

Ecosystem Services Based Management:
Evaluation of an approach to coastal management
planning and decision making in New Zealand.

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Abstract

The ecosystem services based approach to management offers the potential to improve resource management planning and decision-making under the Resource Management Act 1991 by providing a way to draw together the often competing values contained in the single purpose of ‘sustainable management’ (s5). This thesis used a case study of the East Otago Taiāpure Management Committee and the Environment Court process in *East Otago Taiāpure Management Committee v Otago Regional Council* (2013) to explore values and outcomes of using the ecosystem services based approach for coastal management and in what form the ecosystem services based approach could be incorporated into New Zealand coastal management frameworks. The case study research involved a range of methods including interviews with coastal managers, document analysis of coastal management plans and analysis of expert evidence statements and Environment Court material.

Results of the research showed that a key value of using the ecosystem services based approach is the ability to portray connections between humans and the environment and environmental components. Key outcomes include a greater ability to manage across broader spatial and temporal scales than may otherwise be achieved. Findings highlighted that there is strong potential for ecosystem services to be built into the RMA 1991 and pursuant planning documents to balance competing interests in sustainable management because of the ability to draw connections and manage on wider scales that was demonstrated. Findings also demonstrated that ecosystem services based approaches could be used in planning processes to portray connections and generate resource management decisions which take into account wider scales. However, key limitations to achieving this include short time-frames and miscommunication between coastal stakeholders, who have competing interests.

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List of Abbreviations

AEE	Assessment of Environmental Effects
AO	Alpha Zero
CIA	Cultural Impact Assessment
DOC	Department of Conservation
EMP	Environmental Management Plan
EOT	East Otago Taiāpure
EOTMC	East Otago Taiāpure Management Committee
ESSS	Ecosystem Services Sequential Steps
FA	Fisheries Act 1996
FSAAFAR	Fisheries (South-East Area Amateur Fishing) Amendment Regulations
ICM	Integrated Coastal Management
IPCC	Intergovernmental Panel on Climate Change
MEA	Millennium Ecosystem Assessment
MFE	Ministry for the Environment
MOF	Minister of Fisheries
NIWA	National Institute of Water and Atmospheric Research
NZCPS	New Zealand Coastal Policy Statement
PCE	Parliamentary Commissioner for the Environment
RESA	Rapid Ecosystem Services Assessment
RMA	Resource Management Act 1991
SCBB	Secretariat of the Convention on Biological Biodiversity

Glossary

Aotearoa	New Zealand
Hui	Gathering
Kaimoana	Seafood
Kaitiaki	Guardian
Kaitiakitanga	Guardianship
Kaumātua	Māori elder
Mahinga kai	Customary food
Mana Whenua	People with demonstrated authority
Marae	Meeting grounds
Rangatiratanga	Chieftainship
Rohe	Tribal boundaries
Rūnaka	Māori governing group
Takiwā	District
Tamariki	Children
Tangata Tiaki	Customary fisheries managers
Tangata whenua	People of the land
Taonga	Treasure

Note: English words that closely reflect the meanings of Māori words are used, although it should be recognised that some of the concepts referred to are not able to be fully represented by English words. A mix of Southern and Northern dialects is adopted where needed, which best reflect the dialects used in the case study of the East Otago Taiāpure and the examination of the Environment Court appeal process in *East Otago Taiāpure Management Committee v Otago Regional Council* [2013] 58 ENV 1.

Chapter 1: Introduction

Coastal environments now face a wide variety of threats including a predicted likelihood of increased flooding, exacerbated coastal erosion and the rising of groundwater tables (Parliamentary Commissioner for the Environment, 2015). Changes to coastal process including increases in storm frequencies and intensities, higher peak wind speeds and heavier precipitation are expected to cause these threats (Intergovernmental Panel on Climate Change (IPCC), 2013). The recognition of the impacts of climate change on coastal systems also continues to grow internationally as the acknowledgment of the need to address climate change strengthens, as shown by the recent global agreement to reduce climate change at the 2015 United Nations Climate Change Conference. Coastal environments also face pressures from increased human development and coastal population densities, with nearly 41% of the human population now living within 100km of the coast (Martinez et al., 2013).

There are clear links between changes in the coastal environment, human actions and impacts on coastal ecosystems. Stubler et al. (2015) demonstrated a clear link between increased sediment runoff, which had been caused by coastal development and changes in sponge community ecology. Jackson and McIlvenny (2011) also demonstrated how coastal squeeze, which occurs when sea defences act as a barrier to the retreat of a habitat, has an impact on the abundance and distribution of species in Scottish rock coast environments. There are also clear direct impacts of climate change on coastal ecology, which demonstrate the feedbacks between human actions and coastal ecosystems. For example, novel species interactions between coralline algae and grazing gastropod communities have been shown to be caused by the impacts of climate change on the ecological traits of species that inhabit the coastal environment (Jackson and McIlvenny, 2011). Climate change also has wider impacts on ecosystems by modifying the impacts of invasions and biodiversity (Jackson et al., 2015). In turn, this can modify the contributions of ecosystems to carbon pools and the ability of ecosystems to play a role in carbon dioxide absorption and climate change mitigation (Seto et al., 2012).

Ecosystem services provides a possible mechanism to recognise and provide for coastal ecosystem services within the context of increasing coastal pressures and human impacts on coastal environments. The ecosystem services concept was proposed by Costanza et

al., (1997) and was developed into a widely accepted framework through the Millennium Ecosystem Assessment (2005). The MEA was carried out from 2001-2005 with the aim of facilitating better decision making at multiple scales, in response to a call by United Nations Secretary-General at the time, Kofi Annan (Ash et al., 2010). The MEA (2005) framework divides ecosystem services into four main categories; provisioning services which are natural resources that are exploited for use, regulatory services which are services which regulate essential ecological functions, supporting services which underpin other ecosystem services and cultural services which are the non-material benefits derived from the environment (Townsend and Thrush, 2010). Ecosystem services assessment measures the benefits that humans can derive from ecosystem processes and functions (Luisetti et al., 2011a).

Advantages of using the ecosystem services based approach in environmental management and planning include the ability of the ecosystem services concept to connect environments and humans by considering both the ecosystem that provides the services and the humans who may be affected by these services (Ash et al., 2010). Ecosystem services also has the potential to reduce complexity and to encourage stakeholder participation in coastal management decisions (Lithgow et al., 2013). Macdiarmid et al. (2013) have also shown that the ecosystem services assessment can be used to show the spatial distribution of ecosystems with different levels of service provision. However, the ecosystem services concept has had limited use in New Zealand. The approach was applied to determine the goods and services provided by the Hauraki Gulf in an aquaculture risk assessment for Waikato Regional Council (NIWA, 2013). Where applied in New Zealand, the general principles approach has been used to categorise ecosystem services, using ecological principles amongst different ecosystem service categories to determine the delivery of ecosystem goods and services (Townsend and Thrush, 2010).

New Zealand coastal environments provide an important range of ecosystem services estimated to be worth \$357 US billion per year (MacDiarmid et al., 2013). MacDiarmid et al. (2013) identify 12 regulatory, 5 provisioning and 9 non-consumptive services, including the important role of marine ecosystems in food provision and the habitat supporting role played by some species of the marine ecosystem which connects trophic levels. As an example of the ecosystem services provided by New Zealand coastal ecosystems, Win (2011) shows that there are strong associations of reef fish and epifaunal

species with macroalgal habitats on the East Otago coastline of New Zealand, indicating that kelp ecosystems on rocky reefs are extremely valuable to coastal areas because they facilitate healthy fish populations and subsequently providing food provisioning services for humans. Coastal development and other human impacts may affect coastal environments and the ecosystem services provided, having flow on effects for human wellbeing (Jackson and McIlvenny, 2011). Despite this awareness, there has been little application of the ecosystem services based approach to establish the range of ecosystem services that New Zealand coastal environments provide, the management techniques which can be used to protect these services and the wider benefits for New Zealand economy and society from doing this.

Internationally, there has been a shift towards sustainable development through the production of the Brundtland Report (1987) which defines sustainable development as meeting the needs of the present without compromising future generations and the development of Agenda 21 and commitment to a set of 17 goals through the Rio Summit (1992). New Zealand was one of the first countries to take the international concept of sustainable development and embed it in national legislation by enacting the Resource Management Act (RMA) 1991, with the single purpose of ‘sustainable management’ in section 5 (de Freitas and Perry, 2013). The RMA 1991 is intended to provide a holistic and integrated framework for the management of natural resources in New Zealand. In the New Zealand planning context, ecosystem services provides a possible way to balance the often ‘competing and indeterminate’ ecological and social interests contained in the sustainable management purpose of the RMA 1991 by considering the connections between humans and the environment (Palmer, 1995, p147; Ash et al., 2010).

There is also scope to consider how ecosystem services can be used in subordinate coastal management documents, including the New Zealand Coastal Policy Statement (NZCPS) (2010) and in Regional Coastal Plans. Ecosystem services could be used in these planning documents to achieve sustainable management in relation to the objectives of the documents. Alongside this, ecosystem services could be used in a variety of planning processes to reduce complexity and achieve integrated management (Lithgow et al., 2013). Planning processes include resource consent decision making, consultation and plan-making (Quality Planning, 2016). There has been a recent upsurge in investigating how ecosystem services could be incorporated into New Zealand resource management and planning frameworks and to assist in decision-making (Greenhalgh and Hart, 2015).

However, a range of key challenges remain, including obtaining adequate ecosystem knowledge, recognising cultural values and the use of ecosystem indicators (Greenhalgh and Hart, 2015).

There is considerable scope to consider if benefits might arise from the use of ecosystem services in resource management and planning in New Zealand and internationally, given the prominence of coastal management in New Zealand and the rise of ecosystem services in international environmental management agendas and its potential for use to create a more holistic and integrated approach to resource management decisions in New Zealand, which recognises and plans for connections between ecosystem components. Investigation of the ecosystem services framework and its applicability to resource management is particularly valuable in New Zealand where the challenge of implementing sustainable management through the RMA (1991) and the pursuant planning framework is ongoing. Investigating ecosystem services in relation to coastal environments is particularly relevant given that coastal environments harbour a unique opportunity for cumulative ecosystem service benefits to be gained which are more significant and unique than other single service ecosystems because of their positioning as connecting points between the interface of coasts, lands and watersheds (Barbier et al., 2011).

1.1 Research Objectives

The aim of this thesis is to evaluate the role of ecosystem services based approaches in coastal management and coastal management decision making processes. This research involves a case study of the coastal management approach of the East Otago Taiāpure Management Committee to manage the East Otago Taiāpure and an examination of the Environment Court appeal process in *East Otago Taiāpure Management Committee v Otago Regional Council* [2013] 58 ENV 1 to evaluate the role of ecosystem services in resource management and planning processes. Both case studies are used to inform an understanding of how ecosystem services assessment could fit into the RMA 1991 and the current pursuant planning framework. The key findings will relate broadly to coastal management decision making processes and wider resource management decision making processes. The study is guided by the following research objective:

To determine whether ecosystem services based approaches can be used to improve coastal management decision making processes within New Zealand's resource management framework.

The following research questions seek to inform the overall research objective:

1. What is the value of using ecosystem services for coastal management and decision making?
2. Does the use of ecosystem services in coastal management lead to improved outcomes for the coastal environment?
3. In what form can ecosystem services be incorporated into coastal management and planning frameworks in New Zealand?

Research Question 1 seeks to establish if there are benefits to using an ecosystem services based approach for coastal management in practice. Establishing this helps to identify best practice approaches to ecosystem services based management that can be used in the resource management context. Research Question 2 seeks to determine if ecosystem services based coastal management leads to improved outcomes for coastal environments. This research question seeks to establish whether there are gains that can be made from the use of ecosystem services in coastal management and decision making. Research Question 3 seeks to identify opportunities to integrate ecosystem services based concepts into New Zealand coastal management policy and planning frameworks. These research questions build towards an understanding of how ecosystem services can be applied to decision making in appropriate contexts for enhanced coastal management decision making and coastal environment outcomes. Overall, the research aims to establish whether an ecosystem services based approach to coastal management can contribute to the sustainable management of New Zealand's natural and physical resources under the RMA 1991. This research will also provide international lessons for incorporating sustainable development, sustainable management and related ecosystem service concepts into planning frameworks by demonstrating how the concepts can be built into environmental management frameworks in a way which has practical outcomes in its implementation.

The research questions will be answered through the examination of case studies where approaches which can be broadly classed as ecosystem service based approaches have been employed for coastal management and used within planning processes. Environment

Court decisions and environmental management legislation will be analysed to determine the usefulness of ecosystem services for resource management in planning processes and the RMA 1991 framework. Document analysis will also be carried out to determine the appropriateness of ecosystems services within coastal management policies and plans. The study contributes to the body of knowledge relating to the potential for ecosystem services to be used for coastal management and decision making. The research follows from the international development of the ecosystem services framework and seeks to determine the applicability of the use of ecosystem services assessment for the sustainable management of New Zealand's natural resources. Consequently, the applicability of ecosystem services to planning and management internationally will be highlighted through local case studies, demonstrating that local research can inform global resource management questions.

1.2 Thesis Structure

This thesis consists of 9 chapters. Chapter 1 provides an overview of the broad context, aims and objectives of the research. Chapter 2 undertakes a critical review of the literature on coastal ecosystem services and ecosystem services based coastal management approaches. The review provides a general context of ecosystem services based management and coastal management with a particular focus on human impacts on ecosystems and the services they provide, and focusses on establishing best practice principles for ecosystem services based approaches to coastal management. Chapter 3 outlines the overall research approach taken in the thesis and the particular research methods used to collect and analyse data to answer the research question and address the objective of the thesis. Chapter 4 presents the context of the two case studies; the East Otago Taiāpure and *East Otago Taiāpure Management Committee v Otago Regional Council* [2013] 58 ENV 1. Chapters 5, 6 and 7 present the results and discussion to answer research question 1, 2 and 3 for both case studies through analysis of primary research data and discusses the main findings in the context of the literature review. Chapter 8 presents a discussion and results surrounding the key research objective, drawing on the findings of the three previous chapters. Chapter 9 contains a synthesis of the findings to conclude the thesis and presents recommendations for future coastal management, future areas of research, the incorporation of the ecosystem services based approach into the RMA 1991 planning framework and lessons for international coastal management.

Chapter 2: Literature Review

2.1 Introduction

This literature review provides an overview and critical analysis of coastal management and ecosystem services literature, to address the aim of understanding whether ecosystem services contributes to the improvement of coastal management decision making in New Zealand and in what form it can be brought into planning frameworks. The ecosystem services concept is explored and ecosystem services assessment is defined. New Zealand marine ecosystem services and the frameworks for understanding them are evaluated and ecosystem services valuation is assessed. The second part of the literature review explores coastal management options and the impacts of coastal management on ecosystem services. The development of the understanding of the use of ecosystem services assessment for coastal management is then examined. This builds towards an understanding of whether ecosystem services based approaches to coastal management could improve coastal management outcomes and provide benefits for coastal management decisions and how and in what form the ecosystem services concept can ultimately be brought into the planning and resource management framework in New Zealand and internationally for more sustainable forms of coastal management.

2.2 Ecosystem Services and Sustainable Management

2.2.1 Ecosystem Services and the Resource Management Act 1991

The most widely used definition of ecosystem services is the Millennium Ecosystem Services Assessment (2005) definition of ‘the direct and indirect benefits that humans derive from the natural environment’. The MEA (2005) provides an overarching framework for ecosystem services and divides ecosystem services into four main categories; Provisioning services exploited for human use as food or other material resources, regulatory services which regulate essential ecosystem functions, supporting services which underpin other services and provide indirect benefits and cultural services which provide non-material benefits that humans derive from the environment (Townsend and Thrush, 2010). The MEA (2005) ecosystem services framework with key services in each ecosystem service category is shown in Figure 2.1.

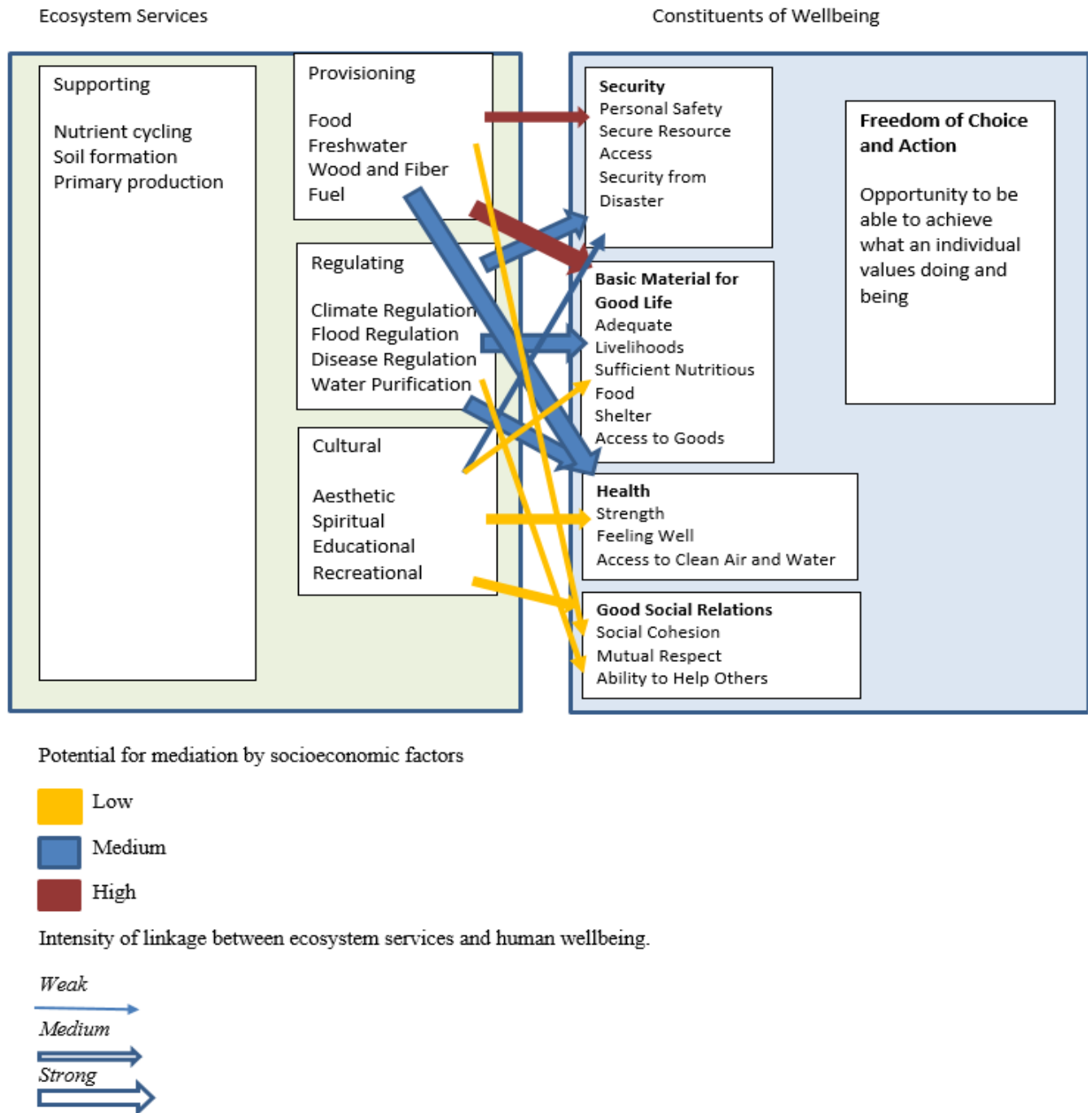


Figure 2.1: Ecosystem services framework. The four key service categories are shown in the green box. The strength of the connection of each service with the 5 constituents of human wellbeing as defined by the MEA (2005) are indicated by the thickness of the connecting arrow to the blue box. The colour of the arrow demonstrates the potential for mediation by socioeconomic factors. For example, the thickness of the arrow from provisioning ecosystem services suggests a medium ability to mediate socio economic factors and a strong intensity of linkage to human well-being. Regulating services show medium links with 3 wellbeing types and cultural services have weak links with low potential for socioeconomic mediation to the majority of service types (MEA, 2005).

Figure 2.1 shows that there are particularly strong connections between provisioning and regulatory services and health outcomes and weak connections between provisioning and regulatory services and social relations. Examples of ecosystem services provided by the coastal environment which create connections between environmental and human systems include environmental education and research (Ronnback et al., 2007) and the provision of foci points for scientific research and monitoring at local, regional and global scales (Macdiarmid et al., 2013). Overall, Figure 2.1 demonstrates how the MEA (2005) framework defines the environment broadly, connecting ecosystem services provided by a given environment to social, cultural and economic factors, assuming that people are integral parts of ecosystems (Ash et al., 2010; Fig 2.1). The MEA (2005) definition of ecosystem services aligns with the RMA 1991 definition of sustainable management because sustainable management in the RMA 1991 is also defined broadly to incorporate human and environmental components:

S5: (2) managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well-being and for their health and safety while—

- (a) Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and
- (b) Safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and
- (c) Avoiding, remedying, or mitigating any adverse effects of activities on the environment.

Sustainable management is interpreted as requiring resources to be used in a way which enables social well-being while sustaining and safeguarding the environment (Curran, 2004). This requires a balancing approach to be taken by decision makers rather than treating the environmental components of the definition as a bottom line which must be met in order for sustainable management to occur (Curran, 2004). The similarities in the broad definition of environment in the sustainable management purpose of the RMA 1991 and the ecosystem services concept developed by the MEA (2005) suggest that ecosystem services could be used as an environmental tool to assist in achieving sustainable management of resources under the RMA 1991 planning framework.

The New Zealand Coastal Policy Statement (NZCPS, 2010) sits underneath the RMA 1991 and contains policies in order to achieve the purpose of sustainable management contained in the RMA 1991 in relation to the coastal environment of New Zealand.

Regional policy statements, regional plans and district plans give effect to the NZCPS (2010). Therefore, the NZCPS (2010) provides a powerful way forward for ecosystem services to be brought into New Zealand's resource management framework. This thesis will identify key gaps and opportunities for the ecosystem services concept to be brought into the framework as well as best practice methods of ecosystem services based approaches to management that should be incorporated.

The particular objectives of the NZCPS (2010) that will be focussed on include:

Objective 1: To safeguard the integrity, form, functioning and resilience of the coastal environment and sustain its ecosystems, including marine and intertidal areas, estuaries, dunes and land

Policy 11: To protect indigenous biological diversity in the coastal environment:

(iii) indigenous ecosystems and habitats that are only found in the coastal environment and are particularly vulnerable to modification, including estuaries, lagoons, coastal wetlands, dunelands, intertidal zones, rocky reef systems, eelgrass and saltmarsh;

Policy 12: Human impacts through discharges

(1) Provide in regional policy statements and in plans, as far as practicable, for the control of activities in or near the coastal marine area that could have adverse effects on the coastal environment by causing harmful aquatic organisms to be released or otherwise spread, and include conditions in resource consents, where relevant, to assist with managing the risk of such effects occurring.

(2) Recognise that activities relevant to (1) include:

(b) The discharge or disposal of organic material from dredging, or from vessels and structures, whether during maintenance, cleaning or otherwise; and whether in the coastal marine area or on land;

Objective 1 is relevant to this research because it recognises that coastal environments are complex and dynamic and seeks to manage coastal environments in this way. The policies that have been selected as a focus for the study further the recognition of the connected nature of ecosystems and the importance of managing human impacts on ecosystems, which could flow on to have impacts on ecosystems and the services which they provide.

2.2.2 Ecosystem Services and Planning Frameworks

Currently, there is little direct or explicit reference to ecosystem services based approaches in planning frameworks, despite the recent upsurge in studies which critique the use of ecosystem concepts for decision making (Greenhalgh and Hart, 2005). Research which addresses this knowledge gap is warranted. The most recent definitions of ecosystem services may better achieve the sustainable management purpose of the RMA (1991) than early definitions if they are incorporated into planning frameworks in New Zealand. These definitions use the MEA (2005) definition of ecosystem services as a platform and re-orientate the concept so that it is better suited to policy contexts (Turner et al., 2010). The more recent definitions focus on the ecosystem services themselves rather than the benefits derived from ecosystems (Luisetti et al., 2011a). Defining ecosystem services in this way explicitly recognises ecosystem services as ecological phenomena of the ecosystem rather than focussing on the human welfare benefit component of the service (Fisher et al., 2009). This is distinct from Costanza et al. (1997, p.253) whose original definition of ecosystem services as “the benefits human populations derive, directly or indirectly, from ecosystem functions” focusses on the benefits derived from the ecosystem service provider.

Boyd and Banzhof (2007, p.619) were the first to shift away from the early definition of ecosystem services as benefits by proposing that the ecosystem services are the “components of nature, directly enjoyed, consumed or used to yield human well-being”. Fisher et al. (2009) further extended this to define ecosystem services as the link between ecosystems and the things that humans benefit from. The use of this definition in planning may connect human and environmental outcomes through focussing planning on societally important ecological components of the ecosystem, ultimately improving coastal decision making and leading to better coastal management outcomes. Figure 2.2 shows the recent recognition of the connections between ecosystem services and human wellbeing (Townsend and Thrush, 2010).

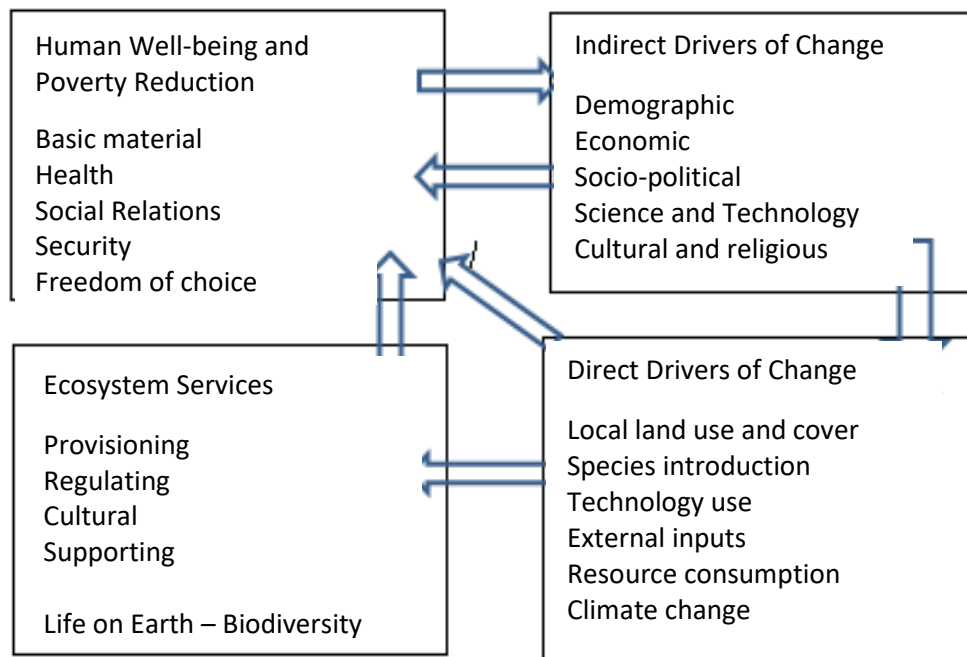


Figure 2.2: Interactions between ecosystem services and human wellbeing. Processes operate on a variety of spatial and temporal scales. Multiple interactions exist, including two way interactions between human well-being and poverty and indirect drivers of change. Ecosystem services are impacted by direct drivers of change, which are impacted by the other factors (adapted from MEA 2005 framework, Townsend and Thrush, 2010).

Building ecosystem services concepts into coastal planning frameworks could help to achieve the sustainable management purpose of the RMA 1991 by recognising and providing for ecosystem services at a variety of spatial and temporal scales and across ecosystems (Townsend and Thrush, 2010). This is particularly important in the management of coastal environments because they are connecting points between the interface of coasts, lands and watersheds (Barbier et al., 2011). The connections between coastal environments and other environments creates a unique opportunity for cumulative ecosystem service benefits that are more significant and unique than other single service ecosystems (Barbier et al., 2011). This makes coastal environments and their ecosystem services an important focus in achieving the sustainable management purpose of the RMA (1991).

Ecosystem services in planning frameworks could also help to recognise and plan for the contributions of ecosystems to wider coastal processes and climate phenomena. This recognition is becoming increasingly important as the direct impacts of human activities

on wider climate processes becomes increasingly recognised (Arias and Menendez, 2014). For example, coastal environments are now beginning to be recognised for their 'blue carbon' role, which means they capture and store carbon (Siikimäki et al., 2013). Coastal vegetation such as mangroves can sequester and bury up to 16 million ton of Carbon per year and CO₂ would be 70% greater than it currently is without the role which phytoplankton play in photosynthesis globally (Siikimäki et al., 2013; Siegenthaler and Sarmiento, 1993). The ecosystem services concept could make an important contribution to sustainable management if brought into planning frameworks, by highlighting the feedbacks between coastal and marine environments to reduce the sea level rise and coastal erosion problems which they are facing.

Ecosystem services incorporation into planning frameworks is also important in order to recognise and plan for the component parts of the ecosystems including goods, processes and functions provided by ecosystems (Fisher et al., 2009). Early definitions of ecosystem services recognise ecosystem functions as the properties and processes of ecosystems (Costanza et al., 1987). More recent definitions identify ecosystem processes as distinct from functions, being the physical, chemical and biological actions that connect organisms (Townsend and Thrush, 2010). Planning for these processes may be facilitated through the use of ecosystem services in planning frameworks. Ecosystem functions are the sum of the processes that drive energy and matter transfer (Townsend and Thrush, 2010) and ecosystem goods are now identified as the tangible resources that can be extracted from ecosystems for human use (Townsend and Thrush, 2010). The development of the understanding of the ecosystem in these components over time demonstrates the need to recognise and distinguish them in planning, which the ecosystem services concept can help to achieve.

Planning for different forms of ecosystem services may be further facilitated through the ecosystem services definition of Fisher et al. (2009) which separates intermediate and final services. Intermediate services indirectly influence human wellbeing and final services directly contribute to human wellbeing and provide welfare benefits. An example of the connections between intermediate and final services and human benefits for the coastal environment is provided in Figure 2.3.

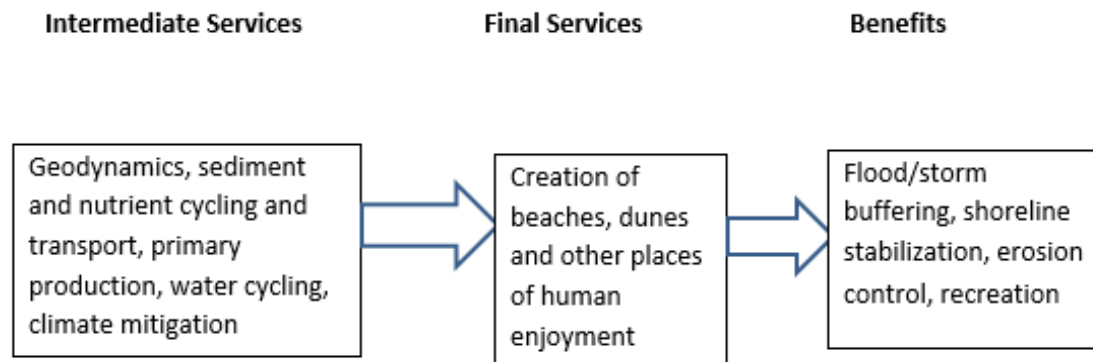


Figure 2.3: Relationships among representative intermediate services, final services and benefits; an example for marine and coastal ecosystems. Underlying processes such as geodynamics are separated from the final services of dune creation, which are then connected to the benefits provided by the dunes such as storm buffering and recreation (Adapted from Fisher and Turner, 2008).

Recognising the context dependency of environmental management approaches could be promoted through use of the ecosystem services concept. Classification of ecosystem services as intermediate or final services is context dependent and final services may differ from an ecosystem service benefit (Turner et al., 2010). Ecosystem services also helps to distinguish ecosystem services globally. Ronnback et al. (2007) identify the threads of blue mussels as an important provisional ecosystem service which provides benefits for glue production, while Townsend and Thrush (2010) identify the anti-cancer properties of *Mycale hentscheli* as an important provisional service in New Zealand which provides benefits for the pharmaceutical industry. Ecosystem services helps to distinguish ecosystem services on a local scale between ecosystems. Soil formation and pollination are not included in the classification of New Zealand coastal and marine ecosystem services they fall outside the scope of the coastal and marine environment (Townsend and Thrush, 2010).

Categorising ecosystem services at a local scale is facilitated through the ecosystem services approach to resource management. Multiple approaches for categorising ecosystem services have been developed since the MEA (2005) framework. These include the division of ecosystem services into core ecosystem processes, beneficial ecosystem processes and beneficial ecosystem services for coastal and marine environments (Fletcher et al., 2012) and the development of a framework suited to rural land management (Wallace, 2007). The latter framework contains principles which apply broadly across ecosystem service frameworks, including the use of a minimum set of

clearly defined terms and the clear characterisation of services and specification of points at which linked processes deliver a service. In New Zealand, the general principles approach is commonly applied to categorise coastal ecosystem services where assessments have been carried out. This involves the application of ecological principles to different ecosystem service categories and the breakdown of provision and utilisation across space to determine the delivery of ecosystem goods and services at spatial scales (Townsend and Thrush, 2010).

2.2.3 Coastal and Marine Ecosystem Services

Ecosystem services have now been studied in relation to a wide range of ecosystem types. For example, Woodward and Wui (2001) performed a meta-analysis of wetland ecosystem services, drawing together 39 studies to identify key services contributed by the ecosystem type. In particular, coastal and marine ecosystem services have been relatively well examined internationally. For example, the ecosystem services of English marine areas carried out by (Fletcher et al., 2012) broke the marine ecosystem into 16 broad scale habitats and 18 habitats of conservation importance and reviews the beneficial ecosystem processes, services and core ecosystem processes of each habitat type. Barbier et al. (2008) also based their study of ecological concepts and ecosystem service principles around mangroves and a range of other coastal ecosystem types, highlighting the value of wave attenuation as a dynamic service that changes over temporal and spatial scales. There has also been a thorough examination of the use of ecosystem services based approaches for coastal management internationally, including assessments to inform managed retreat decisions of Humber and Blackwater estuaries, UK (Luisetti et al., 2011a), flood and coastal erosion risk management schemes in the United Kingdom (Rouquette, 2013), the impacts of coastal squeeze in Scotland (Jackson and McIlvenny, 2011) and the implications of ecosystem shifts in Sweden (Ronnback et al., 2007).

However, there are very few examples of investigations of coastal and marine ecosystem services in New Zealand. Macdiarmid et al. (2013) have carried out one of the few comprehensive nationwide marine ecosystem service assessments in New Zealand. Macdiarmid et al. (2013) identify 12 regulatory, 5 provisioning and 9 non-consumptive services with a possible value of \$357 US billion per year. This total was calculated by identifying services using the Boyd and Banzhof (2007) definition of services as the ecosystem contribution rather than the human contribution towards an activity

(Macdiarmid et al., 2013). The magnitude of each service/unit area/year was assessed by applying the general principles approach which links the provision of ecosystem services with underlying ecosystem processes (Townsend et al., 2011), as described in section 2.2.2. The ecosystem services that were identified through this review are shown in Table 2.1.

Table 2.1: Marine and coastal ecosystem services classification. The twelve main regulatory, five main provisioning services and nine main non-consumptive services are identified. It is demonstrated that marine ecosystem play a diverse role through the services that they provide. The combination of cultural and supporting services in the non-consumptive category is also shown (Macdiarmid et al., 2013).

Ecosystem Service Category	Ecosystem Services
Regulatory	<ul style="list-style-type: none"> • Climate regulation • Biophysical sediment capture • Biological sediment capture • Carbon capture and sequestration • Pollutant capture and sequestration • Pollutant detoxification • Storm surge amelioration • Erosion dampening • Nutrient storage • Nutrient cycling • Net annual O₂ production per unit area • Biogenic habitat material provision
Provisioning	<ul style="list-style-type: none"> • Wild food • Aquaculture • Biological compounds • Bacterial gas and mineral deposits • Biodiversity
Non-Consumptive (cultural and supporting)	<ul style="list-style-type: none"> • Visual amenity • Spiritual and inspirational value • Existence value • Non-water recreational support • Water recreational support • Educational foci • Scientific research foci • Watchable wildlife • Biological indicators of ecosystem health

The framework devised by Macdiarmid et al. (2013) provides a good platform for understanding coastal and marine ecosystem services in the New Zealand context because

it recognises context specific ecosystem services within particular New Zealand regions. Ecosystem services based approaches to coastal management should take into account context specific environmental factors because there may be a context based relationship between services (Turner et al., 2010). Contextual analysis that encompasses appropriate socio-economic, political and cultural parameters should be carried out in order to fully identify ecosystem services and develop an understanding of the baseline knowledge of biophysical and structural processes in a given place (Turner et al., 2010). For example, a study by Desmond et al. (2015) along modified and forested coasts of East Otago has demonstrated the potential of reduced light ability in modified catchments to reduce macroalgal biomass density compared to forested catchments, showing that reductions in light availability could alter the distribution, community composition and productivity of key ecosystem service providers within the ecosystem. Identification of these local services and their modification between environmental types highlights the potential use of ecosystem services based approaches to coastal management for drawing attention to the connections between different scales of environmental systems and the connections between socio-economic and environmental systems.

It is also important to focus on ecosystem services which may be affected by environmental change (Arias and Menendez, 2014). One of the most important changes in the marine environment will be changes to seawater carbonate chemistry as a result of ocean acidification (Arias and Menendez, 2014). Cornwall et al. (2014) demonstrated that there may be feedbacks between marine vegetation and these chemical changes, providing evidence that the coralline macroalgae *Arthrocardia corymbosa* could provide a buffering capacity to lower pH and ocean acidification, by creating localised hydrodynamic conditions where metabolic activity ameliorates the negative impacts of ocean acidification., in a study carried out in *Macrocystis pyrifera*-dominated kelp forest near Kāritane, New Zealand. Changes to climate cycles could also impact phytoplankton communities through chemical and physical changes in the marine environment, while phytoplankton could play a potential role in reducing climate change, as shown by evidence that CO₂ would be 70% higher at present globally without this service (Siegenthaler and Sarmiento, 1993; Arias and Menendez, 2014). This further demonstrates the potential for exploring how the ecosystem service based approach to coastal management could connect the impacts that human activities could have on marine ecosystem services in changing environmental conditions.

2.2.4 Ecosystem Services Assessment

Ecosystem services assessment is a resource management tool with a range of definitions and approaches that have developed overtime in parallel with the development of the ecosystem services concept. Luisetti et al. (2011a) define ecosystem services assessment as a tool to measure the benefits that humans can derive from ecosystem processes and functions. Apitz (2013) sets ecosystem services assessment within a three-part conceptual cascade and views it as a process that sits between decision analysis and ecosystem service valuation which evaluates how changes affect biophysical structure and then ecosystem function and services. Like the ecosystem service concept, ecosystem services assessment emerged in tandem with the incorporation of sustainable management as the single purpose of the RMA 1991 contained in section 5. This section of the literature review will explore whether the use of ecosystem service assessment may provide a way forward for achieving coastal management decisions which connect across human and environmental systems for balanced outcomes and in what form ecosystem service assessment should be brought into coastal planning frameworks.

The methods that have been developed for ecosystem service assessment could assist in environmental management which achieves the sustainable management purpose of the RMA 1991 in New Zealand. The Rapid Ecosystem Services Assessment (RESA) method has been used by Van Den Belt and Cole (2014) for assessment of marine protected areas. Van Den Belt and Cole (2014) employed five key steps to carry out the RESA for seven marine protected areas in New Zealand, including the identification of all ecosystems of interest and the creation of a habitat or biome inventory for each and measuring the size of these. Each biome is further categorised based on the Farber et al. (2006) framework which sets out 23 service types. RESA can be undertaken in a short time frame to produce reliable and applicable results (Secretariat of the Convention on Biological Biodiversity (SCBB), 2006). RESA could provide an efficient way of understanding the ecosystem services of a given environment to inform management decisions and create sustainable outcomes of coastal environments, leading to balanced sustainable management decisions under the RMA 1991 s5.

Many common factors between assessment types must be taken into account if ecosystem service assessment method is incorporated into planning frameworks in New Zealand, to recognise ecological principles embedded in the environmental management tool (Turner

et al., 2010). Ecosystem services assessments incorporate the idea of marginal changes, recognising that changes occur on small scales within an ecosystem. There is also a need to recognise the threshold effect, the concept that ecosystems can change into alternative steady states at abrupt points (Barbier et al., 2008). Non-linear responses to disturbances should also be recognised in ecosystem service assessments which are used in the New Zealand planning context. The importance of non-linearity is emphasised by Barbier et al. (2011) who performed an assessment of coastal mangrove and salt marsh ecosystems, attributing non-linear responses to habitat variables such as area and size. Turner et al. (2010) offer an ecosystem services decision-support system that could be a useful way to structure assessments in New Zealand environmental management regimes (Figure 2.4). This system could also be used to address the common factors which assessments must take into account.

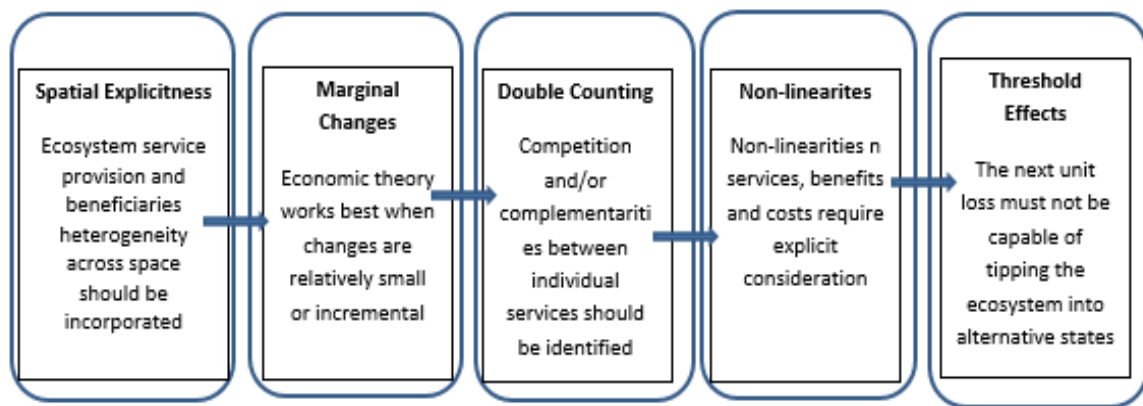


Figure 2.4: Ecosystem Services Sequential Steps (ESSSs) framework for appropriate economic valuation. The five key steps to consider in an ecosystem services assessment are and their importance in relation to economic theory is shown (Turner et al., 2010).

Luisetti et al. (2011a) use the ESSS system developed by Turner et al. (2010) in the context of economic valuation to inform a managed realignment policy decision in England. It was shown that spatial explicitness is particularly important to consider and a distance-decay effect is also demonstrated, where utility of a given ecosystem service declines with distance from the site. The need to take into account spatial variation in ecosystem services was also illustrated by Naidoo and Ricketts (2006) in a study of ecosystem service benefits of conservation corridors in Mbaracayu Biosphere Reserve, Eastern Paraguay, where two of five ecosystem services are shown to vary between

conservation corridors, resulting in net benefits three times higher than other corridors. These case studies demonstrate the small scale within which coastal ecosystem services assessment must operate to produce assessment results which can effectively inform coastal management decision makers, again emphasising that the scale and location at which ecosystem service assessments are carried out is important to consider.

2.2.5 Ecosystem Services Valuation

Ecosystem service valuation differs from ecosystem service assessment because it takes the results generated by ecosystem service assessments and generates valuations to inform decisions (Apitz, 2013). This thesis will focus on the former part of the environmental decision making process but some understanding of the latter part of the process is useful context for the research. However, the ecosystem services valuation part of the process is briefly explored here to provide context for the analysis of ecosystem services based approaches to coastal management. Ecosystem services valuation commonly uses a process of benefit transfer, which is defined by Liu et al. (2011) as ‘obtaining an estimate for the value of an ecosystem service through the analysis of a single study or groups of studies that have been previously carried out to value goods and services in a similar context’. Ecosystem service valuation is an important stage of the ecosystem service process because it can provide a common language for groups with competing interests and worldviews to make decisions (Lithgow et al., 2013). Ecosystem services valuation promotes benefits for coastal management and decision making including the provision of an objective method to weigh and assess factors in complex environmental management situations (Luisetti et al., 2011a).

Ecosystem services valuation should also be embedded in a wider multi-criteria analysis process (Turner et al., 2010). Lithgow et al. (2015) develop a multi-criteria analysis tool to facilitate a decision-making process for coastal dune restoration. The process involves the use of a checklist which contains multiple criteria including 36 indicators which have a positive influence on foredunes by facilitating ecosystem recovery or a negative influence on foredunes by driving perturbations and stress on the system (Lithgow et al., 2015). The criteria are weighted by an expert panel which is made up of multiple disciplines ranging from geomorphologists, ecologists and anthropologists (Lithgow et al., 2015). To calculate the values, pairwise comparisons are carried out between each criteria to weigh all criteria in relation to each other and the value of the matrix is divided

by the sum of each column in relation to its values. Values can then be assigned a mean relative of importance to determine which elements are priorities from a range of perspectives, including the public, financial investment for restoration, tourists and proximity to protected areas (Lithgow et al., 2013).

2.2.6 Approaches to Ecosystem Services Assessment

Many ecosystem services assessments and ecosystem services based management approaches determine services based on contributions to human health and well-being. Human wellbeing is defined as consisting of five principal dimensions in the MEA (2005) framework; access to basic materials, freedom of choice, health, social relations and social capital and security. Ecosystem services can be directly connected to human wellbeing through the application of this framework in China. For example, an assessment of the ecosystem services of the Three Gorges Dam groups ecosystem services in the region into 4 categories based on this framework (Kittenger et al., 2010). Kittenger et al. (2010) found that social and ecological impacts of the Three Gorges Dam can be grouped into four context-specific categories based on this framework; toxicological impacts, shifting infectious disease dynamics, natural hazards and social health. The application of ecosystem services based approaches in this context can be used to ensure that long-term socio-economic considerations are not left out of decision making in favour of short term economic gains (Kittenger et al., 2010).

The weighing of economic costs and benefits is a common approach to determining ecosystem service values. Bishop (1978) clearly demonstrated the link to ecological economics, including the use of the modified maxima principle which states that a safe minimum standard should be adopted unless social costs are acceptably large. Luisetti et al. (2011) also employ the value maximization principle which has developed in consumer theory, assuming that any option has a utility value and that the consumer is always able to select the option with the highest value. Willingness to pay is often used in conjunction with the assessment, determining an individual's willingness to pay for an environmental attribute (Luisetti et al., 2011). Willingness to pay relies on the use of existence values, which are present when there is no market for a good to express the willingness to pay (Bishop, 1978). Recognising the economic value of nature and the services it provides is becoming increasingly important in coastal zone management (Luisetti et al., 2011a). For example, the forfeiting of property with immediate value may

not be favoured without recognition of the economic value of ecosystem services in coastal hazard management decisions (Luisetti et al., 2011a). Ecological economics is integral to ecosystem services assessment and decision making in the context of coastal management.

No matter which approach is taken, any coastal management decision will require a complex mix of 'political, social, economic and ethical concerns' (Luisetti et al., 2014). Cost-benefit analysis is unlikely to be able used decisively to determine adaptation approaches in this context (Luisetti et al., 2011). While the advantages of the cost benefit processes include the bridging of disciplines, ease of time, enhanced credibility of decisions and objective decision making, the detractor of these methods is that the subjective factors must also be considered. Costanza et al. (1997) who are the original proposers of the ecosystem services concept justify the economic valuation of the environment simply by recognising that ecosystem services are largely ignored or undervalued because they sit outside the market and are uncertain, leading to projects with social costs that far outweigh their benefits. With an estimated value of US \$11.9 trillion (or 35%) from terrestrial ecosystem processes and \$22.1 trillion (or 65%) from marine processes it is clear that these values must not be overlooked in resource management decisions (Daily, 1997). Section 2.3 of the literature review will provide a critical review of literature which establishes coastal management and decision making factors and provides a basis for assessing the approaches to ecosystem services based coastal management in this context.

2.3 Ecosystem Services and Coastal Management

2.3.1 Coastal Management Policies and Ecosystem Services

There are a range of coastal management policy options available to coastal managers. Among the classifications of coastal policy options that exist, Alexander et al. (2012) provide a useful way of understanding these options in a classification of coastal protection policies into three sea level rise risk mitigation policy categories. Hard and soft forms of protection options fall under the category of protection policy options which involve engineering defences such as seawalls, gates, levees, artificial headlands, beach nourishment and enhanced ecological protection. These protection options can be further

classified into a range of soft protection measures and hard protection measures (Table 2.2). Hard protection options include the construction of sea walls or gyrones, which reduce the effects of wave energy and stop the sea from interacting with hinterland (French, 2001). Soft protection options include dune building and beach nourishment, which restore a natural landform to buffer against sea level rise and storms (French, 2001; Brake and Peart, 2013).

Table 2.2: Common classification for hard and soft planning options (French, 2001).

Hard Protection	Soft Protection
Gyrones	Beach Nourishment
Sea Walls	Dune Building
Revetments/armouring	Managed Realignment/Retreat
Breakwaters/sills	Abandonment
	Adaptation
	Do Nothing

Accommodation policies attempt to reduce the sensitivity and/or exposure to the impacts of sea level rise through techniques such as flood proofing, modification of drainage systems and the raising of infrastructure. Retreat policies involve the relocation of homes and infrastructure under threat (Few et al. 2007a in Alexander et al., 2012). Managed retreat and managed realignment prevent development from occurring because land is yielded to the sea (Alexander et al., 2012). Managed retreat requires either the purchasing of land or regulatory control to be able to take place (Viles and Spencer, 1995). Policy options which allow development to occur include deferring action through ordering people out or buying people out or presuming mobility through leases and notifying property owners of future inabilities to build protection mechanisms without interfering with current private activities (Viles and Spencer, 1995). Section 2.3 outlines the wide range of considerations of coastal management options and builds towards an understanding of how ecosystem services based approaches to management could be used to address these and contribute to more sustainable forms of coastal management decisions and outcomes, pursuant to the single purpose of the RMA (1991) of sustainable management of natural and physical resources.

2.3.2 Coastal Management Methods and Ecosystem Services

Coastal management methods can be arranged on a spectrum of environmental impacts (Alexander et al., 2012). Some forms of coastal management can be designed to accommodate and provide for ecosystem services. For example, Coombes et al. (2015) showed that grooved textures on seawalls can enhance the abundance of barnacles, a key ecosystem engineer in rock coast environments in urban coasts in the South West of England, United Kingdom. These solutions are based around the principle that novel material designs could mitigate the effects of climate change while making space for nature in marine engineering (Thompson et al., 2009). However, coastal management can also negatively impact ecosystem services. Sea defenses can impact ecosystem services by acting as a barrier for habitats retreating inwards from rising sea levels and leading to a narrow intertidal zone, a phenomena known as coastal squeeze (Jackson and McIvenny, 2011). The environmental impacts of management options selected by coastal managers should be considered in coastal management decisions and in coastal management plans.

Coastal management methods can utilise ecosystem services to protect against coastal hazards and promote gains for coastal environments in the human management and ecological sense. For example, *Ammophelia arenaria* traps sand and causes vertical accretion of foredunes (Hilton et al., 2000). *A. arenaria* invasion in New Zealand is linked with a series of dune forming processes, including shadow dune development, migration of long-walled parabolic dunes, stoss face blowout development and barrier progradation (Hilton, 2003). Despite its potential to buffer natural hazards, the speed of sand trapping and dune building has resulted in loss of native vegetation, which may make it unsuitable as a coastal erosion buffer species (Hilton, 2003). However, similar ecosystem services provided by native sand-binding species such as spinifex and pingao have been used in coastcare schemes in New Zealand (Dahm et al., 2005). These have contributed to a 1-2m vertical sand build-up of the Papamoa East beach in the Bay of Plenty region and facilitated seaward advancement by around 10-15m from 1998 to 2004. The dune advance has produced a wider dune with a gentler and vegetated slope which can buffer storm erosion (Jenks and Brake, 2001). Coastal care groups meet to review dune restoration activities and develop management plans, further contributing to sustainability and resilience (Dahm et al., 2005).

2.3.3 Coastal Management Impacts and Ecosystem Services

It has become increasingly important to recognise the impacts that human management actions and environmental change could have on physical environments and the ecosystem services which they provide. Jackson and McIlvenny (2011) demonstrated this on Scotland rock coasts, where a sea level rise of 0.3m was linked to a change to physical habitats with a mean slope increase of 0-3%. The change of slope caused changes to the abundance, distribution and phenology of species (Jackson and McIlvenny, 2011). The steepening of the intertidal profile meant that species near the low range of the intertidal were more likely to interact with species near the upper range of the intertidal due to compressed horizontal distances (Chapman 2006). It is also uncertain whether abundances of intertidal organisms will remain constant with increased densities or whether densities of organisms will remain similar with decreased abundances of organisms (Underwood and Jernakoff, 1981). Changes in density will alter types and intensities of biotic interactions while changes in abundance will influence viability, persistence and risk of extinction of populations, as shown by experiments which demonstrate the effects of interactions between algae and grazing gastropods on the structure of low-shore intertidal communities (Underwood and Jernakoff, 1981). These types of uncertainties provide further emphasis on why the interconnected approach to management provided by ecosystem services may be useful in coastal management planning and decision making.

There are many uncertainties that must be taken into account about the impacts of coastal management solutions on the ecosystem services provided by coastal ecosystems because of environmental changes. For example, the relocation of communities for managed retreat from coastal hazards could negatively impact ecosystem services by increasing the flows of goods to new settlement areas and introducing non-native invasive species to local ecosystems (Ruhl, 2008). Goods in this context represent direct and indirect benefits that humans derive from the environment (Costanza, 1987). However, there is some evidence to suggest that ecological impacts may not increase linearly with invader density (Jackson et al., 2015). Quantifying the link between biodiversity and ecosystem goods and services also remains a major scientific challenge (Pereira et al., 2010). Presently there is no general ecological relationship between ecosystem function and diversity

owing to species-specific effects and important trophic links (Paine 2002; Willims et al., 2002).

The linkages between ecosystem services could be affected by human actions and changes in coastal environments. Increased development pressures and conversion of land uses from migrations away from coastlines could impact carbon pools provided by terrestrial habitats, contributing to further climate change, sea level rise and the need to retreat (Ruhl, 2008; Seto et al., 2012). Land conversion for agriculture and water supply provide examples of the drivers of land use change which occur through managed retreat processes (Ruhl, 2008). Seto et al. (2012) demonstrate that there has been a 1.38PgC aboveground biomass carbon loss from 2000 to 2030 from land clearing in Seto, making a significant contribution to land use change emissions. Relocation of communities could also lead to degraded ecological conditions from new and amplified pollution (Ruhl, 2008). Sedimentation can have a negative impact on the quality of water and photosynthetic symbionts which sponges acquire their nutrients from (Bell et al., 2015). This was emphasised by Fabricius (2005) who show that sedimentation from construction and runoff is a very common effect of coastal development.

New Zealand coastal and marine ecosystems are likely to experience similar consequences to international ecosystems as a result of increased development density and land impacts that are caused by managed retreat. Sedimentation reduces light which is a fundamental driver of primary production in marine environments (Desmond et al., 2015). Sedimentation on the blade surfaces of *Adamsiella chauvinii* has been shown to reduce the amount of light available for photosynthesis and growth (Kregting et al., 2008). Furthermore, the lower biomass of kelp forest communities in Southern New Zealand was shown to be indicative of light limitation of the kelp communities (Desmond et al., 2015).

2.3.4 Socio-Economic and Regulatory Factors

Coastal management requires a wide range of considerations alongside the natural and physical resources of coastal ecosystems, including economic and social costs of decisions. It is because of these considerations that coastal management decisions can lead to the formation of strong tensions in coastal communities, creating high social

barriers to overcome before implementing coastal management solutions (Alexander et al., 2012). For example, the requirement put in place for all development to be located at a minimum of 20m from the coastline alongside retreat clauses to accommodate erosion formed the centre of a heated debate in the local community in the management of adaptation to projected sea level rise for Fleurieu Peninsula, South Australia (Niven & Bardsley, 2012). This demonstrates the complex social implications of coastal management decisions and the need for a tool such as ESA to assist in drawing these range of stakeholder interests together to reach a solution which can be implemented.

New Zealand coastal management provides a very suitable context to assess the contribution of ecosystem services assessment to sustainable management. New Zealand communities demonstrate opposition to coastal management options which is similar or higher than that evident internationally. For example, the Taranaki District Council faced strong opposition to implementing retreat in response to erosion of 1.07 m/year and 6 m/yr of the eastern end of Urenui beach (Tinker, 2013). Owners of baches at the western end of the beach and users of the public golf course formed a lobby group to protest for a seawall to be put in place because of a desire to not lose their land to the sea. This resulted in the adoption of a hold the line approach instead of planned retreat (Blackett et al., 2007). The ability of ecosystem services assessment to prioritise considerations in decision making exists in New Zealand in the same way as it does internationally, which makes it a highly suitable context to evaluate the ecosystem service assessment as a coastal management tool.

Coastal management regulatory frameworks are important determinants of whether local authorities prioritise short-term or long-term outcomes in coastal management decision making. These are another factor which must be considered in coastal management decisions. For example, the Queensland Sustainable Planning Act (2009) requires local councils to compensate owners when a planning decision reduces property values (section 704). Queensland local authorities must decide whether to prioritise short term risks of litigation or risk future liability as hazards increase (Alexander et al., 2013). This demonstrates the high level of impact regulatory controls can have on coastal hazard management and decision making and the need for a coastal management tool such as the ecosystem services assessment to underlie these decisions and assist in prioritisation.

The New Zealand resource management framework provides a useful lens to examine the application of the ecosystem services method of management and decision making because it does not provide for the protection of private property rights over public interests, unlike the Queensland example (Berry and Vella, 2010). Private property rights have always been subject to some form of legislation or regulation in common law historically and section 85 of the RMA 1991 does provide some relief to private property owners for the purpose of ensuring that local authority land use regulation does not amount to injurious effects on private property owners. The NZCPS (2010) policy 141 also promotes the setting of hazard lines to restrict buildings and has generally been accepted by the Courts as fulfilling the section 31 function of effective hazard management (Berry and Vella, 2010). This makes for a useful context because long-term effects of a decision can be weighed against short term implications, creating a potential need for a management tool which allows the consideration of balancing outcomes on competing timeframes to be made.

Community engagement is also a very important aspect of coastal management decision making (Blackett et al., 2010). It ensures that decision makers “have an understanding of the decision-making criteria that property owners draw upon to make sense of sea level risk mitigation policy” (Alexander et al., 2012). As stated in the Ministry for the Environment (2015) best practice guide to consultation, it ensures that the public have a sense of ownership over the decision, increasing the likelihood they will be involved in its implementation and decreasing opposition towards it. This is demonstrated in the retreat of land with public assets near Muriwai beach, New Zealand, where the public’s initial suspicion about a planned retreat strategy in response to long term cyclic erosion was overcome through a robust participatory process (Blackett et al., 2007). The process involved the use of a consultant who was hired by the Regional Council to work with the community and key stakeholders to reach a solution (Blackett et al., 2007). Success of this was partly owing to the fact that the retreat was predominantly going to impact public land and that no preconceived outcome was committed by stakeholders (Blackett et al., 2010).

The wide range of stakeholders involved in the majority of coastal management decisions with a range of desires based on their position in the debate make a very useful case study of the application of ecosystem services assessment. Owners of private property tend to

seek solutions that maintain the value of their property and have a preference for coastal maintenance to be carried out by local authorities (Gibbs et al., 2013). Local authorities seek to minimise the need for ongoing maintenance and the need to provide compensation. This is demonstrated by Gibbs et al. (2013) who portray that for councils it is politically unpalatable to use ratepayer money to protect private properties from coastal hazards in Queensland. This builds towards an understanding of the large social complexity and regulatory drivers behind coastal management decision-making and demonstrates a need for further examination of decision making tools. Tools such as the ecosystem, services assessment could assist in finding a solution to satisfy conflicting desires and resolve coastal management decision making tensions, bringing together a range of stakeholder desires for satisfying outcomes.

Moral arguments around valuing ecosystem services can complicate ecosystem services based approaches to management, translating the decision problem into a different set of dimensions (Costanza, 1987). For example, decisions must be made about how much to discount future benefits when using ecosystem services as a form of decision making. Discounts are lower values placed on future benefits and discount rates dictate how much the future is discounted (Anderson, 2013). These kind of decisions also emphasise the challenges around integrating disciplines that must take place in an ecosystem services assessment (Daily, 1997). A key area of future research for ecosystem services is developing a better understanding of how to draw together investigators from a range of disciplines including biology, ecology and hydrology as well as a range of professionals including engineers, economists, politicians and scientists in order to make these assessments (Daily, 1997). Disciplines such as ecology also need leadership that encourages collaboration to generate a wide range of understandings in multiple localities about concepts such as ecosystem services (Connell et al., 2008).

2.3.5 Customary Approaches to Coastal Management and Ecosystem Services

The ecosystem services concept shares some commonalities with customary approaches to management. Both approaches recognise the environment is a set of interdependent systems (Greenhalgh and Hart, 2015). For example, in Aotearoa (New Zealand) humans are viewed as a member of the land community in traditional resource management through the concept of kaitiakitanga (guardianship), a concept which is best represented in English as a sense of stewardship and responsibility towards the environment

(Williams, 2002; Dick et al., 2012). In the recent use of the ecosystem services concept in New Zealand policies and plans, ecosystem services has been used to facilitate resource management which views ecosystems and their services as interdependent rather than taking a single species focus (Greenhalgh and Hart, 2015). Both approaches also recognise that there are interdependencies within the ecosystem and that changes in one species indicate changes in other parts of the ecosystem (Greenhalgh and Hart, 2015). Traditional methods of coastal management include the flushing of lagoons to remove silt in order to enhance coastal fisheries (Williams, 2002), while ecosystem services based management approaches include the use of indicator species to determine impacts of changes in an ecosystem (Greenhalgh and Hart, 2015).

Embedding ecosystem services based concepts in New Zealand planning frameworks has the potential to promote the use of customary resource management methods in its implementation. The ecosystem services based approach to coastal management has the potential to align with the connected approach taken towards environmental management that is portrayed in the concept of Kaitiaki (guardians). This is important because Kaitiaki recognise that traditional resource management methods should be used to exercise their responsibility for their environment as Kaitiaki (Dick et al., 2012). Interviews carried out by Dick et al. (2012) show that Kaitiaki are concerned about both ecological and cultural losses caused by degradation of coastal environments, rather than being primarily concerned with ecological impacts which Western views may focus more on. This thesis will build towards an understanding of how it is possible to address this and build towards a coastal management approach which integrates considerations of coastal ecosystem losses, seeking to make the commonalities between cultural approaches to resource management and the ecosystem services based approach to management better understood through engagement with coastal management stakeholders in New Zealand and an examination of the presence of the concept in planning and environmental laws in New Zealand.

The ecosystem services concept also shares some commonalities with collaborative and local management approaches to coastal management. For example, the concept of citizen scientists is becoming increasingly well recognised as a method to approach coastal management. This method is defined as connecting citizens with the resources, species and habitats they are focusing on or working with (Beatley, 2014). This concept builds on the desire to affiliate with other life forms which is captured in Wilson's (1986)

concept of biophilia. Collaborative planning and co-management are further planning approaches which share commonalities with the ecosystem services based approach by promoting the use of collective decision making to improve the qualities and connectivity of places (Healey, 2003). Miller and Hobbs (2002) also refer to a positive feedback loop between local connections with the environment and an increased interest in conservation, which could be promoted by the connections between humans and the environment that are facilitated through ecosystem services based approaches to coastal management (MEA, 2005; Ash et al., 2010).

2.4 Conclusion

Chapter 2 provided a contextual understanding relating to ecosystem services within the coastal environment, approaches to ecosystem service assessment and the potential for ecosystem services based coastal management options. Ecosystem services are an emergent field of research with the concept only taking a prominent position in environmental planning following the development of the MEA (2005) framework. The MEA framework provides a solid platform for further development of the concept, including the evolution over time to recognise that ecosystem services differ from ecosystem service benefits (Fisher et al., 2009). The approach taken to ecosystem services assessment in New Zealand is most often the general principles approach, linking the provision of services with underlying ecosystem processes (Townsend and Thrush, 2010). Ecosystem services assessment provides a possible way forward in New Zealand to achieve sustainable management, owing to the development of the concept in parallel to the incorporation of sustainable management as the primary purpose within New Zealand resource management regimes. Key review findings relating to the research questions are considered below:

1: What is the value of using ecosystem services for coastal management and decision making?

This literature review has illustrated some key benefits of the use of the ecosystem services concept in coastal management and the ecosystem services assessment as a coastal management tool. Ecosystem services can operate over a range of scales and recognising ecosystem services has the potential to connect local management decisions with global resource management outcomes (Townsend and Thrush, 2010; Siikimaki et al., 2013). Ecosystem services can also generate context based resource management

information by providing a broad framework which can be adapted to categorise site-specific ecosystem services (Ronnback et al., 2007; Townsend and Thrush, 2010). Ecosystem services allow a range of aspects of an ecosystem to be broken down, including goods, services, processes and functions (Fisher et al., 2009). The major drawback of the ecosystem services concept is that the process and definition of the concept remains unclear, with a range of processes defined and used to carry out assessments internationally (Luisetti et al., 2011a; Apitz, 2013) and nationally (Macdiarmid et al., 2013; Van den Belt and Cole, 2014; Townsend and Thrush, 2010). This thesis seeks to explore the level of clarity of the concept within the context of New Zealand coastal management and establish where similarities lie in approaches that are currently used to manage our coasts.

2: Does the use of ecosystem services in coastal management lead to improved outcomes for the coastal environment?

The literature review has also identified that ecosystem services has the potential to improve outcomes for the coastal environment, in its broader sense of economic, cultural, social and environmental dimensions in line with the MEA (2005) framework. Ecosystem services approaches to coastal management provide a potential avenue to foster a more culturally appropriate form of environmental management in New Zealand, viewing ecosystems as connected and interdependent and recognising that humans are members of the land community rather than managers of it (Williams, 2002). This is made evident in the ability of ecosystem services based concepts to highlight the interdependencies between environmental components, particularly when the concept is built into planning frameworks (Greenhalgh and Hart, 2015). Ecosystem services can also result in ecological concepts being built into management plans and decision-making, embedding ecological concepts such as non-linearities, thresholds and alternative steady states (Barbier et al., 2008; Turner et al., 2010;). Ecosystem services draws the attention of the public and decision makers to the very large economic and wider societal benefits provided by ecosystems that may otherwise be overlooked in decisions in favour of short term economic gains (Kittenger et al., 2010; Costanza et al., 1997).

3: In what form can ecosystem services assessment be incorporated into coastal management and planning frameworks in New Zealand?

This thesis seeks to establish whether in the right circumstances and based on best management principles, ecosystem services could be brought into coastal management frameworks in New Zealand. Ecosystem services has the potential to create a common collaborative process which engages citizens across New Zealand in coastal management, producing not only short term environmental gains but also fostering a culture of kaitiakitanga (stewardship) towards the coastal environment, so that the coastal environment and its services can be conserved for future generations (Beatley, 2014). There are particular opportunities within the NZCPS (2010) within provisions in relation to sustaining ecosystems and the consideration of the impact that human actions can have on ecosystem services. Ecosystem services could also be used to connect across scales, placing the management decisions that are made today in our own environments in the context of the wider environmental processes of climate change and the consideration of long term objectives (Fisher et al., 2009; Townsend and Thrush, 2010). However, the benefits of the ecosystem services based approach to management and its ability to bring together the range of considerations which need to be balanced to facilitate the achievement of sustainable management outcomes for the coastal environment remains unclear.

Research Objective: To determine whether ecosystem services assessment can be used to improve coastal management decision making processes within New Zealand's resource management framework.

The object of this thesis is to identify the benefits and key ecosystem services based approaches that are required for securing sustainable management outcomes. In doing so, it is hoped that the best pathway forward for building a meaningful and emerging environmental management tool into coastal management regimes in New Zealand will be discovered. The findings can be broadly applied to other ecosystems, which provide similar ecosystem services to coastal and marine environments in the context of climate change (Daily and Ellison, 2002). The findings can also assist with coastal management decision making, which is becoming increasingly pressing in New Zealand given the intensification of coastal pressures and climate change impacts on coasts (PCE, 2015) and increased recognition of coastal hazards within the RMA 1991. The research is also very timely as the use of the ecosystem services concept continues to rise internationally. Chapter 3 outlines the methodology that will be used to carry out this investigation, with presentation of results and a discussion to follow.

Chapter 3: Methodology

3.1 Introduction

Chapter 3 explains how the research methodology addresses the research objective of determining whether ecosystem services based approaches to coastal management can be used to improve coastal management decision making processes within New Zealand's resource management framework. It will also explain the methods used to answer the three research questions which will be used to achieve the above objective. The first section outlines the research approach taken in the research. The next two sections present the research design and detail the methods used to collect, analyse and interpret data where it was appropriate to do so. The final section discusses limitations to the research and the effectiveness of the research method selected. This chapter concludes with a summary of the research process that will be used to address the objective and answer the research questions.

3.2 Research Approach

Research is an iterative process, involving the planning and design of a research method before data collection and analysis are carried out (Yin, 2014). The planning of this research was carried out through combining a range of disciplines including marine science, physical geography and planning. The combination of these methods resulted in the emergence of a mixed methods approach to data collection and analysis. The mixed methods approach was also determined to be the most suitable approach to research given the multi-disciplinary nature of ecosystem services, which spans natural and physical environment, cultural, economic and social dimensions (MEA, 2005). There is also a recognised need to work across a range of disciplines to assess ecosystem services within theory (Connell et al., 2008). The range of disciplinary approaches is reflected in the use of legal analysis, observational research and analysis of scientific articles, as detailed in the research methods section.

The mixed-methods approach was also selected because of its well-known abilities to strengthen research methodologies (Sarantankos, 2005). The mixed-methods approach can ensure that weaknesses in one method are covered through strengths of another method (Hall and Hall, 1996). Using both quantitative and qualitative data allows

triangulation to be used to examine the phenomena being observed from more than one angle (Boeije, 2010). Triangulation also ensures that reliable data is obtained (Sarantankos, 2005). Participatory research methodologies involve research that has two goals; one of science and one of practice (Bergold and Thomas, 2012). This research involved some elements of participatory action research because the researcher engaged with community and cultural groups during the process of the research and communicated findings to these groups at the completion of the process with the aim of providing meaningful resource management practice findings to the groups (Bergold and Thomas, 2012).

This research adopts a case study approach. Case studies are intensive studies producing rich descriptions of a single phenomenon or occurrence (Yin, 2014). For the purposes of this research, the case study was used to gain an in depth understanding of a management approach applied at a particular location. The case study approach also provides a useful way to assess theoretical concepts and applicability in real world situations (Yin, 2014). In this research, the concept that was being tested through the case studies was ecosystem services. Through both case studies an in depth knowledge of the sites, the ecosystem services present at the sites, the management and planning processes used at the sites and the networks of people involved in the management of the sites was sought to be obtained, in accordance with the purpose of case studies which Marczyk et al. (2008) proposed. The range of methods used in each case studies are outlined in section 3.4.2.1 and 3.4.2.2.

The first case study obtains in depth knowledge of the East Otago Taiāpure and the form of management carried out by the East Otago Taiāpure Committee. This case study was selected through engagement with the Otago University Marine Sciences Department and based on preliminary observations showing a range of ecosystem service values were present at the site, which closely reflects the use of an ecosystem services based approach to management. The second case study is used to examine the use of ecosystem services in relation to the kelp beds of the East Otago Taiāpure Committee and the recognition of ecosystem services in *East Otago Taiāpure Management Committee v Otago Regional Council* [2013]. This case study was selected through context research which identified that avoiding discernible adverse effects on the inshore coastal area and the kelp beds were recognised as a key issue raised by the East Otago Taiāpure Management Committee *East Otago Taiāpure Management Committee* [2013, p.2, para 4], which suggests a focus on ecosystem services may be present in the case. The kelp forests of the East Otago

Taiāpure were also selected as the ecosystem subject to investigation based on preliminary research which identified kelp as a base of ecosystems by playing a habitat supporting role (Hepburn et al., n.d; Vandendriessche et al., 2007; Bates and DeWreede, 2007). Further background and contextual information for both case studies is established in chapter 4.

3.3 Research Design

The research design is guided by the research objective and the key questions which will be used to inform the research objective contained in section 1.1. A theoretical basis was established through a literature review in chapter 2. The literature review will also be used in the analysis of the data to compare the theoretical understanding of the ecosystem services concept with findings from the research. The coastal environment is defined broadly in this research as the aspects of the environment contained in the ecosystem services definition; including the natural and physical, social, economic and cultural factors of the environment (MEA, 2005).

Case Study 1: East Otago Taiāpure

The research questions are first answered in relation to the management of the East Otago Taiāpure. Research question 1 will be answered through engagement with local coastal managers to determine if an ecosystem services based approach to management is valuable for management and if so what the key parts of the concept that add value to management are perceived to be (Figure 3.1). Research question 2 will be addressed through observations and analysis of the outcomes of the ecosystem services based management approach taken in the case studies (Figure 3.1). To answer research questions 1 and 2, it was necessary to first establish whether an ecosystem services based approach was taken in the case studies used to justify the selection of the case studies. This is set out in the Chapter 4 prior to the case study results and discussion and was drawn from research of the management approaches taken at the case study site. Summaries of these justifications are included in section 3.2.

Case Study 2: East Otago Taiāpure Management Committee (2013)

Research question 1 and 2 are then answered in relation to coastal management decision making through the examination of a case study of *East Otago Taiāpure Management*

Committee v Otago Regional Council [2013] 58 ENV 1. Research question 1 is addressed through the examination of expert witness statements and analysis of where ecosystem services have been used in the Environment Court process (Figure 3.1). The evidence of the appellants and the Environment Court decisions are analysed to determine whether ecosystem services were considered in the decision making process to determine the outcome of the hearing. Research question 2 is assessed through examination of current management plans and processes surrounding Port Otago, to determine whether the decision has improved outcomes for the coastal environment (Figure 3.1). The process to balance the evidence and make the decision is also examined in wider literature to see if an ecosystem services based decision making approach could be viable in this context. The nature of the planning process that is examined is set out in Section 4.4, Chapter 4.

Research question 3 is answered in relation to both case studies by combining the findings of these case studies and analysing the principles of ecosystem services that could best strengthen coastal management and planning frameworks (Figure 3.1). Document analysis of natural resource management plans, the RMA 1991, the New Zealand Coastal Policy Statement (2010) and the Otago Regional Plan: Coast (Otago Regional Council, 2012) are carried out to provide the context for recommendations for the incorporation of ecosystem services into these frameworks. The findings for each research question in relation to both case studies are compared and contrasted and these are presented in the results and discussion chapters.

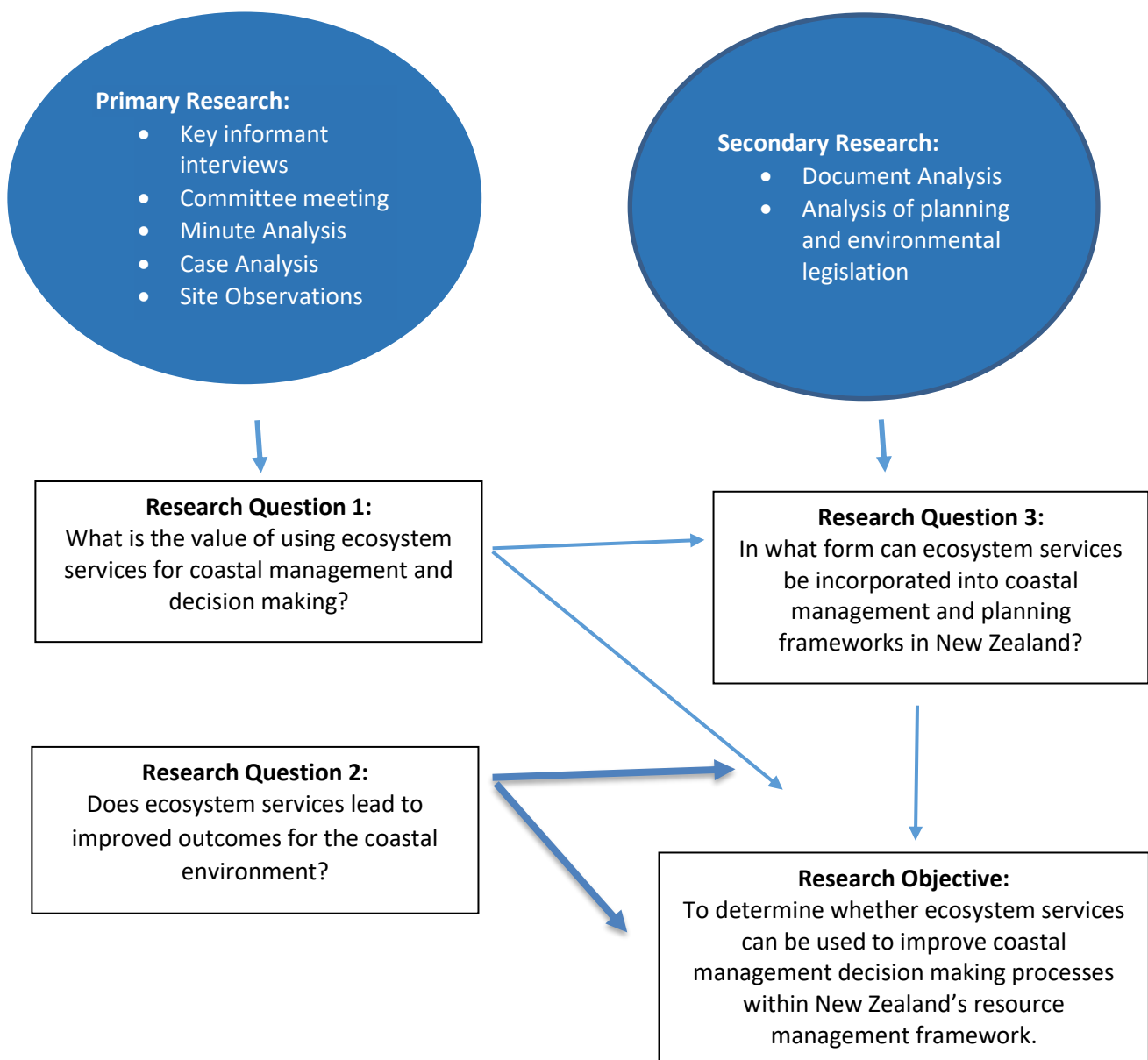


Figure 3.1: Research Framework. The framework illustrates how the primary data that is collected answers research questions 1 and 2. The context for answering research question 3 is established through the secondary research and the findings from the primary research inform research question 3. These findings combine to answer the research objective.

3.3.1 Positionality and Ethical Considerations

Positionality and the relationship of the researcher to the content of the research is important to consider in the research process because it can shape the structure and outcomes of the research (Sarantankos, 2005). I maintained a neutral position throughout my research and an awareness of any positionality issues that could arise from involvement with local environmental groups. I ensured that interviews were carried out in a non-biased way and that a range of stakeholder views were taken into account through attendance of the East Otago Taiāpure Management Committee meetings and an examination across all parties evidence in *East Otago Taiāpure Management Committee v Otago Regional Council* [2013]. I also ensured that any assumptions that an ecosystem services based approach was used in the case studies were removed throughout the research.

University of Otago ethics requirements were fulfilled through the submission of a human ethics form to the ethics committee prior to data collection. Interview participants were provided with an information sheet in electronic or hard copy form which outlined the interview process (Appendix A). The consent of participants was also obtained before interview were carried out using the attached consent form (Appendix B). Personal anonymity was guaranteed and all interviewees were informed of their right to withdraw at any stage.

3.3.2 Māori Consultation and Community Engagement

Consultation was carried out with the University of Otago Māori Consultation Committee to ensure that the needs and aspirations of Ngāi Tahu were met through the research. The membership of co-supervisor Dr. Hepburn to the East Otago Taiāpure Committee and the ability to communicate findings to tangata tiaki (customary fisheries managers) through these connections further helped to ensure these needs were fulfilled. The University of Otago Marine Science Department also have strong links with Ngāi Tahu directly surrounding the East Otago Taiāpure study site and to the broader network of customary protection areas throughout Ngāi Tahu's takiwā (district). The researcher will also participate in the annual student presentation night held at Puketeraki Marae in Kāritane to communicate the research findings with the local community and enable the findings to be used at the site.

3.4 Data Collection and Analysis

3.4.1 Secondary Data Collection

Secondary data collection included the literature review carried out in chapter 2 to provide a theoretical basis for the study, document analysis, analysis of legislation and legal database searches. Documents analysis is the systematic procedure for reviewing and evaluating documents and is increasing in use as a social research method (Bowen, 2009). Document analysis can be performed on a wide range of documents (Bowen, 2009). Document analysis often involves examining the contents of documents (Silvermann, 2004). In this research documents that were analysed include management plans of the East Otago Taiāpure and Port Otago, evidence statements from *East Otago Taiāpure Management Committee v Otago Regional Council* [2013], the minutes of the East Otago Taiāpure Management Committee and local government management plans. Bowen (2009) identifies five specific functions of document analysis; providing context, questions to be asked, supplementary research data, tracking changes and developments and verifying evidence from other sources. Table 3.1 shows the purpose that each document was used for.

Table 3.1: Document analysis purpose. Table 3.1 shows the main source of information that each document which was selected for document provided in the research according to Bowen's (2009) classification of the purposes of document analysis.

Document Number	Document Type	Purpose
1	Management plans of the East Otago Taiāpure and Port Otago Ltd.	Context
2	Expert witness statements from <i>East Otago Taiāpure Management Committee v Otago Regional Council</i> [2013]	Supplementary research data, verification of findings
3	East Otago Taiāpure Management Committee Minutes	Tracking changes and developments
4	RMA 1991 planning framework documents and management plans	Context

Documents (1) and (4) provide context for the two case studies; the East Otago Taiāpure management and the kelp beds and *East Otago Taiāpure Management Committee v Otago Regional Council* [2013] (Table 3.1). They show the management approaches taken at each of the sites relevant to the case studies. Document analysis was performed on (2) and (3) to assess the occurrence of the use of the ecosystem services based approach within the documents (Table 3.1). The results of the analysis were treated in a similar way to primary research material such as interview transcripts. Four primary codes were selected to be consistent with the chapters of the discussion sections; values of ecosystem services, outcomes of ecosystem services, ecosystem services and planning frameworks and ecosystem services and decision-making. Analysis was carried out by skimming the documents and extracting examples which illustrated these codes (Bowen, 2009). Advantages of this method include ease of access to information and the potential for high quality data (Sarantankos, 2005; Bowen, 2009). It was recognised that there were some weaknesses in the document analysis research method because of the possible incompleteness and biased nature of the documents and documents were selected where this could best be avoided (Sarantankos, 2005).

Analysis of relevant New Zealand environmental legislation was also carried out to identify gaps and to generate recommendations for improvements and the incorporation of ecosystem services into the RMA 1991 and the pursuant planning framework. This could also be identified as a form of document analysis carried out for the purpose of context (Bowen, 2009). The RMA 1991 was assessed in relation to the purpose of sustainable management contained in s5. The FA 1996 was assessed in relation to the sustainable utilisation purpose contained in s8 as well as the provisions for the establishment and the powers delegated to taiāpure management committees within s174-s185 and including the provisions for customary management contained in s186-186B of the Act to provide a comparison with the RMA 1991 s5 purpose of sustainable management.

3.4.2 Primary Data Collection

This section will explain how primary data was collected, analysed and interpreted for each of these case studies. Primary data was collected through a range of methods for each of the case studies carried out. Data collection for both case studies took place from the June 14th 2016 to the July 12th 2016. Locations where research was undertaken

included desk-based research, research on site at the East Otago Taiāpure, Kāritane, Otago and field visits to Port Chalmers and the Port Chalmers Harbour to collect observations to inform the second case study. This helped to strengthen the analysis by exposing the researcher to the context that was being understood (Yin, 2014).

3.4.2.1 Case Study 1: East Otago Taiāpure Approach to Management

Key Informant Interviews

Semi-structured interviews were carried out with key members of the East Otago Taiāpure Management Committee. The researcher played a guiding role in the interviews, asking neutral, guiding questions in accordance with best practice qualitative research principles (Sarantankos, 2005). The general line of questioning involved the participants understanding of the management approach in relation to the ecosystem services based management approach, their understanding of the ecosystem services present at the management site and the way that they perceived the ecosystem services based approach being used at the Taiāpure currently. The main advantages of the interview approach are that it is flexible and allows for spontaneity and the researcher has control over the time and place of the data collection (Sarantankos, 2005). Coding of interviews was used to draw out key themes and analyse any conceptual patterns that emerged (Sarantankos, 2005). The interview method was selected because it provides a way of directly understanding the socially constructed understanding of the phenomena of ecosystem services (Minichiello and Kottler, 2010). The list of key informants is provided in and an outline of the interview questions for each key informant is provided in Appendix C.

Attendance of Committee Meetings

One of the monthly East Otago Taiāpure Committee meeting was attended on the June 14th 2016. The purpose of attending the meeting was for the researcher to engage directly with the case study context to provide an in depth understanding of the concepts that were applied in the management of the site. Notes from the committee meeting were recorded and coded to draw out key themes, consistent with the codes listed in section 3.4.1 (Sarantankos, 2005). The codes were sorted with the codes generated from the other forms of research to form the basis for the results and discussion to address the research objective and the key questions.

Minute Analysis

The minutes of the East Otago Taiāpure Management Committee from the inaugural meeting on May 6th 2003 to the most recent meeting on May 11th 2016 were coded and analysed in the same process as described above. Access to the minutes was obtained through contact with the secretary of Kāti Huirapa ki Puketeraki Marae. The minutes were stored on a dropbox folder. A range of other primary material produced by the Taiāpure Management Committee including Puketeraki Marae newsletters, management plans and magazines was examined to provide further evidence of the value and outcomes of the ecosystem services based approach and contextual information for demonstrating the use of the ecosystem services based approach at the site. The key advantages of this approach include the high quality of the data and the ease of access to information (Sarantankos, 2005).

3.4.2.2 Case Study 2: Port Otago Dredging

Environment Court Case Analysis

The expert witness statements of appellants in *East Otago Taiāpure Management Committee v Otago Regional Council* [2013] were analysed for their use of ecosystem services in their arguments. The range of expert witness evidence statements that were examined are provided in Appendix D. The expert witness statements were analysed both for their contents and the way that they were structured to align with an ecosystem services based approach (Silverman, 2004). The qualitative data obtained through the analysis was interpreted in a similar way to the interview data. The judgement text was also analysed to determine the weight given to any ecosystem service concepts used in these evidence statements. The documents provided a useful verification of findings and material to be used to compare and contrast the use of ecosystem services in environmental management and Environment Court processes, fulfilling the role of providing supplementary research data which Bowen (2009) classifies as one of the main possible purposes of document analysis.

Site Observations

Observations of the Port Chalmers study site and the marine environment were carried out to collect contextual information on the context over which the Port Chalmers contestation was taking place. The observations also provided the researcher with the

opportunity to gain a better understanding of what was proposed by the opponents and what the appellants were arguing (Yin, 2014). The site observations were also used to gain an understanding of the ecosystem services at the contested site and the outcomes of the court decision for the coastal environment, to address research question 2. Images portraying giant kelp (*Macrocystis pyrifera*) forests of the East Otago Taiāpure were also obtained from the Otago University Marine Sciences Department to provide contextual information.

Key Informant Interviews

Interviews were carried out with key expert witnesses involved in the legal process on the side of the appellants, including the lawyer representing the appellants and a range of expert witnesses. The general line of questioning in these interviews included establishing the legal process that had been undertaken, the use of the ecosystem services concepts within the litigation and the participant's views on whether this helped to influence the final judgement. The interviews followed a similar collection, analysis and interpretation process to case study 1. Participants were also asked whether the outcomes of the decision were reflected in the subsequent coastal management and coastal environment outcomes.

Management Plans and Photographs

Port Otago Ltd. and related environmental management plans were analysed to determine what the management outcomes of the Environment Court decision have been for the environment. This analysis will provide the basis for a discussion on the outcomes of the use of ecosystem services assessment in coastal management and decision making. Images of kelp that were obtained from the Otago University Marine Sciences department were also used to provide an in depth understanding of the subject species and study used in the research.

3.5 Reflections on Research

Identifying limitations of research feeds into the iterative process of data collection and formation of methods (Yin, 2014). The main limitations of this research included the application of the case study approach and the extent to which the concept of ecosystem services could be examined from the multiple disciplines which it draws from.

Findings of case studies are often limited to the specific case which is subject to investigation (Marczyk et al., 2008). In this research, the case study approach was advantageous for gaining in depth analysis of the application of the ecosystem services concept (Yin, 2014). However, the case study was based specifically around the Kāritane and Otago Harbour coastal and marine ecosystems so caution must be taken in discussing the findings in relation to other marine ecosystems and broader ecosystem types. As identified in the literature review, ecosystem services are highly context dependent, being highly variable between species and also on local and global scales in relation to the environment being examined (Townsend and Thrush, 2010). The values placed on the environment from cultural and community perspectives are also highly likely to vary between case studies, limiting the applicability of the findings. The case study of planning processes will also be limited to application within New Zealand because of the differences in the planning regimes of other countries.

Selecting a representative sample of key informants for the interviews that were conducted also had limitations. It was important to ensure that the different perspectives surrounding the ecosystem services concept were represented, including social, cultural and scientific perspectives. Key informants who were interviewed often identified other potentially useful key informants, but contacting them within the time period that the research was being conducted constrained the ability to interview all suggested stakeholders. There was also often a lack of full understanding about the ecosystem services concept among the key informants. This limitation was partly overcome by providing information sheets and explaining the context for the research. In most cases the nature of the key informants understanding of their environment and community and the relationship with this to the ecosystem services concept was more important to observe than directly discussing the ecosystem services concept.

Access to legal resources in relation to case study 2 was also limited. For example, one key informant suggested that an Official Information Act 1982 request may be necessary to access Environment Court documents in relation to *East Otago Taiāpure Management Committee v Otago Regional Council* [2013]. Another key informant had limited storage of documents they had prepared, noting that they had handed the resources that they had prepared for the case to the East Otago Taiāpure official records system after the court case was completed. The FA 1996 and RMA 1991 were comparatively less difficult to

access than these resources. The expert witness statements that were analysed were also able to be obtained through engagement with key stakeholders involved in the case.

Ecosystem service data for the study sites was collected during the research alongside the investigation into the use of ecosystem services in environmental management and planning and is table 5.1, chapter 5 with a short discussion on the findings. There were limitations in the range of data that could be collected and the methods used to collect this data. The first limitation was that the method used to collect the data was required to be formulated by synthesising various ecosystem service assessment approaches, since there is no one established approach that was used by the researcher. Another limitation was the ability to collect and analyse quantitative data relating to the case studies. Collecting quantitative data can be useful for assessment types such as change assessments as baseline data to assess changes to ecosystem services (SCBB, 2016). The research instead relied on scientific articles that had already been published as primary sources of information about the quantitative factors of the ecosystems that were selected to be studied, which meant that it was not always possible to target the specific species or locations of interest in the selected study area.

Further case studies and engagement with a greater number of key informants could have been beneficial to address the limitations that have been identified. This would strengthen the quality and quantity of data obtained and allow findings to be drawn which had wider application. However, this was not easily achievable within the scope of the research parameters. It could also be beneficial to gather information from coastal managers with different roles and perspectives within the case studies examined, including the Port Otago Ltd. and local authority employees. This was also beyond the scope of the project. Further research which focused on the quantitative aspects of the ecosystems would also be beneficial to better understand the extent to which the ecosystem services provided by the subject species are present at the selected site based on their presence and functions at the study site.

3.6 Conclusion

The research methodology employs a mixed-method approach which is drawn from the use of multiple disciplines to examine the research question. One of the key advantages of this approach is that triangulation can be used to ensure data collection is reliable and

accurate. Secondary data collection involves desk based research of planning frameworks and legal analysis to provide a context for identifying how ecosystem services can be brought into planning frameworks to answer research question 3. Primary data collection is carried out for two case studies to inform research questions 1 and 2. The case study of the East Otago Taiāpure approach to management is used to better understand the value of using an approach similar to that of an ecosystem service based approach for natural resource management and outcomes for coastal environments. This is investigated through the use of key informant interviews, the attendance of committee meetings and legal analysis. The case study of *East Otago Taiāpure Management Committee v Otago Regional Council* [2013] is used to identify the value of using concepts which broadly reflect ecosystem services concept for resource management decision making and Environment Court processes. Primary data collection involves analysis of expert witness statements and key informant interviews. Observations of the contested site and analysis of Port Otago Ltd. management plans also helps to provide an understanding of the outcomes of the use of ecosystem services in decision making for resource management and for coastal environments.

Chapter 4: Context: Ecosystem Services Based Coastal Management in Otago

4.1: Introduction

Chapter 4 provides a context for the research and analysis. It presents a justification for the selection of the East Otago Taiāpure as a case study based on preliminary research. It also presents a justification for the selection of *Macrocystis pyrifera* (*M. pyrifera*, giant kelp) as a subject of the case study based on the ecosystem service role that it provides. Contextual information is presented for case study 1 of the East Otago Taiāpure Management Committee, including the background of the establishment of the East Otago Taiāpure and the East Otago Taiāpure Management Committee. Contextual information is also provided for case study 2 in relation to the appeal of the Otago Regional Council's (2011) decision to grant Coastal Permit 2010.198 for the disposal of dredged material as a part of the Port Otago Ltd. Next Generation channel deepening project in *East Otago Taiāpure Management Committee v Otago Regional Council* [2013]. It is demonstrated that there is a strong presence of the ecosystem services based approach at the East Otago Taiāpure, which provides a foundation for the research and analysis in the study.

4.2: East Otago Taiāpure

4.2.1: East Otago Taiāpure Site: The People and the Land

The East Otago Taiāpure covers a stretch of 25km of coastline along the East Coast of the South Island of New Zealand. The Taiāpure begins at Ohineamio (Cornish Head) (at 45° 37.28'S and 170° 36.0'E) along a straight line east towards Waiweke (Potato Point) (at 45° 44.42'S and 170° 38.3'E) and then west and north along the mean high water mark (East Otago Taiāpure Management Committee, 2008; Figure 4.1). This area is protected to fulfil the aspirations of Kāti Huirapa Rūnaka ki Puketeraki (2013) to ensure the maintenance of the health and wellbeing of depleting pāua stocks for current and future generations. The area protected by the Taiāpure also contains culturally important species including pāua (abalone, *Haliotis iris*), koura (crayfish, *Jasus edwardsii*), tuaki (cockles, *Austrovenus stutchburyi*), tio (oysters *Tiostrea chilensis*) and finfish like rawaru (blue

cod, *Parapercis colias*) and pātiki (flounder) (East Otago Management Committee, 2008). Kāti Huirapa Rūnaka ki Puketeraki (the local iwi group) was formed in 1990 to provide the Rūnaka (cultural group) with legal form and has a takiwā (district) which centres on Kāritane where Puketeraki Marae is located and extends from Waihemo to Purehurehu (Beyond Orokonui, 2015).

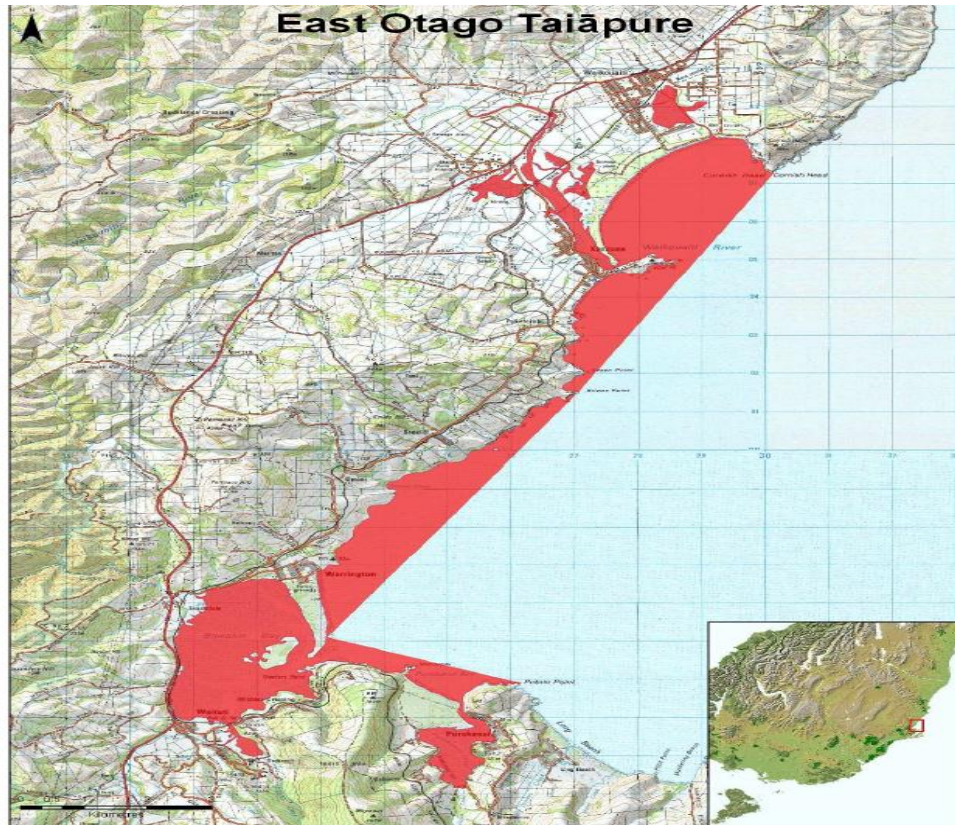


Figure 4.1: Map showing spatial boundaries of the East Otago Taiāpure (*East Otago Taiāpure Management Committee, 2008*).

The earliest cultural groups to arrive in the area were Rapuwai, Hawea and Waitaha followed by Kāti Mamoe and Kāi Tahu in recent times (Beyond Orokonui, 2015). The Waikouaiti River provided an impetus for settlement in the area for these groups because of the mahinga kai (customary food gathering) network which it sustained (Beyond Orokonui, 2015). Connections between the East Otago Taiāpure and the broader environmental area include Orokonui Ecosanctuary and the Waikouaiti River which flows into the Pacific and is closely connected to Huriawa Peninsula (Hepburn et al. 2011).

European settlement in East Otago was driven by a desire to be located nearby to prevalent food sources, high quality soils and an amenable landscape (Beyond Orokonui, 2015). The settlement forms one of the key communities of the North Coast area (Beyond Orokonui, 2015). Development has contributed to the formation of the modified catchment that exists today, which is dominated by agricultural farmland and small patches of exotic forest (Hepburn et al., 2011). This development may be driving environmental impacts on the kelp forest ecosystem of the East Otago Taiāpure. For example, sedimentation from land run-off can smother gametophytes and prevent spore settlement because rocky substrate that is needed for attachment (Schiel et al., 2006). This could lead to wider impacts on the ecosystem in relation to the supporting services and other categories of ecosystem services provided by kelp forests, which are explored in further detail in section 4.2.4. Suspended sediment may also reduce the amount of light energy that the kelp can access, reducing their potential for primary production (Desmond et al., 2015). Sedimentation could also reduce their ability to contribute to higher trophic levels and to provide supporting services such as habitat provision, which may have implications for further trophic levels (Vandendriessche et al., 2007). The management of the area to acknowledge these connections and ability of ecosystem services to illustrate the impacts of human actions on ecosystem services is explored in the results and discussion chapters.

There are ongoing processes to put in place protection mechanisms in the surrounding environment of the East Otago Taiāpure. A mātaihai reserve for the Waikouaiti River which flows into the Pacific Ocean approximately 800m from the site has recently been declared through the Fisheries (Declaration of Waikouaiti Mātaihai Reserve) Notice 2016. The application for the mātaihai reserve was lodged by Kāti Huirapa ki Puketeraki (2013) and allows tangata whenua (the people of the land) to make bylaws to manage all non-commercial fishing activities within the river area and prevent commercial fishing from taking place within the area (Ministry for Primary Industries, 2014). There is also an ongoing process to establish a network of management areas through the South-East marine protected area on the coastline between Timaru in the north to Waipapa Point on the southern coast as part of the Southern South Island coastal bioregion (South-East Marine Protection Forum, 2016). This process is being overseen by the South-East marine protected planning forum and the completion date has recently been extended to April 2017. The marine protected area would enable restrictions to be put in place to protect marine resources. Recognising and providing for indirect services through the use of the

ecosystem services concept in these management decisions for areas closely connected to the East Otago Taiāpure could enhance outcomes for coastal environments in the area, in line with the increased protection that is taking place.

4.2.2: Evidence of Ecosystem Services Based Approaches

The approach taken towards the understanding of the environment and the management of the environment of the East Otago Taiāpure shows many similarities to the ecosystem services based approach to management. Section 4.2.2 provides examples of the approach taken to the management of the East Otago Taiāpure and the surrounding site by the Otago University Marine Sciences Department, who have partnered with the East Otago Taiāpure to manage the site following an agreement in 2006 (Te Tiaki Mahinga Kai, 2016). This partnership in itself reflects an ecosystem services based approach to management, connecting citizens directly with the resources, species and habitats which they are working with (Beatley, 2014). This reflects the interconnected perspective taken to people and ecosystems in the ecosystem services concept (MEA, 2005). The East Otago Taiāpure and the surrounding site can be viewed as interconnected in the same sense, as impacts on one part of the ecosystem are understood to impact other parts of the system in the Māori worldview (Greenhalgh and Hart, 2015).

There is clear evidence of management techniques operating across spatial scales to understand the ecosystem in the management of the East Otago Taiāpure. Townsend and Thrush (2010) identify this as a key component of the ecosystem services concept. For example, Hepburn et al. (2011) studied the carbon uptake mechanisms of a range of macroalgae on the Huriawa Peninsula, (45°38'20"S, 170°40'15"E) located on the East Coast of the South Island near to the East Otago Taiāpure (45° 37.28'S and 170° 36.0'E), highlighting in the process of the study the importance of carrying out community-wide quantification of such mechanisms in order to understand variability in different species within one location. This contrasts to the approach taken in related ecosystems research which investigate nutrient uptake mechanisms of individual species in similar locations (Hepburn et al., 2011a; Pritchard, 2011 and Kregting et al., 2008). Connections between ecosystem components are also a central part of the ecosystem services concept (Fisher et al., 2009). These are well recognised in the management of the East Otago Taiāpure and the surrounding area. For example, Hepburn et al. (n.d.) investigated the ability of kelp forest restoration to promote fisheries restoration, linking loss of kelp and fisheries

declines with fisheries restoration through bottom-up processes that are restored when kelp beds are restored. These studies are carried out to investigate the impacts of the loss of one species on another within the trophic chain, connecting across components of the ecosystem.

There is also a clear recognition of the role of the kelp forest ecosystem in contributing to and interacting with wider global coastal processes in local management methods (Arias and Menendez, 2014). Ocean acidification is caused by sustained absorption of atmospheric CO₂ by the world's oceans and results in a change in seawater carbonate chemistry (James et al., 2014). There have been multiple studies carried out to identify and address the response of the local environment to global processes such as ocean acidification, including studies which show that kelp provides a buffering capacity to lower pH and ocean acidification (Cornwall et al., 2014, Hurd et al., 2011 and Hurd et al., 2009). In relation to the particular context of the East Otago Taiāpure and the surrounding site, James et al. (2014) have investigated the growth of coralline algae from the Northern coast of the Huriawa Peninsula at different pH levels to determine the effect of modified seawater carbonate chemistry, in doing so demonstrating an understanding of the impacts of global human actions on local ecosystem processes. This study will assess whether ecosystem services can be used to link the impacts of these human actions on the ecosystem back to the impacts on their own socio-economic systems in management decisions and the result of this form of management on outcomes for the coastal environment.

4.2.3: Kelp Forests of the East Otago Taiāpure and North-East Otago Coasts

Kelp forests are highly productive, structurally complex and diverse ecosystems which form on shallow rocky marine coastlines in mid-latitudes (Steneck et al., 2002). One of the major controls on the distribution, size and abundance of kelp forests is temperature. The distribution, size and abundance of kelp forests tends to decline as sea surface temperature increases (Dayton et al., 1992). This decline in abundance is particularly prevalent where kelp species are living close to their thermal tolerance threshold (Desmond, 2016). Temperature controls can also be observed locally. For example, Wernberg et al., (2011) demonstrated significant temperature related variation in habitat structure across ocean temperature gradients from a latitudinal band of 34-27°S in Western Australia, with declines in mixed patches and an increase in *Sargassum* species

associated which were related to warmer temperatures. Werner (2015) also demonstrated a temperature driven growth pattern of *Fucus* species in the Baltic Sea, linked to a temperature driven collapse of grazers in late summer, using mesocosm experiments to show that warm winter temperatures lead to intensified grazing and a significant reduction in *Fucus* biomass. In New Zealand, *M. pyrifera* does not persist in areas where maximum temperatures exceed 18-19 °C for several days and where the warmest monthly isotherm does not exceed 16-17 °C (Hay, 1990). Kelp forest distributions are also constrained globally by light from high latitudes and by nutrient availability from low latitudes (Steneck et al., 2002).

There is a large variation in macroalgae community structure within New Zealand, in relation to the biomass of macroalgal species groups within and among locations (Shears and Babcock, 2007). However, kelp forests with subsurface canopy-forming brown algae can be found throughout New Zealand (Desmond, 2016). South Island kelp forests are typically dominated by macroalgal species such as *Durvillaea* spp., *M. pyrifera*, and *Marginariella* spp., (Fyfe, 2000; Shears and Babcock, 2007). *M. pyrifera* is one of the better studied species of the South Island kelp forest community and because of its dominance in these environments and in international environments which it inhabits such as in California (Foster and Schiel, 1985; Steneck et al., 2002; Win, 2010). It has also been of interest because of its high productivity and large contribution to the carbon utilised in foodchains in the region of the sea that is closest to the shore (nearshore) foodchains (Dayton et al., 1992; Duggins et al., 1989 in Fyfe, 2000). For example, Fyfe (2000) has undertaken a study of the *M. pyrifera* beds situated further from the shore (offshore) at Pleasant River Otago, which make up part of the 300ha of *M. pyrifera* beds within the 4km stretch of south coast adjacent to the site. Pleasant River is located approximately 18km North of Kāritane, East Otago (45° 35.24'S and 170° 44'24E) (Figure 4.2). Distributions of the two main canopy classes are shown in Figure 4.3.

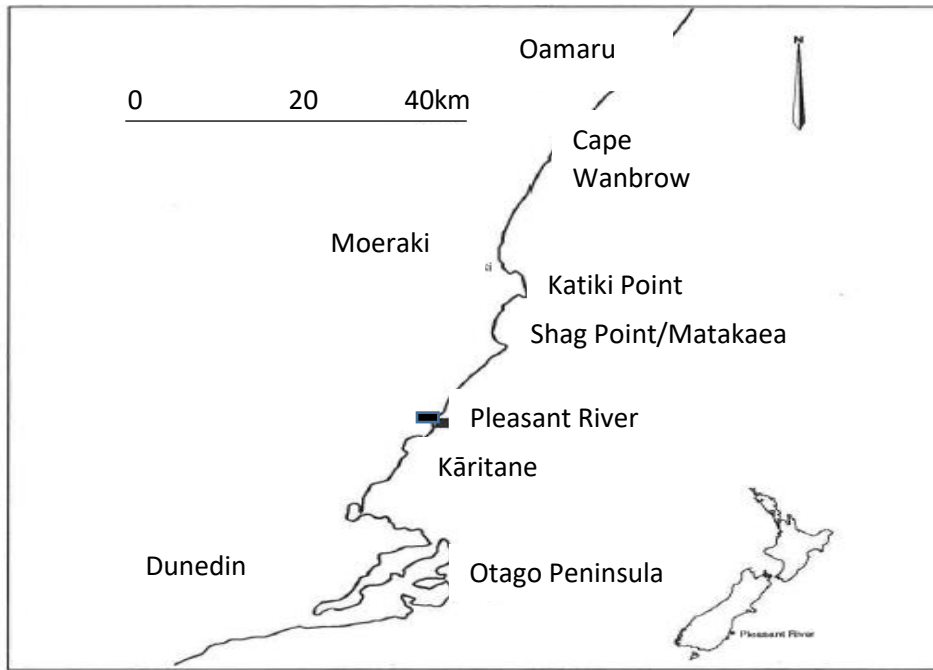


Figure 4.2: Map showing location of Pleasant River, East Otago, New Zealand (Fyfe, 2000).

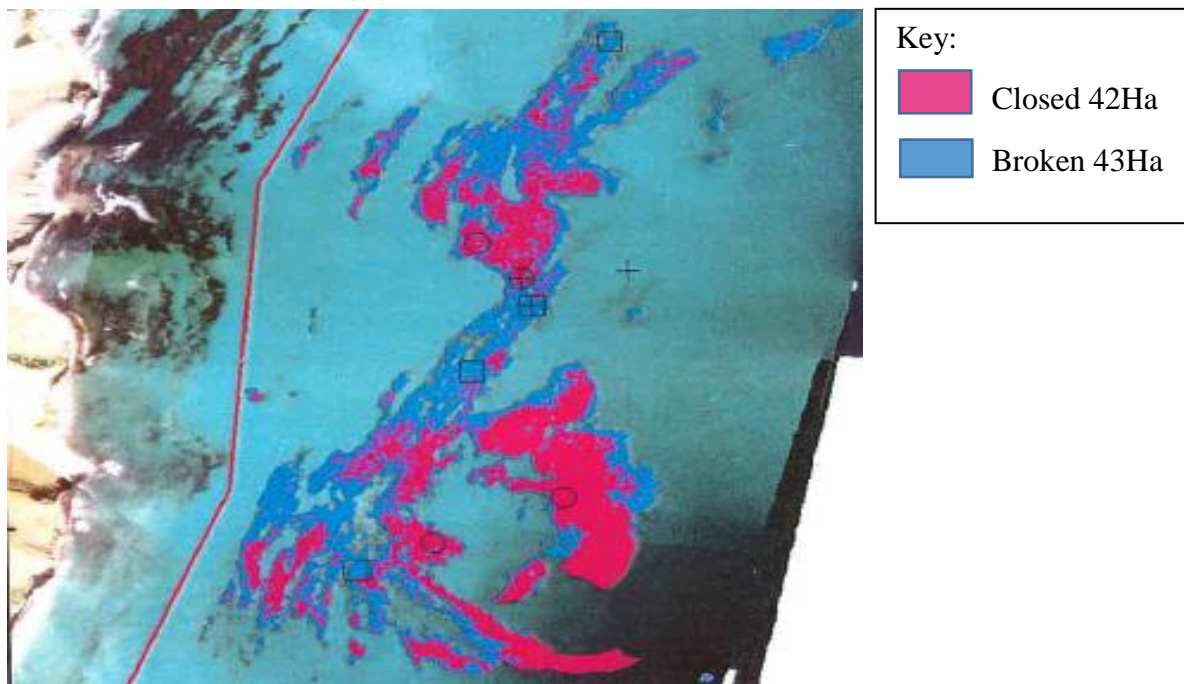


Figure 4.3: August 1995 photograph mosaic with two classes of offshore beds of *Macrocyctis pyrifera* identified. There are two main canopy types within this area; thick closed canopy and broken canopy. The two canopy classes include most of the *M. pyrifera* in the area and several distinct water masses, ranging from turbid to clear, accounted for another 4 classes (Fyfe, 2000).

M. pyrifera grows predominantly in the central and southern regions along the East Coast (Hay, 1990 in Fyfe, 2000). *M. pyrifera* belongs to the Lessoniaceae family and has two life cycle phases; a microscopic gametophyte phase and a macroscopic sporophyte phase (Foster and Schiel 1985 in Fyfe, 2000). *M. pyrifera* is a perennial species living for several years (Desmond, 2016). It will grow in water up to 20m deep and typically occupies 33-50% of the total biomass where it is present (Geange, 2014). *M. pyrifera* beds in this site and the broader area have been shown to undergo 3 main lifecycle stages; canopy establishment, canopy maintenance and canopy decline, which is caused by the mortality of large *M. pyrifera* (Fyfe, 2000). The wave climate plays a large role in influencing *M. pyrifera* beds through impacts on mortality, canopy biomass and reproductive success of individuals (Fyfe, 2000). The next section will present the context of *East Otago Taiāpure Management Committee v Otago Regional Council* [2013] 58 ENV 1 and set out the main pressures on the kelp of the East Otago Taiāpure and the surrounding kelp beds based on the human activities that are occurring at the site. The ecosystem services that could be lost through these actions and how well recognised these are in the management and planning of the site will be the subject of the results and discussion.

4.2.4: Ecosystem Services of East Otago Taiāpure Kelp Beds

M. pyrifera was selected for study in this research because of the wide range of ecosystem services that it provides (Smale et al., 2013, Table 4.1). In particular, *M. pyrifera* can be considered the ultimate provider of services because of its role as an autogenic engineer, transforming its ecosystem through its own growth and playing an integral role in the altered environment (Clive et al., 1997). *M. pyrifera* also plays an important role in supporting local fisheries, for pāua, crayfish and finfish directly by providing food (Jimenez et al., 2015), providing habitat (Win, 2010) and by playing indirect roles such as facilitating larval recruitment (Hinojosa, 2015). Regulatory ecosystem services provided by *M. pyrifera* include the dampening of waves to reduce coastal erosion (Stevens et al., 2001), reduction of nutrient runoff (Vitousek et al., 1997) and sediment trapping (Marsden, 1991). *M. pyrifera* is also of high cultural importance, in supporting mahinga kai (customary interests in traditional food sources) (Te Runanga o Ngāi Tahu, 1997) and by encouraging tourism/recreation and diving activities (Desmond, 2015). The presence of these ecosystem services in the case studies will be determined and discussed

in this research. The *M. pyrifera* kelp forest of the East Otago which provides these services is shown in Figure 4.4.



Figure 4.4: *Macrocyctis pyrifera* forest on the North Otago coast (Source: photo taken by Dr. Chris Hepburn, Otago University Department of Marine Science).

Table 4.1: Key ecosystem services provided by *Macrocyctis pyrifera* (adapted from Desmond, 2016; MEA 2005).

Supporting	Regulating	Provisioning	Cultural
Habitat provision	Nutrient uptake	Habitat for commercial species	Recreation
Primary production	Sediment trapping	Industrial uses	Taonga (treasure)
	Coastal erosion buffering		Mahinga kai (Customary Food Gathering)

The kelp beds of the East Otago Taiāpure were chosen for this study because the ecosystem services which they provide have the potential to illustrate the connected nature of ecosystem services. The key ecosystem service which will be focussed on in this study is the habitat provision service. The reason this service will be focussed on is because the key difference between this service and other types of services being that it

is an indirect service, which underpins other ecosystem services (Townsend and Thrush, 2010). Anecdotal evidence shows that *M. pyrifera* plays an important role in many commercial fishery industries such as pāua and crayfish because of this service (Anderson, 2011). It also plays an important role through the indirect role as nursery habitat for invertebrates through the habitat provision service (Win, 2010). The habitat provision service varies depending on the type of species that uses the kelp forest ecosystem. Some species are permanent residents while some use the habitat during crucial stages of development, taking advantage of reduced flow rates for larval settlement and egg dispersal (Rowley, 1989). Kelp forests are also used as nursery habitats by many species because of the protection which they provide from predators (Levin and Hay, 1996). The habitat provision service provided by kelp will be focussed on in order to assess whether indirect services are recognised in resource management and the effectiveness of ecosystem service based approaches in facilitating this.

The role of seaweed communities in providing habitat and support for higher trophic levels has been demonstrated in wider literature, further demonstrating the potential of this ecosystem service to be used to assess the recognition of the connections between ecosystem services in the research. Vandendriessche et al. (2007) demonstrated that floating seaweed clumps from the North Sea provide important refuges and feeding grounds for juvenile fish. Stomach analysis was used to confirm that fish species such as *Cyclopterus lumpus* and *Ciliata mustela* have a close spatial affinity with the seaweed clumps and size-frequency distribution curves demonstrated enhanced growth associated with feeding on the seaweed clumps. Another study by Bates and DeWreede (2007) finds that seaweed communities only have no relationship with epifauna richness and abundance, although the functional composition of seaweed communities is correlated with invertebrate assemblage structure. These studies illustrate that the structure and composition of seaweed communities will have implications for epifauna communities and fish species under certain conditions, which may vary considerably relative to the seaweed community that is the subject of investigation (Bates and DeWreede, 2007). Understanding the environmental variables of the case studies will be necessary to gain an understanding of the ecosystem services at the sites.

4.3: Establishment of the East Otago Taiāpure and the East Otago Taiāpure Management Committee

The management of the *M. pyrifera* beds of the East Otago Taiāpure by the East Otago Taiāpure Management Committee (EOTMC) is used as the first case study of this thesis. As discussed in section 4.2.2, the management of the site by the EOTMC has been determined to broadly reflect an ecosystem services based approach, which was a key reason why the case study was chosen. In chapters 5-8, an in depth analysis of the value and outcomes of this approach, the incorporation into management plans and the use in decision making is provided. At each stage, the amount to which the approach used by the EOTMC reflects the ecosystem services based approach is briefly discussed, so that an awareness of the distinction between the approach employed by the EOTMC and the ecosystem services based approach is sustained. The reason for this assumption is that a case study of a New Zealand coastal environment where the explicit use of an ecosystem services based approach for resource management could not be identified by the researcher, so this case study was determined to provide the best possible mechanism available to study the use of the approach in environmental management.

4.3.1: Establishment of the East Otago Taiāpure

A taiāpure (local fishery) is a statutory fisheries management tool which is a key component of the fisheries settlement redress. The FA 1996 provides for the making of any area of New Zealand fisheries waters to be a taiāpure provided they have been customarily significant to iwi or hapū as a source of food or for cultural or spiritual reasons, in order to better provide for the recognition of rangatiratanga (chieftainship) and rights secured in relation to fisheries by Article II of the Treaty of Waitangi. The Governor General must declare the making of a taiāpure through an Order in Council in accordance with s175 on a recommendation made by the Minister of Fisheries (MOF) in accordance with s175-s185 of the FA 1996. The MOF must not make this order unless they are satisfied that the order will further the object of a taiāpure which is set out in s174 and that the order is appropriate in regards to the size of the area of water, the impact on community welfare in the vicinity of the area, the impact on those with special interest in the area and the impact of the order on fisheries management.

The object of the taiāpure which the Minister must consider in the decision to establish a taiāpure under s175 is to make better provision for the recognition of rangatiratanga and the right secured in relation to fisheries by Article II of the Treaty of Waitangi. Taiāpure can be applied to areas that have customarily been of special significance to iwi and hapu as a source of food or for spiritual and cultural reasons. The gazette notice for a taiāpure is published by the MOF after consultation with the Minister of Māori Affairs and the hearing of submissions to the office of the Māori Land Court in the nearest locality relating to the proposal (Ministry for Primary Industries, 2014a). The East Otago Taiāpure was formally gazetted in 1999, following an extensive process of working through community concerns surrounding the application for management (Kāti Huirapa ki Puketeraki, 2013; Fisheries (East Otago Taiāpure) Order 1999). The approximate area of East Otago that was gazetted for protection is shown in Figure 4.5.



Figure 4.5: East Otago Taiāpure, Kāritane, New Zealand approximate area where the adverse effects on inshore kelp forests were a concern to appellants in East Otago Taiāpure Management Committee (2013) (Fox, 2009).

The East Otago Taiāpure was put in place to address the concerns of Kaumātua (elders) of Kāti Huirapa ki Puketeraki over depleting pāua stocks within their rohe (Kāti Huirapa ki Puketeraki, 2013). The East Otago Taiāpure Management Committee was established in 2001 to oversee the carrying out of the principles and objectives of the committee (Kāti Huirapa ki Puketeraki, 2013).

4.3.2: Establishment of the East Otago Taiāpure Management Committee

The main tensions surrounding the establishment of the East Otago Taiāpure were the possibility of leaving the public out of decisions surrounding the management of the designated taiāpure area and the prospect of Māori aspirations being reflected above wider community aspirations in the management of the area (Kāti Huirapa ki Puketeraki, 2013). However, the members of the East Otago Taiāpure Management Committee make it clear that they exercise rangatirantanga over the East Otago Taiāpure but do not represent the views of Kāti Huirapa ki Puketeraki. This distinction is made clear in the submission in relation to the application for Consent No. 2010.198 where the East Otago Taiāpure Management Committee state that they represent ‘multiple sectors of the community of which Māori is one aspect’, in accordance with their gazetted mandate (Otago Regional Council, 2013; East Otago Taiāpure Management Committee, 2013). The East Otago Taiāpure Management Committee put in place a management plan in 2008 to provide guidance on the management of the East Otago Taiāpure (Kāti Huirapa ki Puketeraki, 2013).

The overarching vision of the East Otago Taiāpure Management Committee which is contained in the East Otago Taiāpure management plan (2008) is to create a healthy, abundant and accessible fishery inside the Taiāpure that provides for the communities customary, recreational and commercial needs (East Otago Taiāpure Management Committee, 2008, p.1). The guiding objectives of the East Otago Taiāpure Management Committee include the establishment of monitoring regimes, the employment of people who are responsible for the planning and management of the East Otago Taiāpure’s programs and the employment of people with the skills to further develop the East Otago Taiāpure’s (East Otago Taiāpure Management Committee, 2012). The overarching principle that sits behind the management of the East Otago Taiāpure is to ‘manage the East Otago Taiāpure in a sustainable manner’ (East Otago Taiāpure Management Committee, 2012). These provisions are analysed further and related to ecosystem service based concepts in chapter 7.

Once established, a committee of management appointed for a taiāpure has the ability to recommend to the Minister the making of regulations under section 186 or section 297 or section 298 for the conservation and management of the fish, aquatic life, or seaweed in the taiāpure-local fishery under s185 of the FA 1996. This is the primary legislative

mechanism through which the East Otago Taiāpure Management Committee can achieve their vision. Regulations that can be made by the Governor-General under s186 must both recognise and provide for customary food gathering by Māori and the special relationship between tangata whenua and places of importance for customary food gathering. Recommendation of regulations under s186 is also limited to non-commercial good gathering purposes. In order to impose a restriction on an area of New Zealand fisheries waters, including those recommended by the management committee, the Minister must be satisfied that it will recognise and make provision for the use and management practices of tangata whenua in the exercise of non-commercial fishing rights in accordance with two considerations under s186A(2); (a) that it will improve size and/or availability of these species or (b) that it will recognise a customary fishing practice in that area. The Minister must also be satisfied that it will not have an adverse effect on the use and management practices of tangata whenua in the exercise of non-commercial fishing rights in accordance with s186A(3).

The East Otago Taiāpure Management Committee has successfully recommended and set two sets of regulations; the first for set netting on October 1st 2007 and the second for a temporary closure and reduction in bag limits for finfish and shellfish on October 1st 2010 (Fisheries (South-East Area Amateur Fishing) Amendment Regulations 2010) (FSAAFAR). Section 5 of the FSAAFAR (2010) provides for the insertion “s3AB the maximum daily number of finfish” and contains provisions which limit the take and possession of more than 10 finfish in the southern part of the Taiāpure. Contravention of the s3AB occurs when more but not 3 times more than the daily maximum number are taken. Section 6DB of the FSAAFAR (2010) establishes a restricted take of not more than 5 pāua from the East Otago Taiāpure, s6DC limits the taking of kina to a maximum daily number of 10 and s6DD limits the taking of shellfish to not more than 50. The regulations also include the prohibition of the taking of pāua from Huriawa Peninsula for a 2 year period. The FSAAFAR 2010 regulations also revoke s3E(2) which controlled the use of unattended set nets within the Taiāpure.

4.4: East Otago Taiāpure Management Committee v Otago Regional Council [2013] 58 ENV 1

The appeal process in the Environment Court of New Zealand (Environment Court) of the decision of the Otago Regional Council (2011) to grant Coastal Permit 2010.198 to Port Otago Ltd. to carry out dredging as part of the Next Generation channel deepening project by the East Otago Taiāpure Management Committee (EOTMC) and other appellants is the second case study of this thesis. An Environment Court appeal is lodged under s120 of the Resource Management Act 1991, which provides parties with the right to appeal to the Environment Court in relation to the decision of a consent authority on an application for a resource consent (Quality Planning, 2016). The process of an appeal through the Environment Court often involves a pre-hearing conference to ensure preparations are efficient, fair and ordered in Court proceedings and mediation (Quality Planning, 2016). Submitters must formally lodge notice under s274 of the RMA 1991 to be involved in the proceedings (Quality Planning, 2016).

As for case study 1, an approach that closely reflects an ecosystem services based approach is examined in case study 2 because of the lack of availability of a case study of a New Zealand coastal planning process where the ecosystem services based approach has been used explicitly. Research of legal databases revealed that are many examples of the holistic and connected approach to understanding ecosystems which is embedded in the ecosystem services concept (Ash et al., 2010; Greenhalgh and Hart, 2015). For example, in *Waikato Regional Council v Transfield Services (NZ) Ltd*, Harland J. made clear reference to the downstream impacts from the uncontrolled release of sediment from an upstream source. However, very few explicit references to ecosystem services have been made. In *East Otago Taiāpure Management Committee* (2013) the submitters refer to the ‘ecological values’ of *M. pyrifera* in expert witness statements, providing evidence that an approach similar to that which recognises ecosystem services has been used (Hepburn, 2011). The integration of multiple components of the environment in the appeal process provides further support that an approach similar to that which recognises ecosystem services has been used.

4.4.1: East Otago Taiāpure Management Committee Environment Court Appeal

Port Otago applied for Coastal Permit 2010.198 as part of the ‘Next Generation’ project which was planned to carry out a substantial capital works project to deepen the Port Otago channel (Bell et al., 2009). Port Otago sought to deepen the channel to 17.5m below Chart Datum in the offshore approach channel and to deepen the main Harbour channel from Port Chalmers to Harrington Point to 15m below Chart Datum for the Next Generation project (Bell et al., 2009). The final channel design required a yield of 7.06Mm³ of dredged sediment to be disposed (Bell et al., 2009). The activity was classed as a discretionary activity in the Regional Plan: Coast and required a coastal permit (*East Otago Taiāpure Management Committee*, 2013). The project was driven largely by economic incentives, with the aim to allow for larger container and cruise ships to arrive in the port and for the aggregation of cargo at key ports and at a cost of \$30 NZ million dollar for the operation (Port Otago Ltd., 2015). Otago Regional Council (2011) granted Coastal Permit 2010.198 in 2010 pursuant to section 104B of the RMA 1991 which provides consent authorities with the ability to grant consent for a discretionary or non-complying activity after a hearing process had been carried out. Coastal Permit 2010.198 was granted in conjunction with Coastal Permits 2010.193 and 2010.195.

The capital works that were proposed to be carried out by Port Otago Ltd. can be divided into two major components. Incremental capital works involve dredging and ancillary works in the Otago Harbour using trailing suction dredges and grab dredge or back hoes. Incremental works also involve maintenance dredging that is not permitted in the Regional Plan: Coast (Otago Regional Council, 2012) and require resource consents for the disposal of the dredged material. Major Capital Works are any kind of dredging or ancillary works in the Otago Harbour that are not incremental capital works or part of the Maintenance Programme. The maximum capacity of incremental capital works is no more than 1.45 million cubic metres and the maximum capacity of any dredge used for major capital works shall not exceed 11,000 cubic metres (Bell et al., 2009).

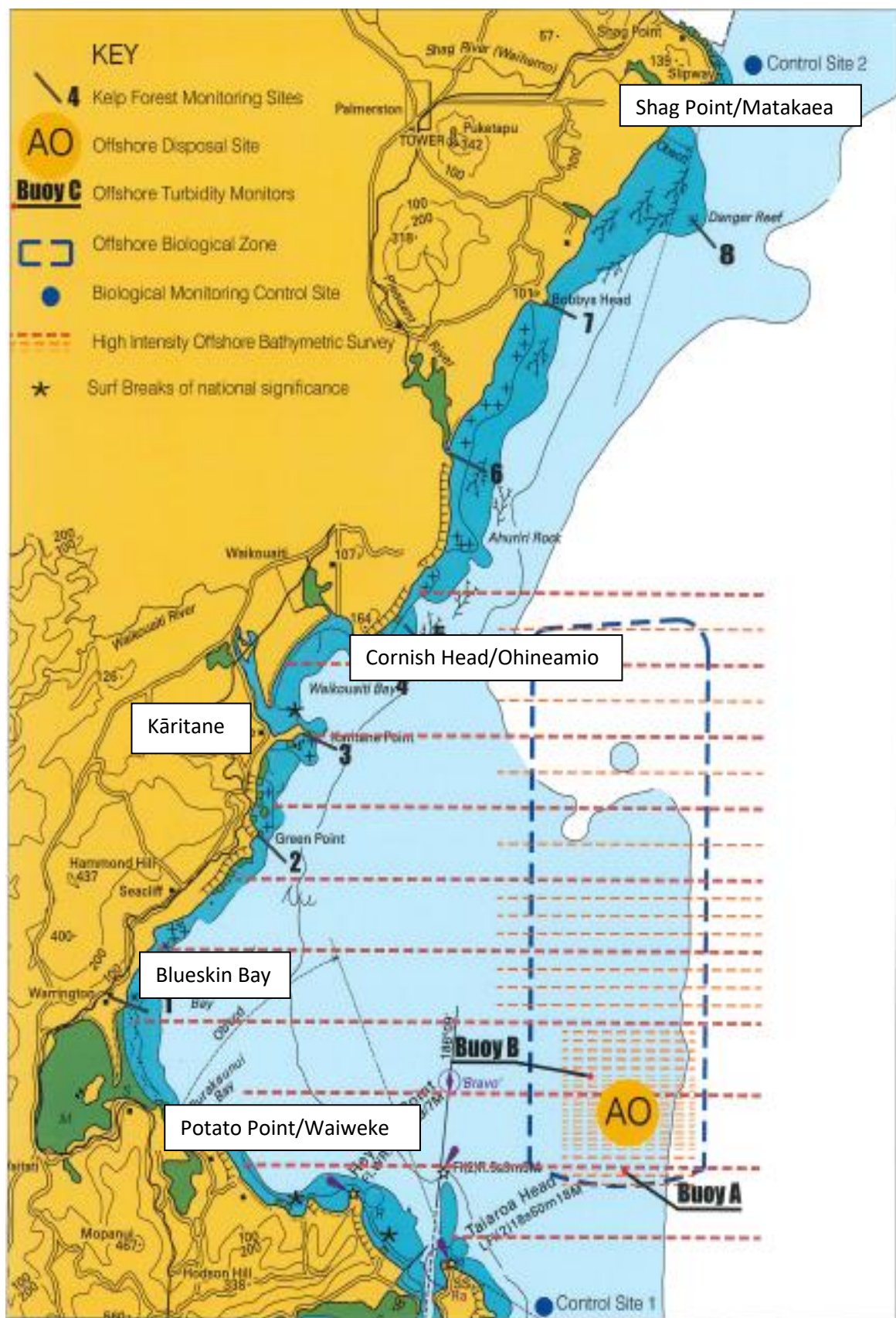
Coastal Permit 2010.198 provided Port Otago Ltd. with consent to deposit up to 7.2 million cubic metres of dredged material sourced from the Otago Harbour for the purpose of deepening and widening the Lower Harbour channel and the Port Chalmers swinging and berthing area (Otago Regional Council, 2013). Coastal Permit 2010.198 also sets out conditions for the use of site Alpha Zero (A0) for the disposal of sediment dredged from

Otago Harbour. The Otago Harbour area where the activity was proposed to take place is shown in Figure 4.6 (Coe, 2012).



Figure 4.6: Otago Harbour approximate area where Port Otago Next Generation channel deepening project was proposed to take place (Coe, 2012).

The conditions were imposed on the consent by the Otago Regional Council pursuant to s104B (b) of the RMA 1991 (*East Otago Taiāpure Management Committee*, 2013). The disposal site for dredging that was stipulated on the consent was, Alpha Zero (A0) is located in the Pacific Ocean, approximately 6.3 kilometres north east of Taiaroa Head, a circle with a 1 kilometre radius centred on WGS 84 45° 44' 8" S 170° 47' 56" E (NZTM 2000 4932950N 1428763E) and to a minimum depth below 25m chart datum (*East Otago Taiāpure Management Committee*, 2013). The location of site AO is shown in Figure 4.7 (Port Otago Ltd., 2016).



The conditions of the physical environment are an important factor in determining the behaviour of the deposited sediment. The environmental conditions of AO are documented in detail by De Lange (2012) including swell periods and deep-water wavelengths. Wave modelling that was carried out to assess the environmental impacts of the 15m dredged channel option with the terminating bed level of 17.5m Chart Datum defines two main receiving environments for the dredged sediment (Bell et al., 2009). The first is the Otago Harbour block which is 21km long and 46km² in area, with a tidal range of 1.2m mean neap-tide and 2.0m spring tide. The second receiving environment for dredged sediment is the Otago Heads shelf, which extends from Cape Saunders south up to Green Point at the northern end of Blueskin Bay to a 30m depth contour. Wind generated currents and the Southland current dominate this area while tidal currents are quickly dissipated. Chapter 6 analyses in further detail how these factors influence the deposition of sediment in the kelp forests nearby and how an ecosystem services based approach could be used to understand this.

The monitoring and management of the Otago Harbour in relation to the proposed dredging extends to a wider area than the sediment plume sites. Turbidity monitoring is proposed to take place within a 20m boundary of sites ranging from the Upper Harbour, the Aramoana Ecological Area and Harbour Seagrass Beds (Port Otago Ltd., 2012). The locations where offshore monitoring, including monitoring of turbidity and kelp forest monitoring sites will take place are shown in Figure 4.7 and demonstrate the extent of the site area which will be monitored in relation to the dredging (Port Otago Ltd., 2016). Turbidity monitoring is proposed to take place for a minimum of six months following the beginning of Incremental Capital works. Biological monitoring surveys and bathymetric surveys are also proposed to take place in the wider area in relation to Project Next Generation. Chapters 7 and 8 provide further analysis of how well recognised and monitored the biological environment was in the process and subsequent to the consent being granted.

Coastal Permit 2010.198 was subject to 37 conditions (*East Otago Taiāpure Management Committee*, 2013). Condition 7 requires Port Otago to prepare an Environmental Management Plan (EMP, 2012) prior to exercising the consent. The contents of this plan were to include details about the proposed monitoring of the site in accordance with conditions 9, 18 and 36 for Major Capital Works and Incremental Capital Works and a description of the methods to be implemented to manage the disposal at site AO (*East*

Otago Taiāpure Management Committee, 2013). Among this set of conditions was also a requirement for baseline monitoring (C9), requirements for consultation to be carried out with Kāi Tahu (C11) and the requirement for a Technical Group to be established with functions specified within condition 12. Other conditions provided for standard consent processes under the RMA 1991, including providing the consent authority with the ability to serve notice to review the consent conditions within 3 months of the commencement of the consent.

Port Otago produced a Draft Environmental Management Plan in 2012 in response to Condition 7 of Coastal Permit 2010.198. The EMP (2012) describes actions that would be taken in relation to events that occurred as a part of dredging, the dredging methodology and provides a detailed Monitoring Plan, list of key positions and an outline of the approach taken to stakeholder engagement, as required by the consent conditions. Part 10 of the plan outlines the four main components of the Next Generation Project; Deepening and widening the Otago Harbour channel, disposing dredge material at sea, construction a multipurpose wharf platform and placement of a rock revetment to support berths.

The East Otago Taiāpure Management Committee and the Pāua Industry Council Ltd., Pāuamac 5 Inc., New Zealand Federation of Commercial Fisherman Inc. and the Otago Rock Lobster Industry Association Inc brought an appeal against the decision of the Otago Regional Council to grant Coastal Permit 2010.198 in 2013 under s120 of the Resource Management Act 1991, which provides parties with the right to appeal to the Environment Court in relation to the decision of a consent authority on an application for a resource consent (Quality Planning, 2016). The contentious issue that was brought to the Environment Court surrounding the consent was in relation to the desires of the appellants to avoid ‘any discernible adverse effect on the inshore coastal area, in particular the kelp forest ecosystem’ (*East Otago Taiāpure Management Committee*, 2013, p.2). The Environment Court sought to clarify how to address this issue in the conditions of consent 2010.198. Four expert witnesses were called upon to provide evidence and assist the Court in determining this issue.

The appeal decision and the Environment Court process under s120 of the RMA 1991 in relation to Coastal Permit 2010.198 are used in this research as the planning process in which to evaluate how ecosystem services may be able to be used to enhance the

recognition of possible adverse impacts on the kelp forest ecosystem, which will be discussed in further detail in chapters 5, 6, 7, and 8 (Quality Planning, 2016). The evidence statements of these experts will be assessed in this research to tease out where the ecosystem services concept has been incorporated into the evidence statements. Where identified, the values of using this approach and the outcomes of employing this approach for the decision and the coastal outcomes of the decision will be assessed. This will answer the third research question of how best to incorporate ecosystem services assessment into decision making processes, ultimately answering the question of whether ecosystem services can be applied as a concept to improve coastal management decision making and outcomes in New Zealand.

4.5: Conclusion

The East Otago Taiāpure provides a site through which the use of the effectiveness of the ecosystem services based approach to coastal management can be examined. Preliminary research findings show that the approach taken towards the management of the site broadly reflects an ecosystem services based approach to management. There are a number of ecosystem service providers at the site. This research will focus on *M. pyrifera* because of the crucial role it plays as an autogenic habitat provider in the East Otago Taiāpure coastal ecosystem. The management approach is guided by the East Otago Taiāpure Management Committee and the powers they are delegated under the FA 1996. The use of an ecosystem services based approach in an Environmental Court process relating to the decision on a resource consent will also be examined through analysis of the *East Otago Taiāpure Management Committee, 2013* case. This case study is consistent with the first case study because the impacts on the habitat providing role of *M. pyrifera* of the East Otago Taiāpure from the disposal of dredged material as part of the Port Otago Ltd. Next Generation project were the main point of contention in the case.

Chapter 5: Values of Ecosystem Services Based Approach to Coastal Management

5.1: Introduction

Chapter 5 presents the results and discussion in relation to research question 1: what is the value of using ecosystem services for coastal management and decision making (Fig 3.1)? The research question is used to establish if there are benefits to using an ecosystem services based approach for coastal management. The results of the ecosystem services of the East Otago Taiāpure are first presented to establish the context for assessing this question. This is followed by a discussion firstly in relation to environmental management through the case study of the East Otago Taiāpure Management Committee (EOTMC) and the approach to management applied at the site. It is answered secondly in relation to the case study of *East Otago Taiāpure Management Committee v Otago Regional Council* [2013] 58 ENV 1, with a particular focus on the way that ecosystem services based concepts were employed throughout the Environment Court process by the appellants.

Ecosystem services are the ‘direct and indirect benefits that humans derive from the natural environment’ and are divided into four categories; supporting, provisioning, regulating and cultural services (MEA, 2005). By definition, the ecosystem services concept integrates human and environmental systems and draw connections between different components of the environment (Fisher et al., 2009; Townsend and Thrush, 2010; Boyd and Banzhof, 2007). Chapter 5 reinforces the theoretical definition of ecosystem services that has been developed, identifying the main value of ecosystem services as being the ability to provide for the recognition of connections between human and environmental systems and between components of the environment through the synthesis of primary and secondary research results including key informant interviews, observations and minute analysis of the EOTMC meetings. The case study of *East Otago Taiāpure Management Committee (2013)* is used to bring these findings into the context of the process of appealing a planning decision in the Environment Court, forming a discussion around whether the use of ecosystem services throughout the processes has value.

Through identifying the value of the use of the ecosystem services concept in planning and resource management in the case studies, chapter 5 ultimately seeks to develop an

understanding of the valuable aspects of the ecosystem services based approach that should be brought into natural resource planning and management internationally and in New Zealand.

5.2: Results: Ecosystem Services of the East Otago Taiāpure

Ecosystem services assessments measure the benefits that humans can derive from ecosystem processes and functions (Luisetti et al., 2011a.). Although performing an ecosystem services assessment of the East Otago Taiāpure was not the primary focus of this research, key ecosystem services that related to the site were recorded as they were raised throughout the research and categorised according to the ecosystem service frameworks of Macdiarmid et al., (2013) and Townsend and Thrush (2010) to provide a basis for the subsequent assessment of the research questions. It should be noted that no systematic ecosystem services assessment methodology was adopted for the analysis, although a range of methods would be available for further research that have been developed specifically for New Zealand coastal environments. (Van Den Belt and Cole, 2014; Farber et al., 2006). In this research, the ecosystem services of the East Otago Taiāpure were identified through a range of methods that were employed to answer the research questions, as explained in chapter 3. The results of this analysis are presented in Table 5.1. A wide range of environmental components of the East Otago Taiāpure and the surrounding environment were identified as providing ecosystem services. Three services were identified as being provided by the wider environment, four services from various species from the coastal ecosystem and two ecosystem services specifically provided by the *M. pyrifera* at the site directly through the research. Section 5.3 of this research provides a discussion of the particular ecosystem services that were observed at the site in relation to the research objective and key research questions.

The ecosystem service category with the most ecosystem services identified at the East Otago Taiāpure through this research was the cultural services category. Four cultural services were identified through the analysis of a range of document types and interviews (Table 5.1). Most cultural services identified by Macdiarmid et al. (2013) in their coastal ecosystem services framework (Table 2.1, chapter 2) were present, with the exception of watchable wildlife. Two ecosystem service categories had the lowest quantity of ecosystem services at the East Otago Taiāpure; the supporting and regulatory ecosystem services category, which each had 1 identifiable ecosystem service at the site (Table 5.1).

This reflects coastal and marine ecosystem services frameworks which also contain the lowest number of ecosystem services for the supporting category (Townsend and Thrush, 2010). The quantity of only 1 regulatory service is also much smaller in comparison to the quantity of 12 regulatory coastal ecosystem services contained in the ecosystem service frameworks of Macdiarmid et al. (2013) and Townsend and Thrush (2010).

The finding of only 1 regulatory and supporting service compared to the 12 identified by Macdiarmid et al. (2013) and Townsend and Thrush (2010) may reflect the predominant use of qualitative research techniques in this research. A study of the adequacy of quantification of ecosystem services by Boerema et al. (2016) shows that regulatory services are the most readily quantifiable ecosystem services, supporting this conclusion. The finding may also reflect the indirect nature of regulatory services, which makes them less readily identifiable through these techniques (MEA, 2005). Developing methods to determine the magnitude and value of ecosystem services and the contribution of individual ecosystems to national values has been identified as a critical area of research that requires further attention by multiple ecosystem service researchers (Macdiarmid et al., 2013; Boerema et al., 2016).

Table 5.1: Key ecosystem services identified at the East Otago Taiāpure. The ecosystem service and the component of the environment that the ecosystem service relates to are shown. The framework that the categorisation based on is also shown, as well as how the service was identified through this research.

Service at East Otago Taiāpure	Service in Framework	Coastal Ecosystem Services Framework	Service Type	Environmental Component	Identification Source
Sense of Place	Inspirational Value	MacDiarmid et al., 2013	Cultural	East Otago Taiāpure area	<ul style="list-style-type: none"> • Key Informant 1
Educational and Scientific Research Foci	Educational and Scientific Research Foci	MacDiarmid et al., 2013	Cultural	East Otago Taiāpure area	<ul style="list-style-type: none"> • Minute Analysis • Key Informant 1
Customary Management Value	Cultural Heritage	Townsend and Thrush, 2010	Cultural	East Otago Taiāpure coastal species	<ul style="list-style-type: none"> • East Otago Taiāpure Management Plan (2008) • Flack (2011)
Observation, recreational activities	Recreational	Townsend and Thrush, 2010	Cultural	East Otago Taiāpure area and <i>M. pyrifera</i>	<ul style="list-style-type: none"> • Key Informant 2 • Site observations
Carbon Uptake	Carbon capture and sequestration	MacDiarmid et al., 2013	Regulatory	East Otago Taiāpure large brown macroalgae	<ul style="list-style-type: none"> • Secondary research articles
Customary harvesting	Wild Food	MacDiarmid et al., 2013	Provisional	East Otago Taiāpure coastal species	<ul style="list-style-type: none"> • East Otago Taiāpure Management Plan, 2008
Commercial Harvesting	Food Provision	Townsend and Thrush, 2010	Provisional	Rock lobster, pāua, clams	<ul style="list-style-type: none"> • Expert witness statements
Habitat Provision	Habitat Structure	Townsend and Thrush, 2010	Supporting	East Otago Taiāpure <i>M. pyrifera</i>	<ul style="list-style-type: none"> • Expert witness statements

Note: Expert witness statements are from *East Otago Taiāpure Management Committee* (2013)

5.3: Discussion: Value of Using Ecosystem Services Based Concepts in Case Study 1: Management of the East Otago Taiāpure

5.3.1: Introduction

Section 5.3 presents results and findings for case study 1: The value of ecosystem services based approaches for the management of the East Otago Taiāpure, through the synthesis of key informant interviews, observations and minute analysis of the EOTMC meetings.

The ecosystem services present at the site are determined first, so that the value of recognising and providing for the ecosystem services in the management of the East Otago Taiāpure can be established. There are a wide range of ecosystem services from all MEA (2005) categories found to be present at the site, which are provided on a range of temporal and spatial scales of the East Otago Taiāpure environment. The main ecosystem services include; inspirational and sense of place, customary harvesting and habitat provision.

As stated in section 4.3, chapter 4, the assumption that an approach similar to an ecosystem services based approach has been applied at the study site is adopted in this research in order to study the use of the ecosystem services based approach to coastal management in New Zealand broadly. Furthermore, establishing the recognition and presence of ecosystem services at the site helps to support the use of the East Otago Taiāpure as a case study of the ecosystem services based approach to management. The value that recognising and providing for these ecosystem services through an ecosystem services based approach to management an ecosystem services based approach to coastal management can then be drawn from the case study.

In particular, the ability of the ecosystem services based approach to illustrate connections between humans and the environment and the connections between environmental components is demonstrated. This section helps to address how ecosystem services based approaches can be incorporated into the RMA 1991 planning framework, by showing that the flexibility should be built into planning frameworks and environmental legislation to provide for a holistic approach to resource management which recognises the inherent connections between ecosystem components.

5.3.2: Coastal Ecosystem Services of the East Otago Taiāpure and Surrounding Environment

Results of this research revealed that a wide range of cultural services are recognised in relation to the East Otago Taiāpure kelp beds and the wider East Otago Taiāpure area. Cultural services are the non-material ecosystem services which people derive from the environment (MEA, 2005, Table 5.1). For example, Key Informant 1, Kāritane community representative on the EOTMC, identifies inspiration and a sense of place as an important service associated with the East Otago Taiāpure and the Kāritane area where the Taiāpure is located (Table 5.1), stating:

This place there is something about it...you can just feel it alright, and I'd say that's what's important, and just the way the place is...an inspirational place, or as a place where you can be at home, or a place that you can have a family, or a place that you welcome people to be part of your world, you know what I'm saying (Key Informant 1).

Observations of the use of the East Otago Taiāpure and the surrounding area also reinforced that there are a wide range of cultural ecosystem services present and identified by users of the site. Educational foci is one of the key cultural services identified in ecosystem services frameworks (Macdiarmid et al., 2013; Townsend and Thrush, 2010). The East Otago Taiāpure is actively used as an educational site. There is a history of the use of the site for school group visits since the establishment of the Taiāpure in 1999. For example, in May 2010 the Taiāpure Committee assisted with plantings and education for a Hui held by Enviroschools for students from South Island high schools (East Otago Taiāpure Management Committee, 2010a). Key Informant 1 also explains how the University of Otago Marine Science Department use the site, conducting regular educational visits and field research at the site and using the Puketeraki Marae as a place to communicate research findings to the wider community (Beyond Orokonui, 2015; KI 1). The strong presence of the educational ecosystem service at the site demonstrates that an ecosystem services based approach to management is present at the East Otago Taiāpure and also demonstrates the benefits of the use of the ecosystem services based approach to coastal management.

There was a very strong and clear recognition of the customary importance of the East Otago Taiāpure site. This can most likely be attributed to the fact that the establishment of the Taiāpure was driven by the desires of Kaumātua (elders) of Kāti Huirapa ki Puketeraki to manage depleting pāua stocks within their rohe (Kāti Huirapa ki Puketeraki, 2013). The presence of the customary value ecosystem service is best exemplified through the inclusion of an extensive list of mahinga kai (customary food) resources of Kāritane and Puketeraki, which sets out the culturally important species within the East Otago Taiāpure within the East Otago Taiāpure Management Plan (2008), as shown in Table 5.2. Mahinga kai resources recognised at the site include a range of fish, marine mammal and seaweeds (Table 5.2). All mahinga kai resources have Māori names associated with them, further demonstrating their cultural importance. It is evident that those who manage and use the East Otago Taiāpure site attach a range of cultural values to the site and understand the importance of managing the site to support these values.

Table 5.2: Mahinga Kai resources of Kāritane/Puketeraki. Kekenos is protected under the Marine Mammals Protection Act 1978 and is recognised as a taonga species under the Ngāi Tahu Claims Settlement Act 1998. Pipi, Tuaki and Tuatua are identified as Customary Fisheries “Shellfish Species” under the Ngāi Tahu Claims Settlement Act 1998. Karengo is recognised as a non-commercial species under the Ngāi Tahu Claims Settlement Act 1998 (adapted from East Otago Taiāpure Management Plan, 2008).

Resource	Name
Ika (Fish)	Maka (barracouta), Hāpaku (groper), Hokarari (ling), Rāwaru (blue cod), Pātaki (flatfish), Pawhaiwhakarua (wrasse), Tuna (eels), Moki, Pau (wrasse), Inaka (whitebait), Kanakana
Marine Mammals	Kekeno (NZ fur seal)
Mahinga Kai	Pipi, Pāua, Kōura (crayfish), Kutai (green mussel), Tuaki (cockles), Tuatua, Tio (oysters)
Seaweed	Karengo (red sea lettuce)

Table 5.1 shows that the supporting and regulatory services are also recognised at the Taiāpure site. For example, in *East Otago Taiāpure Management Committee* (2013) Hepburn (2011) made clear reference to *M. pyrifera* of the East Otago Taiāpure as “critical habitat to support...fisheries”, which is also well recognised in scientific literature (Levin and Hay, 1996; Vandendriessche et al., 2007 and Win, 2011). The value of the habitat supporting role of *M. pyrifera* was emphasised by other expert witnesses in *East Otago Taiāpure Management Committee* (2013) who had commercial interests in the marine ecosystem. Executive Officer of the Otago Rock Lobster Industry Association and New Zealand Federation of Commercial Fisherman representative Gilmour (2011) identifies kelp forests as “important for recruitment” for rock lobsters and emphasised that a core principle of the Otago Rock Lobster Industry Association was that the “lobster habitat is the foundation of [the] industry”. Through a combined approach, Hepburn (2011) and Gilmour (2011) used an ecosystem services based approach to connect the habitat provision services of *M. pyrifera* with the benefits for other components of the marine ecosystem. The observation that these supporting services are recognised by coastal managers and users of the Taiāpure demonstrates that indirect ecosystem services, as well as the direct ecosystem services referred to above, are valued by the users and managers of the Taiāpure site.

Finally, a range of provisioning services are recognised in relation to the East Otago Taiāpure site and the surrounding environment (Table 5.1). Provisioning services are direct ecosystem services that are exploited for human use as food or other material resources (MEA, 2005). In particular, fish and other marine species such as clams and crayfish are harvested for commercial purposes in the surrounding area (Belton, 2011; Gilmour, 2011). Provisioning services are defined as exploitative by the MEA (2005). Despite this, the commercial users of the area surrounding the East Otago Taiāpure are likely to have a deeper understanding of the ecosystem than those who do not engage with the site. Beatley's (2014) concept of citizen scientists supports this finding because it explains that connecting citizens with the resource, species and habitats they are working with as integral to sound coastal management. Hepburn (2011) also drew from “local anecdotal evidence” to support scientific material about the strong relationship between sediment and the presence of kelp forests in *East Otago Taiāpure Management Committee* (2013). The prevalence of provisioning services identified in relation to the Taiāpure and the surrounding environment indicate that exploitation may be high in the area but also that the area is likely to be viewed and managed from an ecosystem services based perspective.

5.3.3: Values of Ecosystem Services Based Approach for Management of the East Otago Taiāpure and Surrounding Environment

Identifying ecosystem services at the East Otago Taiāpure and surrounding site helps to answer research question 1 by revealing the presence and use of the ecosystem services based approach at the site and providing a basis for analysing the valuable aspects of the ecosystem services based approach for managing coastal environments. Through case study 1, it is apparent that ecosystem services based approaches to coastal management allow the connections between humans and the environment to be recognised. This was also revealed as a fundamental part of the ecosystem services concept through the literature review (Boyd and Banzhof, 2007; Townsend and Thrush, 2010; Fisher et al., 2009). Identifying the dependencies of human wellbeing on the environment was identified as one of the primary ways that ecosystem services assessment could be used by Kittenger et al. (2010) in the study of the social and ecological impacts of the Three Gorges Dam, China. It is also apparent that the ecosystem services based approach can be used to understand the connections between environmental components.

The use of the ecosystem services based approach to highlight connections between humans and the environment is demonstrated most strongly in the cultural ecosystem services that are recognised and the identification of the site as an important educational space which can be used to facilitate connections with nature (Table 5.1). For example, Key Informant 1, Kāritane community representative on the EOTMC, recognises that engagement with the Taiāpure environment is important for students to “be able to do something that is actually going to mean something to someone”, while at the same time acknowledging the student’s research is “fantastic” in terms of providing information to further the effective management of the Taiāpure. This demonstrates a clear recognition of feedbacks between human contributions to managing the environment and the contributions of the environment to humans in relation to the value that students gain from using the site, which aligns with the abilities of the ecosystem service concept to connect humans and their environments discussed in previous studies of ecosystem services (Ash et al., 2010).

The ecosystem services that are identified at the site also demonstrate how ecosystem services based approaches can be used to understand connections between different components of the environment. This is best demonstrated through the example of the evidence statements of Hepburn (2011) and Gilmour (2011). Hepburn (2011) first identifies the habitat supporting service of *M. pyrifera* and Gilmour (2011) connects this service to facilitating the provisional commercial harvesting service provided by the rock lobster. Connecting these services parallels the model of ecosystem services constructed by Fisher and Turner (2008, Fig. 2.3, chapter 2) which portrays intermediate and final services as distinct from the benefits which the services generate. In this case, the habitat supporting role is the intermediate service and the lobster recruitment is the final service. The benefit is the provision of lobster as a food source and a commercial product. This type of service is also recognised in generic New Zealand marine ecosystem service frameworks as of high importance nationally, as demonstrated by the estimate that New Zealand coastal environments provide important ecosystem services of a value of approximately \$357 US billion per year (MacDiarmid et al., 2013). The connections between different components of the marine environment are able to be identified through the use of the ecosystem services based approach.

5.4: Discussion: Value of Using Ecosystem Services Based Concepts in Case Study 2: Environment Court appeal process in East Taiāpure Management Committee (2013)

5.4.1: Introduction

Section 5.4 presents results and findings of the case study of the value of ecosystem services based approaches in the process of the *East Otago Taiāpure Management Committee (2013)* Environment Court hearing, through the analysis of expert witness statements and Environment Court materials. Building on the findings from section 5.3, it is found that expert witnesses portray connections between humans and the environment and the connections between different components of the marine environment through the use of ecosystem services in expert witness statements. The ecosystem services based approach is found to be able to be utilised in the appeal of a resource consent decision in the Environment Court as a way of highlighting possible losses of ecosystem services and impacts on humans to decision-makers, acting as a possible way to draw attention to the need to make decisions which promote management which provides for the ecosystem. As outlined in section 4.4, Chapter 4, the Environment Court appeal process is treated as the planning process that is investigated. It is also assumed that an approach very similar to the ecosystem services based approach has been used by appellants, based on reference made to the ecological and other environmental values of the environment subject to consideration in the case.

5.4.2: Ecosystem Services identified in East Otago Taiāpure Management Committee (2013)

To determine the value of using ecosystem services based approaches in the Environment Court setting through the case study of the *East Otago Taiāpure Management Committee (2013)* the nature of the ecosystem services based arguments that were used must first be established, to support the use of the Environment Court process as a case study of the ecosystem services based approach to management. Section 5.4.2 will set this out before presenting a discussion on the main values of using the ecosystem services based approach in the Environment Court case to appeal the decision of the Otago Regional Council (2011) to grant Coastal Permit 2010.198 pursuant to section 104B of the RMA 1991.

Hepburn (2011) demonstrated an understanding of *M. pyrifera* from an ecosystem services based approach in the evidence statement presented to the Environment Court by drawing connections between *M. pyrifera* and other environmental components. Although no direct reference was made to ecosystem services, Hepburn (2011) made reference to the ‘ecological value’ of *M. pyrifera* in the ‘wider coastal system’ through the provision of refuge habitat and food for other coastal species that are recognised as having customary importance at the East Otago Tāiapure, including pāua, mussels, red cod and moki (Table 5.2). Visualising the place of *M. pyrifera* within the wider marine ecosystem demonstrated an approach to management which aligns closely with ecosystem services because connections were drawn over a wide spatial scale between environmental components of system that is being managed (Boyd and Banzhof, 2007; Townsend and Thrush, 2010; Fisher et al., 2009). The marine ecosystem and the connections to other environmental components as portrayed in this statement are shown in Figure 6.1, chapter 6, which shows how *M. pyrifera* provides a range of indirect ecosystem services to support the provision of direct ecosystem services by other marine species (Levin and Hay, 1996; Vandendriessche et al., 2007 and Win, 2011).

East Otago Taiāpure Management Committee chair and Kāti Huirapa ki Puketeraki rūnaka representative on the EOTMC Flack (2011) drew connections between *M. pyrifera* and human wellbeing in the expert witness statement for *East Otago Taiāpure Management Committee (2013)* by emphasising the importance of the wider Taiāpure area as a mahinga kai (customary food gathering) site, stating that:

The area of the taiāpure has been a place of importance for tangata whenua (people of the land) ever since our ancestors set foot on the land, many of the coastal place names related to the food resources can be found there (Flack, 2011).

Drawing these connections between humans and the environment has also been demonstrated through previous research as an integral part of management and planning of a marine ecosystem from an ecosystem services based approach (Kittenger et al., 2010; Ash et al., 2010). Both Hepburn (2011) and Flack (2011) make reference to a range of ecosystem services in *East Otago Taiāpure Management Committee (2013)* which demonstrate connections between humans and the environment and environmental components, supporting the presumption that an approach similar to the ecosystem services based approach has been employed by the appellants in the case study.

Several expert witnesses also drew attention to the provisional services provided by *M. pyrifera*, particularly the commercial importance (Macdiarmid et al., 2013; Gilmour, 2011; Anderson, 2011). For example, Executive Officer of the Otago Rock Lobster Industry Association and New Zealand Federation of Commercial Fisherman representative Gilmour (2011) states that:

Over the last 30 years the demise of kelp and hard rock habitat on the Otago coast is directly responsible for the dramatic decline in the...commercial lobster catch owing to the loss of habitat (Gilmour, 2011).

Building on this, EOTMC local commercial fishing and recreational representative Anderson (2011), described how the rock lobster life cycle relies on the kelp, demonstrating a full understanding of the relationship between the kelp and other species in the environment and the likely impacts this will have on human wellbeing, as well as the impacts that human activities may have on this service. This is best exemplified in the following statement:

If the *Macrocystis* beds were to disappear then the impact on that marine system would be huge, so would the impact on rock lobster, pāua and kina fisheries and all fish species that are dependent on that habitat (Anderson, 2011).

There is strong evidence to suggest an ecosystem services based approach has been employed throughout the case by the appellants.

5.4.3: Values of Ecosystem Services Based Approach for Environment Court Processes in East Otago Taiāpure Management Committee (2013)

It becomes apparent through this analysis that the use of ecosystem services in the Environment Court case to appeal the decision of the Otago Regional Council (2011) to grant Coastal Permit 2010.198 pursuant to section 104B of the RMA 1991 provides a very similar value as it does in the context of the management of the East Otago Taiāpure examined in case study 1, section 5.3: bringing to the attention of the decision maker and the respondents the connections between humans and the environment and environmental components. Additionally, it demonstrates that ecosystem services can be used to identify the flow on effects for the ecosystem from the impacts which humans have on their environment and to emphasise the value in conserving the environment to protect these services. Furthermore, ecosystem services has been shown to be able to be used in this context to allow technical, local and commercial perspectives to work together around

shared values towards a common outcome which is sought in the court case (Connell et al., 2008).

Similar connections between ecosystem services have been shown to be recognised by a limited number of submitters from the general public early in the process of the consent application (Otago Regional Council, 2011). Analysis of submissions made to the Otago Regional Council (2011) in relation to the decision about whether to grant shows that 2 submitters identified the ‘trickle down effects’ on the harbour food chain and the destruction of a valuable ‘food source’ for pāua as reasons for submitting in opposition of the consents being granted (submission 34, 171 and 182). Other submitters opposed Coastal Permit 2010.198 based on the indirect impact that the sediment will have on the kelp, having a ‘blanket effect’ (submission 131) and ‘blocking light to the sea floor’ which will ‘ruin’ the kelp beds. This demonstrates that there is some understanding of both the effects of the sediment and services that may be lost in the general public, as well as the expert witnesses with relationships to the East Otago Taiāpure site in the Environment Court case.

Compared to key review findings, there was less emphasis on the site specific nature of ecosystem services and the breakdown of the ecosystem into component parts, suggesting that the ecosystem services based approach may provide less specific information than previous research has suggested (Townsend and Thrush, 2010; Fisher and Turner, 2008). It also becomes clear that the ecosystem services based approach can be used to understand the connections between human impacts on a single component of an ecosystem, the flow on effect this may have on other parts of the ecosystem and the subsequent impacts on the ecosystem services which humans rely on from that ecosystem, supporting the suggestion that ecosystem services can build connections across a range of scales. This could lead to an enhanced ability to achieve sustainable management by facilitating an integrated understanding of the ecological and human aspects of the environment, which are referred to in s5 of the RMA 1991.

5.5: Conclusion

In section 5.2 and 5.3 it is shown that there are a wide range of ecosystem services which are recognised and actively provided for at the East Otago Tāiapure and the surrounding environment, including educational services, recognition of the customary significance

of the environment and the underlying habitat provision role played by *M. pyrifera*. The value of using an ecosystem services based approach to identify and provide for these services at the East Otago Tāiāpure site is found to be that an understanding of the connections between humans and the environment and environmental components within the ecosystem is generated. The ecosystem services based approach to management promotes a form of management which provides for the connections between humans and the environment and within environments by drawing attention to the benefits that humans derive from the environment, in accordance with the MEA (2005) definition of the ecosystem services concept. The identification of the recognition and presence of ecosystem services at the site supports the use of the case study to investigate the ecosystem services based approach to coastal management.

The analysis of the use of the ecosystem services based approach in the process of appealing a resource consent in the Environment Court in the *East Otago Taiāpure Management Committee* (2013) in section 5.4 supports the main finding of chapter 5: that the key value of the use of the ecosystem services based approach in coastal management is to understand connections between humans and the environment and environmental components. Chapters 6, 7 and 8 will build on this finding through a discussion of how the use of ecosystem services based approaches in the environmental management approach taken at the East Otago Taiāpure and the Environment Court processes influences decision makers and the outcomes of coastal management decisions. Chapter 6 will present results and discussion to answer the research question 2: Does the use of ecosystem services based management lead to improved outcomes for the coastal environment?

Chapter 6: Results and Discussion: Outcomes of Ecosystem Services Based Approach to Coastal Management

6.1: Introduction

Chapter 6 presents results and discussion in relation to research question 2: Did the use of the ecosystem services based concept in the context of the case studies result in improved outcomes for the coastal environment (Fig. 3.1)? It will also seek to inform the wider research objective to determine if the use of an ecosystem services based approach can better enable sustainable management to be achieved under the Resource Management Act (RMA) 1991 chapter 5 has identified that a wide range of ecosystem services are provided by the East Otago Taiāpure and the surrounding environment. It has also been shown that a key value of the ecosystem services based approach to management is that it can be used to understand connections between humans and the environment and connected components of the environment. The findings in chapter 5 will be built on in chapter 6 by drawing on a range of primary research results to assess whether the use of the ecosystem services based approach resulted in achieving sustainable management where it has been applied in relation to the management taking place in case study 1 at the East Otago Taiāpure and then for case study 2 in relation to the appeal process for resource consents in relation to *East Otago Taiāpure 2013*. The results of the linkages between the *M. pyrifera* coastal ecosystem will first be presented, followed by a discussion of the research question in relation to the two case studies.

The assumption that each case study broadly employs an ecosystem services based approach is again employed in order to generate research findings. Support for the assumption for each site has also been provided by the identification of ecosystem services in each case study and the recognition of these through the management and court appeal process in section 5.3.2 and 5.4.2. Overall, the outcome of using an ecosystem services based approach that connects across humans and the environment in coastal management is shown to be the strengthening of social bonds to better manage the environment and achieve the sustainable management purpose of the RMA 1991. The key outcome of using an ecosystem services based approach to connect across environmental components is shown to be the enhancement of coastal management that recognises cumulative impacts and management across broad spatial and temporal scales,

supporting previous research findings where related concepts have been examined (Simmens et al, 1993; Dahm et al., 2005).

6.2: Results: *Macrocystis pyrifera* Ecosystem Service Connections

Section 6.2 sets out the key results in relation to the various drivers, impacts and ecosystem service connections of the *M. pyrifera* ecosystem which have been drawn from multiple sources throughout the study. The source that each aspect was identified in is also provided.

Human Actions and Kelp Depletion:

Figure 6.1 provides a synthesis of the linkages between human actions, the drivers of these actions and the subsequent gains and losses of ecosystem services of *M. pyrifera* at the East Otago Taiāpure that have been found through this study. Economic productivity was found to be the main driver for exploitive human actions that are taken (Coe, 2012). Figure 7.1 also reveals the complex nature of the linkages between human actions and inputs into the *M. pyrifera* ecosystem, which make total impacts on *M. pyrifera* difficult to quantify (Boerema et al., 2016). For example, Figure 6.1 demonstrates how land clearance can lead directly to sedimentation and can also allow agricultural practices to occur which lead to nutrient inputs into the system (Beyond Orokonui, 2015; Hepburn et al., 2011; Schiel et al., 2006; Vitousek et al., 1997). The understanding of the linkages between ecosystem services and human actions on the environment that has been developed through the study demonstrates how the use of the ecosystem service concept can allow management to occur on a sufficiently wide spatial scale to recognise multiple inputs and the interactions between them, as discussed in chapter 5 and chapter 6.

Inputs and *M. pyrifera*:

M. pyrifera is a perennial species which means it lives for several years before entering the third stage of its life cycle; canopy decline (Fyfe, 2000). In the initial canopy emergence stage, a dense canopy forms (Fyfe, 2000). For example, Fyfe (2000) has observed a 40 alga/msq density in the early emergence stages of the canopy at pleasant river. Self-thinning is often associated with this stage of the life cycle, where holdfasts weaken due to shading, leaving the understory more susceptible to wave forces, particularly during storm events (Santelices and Ojeda, 1984). Reductions in density and

high light intensities are associated with canopy decline and allow emergent macroalgae to access the light required for photosynthesis and growth (Desmond et al., 2015). Sediment can interfere with this process by shading the canopy and act in the same way as a dense canopy would, preventing regeneration of the kelp forest in the gametophyte stage of the lifecycle and reducing the ability of kelp to recover after storm events (Gaylord et al., 1994). In Figure 6.1, the broader ecosystem service losses which may result from these impacts that have been found through a range of sources are demonstrated, reinforcing that the ecosystem services concept can be used to understand the interactions between human actions on wide spatial scales and to illustrate the subsequent losses for the wider ecosystem across these scales.

Human Actions and Restoration:

Examples of the actions which humans take to restore *M. pyrifera* that have been found through this research are shown in Figure 6.1. The understanding of the ecosystem services provided by *M. pyrifera* was found to be a major driver of restoration actions. In chapter 5, it is explained that the direct ecosystem services are more commonly recognised by people and therefore are more commonly the drivers of restorative actions, particularly at the EOTP site (ref Table 1). Examples from a more extensive list of actions that have been found to be taken to restore *M. pyrifera* beds are shown in Figure 6.1.

Long Term Impacts of Human Actions on Ecosystem Services:

Figure 6.1 ultimately illustrates the interconnected nature of ecosystems and their services, which has been revealed through this study. It shows how the long term nature of human actions and their impacts on ecosystems can be understood through the use of ecosystem service based approaches. For example, Figure 6.1 shows how long term considerations such as “sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations” (RMA s5 (2)(a)) and “safeguarding the life-supporting capacity of air, water, soil, and ecosystems” can be understood and incorporated into coastal management considerations through the use of ecosystem services based approaches, leading to the possible achievement of “sustainable management” (RMA s5(1)) of coastal ecosystems.

Limitations:

There are limitations to the amount which the impacts of human activities on *M. pyrifera* can be understood in relation to the *East Otago Taiāpure* (2013) case study. One of the key assumptions is that the actual impacts of the sediment on the kelp are relatively unknown in the given case (Key Informant 3, EOTMC scientific advisor). This is partly due to limitations in the modelling available to Port Otago Ltd. and the EOTMC. There are also uncertainties about what the impact of sediment on the kelp ecosystem would be. Key Informant 3 explains that it is mostly only known “in general terms what sediment will do to rocky reef species”. The main expected effect is the indirect effect caused by light penetration and changes in primary productivity through blanketing by suspended sediments (Gaylord et al., 1994; Desmond et al., 2015).

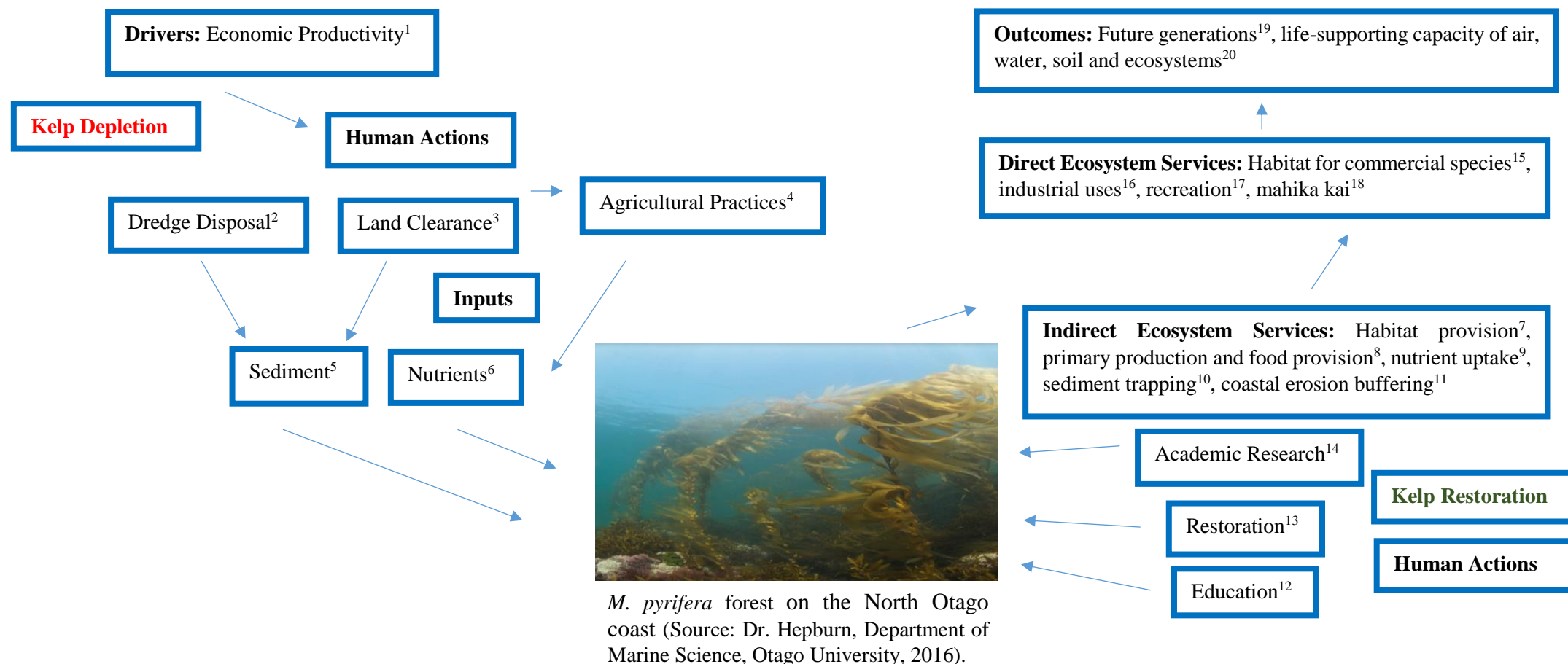


Figure 6.1: *M. pyrifera* ecosystem service connections at the East Otago Taiāpure. Figure 1 provides a synthesis of the findings of the relationship between *M. pyrifera* at the case study site, the drivers and factors that influence its depletion and restoration and the direct and indirect ecosystem services that it provides. The sources that the information was drawn from are presented below alongside a discussion of the findings.

List of Figure 6.1 Information Sources: 1: Coe, 2012, 2: Bell et al., 2009, 3: Beyond Orokonui, 2015, 4: Hepburn et al., 2011, 5: Schiel et al., 2006, 6: Vitousek et al., 1997, 7: Win, 2010, 8: Jimenez et al., 2015, 9: Vitousek et al., 1997, 10: Marsden, 1991, 11: Stevens et al., 2001, 12: East Otago Taiāpure Management Committee (2010) ‘2. Enviro Schools Hui’. Minutes of the East Otago Taiāpure Management Committee meeting 18 May 2010, East Otago Taiāpure Management Committee, Puketeraki Marae., 13: Flack, 2011, 14: KI1, 15: Anderson, 2011, 16: Hepburn et al. (n.d.), 17: Desmond, 2015, 18: Te Rūnaka O Ngāi Tahu (1997), 19: (RMA s5(2)(a)), 20: (RMA s5(2)(b))

6.3: Discussion: Outcomes of Using an Ecosystem Services Based Approach in Case Study 1: Management of the East Otago Taiāpure

6.3.1: Introduction

Section 6.3 presents results and findings of the case study of the outcome of ecosystem services based approaches for case study 1: the management of the East Otago Taiāpure, through the synthesis of key informant interviews and minute analysis of the East Otago Taiāpure Management Committee (EOTMC) meetings. The key outcome of recognising connections between humans and the environment through an ecosystem services based approach is shown to be the formation of strong social bonds through environmental management, leading to a balancing of social and environmental benefits to balance the often ‘competing and indeterminate’ functions of the RMA 1991 s5 purpose of sustainable management (Palmer, 1995, p147). The key outcome of recognising connections between components of the environment is shown to be the ability to operate on wide spatial scales and identify cumulative environmental impacts in resource management. This contributes to the achievement of providing for the “life-supporting capacity of air, water, soil, and ecosystems” as required to achieve the RMA 1991 s5 purpose under s5(2)(b). Recognising indirect impacts also helps to achieve providing for “the reasonably foreseeable needs of future generations” under the RMA 1991 s5(2)(a).

6.3.2: Outcomes of Recognising Connections between Humans and the Environment at the East Otago Taiāpure

In chapter 5 it has been established that ecosystem services based concepts can be used to recognise and provide for connections between humans and the environment in resource management. Section 6.3 focuses on determining what the outcomes of managing from this approach are for coastal environments. The key ecosystem service which provides for connections between humans and the environment at the East Otago Taiāpure was shown to be the educational services, which is classed in the cultural ecosystem services category (MEA 2005; Table 5.1; Section 5.3.3). The outcome of providing for this ecosystem service in the approach to coastal management of the East Otago Taiāpure appears to be the formation of strong social bonds over a shared understanding of the importance of the environment (Miller and Hobbs, 2002). Building on the findings of case study 1 in section 5.3.3, Key Informant 1, Kāritane community

representative on the EOTMC, described a reciprocal relationship that formed between students and community members at the Taiāpure over a shared desire to understand and manage the Taiāpure ecosystem effectively, as shown in the following statement:

Some of them are still wet. They've come out of the water and the nice thing about asking them then, is that they don't have to have a finished product. They just have to come and tell us what they've noticed, what they have encountered, what they saw. And what their impressions are. And that usually pads out in the final write up (Key Informant 1).

Evidently, the community members recognise the importance of the knowledge that the students provide and trust their research and judgements of the environment, as well as the importance of ensuring they are engaged with the environment they are working with. Further evidence for the trust and respect that is shared between the parties is also shown by the provision of “cups of tea” and “volunteer opportunities” which are not obligatory but provide chances for further engagement for students which Key Informant 1 raises. In exchange, the students provide research and information which benefits the management of the Taiāpure. Miller and Hobbs (2002) refer to a positive feedback loop between local support and an increased interest in conservation, each reinforcing the other. In this example, the understanding and presence of the educational ecosystem service at the site creates a situation where both groups share a desire to manage the Taiāpure effectively and support each other to do so, leading to the formation of an ongoing and durable commitment to the management of the Taiāpure. This demonstrates how an outcome of using the ecosystem services based approaches may be able to be used to achieve sustainable management and enable the balancing of the ‘competing and indeterminate’ ecological and social interests contained in the RMA 1991 s5 definition through the implementation of management actions (Palmer, 1995, p147) by providing dual benefits for humans and the environment.

Another potential outcome of using the ecosystem services based approach could be to achieve the direction to have particular regard to kaitiakitanga (stewardship) under the RMA 1991 s7(a) and the aspirations of Kāti Huirapa ki Puketeraki (2013) in establishing the East Otago Taiāpure to ensure the health and wellbeing of depleting pāua stocks is maintained for current and future generations as an outcome of its use (Dick et al., 2012). The reciprocal relationship between people and the environment that was revealed to be generated through an ecosystem services based approach in chapter 5 reflects traditional Māori resource management. Kaitiakitanga is expressed when humans view themselves

as a member of the land community which they are a part of and exercise stewardship of the land to manage it (Williams, 2002). Using an ecosystem services based approach to coastal management could provide for customary forms of management as an outcome of its implementation.

6.3.3: Outcomes of Recognising Connections between Components of the Environment at the East Otago Taiāpure

It was also shown in chapter 5 that the ecosystem services concept can be used to understand connections between different components of the environment. The key ecosystem service which provided for connections between environmental components was the habitat providing service which Hepburn (2011) and Gilmour (2011) identified in *East Otago Taiāpure Management Committee* (2013). Chapter 6 discusses how one of the main outcomes of recognising these connections through the ecosystem services based approach is that cumulative impacts of human actions can be identified and managed. Cumulative impacts are impacts on the environment from past, present and future actions which may be insignificant on their own but add up to be significant (Simmens et al., 1993). Cumulative impacts are able to be managed through use of an ecosystem services based approach because it generates a form of management in which the environment is viewed on a wider spatial scale.

Hepburn (2011) and Gilmore (2011) identified connections between environmental components through recognising the range of sediment inputs (shown in Fig. 6.1) which could have been impacting the kelp from different sources. Hepburn (2011) made reference to the already high levels of suspended sediment as triggering sediment problems within the Taiāpure when combined with the expected 1.45 M m³ of sediment which was proposed to be dredged and dumped by Port Otago Ltd (Bell et al., 2009). As an outcome of using an ecosystem services based approach to management, Hepburn (2011, p5) was able to identify the human actions which may impact the ecosystem services of *M. pyrifera* including “land clearance and runoff from catchments” and portray these actions and impacts to decision makers, leading to an enhanced awareness of cumulative impacts in the case as a result of the use of the ecosystem services based approach to management.

Assuming that an ecosystem services based approach is employed in case study 1, thinking about the management of the East Otago Taiāpure on a broader scale as an

outcome of using the ecosystem services based approach to management at the case study site was also reflected in the statement by KI (1) that Kāritane is:

Not a lake, and it's not really an ocean, it's not just a river. It's a catchment that goes through an estuary that changes with the tides, that enters the sea and it goes along the coast with all these little communities (Key Informant 1).

The findings demonstrated that if an ecosystem services based approach has been employed for the management of the East Otago Taiāpure, members of the EOTMC are able to view the environment as broader than just an individual component through the use of the approach, recognising that independent inputs from the wider environment may have a combined impact on a given component of the environment. The understanding of the interconnected nature of the environment that is developed through an ecosystem services based approach may allow for the environment to be managed in a way which recognises cumulative impacts of system inputs on a broader scale. Through allowing the sum of past, present and future impacts to be identified because of management that is promoted across broad spatial scales, ecosystem services based approaches may help to promote the safeguarding of the “life-supporting capacity of air, water, soil, and ecosystems” as required to achieve sustainable management under RMA s5(2)(b).

6.3.4: Outcomes of Using an Ecosystem Services Based Approach for Coastal Management

Chapter 5 has demonstrated that the impacts of human actions on environmental components and the flow on effects for human wellbeing can be identified through the use of an ecosystem services based approach to management. Chapter 6 has built on this by showing how ecosystem services based approaches to management stimulate management which identifies impacts over longer timescales and which takes into account broad spatial scales than may otherwise be identified. The wide spatial and temporal scales which can be managed through the use of ecosystem services based approaches are shown in Figure 6.1.

Firstly, it has been demonstrated that the ecosystem services based approach results in environmental management which takes into account impacts on the environment on a broad spatial scale. This is exemplified by the recognition of cumulative impacts of sediment on the East Otago Taiāpure kelp beds. The spatial scale and context of an ecosystem service management approach are identified as key to successful outcomes of

the use of an ecosystem services based approach by Turner et al., (2010) who explained that ecosystem services will often have context based relationships. The model of the interactions between ecosystem services and human wellbeing developed by Townsend and Thrush (2010) was also designed to be applied at a range of spatial scales, which ecosystem processes and functions operate across. Spatial explicitness is also embedded in Turner et al.'s (2010) ESSS as a fundamental component of ecosystem services because of heterogeneity across space and the effect this has on service provision. The recognition of the East Otago Taiāpure as a catchment by Key Informant 1, Kāritane community representative on the EOTMC, also reinforces this finding.

There is some evidence which contradicts the finding that the ability to understand wider scales is advantageous for coastal management. Key Informant (1) describes the East Otago Taiāpure area as:

Powerfully dynamic...so dynamic that it puts some people off, they think it's in the too hard basket. How could you ever get a grip on anything that's happening there? But that's what's exciting about it (Key Informant 1).

This also contradicts previous ecosystem services research which tends to find that the ability of ecosystem services to improve spatial and temporal understandings is beneficial for coastal management (Townsend and Thrush, 2010; Turner et al., 2010; Luisetti et al., 2014). For example, Luisetti et al. (2014) stated that ecosystem services valuation promotes benefits for coastal management and decision making by providing a method to weigh and assess factors in complex environmental management situations. However, overall the research aligns with the key review findings, showing that wider societal benefits provided by ecosystems and their services can be identified and managed through the use of the approach and that ecological concepts can be built into resource management through use of the approach, as well as cultural considerations (Costanza et al., 1997; Williams, 2002; Barbier et al., 2008; Kittenger et al., 2010).

6.4: Discussion: Outcomes of Using Ecosystem Services Based Concepts in Case Study 2: Environment Court appeal process in East Otago Taiāpure Management Committee (2013)

6.4.1: Introduction

Section 6.4 will build on the findings in section 6.3 by exploring the outcomes of using the ecosystem services based approach to take into account wider scales in coastal management, to address the identification by Lithgow et al. (2013) that ecosystem services based approaches can be used to achieve integrated coastal management by reducing complexities. Integrated Coastal Management (ICM) recognises complexities across sector levels of government, the cumulative impacts of decisions and actions and the dynamic and complex nature of coastal ecosystems and the connections between them (Sorensen, 1997; Cicin-Sain and Knecht, 1998). ICM fits broadly into coastal management approaches discussed in section 2.3.

In section 6.4 the ability to manage across temporal scales rather than spatial scales through the use of the ecosystem services based approach is explored. It will build on the previous findings in chapter 6 in relation to the use of ecosystem services in the Environment Court appeal of the decision of the Otago Regional Council (2011) to grant Coastal Permit 2010.198 pursuant to section 104B of the RMA 1991. The findings in chapter 6 have shown that ecosystem services can be used to portray how impacts on the environment result in an enhanced understanding of the connections between human actions, environmental impacts and social wellbeing. It will further the understanding of the aspects of ecosystem services that should be incorporated into New Zealand planning frameworks and environmental legislation and how that can best be achieved and further the research objective to determine if the ecosystem services based approach to planning and management results in improved coastal management and decision making processes.

6.4.2: Outcomes of Recognising Connections between Humans and the Environment in East Otago Taiāpure Management Committee (2013)

In section 6.4.2 one of the key outcomes of managing the environment based on the recognition of human and environmental connections is shown to be taking into account a range of temporal scales and ‘future generations’ under the RMA 1991 s5(2)(a) and what the implication of this is where ecosystem services are used in the appeal of a

resource consent decision by the Environment Court. The understanding of human and environmental connections and wider temporal scales is best exemplified through the expert evidence provided by East Otago Taiāpure Management Committee chair and Kāti Huirapa ki Puketeraki representative Flack (2012). Flack (2012, p.3) listed 12 activities that the EOTMC undertake to ‘ensure that future generations have access to Kaimoana (seafood)’ in the expert witness statement in East Otago Taiāpure Management Committee (2013). He also explains that ‘when the value of (our Kaimoana) is extrapolated 20 generations from now, we understand the risk that we face’. These statements demonstrate that the EOTMC have drawn strong links between their activities and actions taken towards the environment and long terms outcomes in the Environment Court process, as an outcome of what broadly reflects using an ecosystem services based approach to form arguments in the Environment Court and portray key coastal values to decision makers.

Flack (2012) portrayed to decision makers not only the positive impacts that humans can have to restore the kelp ecosystem, but also an awareness of how conserving the ecosystem services will provide benefits for people into the future, showing a full picture understanding of the *M. pyrifera* ecosystem and the inputs and outputs illustrated in Figure 6.1. In this case, the outcome of using the ecosystem services concept in this case has been to help to identify connections between humans and the environment and to elevate the understanding of the cultural importance of the environment and the need to provide for the avoidance of discernible effects on it in Coastal Permit 2010.198 through the Environment Court decision (Otago Regional Council, 2013).

One of the other main findings that was supported through the investigation of both the Environment Court process and environmental management and the use of ecosystem services was that cumulative and indirect effects are more likely to be identified and managed as an outcome of using the ecosystem services based approach to planning and management. One of the key ways in which this is portrayed in the Environment Court case by the appellant party is the recognition of the permanence of the sediment and the concerns about the impacts this will have on ecosystem services of *M. pyrifera*. Key informant 3, EOTMC scientific advisor, demonstrates this understanding, explaining that:

When suspended sediment arrives at a rocky reef it could settle there, and because it is sediment and not sewerage or something like that it is persistent, so it can be resuspended and then settle again, and resuspended and settle again, you know like

it doesn't just disappear overtime...some bacterial things in shellfish take ages to go away, but sediment never goes away right (Key Informant 3).

The same concern about the permanence of the sediment is reflected in the evidence statement of Flack (2012, p.5) and are related to the intergenerational perspective which is demonstrated in his evidence, stating that: "once the mud and fine silts are dumped in the Bay, there is no getting it back out again".

Through understanding both the permanence of sediment as an outcome of using the ecosystem services based approach to management and as discussed in section 6.3.3, the appellants can build a longer term and larger scale understanding of what the impacts of the sediment dumping and dredging will be and portray this to decision makers than would otherwise be possible, moving towards an outcome of the case which may recognise and provides for the life-supporting capacity of natural resources and the maintenance the potential of natural resources for future generations under the RMA 1991 s5(2) (a) and (b). Alignment of the ecosystem services concept with customary approaches to management and the potential to achieve having particular regard to kaitiakitanga under the RMA 1991 s7(a) through the use of the ecosystem services based approach in coastal management has also been demonstrated by the finding that these values are portrayed by stakeholders with cultural interests in the East Otago Taiāpure in the Environment Court process.

6.4.3: Outcomes of Recognising Connections between Components of the Environment in East Otago Taiāpure Management Committee (2013)

In section 6.3.4 one of the outcomes of managing the environment based on the recognition of connections between different components of the environment was shown to be taking into account a range of spatial scales. This was reinforced as an outcome of using the ecosystem services based approach in the context of the Environment Court process. One of the strongest themes that emerged in the analysis of expert evidence statements was the widespread understanding by the appellants that an understanding of the oceanographic conditions and the wave hydrodynamics was necessary to properly understand the likely impacts of the dredging on the kelp beds. For example, key Informant 2, solicitor for the appellant parties, suggested that this information had helped to form a stronger argument to portray the impacts on the kelp to decision makers throughout the case, as shown by the following statement:

One of the key factors in the case was the behaviour of the gyre...the behaviour of the Southern Current relative to the dump site out here, and what would happen to fine sediments that were dumped out here, whether they would continue up the coast out the sea, whether they would be entrained by the current and concentrate effectively in the bay, whether they would be washed ashore up into the *Macrocystis* forest up here (Key Informant 2).

However, the appellant party were not able to form any arguments based around the behaviour of the behaviour of the Southern Current and the gyre because of a lack of information. Key Informant 3 notes that the appellant party were:

Missing someone who had international experience and expertise on modelling in 3D, because this gyre doesn't behave consistently surplus, to know how all of that ought to be modelled from a software point of view (Key Informant 3).

Despite this, the Environment Court in East Otago Taiāpure Management Committee (2013, para 42) sought to change the conditions of the consent so that Environmental Turbidity Limits were prescribed rather than “relying entirely on verification of the hydro-dynamic model” because of questions about the adequacy of the modelling that had been carried out by experts on behalf of Port Otago Ltd.

The ecosystem services based approach has been shown to have the potential to be used to identify connections between environmental components, leading to an understanding of the environment on a wider spatial scale than may otherwise be perceived. However, in the case of the *East Otago Taiāpure Management Committee (2013)*, the appellants were only able to portray the impacts of the sediment on the kelp to a limited extent through the use of an approach which broadly reflected the ecosystem services based approach because of a lack of information about wider environmental variables, which would require cross-disciplinary input (Connell et al., 2008). The inability to utilise this approach because of a lack of adequate monitoring and data was also reflected in conflict leading up to the court case and means that only weak conclusions can be drawn about the use of ecosystem services to portray wider spatial considerations in this case study. This finding emphasises the need for adequate spatial information to be able to make full use of an ecosystem services based approach in planning processes.

6.5: Conclusion

Section 6.2 and 6.3 have shown that a key outcome of recognising connections between humans and the environment through the use of the ecosystem services based approach is that it allows strong social bonds to form which achieve a balancing of social and

environmental functions in the sustainable management purpose of the RMA 1991 s5. The outcome of recognising connections between components of the environment is that environmental management can be carried out on a broader scale than is otherwise possible. This makes cumulative and indirect impacts apparent, assists in safeguarding the life-supporting capacity of natural resources and the maintenance the potential of natural resources for future generations under the RMA 1991 s5(2) (a) and (b) and also better achieves integrated coastal management (Sorensen, 1997; Cicin-Sain and Knecht, 1998). From this analysis, it has been determined that the key outcome of using an ecosystem services based approach for coastal management is that coastal management can take place on broader spatial scales than may otherwise be achieved.

Section 6.4 reinforces the findings in section 6.2 and 6.3 in relation to decision-making about resource consent appeals and Environment Court processes. It is also shown that by employing an ecosystem services based approach to portray impacts of human activities over broad temporal scales, the recognition of long term consequences of impacts of human actions on the environment on future generations can be achieved, providing for sustainable management under the RMA 1991 s5. It has also been demonstrated that a key outcome of managing on wider spatial scales through an ecosystem services based approach is that an understanding of the impacts of human actions on one component of the ecosystem on another may be strengthened. A key input for fulfilling this is access to and provision of adequate spatial information for appellant parties. Collectively, the findings highlight the key outcomes of the ecosystem services based approach are management on broader spatial and temporal scales, through the recognition of connections between humans and the environment and an understanding of the benefits that humans derive from the environment, in accordance with the MEA (2005) definition of ecosystem services.

The findings of chapter 6 broadly supported key review findings, showing that the outcome of using an ecosystem services based approach is that ecological concepts, including the consideration of human impacts on the environment on broader spatial and temporal scales, can be embedded into coastal management (Barbier et al., 2008; Kittenger et al., 2010). Chapter 7 will discuss how ecosystem services can be incorporated into resource management plans and the RMA 1991 planning framework to build the connected understanding of the ecosystem that has been found to be provided by ecosystem services based approaches through this research, with a focus on coastal plans.

Chapter 7: Incorporating Ecosystem Services Based Approaches into Coastal Management Plans, Planning Processes and the RMA 1991 Planning Framework

7.1: Introduction

Chapter 7 presents the results and discussion to research question 3: In what form can ecosystem service based approaches to coastal management be incorporated into coastal management and planning frameworks in New Zealand (Fig 3.1)? The management plans and frameworks that have been evaluated to inform the research are used as a basis to answer this question. The section begins with an evaluation of the role that ecosystem services plays within the East Otago Taiāpure Environmental Management Plan (2008). The use of ecosystem services based approaches in planning processes is then evaluated, with a focus on the use of ecosystem services as a risk management and predictive environmental management tool. The section then evaluates the way that ecosystem services could be incorporated into environmental management plans and the New Zealand Coastal Policy Statement (NZCPS) (2010) based on the research findings. It is shown that ecosystem services based concepts align with provisions which focus on human impacts on the environment and ecological values in resource management plans, providing the ability to focus decisions on the connections between humans and the environment, environmental components and indirect and cumulative effects which has been identified in the previous chapters through the incorporation of an ecosystem services based approach into the plans.

7.2: Incorporating Ecosystem Services Based Approach into Coastal Management Plans in Case Study 1: Management of the East Otago Taiāpure

7.2.1: Introduction

Section 7.2 presents an evaluation of the environmental management plans of the East Otago Taiāpure which are employed by the East Otago Taiāpure Management Committee (EOTMC) to manage the site. It shows the linkages between the use of the ecosystem services based approach and an approach similar to the ecosystem services based approach within the management plans and how these are reflected in practice at the site

and through the understanding of the concept by EOTMC members and users of the site. Further support is provided to demonstrate the ability of ecosystem services based approaches to draw connections between humans and the environment and environmental components, as demonstrated in chapters 5 and 6. This is shown to filter into management practices and to possibly assist in achieving sustainable management under the RMA 1991 through use of the approach.

7.2.2: Ecosystem Services Based Approaches in Environmental Management Plans in Case Study 1: Management of the East Otago Taiāpure

In case study 1, the management of the East Otago Taiāpure, reference to approaches similar to ecosystem services approaches can be observed in East Otago Taiāpure Management Committee management plans, which was produced seven years following the establishment of the EOTPMC (EOTP, 2008; EOTP, 2012). Despite its similarities it must be recognised that the approach is likely to differ from an ecosystem services based approach but may closely reflect the approach, as outlined in section 4.3. The vision for the East Otago Taiāpure is to “provide for the community’s customary, recreational and commercial needs” (East Otago Taiāpure, 2008, p1). This vision establishes an overarching direction towards an approach similar to the ecosystem services based approach to management, by recognising environmental values which are similar to provisional and recreational ecosystem services (MEA, 2005; Table 1). East Otago Taiāpure Management Committee participants also show a clear understanding of how an approach similar to ecosystem services based management can be employed in relation to the conducting ecological studies at the site, demonstrating that the management plans ecosystem services based approach is translating into environmental management practice at the site. For example, Key Informant 3, EOTMC scientific advisor and former Otago University Marine Sciences PhD candidate explains that ecosystem services could be used to make ecological studies more relevant by providing a wider purpose to studies that are carried out at the site, stating in relation to their own studies:

Nobody cares about the photosynthetic physiology of *anotrichium*, but the photosynthetic physiology of all seaweed once you reduce the light level through some sort of activity like deforestation or dredging, everybody cares about that (Key Informant 3).

Note: *Anotrichium crinitum* is a deep-water red macroalgae which is a dominant component of subtidal rocky reefs below 10 m along the coast of New Zealand's South Island (Pritchard, 2011).

Key Informant 3 also acknowledges that they “didn’t use the term ES to define it at the time” but states that “it seems like it would fit with what we are talking about here”, identifying a close relationship between the approach used and the ecosystem services based approach and demonstrating some understanding of what the approach may involve.

The Actions listed in the East Otago Taiāpure Management Plan (2008) further encourage the application of a management approach similar to the ecosystem services based approach contained in the vision to be applied at the site, including actions too:

- Support research and monitoring that promotes the protection of the environmental health of the Taiāpure (Action 2s) and to
- Encourage the active involvement of kaumātua (elders) and the local Kāritane community (including senior citizens and tamariki (children)) and other community-based groups (such as the Waikouaiti Estuary/Rivercare Group) in the management of the Taiāpure (Action 2t)

The combined ecological and socio-economic benefits of this approach are clearly reflected in practice, as shown by the following statement of Key Informant 3:

Working with people like Brendan [Flack, EOTMC chair and Kāti Huirapa ki Puketeraki rūnaka representative on the EOTMC] who understand the connected nature of it...pulled me out of really focussed academic project and made me look at wider context of what I was doing (Key Informant 3).

The provisions contained in the East Otago Taiāpure Management Plan (2008) demonstrate clearly how the recognition of the linkages between human values and environmental components can be built into environmental management plans in simple provisions. In the case of the East Otago Taiāpure Management Plan (2008) and ecological studies at the site, the approach which broadly reflects an ecosystem services based approach emerges with the same purpose as it has been shown to provide for environmental management and in planning processes; to draw attention to the connections between humans and the environment to focus management and research around these connections (MEA, 2005; Ash et al., 2010). The analysis of the East Otago Taiāpure Management Plan (2008) and its practical implementation strengthens the finding the ecosystem services based approaches can be used in environmental management to balance the “competing and indeterminate” social and ecological values of sustainable management and assist in achieving the RMA 1991 purpose (Palmer, 1995)

and provides evidence that approaches similar to ecosystem services based approaches to management can be built successfully into environmental management plans.

7.2.3: Ecosystem Services Based Approaches in Environmental Management Plans: Understanding Feedbacks

Further evidence for how to embed ecosystem services in management plans to show the linkages between human impacts, environmental components and outcomes for humans can be found in the East Otago Taiāpure Management Plan (2008). Embedding ecosystem services based concepts in management plans supports the positive feedback loop between humans understanding their actions, the value of the environment and encouragement to restore the environment that has been shown to exist at the site in chapter 5, demonstrated in Figure 6.1, chapter 6 and raised by Miller and Hobbs (2002). This goes beyond identifying the value of the ecosystem to people and extends to identifying that human actions can impact the ecological functioning of the ecosystem, impacting their own wellbeing in return, which is a fundamental principle behind the ecosystem services concept (Ash et al., 2010).

Further examples of how specific ecosystem services have been embedded in the plan include the recognition that food should be fit for human consumption, which a high emphasis is placed on in section 2: Health of the Environment. Focussing on the value of the ecosystem for human consumption can be used to articulate the need to provide for the ongoing health of the ecosystem, connecting human and environmental well-beings, which has also been described as a key use of ecosystem services by Kittenger et al. (2010). Further to this, the East Otago Taiāpure Management Plan (2008, p7) identifies marine pollution as a driver of decline of species within the Taiāpure. This supports the finding that ecosystem services can be used to manage on broad spatial and temporal scales which has been discussed in chapter 6, by showing the complex interactions which an ecosystem services based approach to management can articulate in environmental management plans.

The provisions contained in the East Otago Taiāpure Management Plan (2008) demonstrate how ecosystem services based approaches can be incorporated into management plans in a meaningful way and successfully translated into practical ecosystem services based management actions and generate an understanding between environmental managers at a site.

7.3: Incorporating Ecosystem Services Based Approaches in Case Study 2: Environment Court Processes and the Resource Management Act 1991 Framework

7.3.1: Introduction

In section 7.3 there will first be an analysis the use of ecosystem services based approaches in Environment Court processes and then a discussion of the potential for the incorporation of ecosystem services based approaches into the RMA 1991 and the New Zealand planning hierarchy. It is shown that ecosystem services can be effectively used as a predictive tool in planning processes and that there are opportunities to build the ecosystem services based approach into the RMA 1991 to further embed ecological values in the Act and to balance the ecological and management considerations in the s5 purpose of sustainable management and the overall broad judgement approach taken by the Courts. The opportunity to embed ecosystem services into the NZCPS (2010) is also evaluated in light of *Environmental Defence Society v Marlborough District Council* [2014] in relation to objectives and policies which most closely parallel the approach. The potential use of ecosystem service based approaches in the Anticipated Environmental Outcomes sections of Regional Plans is also discussed in relation to the Regional Plan: Coast for Otago (2012).

Chapter 7 concludes with a comparison to the East Otago Taiāpure Management Plan (2008) that was analysed in section 7.2 to assess whether the purposes of the plans examined in section 7.3 would be met through the incorporation of the concept and whether it would be likely to translate to ecosystem services based management in practice, to achieve sustainable management for coastal environments.

7.3.2: Ecosystem Services Based Approaches in Planning Processes in Case Study 2: East Otago Taiāpure Management Committee (2013)

Looking broadly at the use of ecosystem services based approaches in case study 2: *East Otago Taiāpure Management Committee* (2013), sheds light on where the ecosystem services based approaches could best fit into resource management and planning processes. One of the key findings of the research is that ecosystem services based approaches can be applied in planning contexts where decisions are being made about risks and adverse impacts of activities in the Environment Court and in planning

processes. In this case, the planning process in which the decision about adverse effects was being made in response to an appeal to the Environment Court under s120(1) of the RMA 1991 in relation to Coastal Permit 2010.198 which was granted by the Otago Regional Council (2013) (Quality Planning, 2016). The key point of contention in *East Otago Taiāpure Management Committee* (2013) was whether there were any adverse effects after mitigation of adverse effects of the activity. Smith J. clearly states:

[31] This is a case involving risk of effects...The applicant's evidence is that there would be no effects. The question is, if that assessment is wrong, what is the risk of adverse effects? (*East Otago Taiāpure Management Committee*, 2013).

In *East Otago Taiāpure Management Committee* (2013) the appellants have successfully used a concept similar to the ecosystem services based approach concept to portray the potential loss of ecosystem service losses from the impacts of the deposit of the dredged sediment, providing an evaluation of the risk of what could be lost from the activity using the ecosystem services based approach. This closely reflects the use of ecosystem services to understand the impacts of increased development pressures on terrestrial habitats which has been employed by Ruhl (2008) and Seto et al., (2012).

Key Informant 2, solicitor for the appellants, provides evidence that ecosystem services based approaches were able to play a very useful role for the appellant to portray the information about what could be lost to the court and that this successfully influenced risk identification and management considerations throughout the Environment Court process.

What we were effective in doing was...demonstrating firstly that there was a risk, that there was uncertainty about what the magnitude of that risk was, and that that risk wasn't being managed...we were not able to say that the dumping at this area here was going to have an adverse effect on the *Macrocystis* forest and the ecological functioning that it supports, but we were able to say that there was a risk that it would be, and that risk needs to be identified and managed and monitored (Key Informant 2).

The appellants brought to the attention of the decision makers the importance of recognising this risk, portraying the linked parts of the ecosystem that would be impacted if the activity was to have adverse impacts outside of Alpha Zero (AO), the dumping site of the sediment which was located 6.3 kilometres north east of Taiaroa Head (Figure 4.3, Chapter 4). Key Informant 2, solicitor for the appellants, portrays in particular the advantages to the appellants of working together to piece together the combined risks associated with the dredging activity by drawing from a range of understandings and

backgrounds. The identification of the advantages of drawing together a range of disciplines to build on the understanding of the connections between ecosystem services addresses the research gap of the understanding of how to draw together investigators from a range of disciplines to make ecosystem services assessments identified by Daily (1997), assuming an approach similar to the ecosystem services based approach has been used. The drawing together of disciplines in the case is exemplified in the following statement:

I think it was a range of disciplines from someone like Chris who was able to explain that this was important and it was not something that should lightly be ignored, people like Brendan Flack who was able to explain the cultural importance of the Taiāpure and why any effect on that would have a cultural impact even not necessarily an ecological functioning impact. People like Roger Belton who, although he was less interested in the functioning of these areas here, had a lot of research about the impact of sedimentation in Blueskin Bay itself down here, and the impact that reductions in water quality had on the functions of other organisms....So there was a whole bunch of things which were able to paint a picture that the Ports approach to identifying and managing risk wasn't sufficient (Key Informant 2).

Besides being used to determine the level of effects of an activity, the ecosystem services concept has also been demonstrated to be useful as a predictive tool. Key Informant 2, solicitor for the appellant parties, also draws attention to the way that the ecosystem services based approach was used to draw together environmental and socio-economic considerations to make predictions about future risks, stating:

What we are doing here is predicting what might happen in the future, so there is always going to be degrees of risk about – is this a very high likely impact, is this a low likely impact. And so there's probability and there is seriousness of that probability to be thought about, and so we were able to demonstrate that a potential outcome was quite serious but we weren't able to be clear about what the probability of that was (Key Informant 2).

Based on these findings, it is possible that the ecosystem services based approach to coastal management could be used as a management tool to address the barrier which Alexander et al. (2012) refers to as a key factor that complicates coastal management decisions by working across a wide range of considerations alongside the natural and physical resources of coastal ecosystems, including economic and social costs of decisions. The barrier of working across a range of considerations to make coastal management decisions has also been demonstrated to exist by Niven & Bardsley (2012) in the context of putting in place clauses for retreat as an adaptation strategy to manage projected sea level rise in Fleurieu Peninsula, South Australia.

Analysis of the use of ecosystem services based approaches in the Environment Court appeal demonstrates the potential use of the concept to increase the decision makers understanding of the level of risk associated with an activity, portraying the full breadth of effects it could have across spatial and temporal scales in planning processes. Chapter 8 will provide results and a discussion to address whether the use of ecosystem services to portray this has resulted in more effective coastal management decision making, to achieve the sustainable management purpose of the RMA 1991. Prior to this, section 7.3.3 will set out an analysis of the potential of incorporating the ecosystem services based approach into the Resource Management Act 1991 and the pursuant coastal management and planning framework.

7.3.3: Ecosystem Services Based Approaches in the Resource Management Act 1991

This research highlights a range of opportunities to incorporate ecosystem service based approaches to management into the Resource Management Act 1991 and the pursuant planning framework. An extended analysis of the relationship of ecosystem services based approaches and the RMA 1991 is provided in Payne-Harker (in press; see Appendix E). In summary, the development of the sustainable development paradigm internationally and the incorporation of this into the RMA 1991 as sustainable management occurred alongside the development of the ecosystem services concept (World Commission on Environment and Development, 1987; Birdsong, 2002). This represents an opportunity to build ecosystem services concepts into the RMA 1991 framework. Furthermore, the definition of sustainable management in the RMA s5(2) has two functions; the first part is the management function (s5(2) and the second the ecological function (s5(2)(a)(b) and (c)) (Fisher, 1991). The approach developed through the courts has been to interpret the ‘while’ in s5(2) as meaning ‘at the same time as’, treating the while as a coordinating conjunction and allowing a balance to be struck between the two functions of sustainable management contained in section 5 (*NZ Rail Ltd v Marlborough District Council* [1994], *Trio Holdings Ltd v Marlborough District Council* [1997]; *North Shore City Council v Auckland Regional Council* [1997]). This research has found substantial evidence that ecosystem services based management can assist in striking this balance, by providing a mechanism for weighing the often ‘competing and indeterminate’ ecological and social interests contained in this section (Palmer, 1995).

Furthermore, incorporating ecosystem services based concepts in the RMA 1991 builds on the historical incorporation of ecological concepts into the RMA 1991. A document published by the Ministry for the Environment only two years after its establishment in the Environment Act 1986 outlines ecological principles for sustainable management, showing clear recognition of concepts such as dynamic steady states and the flow of energy through linked environmental systems (Cronin, 1988). This research has also found substantial evidence that ecosystem services based approaches would build on this by recognising the connections between resources and human systems. The ecological principles which ecosystem services are based on, including non-linearity and thresholds, are also identified by ecosystem service researchers such as Barbier et al. (2011). Building ecosystem services based approaches into the RMA 1991 will most likely help to achieve a balance between the ecological and management functions of the s5 sustainable management purpose and allow ecological concepts to continue to be brought into the Act.

7.3.4: Ecosystem Services Based Approaches in the New Zealand Coastal Policy Statement (2010)

East Otago Taiāpure Management Committee (2013) provides some clear guidance on the application of ecosystem services based approaches in the context of the New Zealand Coastal Policy Statement (2010). The discussion on this subject is also expanded on in Payne-Harker (in press; see Appendix E). The most relevant policies identified through which ecosystem services have been employed for tend to focus on the physical processes of the marine environment and ecosystems. Objective 1 does incorporate elements of the ecosystem services concept that have been identified in this research. One of the main ways in which it does this is by identifying interdependencies and through recognising the ‘complex’ and ‘dynamic’ nature of coastal environments (NZCPS, 2010; Objective 1, p.9). Policy 11 and 12 (NZCPS, 2010; p.16 and 17) demonstrate an ecosystem services based approach by connecting human activities with impacts on the environment and seeking to manage these through resource management plans and resource consents, portraying an understanding of the connections between drivers of human impacts, human impacts and environmental outcomes, similar to that illustrated in Figure 6.1, chapter 6 in relation to *M. pyrifera* of the East Otago Taiāpure. Given that similar concepts already exist in the NZCPS (2010) there is scope to consider how the ecosystem services based

approach could be built into the National Policy Statement and what the implication of this would be.

There are opportunities to build the ecosystem services concept into coastal management frameworks to promote a more holistic form of coastal management, which recognises the connections between humans and the environment and environmental components. The decision of the Supreme Court in *Environmental Defence Society v Marlborough District Council* [2014] that ‘avoid’ in the NZCPS (2010) has its ordinary meaning of ‘not allow’ or ‘prevent the occurrence of’ could have meaning for the integration of ecosystem services into the NZCPS (2010). If provision was made to avoid impacts on ecosystem services within the NZCPS (2010), this would set a strong direction to avoid impacts on ecosystem services. Following the conclusions that have been drawn about ecosystem services in this thesis, this would be providing not only to avoid impacts on the ecosystem, but to avoid the flow on effects for human welfare. In this respect, building ecosystem services into the NZCPS (2010) could help to achieve sustainable management, providing for the integrated human and environmental considerations in the National Policy Statement.

Ecosystem services also assists with embedding ecological concepts into the NZCPS (2010). In particular, the use of the concept builds on the direction to “safeguard the integrity, form, functioning and resilience of the coastal environment and sustain its ecosystems, including marine and intertidal areas, estuaries, dunes and land” contained in Objective 1 (NZCPS, 2010, p.9). This is particularly important in the context of coastal management because of the uniqueness of coastal ecosystem services, which provide cumulative benefits as conduits between coasts, lands and watersheds (Barbier, 2011). Ecosystem services has the ability to highlight and provide for the interconnected nature of the coastal ecosystem through its incorporation into the NZCPS (2010).

7.3.5: Ecosystem Services Based Approaches in the Regional Plan: Coast (Otago Regional Council, 2012)

One of the key policy documents which the Environment Court considered in *East Otago Taiāpure Management Committee* (2013) for the decision about the appeal of Coastal Permit 2010.198 was the *Regional Plan: Coast* (the Coastal Plan) (Otago Regional Council, 2012). Regional Coastal Plans are required under section 64 of the RMA 1991 and have the purpose of assisting the regional council to promote the sustainable

management of resources in the coastal marine area (Otago Regional Council, 2012). The compliance of the consent with the regional plan was not a primary concern of the Court, who stated that the regional council decision was far more complex than what they faced (*East Otago Taiāpure Management Committee*, 2013). There was also clear agreement that the consent would achieve the objectives and policies of the Plan. As discussed in section 8.3.2, the key point of debate was whether there were any adverse effects after mitigation, and the fact that the matter has proceeded on the basis that there would be no discernible adverse effects on the inshore area. Given that the effects were the main consideration of the case, the most relevant section of the Regional Coastal Plan was Chapter 9 *Alteration of the Foreshore and Seabed* at 9.7 *Anticipated Environmental Results* of the Coastal Plan.

The particular provisions of interest are as follows:

- 9.7 *Anticipated Environmental Results*
- 9.7.4 *Activities which alter the seabed or foreshore do not result in a loss of natural character from Otago's coastal environment;*
- 9.7.5 *Applications for resource consent for activities that alter the seabed or foreshore, which may permanently affect water and sediment movement, are considered carefully and a precautionary approach taken;”*

The focus of the Environment Court in *East Otago Taiāpure Management Committee* (2013) on the effects of the activity further emphasises the extent to which ecosystem services can best be used as a form of assessment of effects and to assist in forming a better and deeper understanding of what the effects of an activity may be than without using the concept. It does this by taking into account both human actions (cumulative and at a range of scales) and human outcomes of environmental impacts. It can be used to portray these linkages to decision makers relatively effectively, as shown by the inclusion of consideration of the kelp forest as an outcome of the use of the ecosystem services based approach in the planning process. Further analysis of Regional Coastal Plans and related planning documents could assist in demonstrating how to build ecosystem services based approaches into the New Zealand planning framework.

7.3.6: RMA 1991 and Coastal Planning Frameworks Summary

The analysis of the use of ecosystem services based concepts in an appeal of a resource consent decision to the Environment Court has shown that ecosystem services has the potential to be used to convey the level of risk of an activity in planning processes, providing a full picture of what stands to be lost from the impacts of activities by showing human dependencies on the environment and the interconnected nature of ecosystems. Ecosystem services could be built into the RMA 1991 to balance competing social and ecological considerations in the s5 sustainable management purpose. There is also potential to make the considerations of ecosystem services mandatory using provisions that require the avoidance of impacts on ecosystem services in the NZCPS (2010), following the decision in *Environmental Defence Society* (2014). Ecosystem services based concepts can be brought into Regional Plans through provisions which recognise the connectedness of ecosystems in the Anticipated Environmental Results sections of plans.

7.4: Conclusion

Chapter 7 has provided an analysis of the use of ecosystem services in a range of different types of environmental management and planning documents and in the Environment Court as an example of a planning processes in response to research question 3 (Fig. 3.1). It has been demonstrated that ecosystem services based concepts have the ability to successfully translate into ecosystem services based management when they are built into management plans. This suggests that the incorporation of ecosystem services based approaches into planning frameworks in New Zealand could better help to achieve the sustainable management purpose of the RMA 1991 through incorporation in the RMA 1991 and pursuant planning documents. The use of ecosystem services as a risk management and predictive tool in planning processes has also been highlighted in relation to the case study of *East Otago Taiāpure Management Committee* (2013). Overall, it has been shown that there are opportunities to incorporate ecosystem services based approaches into coastal management plans in New Zealand and because of the values and outcomes that it has been determined that the approach may provide in chapter 5 and chapter 6, this could lead to the achievement of sustainable management under the RMA 1991 s5 purpose. Chapter 8 will draw on these findings to explore the research

objective: To determine whether ecosystem services assessment can be used to improve coastal management decision making processes within New Zealand's resource management framework.

Chapter 8: Improving Coastal Management Decisions through Ecosystem Service Based Approaches

8.1: Introduction

This chapter presents the results and discussion to address the research objective: To determine whether ecosystem services can be used to improve coastal management decision making in New Zealand (Fig 3.1). It builds on the findings of previous chapters to show that ecosystem services based decision making can result in robust decisions and that ecosystem services can be used to re-orientate decisions and achieve sustainable management within the case that it is used in. However, some wider barriers to achieving sustainable management using the ecosystem services based approach are identified, including the complex nature of coastal management decisions, timeframes and miscommunication between coastal management stakeholders. Suggestions of how to overcome these are made and a discussion on how ecosystem services can be used to address these barriers are made as recommendations in section 9.5 and 9.6, Chapter 9, following the conclusion which synthesis key research findings.

8.2: Building Ecosystem Services Based Approaches into Decision Making in Case Study 1: Management of the East Otago Taiāpure

8.2.1: Introduction

This section presents the results and discussion surrounding case study 1: The management of the East Otago Taiāpure in relation to the research objective: to determine whether ecosystem services can be used to improve coastal management decision making in New Zealand. In this section, the decision making process of the East Otago Taiāpure Management Committee (EOTMC) will be assessed against the ecosystem services concept and the aspects of the concept which have been revealed through this research to first establish whether the decision-making process broadly reflects an ecosystem services based approach and then to assess whether the ecosystem services based approach can be used to assist in decision making. Section 8.2 shows that within a site where ecosystem services based management is taking place, ecosystem services based approaches to decision making can result in successful environmental management and planning outcomes. The findings show that the ecosystem services based approach used includes

working across disciplines to understand the environment and linking together components of the environment to make decisions, further strengthening community bonds through decision making processes and enhancing the achievement of sustainable management under the RMA 1991 s5.

8.2.2: Decision Making Processes of the East Otago Taiāpure Management Committee

The case study of the management of the East Otago Taiāpure demonstrates that approaches which reflect ecosystem services based approaches can improve decisions within the site where they are being used. At this point, the similarities between the EOTMC approach to management and the ecosystem services based approach to management have been supported through evidence that ecosystem services are recognised and provided for at the site in chapter 5 and that provisions which reflect an ecosystem services based approach have been built into the management plans of the EOTMC in chapter 7. Therefore, the findings that have been drawn from the case study can be used to provide a good foundation for understanding the ecosystem services based approach to management.

Chapter 5 has also supported the findings of Ash et al. (2010) by showing that the ecosystem services based approach can be used in environmental management to illustrate connections between humans and the environment and between different components of the environment. Assuming that an ecosystem services based approach is employed at the East Otago Taiāpure, there is evidence to demonstrate that ecosystem services based decision-making recognises these connections. Observations of EOTMC meetings and analysis of Key Informant interviews reveal that the EOTMC are able to make these connections between humans and the environment and environmental components by drawing together multiple perspectives and disciplines. This is most strongly demonstrated in the statement that Key Informant 1, Kāritane community representative on the EOTMC, makes in relation to the setting of regulations under the FA 1996. Key Informant 1 emphasises the ability of the EOTMC to persevere and work through differing perspectives to achieve a robust and well-justified decision to suit a variety of interests. It is noted by Key Informant 1 that this takes place with the knowledge that it will lead to more satisfactory outcomes for the EOTMC and the community which they represent:

One of the spinoffs of having meetings like that is that when we come to a decision we have heard every single angle of things discussed, usually for months, sometimes for years. Which means that if people outside the committee or outside the community ask us about a decision we have made, we can actually feel quite confident explaining it. And also countering any questions that people have, so it's quite strong (Key Informant 1).

The approach taken to decision making at the East Otago Taiāpure site adequately recognises the wide range of considerations alongside the natural and physical resources of coastal ecosystems, including economic and social costs of decisions and the tensions that this can lead to amongst communities in coastal management decisions (Alexander et al., 2012). The use of the ecosystem services based approach leads to robust decisions being made by allowing the group using the approach to work through conflicts and resolve tensions between different interests.

Case study 1 of the management of the East Otago Taiāpure by the EOTMC also demonstrates that ecosystem services based approaches can improve decisions outside of the site where they are being used. As Key Informant 1 explains, one of the strengths of the EOTMC is that decisions are made by bringing together multiple knowledge pools and perspectives. In *East Otago Taiāpure Management Committee (2013)*, the group:

...brought the different strands together and understood where everything fitted in...demonstrating the value of having different skillsets in the committee (Key Informant 1).

This reflects the ecosystem services based approach to management that has been demonstrated as effective in the ecosystem services valuation stage of ecosystem services assessments by Lithgow et al. (2013), where a checklist of 36 foredune indicators are assessed by a multi-disciplinary expert panel made up of geomorphologists, ecologists and anthropologists. Chapter 7.2 has also discussed how this approach resulted in a coherent argument based around the risk of the Port Otago Ltd. which portrayed the linkages between people and the environment and lead to an increased consideration of protection of kelp in the court case.

8.3: Building Ecosystem Services Based Approaches into Environment Court Decision Making Processes in Case Study 2: in East Taiāpure Management Committee (2013)

8.3.1: Introduction

Section 8.3 will analyse the outcome of *East Otago Taiāpure Management Committee (2013)* to determine whether the use of the ecosystem services based approach which has been set out in chapters 5, 6 and 7 has contributed to improved decision making of the Environment Court and the implications of the decision for the management and protection of *M. pyrifera* within the Next Generation channel deepening project. The implications for the environmental management and recognition of *M. pyrifera* outside of the of the Next Generation channel deepening project will then be discussed. It is shown that within the case, the addition of Condition 4(a) to Coastal Permit 2010.198 has greatly enhanced the recognition of *M. pyrifera* in the management plans of Port Otago Ltd. This is attributed to the use of the ecosystem services based approach by the appellants to portray the value of sustaining the *M. pyrifera* beds of the East Otago Taiāpure and portraying the risks associated with their loss. The case study also shows that the use of ecosystem services in the Court case may be reflected in increased recognition of *M. pyrifera* in the management approach which Port Otago Ltd. has taken towards the consent.

8.3.2: Next Generation Channel Deepening Project: Environment Court Decision and Consequences for Port Otago Ltd. Management Requirements

The outcome the Environment Court decision and the influence that ecosystem services based approaches have had on the decision can be analysed in relation to the *East Otago Taiāpure Management Committee (2013)*, assuming that the ecological values referred to broadly reflect an ecosystem services based approach. The final decision of the Environment Court in *East Otago Taiāpure Management Committee (2013)* was to grant Coastal Permit 2010.198 with an amendment of the conditions so that a representative area of the wider shoreline coastal environment was required to be identified for monitoring. There is strong evidence that the intention behind this was to promote the protection of the *M. pyrifera* of the Taiāpure. In particular, a change to condition 4(a) was made with the expectation that it would re-orientate the consent and the subsequent

management of the dredge disposal towards protection of *M. pyrifera*. In *East Otago Taiāpure Management Committee (2013)* Smith J. states:

[10] The key outcome of the Conditions of Consent is now to recognise under Condition 4(a) that there is to be no discernible effect on the shoreline coastal environment, including the kelp forests. This then focuses much of the rest of the consent in terms of the purposes of monitoring, consultative committees, and other outcomes (*East Otago Taiāpure Management Committee, 2013*).

Condition 4(a) required that: The exercising of [Coastal Permit 2010.198] shall result in no discernible adverse effects on the shoreline coastal environment including kelp forests (Otago Regional Council, 2013).

Condition 4(a) was added alongside the requirement to specify minimum depth, maximum volume of material and a requirement for the even distribution of the material in 4(b), (c) and (d). Prior to the addition of Condition 4(a) there was very little recognition of the need to provide for the impacts on *M. pyrifera* beds in the disposal of the dredged sediment. For example, under Condition 7 of Coastal Permit 2010.198 which had required Port Otago Ltd. to produce an environmental management plan, the plan had been required to include monitoring of the bathymetry, turbidity, biology and coastal processes of the area (7b) and methods to be implemented to avoid any discernible effects on marine biota (7d). Condition 19 required the avoidance of aggregations of feeding birds and marine mammals in the disposal area. *M. pyrifera* and kelp forests do not appear to have been included as a suggested consideration in these conditions.

The fact that the outcome of *East Otago Taiāpure Management Committee (2013)* was to add the condition that made explicit reference to avoiding adverse effects on *M. pyrifera* through the activities of Port Otago Ltd. provides strong evidence that the use of ecosystem services by the appellants in their expert witness statements in the case and the drawing of connections between human impacts, *M. pyrifera* and outcomes for social, economic and environmental well-beings has resulted in a coastal management decision which has improved outcomes for the kelp at the East Otago Taiāpure site. The decision of the Environment Court has ensured that the consent is better orientated towards their management and protection than it was prior to the use of ecosystem services in the Environment Court process.

The next indication of the extent to which using an approach similar to the ecosystem services based approach in expert witness statements has resulted in improved decision

making outcomes for the kelp beds of the East Otago Taiāpure is to consider whether the requirements of condition 4(a) are reflected in the draft Environmental Management Plan (EMP, 2012). The EMP (2012) was required to be prepared by Port Otago under condition 7 of Coastal Permit 2010.198. Following the addition of condition 4(a), the monitoring of kelp forests is explicitly referred to in the EMP (2012, p.2) under Biological Monitoring B(2)(b)(i) which states that “information about meaningful parameters” shall be gathered at “a representative area of shoreline and associated kelp forest between Shag Point and Cornish Point” as well as “sites near Shag Point and Pipikaretu Point as control sites under 2B(b)(ii)”. The aim of this monitoring specified in 3(a) is to provide a clear understanding of the degree and extent of impacts to a standard that enables decisive and timely decisions about dredge disposal management.

The importance and the need for the monitoring of *M. pyrifera* has very likely been elevated for Port Otago Ltd. in relation to the Next Generation channel deepening project by the Environment Court decision and the use of ecosystem services to portray the importance of *M. pyrifera* in the case study of in *East Otago Taiāpure Management Committee* (2013). This is reflected in the addition of Condition 4(a) and the incorporation of the consideration of *M. pyrifera* in the EMP (2012) produced by Port Otago Ltd. In doing this, the use of ecosystem services in the case adequately addressed the key point of contention: the avoidance of adverse effects on the inshore area after mitigation (*East Otago Taiāpure Management Committee*, 2013).

8.3.3: Next Generation Channel Deepening Project: Environment Court Decision and Port Otago Ltd. Responses beyond East Taiāpure Management Committee (2013)

The most recent Port Otago Ltd. EMP (2016) can be examined to provide an indication of the extent to which the ecosystem services based approach to management is being implemented by Port Otago Ltd. following the decision of the Environment Court in *East Otago Taiāpure Management Committee* (2013), outside of the requirements under condition 4(a) of Coastal Permit 2010.198 (Otago Regional Council, 2011) which have been discussed in section 8.3.2. In particular, the most recent EMP (2016) can be compared to the EMP (2012) that was produced immediately after the decision of the Environment Court in *East Otago Taiāpure Management Committee* (2013) to see how the management approach taken by Port Otago Ltd. has evolved in response to the requirements in relation to the Next Generation channel deepening project. The main

change to note is the addition of appendix 4: Technical Brief, Kelp Forest Monitoring Program Revision 3. The ecosystem services of the kelp beds are provided recognition in the monitoring program as shown by the following extract:

The kelp beds are recognised for their importance as a habitat for a wide variety of marine life and in particular pāua, kina and fish species that are important taonga (treasured) species for Kāi Tahu (EMP, 2016, p71).

The inclusion of the recognition of the importance of *M. pyrifera* and the habitat providing service that it provides in Port Otago Ltd's most recent EMP (2016) provides evidence that the use of ecosystem services in the East Otago Taiāpure (2013) has resulted in a change of management approach outside of the Environment Court decision in relation to the Next Generation project and the way that the ecosystem is managed by Port Otago Ltd. Port Otago Ltd. also show some willingness to adapt plans based on the information provided by Technical Advisory Group member and East Otago Taiāpure Management Committee representative Hepburn, revising the brief about the project based on the input which they have received. The Technical Advisory Groups was required to be established under condition 12 of the EMP (2012). The willingness to adapt based on the input of members demonstrates consistency with the Ministry for the Environment (2015) consultation guidelines which state that consultation should be genuine and the consulting party should keep an open mind to how the results of consultation will affect their decisions. As shown in coastal management literature, this is a very important aspect of coastal management because it ensures that stakeholders feel a sense of ownership over decisions that are made (Blackett et al., 2007; Blackett et al., 2010; Alexander et al., 2012).

The work that will be carried out to gather the information surrounding Coastal Permit 2010.198 subsequent to the case also reflects some of the ecosystem service based principles that have been revealed through this research. Aerial photography to map the extent of the kelp beds is proposed as a monitoring method. The photography will be carried out at a broad scale, demonstrating the recognition that a wide spatial scale is required to gain a proper understanding of the impact of human actions (Townsend and Thrush, 2010). Light attenuation will also be monitored, again displaying acknowledgement of the relationship between biotic and abiotic environmental components and how abiotic conditions could impact ecosystem services which is recognised in studies relating to the East Otago Taiāpure (Desmond et al., 2015). This

demonstrates that the portrayal of the ecosystem services provided by the kelp through the Environment Court case has raised the recognition of the importance of the kelp to the port and resulted in enhanced management and that some aspects of the ecosystem services based approach may be applied by Port Otago Ltd. similar to that applied by the EOTMC at the East Otago Taiāpure site. Section 8.4 will assess whether this is reflected beyond the isolated case where ecosystem services has been used, to determine whether the use of ecosystem services in Environment Court and planning processes can result in large scale changes in coastal management to achieve sustainable management of coastal environments.

8.4: Building Ecosystem Services Based Approaches and Decision Making into Planning Processes

8.4.1: Environment Court Decision and Improvements Required Outside of the Next Generation Channel Deepening Project

Despite the improvements demonstrated in section 8.3.4 towards the management of impacts on the East Otago Taiāpure kelp beds, there is strong evidence that there are ongoing tensions between the EOTMC and Port Otago Ltd. in relation to further resource consent applications outside of the requirements in Coastal Permit 2010.198, subsequent to the decision of the Environment Court on the appeal of the Otago Regional Council (2011) decision to grant the consent in *East Otago Taiāpure Management Committee* (2013). Port Otago Ltd. completed their final consent application and Assessment of Environmental Effects (AEE) for the renewal of coastal permit RM 11.153.01 which allows for Port Otago Ltd. to dispose dredging material at three inshore sites adjacent to the harbour in June 2016 (GHD, 2016). The consent would allow for disposal into the sea of up to 450,000m³ per year of dredged material at three existing disposal sites; Heyward Point, Aramoana and Shelley Beach (GHD, 2016). This section will present the results and discussion surrounding this finding with a focus on the recent inshore dredging disposal consent renewal applications, to assess whether the interactions between the groups have improved and whether the achievement of sustainable management is being met under s5 of the RMA 1991 subsequent to *East Otago Taiāpure Management Committee* (2013).

8.4.2: Recognition of *M. pyrifera* in Future Port Planning Processes

Evidence that the management approach applied towards *M. pyrifera* of the East Otago Taiāpure by Port Otago Ltd. has not improved beyond the management applied in relation to Coastal Permit 2010.198 can be drawn from the assessment of ecological effects that was prepared by the National Institute of Water and Atmospheric Research (NIWA) as part of the AEE (2015) for the dredging disposal application in June 2016. The AEE prepared by NIWA (2015, p.7) on behalf of Port Otago Ltd. draws attention the need to apply an adaptive management approach to ensure that “unforeseen effects are identified, prioritised and resolved early via a collaborative process involving relevant stakeholders”. However, the AEE clearly states that “monitoring of kelp forests and rocky reef benthos around Blueskin Bay seems unwarranted unless sediment plumes generated during dredging operations increased” and the potential effects of the disposal on kelp beds is assessed where the threat is determined to be “uncertain” (NIWA, 2015, p.43). This does not demonstrate the recognition of the kelp and the monitoring that was implemented subsequent to East Otago Taiāpure (2013) which has been demonstrated in section 8.3, suggesting the impact of the use of ecosystem services and the subsequent requirements placed on Port Otago Ltd. in East Otago Taiāpure (2013) may have been confined to the case and driven predominantly by the requirements placed on Port Otago Ltd. By the Environment Court, who did demonstrate a recognition of the need to provide for the *M. pyrifera* of the East Otago Taiāpure.

The lack of recognition of *M. pyrifera* beyond the decision of the Environment Court regarding Coastal Permit 2010.198 *East Otago Taiāpure Management Committee* (2013) highlights that there are possible barriers to achieving sustainable management under s5 of the RMA 1991 through the use of the ecosystem services based approach in Environment Court and planning processes. The possible barriers to achieving sustainable management under the RMA 1991 (s5) using the ecosystem services based approach may relate to the contrast between the time required to understand the complexity of coastal and marine ecosystems and the short timeframes required for resource consents under the RMA 1991. Time frame milestones under the RMA 1991 in relation to resource consents include a ten day timeframe for consent authorities to determine if an application is complete once it has been lodged (s88(3)) and a duty to ‘avoid unreasonable delay’ under s21 (Quality Planning, 2016). In this case, Port Otago Ltd. were renewing consent to

dispose dredging material at the three inshore sites which meant there was a set timeframe within which the application for the renewal was required to be lodged by Port Otago Ltd. (GHD, 2016).

The concerns about the tensions between resource consent timeframes and the timescale needed for collecting ecological information are raised by Key Informant 3, EOTMC scientific advisor who states:

I don't think they know how complex the system is, and I don't think they really care to find out, like they need to get the job done, which is get the consent in...they will do the bare minimum they could get away with for, you know, meeting the RMA 1991 requirements (Key Informant 3).

The time limits required for the renewal of the consent also meant that the submission took place without the receipt of the Cultural Impact Assessment (CIA), which local Māori resource management agency Kāi Tahu ki Otago Ltd. carry out on behalf of several Otago rūnaka (cultural groups) to assess how Port Otago Ltd's proposed programmes impact upon their cultural values (Kāi Tahu ki Otago Ltd., 2010). As stated by Key Informant 3, this was required so that they could:

Hit that date [which meant] not waiting for manawhenua (the local people who have authority over the land) to have their say through the CIA (Key Informant 3).

Key Informant 3 does also recognise that there are conflicting complexities which the planner preparing the resource consent on behalf of the applicant must deal with, stating that there are:

A whole lot of complexities in the background of a consent application that [they] don't understand (Key Informant 3).

Further analysis of research findings reveals that there are possible ways to address this issue, one of the key ways being for ecosystem service researchers and planners to work in a more collaborative way to prepare resource consents, so that the complexities that each face are understood by the other party. This finding reinforces Berry and Vella (2010) and Gibbs et al's (2013) research, alongside other coastal management literature, which demonstrates the complex nature of coastal hazard management decisions in relation to public and private interests. Furthermore, building a shared understanding of consent requirements and scientific requirements has proven to be successful in the case of the preparation of resource consents for the disposal of dredging material for the proposed channel deepening of Lyttleton Harbour for Lyttleton Port (Lyttleton Port of

Christchurch, 2016). This is reflected in the experiences of Key Informant 3, who explains:

Luckily, they've shifted their consent lodgement quite a bit since we've first started talking. So that's given us a lot more time to understand... partly because our process was moving so slowly...they seem more willing to tackle the complexities. Rather than saying we need to do a unit of science up to a particular level to satisfy the consent, they actually want it to be, well, they tell us that they want it to be better than anything that's ever been done before (Key Informant 3).

Another way to address this issue could be to introduce some flexibility into the RMA through adjusting provisions such as s21, which currently requires "every person who...is required to do anything, under this Act for which no time limits are prescribed to do so as promptly as is reasonable in the circumstances".

8.4.3: Relationships between Coastal Management Stakeholders: EOTMC and Port Otago Ltd.

Another key way to address the lack of ability of ecosystem services to achieve sustainable management beyond *East Otago Taiāpure Management Committee* (2013) may be to improve communication and encourage the formation of positive relationships between the coastal management stakeholders, based on principles of open-mindedness and respect to align with best practice consultation principles (MFE, 2015). There is substantial evidence that negative relationships were formed between the groups and that this prevented ecosystem services from being able to achieve sustainable management beyond the case. Early gaps in communication began between the EOTMC and Port Otago Ltd. in relation to Coastal Permit 2010.198 began in May 2008, when the EOTMC contacted the Port to request more information about the plans for dredging (East Otago Taiāpure Management Committee, 2008a). It is noted in the May 2008 minutes of the EOTMC that:

There [was] no report back from the rūnaka regarding this issue, there has been no contact directly from Port Otago. Need to contact Port Otago regarding the lack of communication with the Taiāpure committee (East Otago Taiāpure Management Committee, 2008a).

By August 2008, Hepburn and Flack had attended a Port Otago Ltd. meeting where the way that dredging was going to be undertaken was discussed (East Otago Taiāpure Management Committee, 2008b). Port Otago were "apologetic" about their lack of communication with the EOTMC (East Otago Taiāpure Management Committee,

2008b). However, during 2009, there is evidence of a continued lack of communication between Port Otago and the EOTMC, with members expressing concern about the apparent quietness of the Port (East Otago Taiāpure Management Committee, 2009). The EOTMC were mostly engaged through the preparation of the cultural impact assessment (East Otago Taiāpure Management Committee, 2009). In June 2010 a meeting was held at Puketeraki Marae to discuss the Port Otago Project Next Generation (East Otago Taiāpure Management Committee, 2010b). Discussion centred on the possibility of monitoring sediment, the use of a scientific approach to assess it and the absence of sediment thresholds. The EOTMC recognised that concerns about the dredging were legitimate regardless of where the sediment would be dumped and the Environment Court date was set for November 26 and December 2010 (East Otago Taiāpure Management Committee, 2010).

The need for appeal of the decision of the Otago Regional Council to grant coastal permit (2010.198) may not have been as great if better communication had taken place between the two parties from an early stage of the process, such as the one that appears to be taking place between Port Lyttleton and coastal ecosystem managers and stakeholders, which was discussed in Section 8.4.2 (Lyttleton Port of Christchurch, 2016). The hostility between the groups was also demonstrated by EOTPMC participants. For example, Key Informant 3, EOTMC scientific advisor did not take up an opportunity offered by Port Otago Ltd. to collaborate on scientific research in relation to the impacts of dredging because of cultural considerations stating:

Actually twice [Port Otago Ltd. General Manager] has tried to contact me to engage me to do some work...but I guess what he doesn't understand is that that stuff needs to come from the manawhenua side, like it needs to come from the rūnaka, they need to say we want this to happen and we want you to talk to this person, like I'm not sitting isolated, people can't just contact me and get me to do work for them, it needs to come up through the organisation.

There is also evidence that tension that has formed between the two groups has been translated into engagement with other port dredging projects. Key Informant 3, who has attended Port Otago Ltd. Technical Advisory group meetings on behalf of the EOTMC and has been involved with providing scientific advice for the Port Lyttleton project states in relation to their involvement with the Port Lyttleton dredging:

I'm poisoned by my experience down here, and I sort of actually had to catch myself a bit in the Lyttleton meetings, 'cause we sort of have a really good relationship

with those guys and you don't wanna drag in all this negativity from the Port Otago Ltd. Case (Key Informant 3).

Despite the lack of apparent translation of the ecosystem services based approach beyond the East Otago Taiāpure site, for reason which appear to be on both parties' behalf, the EOTMC sustained a tight group and continued to apply decision-making processes similar to those which reflect an ecosystem services based approach by working across multiple disciplines, as discussed in section 8.2.2, Key Informant 1, Kāritane community representative on the EOTMC, stating that:

It was a trial by fire for six years. And every one of us over those six years had a time where we just said it's too hard. We can't do it...I think we should stop. And then somebody across the way would say, nope, nope this is my take on it. And they would start holding it (Key Informant 1).

8.5: Conclusion

In section 8.3, it was shown that the decision making of the East Otago Taiāpure Management Committee broadly reflects an ecosystem services based approach, drawing together knowledge from a range of disciplines to understand the connections within ecosystems to inform management. This has been shown to result in robust decisions because of the wide range of input that is required and the involvement which this facilitates. The use of ecosystem services within the East Otago Taiāpure (2013) has also been shown to inform decision makers sufficiently of the full scope of impacts of management actions, leading to decisions which orientate management towards a balancing between the use and protection of the coastal environment to achieve sustainable management. In case study 2, this was reflected in the addition of Condition 4(a) to Coastal Permit 2010.198 and the adaptation of the EMP (2012) by Port Otago Ltd. to take into account impacts on *M. pyrifera*, through the application of best practice coastal management principles and the use of consultation and monitoring methods.

Section 8.4 has demonstrated that the ecosystem services based approach employed in the *East Otago Taiāpure Management Committee* (2013) case may not have translated into improvements in coastal management beyond the isolated decision of the Environment Court on the appeal of Coastal Permit 2010.198 and the addition of condition 4(a) to re-orientate the consent towards avoiding adverse effects of sediment disposal on *M. pyrifera* of the East Otago Taiāpure, drawing from the analysis of current coastal management decision making processes of Port Otago Ltd. This demonstrates that

there may be wider barriers to using ecosystem services to achieve sustainable management under the RMA 1991. Possible mechanisms to address this include encouraging coastal management stakeholders to work collaboratively so that complexities in decision making are understood, including timeframes and the complexities of coastal ecosystems, and to encourage early and ongoing communication between coastal management groups from the beginning of coastal management decision making processes. Despite this, the ecosystem services based approach is demonstrated to persist at the East Otago Taiāpure site. Chapter 9 concludes by summarising the findings of the research in relation to each research question and the research objective and provides recommendations for how to build ecosystem services based approaches into planning frameworks to achieve sustainable management, in light of the opportunities and barriers that have been illustrated in chapter 8.

Chapter 9: Conclusion

The use of ecosystem services in New Zealand's planning framework provides for the recognition of connections between humans and the environment and between environmental components of ecosystems, contributing to a more holistic form of natural resource management to achieve the sustainable management purpose of the RMA 1991 contained in s5. As a concept which emerged at a similar time to the international concept of sustainable development and the incorporation of this concept into the RMA 1991 as sustainable management, ecosystem services presents an opportunity to further the understanding of how to achieve this purpose in New Zealand's coastal planning frameworks. The case study of the East Otago Taiāpure and the *East Otago Taiāpure Management Committee* (2013) Environment Court case provided a mechanism to observe in depth the use of ecosystem services in relation to environmental management and within coastal planning processes.

This research followed the development of ecosystem services into an accepted framework containing four key ecosystem service categories in the Millennium Ecosystem Assessment (2003) and the subsequent redefining of the concept in the early 21st C (Boyd and Banzhof, 2007; Fisher et al., 2009; Turner et al., 2010). It sought to determine whether ecosystem services could be used to improve coastal management planning and decision making processes within New Zealand's resource management framework. The study was guided by the following research questions to inform this objective:

1. What is the value of using ecosystem services for coastal management and decision making?
2. Does the use of ecosystem services in coastal management lead to improved outcomes for the coastal environment?
3. In what form can ecosystem services be incorporated into coastal management and planning frameworks in New Zealand?

Research findings were presented in chapters 5, 6, 7 and 8 in relation to the research questions and the research objective. The review of ecosystem services and coastal management literature contained in chapter 2 identified the principles behind ecosystem services based management approaches and provided a context to assess the use of such

approaches in coastal management and planning contexts. Key features of the ecosystem services based approach include its ability to connect environmental and socio-ecological systems (Ash et al., 2010), the application of the concept over broad spatial and temporal scales (Townsend and Thrush, 2010) and a range of ecological concepts which underpin ecosystem services based management approaches, including thresholds and non-linearity's (Turner et al., 2010; Barbier et al., 2011). The coastal management and decision making context was demonstrated to require an ability to consider economic, social and natural and physical factors to make sound management decisions (Alexander et al., 2012). Coastal management regulatory frameworks were also found to play a leading role in determining how coastal decision were made in coastal planning, as shown by the example of the Queensland Sustainable Planning Act (2009).

Taking into account the ecosystem services based principles highlighted in the literature review and the coastal planning context, this research sought to consider the values and outcomes of using the ecosystem services based approach for coastal management in the Otago coastal area. Results were then considered in relation to the achievement of sustainable management in the New Zealand resource management and planning context and in the context of international lessons for the implementation of sustainable management. Key findings are presented in relation to the research questions in the next sections, followed by a brief reflection on the research process and suggestions for future research opportunities.

9.1: Research Question 1: What is the value of using ecosystem services for coastal management and decision making?

Research question 1 sought to establish the value of using ecosystem services based approaches to coastal management, to inform the research objective and provide guidance about the potential use of ecosystem services in New Zealand coastal management. Results were consistent with previous ecosystem service research, which identified the ability of ecosystem services based approaches to illustrate connections between humans and the environment (Kittenger et al., 2010). Through the case study of the East Otago Taiāpure it was shown that some ecosystem services demonstrated this principle particularly well, including educational ecosystem services. Results were also consistent with previous ecosystem service research, which identified the ability of ecosystem services based approaches to illustrate connections between environmental components.

It could be expected that indirect ecosystem services such as habitat provision implement this principle particularly well.

Through the case study of *East Otago Taiāpure Management Committee* (2013) it was shown that ecosystem services can be used to understand the connections between human impacts on a single component of an ecosystem, the flow on effect this may have on other parts of the ecosystem and the subsequent impacts on the ecosystem services which humans rely on from that ecosystem. This was determined through the analysis of expert witness statements, which built on each other to portray the value of *M. pyrifera* to humans and the wider ecosystem through the habitat supporting role which it plays (Win, 2010). The ability of ecosystem services to illustrate these connections was determined to be a key factor that could be brought into the coastal planning framework to achieve sustainable management, by bringing together the management and ecological functions contained in the RMA 1991 s5 definition (Fisher, 1991) through the incorporation of ecosystem services into the framework.

9.2: Research Question 2: Does the use of ecosystem services in coastal management lead to improved outcomes for the coastal environment?

Research question 2 sought to determine what the outcomes of the use of the principles revealed through research question 1 were in relation to coastal management and the coastal environment. The key outcome in relation to recognising connections between humans and the environment was shown to be the formation of strong social bonds to enhance the management of the coastal environment. This was demonstrated to provide for sustainable management by resulting in joint benefits for humans, to address the management function of the definition (s5 (2)) and the environment, to address the ecological function of the definition (s5 (2)(a), (b) and (c)). The main evidence for this was drawn from key informant interviews and case study analysis of the management of the East Otago Taiāpure site. This finding supports the positive feedback loop that is developed by Miller and Hobbs (2002).

The key outcome of recognising connections between environmental components was found to be the facilitation of environmental management on broad temporal and spatial scales. This also supports the previous ecosystem services research of Townsend and Thrush (2010) in relation to New Zealand coastal ecosystems. This outcome was also linked to the ability to identify and manage indirect and cumulative ecosystem impacts,

to enhance sustainable management. These findings were supported in the case study of *East Otago Taiāpure Management Committee* (2013), where it was shown that appellants were able to use the ecosystem services based approach to illustrate the long term and ecosystem wide consequences of actions which would impact *M. pyrifera*, drawing attention to the life supporting capacity of the species in relation to s5(2)(b) of the RMA 1991 and the possible implications of the loss of *M. pyrifera* for future generations in relation to s5(2)(a) of the RMA 1991.

9.3: Research Question 3: In what form can ecosystem services be incorporated into coastal management and planning frameworks in New Zealand?

Research question 3 draws on the findings of research question 1 and 2 to establish the primary ways in which the ecosystem services based approach to management could be incorporated into coastal management and planning frameworks in New Zealand. A range of planning documents were analysed to provide the context for answering this research question. Firstly, analysis of the *East Otago Taiāpure Management Plan* (2008) was carried out to determine whether the ecosystem services based approach present at the site, as established in previous sections, was facilitated through incorporation of the ecosystem services based approach in the *Management Plan* (2008). It was found that the ecosystem services based approach was promoted in the vision of the plan through reference to ecosystem service values and the need to sustain them. This was shown to successfully filter down into management actions, by promoting activities which recognised and provided for the ecosystem services at the site.

In the *East Otago Taiāpure Management Committee* (2013) decision, ecosystem services were shown to be incorporated into planning processes by illustrating the full risk and the flow on impacts of the actions of Port Otago Ltd., providing a predictive tool. It was determined that ecosystem services could be best used for these means in planning processes. The findings addressed a literature gap which Daily (1997) has identified in determining how to draw together a range of disciplines to carry out the assessment of ecosystem services and make this determination. Ecosystem services was shown to be able to be incorporated into the RMA 1991 to bring together the ‘competing and indeterminate’ ecological and social functions contained in the s5 purpose of sustainable management (Palmer, 1995) and to continue to build ecological theories into the Act (Cronin, 1988; Barbier et al., 2011). Opportunities to incorporate ecosystem services into

the NZCPS (2010) and the Anticipated Environmental Results (AER) sections of Regional Coastal Plans have also been identified, based on sections where similar ecological concepts and the recognition of the complex and dynamic nature of coastal environments are present in the documents and case law which has determined that the meaning of the term ‘avoid’ must be treated as ‘not allowing’ to occur under the NZCPS (2010) (*Environmental Defence Society*, 2014).

9.4: Research Objective: Does ecosystem services improve coastal management planning and decision making processes within New Zealand’s resource management framework?

The research objectives sought to establish if the incorporation of the ecosystem services based approach into New Zealand planning legislation and planning processes will improve coastal management, based on the principles identified in research question 1, the outcomes of these principles demonstrated in research question 2 and the coastal planning and management context established in research question 3. In relation to the East Otago Taiapure, it was found that coastal management decisions which brought together a range of stakeholder interests resulted in robust coastal management decisions. This approach was deemed to reflect an ecosystem services based approach because it connected human and environmental components and considered both and the interactions between them in decisions (Ash et al., 2010). The use of the ecosystem services based approach in East Otago Taiāpure (2013) was also shown to successfully inform the decision maker of the full suite of risks associated with the proposed dredging activity of Port Otago Ltd. in relation to the impacts on *M. pyrifera*. Connections were drawn between the ecosystem services provided by *M. pyrifera* and the outcomes for the wider environment to portray this. The result of this was the reorientation of the consent through the addition of Condition 4(a), which was reflected in the Environmental Management Plan (2012) prepared by Port Otago Ltd. in relation to the Coastal Permit 2010.198.

However, the enhanced recognition of *M. pyrifera* by Port Otago Ltd. was not shown to be reflected in subsequent management of the Port. Recommendations to achieve improved coastal management through the use of the ecosystem services based approach outside of the case include ensuring communication is transparent from the beginning of the management and addressing the contrasting timeframes to gather scientific

information and prepare a resource consent. In particular, the differences in timeframes between resource consent requirements under the RMA 1991 and the time required to understand the linkages between ecosystems was shown to lead to tensions between coastal management stakeholders attempting to work collaboratively to produce information and to process resource consent applications. Building strong relationships between coastal management stakeholders where communication is ongoing, open and transparent in line with best practice principles was also suggested as a way to address this.

9.5: Thesis Evaluation and Options for Future Research

Evaluation of this study can be based on the consideration of the current status of ecosystem services research. Ecosystem service definitions have developed slowly since the original proposal of the concept by Costanza et. al. in 1997 and the solidification of the concept in the MEA (2005) ecosystem services framework. More recently, ecosystem service researchers such as Boerema et al. (2016) have identified a need for research which established standardized methods of quantification of ecosystem services. This research employed mostly qualitative methods, reaffirming the ease of these methods over quantitative in relation to ecosystem services research and the need to further develop standard methods to quantify ecosystem services.

Another key area that has been highlighted as needing further research in the ecosystem services field is the determination of how to draw together a range of disciplines to carry out an ecosystem services assessment (Daily, 1997; Connell et al., 2008). Connell et al. (2008) also emphasise that leadership in the field of ecosystem services requires further collaboration, inheritance of data and building in previous knowledge to achieve long-term goals. This research has built on this identified need by analyzing the use of ecosystems services by the East Otago Taiāpure, a study site in which a range of disciplines are involved in the management of the area. Furthermore, in the process of carrying out the research, the methodology adopted here has been a mixed-method approach, which has drawn from a range of disciplines including law, social science, physical geography and marine science (Hall and Hall, 1996). More research which employs these methods and brings together disciplines to generate original research findings is encouraged.

This research has maintained a focus on the coastal environment. Further research could explore the use of ecosystem services to achieve sustainable management as it applies to other environments and their management. For example, research looking at the use of ecosystem services in terrestrial environments could assist agencies such as the New Zealand Department of Conservation (2015) to understand how to manage the environment in a way which achieves the environmental, social and economic benefits from healthy functioning ecosystems, by illustrating how to balance the competing interests to make management decisions for terrestrial ecosystems. Ecosystem services should also be considered in light of global changes in environmental conditions, which could impact ecosystems and alter their ability to provide ecosystem services in the future. Mapping and quantification of ecosystem services and projection of how ecosystem services may change as environmental changes take place in the future could be undertaken to address this (Ding and Nunes, 2014; Siikamäki et al., 2013). The research has also been based in the New Zealand planning context and further international research on the use of ecosystem services in international planning regimes would be highly beneficial.

Furthermore, it has been found that the concept of ecosystem services is generally poorly defined and understood. Internationally relevant lessons from the incorporation of sustainable management concepts into the RMA 1991 demonstrate that a clear definition is crucial for the outcome of using the concept to be achieved in its implementation. It is recommended that further work is carried out to clarify the concept of ecosystem services before it is incorporated into the New Zealand planning frameworks and used internationally to achieve sustainable management outcomes for coastal environments. Likewise, a better understanding should be developed about the relationship between ecosystem services, customary resource management practices and the achievement of kaitiakitanga under the RMA s7(a). Further research could also examine how to build flexibility into the Fisheries Act 1996 to accommodate for the management of species which provide ecosystem services for fish species in order to allow groups such as the EOTMC to carry out the holistic approach to fisheries management which is desired at the site and the opportunities this could create to achieve the sustainable utilisation of fisheries under s8(1) of the Act.

9.6: Concluding Remarks

New Zealand has come a long way in terms of achieving sustainable management, by enacting the Resource Management Act 1991 and in doing so bringing together 59 statutes through an extensive law reform effort under a single decision making framework governed by the purpose of sustainable management (Warnock and Baker-Galloway, 2015). However, further work to identify and understand how to achieve sustainable management must be carried out as environments face growing pressures from climate change and increases in the human population, particularly for coastal environments which are vulnerable to these changes. Ecosystem services provides a starting point for understanding how to bring together humans and the environment to create joint benefits for each and to connect humans with nature and recognise their dependencies on it, so that sustainable management is reflected in everyday actions.

This research has served to demonstrate that it is only through a combination of changes in the law and the shifting of the approach of communities towards sustainable environmental management actions that sustainable management of the environment will truly be achieved. Furthermore, as shown through the case study of the East Otago Taiāpure and their use of what could be recognised broadly as an ecosystem services based approach in the Environment Court, it is more often than not the drive by communities to bring about changes in the law that will encourage legislatures to make these changes.

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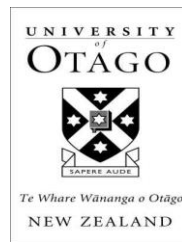
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Appendix A: Information Sheet for Participants



Ecosystem Services Based Approach to Coastal Management **INFORMATION SHEET FOR** **PARTICIPANTS**

Thank you for showing an interest in this project. Please read this information sheet carefully before deciding whether or not to participate. If you decide to participate we thank you. If you decide not to take part there will be no disadvantage to you and we thank you for considering our request.

What is the Aim of the Project?

The aim of this project is to evaluate the use of ecosystem services assessment for coastal management and coastal management decision making. This project is being undertaken as part of the requirements for Hannah Payne-Harker's Master of Planning.

What Types of Participants are being sought?

Participants with knowledge about the management of local coastal ecosystems and the use of ecosystem services assessment are being sought. Participants will be recruited by making contact and requesting participation. It is expected that 2-5 participants will be involved. The participants will gain an understanding of the use of the ecosystem services assessment as a coastal management tool as an outcome of the research.

What will Participants be asked to do?

Should you agree to take part in this project, you will be asked to participate in an interview to share your understanding of the use of the ecosystem services based approach in your management area. The interview will take no more than an hour. You may also be asked to provide contextual information about your management site. Please be aware that you may decide not to take part in the project without any disadvantage to yourself.

What Data or Information will be collected and what use will be made of it?

Raw data collection will take place through audio recordings. The recordings will be transcribed and information will be analysed to inform the research questions. Only the student researcher and the two co-supervisors will have access to the information. The research is being partly funded by the Resource Management Law Association but they will not have access to any data that is collected.

The data collected will be securely stored in such a way that only those mentioned below will be able to gain access to it. Data obtained as a result of the research will be retained

for **at least 5 years** in secure storage. Any personal information held on the participants may be destroyed at the completion of the research even though the data derived from the research will, in most cases, be kept for much longer or possibly indefinitely.

The results of the project may be published and will be available in the University of Otago Library (Dunedin, New Zealand) but every attempt will be made to preserve your anonymity.

You will have the opportunity to read the results of the study in the thesis which will be produced.

This project involves an open-questioning technique. The general line of questioning includes the use of ecosystem services based management approaches in the management area, context information of the management area and scientific information about the management area. The precise nature of the questions which will be asked have not been determined in advance, but will depend on the way in which the interview develops. Consequently, although the Department of Geography is aware of the general areas to be explored in the interview, the Committee has not been able to review the precise questions to be used.

In the event that the line of questioning does develop in such a way that you feel hesitant or uncomfortable you are reminded of your right to decline to answer any particular question(s).

Can Participants change their mind and withdraw from the project?

You may withdraw from participation in the project at any time and without any disadvantage to yourself.

What if Participants have any Questions?

If you have any questions about our project, either now or in the future, please feel free to contact either:-

Hannah Payne-Harker

and

Dr. Wayne Stephenson

*Department of
Geography*

Geography Department of

0277246130

03 479 8776

payha118@student.otago.ac.nz

wayne.stephenson@otago.ac.nz

This study has been approved by the Department stated above. However, if you have any concerns about the ethical conduct of the research you may contact the University of Otago Human Ethics Committee through the Human Ethics Committee Administrator (ph 03 479-8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.

Appendix B: Interview Participant Consent Form

Ecosystem Services Based Approach to Coastal Management CONSENT FORM FOR ***PARTICIPANTS***

I have read the Information Sheet concerning this project and understand what it is about. All my questions have been answered to my satisfaction. I understand that I am free to request further information at any stage.

I know that:-

1. My participation in the project is entirely voluntary;
2. I am free to withdraw from the project at any time without any disadvantage;
3. Personal identifying information and audio tapes will be destroyed at the conclusion of the project but any raw data on which the results of the project depend will be retained in secure storage for at least five years;
4. This project involves an open-questioning technique. The general line of questioning includes the use of ecosystem services based management approaches in the management area, context information of the management area and scientific information about the management area. The precise nature of the questions which will be asked have not been determined in advance, but will depend on the way in which the interview develops and that in the event that the line of questioning develops in such a way that I feel hesitant or uncomfortable I may decline to answer any particular question(s) and/or may withdraw from the project without any disadvantage of any kind.
5. The project is partly funded by a Resource Management Law Association Masters Scholarship
6. The results of the project may be published and will be available in the University of Otago Library (Dunedin, New Zealand) but every attempt will be made to preserve my anonymity.

I agree to take part in this project.

.....
(Signature of participant)

.....
(Date)

.....
(Printed Name)

Appendix C: List of Key Informants and Interview Questions

Key Informant	Organisation/Role
1	East Otago Taiāpure Management Committee member, Kāritane community representative
2	Galloway Cook Allen lawyer, solicitor for EOTMC, Pāua Industry Council Ltd., Pāuamac 5 Inc., NZ Federation of Commercial Fisherman Inc. & ORS, Otago Rock Lobster Industry Association Inc. in <i>East Otago Taiāpure Management Committee</i> (2013)
3	Scientific advisor to the East Otago Taiāpure Management Committee, former Otago University Marine Sciences PhD candidate

General Line of Questioning

Background

- What is your role in relation to the East Otago Taiāpure?
- What are the ecosystem services that you value at the East Otago Taiāpure?

East Otago Taiāpure Management

- What is your understanding of ecosystem services/an ecosystem services based management approach?
- Have you seen examples of this form of management being applied at the Taiāpure?
- What has motivated the recognition of these services/management from this approach?
- If it is present, have there been restrictions to being able to apply such a management approach at the Taiāpure?

East Otago Taiāpure Management Committee (2013)

- What was your involvement in relation to the Port Otago Ltd. Next Generation project?
- Do you think that ecosystem services were a part of the process? How do you think they were if so?
- What was the outcome of the approach in the case? Were those involved satisfied with the outcome?

Appendix D: List of Expert Witnesses in East Otago Taiāpure Management Committee (2013)

Expert Witness	Organisation/Role
Dr. Hepburn	East Otago Taiāpure Management Committee scientific advisor and representative
Gilmour	Executive Officer of the Otago Rock Lobster Industry Association, New Zealand Federation of Commercial Fisherman representative
Anderson	East Otago Taiāpure Management Committee local commercial fishing and recreational representative
Stanley	Pāua Industry Council Ltd. Chairman (since 2008)
Belton	Southern Clams managing director
Flack	East Otago Taiāpure Management Committee chair and Kāti Huirapa ki Puketeraki Rūnaka representative
Coe	General Manager for Infrastructure for Port Otago Ltd.
Dr. Hepburn and Dr. James (Port Otago Ltd. Aquatic Ecologist)	Port Otago Ltd.'s disposal at Alpha Zero (AO) (2012) Expert Witness Conference.

Appendix E: Reprinted Article

Reprint of: Payne-Harker, H. (in press) Ecosystem services based approaches to resource management and the Resource Management Act 1991. *Journal of Resource Management Theory and Practice* 13.

Ecosystem Services Based Approaches to Resource Management and the Resource Management Act 1991

Introduction

The Resource Management Act 1991 (RMA) was enacted following an extensive law reform effort in which 59 statutes were replaced and brought under a single decision making framework governed by the purpose of sustainable management.¹ New Zealand was one of the pioneering countries to take the international concept of sustainable development and embed it in a statute to manage natural and physical resources.² The concept of sustainable management differed from sustainable development in that it required an effects based approach to be taken to manage the environment.³ The interpretation of sustainable management that was intended has been a matter which has been contested and developed overtime in the courts since the original enactment of the RMA. The concept of ecosystem services⁴ developed in parallel to the concepts of sustainable management and sustainable development⁵ and this stimulates the need for further exploration of how it can be built into planning frameworks in New Zealand to better enable sustainable management to be achieved.

This article first establishes the historical incorporation of ecological principles in the RMA as a basis for investigating how ecosystem services based approaches can be built into planning frameworks. It then establishes the outcomes of using an ecosystem services based approach for planning within a single planning process and draws findings about how the advantageous aspects of the concept can be built into resource management and planning frameworks in New Zealand. It concludes with a broader discussion on how ecological and sustainability theories can be incorporated into resource management in New Zealand. Overall, it is determined that the ecosystem services concept has the potential to improve resource management by building towards a holistic environmental management approach, but that more effort to understand the concept and how it can apply to resource management is needed.

Sustainable development, Ecosystem Services and the Resource Management Act 1991

There has been a global shift towards sustainable development. The concept of sustainable development was introduced through the 1987 World Commission on the Environment's Report, Our Common Future which defines sustainable development as

“development that meets the needs of the present without compromising the ability of future generations to meet their needs”.⁶ The movement towards sustainable development was furthered through the development of Agenda 21 and commitment to a set of 17 goals through the Rio Summit (1992). New Zealand was one of the first countries to take the international concept of sustainable development and embed it in national legislation by enacting the RMA with the single purpose of ‘sustainable management’ in section 5(1).⁷ ⁸ The RMA provides a holistic and integrated framework for the management of natural resources in New Zealand with this purpose.⁹

The definition of sustainable management in the RMA s5(2)¹⁰ has two functions; the first part is the management function and the second is the ecological function.¹¹ According to Upton, at the time that he was leading the passage of the bill through Parliament following the election of the National government in 1994, the framework was to establish a ‘biophysical bottom line’, allowing society to do what was desired so long as RMA section 5(2)(a), (b) and (c)¹² were met.¹³ This interpretation takes the ‘while’ in RMA section 5¹⁴ to mean ‘if’ and treats the management function as subordinate to the ecological function.¹⁵ This establishes an environmental bottom line. However, the approach developed through the courts¹⁶ has been to interpret the ‘while’ as meaning ‘at the same time as’, treating the while as a coordinating conjunction and allowing a balance to be struck between the two functions sustainable management contained in section 5.¹⁷ This article seeks to determine whether ecosystem services assessment can assist in striking this balance, by providing a mechanism for weighing the often ‘competing and indeterminate’ ecological and social interests contained in this section.¹⁸

The ecosystem services concept has its origins in tandem with the sustainable development concept. One of the earliest definition of ecosystem services provided by Costanza et. alia in 1997 is the benefits human populations derive, directly or indirectly, from ecosystem functions.¹⁹ This definition identifies ecosystem services as benefits derived from ecosystem functions. Boyd and Banzhof were the first to shift away from the early definition of ecosystem services as benefits in 2007 by proposing that the ecosystem services are the “components of nature, directly enjoyed, consumed or used to yield human well-being”.²⁰ Fisher, Kerry and Morling further extended this to define ecosystem services as the link between ecosystems and the things that humans benefit from.²¹ The dual focus on human and environmental aspects of the environment which is

provided by the ecosystem services concept suggests that use in planning frameworks may provide a way forward to enable sustainable management to be achieved.

Today, the most widely used definition of ecosystem services is the Millennium Ecosystem Services Assessment (MEA) definition of ‘the direct and indirect benefits that humans derive from the natural environment’.²² The MEA provides an overarching framework for ecosystem services and divides ecosystem services into four main categories; Provisioning services exploited for human use as food or other material resources, regulatory services which regulate essential ecosystem functions, supporting services which underpin other services and provide indirect benefits and cultural services which provide non-material benefits that humans derive from the environment.²³

Alongside the possibility of enabling sustainable management to be achieved in the RMA, ecosystem services could continue to allow ecological concepts to be incorporated into the RMA through building in the assumptions that underpin the ecosystem services concept. A document published by the Ministry for the Environment only two years after its establishment in the Environment Act 1986²⁴ outlines ecological principles for sustainable management, showing clear recognition of concepts such as dynamic steady states and the flow of energy through linked environmental systems.²⁵ Ecosystem services builds on this because it recognises the connections between resources and human systems.²⁶ This ensures that decisions take into account better the functioning of ecosystems based on the most recent understandings within scientific realms. These considerations can often be overlooked in favour of overarching goals of economic growth.²⁷ It is important that this balance is struck given that New Zealand is taking a leading role in demonstrating the use of the sustainable development paradigm within legislation.²⁸

Presently, there is very little direct reference to or use of ecosystem services concept in New Zealand cases and legislation. There are many examples of the holistic and connected approach to understanding ecosystems which the concept encourages. For example, in *Waikato Regional Council v Transfield Services (NZ) Ltd*, Harland J. made clear reference to the downstream impacts from the uncontrolled release of sediment from an upstream source.²⁹ There are examples where similar terms to ecosystem services have been used. For example, ecological values³⁰ were referred to by the appellants in *East Otago Taiāpure Management Committee v Otago Regional Council* in the Environment

Court in regards to *Macrocystis pyrifera* (giant kelp) ecosystem services.³¹ It is possible that ecosystem services based approaches are currently used within New Zealand resource management and planning without direct reference to the concept.

The ecosystem services concept has also had limited use in environmental management New Zealand. The approach was applied to determine the goods and services provided by the Hauraki Gulf in an aquaculture risk assessment for Waikato Regional Council.³² Where applied in New Zealand, the general principles approach has been used to categorise ecosystem services, using ecological principles amongst different ecosystem service categories to determine the delivery of ecosystem goods and services.³³ The evident lack of direct use of ecosystem services in legal contexts and applied environmental management in New Zealand provides further impetus for investigation of how the concept can be used to achieve sustainable management.

Ecosystem Services in the New Zealand Environment Court: Case Study of EOTPMC 2013

This section of the article will use the East Otago Taiāpure as a case study to investigate the advantages and disadvantages of using an ecosystem services based approach for planning and draws findings about how the advantageous aspects of the concept can be built into resource management and planning frameworks in New Zealand.

A taiāpure (local fishery) is a statutory fisheries management tool which is a key component of the fisheries settlement redress. The Fisheries Act 1996 (FA), s74 provides for the making of any area of New Zealand fisheries waters to be a taiāpure provided they have been customarily significant to iwi or hapū as a source of food or for cultural or spiritual reasons, in order to better provide for the recognition of rangatiratanga and rights secured in relation to fisheries by Article II of the Treaty of Waitangi.³⁴ The East Otago Taiāpure was formally gazetted in 1999, following an extensive process of working through community concerns surrounding the application for management.³⁵ The East Otago Taiāpure was put in place to address the concerns of Kaumātua of Kāti Huirapa ki Puketeraki over depleting pāua stocks within their rohe.³⁶ The East Otago Taiāpure Management Committee was established in 2001 to oversee the carrying out of the principles and objectives of the committee.³⁷

The East Otago Taiāpure covers a stretch of 25km of coastline along the East Coast of the South Island of New Zealand. The Taiāpure begins at Ohineamio (Cornish Head) (at

45° 37.28'S and 170° 36.0'E) along a straight line east towards Waiweke (Potato Point) (at 45° 44.42'S and 170° 38.3'E) and then west and north along the mean high water mark.³⁸ The area protected by the Taiāpure contains culturally important species including pāua (abalone, *Haliotis iris*), koura (crayfish, *Jasus edwardsii*), tuaki (cockles, *Austrovenus stutchburyi*), tio (oysters *Tiostrea chilensis*) and finfish like rawaru (blue cod, *Parapercis colias*) and patiki (flounder).¹ The main focus of this article will be on the ecosystem services provided by *Macrocystis pyrifera* (giant kelp), the ecosystem service based management approach applied towards these by the East Otago Taiāpure Management Committee.

M. pyrifera was selected as a focus for the article because of the habitat provision and primary production supporting roles that it plays and the wide range of ecosystem services that it provides.⁴⁰ In particular, *M. pyrifera* can be considered the ultimate provider of services because of its role as an autogenic engineer, transforming its ecosystem through its own growth and playing an integral role in the altered environment.⁴¹ *M. pyrifera* also plays an important role in supporting local fisheries, for pāua, crayfish and finfish by providing food⁴², habitat⁴³ and in indirect roles such as facilitating larval recruitment⁴⁴ Kelp forests provide valuable provisioning services, both for direct harvest and as indirect habitat providers for commercially harvested fish species such as blue cod, red cod as well as rock lobster.⁴⁵ Regulatory ecosystem services provided by *M. pyrifera* include the dampening of waves to reduce coastal erosion⁴⁶, reduction of nutrient runoff⁴⁷ and sediment trapping.⁴⁸ *M. pyrifera* is also of high cultural importance, in supporting mahinga kai (customary interests in traditional food sources)⁴⁹ and by encouraging tourism/recreation and diving activities.⁵⁰

The article will also assess the recognition of the ecosystem services of *M. pyrifera* and the use of an ecosystem services based approach in the Environment Court. The East Otago Taiāpure Committee brought an appeal against the decision of the Otago Regional Council to grant the consent in 2013 under s120 of the RMA⁵¹, which provides parties with the right to appeal to the Environment Court in relation to the decision of a consent authority on an application for a resource consent. East Otago Taiāpure sought to appeal the decision of the Otago Regional Council to grant Consent No: 2010.198⁵², which allowed Port Otago Ltd. to carry out a substantial capital works project to deepen the Port

Otago shipping channel.⁵³ Coastal Permit 2010.198⁵⁴ also sets out conditions for the use of site A0 located approximately 6.3 kilometres north east of Taiaroa Head, a circle with a 1 kilometre radius centred on WGS 84 45° 44' 8" S 170° 47' 56" E (NZTM 2000 4932950N 1428763E) for the disposal of sediment dredged from Otago Harbour. The East Otago Taiāpure Management Committee were primarily concerned with the effects of sedimentation on the *M. pyrifera* beds located within the East Otago Taiāpure.⁵⁵ The key issue was to avoid any discernible adverse effect on the inshore coastal area, and in particular the kelp forests.⁵⁶

Principles of the Ecosystem Services Based Approaches

One of the main principles behind the ecosystem services based approach is that it allows the connections between humans and the environment to be recognised. The ability of the ecosystem services based approach to fulfil this function can be identified through the case study of the management of the Taiāpure by the East Otago Taiāpure Management Committee. There is a very strong and clear recognition of the customary importance of the East Otago Taiāpure site, particularly taking into account that the establishment of the Taiāpure was driven by the desires of Kaumātua of Kāti Huirapa ki Puketeraki to manage depleting pāua stocks within their rohe.⁵⁷ The East Otago Taiāpure is actively used as an educational space. There is a history of the use of the site for school group visits since the establishment of the Taiāpure in 1999. For example, in May 2010 the Taiāpure Committee assisted with plantings and education for a Hui held by EnviroSchools for students from South Island high schools and the University of Otago Marine Science Department also conducts regular educational visits to the Taiāpure.⁵⁸ The ecosystem services based approach can be used to analyse and illustrate the connections between humans and the environment at the site.

Another main principle of the ecosystem services based approach is that it can be used to understand how ecosystems are connected between different components of the environment and how impacts on one aspect of the environment may impact another. This is best demonstrated through the example of the evidence statements of Hepburn⁵⁹ and Gilmour⁶⁰ in the case study of *East Otago Taiāpure Management Committee*. Hepburn⁶¹ primarily identifies the habitat supporting service of *M. pyrifera* and Gilmour⁶² the contribution of this to facilitating the provisional service provided by the lobster. For example, in Hepburn's Environment Court evidence, clear reference is made to *M.*

pyrifer as “critical habitat to support...fisheries”.⁶³ Representative of the Rock lobster industry association Gilmour identifies kelp forests as “important for recruitment” for rock lobsters and emphasises that a core principle of the association is that “lobster habitat is the foundation of (our) industry”.⁶⁴ Hepburn⁶⁵ and Gilmour⁶⁶ are able to connect the provision of habitat with the outcomes for other components of the marine ecosystem, identifying that management to allow these services to be present will ultimately have benefits for the wider environment and other ecosystem components.

Drawing these two advantages of the ecosystem services based approach together, it becomes clear that the ecosystem services based approach can be used to understand the connections between human impacts on a single component of an ecosystem, the flow on effect this may have on other parts of the ecosystem and the subsequent impacts on the ecosystem services which humans rely on from that ecosystem. This is best demonstrated where expert witnesses refer to the impacts of human actions and the resultant outcomes for environment and society. For example, East Otago Taiāpure chair Brendan Flack lists 12 activities that the EOTMC undertake to ‘ensure that future generations have access to Kaimoana’, demonstrating that the EOTMC draw strong links between their activities and actions taken towards the environment and long terms outcomes.⁶⁷ Flack portrays to decision makers not only the positive impacts that humans can have to restore the kelp ecosystem, but also an awareness of how conserving the ecosystem services will provide benefits for people into the future.⁶⁸ The references to the impacts of dumping the dredged sediment within the site and the ability of this to impact the kelp forests of the Taiāpure also completes this chain of connections between human and environmental impacts in relation to the above two examples.

Incorporating the ecosystem services concept into New Zealand’s resource management framework would continue to embed ecological theory into the system and ensure that decisions take into account better the functioning of ecosystems based on a sound understanding of scientific theories. The ability to connect between components of the environment and the services which they provide parallels the model of ecosystem services constructed by Fisher and Turner in 2008 which portrays intermediate and final services as distinct from the benefits which the services generate.⁶⁹ Intermediate services indirectly influence human wellbeing and final services directly contribute to human wellbeing and provide welfare benefits. In this case, the habitat supporting role is the intermediate service and the lobster recruitment is the final service.⁷⁰ The benefit is the

provision of lobster as a food source and a commercial product. Using these theories within planning frameworks could help to recognise services of high importance nationally, as demonstrated by the estimate that New Zealand coastal environments provide important ecosystem services estimated to be worth \$357 US billion per year.⁷¹

The ecosystem services based approach can be used to understand the impacts of human actions on the environment and how this will ultimately impact their own wellbeing in planning decisions. It can also be used to embed this understanding into resource management frameworks. The next section of the article will assess how this effects environmental decision making in the Environment Court and subsequent environmental outcomes, to assess whether the ecosystem services based approach can be used to achieve sustainable management in this setting. It will then discuss how the ecosystem services based approach principles that have been revealed through this research can be embedded in resource management and planning frameworks in New Zealand to better enable sustainable management to be achieved.

Building Ecosystem Services into Resource Management and Planning Frameworks in New Zealand

This article has established that a wide range of ecosystem services of *M. pyrifera* of the East Otago Taiāpure were portrayed by expert witnesses in *East Otago Taiāpure Management Committee*.⁷² It has also set out the value of using the ecosystem services based approach in this context. The next section will answer the question: Did the use of the ecosystem services based concept in this context result in the achievement of sustainable management under the Resource Management Act 1991 in the short term and long term in relation to the coastal environment? The outcomes in relation to the single case study will be analysed to assess the immediate effects of the use of the ecosystem services based approach. The outcomes outside of the case study will be assessed to determine whether the use of ecosystem services based approaches facilitates the achievement of sustainable management beyond a single case and if not what this suggests about the need to incorporate the ecosystem services concept into the RMA framework to achieve sustainable management. The key documents subject to modification in East Otago Taiāpure (2013) were Coastal Permit 2010.198⁷³ and the Draft Environmental Management Plan in 2012.⁷⁴

Coastal Permit 2010.198 was subject to 37 conditions.⁷⁵ Condition 7 requires Port Otago Ltd. to prepare an Environmental Management Plan (EMP) prior to exercising the consent.⁷⁶ The contents of this plan were to include details about the proposed monitoring of the site in accordance with conditions 9, 18 and 36 for Major Capital Works and Incremental Capital Works and a description of the methods to be implemented to manage the disposal at site AO.⁷⁷ Among this set of conditions was also a requirement for baseline monitoring (C9), requirements for consultation to be carried out with Kāi Tahu (C11) and the requirement for a Technical Group to be established with functions specified within condition 12.⁷⁸ Other conditions provided for standard consent processes under the RMA, including providing the consent authority with the ability to serve notice to review the consent conditions within 3 months of the commencement of the consent.⁷⁹

Port Otago produced a Draft Environmental Management Plan in 2012 in accordance with the conditions of the consent, which describes actions that would be taken in relation to events that occurred as a part of dredging, the dredging methodology and provides a detailed Monitoring Plan, list of key positions and an outline of the approach taken to stakeholder engagement, as required by the consent conditions.⁸⁰ Part 10 of the plan outlines the four main components of the Next Generation Project; Deepening and widening the Otago Harbour channel, disposing dredge material at sea, construction a multipurpose wharf platform and placement of a rock revetment to support berths.⁸¹

The final decision of the Environment Court was to grant Coastal Permit 2010.198 with an amendment of the conditions so that a representative area of the wider shoreline coastal environment would be required to be identified for monitoring.⁸² There is strong evidence that the intention behind this was to promote the protection of the *M. pyrifera* of the Taiāpure. For example, Smith J. states:⁸³

[10] The key outcome of the Conditions of Consent is now to recognise under Condition 4(a) that there is to be no discernible effect on the shoreline coastal environment, including the kelp forests. This then focuses much of the rest of the consent in terms of the purposes of monitoring, consultative committees, and other outcomes.

Building Ecosystem Services into Resource Management and Planning Frameworks in New Zealand: Achievement of Sustainable Management within the Case Study

Condition 4(a) was added alongside the requirement to specify minimum depth, maximum volume of material and a requirement for the even distribution of the material

in 4(b), (c) and (d).⁸⁴ The change to the conditions was expected to re-orientate the consent and the subsequent management of the dredge disposal towards protection of *M. pyrifera*. This provides very strong evidence that the use of ecosystem services by expert witnesses in the case and the drawing of connections between the *M. pyrifera* and human impacts and outcomes has resulted in improved outcomes for the kelp at the East Otago Taiāpure site, by ensuring that the consent is better orientated towards their management and protection.

The next indication of the extent to which using the ecosystem services based approach in expert witness statements has resulted in improved outcomes for the kelp beds of the East Otago Taiāpure is to consider whether the requirements of condition 4(a) are reflected in the draft Environmental Management Plan (2012)⁸⁵ which is required to be prepared by condition 7 of Coastal Permit 2010.198.⁸⁶ The monitoring of kelp forests is explicitly referred to in the EMP (2012) under Biological Monitoring B(2)(b)(i) which states that “information about meaningful parameters” shall be gathered at “a representative area of shoreline and associated kelp forest between Shag Point and Cornish Point” as well as “sites near Shag Point and Pipikaretu Point as control sites under 2B(b)(ii).⁸⁷ The aim of this monitoring as specified in 3(a) is to provide a clear understanding of the degree and extent of impacts to a standard that enables decisive and timely decisions about dredge disposal management.⁸⁸ In the short term, the use of ecosystem services in the court case and the addition of the conditions to the consent have resulted in improved outcomes for the *M. pyrifera* beds.

In answer to the question above, the use of the ecosystem services based concept has been successful in allowing for sustainable management to be achieved. In this case, the ecosystem services provided by *M. pyrifera* have been made clear by expert witnesses, the dependencies on the kelp beds and the wider environment have been identified by the decision maker and the consent has been re-orientated to provide for the protection of *M. pyrifera* and the services that it provides. This is reflected by changes to the monitoring approach taken by Port Otago Ltd.

Building Ecosystem Services into Resource Management and Planning Frameworks in New Zealand: Achievement of Sustainable Management Beyond the Case Study

The most recent Port Otago EMP can also be examined to provide an indication of the extent to which the ecosystem services based approach to management is being

implemented by the port following the court case, outside of the requirements in the case itself. In particular, it is worthwhile to compare the most recent EMP⁸⁹ to the EMP⁹⁰ that was produced immediately after the case to see how the management of the port has evolved. The main change to note is the addition of appendix 4: Technical Brief, Kelp Forest Monitoring Program Revision 3.⁹¹ The ecosystem services of the kelp beds are provided recognition in the monitoring program as shown by the following extract:⁹²

“The kelp beds are recognised for their importance as a habitat for a wide variety of marine life and in particular pāua, kina and fish species that are important taonga species for Kāi Tahu”.

This provides evidence that the use of ecosystem services in the East Otago Taiāpure (2013) has resulted in a long term change to the way that the ecosystem is managed and assisted in allowing for sustainable management to be achieved. However, the assessment of ecological effects that was prepared as part of the AEE for the dredging disposal application in June 2016 clearly states that “Monitoring of kelp forests and rocky reef benthos around Blueskin Bay seems unwarranted unless sediment plumes generated during dredging operations increased”.⁹³ Alongside this recommendation, the potential effects of the disposal on kelp beds is assessed in section 3.3.3 of the report. This does not demonstrate the recognition of the kelp and the monitoring that was implemented subsequent to East Otago Taiāpure (2013) which has been demonstrated in the above analysis. The East Otago Taiāpure continue to be “concerned about habitats that provide for the taiāpure” through the process.⁹⁴ This provides an indication that the decision of East Otago Taiāpure has not resulted in a long term change to the environmental management and recognition of the importance of *M. pyrifera* beyond the requirements in the case. Therefore, the use of ecosystem services in planning processes may have a limited impact on the long term achievement of sustainable management in the RMA.⁹⁵

Achieving Sustainable Management and the Ecosystem Services Based Approach

This article has demonstrated that ecosystem services can be used to understand the connections between humans and the environment and environmental components. It has also shown that reference to ecosystem services within planning processes can demonstrate these connections, forming an understanding of the connections between human impacts on the environment, environmental components and flow on impacts to human welfare. Therefore, sustainable management can be achieved because decisions

which provide for both the management and the ecological functions in RMA section 5.⁹⁶

⁹⁷ These are promoted in the short term through a change of management actions, but may not be perpetuated in the long term. The question that remains is how sustainable management can be achieved in the long term through use of the ecosystem services concept?

The main conclusion that can be drawn about ecosystem services and achieving sustainable management in the long term is that there is a need to clarify concepts relating to sustainable management before attempts are made to incorporate them into the Resource Management Act 1991 and planning frameworks. In *East Otago Taiāpure Management Committee*⁹⁸, there were clearly contrasting understandings of what constituted sustainable management. For example, a Port Otago Limited stakeholder states:⁹⁹

This project is very important for port, city and wider region. It is essential to undertake the project if Port Otago is to provide and operate an efficient and competitive port in future

This demonstrates a weak sustainability approach, where the environment is managed in a way which places the economy in parallel with environment and society in decisions.¹⁰⁰

In contrast, East Otago Taiāpure member states: ¹⁰¹

I'd say it has to do with environmental capital. It has to do with social capital, those two things. And certainly cultural capital. So you've got these 3 biggies, I don't know about the financial, economic.

This demonstrates a strong approach to sustainability, which assumes that economy and society are constrained by environmental limits and that natural capital cannot be exchanged for man-made capital.¹⁰²

Overall, an inherent tension in achieving sustainable management is revealed through this article; unclarity about what is sought to be achieved in regards to sustainability. This same conclusion can be drawn for the ecosystem services concept, which developed in the same era as the sustainable development paradigm.¹⁰³ These concepts will require clarification as they continue to be built into resource management frameworks. Building an understanding of ecosystem services outside of the RMA framework and within society could also help to directly achieve sustainable management, by illustrating the connections between people and the environment and allowing resource managers and society to understand the dependency of humans on nature.¹⁰⁴ In this way, the concept of ecosystem services can be used to directly build towards a strong sustainability model.¹⁰⁵

This article has drawn out some of the key principles behind the approach, to further the development of the understanding and the way that the concept can be used in New Zealand resource management. Given the increasing and wide variety of threats that environments are now facing, investigating the merit of ecosystem services in resource management in the New Zealand context is now becoming increasingly important.

Ecosystem Services and the New Zealand Coastal Policy Statement (2010)

There are opportunities to build the ecosystem services concept into coastal management frameworks to promote a more holistic form of coastal management, which recognises the connections between humans and the environment and environmental components. The decision of the Supreme Court in *Environmental Defence Society v Marlborough District Council* [2014] that ‘avoid’ in the NZCPS has its ordinary meaning of ‘not allow’ or ‘prevent the occurrence of’ could have meaning for the integration of ecosystem services into the NZCPS.¹⁰⁶ If provision was made to avoid impacts on ecosystem services within the NZCPS¹⁰⁷, this would set a strong direction to avoid impacts on ecosystem services. Following the conclusions that have been drawn about ecosystem services in this article, this would be providing not only to avoid impacts on the ecosystem, but to avoid the flow on effects for human welfare. In this respect, building ecosystem services into the NZCPS 2010¹⁰⁸ could help to achieve sustainable management, balancing the ‘competing and indeterminate’ ecological and social interests contained in this section.¹⁰⁹

Ecosystem services also assists with embedding ecological concepts into the NZCPS 2010¹¹⁰. In particular, the use of the concept builds on the direction to “safeguard the integrity, form, functioning and resilience of the coastal environment and sustain its ecosystems, including marine and intertidal areas, estuaries, dunes and land” contained in Objective 1.¹¹¹ This is particularly important because coastal marine ecosystem services are considered to be unique because of the cumulative benefits they provide as conduits between different environments.¹¹² Therefore, ecosystem services has the ability to highlight and provide for the interconnected nature of the coastal ecosystem.

Conclusion

The Resource Management Act 1991 and pursuant planning framework currently does not incorporate the ecosystem services based approach to management. The result is that the understanding of the connections between management actions, impacts on

ecosystems and the services they provide and the outcomes for human welfare are not commonly recognised in management decisions. Incorporation of the concept would help to balance ecological and societal needs and to achieve sustainable management. This article has illustrated several advantages to incorporating the ecosystem services based approach into the Resource Management framework, including; recognising connections between humans and the environment, connections between different components of the environment and the flow on impacts of human actions on societal wellbeing. It has also established that the definition of ecosystem services needs to be further clarified before it is incorporated into the Resource Management Act 1991 framework, drawing on lessons from the use of related concepts in the Act. Finally, it has shown how incorporation of ecosystem services into the RMA framework would assist in continuing to embed best practice resource management principles into the Act, building on the historical development of the Act and the intentions for a strong theoretical ecological grounding in the Act.

Notes

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