M., Kenter, J. O., Plieninger, T., Turner, N. J., & Alexander, K. A. (2014). Comparing instrumental and deliberative paradigms underpinning the assessment of social values for cultural ecosystem services. *Ecol. Econ.*, *107*, 145–156. doi:10.1016/j.ecolecon.2014.07.033

Reed, M. S. (2008). Stakeholder participation for environmental management: A literature review. *Biological Conservation*, *141*(10), 2417–2431. doi:10.1016/j.biocon.2008.07.014

Reed, M. S., Fraser, E. D. G., & Dougill, A. J. (2006). An adaptive learning process for developing and applying sustainability indicators with local communities. *Ecological Economics*, *59*(4), 406–418. doi:10.1016/j.ecolecon.2005.11.008

Reed, M. S., Graves, A., Dandy, N., Posthumus, H., Hubacek, K., Morris, J., … Stringer, L. C. (2009). Who's in and why? A typology of stakeholder analysis methods for natural resource management. *Journal of Environmental Management*, *90*(5), 1933–1949. doi:10.1016/j.jenvman.2009.01.001

Reed, M. S., Stringer, L. C., Fazey, I., Evely, A. C., & Kruijsen, J. H. J. (2014). Five principles for the practice of knowledge exchange in environmental management.

Journal of Environmental Management, 146, 337–345.
doi:10.1016/j.jenvman.2014.07.021

Rimmer, A. (2009). *Tiritiri Matangi: A Model of Conservation*. New Zealand: Random House New Zealand.

Rivera, R., & Newkirk, G. F. (1997). Power from the people: A documentation of non-governmental organizations' experience in community-based coastal resource management in the Philippines. *Ocean & Coastal Management, 36*(1-3), 73–95. doi:10.1016/S0964-5691(97)00021-5

Roy, H., Pocock, M., Preston, C., Roy, D., Savage, J., Tweddle, J., & Al., E. (2012). *Understanding citizen science & environmental monitoring*. NERC Centre for Ecology & Hydrology and Natural History Museum on behalf of UK-EOF. Retrieved from https://www.ceh.ac.uk/sites/default/files/citizensciencereview.pdf

RStudio Team (2015). RStudio: Integrated Development for R. RStudio, Inc., Boston, MA. Retrieved from http://www.rstudio.com

Salafsky, N., Salzer, D., Stattersfield, A. J., Hilton-Taylor, C., Neugarten, R., Butchart, S. H. M., Collen, B., Cox, N., Master, L. L., O'Conner, S., & Wilkie, D. (2008). A standard lexicon for biodiversity conservation: Unified classifications of threats and actions. *Conservation Biology, 22*, 897–911. doi:10.1111/j.1523-1739.2008.00937.x

Sanderson, E. W., Redford, K. H., Vedder, A., Coppolillo, P. B., & Ward, S. E. (2002). A conceptual model for conservation planning based on landscape species requirements. *Landscape and Urban Planning, 58*(1), 41–56. doi:10.1016/S0169-2046(01)00231-6

Sandström, A., Crona, B., & Bodin, Ö. (2014). Legitimacy in co-management: The impact of preexisting structures, social networks, and governance strategies. *Environmental Policy and Governance, 24*(1), 60–76. doi:10.1002/eet.1633

Saunders, B. A., & Burbidge, A. A. (1988). *Ecological theory and biological management of ecosystems*. (Occasional Paper No 1/88). Western Australia: Department of Conservation and Land Management.

Sbrocchi, C. D. (2014). *Evaluating the usefulness of citizen science for natural resource management in marine environments*. (Doctoral thesis, University of Technology Sydney, Sydney, Australia). Retrieved from https://opus.lib.uts.edu.au/research/handle/10453/24209

Schultz, W. P. (2001). The structure of environmental concern: Concern for self, other people, and the biosphere. *Journal of Environmental Psychology, 21*(4), 327–339. doi:10.1006/jevp.2001.0227

Schultz, L., Folke, C., Österblom, H., & Olsson, P. (2015). Adaptive governance, ecosystem management, and natural capital. *Proceedings of the National Academy of Sciences, 112*(24), 7369-7374. doi:10.1073/pnas.1406493112

Sea Change—Tai Timu Tai Pari. (2014a). *Our approach.* Retrieved July 12, 2015, from
http://www.seachange.org.nz/About-Sea-Change/Our-approach/

Sea Change—Tai Timu Tai Pari. (2014b). *Roundtables.* Retrieved July 12, 2015, from
http://www.seachange.org.nz/SWG-in/Roundtables/

Sea Change—Tai Timu Tai Pari. (2014c). *What is Sea Change—Tai Timu Tai Pari?*
Retrieved July 12, 2015, from http://www.seachange.org.nz/PageFiles/311/What is
Sea Change fact sheet August.pdf

SeaSketch. (2015). *Sea Change: comprehensive planning in the Hauraki Gulf, New Zealand.*
Retrieved July 12, 2015, from http://www.seasketch.org/case-
studies/2014/05/28/doc.html

Seddon, J. A., Barratt, T. W., Love, J., Drielsma, M., Briggs, S. V., Gibbons, P., & Ferrier,
S. (2010). Linking site and regional scales of biodiversity assessment for delivery of
conservation incentive payments. *Conservation Letters*, *3*(6), 415–424.
doi:10.1111/j.1755-263X.2010.00135.x

Seymour, E., Curtis, A., & Pannell, D. (2010). Understanding the role of assigned values
in natural resource management. *Australasian Journal of Environmental Management*,
17(3), 142–153.

Shanley, P., & Lopez, C. (2009). Out of the loop: Why research rarely reaches policy
makers and the public and what can be done. *Biotropica*, *41*(5), 535–544.
doi:10.1111/j.1744-7429.2009.00561.x

Shucksmith, R., Gray, L., Kelly, C., & Tweddle, J. F. (2014). Regional marine spatial
planning – The data collection and mapping process. *Marine Policy*, *50*, 1–9.
doi:10.1016/j.marpol.2014.05.012

Shucksmith, R. J., & Kelly, C. (2014). Data collection and mapping – Principles, processes
and application in marine spatial planning. *Marine Policy*, *50*, 27–33.
doi:10.1016/j.marpol.2014.05.006

Soulé, M. (1985). What is conservation biology? *BioScience*, *35*(11), 727–734.
doi:10.2307/1310054

Stern, P. C., Kalof, L., Dietz, T., & Guagnano, G. A. (1995). Values, beliefs, and
proenvironmental action: Attitude formation toward emergent attitude objects.
Journal of Applied Social Psychology, *25*(18), 1611–1636. doi:10.1111/j.1559-
1816.1995.tb02636.x

Stringer, L. C., & Reed, M. S. (2007). Land degradation assessment in southern Africa:
integrating local and scientific knowledge bases. *Land Degradation and Development*,
18(1), 99–116. doi:10.1002/ldr.760

Sullivan, B. L., Aycrigg, J. L., Barry, J. H., Bonney, R. E., Bruns, N., Cooper, C. B., … Wood, C. L. (2014). The eBird enterprise: An integrated approach to development and application of citizen science. *Biological Conservation*, *169*, 31–40. doi:10.1016/j.biocon.2013.11.003

Szabo, J. K., Fuller, R. A., & Possingham, H. P. (2012). A comparison of estimates of relative abundance from a weakly structured mass-participation bird atlas survey and a robustly designed monitoring scheme. *Ibis*, *154*(3), 468–479. doi:10.1111/j.1474-919X.2012.01229.x

Tallis, H., & Lubchenco, J. (2014). A call for inclusive conservation. *Nature*, *515*, 27–28. doi:10.1038/515027a

Tengö, M., Brondizio, E. S., Elmqvist, T., Malmer, P., & Spierenburg, M. (2014). Connecting diverse knowledge systems for enhanced ecosystem governance: the multiple evidence base approach. *Ambio*, *43*(5), 579–591. doi:10.1007/s13280-014-0501-3

Thompson, S. C. G., & Barton, M. A. (1994). Ecocentric and anthropocentric attitudes toward the environment. *Journal of Environmental Psychology*, *14*(2), 149–157. doi:10.1016/S0272-4944(05)80168-9

Treml, E. A., Fidelman, P. I. J., Kininmonth, S., Ekstrom, J. A., & Bodin, Ö. (2015). Analyzing the (mis)fit between the institutional and ecological networks of the Indo-West Pacific. *Global Environmental Change*, *31*, 263–271. doi:10.1016/j.gloenvcha.2015.01.012

Tulloch, A. I. T., Possingham, H. P., Joseph, L. N., Szabo, J., & Martin, T. G. (2013). Realising the full potential of citizen science monitoring programs. *Biological Conservation*, *165*, 128–138. doi:10.1016/j.biocon.2013.05.025

Tulloch, A. I. T., Tulloch, V. J. D., Evans, M. C., & Mills, M. (2014). The value of using feasibility models in systematic conservation planning to predict landholder management uptake. *Conservation Biology*, *28*(6), 1462–1473. doi:10.1111/cobi.12403

Van Riper, C. J., & Kyle, G. T. (2014). Capturing multiple values of ecosystem services shaped by environmental worldviews: A spatial analysis. *Journal of Environmental Management*, *145*, 374–384. doi:10.1016/j.jenvman.2014.06.014

Vance-Borland, K., & Holley, J. (2011). Conservation stakeholder network mapping, analysis, and weaving. *Conservation Letters*, *4*(4), 278–288. doi:10.1111/j.1755-263X.2011.00176.x

Voyer, M., Gladstone, W., & Goodall, H. (2015). Obtaining a social licence for MPAs – influences on social acceptability. *Marine Policy*, *51*, 260–266. doi:10.1016/j.marpol.2014.09.004

Waitangi-Tribunal. (1985). *Report of the Waitangi Tribunal on the Muriwhenua Fishing Claim.* Wellington, New Zealand.

Walker, B., Holling, C., Carpenter, S. R., & Kinzig, A. (2004). Resilience, adaptability and transformability in social-ecological systems. *Ecology and Society*, *9*(2), 9. Retrieved from http://www.ecologyandsociety.org/vol9/iss2/art5/

Weeks, R. (2010). *Developing marine protected area networks in the Philippines: Reconciling regional-scale planning with community-based implementation.* (Doctoral thesis, James Cook University, Townsville, Australia). Retrieved from http://researchonline.jcu.edu.au/19005/

Weeks, R., Aliño, P. M., Atkinson, S., Beldia, P., Binson, A., Campos, W. L., … White, A. T. (2014). Developing marine protected area networks in the Coral Triangle: Good practices for expanding the Coral Triangle Marine Protected Area System. *Coastal Management*, *42*(2), 183–205. doi:10.1080/08920753.2014.877768

Wesley, S. P. (2001). The structure of environmental concern: Concern for self, other people, and the biosphere. *Journal of Environmental Psychology*, *21*(4), 327–339. doi:10.1006/jevp.2001.0227

Westley, F. R., Tjornbo, O., Schultz, L., Olsson, P., Folke, C., Crona, B., & Bodin Ő (2013). A theory of transformative agency in linked social-ecological systems. *Ecology and Society*, *18*(3), 27. doi:10.5751/ES-05072-180327

White, A., Christie, P., D'Agnes, H., Lowry, K., & Milne, N. (2005). Designing ICM projects for sustainability: lessons from the Philippines and Indonesia. *Ocean & Coastal Management*, *48*, 271–296.

White, G. F., Kates, R. W., & Burton, I. (2001). Knowing better and losing even more: the use of knowledge in hazard management. *Global Environmental Change Part B: Environmental Hazards, 3*, 81–92. doi:10.1016/S1464-2867(01)00021-3

Whitehead, A. L., Kujala, H., Ives, C. D., Gordon, A., Lentini, P. E., Wintle, B. A., Nicholson, E., & Raymond, C. M. (2014). Integrating biological and social values when prioritising places for biodiversity conservation. *Conservation Biology, 28*(4), 992-1003. doi:10.1111/cobi.12257

World Parks Congress. (2014). *The Promise of Sydney: innovative approaches to reaching conservation goals.* Retrieved May, 30, 2015 from http://worldparkscongress.org/drupal/node/140

Wyborn, C. (2015a). Co-productive governance: A relational framework for adaptive governance. *Global Environmental Change*, *30*, 56–67. doi:10.1016/j.gloenvcha.2014.10.009

Young, O. R., Osherenko, G., Ekstrom, J., Crowder, L. B., Ogden, J., Wilson, J. A., … Peach, R. (2007). Solving the crisis in ocean governance: Place-based management of

marine ecosystems. *Environment: Science and Policy for Sustainable Development,* *49*(4), 20–32. doi:10.3200/ENVT.49.4.20-33

Glossary

Term	Definition
Actors	Expanded definition of "stakeholders" to include any individuals, groups, or organisations likely to affect, or be affected by, conservation. May also include residents, citizens, and members of the public (McGinnis & Ostrom, 2014; Ostrom, 2007, 2009).
Adaptive conservation planning (adaptive planning)	A planning approach that encourages iterative updates to fine-tune the original plan as understanding improves, new information becomes available, threats change, conservation interventions are evaluated, and feedback loops become apparent in the system (Mills et al., 2015; Pressey et al., 2013).
Citizen science	A method for integrating voluntary information, local knowledge, and public involvement in conservation (Bonney et al., 2014).
Conservation action	Implementable conservation interventions that contribute to achieving a conservation goal (Salafsky et al., 2008).
Conservation goal	A strategic objective to improve the status of biodiversity, ecosystem types, and processes, and enhance the benefits of conservation to people (CBD, 2010; World Parks Congress, 2014).
Conservation opportunity	A set of circumstances that facilitate the successful implementation of a conservation action to achieve a conservation goal (Knight et al., 2010; Moon et al., 2014).
Governance	The decision-space where knowledge is produced, shared, and used, within which conservation planning and management is undertaken (Bennett, 2015; Lockwood, 2010).
Implementation gap	The gap between knowledge and effective action (Knight et al., 2006, 2008).
Knowledge	Diverse ways of knowing, including scientific, local, indigenous, practical, and experiential types of knowledge (Raymond et al., 2010; Fazey et al., 2014; Reed, 2008).
Knowledge exchange	Processes that produce, share, or use knowledge (Cvitanovic et al., 2015; Fazey et al., 2013; Reed et al. 2014).
Local knowledge	Site-specific and context-dependant knowledge held by local people about the areas they regularly use or visit (Raymond et al., 2010; Reed, 2008).
Management effectiveness	The contribution of management to successfully achieving conservation goals (Bottrill & Pressey, 2012).
Online participatory mapping (participatory mapping)	A process where members of the public can add spatially-referenced voluntary geographic information to an online interactive map of a planning region (Brown & Kyttä, 2014; SeaSketch, 2015).
Social acceptability	Social support for a conservation action, enhancing the liklihood of successful implementation (Voyer et al., 2015; Whitehead et al., 2014).

Term	Definition
Social dimensions	The social components of the social-ecological systems framework, including actors, governance, and local knowledge (Knight et al. 2010).
Social factors	Favourable social conditions that enable the implementation of conservation actions (Ives et al., 2015).
Social network analysis	A key method for understanding interactions between individuals and organisations, and how these interactions affect the efficacy of conservation governance (Bodin & Crona, 2009; Alexander & Armitage, 2015).
Social research agenda	An agenda to provide explicit guidance to researchers, planners, and practitioners on how to better understand the social systems that facilitate and constrain effective conservation action.
Social system	The social, cultural, economic, and political conditions in the conservation system (Ban et al., 2013; Cowling & Wilhelm-Rechman, 2007).
Social-ecological approach	A truly integrative approach that considers both the social and ecological components of the social-ecological system within which conservation takes place (Ban et al., 2013; McGinnis & Ostrom, 2014; Ostrom, 2007, 2009).
Social-ecological system	A framework highlighting how social and ecological systems are intertwined, facilitating the study of complex multi-level systems (McGinnis & Ostrom, 2014; Ostrom, 2007, 2009).
Stakeholders	Any individuals, groups, or organisations with an interest in a conservation planning or action. However, the definition of stakeholder is often narrowed to a small number of key stakeholders rather than a wide set of diverse actors (McGinnis & Ostrom, 2014; Raymond et al., 2014).
Systematic conservation planning (conservation planning)	A conservation planning approach that ensures equitable and representative coverage of biodiversity, ecosystem types, and processes, while enhancing the effectiveness of protection and management (Margules & Pressey, 2000; Pressey & Bottrill, 2009).
Voluntary geographic information (VGI)	Public participation approach aimed at encouraging citizens to act as voluntary sensors to increase the volume and extent of spatial data (Brown & Kyttä, 2014).

Appendices

Appendix A. Ethical approval

AUT
UNIVERSITY
TE WĀNANGA ARONUI O TĀMAKI MAKAU RAU

AUTEC
SECRETARIAT

22 November 2012

Barbara Breen
Faculty of Health and Environmental Sciences

Dear Barbara

Re Ethics Application: **12/221 Understanding socio-ecological systems: Developing a framework to assist in the conservation planning of the Hauraki Gulf Islands.**

Thank you for providing evidence as requested, which satisfies the points raised by the AUT University Ethics Committee (AUTEC).

Your ethics application has been approved for three years until 22 November 2015.

As part of the ethics approval process, you are required to submit the following to AUTEC:

- A brief annual progress report using form EA2, which is available online through http://www.aut.ac.nz/research/research-ethics/ethics. When necessary this form may also be used to request an extension of the approval at least one month prior to its expiry on 22 November 2015;

- A brief report on the status of the project using form EA3, which is available online through http://www.aut.ac.nz/research/research-ethics/ethics. This report is to be submitted either when the approval expires on 22 November 2015 or on completion of the project.

It is a condition of approval that AUTEC is notified of any adverse events or if the research does not commence. AUTEC approval needs to be sought for any alteration to the research, including any alteration of or addition to any documents that are provided to participants. You are responsible for ensuring that research undertaken under this approval occurs within the parameters outlined in the approved application.

AUTEC grants ethical approval only. If you require management approval from an institution or organisation for your research, then you will need to obtain this. If your research is undertaken within a jurisdiction outside New Zealand, you will need to make the arrangements necessary to meet the legal and ethical requirements that apply there.

To enable us to provide you with efficient service, please use the application number and study title in all correspondence with us. If you have any enquiries about this application, or anything else, please do contact us at ethics@aut.ac.nz.

All the very best with your research,

Dr Rosemary Godbold
Executive Secretary
Auckland University of Technology Ethics Committee

Cc: Rebecca Jarvis rjarvis@aut.ac.nz

Appendix B. Māori Research Facilitation Committee approval.

AUT
UNIVERSITY

Private Bag 92006
Auckland 1142, NZ
T: +64 9 921 9999
www.aut.ac.nz

23 November 2012

Rebecca Jarvis
School of Applied Sciences
AUT University

Tena koe

This letter is in support of the study entitled *'Understanding socio-ecological systems: Developing a framework to assist in the conservation planning of the Hauraki Gulf Islands'* investigators Rebecca Jarvis (PhD student), Dr. Barbara Breen (first supervisor) and Dr. Chris Krägeloh (second supervisor), which was presented to the Faculty of Health and Environmental Sciences Māori Research Facilitation Committee on 15 November 2012.

Rebecca Jarvis, Dr. Barbara Breen, Dr. Chris Krägeloh and Dr. Dave Towns met with the Committee, which comprises representatives from the District Health Boards and community Hauora Māori sectors, along with senior AUT academics. The purpose of the Committee is to foster research engagement between faculty research staff and Māori communities or groups and research practice responsive to issues important to Māori health and Māori development and advancement.

The Committee supports the intent of the research and the openness and willingness of the researchers to seek advice and engage with Māori throughout the project, also that there will be outcomes for Māori that will be analysed and fed back to the Māori focus groups.

There are recommendations that are qualifications to the support for this research, namely: that there are Māori focus groups of mana whenua and separate to this there are mātā waka focus groups i.e. Māori who reside in the area but are not mana whenua; that Māori focus groups should be provided with prompts around taonga Māori to inform standard questions and to bring focus to matters important to Māori; that a Te Reo Māori speaker should be present at the focus group meetings to facilitate engagement; that the researchers contact Nick Turoa, the Strategic Iwi Relationships Manager at DoC and Dr. Nicole Coupe, CEO of Hapai Te Hauora Tapui for support with engagement with Māori; that they consider contacting a marae chairperson on each island; that when the draft data analysis is complete, that this be fed back to the focus groups for discussion; and that the draft final analysis and recommendations be presented to the Faculty Committee.

Rebecca Jarvis is required to submit a progress report to the administrator within one year of this presentation, i.e. no later than 15 November 2013. No further presentations to the Māori Research Facilitation Committee can occur until progress in response to the recommendations outlined above, has been reported.

If further information is required please contact Brigitte van Gils, Administrator, Faculty Postgraduate and Research Office, on 09 921 9999 extension 7775, or e-mail: bvangils@aut.ac.nz

Nāku noa, nā

Kate Haswell, Associate Dean (Māori Advancement)

Appendix C. Social network survey

The survey was undertaken using the online Organisational Network Analysis Survey Tool at www.onasurveys.com.

1. Your name:
   [open text box]

2. Do you currently conduct any professional or voluntary conservation work in the Hauraki Gulf?
   - ☐ Yes
   - ☐ No

3. What is the main organisation you work and/or volunteer with?
   [open text box]

4. Please list all the people who you **receive information from** on conservation issues in the Hauraki Gulf Marine Park. This includes information that assists one or both of you in everyday tasks or long-term goals and interests. Please include names of those people both inside and outside of your own organisation:
   *[open text box]*

5. Please list all the people who you **send information to** on conservation issues in the Hauraki Gulf Marine Park. This includes information that assists one or both of you in everyday tasks or long-term goals and interests. Please include names of those people both inside and outside of your own organisation:
   *[open text box]*

The survey software created a node for every participant completing the survey and a node for everyone they name in questions 4 and 5. The software coded the relationship as a positive directional link between the participant and named person in the direction of information flow.

Appendix D. SeaSketch survey screen-caps

Screen-caps of the Hauraki Gulf Marine Park inside the online mapping tool, SeaSketch (www.seasketch.org). The Hauraki Gulf Marine Park was clearly delineated in colour with a red boundary, and participants were able to zoom in and move around the map to increase placement accuracy. Participants added markers and answered survey questions listed in Appendix E.
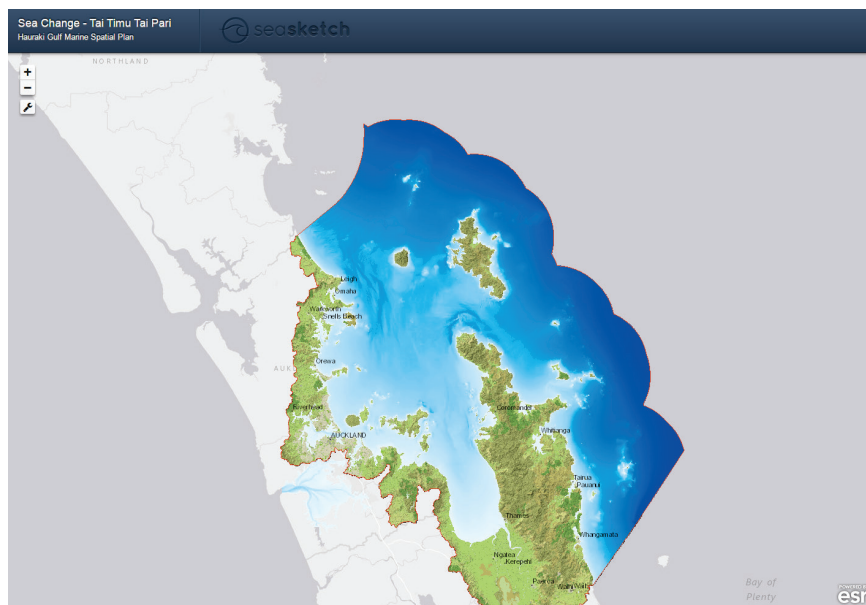
Zoom at full extent.
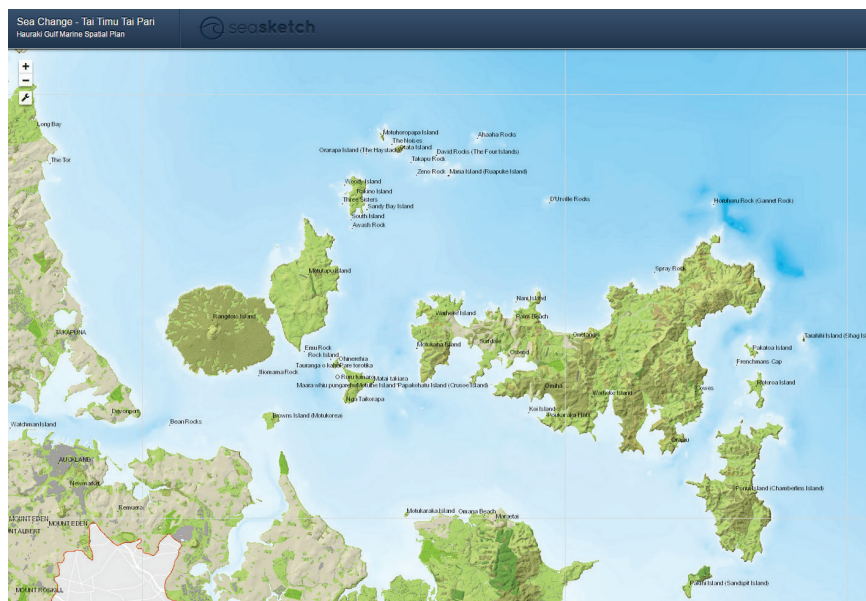
Zoomed in at inner Hauraki Gulf extent.

Appendix E. Social values and citizen science survey

The survey was developed inside the SeaSketch survey tool (Appendix D). After participants dropped a marker on an area important to them on the map they were asked the following questions within the survey tool. Participants could add as many markers to the map as they wished.

Questions at each marker added to the map

1. When was the last time you visited the location?
   - ☐ Never
   - ☐ In the last week
   - ☐ In the last month
   - ☐ In the last six months
   - ☐ In the last year
   - ☐ Over a year ago

2. How many days have you visited the location in the past year
   [option to select a number between 0 and 365]

3. Why is this location important to you? (Please select as many as apply)

   - ☐ Attractive scenery and views, sights, smells or sounds
      [coded as scenic value]
   - ☐ Being wild, uninhabited, or untouched by human activity
      [coded as wilderness value]
   - ☐ Environmental conservation
      [coded as conservation value]
   - ☐ Historical significance
      [coded as historical value]
   - ☐ My community
      [coded as community value]
   - ☐ My culture or heritage
      [coded as cultural value]
   - ☐ My identity
      [coded as identity value]
   - ☐ Native animals, plants, or trees
      [coded as native species value]

☐ Recreation or leisure
[coded as recreation value]

☐ Scientific research
[coded as research value]

☐ Spiritual significance
[coded as spiritual value]

☐ Tourism, travel, or sightseeing
[coded as tourism value]

☐ Work, income, or employment
[coded as employment value]

☐ Because it is my home and I live here
[coded as home value]

4. Who do you visit this location with?
☐ Family
☐ Friends
☐ Colleagues
☐ To spend time on my own
☐ To spend time in nature
☐ Other

5. What activities do you do here? (Please select as many as apply – the list will autocomplete as you type your activity, or add a new activity to the list)

[open field for typing with autofill from a drop-down list, otherwise entered and coded as a new activity. List expands with each new entry. Below is the final list of activities]

☐ 4 wheel drive / dirt bike / quad bike on beach
☐ Aquaculture
☐ Attending a public event
☐ Attending hui and events at my marae
☐ Beachcombing
☐ Bird watching
☐ Boating – anchoring
☐ Boating – charter boat
☐ Boating – launching
☐ Boating – mooring
☐ Boating – motor boating
☐ Boating – racing
☐ Boating – sailing

- ☐ Body boarding / body surfing
- ☐ Camping
- ☐ Caravanning / campervanning
- ☐ Collecting shellfish by diving / snorkelling
- ☐ Collecting shellfish from the shore
- ☐ Conservation / restoration / clean-ups
- ☐ Cycling / mountain biking
- ☐ Dog walking
- ☐ Dragon boating
- ☐ Environmental education
- ☐ Exploring historic sites
- ☐ Exploring the beach / coast
- ☐ Ferry transport
- ☐ Fishing – commercial
- ☐ Fishing – recreation (from boat)
- ☐ Fishing – recreation (line from shore)
- ☐ Gathering kaimoana for tangi or hui
- ☐ Gathering raranga weaving material
- ☐ Gathering rongoa
- ☐ Geocaching / orienteering
- ☐ Golf
- ☐ Hiking / tramping
- ☐ Horseriding
- ☐ Hunting / duck-shooting
- ☐ Jet skiing
- ☐ Kayaking / canoeing
- ☐ Kitesurfing / kiting /
- ☐ Mahinga kai
- ☐ Marine mammal watching
- ☐ Paragliding
- ☐ Photography / underwater photography / underwater filming
- ☐ Picnic / BBQ
- ☐ Playing games / sport
- ☐ Restaurants / bars / cafes
- ☐ Rock climbing
- ☐ Rowing
- ☐ Running / jogging
- ☐ Scientific research
- ☐ SCUBA diving
- ☐ Shipping (mercantile)
- ☐ Shopping

- ☐ Snorkelling
- ☐ Spearfishing
- ☐ Spiritual rite
- ☐ Stand up paddle boarding
- ☐ Sunbathing / relaxing on the beach
- ☐ Surfing
- ☐ Swimming
- ☐ Visiting vineyards / winetasting
- ☐ Volunteering
- ☐ Waka ama training / racing
- ☐ Waka highway
- ☐ Walking
- ☐ Water skiing
- ☐ Wind surfing
- ☐ Yoga / meditation
- ☐ None / Nothing / I don't visit but I think it is important

6. How would you rate the environmental health at this location?
   - ☐ Very good
   - ☐ Good
   - ☐ Ok / average
   - ☐ Poor
   - ☐ Very poor
   - ☐ Don't know / rather not say

7. How has the environmental health at this location changed over the past five years?
   - ☐ Improved
   - ☐ Stayed the same
   - ☐ Degraded
   - ☐ Don't know / rather not say

Questions at the end of survey after all markers have been added

1. Gender
   - ☐ Female
   - ☐ Male
   - ☐ Rather not say

2. Ethnicity
   - ☐ New Zealand European
   - ☐ Māori
   - ☐ Pacific peoples
   - ☐ Asian
   - ☐ Middle Eastern/ Latin American/ African
   - ☐ Other
   - ☐ Rather not say

   [participants could select multiple ethnicities]

3. When were you born?

   [type in birth date – converted to age in years]

4. Where do you live?

   [open field for typing and autofill from a drop-down list of areas within HGMP

   boundary. Alternatively, could select "other", or "rather not say"]

5. Iwi

   [open field for typing and autofill from a complete list of iwi]

Appendix F. Survey participant demographics

Participant demographics for the survey completed in Appendix D (n=1,491).

		Number of participants	Percentage of total participants (%)
Gender	Female	646	43.33
	Male	832	55.80
	Rather not say	13	0.87
Ethnicity*	New Zealand European	1,383	89.28
	Māori	64	4.13
	Pacific peoples	23	1.48
	Asian	43	2.78
	Middle Eastern/ Latin American/ African	10	0.65
	Other	4	0.26
	Rather not say	22	1.42
Age	18 to 29	108	7.24
	30 to 39	187	12.54
	40 to 49	330	22.13
	50 to 59	364	24.41
	60 to 69	338	22.67
	70 to 79	135	9.05
	over 80	9	0.60
	Rather not say	20	1.34
Area lived	Auckland	1,317	88.33
	Waikato	126	8.45
	Other	46	3.09
	Rather not say	2	0.13

* multiple ethnicities were counted separately, giving a total of 1,549 ethnicities across 1,491 participants.