Motivators, Barriers and Enablers of Biodiversity Protection in Mōtū New Zealand

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Abstract

Despite one-third of New Zealand's land being protected under public conservation estate, the country is facing significant biodiversity loss. Much of the remaining flora and fauna in New Zealand exists within the public conservation estate. However, remaining indigenous vegetation on private land can be representative of land environments that have been heavily deforested, providing an opportunity to protect biodiversity that is underrepresented within the public conservation estate. A critical step towards protecting biodiversity on private land is to understand the current level of protection, and associated conservation behaviours. Understanding landowners' and managers' perceived motivators, barriers, and enablers of biodiversity protection is a key step towards ensuring positive behavioural change. A case study using the Mōtū catchment, located in the East Coast of the North Island of New Zealand was used for this research. Surveys and interviews underpinned by the Theory of Planned Behaviour were used to collect data on the motivators, barriers, and enablers of biodiversity protection along with information on the current level of engagement in biodiversity protection in the catchment.

The research found that respondents were motivated less by financial, economic and social factors and more by conservation and lifestyle motivations, emphasising the strong environmental stewardship ethic of respondents. Lack of resourcing and labour were found to act as strong conservation barriers along with financial impediments. Critical enabling factors were personal motivation and financial and economic incentives while government environmental regulation and environmental management plans were found to be the least important enablers for biodiversity protection. The Theory of Planned Behaviour was used to explain the results of this research. Negative perceived control factors in the form of financial and resource constraints, and positive perceived control factors in the form of financial assistance were found to either prevent or stimulate participation. On the basis of the empirical evidence provided by this study, governments and policy makers would be advised to harness the motivations of private landowners and take into account their perceived motivators, barriers, and enablers when designing conservation programs. Conservation programs need to consider private landowners and managers environmental stewardship motivations and the need for financial incentives to push behavioural intention towards action.

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List of Abbreviations

BMP's	Best Management Practices
BOPRC	Bay of Plenty Regional Council
DOC	Department of Conservation
GDC	Gisborne District Council
MfE	Ministry for the Environment
NPS-FM	National Policy Statement for Freshwater Management
PF2050	Predator Free 2050
PMAs	Protected Managed Areas
QEII	Queen Elizabeth the Second
RMA	Resource Management Act
TB	Tuberculosis
TPB	Theory of Planned Behaviour

1 Chapter 1: Background

1.1 Introduction

Indigenous biodiversity is essential not only for intrinsic conservation and cultural purposes but also for the sustainability of New Zealand's ecosystems (Fairweather & Campbell, 2003). The continuing decline of indigenous biodiversity in New Zealand (Brown et al., 2015; MfE & Stats NZ, 2021) poses a significant management challenge due to degrading habitat quality and the ubiquitous nature of invasive species, which are detrimental across all landscapes (Maseyk et al., 2021). Between 1996 and 2012, New Zealand experienced the clearance of 31000 ha of tussock, 24000 ha of indigenous shrubland, and 16000 ha of indigenous forest with a further 12869 ha of indigenous vegetation cleared between 2012 and 2018 (MfE & Stats NZ, 2021; Monks et al., 2019). Ongoing clearance of indigenous vegetation is likely to have implications beyond what is currently being experienced as functionally extinct patches of indigenous vegetation senesce (Monks et al., 2019; Tilman et al., 1994).

While public conservation estates in New Zealand are relatively well looked after, private landowners and land managers provide a unique opportunity to protect indigenous biodiversity that is underrepresented within the public conservation estate. Despite approximately 56% of New Zealand's land being held in private ownership, only 10% (1500 000 hectares) of this land is protected through legal means, compared to the eight million hectares of publicly owned land under legal protection (Environment Guide, 2018; Pannell et al., 2021). Although thirty-two percent of New Zealand’s land area is in public conservation estate, this land is biased towards high elevation vegetation types and poorly represents lowland areas (Cieraad et al., 2015; Monks et al., 2019; Pannell et al., 2021).

The presence of rare and threatened species on private land is also contributing to the underrepresentation of indigenous species on conservation land. Private land contains a quarter of the remaining indigenous vegetation in New Zealand including threatened and rare biodiversity, with some species only being found on private land making the contribution of this land critical to the integrity of landscape-scale ecology (Brown et al., 2015; Environment Guide, 2018; Holdaway et al., 2012; Monks et al., 2019; Pannell et al., 2021). Alongside this, some of the habitat types within the public conservation estate rely on the remaining fragments of habitat on private land for their survival, especially in agricultural areas (Environment Guide, 2018; Monks et al., 2019; Pannell et al., 2021). This represents a significant gap in the management of biodiversity in New Zealand and highlights the need to encourage and stimulate more conservation action on private land.

How private land is managed has implications for biodiversity protection at a national level, and therefore landowners and managers have a critical role to play (Hanley et al., 2012; Maseyk et al., 2021). In New Zealand, there are currently few nationwide schemes or incentives that support the protection of biodiversity on land held outside of the public conservation estate, or where they do exist, they lack the compliance and monitoring necessary to achieve objectives (Brown et al., 2015; Norton & Cochrane, 2000). Biodiversity protection and restoration is also often unrewarded as it is not well priced into economics in New Zealand. This means that in the case of land outside of

the public conservation estate, the opportunity cost of protecting and restoring biodiversity such as the loss of benefit of productive agricultural land can deter owners and managers from investing in the protection of biodiversity (Hanley et al., 2012). Therefore, there is a reliance on private landowners and managers to voluntarily display pro-biodiversity practices.

Landowners' knowledge relating to the ecological value of remaining patches of indigenous vegetation on private land is critical and while some have sought to protect their remaining patches through covenants, others are unaware of the value of these patches from a biodiversity perspective and continue to clear land. The land cleared is often mostly small fragmented patches which can be important for maintaining indigenous biota through linkages within the ecological landscape (Monks et al., 2019). Alongside knowledge, other factors, influenced by personal perspectives and values, may impact on perceived motivations and the uptake of conservation practices, including lifestyle, social, political, and economic factors, (Greiner & Gregg, 2011; Maseyk et al., 2021; Pannell et al., 2006). Whilst a growing body of literature (Greiner, 2015a; Greiner & Gregg, 2011; Maseyk et al., 2021) suggests that private landowners are looking for financial incentives as enablers to protect and restore biodiversity, it is hypothesised that this situation is more complex. Therefore, this research seeks to understand what are the motivators, barriers, and enablers of biodiversity protection from a New Zealand landowner and land manager perspective. Conservation problems have been linked with human behavioural problems; therefore, a better understanding of conservation behaviours is necessary (Reddy et al., 2017). Acquiring this understanding can help to stimulate much-needed conservation action on private land to close the gap of conservation efforts between public and private estates in New Zealand.

This research uses the Mōtū catchment on the East Coast of the North Island of New Zealand as a case study area to explore the perceived motivators, barriers, and enablers of biodiversity protection. The Mōtū catchment is 312 745 ha in size and supports a wide variety of land use and tenure types, including sheep and beef farming, dairy farming, plantation forestry, indigenous forestry along with conservation estates, private land, and land under legal protection. The Mōtū catchment is used to highlight the importance of biodiversity on private land, alongside the problems associated with its presence on private land and this investigation determines the approaches to address such problems. The results of this research should illuminate perceptions of the important factors influencing motivations, barriers, and enablers of biodiversity protection and highlight what management actions are needed to stimulate participation in conservation actions on private land. Understanding conservation behaviours is essential to being able to adequately inform future policy initiatives, biodiversity protection tools, and guide conservation management towards a tailored approach that will increase pro-biodiversity behaviours.

1.2 Biodiversity

Biodiversity provides life-supporting systems that enable organisms, including humans, to survive and is critical in supporting our natural environment (Czajkowski et al., 2009; Stewart, 2015). The meaning of biodiversity will differ depending on the perspective. For example, gardeners, ecologists, economists, miners, and researchers may perceive the meaning differently (National Research Council, 1999). While there are various definitions, one that is frequently referred to in literature evolves from Article Two from the Convention on Biological Diversity at the United

Nations, Rio de Janeiro 1992 Conference on the Environment and Development (Czajkowski et al., 2009; DeLong, 1996). This definition refers to biodiversity as the following:

> Biological diversity means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part of; this includes diversity within species, between species and of ecosystems" (United Nations, 1992, p. 3).

While biodiversity encapsulates global diversity, endemic biodiversity is found nowhere else in the world and is important to the culture, society, economy, and environment of a landscape (Langton & Rhea, 2005). Biodiversity in New Zealand contributes significantly to global biodiversity since many of its plants and animals are endemic (Yao & Kaval, 2009) and New Zealand is internationally recognised as a biodiversity hotspot (Department of Conservation [DOC], 2020). New Zealand's landscapes are also diverse which has allowed for a substantial range of ecosystems to develop involving 152 major ecosystems, and 71 rare ecosystems all with distinct plants and animals (Singers & Rogers, 2014).

Despite New Zealand having a high number of endemic species, it has experienced one of the highest percentages of biodiversity loss in the world (Hitchmough et al., 2007). The presence of invasive pests is contributing to the rapid decline of ecosystems and has contributed to the extinction of 79 species (DOC, 2020; Ministry for the Environment [MfE], 2020). There are approximately 4000 species threatened or at risk of extinction in New Zealand, which equates to 80 percent of reptiles, bats, birds, and frogs (MfE, 2020). Over the past millennium, 90 percent of New Zealand's wetlands and 75 percent of forest resources have also disappeared (Ewers et al., 2006; Yao & Kaval, 2009). The lack of defence against mammalian predators makes New Zealand's endemic species vulnerable to pests meaning their protection is critical (Parliamentary Commissioner for the Environment [PCE], 2016).

The protection of biodiversity is also essential as it provides humans and society with considerable benefits in the form of ecosystem services, including water purification, soil fertility, carbon sequestration, erosion control, and pollination (Cardinale et al., 2012; Daily, 2003; National Research Council, 1999; Yao & Kaval, 2009). As humans, we rely on ecosystem services; however, the relationship between biodiversity and ecosystem services means that when biodiversity is diminished, so too are ecosystem services (Daily, 2003; National Research Council, 1999). While it is uncertain which species are essential for which services, higher levels of species diversity increases the likelihood that ecosystem services will be maintained (Mace et al., 2012). Despite the numerous benefits biodiversity provides to society, we have been left with the consequences of previous and current decisions that have resulted in its losses (Costanza et al., 1998; Daily, 2003; Duraiappah et al., 2005; Yao & Kaval, 2009). Considering biodiversity is the generator of almost all of the ecosystem service functions it is important to ensure species and ecosystem diversity is maintained in New Zealand (Cardinale et al., 2012; Mace et al., 2012).

While New Zealand has one of the highest protected land areas for any country globally at around 30%, this figure hides the bias towards mountainous areas and the exclusion of many lowland environments (Monks et al., 2019; Norton, 2000; Pannell et al., 2021). Less than 20% of all land within the New Zealand public conservation estate is below 500m, while more than 50% is above

500m (Norton, 2000). These disproportionate figures result from lowland environments' high economic and productive value, meaning many ecosystem types within lowland New Zealand have been almost lost (Monks et al., 2019; Norton, 2000; Pannell et al., 2021). This represents a significant gap in the public conservation estate where the proportion of conservation land is not equally distributed across environments and is biased towards higher altitudes. The underrepresentation of indigenous vegetation on lowland environments is an important gap that needs to be addressed if species diversity and the benefits of ecosystem services are to be maintained.

New Zealand's lowland ecosystems are dominated by agricultural land and exotic species, but also contain indigenous species often found in remnant patches with these types of indigenous species being less prevalent in higher altitude environments (Monks et al., 2019; Norton & Cochrane, 2000). Such lowland vegetation types are underrepresented within the public conservation estate, and the value of remaining lowland patches of indigenous vegetation is high; with 20% of lowland vascular plants occurring only on private land (Norton 2000). However, the remaining indigenous vegetation on private land is often comprised of many scattered small patches, often of poor quality (Norton, 2000). This highlights that even though New Zealand has a high proportion of land within the public conservation estate, this is disproportionate of ecosystem types, and the need to protect what is remaining on lowland New Zealand is imperative.

While a gap exists regarding the protection of indigenous biodiversity on private land, closing this gap has the potential to increase indigenous biodiversity that is underrepresented within the public conservation estate and increase all of the associated ecosystem and biodiversity benefits (Norton & Cochrane, 2000). An opportunity also exists to generate benefits to the agricultural land on which these patches are found, whereby biodiversity acts as the basis of agricultural and food systems through ecosystem services (Mace et al., 2012; Maseyk et al., 2021). An increase in all of the ecosystem and biodiversity benefits can be achieved if remaining scattered patches of poor-quality indigenous vegetation are linked into a mosaic and by ensuring their physical qualities are improved (Dominati et al., 2019; Gómez-Creutzberg et al., 2020).

Despite attempts already being made to protect and restore biodiversity outside of the conservation estate in New Zealand, the current system is complex (DOC, 2020; Norton & Cochrane, 2000). The current system includes legislation, governance, science, and monitoring and is delivered via a range of players, all with different roles and responsibilities (DOC, 2020). Along with an overall lack of coordination between tools and agencies, the system lacks coordination between public and private land management in New Zealand (Norton & Cochrane, 2000; Willis, 2017). The lack of cohesive prioritisation in New Zealand's biodiversity system and overlaps and gaps between the agencies involved creates challenges for biodiversity protection (Department of Conservation [DOC], 2019; Norton & Cochrane, 2000; Willis, 2017). One of these gaps is the lack of cohesive management approaches for public and private land.

1.3 Problem statement

The context for this research topic is the current interest and importance of biodiversity protection to minimise the loss of ecosystems and ecosystem services in New Zealand.

The dangers posed by the loss of indigenous habitats and ecosystems is genuine and will require a significant change in management actions at both public and private levels. Since it is expected that understanding the motivators, barriers, and enablers of biodiversity protection will help to play an essential role in creating targeted management approaches for biodiversity protection, perceptions must be assessed individually across different land use and ownership types. Early on in this research, a review of the literature was used to determine and identify the most significant gaps in biodiversity protection and found that New Zealand was lacking a comprehensive understanding of the perceived motivators, barriers, and enablers of biodiversity protection on private land. Acquiring this knowledge can be used to understand how to help protect and enhance biodiversity on private land and address the gap between the protection of indigenous biodiversity on public versus private land in New Zealand. The review of available literature identified and determined the gaps that exist.

1.4 Aim

The purpose of this research is to determine the perceived motivators, barriers, and enablers of biodiversity protection on private land using an example catchment. The specific research aims are to:

- Outline the benefits of understanding perceptions around biodiversity protection in New Zealand;
- Identify the perceived motivators, barriers, and enablers of biodiversity protection on private land in New Zealand;
- Determine the management activities that are required to successfully protect indigenous biodiversity on private land in New Zealand; and,
- Provide information that will assist in the creation of successful biodiversity protection management activities, including how to get private landowners to participate in biodiversity protection activities.

1.5 Research Question and Objectives

This study was conducted to answer the following research question:

- What are the motivators, barriers, and enablers of biodiversity protection for people in the Mōtū catchment, New Zealand?

To answer the research question, three objectives were formulated:

1. To understand the need for biodiversity protection on private land in New Zealand and identify the management activities required to protect biodiversity.

2. To identify the perceived motivators, barriers, and enablers of action to understand how to get private landowners to participate in management activities to support biodiversity protection in the Mōtū catchment.

3. To determine the most appropriate approach for the future management of biodiversity in the Mōtū catchment.

1.6 Thesis Outline

Chapter One provides background information on biodiversity in New Zealand, the problem statement for this research, aims and objectives.

Chapter Two uses a literature review to gather information on the importance of protecting biodiversity in New Zealand, its value on private land, the implications of habitat fragmentation and biodiversity protection in New Zealand. The importance of understanding motivators, barriers, and enablers and how this can impact the adoption of conservation practices is highlighted.

Chapter Three outlines the case study description, examining the history of the Mōtū catchment and the environmental and biodiversity-related changes over time. The extent of flora and fauna in the catchment is discussed, along with current land cover and land use activities.

Chapter Four describes the methods used for data collection and analysis, the case study participants, and design of survey and interview instruments.

Chapter Five presents the findings of this research, including the results of the survey and interview data.

Chapter Six discusses the findings in relation to the theoretical background, conceptual framework, and broader literature around the perceptions of biodiversity protection in terms of factors that act as motivators, barriers, and enablers.

Chapter Seven reflects on the research as a whole and concludes this thesis. Recommendations are also outlined, which integrate the perceived motivators, barriers, and enablers of biodiversity protection with scientific literature and suggest future research areas.

2 Chapter 2: Literature Review

2.1 Introduction

A literature review relating to biodiversity and its protection on private land is presented across the six sections in this Chapter. The first section addresses biodiversity on private land, outlining its quality, importance, and need for protection. Section two addresses habitat quality in more detail and covers the role of habitat loss, habitat fragmentation, patch isolation, patch size, and animal and plant pests in relation to the quality of biodiversity. The third section reviews current management actions to address problems associated with biodiversity on private land. Section four reviews the adoption of conservation practices and how this affects the quality of biodiversity on private land. The fifth section determines how understanding perspectives on conservation behaviours can assist in the creation of management approaches, followed by an outline of the conceptual model of conservation adoption in section six. The final section summarises the key findings from the literature.

2.2 Managing Biodiversity on Private Land

When assessing the state and extent of indigenous biodiversity on privately owned land in New Zealand, it is important first to gauge land use. The most extensive land-use type in New Zealand is sheep and beef farming, accounting for approximately 40% of the total land area (Norton & Pannell, 2018). Public conservation land is the second most extensive land-use type, covering 31%, while dairy farming equates to 10%, plantation forestry 7%, and urban areas accounting for less than 1% (Norton & Pannell, 2018). Approximately 30% of all land area in New Zealand is within the public conservation estate, making the country the fifth highest globally in terms of protected areas (Norton, 2001). Despite this, there are stark imbalances between conservation efforts on lowland and higher altitude environments in New Zealand (Norton, 2001). Policy changes have an essential influence on the representation of indigenous vegetation on private land. The removal of government subsidies for land development in the 1980s meant that it was no longer viable for many farmers to clear regenerating forest on their land. As a result, remaining indigenous vegetation on farms differs, with some retaining old-growth forests, while others are dominated by early successional species (Pannell et al., 2021). Knowing where biodiversity occurs in a landscape is the first step to maintaining and improving it, and thus designing optimal landscape corridors.

The representation of indigenous vegetation across land-use types in New Zealand differs, yet lower representation does not necessarily equate to a lesser value. Indigenous vegetation covers approximately 43% of the total land area in New Zealand, with 25% of this being found on sheep and beef farms (Maseyk et al., 2018; Norton & Pannell, 2018; Pannell et al., 2021). In the Gisborne Region, 31% of the land is comprised of woody vegetation, yet, 53% of this is found on sheep and beef farms alone, while only 28% is found on public conservation land (Norton & Pannell, 2018). Leathwick (2001) and Norton and Pannell (2018) argue that remnant patches of indigenous vegetation on private land can represent land environments that have been heavily deforested and thus nationally underrepresented in conservation estates.

While these studies (Maseyk et al., 2018; Norton & Pannell, 2018) do not provide a breakdown of the type of vegetation or its quality, they support the need for protection of remaining indigenous vegetation on private land because of its contribution to underrepresented indigenous vegetation types. Despite emphasising the need for protection, a lack of robust engagement with landowners and managers to understand perspectives on biodiversity protection on private land in New Zealand is limited in the literature.

Currently, there is a gap in the management of biodiversity on private land in New Zealand whereby the government does not currently have a robust mechanism to influence private landowners or managers to take action. While recognition of the importance of indigenous vegetation on private land exists, the protection of this vegetation is usually voluntary and, therefore, might not occur in the places that best benefit the overall pattern of biodiversity. The protection of these remaining patches should be focused on improving the quality and connectivity of remnant patches to improve biodiversity (Maseyk et al., 2021; Norton & Pannell, 2018). While these studies focus on sheep and beef farms, they highlight an important gap in the literature, exposing the need to better understand the methods of voluntary conservation efforts on private land to ensure that vegetation types underrepresented in the public conservation estate are protected.

2.2.1 Habitat Quality

When considering how to protect biodiversity on private land, it is important to identify the problem areas and address them through management actions. Human interference and the fragmentation of once continuous natural habitats has created dispersal barriers for many species and endangered the future of many others (Olff & Ritchie, 2002). Habitat fragmentation is often defined in terms of "A large expanse of habitat [that] is transformed into a number of smaller patches of smaller total area, isolated from each other by a matrix of habitats unlike the original" (Wilcove et al., 1986, p. 237).

The effects of habitat fragmentation on biodiversity can be significant and diverse, yet this significance can be challenging to quantify. Fahrig (2003) concluded that while the effects of habitat fragmentation are significant, there is no consistent measure of fragmentation. Some studies (Carlson & Hartman, 2001; Fuller, 2001; Summerville & Crist, 2001; Virgós, 2001) measured fragmentation variously as the amount of habitat remaining on the landscape, while others (Bowers & Dooley, 1999; Laurance et al., 2001; Mac Nally & Brown, 2001; Morato & Campos, 2000; Walters et al., 1999) measured the comparison of aspects of biodiversity at reference sites within a continuous landscape versus a fragmented landscape. Despite differences in the ways of measuring fragmentation, Fahrig (2003) concluded that these studies revealed fragmentation to have adverse effects on biodiversity. The adverse effects of fragmentation and habitat loss directly relate to biodiversity measures such as species richness, genetic diversity, population abundance and distribution (Gibbs, 2001; Gurd et al., 2001; Krauss et al., 2010; Schmiegelow & Mönkkönen, 2002). Considering the direct link to biodiversity measures, one can assume that in the case of New Zealand, habitat fragmentation has had a negative impact on biodiversity.

An understanding of how fragmentation impacts biodiversity requires an understanding of patch characteristics. Patch isolation deals with the spatial and temporal context of the habitat patch

(Fahrig, 2013), while habitat loss measures the lack of habitat in a landscape surrounding a patch (Fahrig, 2003). Patch isolation has been found to negatively impact biodiversity, whereby the more isolated the patch, the more significant the impact (McCoy & Mushinsky, 1999; Rukke, 2000; Virgós, 2001; Wilson et al., 2016). It has been found that the dynamics of plant and animal populations in a patch are influenced by their proximity to other patches containing subpopulations of the same or competing species (Bender et al., 2003; Fahrig, 2003; Kareiva, 1990). This is supported by claims that patch isolation explains why fragmented habitats usually contain fewer bird species in comparison to continuous habitats (Dickman, 1987; Forman et al., 1976; Helliwell, 1976; Moore & Hooper, 1975). Specifically, as habitat becomes fragmented and lost, patches become more isolated from each other over space and time (Fahrig, 2003). This is important to consider relative to biodiversity protection, as when this happens, biodiversity can suffer immediate consequences through the disruption of movement patterns, which can result in the isolation of individual and local populations.

Habitat fragmentation has important metapopulation consequences that should be considered when assessing the importance of biodiversity protection in certain areas. Because fragmented habitat can be relatively small and thus support fewer individuals, there is likely to be fewer within patch intra-specific interaction opportunities (Hanski & Ovaskainen, 2000). While this is concerning, it may not be a problem for individual species and the persistence of populations if movement among habitat patches is maintained through matrix connectivity (Hanski & Ovaskainen, 2000). However, if the ability for movement between patches is impeded or prevented through further loss of habitat patches, then individual species and populations of species within a landscape may become functionally isolated (Hanski & Ovaskainen, 2000).

Differences in food supply have been found to influence the territory size of North Island Brown Kiwi whereby territories that included preferred habitat of indigenous vegetation were smaller than the territories of those whose habitat include less indigenous vegetation (McLennan et al., 1987; Taborsky & Taborsky, 1995). If patches of indigenous vegetation are to support small populations of kiwi, 500 ha is the minimum area needed, and this needs to be supported by nearby suitable habitat where kiwi can disperse (McLennan et al., 1987; Sporle, 2017; Taborsky & Taborsky, 1995). In contrast weka have adapted themselves to various conditions wherever water and cover are sufficient (Carpenter et al., 2021; Carroll, 1963). An important feature of their habitat is the presence of riparian margins and sedges which provide dense cover while not hindering the rapid movement of the weka (Carpenter et al., 2021; Carroll, 1963).

While the isolation of patches affects biodiversity and species movement, so too does patch size. Some species have minimum patch size requirements; therefore, smaller patches will usually contain fewer species. Larger patches equate to more species and larger populations of individual species due to more resources (Collinge, 2009; Haddad et al., 2015; McLennan et al., 1987; Ng et al., 2020; Noss, 2012; Taborsky & Taborsky, 1995). As a result, there has been a focus on conservation efforts of larger patches with high levels of landscape connectivity (Carpenter et al., 2021; Lindenmayer, 2019; Watson et al., 2018). Overall, there is a strong consensus that smaller patches may be of less value to most species; however, they are valuable in maintaining connectivity, and for that reason, their protection is paramount. It is important to consider that despite a conservation focus on larger patches due to their value for individual species, the value of these larger patches may be maintained by connections from smaller remnant patches.

Patch isolation has been found to play a crucial role in the island biogeographic theory (MacArthur & Wilson, 2001) and metapopulation theory (Hanski & Gilpin, 1991). Island biogeography theory promotes the conservation of large patches; however, it can also support the protection of small habitat patches (MacArthur & Wilson, 2001). This theory assumes that there may be concentration effects on species in highly fragmented landscapes as species may retreat from surrounding poor quality landscape and then become confined to remaining small patches (Driscoll et al., 2013; MacArthur & Wilson, 2001). Many species would be lost among landscapes if no attention was to be given to the protection and conservation of remnant patches as they may be all that remain in heavily modified landscapes (Erwin et al., 1995; Fischer & Lindenmayer, 2002; Flaspohler et al., 2010; Kirkpatrick & Gilfedder, 1995; Le Roux et al., 2015; Manning et al., 2006; Ogle, 1987; Wintle et al., 2019).

The protection of remaining patches of indigenous vegetation should be a priority for biodiversity protection due to their connectivity value. Contrary to the island biogeography theory, Wintle et al. (2019) assessed the relationship between the conservation value of habitat patches and their size and isolation, and found that small, relatively isolated habitat patches in fragmented landscapes tend to be of higher conservation value. Wintle et al. (2019) emphasised that the conservation value decreases as patch size increases and the surrounding landscape's intactness increases. Understanding the conservation value of patches is significant for the success of biodiversity conservation. Generally, conservation planning deprioritises the conservation of small isolated patches as it is assumed they are of little ecological value (Wintle et al., 2019). However, Wintle et al. (2019) noted that if we were to give up these small isolated patches, many species would be lost, and biodiversity would decline as a result.

With the value of small, isolated patches being significant, the restoration and reconnection of these patches through linkages that connect to form an overall habitat matrix is essential (Bennett, 1999). Linkages are important for the overall value of remaining patches and can help to retain indigenous biodiversity on private land (Gascon et al., 1999). To maintain a reasonable level of biodiversity globally, 25 to 75% of major ecosystems need to be retained (Baillie & Zhang, 2018; Dinerstein et al., 2017; Pimm et al., 2018; Wilson et al., 2016). While the estimates vary, a recent estimate proposed by Dinerstein et al. (2019) emphasised 30% as a reasonable threshold. Given ongoing land development and anthropogenic pressures, the reality of securing large and intact landscapes for conservation is unlikely (Ng et al., 2020). As approximately 20% of remaining lowland vascular plants are only on private land (Norton, 2000), protecting these is even more important to ensure the retained level of biodiversity is representative of all ecosystem types. With the reality of securing large patches being unlikely, a shift towards protecting and conserving smaller patches, including patches on private land, is necessary.

The presence of weeds is an important consideration as they affect the quality and extent of remaining patches of indigenous vegetation on private land. Weeds in New Zealand reduce the quality of biodiversity by smothering native plants and reducing the quality of patches of indigenous vegetation (Barberi et al., 2010). Weeds are a serious problem to biodiversity as they can harm native plants and animals by reducing the diversity and abundance of native species and can upset the balance of natural ecosystems (Barberi et al., 2010). Alongside this, weeds compete with native vegetation for space, nutrients, water and sunlight, which means they can threaten

native plants and animals that rely on this vegetation for shelter and food (Williams & West, 2000). It is important to recognise the role of weeds in reducing the quality of patches of indigenous vegetation.

Mammalian pests also play a significant role in reducing the quality of remaining patches of indigenous vegetation on private land. In New Zealand, possums, stoats and rats are the main predators of indigenous plants and animals and contribute to the decline of large quantities of vegetation and animals (Ministry for the Environment [MfE], 2021). New Zealand wildlife evolved without mammalian predators and was particularly vulnerable after their arrival (Goldson et al., 2015). Biodiversity is affected by animal pests as they browse indigenous vegetation and native species, making these pests particularly destructive to indigenous biodiversity (Goldson et al., 2015). Pest control can be done via one-off management actions which provide permanent benefit such as through biological control, or where pest control must be continuously applied to achieve a benefit (Parkes & Murphy, 2003). While eradication is a favoured strategy (Myers et al., 2000), it should only be attempted if it is achievable; otherwise, the consequences of abandoning continuous pest control could be detrimental (Parkes & Murphy, 2003). While complete eradication is favourable, it is currently not feasible without further advances in ethical considerations and pest eradication methods and technologies (Forsyth et al., 2018; Goldson et al., 2015; Ross et al., 2020).

2.2.2 Management Actions

Various management approaches have been identified in the literature that support the protection of biodiversity on private land and address problems associated with habitat fragmentation, patch isolation, the presence of vascular and mammalian pests, and the quality of remaining patches. Improving the quality of remaining habitat is a necessary management action that can help protect and enhance remaining patches of indigenous vegetation on private land. Improving the quality of remaining habitat can be achieved through the plantation of native species to increase patch size and shape, the development of linkages, weed control, pest control, fencing and through the addition of native species.

The development of linkages between patches of indigenous vegetation on private land in New Zealand could significantly increase the quality and connectivity of that indigenous vegetation, which could also have flow-on effects that support native species (Mace et al., 2012; Ng et al., 2020). Strategically creating linkages and connections between remaining patches of indigenous vegetation is beneficial for the migration and dispersal of indigenous species, along with having the ability to enhance biodiversity through the safeguarding of genetic flow between populations and increasing resilience in degraded ecosystems (Donald & Evans, 2006; Haddad et al., 2015; Hanski, 1999; Noss, 2012). Alongside this, the creation of linkages and corridors within a landscape can reduce the effects of patch isolation and can therefore play a role in increasing species richness and may assist in the return of species to remaining patches as a result of more resources (Collinge, 2009; Fahrig, 2013).

Strategic fencing as a management action can be used to prevent stock from browsing on regenerating patches of indigenous vegetation, and can be used to protect native species from predators (Burns et al., 2012). Predator proof fences have been shown to create a safe space for native species and can be used to support the growth of populations of native species, such as

through the use of a kiwi creche, which can protect the growth of kiwi chicks to a suitable weight prior to being released into the wild (Innes et al., 2012; Keast et al., 2010). Predator proof fencing has also been praised for its ability to capture public interest and involvement, along with educational opportunities that can benefit overall conservation outcomes (Innes et al., 2012).

Breeding programs can be used as a management action to actively support fauna, reintroduce or enhance species within a landscape, and can have great success if effectively managed (Montgomery et al., 1997). Some kiwi breeding programs in New Zealand have been successful at reintroducing kiwi into landscapes and supporting the growth of population numbers (Department of Conservation [DOC], 2021a). Alongside the reintroduction of native animals into a landscape, native plants can also be reintroduced through planting programs which provides habitat for species and helps to establish linkages within a landscape (Renwick et al., 2014). Planting programs can also assist in weed control whereby in order to protect reintroduced native plants, weed control is undertaken as part of the program (Renwick et al., 2014).

Currently available animal pest control methods include trapping, poisoning, shooting, fencing, and biotechnologies, with trapping and poisoning being the most commonly used pest control method (Goldson et al., 2015). Trapping as a pest control method is usually employed to target possums, rats, mice and stoats (Ross et al., 2020). While there are concerns associated with the use of all pest control measures, New Zealand's current best method for pest control is the use of 1080 where the benefits have been found far outweigh concerns (Department of Conservation [DOC], 2021b; Environmental Protection Authority [EPA], 2020; Goldson et al., 2015; Parkes & Murphy, 2003; Parliamentary Commissioner for the Environment [PCE], 2011; Powlesland et al., 1999; Ross et al., 2020; Urlich & Brady, 2005). The use of 1080 works well in New Zealand because apart from bats, there are no native mammals which means the poison can be used without impacting native populations along with many forests being steep, inaccessible and challenging to trap (DOC, 2021b).

Although the literature has provided an insight into the existence of patches of indigenous vegetation and the best management actions to address biodiversity-related problems across private land in New Zealand, conservation action assumes that landowners and managers are willing and able to engage in biodiversity protection. Information is lacking on how, or if landowners and managers want to protect and restore these remnant patches on their land. An understanding of how to best encourage landowners and managers to participate in these management actions is also lacking in New Zealand. Without this understanding, it becomes difficult to implement management actions and support landowners in the protection of biodiversity. This gap creates a valuable opportunity to understand the behavioural perceptions of landowners, to determine how to best protect remnant patches of biodiversity on private land in New Zealand.

2.3 Adoption of Conservation Practices

Given that conservation schemes on private land must be initiated and sustained by private individuals, it is important to understand the factors that influence adoption or success. While abundant literature supporting the need to protect remaining patches of indigenous biodiversity on private land exists, few investigations have been done in New Zealand that determine the most

effective ways of ensuring participation from landowners and land managers. A fundamental problem is that the public conservation estate does not cover all vegetation types, yet useful sites of underrepresented vegetation types are present on private land. Therefore, there is a need to engage conservation on private land, yet an understanding is needed on how best to do this when authorities have limited control over what happens on private land. Authorities also need to be aware of how to best encourage conservation on private land without landowners feeling as though their control of the land has been taken away from them. Understanding the perceived motivators, barriers, and enablers of biodiversity protection can provide helpful information that can assist in getting private landowners and managers to engage in conservation activities.

There is also a need to understand the best practices for biodiversity management in the field. While the idea of protecting and conserving smaller patches of indigenous biodiversity on private land is supported (Bennett et al., 2006; Benton et al., 2003; Fischer et al., 2009; Law & Dickman, 1998; Rosa et al., 2015; Turner & Corlett, 1996; Wintle et al., 2019), studies often fail to explain the most feasible and favourable way of doing so. Similarly, the perspectives of private landowners and land managers on the most favourable ways of protecting biodiversity on private land must be understood. Without understanding landowners' perspectives and the current motivators, barriers and enablers, it will be challenging to offer ideas around how the protection of biodiversity on land can be configured and optimised pragmatically.

Social changes such as the introduction of alternative meat technologies, consumer demand for sustainable products, and the scrutiny over the carbon footprint of meat are factors which present landowners with an opportunity to improve their environmental footprint and retain profitability and social licence by protecting biodiversity. The importance of policy changes as the catalyst for biodiversity protection has been emphasised (Brockerhoff et al., 2001; Norton & Miller, 2000), alongside the role of societal changes as a contributing factor (Moller et al., 2008; Pannell et al., 2021). While policy and social changes both influence conservation efforts, these are not always perceived by landowners as being beneficial for land use operations due to the fear that such efforts will impact profitability and productivity (Cary & Wilkinson, 1997).

The actual adoption of conservation practices is also influenced by a range of personal, social, cultural, and economic factors (Hajkowicz, 2009; Pannell et al., 2006). A particular factor in adoption is the perception that conservation practices will enhance the achievement of personal goals and the practices are more likely to be successful if they have a high relative advantage (Hajkowicz, 2009; Pannell et al., 2006). Lower adoption and success rates are aligned with a failure to provide a relative economic or financial advantage (Hajkowicz, 2009; Pannell et al., 2006). Economic theory has been used to explain success and failure, suggesting that landowners investment in the environment provides public and private benefits; therefore, private investment in public goods will occur below an optimal level as investors will only invest to a point where marginal private benefit is equal to marginal private cost (Hajkowicz, 2009; Reeson, 2008). While the literature provides an insight into the factors that influence the adoption of conservation practices, a gap has been identified where the current literature fails to be all-encompassing and delve into the perspectives of all players involved in land management operations, along with the inclusion of different land use and ownership types.

2.3.1 Understanding Perspectives

A need for the protection of biodiversity on private land has been highlighted; yet, the need to understand the perspectives of landowners and managers in the process is just as important to ensure participation in management activities that will address biodiversity-related problems. Case studies on the adoption of conservation practices have focused on risk perceptions and the design of conservation policies as influencing factors (Greiner, 2015a, 2015b; Greiner et al., 2009). The importance of understanding motivations for conservation has been emphasised (Greiner, 2015b; Greiner & Gregg, 2011), alongside the need for risk attitudes to be better understood (Greiner et al., 2009; Kleijn & Sutherland, 2003). Regardless of which factor may be more important, authors are in agreement that an understanding of participation behaviour is necessary to inform the design of conservation schemes to ensure successful participation by landowners and managers (Greiner, 2015b; Greiner & Gregg, 2011). With the need for a tailored approach to ensure success, it is imperative to gain a representative understanding of landowners' motivations that are likely to inform conservation programs. This is especially important in New Zealand, where conservation programs targeting landowners are lacking, along with literature on motivations and risk perceptions.

With a lack of robust policy methods, lack of cohesion between the public and private estates, and lack of economic incentives to support biodiversity protection on private land in New Zealand, a pro behavioural shift towards biodiversity management by landowners and land managers is necessary. Problems with conservation are often intertwined with human behavioural problems (Reddy et al., 2017). Specifically, multiple factors have been shown to influence motivations, barriers and enablers of biodiversity protection efforts and these factors are primarily influenced by behavioural beliefs about the outcome of activity (Greiner & Gregg, 2011; Maseyk et al., 2021; Pannell et al., 2006; Reddy et al., 2017). When considering this, it is essential to assess which factors are most influential to the uptake of conservation practices in New Zealand. This can be valuable in understanding what is required to support participation in biodiversity protection activities on private land. The current lack of robust research determining the influential factors of conservation adoption in New Zealand is a gap that needs to be addressed to ensure participation by landowners and managers is successful in addressing biodiversity problems.

Motivating factors have a key influence on the likelihood of participation in and success of conservation practices on private land. These motivating factors include personal motivations (Greiner & Greg 2011), potential for land stewardship (Bermer et al. 2014; Sorice et al. 2013), and duration of activities and land security (Broch et al., 2013; Espinosa-Goded et al., 2010; Sorice et al., 2011). Intrinsic motivations to be the most important motivating factor, such as lifestyle, environmental stewardship, or family orientated motivations (Greiner & Gregg, 2011; Ingram et al., 2013; Jacobson et al., 2003; Kabii & Horwitz, 2006; Smithers & Furman, 2003). Others (Maseyk et al., 2021; Wilson & Hart, 2000) have found financial motivations to be the greatest contributing factor. Economic and social motivations have also been discussed in the literature, yet, these motivations are less likely to influence the uptake of conservation practices (Greiner & Gregg, 2011; Ingram et al., 2013). Conservation schemes cannot simply be applied to all sectors but need to be integrated into different systems based on landowners' differing motivations and goals.

The same motivations play an important role in investment decisions which can influence the uptake of conservation practices. It has been determined that goals of making money are usually a reflection of or tool for achieving higher-order motivations such as lifestyle (Pannell et al., 2006). It has also been found that higher-order motivations are likely to influence investment decisions, and therefore strong conservation and lifestyle motivations translate into intrinsic motivation, while option values would prevent financially motivated landowners from adopting conservation practices without the presence of external incentives (Ahnström et al., 2009; Chouinard et al., 2008; Manner & Gowdy, 2010; Maybery et al., 2005; Watt & Richardson, 2007). Therefore, it is important for biodiversity conservation schemes to consider and take advantage of these motivations, whether intrinsic, financial, or social motivations, as this will likely increase participation and effectiveness.

Landowners may be motivated to engage in conservation; however, the extent to which they do so can be influenced by a variety of constraints. While motivation factors play an important role in the uptake of conservation participation, so too do barriers. Barriers come in different forms, including limits to resources, risk, uncertainty, financial constraints, and low returns on investment (Greiner & Gregg, 2011; Pannell et al., 2006). The most significant perceived barriers have been found in the form of capital and resource constraints (Greiner & Gregg, 2011; Maseyk et al., 2021), while concerns of uncertainty around the future of land tenure have also been highlighted (Greiner & Gregg, 2011). Lack of knowledge has not been found to act as a major barrier (Greiner & Gregg, 2011; Maseyk et al., 2021). This highlights that while respondents in the studies are not hindered by knowledge, they may need support in the form of external incentives.

Understanding the perceived barriers of conservation practices can support the creation of tailored schemes whereby specific support mechanisms can be implemented to ensure barriers are overcome, and concerns are eased. It is important to consider perceived enablers including external incentives as they may be what is required to stimulate and encourage conservation to the required level. Participation in biodiversity schemes has been found to be positively influenced by financial or economic incentives (Espinosa-Goded et al., 2010; Greiner, 2015b; Maseyk et al., 2021; Ruto & Garrod, 2009). Although conservation practices may already be occurring, financial or economic incentives can act as the catalyst to overcome barriers and stimulate conservation practices to the level that is required by society (Espinosa-Goded et al., 2010; Greiner, 2015b; Maseyk et al., 2021; Ruto & Garrod, 2009).

Although it has been determined that understanding landowners' perspectives is important for participation in biodiversity conservation, this may be even more important in landscapes that rely on a few patches of habitat located on private land. In the case where a small number of landowners can be critical to the conservation of a particular species, an understanding of these landowners' motivations and attitudes is even more important (Greiner, 2015b). This is important to ensure participation in conservation and to ensure that the uptake of protection activities is sustained long term. Alongside this, the value and richness of biodiversity on the public conservation estate in New Zealand may be reliant on a few patches of remaining habitat on private land to provide corridors and linkages.

The need for an understanding into perspectives on conservation adoption has been supported, yet, New Zealand lacks an inclusive understanding into such perspectives. While the perspectives of

sheep and beef farmers in New Zealand have been determined (Maseyk et al., 2021; Pannell et al., 2021), a gap exists where perspectives on conservation adoption encompassing all land use and tenure types in New Zealand are unknown. It is important to close this gap, as when looking to achieve successful biodiversity protection, perspectives need to be considered at a landscape-wide level as it is common for a variety of different land use and ownership types to be present in a landscape. An understanding of perspectives on biodiversity protection across the board will help to inform successful conservation approaches in New Zealand.

2.4 Conceptual Model of Conservation Adoption

Landowners often make land-use decisions in both a personal and business context. The personal context of land-use decisions refers to intrinsic motivations for decision making, while economic theory explains the extrinsic drivers of decision making (Ingram et al., 2013). The context in which decisions are made are related to social conditions, personal capabilities and attitude and psychological dimensions (Greiner, 2015b). A common framework for behavioural change builds on the 'Theory of Planned Behaviour' (TPB) (Ajzen, 1991) and is referred to as the reasoned action approach (Fishbein & Ajzen, 2011). A person's behavioural intentions and behaviours are conceptualised within the framework (Figure 2.1**Error! Reference source not found.**), which shows how intentions and behaviours are driven by attitudes, subjective norms and perceived behavioural controls (Ajzen, 1991; Greiner, 2015b). These attitudes, subjective norms, and perceived behavioural controls are influenced by an individual's evaluative beliefs which capture an individual's evaluation of perceived outcomes due to them partaking in the conservation behaviour. The TPB has been used in several behavioural studies to explain how these factors play out in the conservation behaviours of landowners (Ahnström et al., 2009; Beedell & Rehman, 2000; Greiner, 2015a, 2015b; Hansson et al., 2012; Maseyk et al., 2021; Reimer et al., 2012).

The assumption of behavioural control in the form of negatively and positively perceived factors is of particular relevance to this research. Negative perceived control factors such as cost or resource barriers may prevent participation even where the intention exists, while positive perceived control factors such as economic or financial enablers may push behavioural intention towards participation (Maseyk et al., 2021). Behavioural controls have been found to play an important role in the uptake of conservation practices, whereby landowners and managers make assumptions relating to these factors. For example, conservation actions carry a positive normative belief. However, although the intention to participate in conservation behaviours may exist negative perceived control factors such as the cost of conservation may inhibit participation while positive perceived factors such as financial assistance can help to overcome negative factors and stimulate participation.

While the TPB has become a dominant model for explaining human behaviours in social psychology, it comes with its criticisms regarding the influence of attitudes on intention and behaviour where it is assumed that attitudes are linked to behaviours (Eagly & Chaiken, 1993; Johnson & Boynton, 2010; LaPiere, 1934). It has been noted by Burton (2004) that many conservation behaviour studies are overly simplistic with the use of the TPB and fail to establish clear links between attitudes and behaviours. While this may be the case, Festinger and Carlsmith (1959) have shown that causality may work the other way, where attitudes can instead be influenced by behaviour. It has also been suggested that attitude and behaviour are bi-causal

phenomena that have different influencing factors (Kraus, 1995; Sheppard et al., 1988; Wicker, 1969). Despite criticism around the influence of attitudes and behaviours, the TPB has continued to be used throughout the literature (Greiner, 2015b; Maseyk et al., 2021). It has been highlighted by Burton (2004) that despite its failure to establish clear links, the TPB should be used in conservation behaviour studies but that the model needs further developments to account for the complexities of decision making (Reimer et al., 2012).

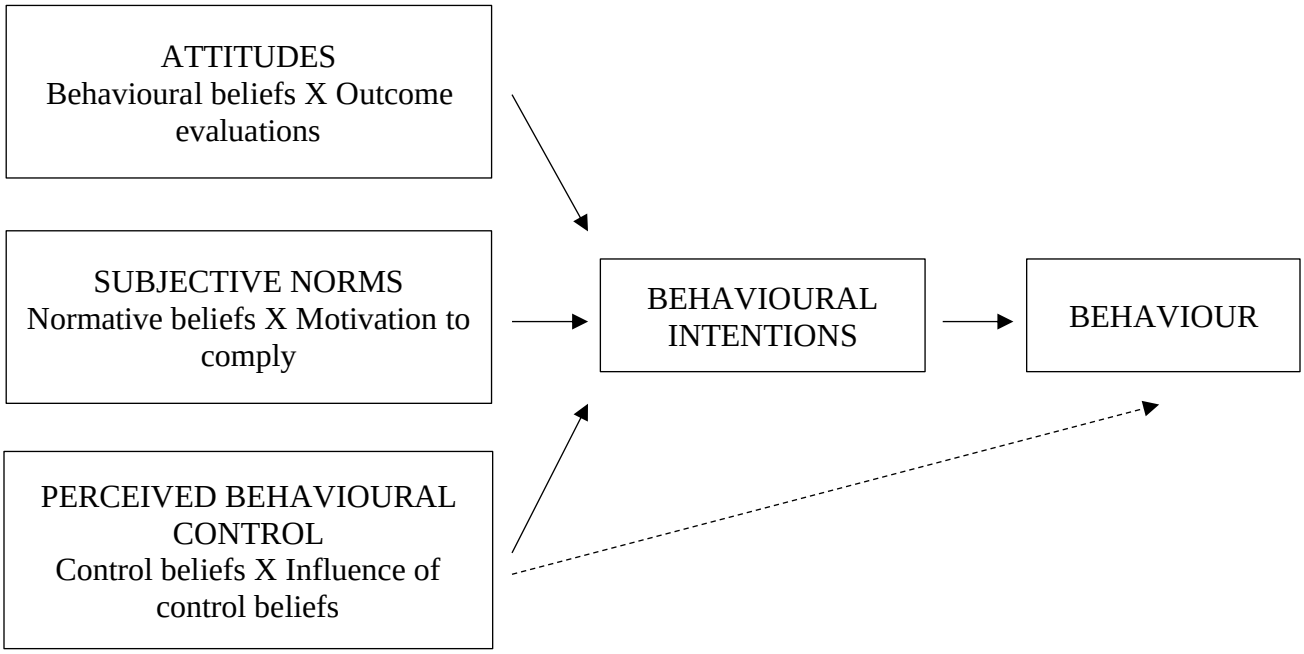


Figure 2.1: Elements of the theory of planned behaviour (Ajzen, 1991).

2.5 Summary

The protection of biodiversity on private land is critical to halt the depletion of the long-term productivity of natural capital, food and water security, and to improve the resilience of farming, social and cultural landscapes. While remaining lowland patches of indigenous vegetation on private land could contribute significantly to biodiversity, their value is markedly increased if fragmentation is minimised. This review of the literature illustrates how habitat fragmentation and loss directly relate to the loss and depletion of biodiversity, especially where species have minimum patch size and vegetation cover requirements. The literature also emphasises that fragmentation can be overcome, and the persistence of individual species and populations can be supported if movement among habitat patches is maintained through matrix connectivity. The importance of reducing habitat loss and fragmentation along with retaining the connectivity of remaining patches was emphasised in the literature. The need for effective weed and animal pest control was also highlighted as being vital to the protection of indigenous biodiversity and for the protection of remaining indigenous habitat.

It was emphasised that while a shift towards more biodiversity protection is occurring, the inclusion of private land is vital. However, success is often determined by landowners' attitudes and willingness to participate. Studies highlighted that in countries such as New Zealand, where there are minimal voluntary conservation programs established to target landowner conservation of biodiversity, an understanding of participation behaviour is necessary to inform the design of conservation schemes. These studies have also suggested that intrinsic motivations for biodiversity protection play an integral role in the uptake of conservation practices while financial and economic factors act as catalysts or external incentives. The current body of literature is in alignment around which factors influence motivations for biodiversity protection; however, has failed to establish the motivations of landowners irrespective of land use or ownership type in New Zealand. The TPB was determined as the conceptual model for this research whereby conservation behaviours can be influenced by positive and negative control factors and this model will be used to examine conservation behaviour in the case study catchment.

3 Chapter 3: Case Study Description

3.1 Introduction

This Chapter provides a description of the case study area. The location of the Mōtū catchment will be described, along with current land use operations and land cover types. Biodiversity in the catchment will be highlighted, including existing flora and fauna and the extent of protected areas and conservation estate within the catchment.

3.2 Location

The Mōtū catchment is a 312, 745 hectare catchment located in the East Coast of the North Island of New Zealand (Figure 3.1) and spans across the Gisborne and Bay of Plenty Regional boundaries.

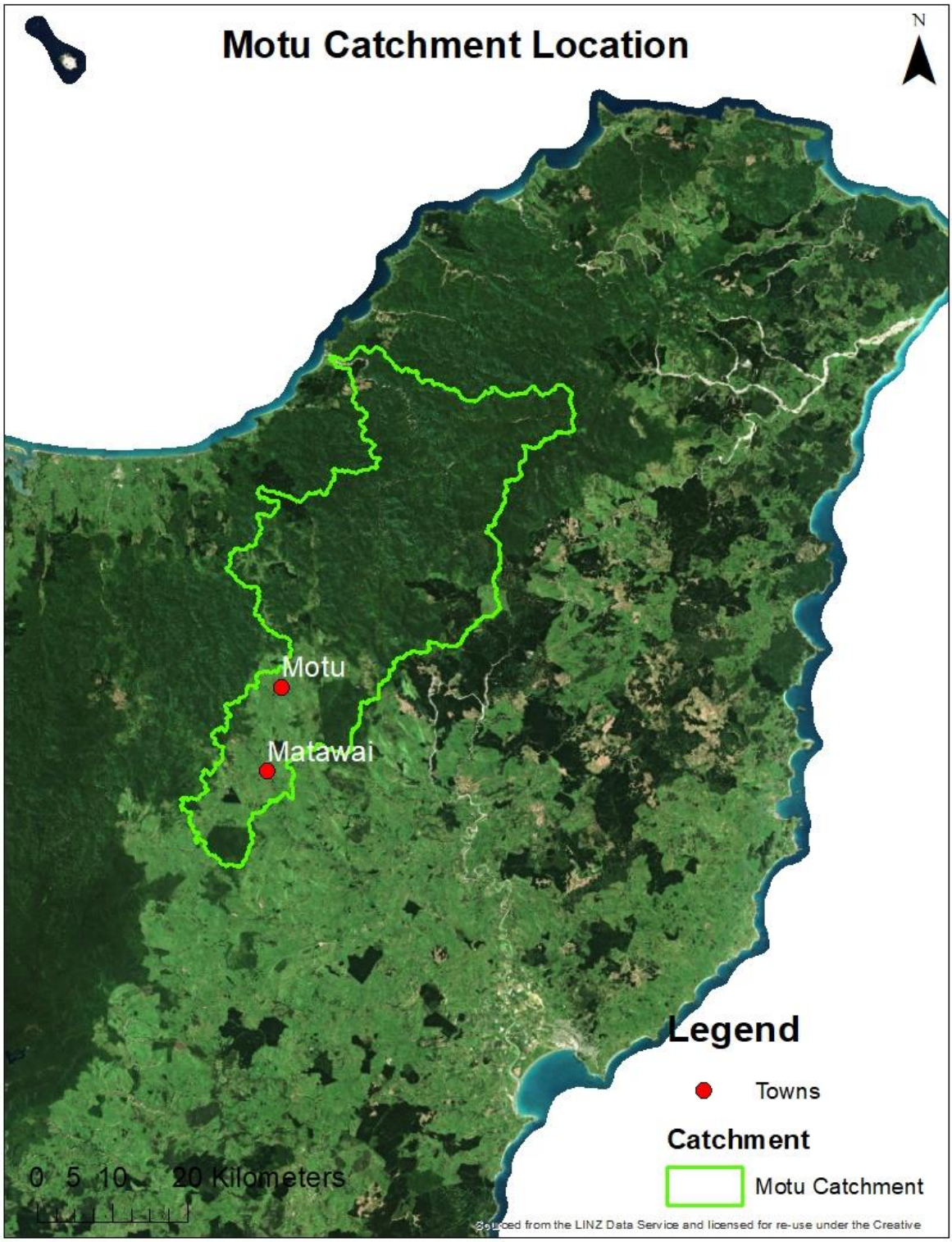


Figure 3.1: Map showing the location of the Mōtū catchment.

3.3 Catchment Land Use

A variety of different land uses exist in the Mōtū catchment. Natural forest is the dominant land use activity accounting for 44672.2 ha (14.3%) of the entire catchment land area. High producing grassland is the second most dominant land use activity at 41960.5 ha (13.4%), followed by low producing grassland at 40788.5 ha (13.0%), grassland with woody biomass contributes to 40481.46 ha (12.9%), post-1990 planted forest covers 37921.15 ha (12.1%), open water wetlands account for 37587.01 ha (12.0%), pre-1990 planted forest contributes to 34426.47 ha (11%), vegetated wetlands cover 14796.51 ha (4.7%), built-up areas contribute to 19.80 ha (0%), and other land use activities account for 20091.70 ha (6.4%). A map showing land use types across the catchment is shown in Figure 3.2. A breakdown of land use types by size is shown in Figure 3.3.

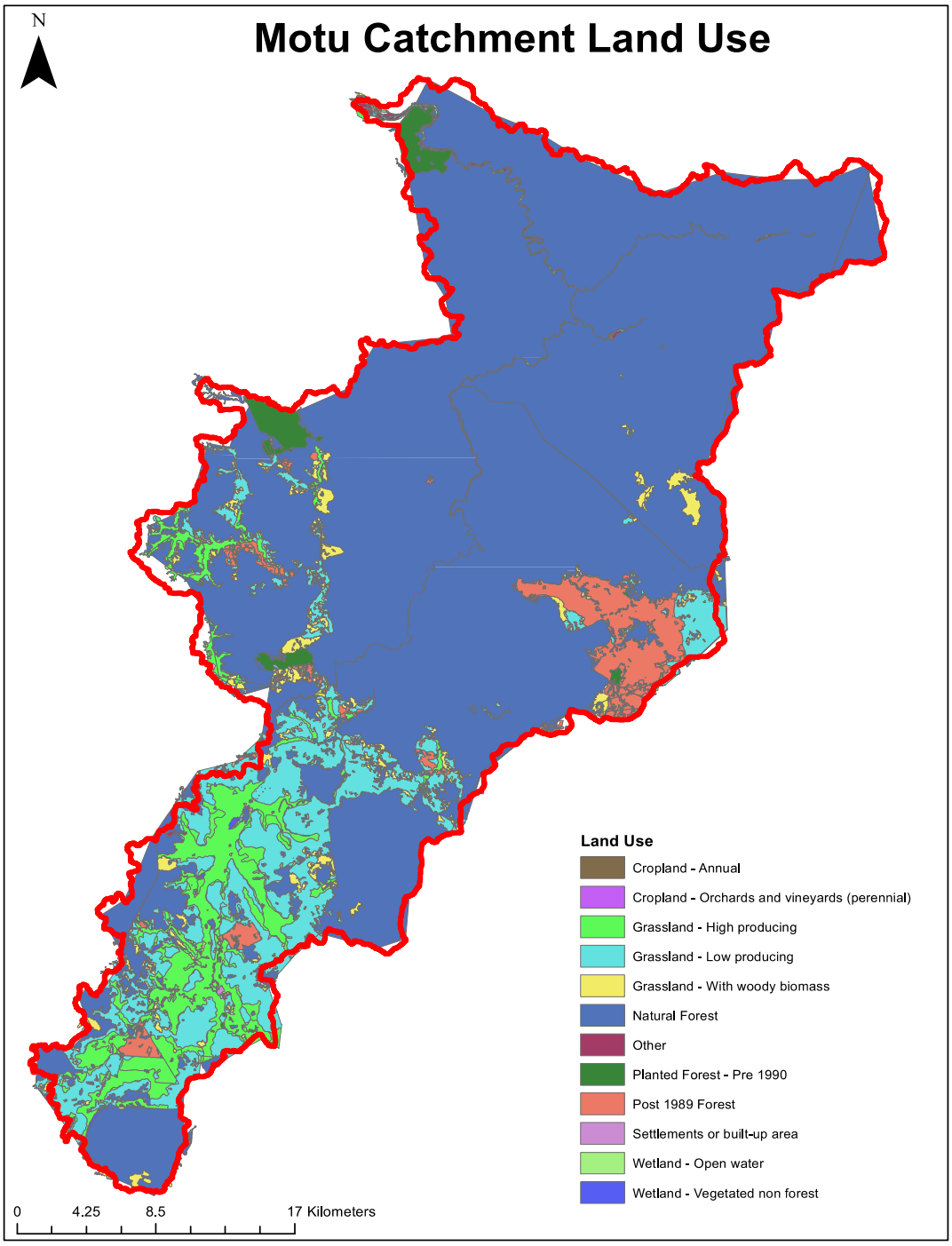
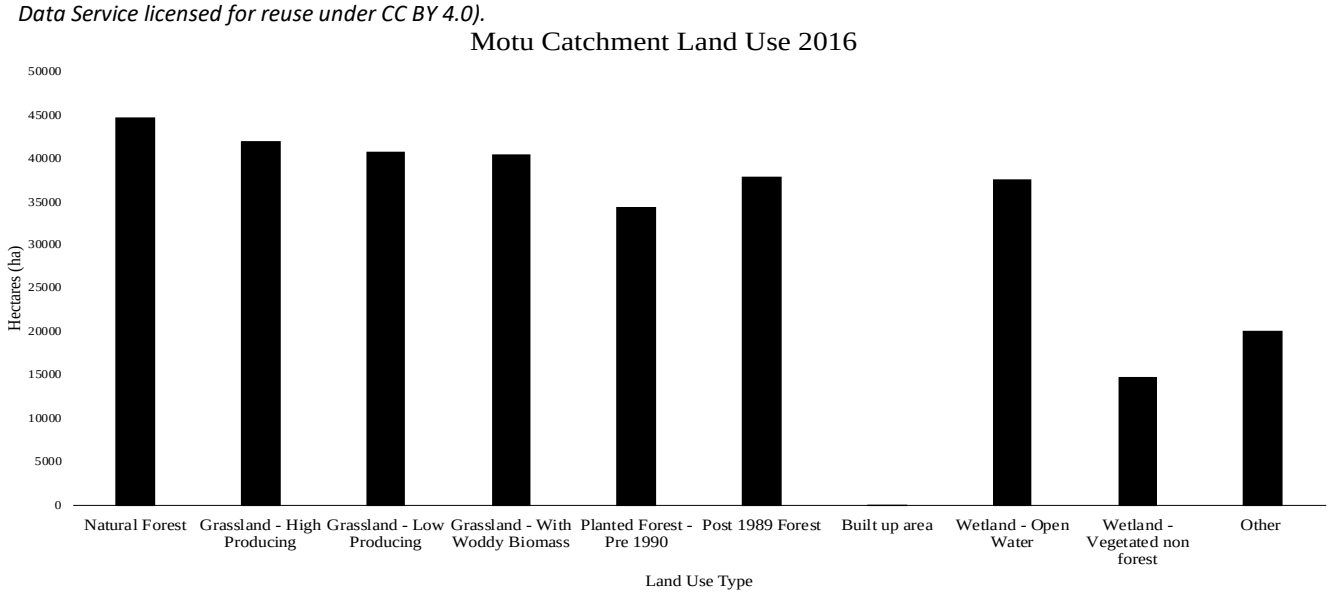


Figure 3.2: Map showing land use classes within the Mōtū catchment (contains data sourced from the LINZ Data Service licensed for reuse under CC BY 4.0).

Figure 3.3: Bar chart showing a breakdown of land use classes within the Mōtū catchment (contains data sourced from the LINZ Data Service licensed for reuse under CC BY 4.0).



3.4 Biodiversity in the catchment

Early European settlers described the Mōtū catchment as being densely wooded and extremely rugged (Williams, 1992). Pishief (2006) supports this description, describing Mōtū as being mostly dense virgin native bush in the 1880s. These descriptions provide a valuable insight into the volume and extent of native bush that once existed in the Mōtū catchment and highlights the area's once natural form and character. In contrast to these descriptions of Mōtū around the time of early settlement, Figure 3.4 shows the current makeup and extent of land cover in the catchment.

The Mōtū catchment has suffered biodiversity loss though habitat loss, fragmentation, and through the presence of invasive pests, yet has retained some areas of significant biodiversity such as in public conservation estates and in areas under QEII (Queen Elizabeth the Second) Covenant. The catchment presents itself as a unique opportunity to assess the environmental context of this research. As the Mōtū catchment has suffered biodiversity loss on private land, there is an opportunity to understand the perceived motivators, barriers, and enablers of protection from a private landowner and land manager perspective. This can assist in understanding how to best protect remaining biodiversity within the catchment and create linkages between larger patches of public conservation estate and smaller patches on private land.

The proportion of production grassland in the Mōtū catchment also provides an opportunity to understand how landowners and managers feel about certain protection activities. For example, increasing planting along riparian margins can assist not only in increasing biodiversity in the catchment, but can also help with erosion control and carbon sequestration; issues that are very real for landowners and managers with production land (Dybala et al., 2019; Stutter et al., 2019). Alongside this, increasing biodiversity on production land can assist in the diversification of production land which has been shown to create multifunctional landscapes that aid in ecosystem service provisioning and help with the general resilience of production land (MacLeod & Moller, 2006).

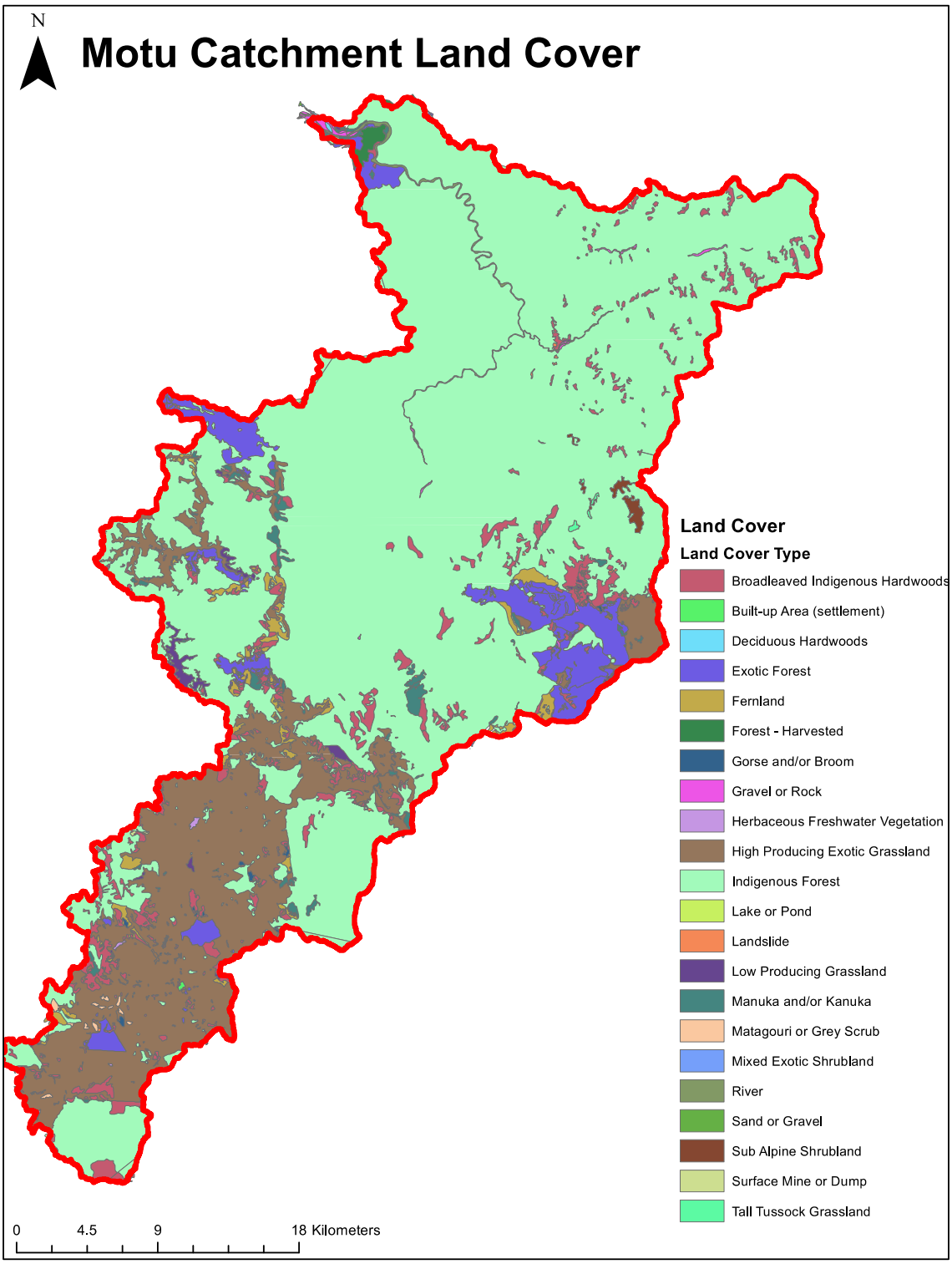


Figure 3.4: Map showing land cover across the Mōtū catchment (contains data sourced from the LINZ Data Service licensed for reuse under CC BY 4.0).

3.4.1 Whinray Scenic Reserve

The Whinray Scenic Reserve is situated 5 km East of the Mōtū village and is comprised of 429 ha of kahikatea dominated forest (Burns et al., 2012). This is the last large remnant of virgin native forest, which use to cover the entire district until the arrival of European settlers in the 1880s (Gundry, 2007; Pishief, 2006). There are six other podocarps in the reserve, including rimu, matai, miro, Hall's totara, kawaka and tanekaha. All of these are regenerating profusely except for kawaka and tanekaha. The understorey of the reserve features five fingers, makomako, horopito, putaputaweta, tarata and many more species. Figure 3.5 shows what the Whinray Scenic Reserve looks like today.

Figure 3.5: Photograph of the Whinray Scenic Reserve (Britney Ford, 2021).

Birdlife is abundant in the reserve and includes fantails, grey warblers, kereru, tui, kaka, shining and long-tailed cuckoos, kingfishers, moreporks, falcons and North Island Robin (Pishief, 2006). The Scenic Reserve is an important and unique part of the biodiversity of the East Cape as it is the only area where North Island weka and North Island Brown Kiwi co-exist (Pishief, 2006). Long-tailed bats can also be frequently seen on the edge of the reserve at dusk (Pishief, 2006). In the early 1900s, North Island weka were common, yet by the 2000s, the only natural mainland population left of approximately 2000 birds was confined to the forests and scrubby farmland of the Mōtū and Motohoura districts, including the Whinray Scenic Reserve (Pishief, 2006).

Weka are known for their inquisitive and mischievous nature, which made them unpopular in the early days and they were hunted as pests (Pishief, 2006). Beauchamp (1997) assessed the declining weka populations throughout the 1980s and highlighted that while hundreds of weka were counted in the Mōtū district between 1985-1986, just two males were heard calling ten years later, and one female was seen but not heard. The presence of stoats, possums and other pests in the district resulted in the rapid decline of weka in the 1950s; however, the establishment of a pest control regime through trapping in the early 2000s resulted in increasing numbers of weka to what is now considered to be a healthy population (Pishief, 2006; Young, 2013).

3.4.2 Kiwi Creche

A large 1.5 ha kiwi plus tuatara creche with predator-proof fencing has been built close to the Mōtū village as a place to raise kiwi and tuatara offspring. Kiwi eggs from the Whinray Scenic Reserve are taken to Rotorua for incubation before being brought back to Mōtū and released into the creche (Pishief, 2006). When they reach a bodyweight of one kilogram, they are released back into the Whinray Reserve (Pishief, 2006; Twisleton, 2007). The rising numbers of kiwi located within the Whinray Scenic Reserve can be attributed to the efforts of those involved with the kiwi creche and the Whinray Ecological Trust. These efforts, along with the extensive pest control measures undertaken within the Whinray Scenic Reserve, play an important role in kiwi survival and the increasing population numbers. Figure 3.6 shows a kiwi from the creche being weighed prior to its release into the Whinray Scenic Reserve.

Figure 3.6: Photograph of North Island Brown Kiwi being weighed prior to release in the Whinray Scenic Reserve (Britney Ford, 2021).

3.4.3 Pests

Pests were of concern in the catchment. It has been emphasised that in the 1970s and 80s, pigs, rats, wild cattle, possums, stoats, wild dogs, and goats were destructive to the native bush and wildlife (McColl, 1986; Young, 2013). It is important to highlight the destructive nature of pests on the native flora and fauna within the Mōtū catchment, as this can play an important role in the quality and survival of native plants and animals. Despite having some of the best stands of rimu, tawa, matai, and kahikatea, it is evident that virgin forest does not do well on its own when left alone, which is reflected by the severe erosion as a result of the effects of active pests (Young, 2013). This includes the presence of goats, which up until 2002 were not controlled.

3.4.4 Vegetation

Typical vegetation within the catchment at an altitudinal sequence of forest types occurs from coastal pohutukawa and puriri, through low altitude conifer-tawa-hard beech forest, rich in tanekaha, podocarp-red beech and silver and red beech forest (McEwen, 1987). Kaikawaka is common in the montane forest belt, beech in the mountains ranges, and low alpine vegetation on the highest mountains (McEwen, 1987). Within the Raukumara Scenic Reserve, Druce (1990) found a variety of 300 different species. These species ranged in variety from gymnosperms, monocot trees and shrubs, dicot trees, dicot shrubs, monocot lianes, dicot lianes, psilopsid, lycopods, ferns, orchids, grasses, rushes, sedges, monocot herbs other than orchids, grasses, rushes and sedges, composite herbs, and dicot herbs. Similar to McEwen (1987), McColl (1986) described vegetation types in the Mōtū catchment to differ across different altitudes. McColl (1986) characterised vegetation types into four different classes; tawa forests on good soils and low altitudes; hard beech forests on poor soils and low altitudes; coastal forests; and red and silver beech forests at high altitudes.

3.4.5 Fauna

Birds in the catchment include North Island Brown kiwi, North Island Robin, whio, New Zealand falcon, kaka, yellow-crowned parakeet, weka and kokako (McEwen, 1987). The Hochstetter's frog is also present within the catchment however is vulnerable to any disturbance that affects the stability of streams (McEwen, 1987). The Ruakumara tusked weta is an insect found in the Raukumara Ranges within the catchment and dwells within close proximity to first and second-order streams (Gibbs, 1998, 2002; Taylor-Smith et al., 2016). This native weta is not currently regarded as a conservation worry. However, the presence of ship and Norway Rats along with feral cats, stoats, possums and pigs threatens the populations of weta in the catchment (Gibbs, 1998).

3.4.6 Catchment Groups

Two catchment groups focused on freshwater management and erosion control have been formed within the Mōtū catchment. One catchment group includes landowners along the main body of the Mōtū river and is focused on reducing erosion, while the other has been formed as a requirement of the National Policy Statement for Freshwater Management (NPS-FM) and is comprised of six stakeholders that represent the Mōtū catchment. While two catchment groups exist, they do not directly focus on biodiversity objectives and are not freely open for all landowners and managers to join.

3.5 Conservation Covenants

A variety of different conservation areas exist within the Mōtū catchment. These conservation areas range from public conservation estate to areas protected under QEII covenant and Protected Managed Areas (PMAs) as prescribed by the Gisborne District Council (GDC). The Mōtū river is also subject to a conservation order made by QEII National Trust, with its status being gained in 1984 (Young, 2013). A large proportion of the Mōtū catchment is within public conservation estate. This includes the Matawai Conservation Area, Raukumara Conservation Park, Waioeka Gorge Scenic Reserve, Waioeka Conservation Area, Urutawa Conservation Area, Marawaiwai Scenic Reserve, and the Mōtū and Whinray Scenic Reserves. The location and extent of conservation estate within the Mōtū catchment is shown in Figure 3.7.

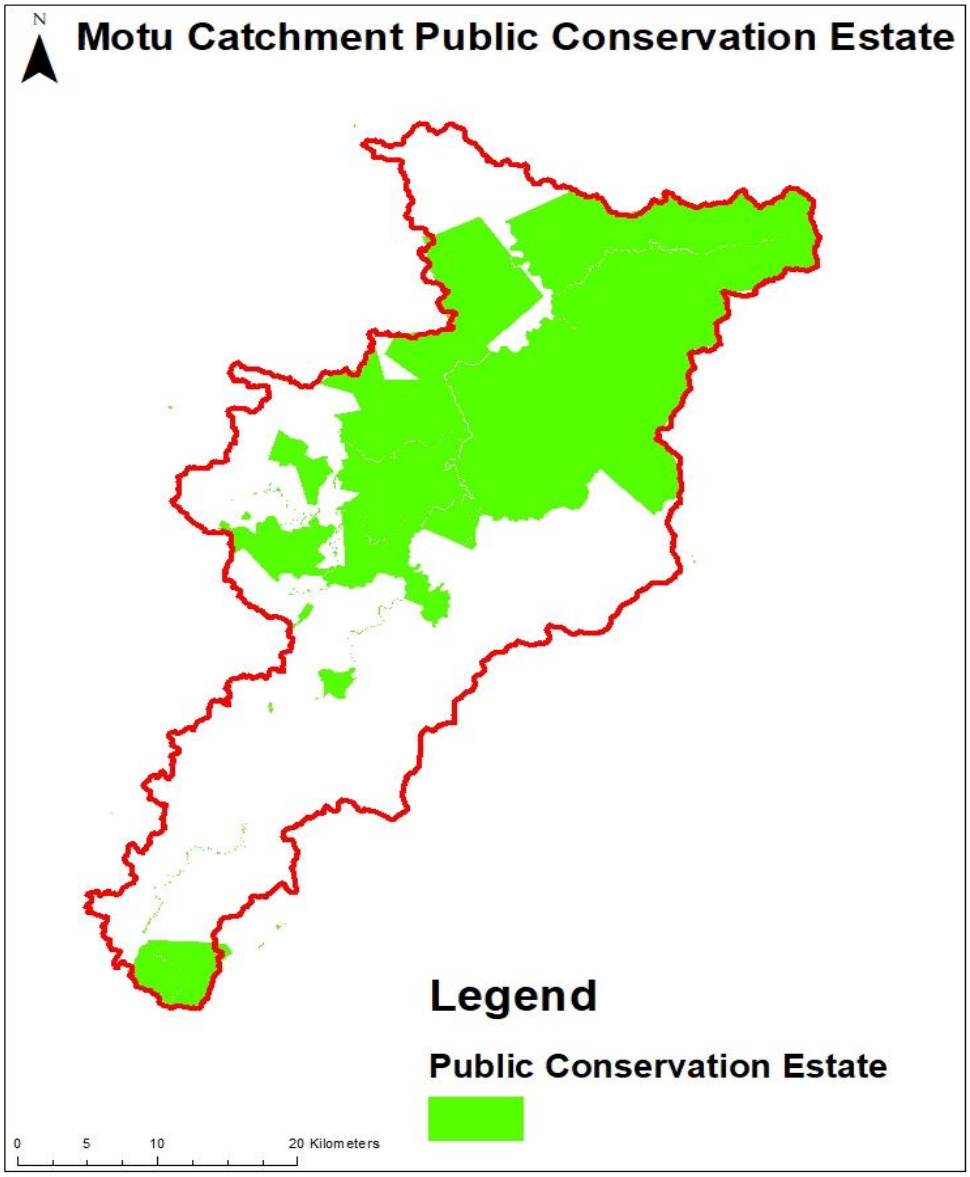


Figure 3.7: Map showing the distribution of public conservation estate within the Mōtū catchment (contains data sourced from the LINZ Data Service licensed for reuse under CC BY 4.0).

Several PMAs exist within the Mōtū catchment. The term PMA is used to define areas of important native bush across New Zealand (Gisborne District Council, 2020). Within the Mōtū catchment, there are a total of 12 PMAs which cover approximately 118 66.7 ha of land. These PMAs consist primarily of high elevation beech forest and areas with significant wetlands. The coverage and extent of PMAs in the Mōtū catchment is shown in Figure 3.8.

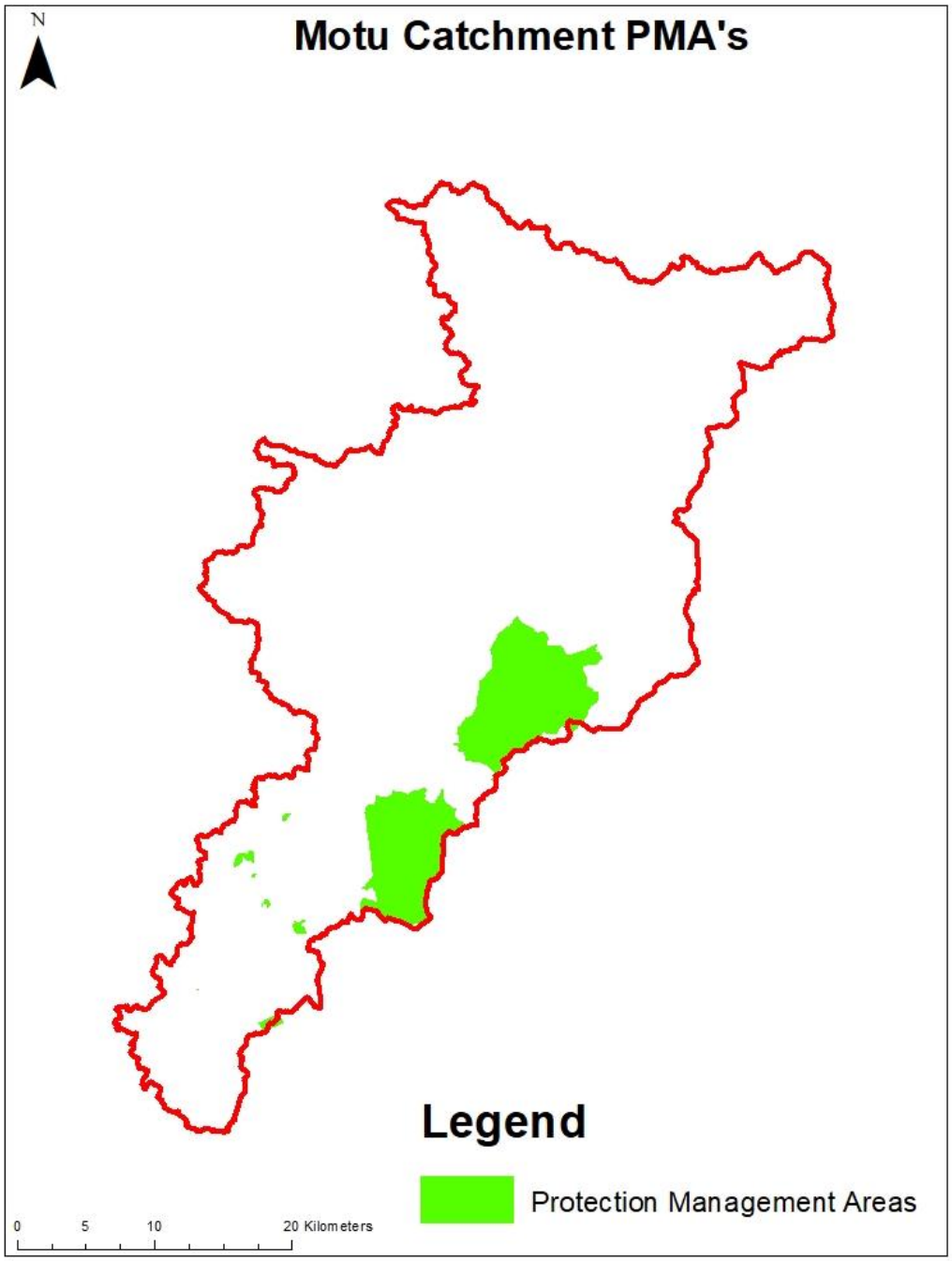


Figure 3.8: Map showing the distribution of Protected Managed Areas within the Mōtū catchment (contains data sourced from the LINZ Data Service licensed for reuse under CC BY 4.0).

Several areas exist under QEII Covenant within the Mōtū catchment. QEII Covenants act as an agreement between QEII National Trust and landowners where the current landowners continue to protect the land and the covenant protection stays with the land even when it is sold (QEII National Trust, 2021). The current extent of land within the Mōtū catchment under QEII covenants is 731.2 ha. These covenants play an important role in protecting some of Mōtū's rarest and most endangered biodiversity ecosystems (QEII National Trust, 2021). The coverage and extent of QEII covenanted areas within the Mōtū catchment is shown in Figure 3.9.

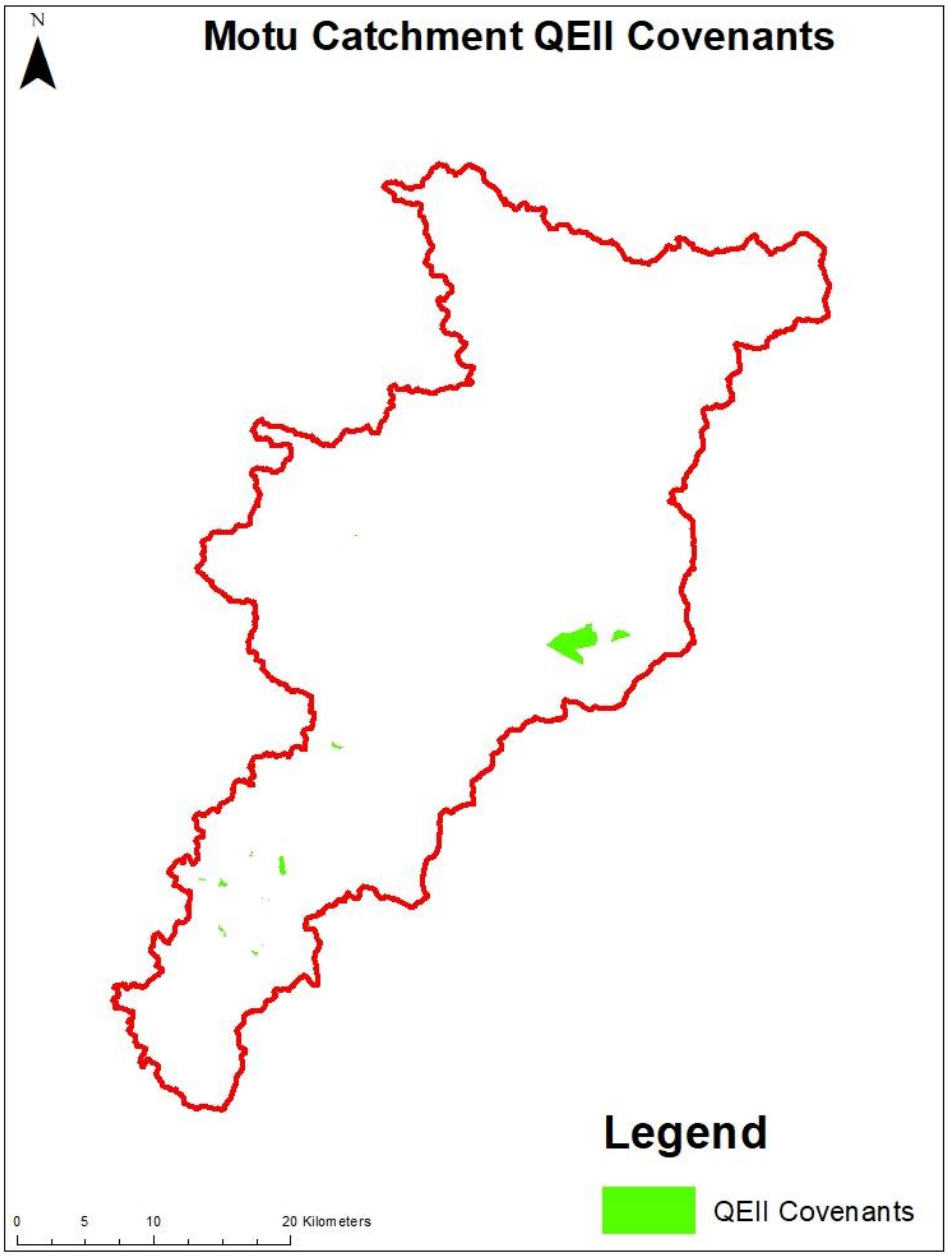


Figure 3.9: Map showing the extent of Queen Elizabeth II National Trust covenants within the Mōtū catchment (contains data sourced from the LINZ Data Service licensed for reuse under CC BY 4.0).

3.6 Summary

This Chapter provided a description of the case study location and its characteristics. The Mōtū catchment is located in the East Coast of the North Island of New Zealand and spans across the Gisborne and Bay of Plenty Regional boundaries. The catchment, which was once dense virgin native forest, is now a combination of land uses including dairy farming, sheep and beef farming, plantation forestry, indigenous forestry and non-productive land. Parts of the catchment are now protected under legal means through QEII National Trust covenants and through public means that protect the Whinray Scenic Reserve, the Matawai Conservation Area, and the Raukumara Conservation Park. The Mōtū catchment is unique in that it is the only place in the North Island where North Island Brown Kiwi and North Island weka co-habit and houses a variety of threatened and endangered types of flora and fauna.

4 Chapter 4: Research Methodology

4.1 Introduction

As discussed in Chapter 1, this research aims to understand the motivators, barriers, and enablers of biodiversity protection by landowners and managers in the Mōtū catchment. To achieve this aim, appropriate research methods were determined from a review of the literature. This Chapter outlines the research design and describes the sampling procedure, data collection and analysis processes used. This Chapter will also discuss the ethical considerations of this research. This research is informed by the work of Greiner and Gregg (2011), whose study focuses on Australian farmers motivations, barriers, and enablers of conservation adoption. The use of a case study for this research will be described, along with the methods for choosing the case study area. As this research builds from a previous study, many of Greiner & Gregg's methods have been chosen for inclusion. These methods were chosen for inclusion to ensure results could be compared and discussed.

4.2 Methodological Approaches

Many different methodological approaches can be used when researching conservation behaviours, so it is important to consider each approach carefully and examine the methods used in other studies. Several studies assessing conservation behaviours employed a survey methodology including phone surveys (Maseyk et al., 2021) and mail out, mail reply surveys (Greiner et al., 2009), along with combination survey formats including face to face and mail out, mail reply (Greiner, 2015b). A phone survey is beneficial as it generally ensures the survey is fully completed, yet it can also be a great cost to the researcher in terms of time that could be spent working on other aspects of the research (Creswell & Creswell, 2018). The use of a mail-out mail reply survey can be beneficial as it generally ensures that most participants within a study area will receive the survey. It also does not require the researcher to obtain a comprehensive email or phone number list; however, it can be expensive in terms of monetary cost and requires more effort from the participant to ensure the survey gets mailed back to the researcher (Creswell & Creswell, 2018).

Choice experiments have been used in studies (Broch et al., 2013; Espinosa-Goded et al., 2010; Greiner, 2015a, 2015b; Ruto & Garrod, 2009) to assess behavioural influences in conservation practices, yet this method has not been used in any New Zealand related studies. The use of a choice experiment for behavioural studies allows respondents to evaluate alternatives which is necessary to inform the design of conservation schemes (Creswell & Creswell, 2018). However, choice experiments can also cause unintended interactions between participants and design aspects that can be related to statistical design properties (Creswell & Creswell, 2018).

The use of semi-structured face to face interviews as a data collection method for studies related to conservation behaviours is not as prevalent as the use of surveys or choice experiments. Semi-structured interviews have been used in studies (Ingram et al., 2013) to reveal current and past motivations along with how these motivations shaped and will shape conservation practices into the future.

While few semi-structured interviews have been used in New Zealand as a method for understanding behavioural perceptions towards conservation practices, the use of this method can be beneficial alongside surveys or choice experiments as they can collect open-ended data, explore participants thoughts, feelings and beliefs, and probe into any interesting or surprising findings (Creswell & Creswell, 2018).

4.3 Research Methods Theory

Both quantitative and qualitative research methods can be chosen to investigate topics such as the one at hand. While these two methods have different advantages and disadvantages when both types of research are used alongside each other, the findings can be clearer and more robust (Bernard, 2013; Bryman, 2016). In this research, a mixed-methods strategy was selected.

Philliber et al. (1980) highlighted that it is important for research to establish a link between an action and a result, and be generalisable, which can be achieved through the use of a sample. Using a sample is important, as aside from a census, very few research methods can assess an entire population (Philliber et al., 1980). While this is important, Yin (2014) highlighted that a number of different research strategies can be applied depending on the type of questions that are likely to be asked. Five research strategies have been identified by Yin (2014), including surveys, archival analysis, historic information, case studies, and experiments. The use of each strategy is based upon three conditions, including the focus on contemporary events, the form of the research question, and the control required over behavioural events (Yin, 2014).

'How' and 'why' questions are both applied to this research, with the main investigation attempting to explore why there may be differences in levels of biodiversity protection and how different factors can influence the level of biodiversity protection. Yin (2014) noted that 'how' and 'why' questions often require case study, history, or experiment methods. As this research is contemporary, the history method was disregarded as it is not suitable. The use of an experiment for this research is also not suitable as it requires control over behavioural events which is not necessary (Yin, 2014). Therefore, the use of a case study has been chosen as the appropriate method as it can investigate situations that require no control over behaviour (Yin, 2014).

4.4 Research Case Approach

There is a belief that a researcher cannot study everything and all things simultaneously, and thus boundaries must be set (Simons, 2009). Boundaries must be set around the context of the research, who to talk to, when, where, about what, and why (Matthew & Huberman, 1994). The Mōtū catchment was specifically chosen as the single case study for this research as it represents a mix of land use and ownership types and was relatively well known to the researcher. Case studies can be designed based on single or multiple cases (Creswell & Creswell, 2018; Gillham, 2000; Simons, 2009). The single case study for this research was based on three stages involving design, data collection, and within-case study analysis (Yin, 2014).

The literature review was used to develop a basis by which to design the case study, along with an effective criteria for undertaking data collection and analysis. Data for the research was collected through a survey and interviews, and finally, the interpretation and analysis of the research was

compared with existing literature. Yin (2014) noted that case study research can be applied to both qualitative and quantitative research. Alongside this, Henn et al. (2005) have highlighted that a qualitative technique is often the best method to use when looking to investigate people's opinions on the world around them, or when aiming to gain a better understanding into their behaviour. Exploring people's opinions and perspectives is a crucial component of this research, and therefore, alongside the use of a survey, interviews were also employed.

4.5 Research Design

The choice of research design is dependent on the nature of the research problem, the lens the researcher views the study through, the expected outcome, and the data collection and analysis tools (Creswell & Creswell, 2018). This research used a mixed-methods strategy, adopting both quantitative and qualitative data collection methods. A separate analysis was done for each dataset to inform a combined interpretation. A mixed methodology strategy allows for the comparison of different data sets and allows for the substantiation of quantitative data with qualitative information for more integration in results (Pope et al., 2000; Walter, 2019). In order to maximise the use of mixed methods data collection, a key requirement involves the use of similar variables for the collection of each data set which allows for comparison and the merging of results for validity (Creswell & Creswell, 2018). To ensure maximum validity, the same variables used to inform the survey design were also used to inform the semi-structured interview design. The survey was used to determine:

1. The current state of biodiversity in the catchment and the extent of biodiversity protection measures.

2. The importance of each factor as a motivator for managing the participant's operation.

3. The extent to which each factor prevents participants from engaging in biodiversity conservation.

4. The effectiveness of each factor in enabling participants to engage in biodiversity conservation.

The semi-structured interviews were used to:

1. Obtain further information on survey elements.

2. Identify any further factors that are preventing the engagement of biodiversity conservation.

3. Determine participants preferences on different biodiversity protection activities.

4.6 Survey Methodology

A self-administered and self-measured postal survey method was chosen for this study. A postal survey was deemed appropriate for the following reasons:

Coverage and autonomy: Postal surveys enable the researcher to cover a wide range of participants while maintaining autonomy and confidentiality (Walter, 2019). When the survey is delivered to the participant via mailbox as opposed to by hand, the researcher cannot know the identity of participants. A self-administered method was also deemed appropriate as it may encourage honest answers, is not subject to interviewer influence or bias, is easily and rapidly distributed, and is less confrontational (Walter, 2019).

Cost: Cost was considered when determining the appropriateness of a postal survey. The financial cost of face to face and phone interviews was deemed higher than postal surveys (Walter, 2019). Postal methods are also cheaper in terms of the researcher's time as it allows the researcher to continue with other aspects of the research while participants complete and return the survey (Walter, 2019).

While there are benefits to using a self-administered postal survey, they often have the lowest response rates of all the main survey data collection methods. They can also require up to three mailings to achieve a satisfactory response rate; they can be prone to providing a biased sample as participation is easy to refuse; and the researcher cannot be sure that the participant has not misinterpreted questions (Walter, 2019). To minimise the disadvantages associated with self-administered surveys, the purpose and value of the research was clearly expressed in the information sheet (Appendix 1), along with a guarantee of confidentiality and details of ethics (Walter, 2019). Two survey mailings were employed in the form of an initial survey delivery, and a follow-up and reminder survey delivery. Participants for the survey were identified using all postal addresses within the Mōtū catchment sourced from the LINZ Data Service and licensed for reuse under the Creative Commons BY 4.0 licence. The survey was posted out to all available addresses and emailed out to other relevant stakeholders. A total of 154 postal addresses were identified to send out the survey. The survey was sent out to all the 154 postal addresses and emailed to a further 4 participants.

4.7 Survey Design

The survey instrument was designed in Qualtrics (Qualtrics, Provo, UT) using closed questions, simple multiple-choice questions, Likert type questions, and open-ended questions (Appendix 2). Closed questions were used to determine land use type, ownership status, role, age, and gender. While closed questions are beneficial to collect simple data, 'other' options were also made available to ensure participants could answer outside the range of options listed (Walter, 2019). These types of questions also allow for the addition of unexpected but important responses that add value to the data collected (Walter, 2019). The survey questions, similar to Greiner and Gregg (2011), consisted of three overarching questions followed by a set of items in which respondents were asked to rate on a pre-defined Likert-type scale to measure responses. Intensity measures such as Likert-type scales are considered effective in measuring subjective judgements and opinions through closed-ended questions (Nardi, 2018). The survey questionnaire from Greiner and Gregg (2011) was used as the basis of the survey but reformatted to suit the conditions of this research. The survey measured how much each participant felt each factor played a role in the overarching question.

4.8 Interview Methodology

The two main types of sampling procedures are probability and non-probability sampling. Probability sampling determines an appropriate sample by minimising selection bias, which results in a sample representing a larger population, allowing for the generalisation of findings (Walter, 2019). Since a case study is being used for this research, non-probability sampling is used to recruit participants who are likely to contribute the most to the study. This research used purposive sampling for interviews in the form of maximum variation, which aims to capture a wide range of perspectives about the research by selecting participants who may hold contrasting opinions (Coyne, 1997; Yin, 2016).

It has been noted by Walter (2019) that recruiting participants for interviews can be challenging as a certain criteria must be met. This criteria includes the interviewee learning about the research project and its need for participants; they must be interested in the topic enough to participate; participation must be feasible; and they must be motivated enough to take the time needed to participate in the process (Walter, 2019). Because of these requirements, recruiting participants can take some time (Walter, 2019). Due to the time constraints of this research, it was decided that one of the survey questions would give participants the option to put themselves forward to participate in the interview process. While this creates self-selection bias, within the pool of participants that put their names forward, purposive sampling and maximum variation was recruited based on land-use type to try and make the sample as representative as possible (Coyne, 1997).

When considering sample size for interviews, current literature varies greatly with little consensus on exact sample numbers (Guest et al., 2006; Walter, 2019). While Walter (2019) noted that more interviews are better, ten people were interviewed for the purpose of this study and the time constraints involved. Although this is relatively few, this number provided insight into some of the reasoning behind survey results and elaborate on questions in more detail. While this is beneficial for the research, the findings cannot be generalised to the broader population due to their qualitative nature and sample size (Walter, 2019). Voice memos were used to audio record interview data. Audio recording, as opposed to note-taking allows the research to give the interviewee their undivided attention and focus on the interview (Walter, 2019). While audio recording is beneficial, participants were given the option to deny permission to do so. All participants agreed to be audio recorded.

4.9 Interview design

Until recently, research on the perceptions of biodiversity protection has primarily been done using quantitative methods such as surveys (Greiner & Gregg, 2011; Greiner et al., 2009). Interviews have only recently been used to understand the perceptions of biodiversity protection in several studies, including Ingram et al. (2013) and Maseyk et al. (2021). While quantitative methods have their place, they do not allow for studies to explore the perceptions of biodiversity protection and how these perceptions may be influenced. For this research, a semi-structured interview type was selected, allowing participants to express their views on the topic pre-determined by the researcher (Berg & Lune, 2017).

It is recommended by Creswell and Creswell (2018) that when structuring an interview, one central question should be followed by a number of sub-questions. Each question should be answerable in a scientific way, and any potential variables should be defined (Creswell & Creswell, 2018). Alongside this, it was ensured that each question was important enough to obtain valuable data within the time constraints. Although it can be challenging to establish what questions are essential, Creswell and Creswell (2018) noted that questions that produce answers that have already been established should be avoided. While both semi-structured and open-ended questions were employed for the interview design to ensure enough order, with some flexibility, the research design itself was left open for review throughout the process. Ritchie et al. (2013) noted that qualitative research design should be left open to continual review throughout the research process allowing for changes to be made to ensure any opportunities to gather valuable information are not missed.

The purpose of the interviews in this research was to capture contextual information that could not be obtained in the survey. During the interview process, participants were asked to elaborate on their perspectives, specifically regarding their perceived motivators, barriers, and enablers. Questions were also asked relating to and elaborating on any interesting or surprising results that were found in the survey data. The purpose of the research and focus of the interview was introduced to interviewees through an information sheet (Appendix 3) prior to the signing of an interview consent form (Appendix 4). The questions developed to use in the interviews are contained in Appendix 5. Included in the information sheet was a copy of assurance of confidentiality and a list of the rights of participants. Of the 12 participants who were approached to participate through email, ten responded positively, none responded negatively, one no longer wished to be interviewed, and one did not respond at all.

4.10 Pre-Testing

After a satisfactory draft of the survey was developed, it was pre-tested. Pretesting is necessary as it assesses the effectiveness of the research tool being used. When a research tool is pre-tested, any loaded, leading or double-meaning questions can be identified, the suitability and appropriateness of wording for the sample can be determined, and it ensures any issues can be identified in the trial run (Creswell & Creswell, 2018). An advantage of pre-testing is its ability to ensure that all questions necessary to achieve research aims are included (Berg & Lune, 2017). Pretesting involves two main steps. The first involves critically reviewing the research instrument by experts or researchers who are knowledgeable in the research topic, while the second involves administering the survey to people with similar characteristics to those who will be the final participants. For this research, both steps were taken.

Two supervisors from Massey University with experience in conducting surveys and interviews examined the survey and interview to identify any confusing or double-meaning questions, ensure the lengths were appropriate, and to ensure there was no duplication of questions. Following examination by the researcher's supervisors, the survey and interview was distributed to three farmers working in the Mōtū catchment. By pre-testing the survey on the farmers, the suitability of the survey and interview was able to be examined to ensure it did not contain questions with technical terms that would not be understood by participants and to assess the time required to

complete the survey and interview. The responses from the farmers working in the catchment also provided insight into the types of responses that could be expected.

Following multiple reviews of the survey, appropriate changes were made. Changes that were made to the survey following review included the addition of some open-ended questions, changing questions to make them more specific, the changing of wording to ensure no ambiguity, the movement of questions to ensure the survey flowed well, the addition of some response options, and the inclusion of open-ended answer boxes to multichoice questions. These changes were made to ensure clarity for the participant and accurate data collection for the researcher. After examining the interview instrument, additional questions were added to ensure objectives would be met, and some of the question wording was changed to be more specific. Following the survey and interview changes, it was confirmed that planned questions could produce high-quality responses.

4.11 Data Collection

Data was collected over two months between the start of March and the end of April 2021. A total of 62 respondents completed the survey, with an additional 10 participants interviewed. Table 4.1 shows the number of participants from each different land use operation type, and Table 4.2 shows the number of participants from each land ownership type.

Table 4.1: Table showing the distribution of participants from each land use operation type.

Land Use Operation	Interview Participants
Sheep and Beef	5
Dairy	1
Indigenous Forestry	1
Plantation Forestry	2
Non-Productive	1

Table 4.2: Table showing the distribution of participants from each land ownership type.

Land Ownership Type	Interview Participants
Private	6
Trust	1
Leased	1
Māori Freehold	1
Crown	1

Each interview was conducted face to face at the participants' workplaces or homes, and the length of each interview ranged between 17 minutes and 45 minutes. Each interview was conducted in English, with participants having the choice between English and Māori. Notes on each interview about general impressions were also taken.

4.12 Data Analysis

4.12.1 Survey Data

Data analysis was done treating the collected Likert Type data as ordinal. While controversy exists within the literature as to whether Likert Type data should be treated as ordinal or interval, Greiner and Gregg (2011) treated it as ordinal, and for the comparison of data, this research will also treat the data as ordinal (Boone & Boone, 2012; Jamieson, 2004; Sullivan & Artino, 2013). Data analysis was carried out using SPSS (v.27) and Qualtrics StatsIQ. Prior to data analysis in SPSS (v.27), data was cleaned, coded and managed in Microsoft Excel 365. A codebook was created in Microsoft Word 365 following the creation of the coded dataset. Coded data was imported to SPSS (v.27), where relevant data was converted to ordinal before undertaking any analysis. Histograms and non-parametric (Mann–Whitney U) tests were employed because of the ordinal nature of the data. Principal component factor analysis was undertaken similar to Greiner and Gregg (2011). Factors were derived from each question and represent groups of variables that correlate as a new variable (Torkamani, 2005).

The use of principal component analysis by the researcher allows for the comparison of data to Greiner and Gregg (2011). The principal component analysis identifies any underlying structures of variables by using combinations of indicator variables (Dunteman, 1989). Orthogonal axis rotation was used similar to Greiner and Gregg (2011) to extract the variance contribution of each factor component (Dunteman, 1989). Prior to undertaking principal component analysis', several assumption tests were run to ensure principal component analysis would suit the data. Scatter plots, Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy, Bartlett's test of sphericity and a check of standard deviations to check for outliers was undertaken to ensure the survey data was suitable (Dunteman, 1989). Following assumption tests and confirmation that the survey data could be used in a principal component analysis; the analysis was undertaken. An inspection of the initial extracted components was conducted to get a sense of the major components and how much of the total variance each component explains (Dunteman, 1989). A determination of the number of components to retain was based on the default SPSS (v.27) eigenvalue-one criterion. The final rotated solution was then interpreted based on the Total Variance Explained output from SPSS (v.27) and Rotated Components Matrix.

4.12.2 Interview Data

A ‘general inductive approach’ as described by Thomas (2006) was employed by the researcher. This strategy is evident in much qualitative data analysis, but often without a label being given to the strategy (Thomas, 2006). The inductive approach has been described by Thomas (2006) as a systematic procedure for analysing qualitative data where the analysis is guided by evaluation objectives and refers to approaches that use detailed readings of raw data to derive concepts or themes. The purpose of using the inductive approach is to allow findings to emerge from the raw data without the restraints that can be imposed through structured methodologies (Thomas, 2006).

It has been highlighted by Thomas (2006) that the following purposes underly the analysis approach:

- To condense raw data into summary format.
- To establish links between research objectives and findings from the raw data.
- To develop a theory about the structure of experiences evident in the data.

All ten interviews were audio-recorded, and all transcribing was done by the researcher using Microsoft Word for Office 365. Once the interview data was transcribed, NVivo (v.12) was used to analyse the interview data. Using NVivo (v.12), the researcher imported the transcribed interview data and coded the data by question number into different nodes. Transcripts from each interview were read several times to identify themes and categories. After all transcripts were read, a coding frame was developed, and each transcript was coded as recommended by Thomas (2006). Throughout this process, if new codes emerged, the researcher changed the coding frame and reread the transcripts according to the new structure. This process was used to conceptualise developed categories into broad themes to be discussed (Thomas, 2006).

4.13 Research Ethics

Researchers have an ethical obligation to ensure the rights, welfare, and privacy of people and communities in which are being studied are protected (Berg & Lune, 2017). As well as maintaining welfare and privacy, researchers also have the responsibility of empowering and building positive relationships with participants (Israel & Hay, 2006; Scheyvens et al., 2003). Prior to the commencement of data collection and fieldwork, ethical concerns associated with this research were identified using the 'Massey University Code of Ethical Conduct for Research, Teaching and Evaluations Involving Human Participants' guidelines. The primary ethical considerations of this research included obliging to participants rights of privacy and confidentiality. While ethics were considered, this research was deemed low risk as it was not expected to cause any harm or discomfort to the participant or researcher.

The methodology of this study was submitted to the researcher's supervisors for peer review. After reading thoroughly through the objectives, materials, and methods, a discussion was had around the ethical issues that could arise. Ethical issues raised through the peer review process included the need to uphold privacy and confidentiality alongside universal ethical principles, including autonomy, avoidance of harm, benefit, justice, and special relationships. Consent for data collection and use in this research was discussed, and the need to obtain written consent prior to data collection was emphasised. Avoidance of harm was discussed, and given that the research involved a survey and face to face interview, physical harm and psychological harm was deemed unlikely, yet the need for the research to remain autonomous and the need for the researcher to be friendly, polite, and come from a place of learning was emphasised. When considering the privacy and confidentiality of this research, it was discussed that given the researcher obtained written consent, participants were aware of their rights, participants remained anonymous, data was protected, and that the data was disposed of once the research was completed, that the privacy and confidentiality of participants could be upheld.

It was discussed that this research would have minor ethical benefits to participants, but a significant ethical positive would not be necessary as this research avoids harm or ethical negatives. A mention was given to special relationships as the researcher lives within the community being researched. As a survey and semi-structured interviews were used, it was discussed that the special relationship the researcher has with the community would not make the research unethical. To ensure this, the need for the researcher to respect and uphold the ethical obligation to respect participants autonomy, welfare, values, and beliefs was emphasised.

During interviews, each participant reserved the right to decline to answer any questions, withdraw from the study at any time, and request for the audio recorder to be turned off. To maintain confidentiality throughout this research, no direct identifiers such as name, location or job title were included without consent from each participant. Due to the nature of the small community, it was decided that each participant would be referred to by a descriptor to maintain confidentiality and autonomy. Each participant was informed that all data and information used and shared with the researcher would be used only in the dissemination of the findings of this research, and that collected data would be held until the completion of research, at which point it would be destroyed.

4.14 Positionality

In qualitative research, the researcher plays a key role, making positionality an important consideration. Positionality refers to the researcher's worldview and position regarding the research task and its political and social context (Foote & Bartell, 2011; Holmes, 2020). The researcher's world view concerns epistemological assumptions, ontological assumptions, and assumptions about human nature and agency, and this influences how the research is conducted, the outcomes, and the results (Grix, 2018; Holmes, 2020; Ormston et al., 2014). The researcher's identity can largely influence how fieldwork unfolds and may be advantageous or create challenges (Grix, 2018; Holmes, 2020). Some aspects of positionality are fixed, such as race, skin colour and nationality, while others are more subjective and contextual such as political views, experiences and life history (Holmes, 2020). The fixed aspects may predispose the researcher to a particular point of view; however, this does not always mean the researcher will hold these particular views or perspectives (Mullings, 1999). With this in mind, the researcher must not make the wrong assumption of an individual's knowledge based on perceived differences as this may interfere with crucial information (Mullings, 1999).

In this research, the most important aspects of the researcher's identity that shaped fieldwork were background and education. Living in the area provided the researcher with an insider status due to pre-established connections and contacts. The insider status may have allowed participants to express their views more comfortably, whereas they may have been more reluctant to communicate to a researcher from a different community. Despite this, having an insider status did not guarantee easy access to suitable participants. Having a background in environmental science, the researcher may have been considered an outsider or a threat to the current agricultural activities within the catchment.

4.15 Summary

This Chapter provided a description of the research methods. Approaches varied throughout the literature, with the use of choice experiments, interviews, and different types of surveys. Data analysis and response techniques also varied, but after weighing up the benefits of each, it was decided to use a combination of a mail-out survey and semi-structured interviews to determine landowner perspectives. The selection of research methods was also based on the research question, objectives, and an evaluation of methods used in previous studies. The research approach employed was a single case study due to time constraints and involved multiple units of analysis. The case study area was selected as it was a relatively well-known community to the researcher and was suitable to give good representation of vegetation and land tenures across the catchment. Pretesting was carried out for both survey and interview tools prior to data collection. Survey data was analysed using principal component analysis on SPSS (v.27) and through StatsIO on Qualtrics. Interview data was analysed on NVivo (v.12). All ethical considerations were adhered to throughout the data collection process, with information sheets made available to all participants and consent being obtained prior to each interview. Positionality was also considered to ensure the researcher would not make assumptions that would interfere with the validity of the research.

5 Chapter 5: Results

5.1 Introduction

This Chapter presents the results and identifies and describes factors that influence biodiversity protection and management within the Mōtū catchment. This Chapter includes results from the survey and interview data along with descriptive characteristics. This Chapter will begin by describing the participants and their backgrounds, followed by the influencing factors of the motivators, barriers and enablers. The current level of biodiversity protection in the Mōtū catchment and perceptions of future management will also be presented and described.

5.2 Descriptive Characteristics

The survey received 62 responses out of the 154 surveys that were posted out. This represents a 40.3% response rate which is considered to be good (Baruch & Holtom, 2008; Kaplowitz et al., 2004). Although the response rate was good, the sample size of this survey is not large enough to be representative of and generalisable to the larger population; however, the findings are representative of respondents in the Mōtū catchment. Of the survey respondents, 68% (42) identified as Male, and 32% (20) identified as Female, with no respondents identifying as 'other' or 'prefer not to say'. A large proportion of survey respondents identified as New Zealand European at 83% (53), with a further 11% (7) identifying as Māori, and 3% (2) identifying as 'other'. The majority of survey respondents were involved with land management operations of 501+ ha at 61% (37); a further 21% (13) involved with an operation size of between 51-500 ha; 8% (5) involved with an operation size of between 5-50 ha; and a further 10% (6) from a land operation size of between 0-4 ha. The breakdown of land management operation sizes is shown in Figure 5.1.

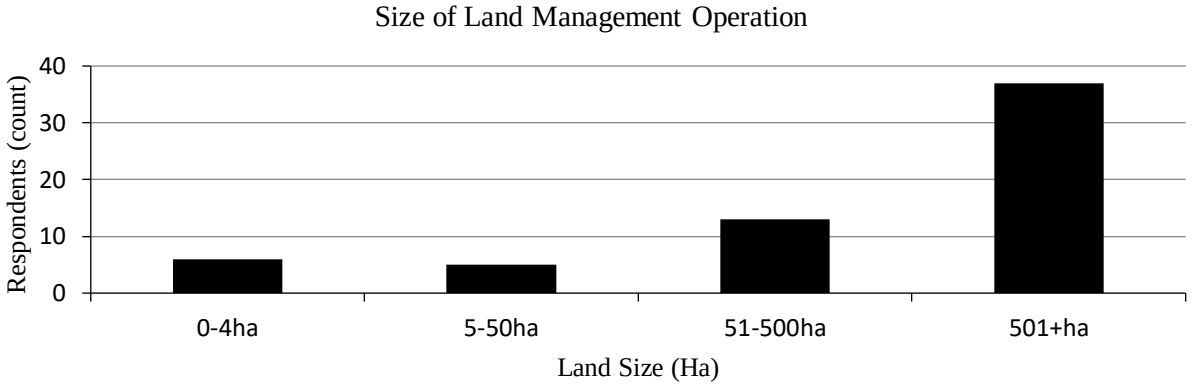


Figure 5.1: Bar chart showing sizes of land management operations for respondents within the Mōtū catchment.

The majority of the survey respondents indicated they have land in private ownership at 67% (41); a further 13% (8) have land in Iwi or Māori ownership; 12% (7) are involved with land in company ownership; a further 3% (2) in crown ownership; 2% (1) in trust ownership; and 3% (2) in 'other' ownership types which include a mixture of private land and conservation estate. The breakdown of land ownership types is shown in Figure 5.2.

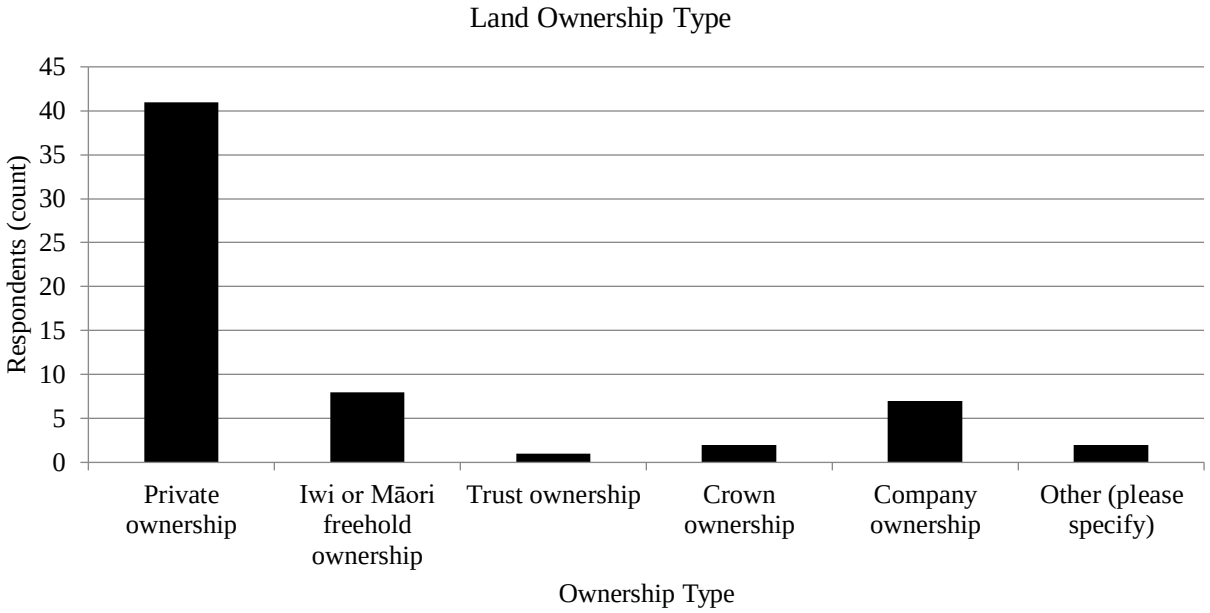


Figure 5.2: Bar chart showing land ownership types for respondents in the Mōtū catchment.

Of the respondents, the majority indicated they are involved with sheep and beef farming operations at 77% (49); a further 8% (5) involved with indigenous forest operations; 6% (4) with plantation forest operations; a further 6% (4) of respondents indicated to be involved with conservation operations; and 3% (2) with dairy farming operations. The breakdown of dominant land management operations is shown in Figure 5.3.

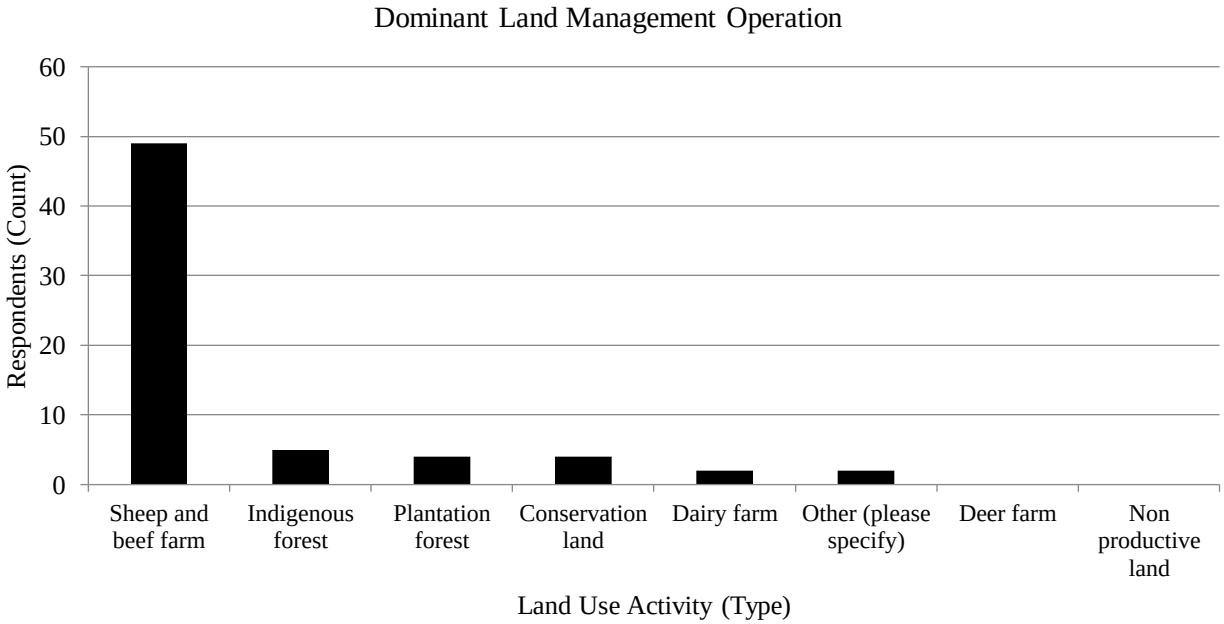


Figure 5.3: Bar chart showing dominant land management operations for respondents in the Mōtū catchment.

5.3 State of Biodiversity

When assessing the representation of native vegetation on respondent's land in the Mōtū catchment, the survey found that 68% (44) of respondents had forest; 67% (43) had shrub; 31% (20) had wetlands; 32% (15) had tussock; and 1% (1) had other which included rimu and other native trees including manuka. All respondents indicated that they had some form of native vegetation on the land they are involved with. The breakdown of native vegetation on respondent's land is shown in Figure 5.4.

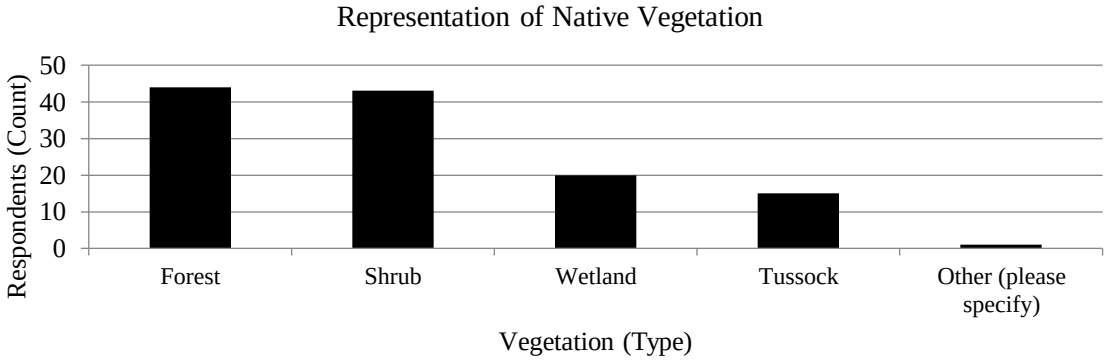


Figure 5.4: Bar chart showing the representation of native vegetation across the Mōtū catchment.

When assessing the native animals that are present on the land respondents are involved with, the survey found that 86% (55) of respondents had weka; 75% (48) had insects such as weta and huhu grubs; 52% (33) had freshwater fish; 31% (20) had geckos and lizards; 22% (14) had kiwi; 16% (10) had whio; 14% (9) noted bats; 11% (7) had Hochstetter's frog; and 17% (11) had 'other' which included different species of native birds. All respondents indicated that they had at least one species of native animal on the land they are involved with. The survey data indicated that the most predominant native animal as perceived by respondents on the land they are involved with is weka. The breakdown of representation of native animals on the land respondents are involved with is shown in Figure 5.5.

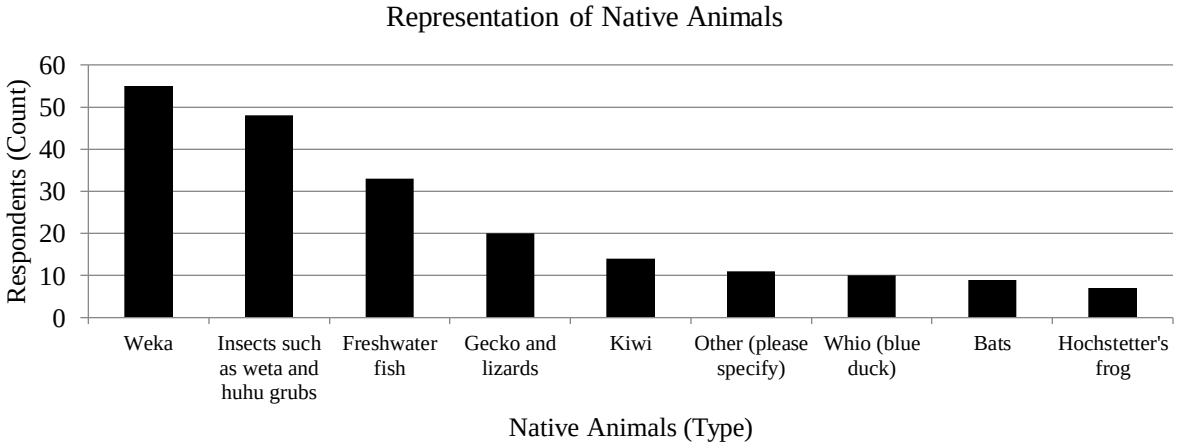


Figure 5.5: Bar chart showing the representation of native animals across the Mōtū catchment.

With respect to pests, the survey data found that 63% (40) of respondents recorded 'all of the above' when considering which pests are present on their land. This includes rats, possums, feral cats, deer, stoats, goats, and pigs. Of the respondents that did not record 'all of the above' 47% (30) knew of rats on their land; 45% (29) know of possums; 42% (27) know of feral cats; 39% (25) know of deer; 36% (23) know of stoats; 30% (19) know of goats; 25% (16) know of pigs; and 9% (6) described 'other' pests including turkeys, pheasants, rosellas, ferrets, hedgehogs, peacocks, mice, wasps, magpies, rabbits, hares, and weasels. All respondents indicated that pests were present on the land they are involved with. The breakdown of representation of pest species is shown in Figure 5.6.

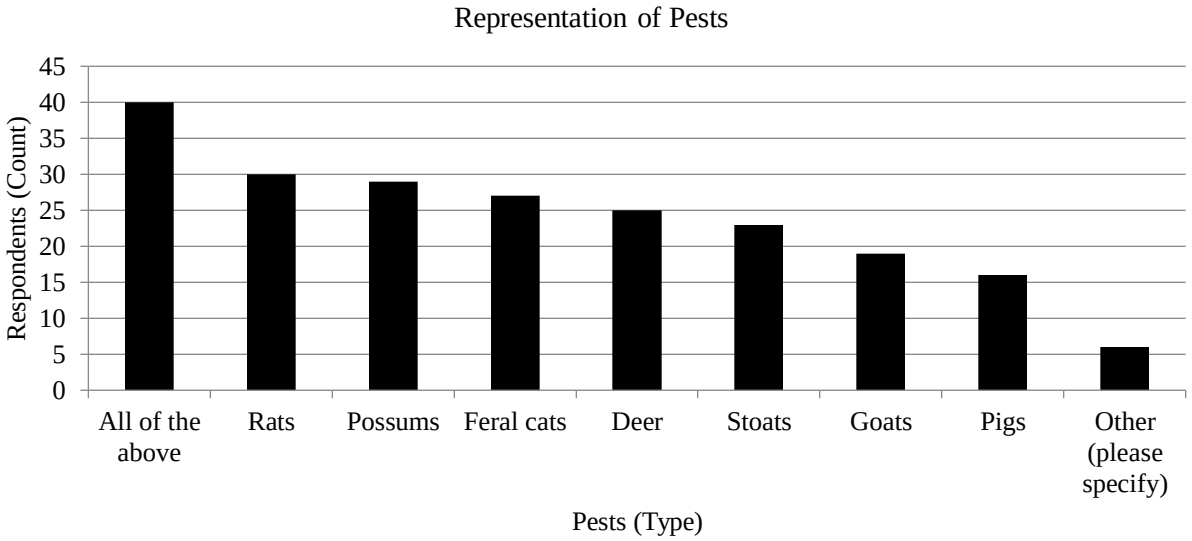


Figure 5.6: Bar chart showing the representation of pests across the Mōtū catchment.

When assessing the importance of native biodiversity in the Mōtū catchment, the survey asked respondents on a scale of 1 to 5 ranging from very unimportant to very important how important or unimportant it was for them to have native biodiversity in the catchment. Of the respondents, 49% (27) felt it was very important to have native biodiversity in the Mōtū catchment; 38% (21) felt it was important to have native biodiversity in the catchment; 7% (4) felt neutral about having native biodiversity in the Mōtū catchment; and 5% (3) felt it was very unimportant to have native biodiversity in the Mōtū catchment. This highlights that most respondents in the Mōtū catchment perceive native biodiversity to be valuable. Data from the interviews suggested that all interviewees thought biodiversity was important to have in the Mōtū catchment and felt intrinsic value from its presence which seemed to play an important role in interviewees motivations. There was not consensus on any particular component of biodiversity being the most important, with interviewees highlighting the importance of healthy waterways, the variety of plant life, and the presence of kiwi, weka, and whio. One interviewee emphasised the extent of perceived motivation and level of protection.

> "Biodiversity is important […] but there is a perceived state by individuals as to what is an optimal level of biodiversity and its quality, meaning motivations for its protection may differ depending on one's perception of their optimal quality and extent of biodiversity (an indigenous forest representative, interview no 3, Gisborne)."

5.4 Current Level of Protection

The survey aimed to understand the current level of biodiversity protection in the Mōtū catchment and indicate the willingness of respondents to participate in future protection activities. This was determined by asking questions about current protection activities and respondents' willingness to increase the size of patches of indigenous vegetation. When assessing the current level of biodiversity protection activities, respondents were asked to indicate what sort of pest control measures they were undertaking, if any. Of the respondents, 98% (63) indicated that they were undertaking pest control management. Of these respondents, 83% (53) indicated that they were using shooting as the main pest control method; 42% (27) were trapping; 25% (16) were poisoning; and 3% (2) were using other pest control methods including the mustering goats. This highlights that most respondents in the Mōtū catchment are actively participating in pest control measures, mostly in the form of shooting. The breakdown of pest control methods used by respondents in the Mōtū catchment is shown in Figure 5.7.

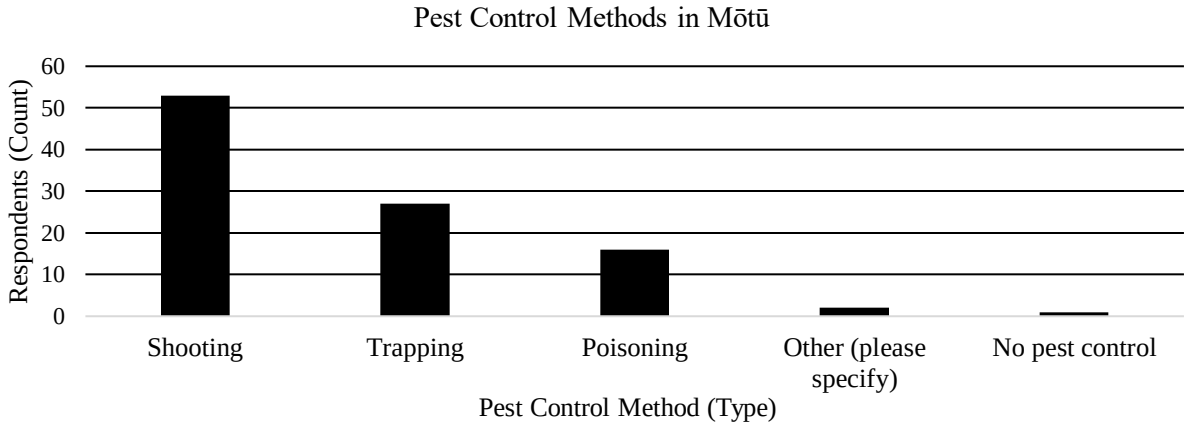


Figure 5.7: Bar chart showing pest control methods used in the Mōtū catchment.

Interview data found that all interviewees were concerned by the presence of pests within the Mōtū catchment and were all undertaking pest control measures. Although all respondents were concerned about the pests, there was no consensus around using 1080 as a pest control method. One interviewee emphasised the need for the use of 1080.

> "To be efficient and effective at controlling pests in the Mōtū catchment, especially in the Raukumara's the use of aerial 1080 is important […] the use of 1080 is the most effective pest control method we have access to right now, and it is needed to control pests in vast areas of steep terrain such as those in the Mōtū catchment (a public conservation estate representative, interview no4, Gisborne)."

While some interviewees emphasised the need for the use of 1080 and its benefits to the Mōtū catchment, others did not respond positively and outlined why it should not be used.

> "Using 1080 in the catchment will wipe out the deer and pigs […] if you have no deer, you can't get people to come and work in the catchment because it is isolated and employees need something to do recreationally […] 1080 can also kill our working dogs if they eat poisoned carcases and same with the weka which are doing well here (a sheep and beef farm representative, interview no 6, Gisborne)."

Although some interviewees were strongly opposed to or strongly for the use of 1080 in the Mōtū catchment, others recognised the challenges associated with its use and suggested potential ways of making it work.

> "If people want to use 1080, then only use it in the conservation estate […] I understand the concerns, especially around dogs, but this can be monitored. Just imagine trying to trap all the conservation estate, people today don't want to do that sort of thing, especially because of the extent and terrain, so you have to assess what other options are out there. Egmont National Park has used 1080 over the national park and surrounded this area by an extensive trapping buffer zone to prevent any pests from getting in or out. Something like that could work in the Mōtū catchment if you 1080 the conservation estate and use a trapping buffer zone (a non-productive land-use representative, interview no 8)."

Alongside understanding the current level of pest control measures, the survey asked a question to gain an understating into other biodiversity protection activities that have been or are being used by respondents in the Mōtū catchment. When asked which of the following they have done or are doing to protect native biodiversity on the land they are involved with, 78% (50) of respondents indicated that they have been or are controlling weeds; 58% (37) have been or are planting native species; 56% (36) have been or are fencing off bush blocks or gully vegetation; 45% (29) have been or are fencing off wetlands or waterways; 13% (8) have been or are legally protecting areas; and 8% (5) have been or are undertaking 'other' measures which include predator fencing, data collection of species present, and deer fencing. This highlights that most respondents in the Mōtū catchment are currently undertaking biodiversity protection activities alongside pest control measures. The breakdown of biodiversity protection activities being undertaken by respondents in the Mōtū catchment is shown in Figure 5.8.

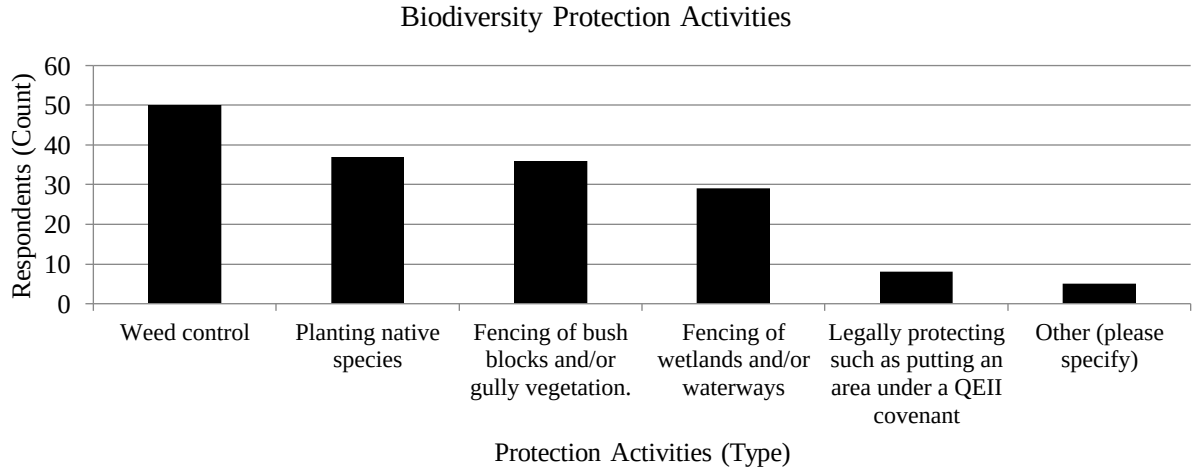


Figure 5.8: Bar chart showing biodiversity protection activities used in the Mōtū catchment.

The interview process was used to determine if a local source of plant material, such as a community nursery, would appeal to interviewees when considering the plantation of native species. All interviewees responded positively to the idea, especially regarding the ability for the plants to grow well and reduce the risk of bringing in plant diseases. All interviewees also responded positively to providing seed source from their land, and some were keen on the idea of getting involved.

> "If I was younger, I would love to be running a community nursery or something similar that would provide native plants to people in the catchment […] having Eco-sourced plants to use in biodiversity protection activities would be great for their chance of survival […] you would have to plan this in advance as the lead in time for collecting seed until germination can take a while and land would need to be available for this (a non-productive land representative, interview no 7, Mōtū)."

One interview question was also used to determine what sort of biodiversity protection measures respondents' thought were the most important going forward into the future. The need for fencing and planting off waterways was the strongest response from interviewees.

> "Stock exclusion needs to happen now anyway, but expertise in the area of planting waterways is lacking. Planting needs to be done, but this needs to be done properly from the beginning, and you need to be using the right plant in the right place, and it will do the job that is meant to. At the moment, there is hardly anyone that knows what plants are needed where or how to look after them and getting the right plants to use can be tricky (a non-productive land representative, interview no 7, Mōtū)."

The need for more in the way of pest control was also highlighted, especially regarding the protection of weka, kiwi and whio in the catchment.

> "Pest control needs to happen along streambanks to protect the blue duck which are exposed to prey. Cats, possums, hedgehogs, and goats are everywhere, preventing the regeneration of the understorey. I do not think 1080 is the absolute best method for pest control in the catchment, but it is also the best pest control tool we have right now to control pests. This is also good for the control of TB, which we do not want in the catchment (a sheep and beef farm representative, interview no 10, Mōtū)."

In order to understand how respondents in the Mōtū catchment felt about increasing the size of patches of native vegetation on the land they are involved with, respondents were asked to consider how likely or unlikely they would be to increase the size of patches of native vegetation on this land. The results showed that 29% (16) respondents would be very likely to increase the size of patches of native vegetation on their land; 38% (21) would be somewhat likely; 24% (13) responded neutrally; 2% (1) would be somewhat unlikely; and 7% (4) would be very unlikely (Figure 5.9). This highlights that over half of respondents in the Mōtū catchment would be likely to increase the size of patches of native vegetation on the land. This is important to note as maintaining or increasing the size of patches of native vegetation may be important to further prevent the effects of habitat fragmentation.

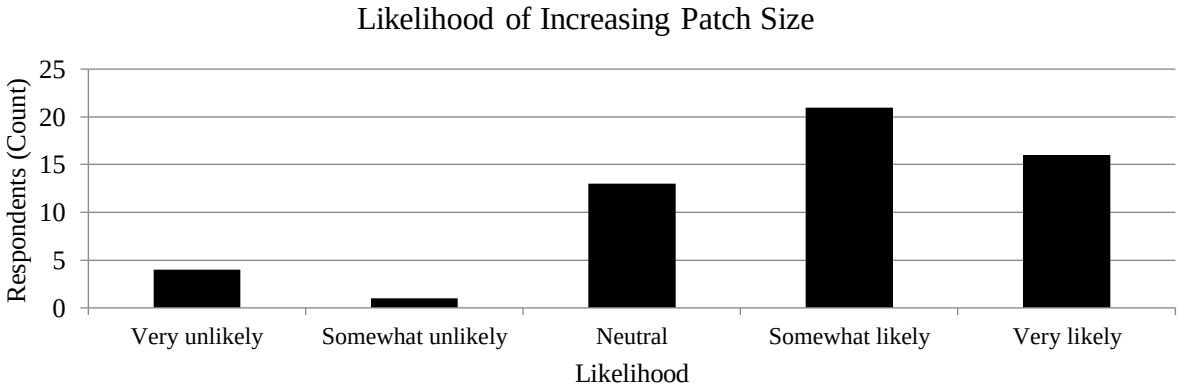


Figure 5.9: Bar chart showing respondents likelihood of increasing the size of patches of indigenous vegetation on their land.

The interview was used to further determine where on their land respondents would be most likely to increase the size of patches of native vegetation. While there were mixed responses from interviewees, many emphasised that they would be most likely to increase the size of patches along streambanks or less productive areas.

> "I would increase native vegetation along waterways as this doesn't encroach on my productive land, but it is also good for streambank stability, habitat creation and shading (a dairy farm representative, interview no 9, Mōtū)."

5.5 Motivating Factors

The survey data found that the most important factor influencing land use operation motivations for respondents in the Mōtū catchment is 'passing on the land in great condition', which received a mean score of 4.7 out of 5 as shown in Table 5.1. The standard deviation for this factor was shown to be 0.5, which indicates that the data points tend to be close to the mean. This suggests that 'passing on the land in great condition' is an important motivating factor for respondents in the Mōtū catchment. The factor labelled 'looking after the environment and protecting native plants and animals' was the second most important motivating factor for respondents in the Mōtū catchment with a mean score of 4.5 out of 5 as outlined in Table 5.1. The standard deviation for this factor was shown to be 0.7, indicating that the data points tend to be close to the mean. The third most important motivating factor for respondents was 'improving resource/ land use' with a mean score of 4.4 out of 5. This factor also had a standard deviation of 0.8, suggesting that the data points are somewhat close to the mean.

Table 5.1: Table showing factor results for motivation items.

Factor	Minimum	Maximum	Mean	Std Deviation	Variance
Passing on the land in great condition	3.00	5.00	4.68	0.53	0.29
Being appreciated by society and colleagues	1.00	5.00	3.15	1.22	1.49
Being amongst the best in the industry	1.00	5.00	3.58	1.14	1.30
Building up wealth and family/company assets	1.00	5.00	3.61	1.26	1.59
Earning a high income	1.00	5.00	2.93	1.31	1.72
Improving resource/land use	1.00	5.00	4.35	0.77	0.59
Looking after the environment and protecting native plants and animals	3.00	5.00	4.49	0.65	0.42

Data from the survey found that for respondents in the Mōtū catchment, 'earning a high income' was the least important motivating factor when it comes to their land management operation. This factor was shown to have a mean of 2.9 out of 5, the lowest of all factors. The standard deviation of this factor is 1.3, suggesting the data points are spread out from the mean. This could mean that respondents in the Mōtū catchment are not in strong agreement around the extent to which earning a high-income acts as a motivating factor. Overall, the survey data highlighted that respondents in the Mōtū catchment were motivated more by intrinsic and stewardship motivations and less so by financial motivations, as shown in Figure 5.10.

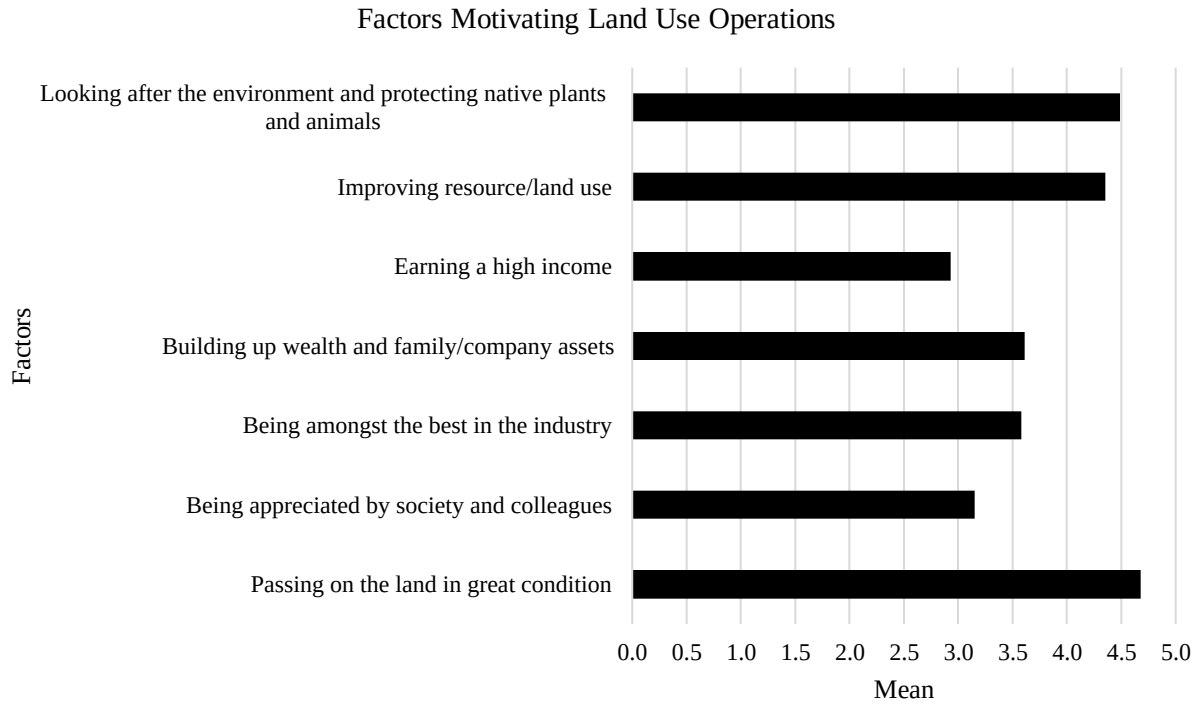


Figure 5.10: Bar chart showing results for motivation items.

5.6 Factors Influencing Barriers

The most important barrier influencing the uptake of biodiversity protection activities for respondents in the Mōtū catchment was the factor labelled 'not enough time, staff or labour', which received a mean score of 4.3 out of 5 as shown in Table 5.2. The factor labelled 'lack of government or financial incentives' was shown to be the second most important barrier to biodiversity protection for respondents in the Mōtū catchment with a mean of 3.8 out of 5, as shown in Table 5.2. The standard deviation for both factors was 1, indicating that the data points vary in distance around the mean and suggesting that respondents in the Mōtū catchment are not in strong agreement around the extent to which these factors act as barriers to biodiversity protection.

Table 5.2: Table showing factor results for barrier items.

Factors	Minimum	Maximum	Mean	Std Deviation	Variance
Conservation is not practical on your land	1.00	4.00	1.72	0.97	0.94
There is lack of government or financial incentives	1.00	5.00	3.76	1.01	1.01
There is lack of industry support	1.00	5.00	2.74	0.94	0.88
There is not enough time, staff or labour	1.00	5.00	4.28	0.97	0.94
It is not necessary to improve the environment	1.00	4.00	1.35	0.69	0.47
Other landowners/managers may not change their ways	1.00	5.00	3.31	0.89	0.80
There is uncertainty about the future of the property	1.00	4.00	2.05	0.94	0.89
It is a waste of potential grazing or production land	1.00	5.00	2.69	1.33	1.77
Regulatory framework	1.00	5.00	2.82	0.93	0.86
Personal financial constraints	1.00	5.00	3.29	0.88	0.78

One interview question was asked to elaborate on the perceived lack of government and financial incentives, with the majority of interviewees agreeing that there is a lack of government or financial incentives. It was emphasised that while there may be financial support available, it is hard for interviewees to apply for this, and assistance would be helpful.

> "There might be funding out there, but I don't know where to look for it, so it doesn't seem like there is much. If someone were to come and help me find the funding and help me apply for it, this would be really good. A catchment group would also be good for this sort of thing […] it can help with sharing knowledge but also everyone in the catchment group could apply for funding together and this would make it a lot easier (a sheep and beef farm representative, interview no 5, Matawai)."

One other interviewee emphasised that despite knowing how to apply for the funding, they still found the process difficult.

> "I don't think there is a lack of government or financial incentives because of jobs for nature funding from the Department of Conservation (DOC) and the Ministry for the Environment (MfE) […] this is linked to job outcomes as well as biodiversity protection so the funding has changed and what use to be available for community groups is now targeted at job creation as a Covid recovery incentive […] understanding the process for getting financial support and applying for this support can be really difficult which can stop a lot of people from progressing with applications (a conservation estate representative, interview no 4, Gisborne)."

Data from the survey found that for respondents in the Mōtū catchment, the factor that had the least importance as a barrier for biodiversity protection was labelled 'it is not necessary to improve the environment'. This factor had a mean of 1.4 and a standard deviation of 0.7, as shown in Table 5.2. The survey data also found that on average, respondents in the Mōtū catchment disagreed with the factor labelled 'conservation is not practical on your land', which had a mean of 1.7 and standard deviation of 1, as shown in Table 5.2. This indicates that respondents in the Mōtū catchment are not hindered by the practically of biodiversity protection on the land they are involved with. Overall, the survey data highlighted that on average, respondents in the Mōtū catchment suggested that a lack of resources and finance are the strongest influencing barriers to biodiversity protection; however, the practically of conservation and need to improve the environment do not act as strong barriers as shown in Figure 5.11.

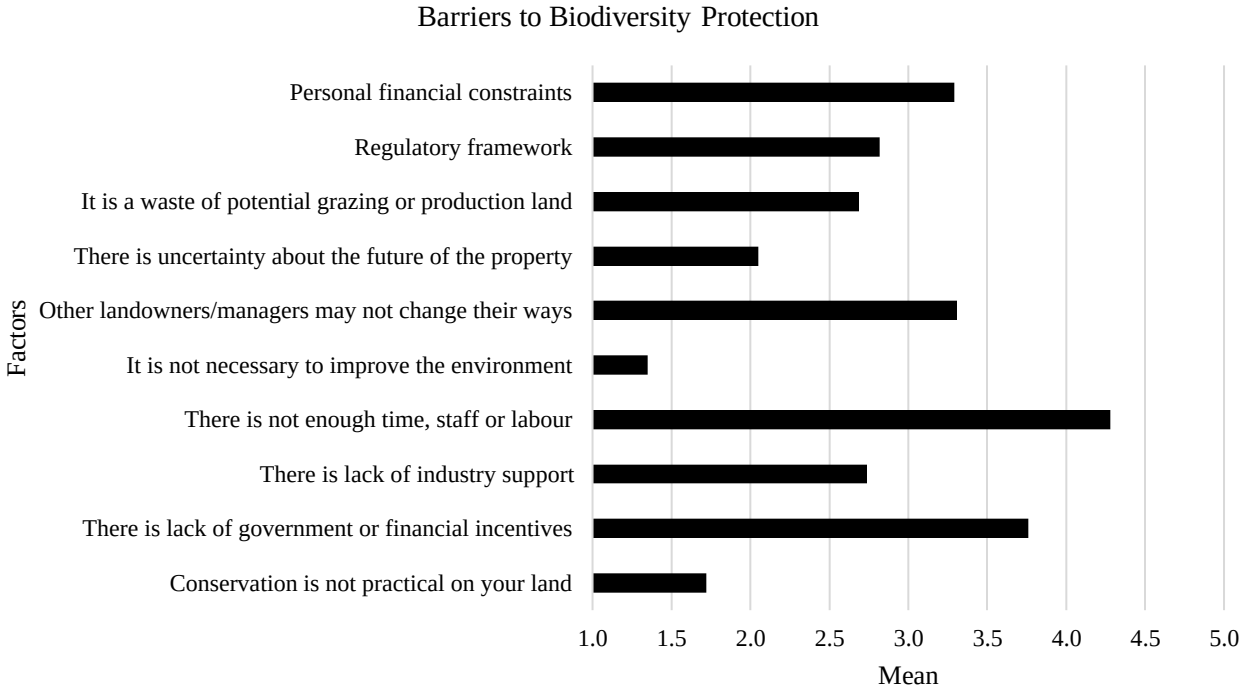


Figure 5.11: Bar chart showing results for barrier items.

5.7 Factors Influencing Enablers

The research found that on average, the most important enabler for biodiversity protection for respondents in the Mōtū catchment would be a 'financial or economic incentive', which received a mean score of 3.9 out of 5 as shown in Table 5.3. The standard deviation of this enabling factor was shown to be 1, indicating that the data points vary in distance around the mean. The interview process was used to further understand how financial or economic incentives could help to enable biodiversity protection and any particular incentives that interviewees were interested in. The need for assistance with funding applications was mentioned by all interviewees, along with the idea that there should be an economic value placed on biodiversity.

> "The crown requires a certain level of paperwork participation that makes many people turn away which is just the nature of the beast […] financial incentives might need to be targeted at collective groups of people, or otherwise there needs to be assistance with funding applications […] catchment groups are beneficial for applying for funding as a collective group but it would also be good to have the value of biodiversity economically recognised (an indigenous forest representative, interview no 3, Gisborne)."

Table 5.3: Table showing factor results for enabling items.

Factors	Minimum	Maximum	Mean	Std Deviation	Variance
Financial or economic incentive	1.00	5.00	3.93	1.02	1.05
Catchment and knowledge sharing groups	1.00	5.00	3.27	0.90	0.82
Personal motivation and goals	2.00	5.00	3.80	0.90	0.82
More research on biodiversity protection and restorat	1.00	5.00	3.07	1.02	1.05
Community involvement in the groundwork	1.00	5.00	2.73	1.12	1.25
Environmental management plans	1.00	5.00	2.68	1.16	1.35
Government environmental regulation	1.00	5.00	2.57	1.09	1.19
Increased public and peer acknowledgement of environmental achievements	1.00	5.00	2.93	1.28	1.63

On average, 'personal motivation and goals' was shown to be the second most important enabler for biodiversity protection for respondents in the Mōtū catchment, with a mean of 3.8 out of 5 as shown in Table 5.3. The standard deviation for this factor was 0.9, suggesting that respondents in the Mōtū catchment are somewhat in agreement around the extent to which this factor acts as an enabler for biodiversity protection. While on average, 'catchment and knowledge sharing groups' was not one of the strongest influencing enablers for biodiversity protection for respondents in the Mōtū catchment, it is still worth mentioning with a mean of 3.3 out of 5 as shown in Table 5.3. Interviews were used to determine if interviewees were currently a part of a catchment group and if they found this to be beneficial. Alongside this, if they were not already a part of one, they were asked their thoughts on being a part of one. All interviewees responded positively to the idea of a catchment group. Those who were already a part of one emphasised that they were great in terms of knowledge generation and project alignment.

> "I would like to be a part of one […] if everyone was on the same page then you know you aren't the only one that is putting in the effort, and it could be the people that aren't putting in the effort that actually need the support and guidance from something like a catchment group (a sheep and beef farm representative, interview no 5, Matawai)."

Overall, the survey data highlighted that on average, respondents in the Mōtū catchment suggested that government and financial incentives along with personal motivation and goals are the most important factors that could enable biodiversity protection, while government regulation and environmental plans would be the least effective as shown in Figure 5.12. The interview data highlighted that interviewees were interested in the creation of a financial or economic incentive.

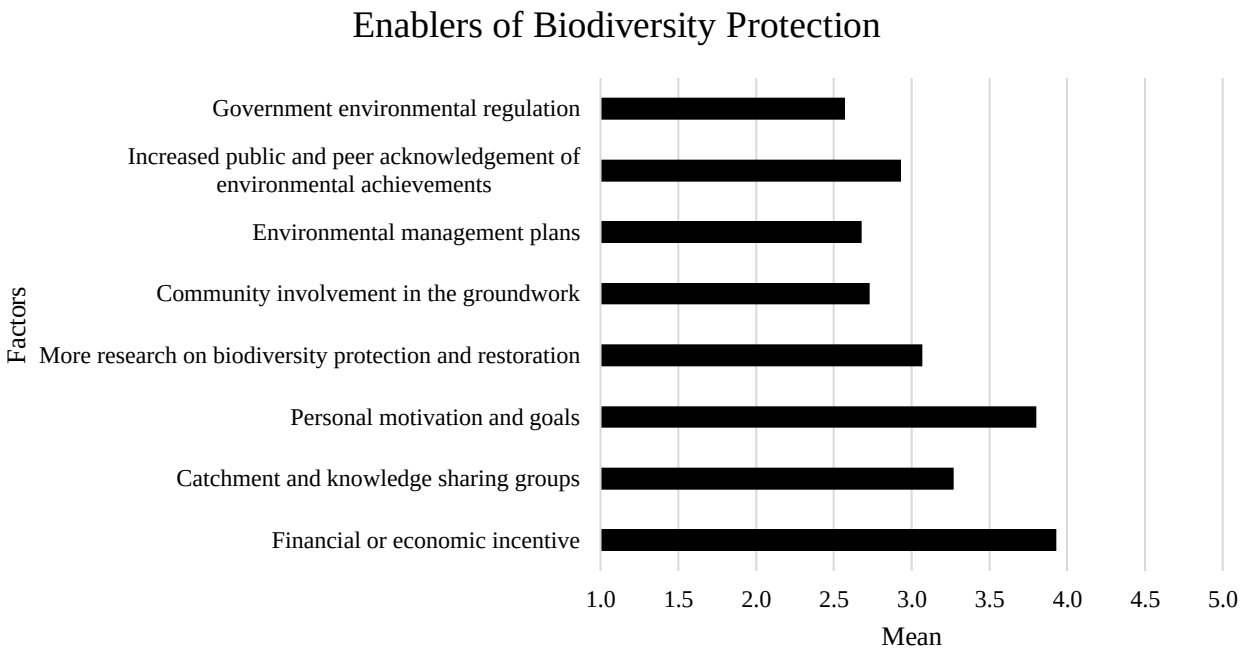


Figure 5.12: Bar chart showing results for enabling items.

5.8 Principal Component Analysis

The principal component analysis for motivational items produced a three-factor model (Table 5.4) explaining 71% of the variance within the dataset. The three motivation factors were 'economic/financial motivation', 'conservation motivation', and 'social and lifestyle motivation'. There was no incidence of items loading on multiple factors and the factors derived were internally consistent. Economic and financial motivations were associated with building up wealth and company assets along with earning a high income. Conservation motivations were associated with improving resource and land use as well as protecting native plants and animals. Social and lifestyle motivations were associated with 'passing on the land in great condition', 'being amongst the best in the industry', and 'being appreciated by society and colleagues'.

Table 5.4: Factor loading matrix of motivation items: three-factor model.

Motivation Item	Component 1	Component 2	Component 3
Passing on the land in great condition	-0.313	0.368	**0.580**
Being appreciated by society and colleagues	0.414	-0.107	**0.649**
Being amongst the best in the industry	0.264	0.061	**0.800**
Building up wealth and family/company assets	**0.873**	0.142	0.139
Earning a high income	**0.814**	-0.143	0.196
Improving resource/land use	0.329	**0.854**	-0.066
Looking after the environment and protecting native plants and animals	-0.290	**0.757**	0.177

The principal component analysis on barrier items produced a four-component model, which explained 64% of the variance within the dataset as shown in Table 5.5. The barrier component 'lack of industry support and guidance' represented barriers based on a lack of perceived support and guidance from industries, along with guidance around regulatory frameworks. The barrier component 'practicality and financial barriers' represented practicality barriers in terms of biodiversity protection which included wasting potential grazing or production land, that conservation is not practical on the land, and a lack of government and financial incentives. The component of 'opportunity cost and resource barriers' was represented by barriers associated with a lack of time, staff and labour and personal financial constraints. The final component termed 'risk and uncertainty barriers' represented risk and uncertainty associated with the perception that other landowners may not change their ways, and that there is uncertainty about the future of the property.

Table 5.5: Factor loading matrix of barrier items: four-factor model.

Barrier Item	Component 1	Component 2	Component 3	Component 4
Conservation is not practical on your land	0.441	**0.569**	-0.252	0.003
Lack of government and financial incentives	0.313	**0.663**	0.146	0.015
Lack of industry support	**0.712**	0.011	-0.060	0.337
Not enough time staff or labour	-0.164	0.404	**0.754**	-0.009
It is not nessecary to improve the environment	**0.516**	0.073	0.194	0.271
Other landowners/managers may not change their ways	-0.102	-0.221	0.351	**0.703**
There is uncertainty about the future of the property	0.149	0.057	0.264	**0.805**
It is a waste of potential grazing or production land	-0.094	**0.823**	0.120	0.304
Regulatory framework	**0.700**	0.211	0.078	-0.127
Personal financial constraints	0.342	-0.112	**0.736**	0.047

The principal component analysis based on biodiversity protection enablers produced a two-component model (Table 5.6), which explained 69% of the total variance within the data. The component ‘industry and community action enablers’ represented voluntary industry and farm-based planning tools along with recognition factors. The other component labelled 'financial and personal enablers' represented personal motivation and economic or financial incentives.

Table 5.6: Factor loading matrix of enabling items: two-factor model.

Enabler Item	Component 1	Component 2
Financial or economic incentive	-0.174	**0.850**
Catchment and knowledge sharing groups	**0.664**	0.399
Personal motivation and goals	0.179	**0.804**
More research on biodiversity protection and restoration	**0.777**	0.113
Community involvement in the groundwork	**0.870**	-0.044
Environmental management plans	**0.867**	-0.124
Increased public and peer acknowledgement of environmental	**0.805**	-0.122
Government environmental regulation	**0.572**	0.133

5.9 Summary

This Chapter described the results and findings of this research based on survey and interview results. The descriptive characteristics were presented from the survey data along with findings which related to the main objectives. This included results relating to the current state of biodiversity in the Mōtū catchment and its current level of protection, along with how strongly different factors acted as motivators, barriers, and enablers for biodiversity protection. It was found that the current level of protection in the Mōtū catchment is relatively high, yet respondents indicated the need for more protection. The results showed that respondents were primarily motivated by environmental factors, including looking after the environment and protecting plants and animals. The main barriers to biodiversity protection were a lack of time, staff, labour, and financial barriers, while the most important enabling factors would be more personal motivation and financial support.

6 Chapter 6: Discussion

6.1 Introduction

This Chapter discusses the findings of this research and is broken down into four main sections. The first section addresses the first objective of this research and discusses the current level of protection in the Mōtū catchment and its associated management activities including the protection of habitat, fencing, planting, and pest control, as determined from the survey and interview results. The following section discusses the perceived motivators, barriers, and enablers in relation to the objective 2 of this research. The perceived motivators, barriers, and enablers are compared to existing empirical evidence and examined in relation to the TPB, and the implications of these findings are assessed. The best approach for the future management of the Mōtū catchment is then discussed in relation to objective 3 of this research. Limitations of this research are then presented, including the sample size and response rate, sampling bias, the sampling procedure, scaled question bias, response bias and interviewer bias.

6.2 Current Management Actions

There is limited detailed data on the biodiversity in the Mōtū catchment; however, data from the survey confirmed that indigenous vegetation is represented across all land use and ownership types and that the majority of respondents are undertaking biodiversity protection activities. Assessing the current extent of biodiversity and associated protection activities in the Mōtū catchment can help to determine any shortfalls and focus areas for the future management of indigenous biodiversity. As the results have shown, biodiversity protection methods include pest control, fencing off wetlands, waterways and bush blocks, alongside planting native species, weed control, and putting areas under legal protection. The survey data found that the predominant biodiversity protection activity is pest control, followed by weed control and then planting native species. While the survey data determined the current level of protection, the interviews confirmed that respondents in the Mōtū catchment would like to see more biodiversity protection.

The perceived need for more protection by respondents indicates that current efforts are not enough. Although respondents want to see more in the way of biodiversity protection, one of the main barriers to achieving this is the lack of external incentives and financial support. As highlighted in the conceptual framework (Figure 2.1), private investment in the environment provides both public and private benefit; therefore, private investment will often be below what is optimal, in this case for biodiversity protection efforts (Hajkowicz, 2009; Reeson, 2008). Although respondents in the Mōtū catchment are already undertaking protection measures, this theory could explain why they emphasise a need for more as investment could be occurring to a point where it is economically rational from a self-interest perspective (Reeson, 2008). An example of this is landowners fencing off waterways to meet the requirements of the NPS – FM. Landowners may invest in fencing, which has spinoffs for biodiversity including erosion control through reducing stock access to waterways. However, they may not invest in the planting of streambanks unless it is a requirement for them to do so as it is not economically rational from a self-interest perspective. As landowners and managers are responsible for part of the New Zealand landscape, the protection efforts they undertake are potentially doing a service for the country which supports the need for

an external incentive such as a payment for ecosystem service scheme. Such an incentive could stimulate biodiversity protection past the point of what is considered economically reasonable from a self-interest perspective (McWilliam & Balzarova, 2017).

Certain land use activities, particularly pastoral farming is encountering social and political pressure to reduce its environmental impact, with concerns being raised around its effects on water quality, erosion and greenhouse gas emissions (Ministry for the Environment, 2019; Norton et al., 2020). These social and political pressures could be having an influence on the landowners' perceived need for more protection activities, and thereby an increase in the perceived need for a social licence to operate. Specifically there is a perceived need for an increase in native planting and pest control by pastoral farmers, which alongside being a biodiversity protection activity has added benefits of reducing flows of nutrients, preventing erosion, locking in carbon, and reducing damage caused by floods (Dominati et al., 2021; Dominati et al., 2019; Forsyth et al., 2018; Mace et al., 2012; Norton et al., 2020; Osborne & Kovacic, 1993). While pressures exist, participating in these protection activities can contribute to creating landscapes that are more diverse and therefore receive a greater range of environmental and biodiversity benefits which is beneficial to the landowner and the environment (Gómez-Creutzberg et al., 2020; MfE & Stats NZ, 2021).

6.2.1 Habitat Quality

As shown in Chapter 3, the Mōtū catchment is unique in that the upper and lower portions of the catchment are in public conservation estate, while pastoral land runs through the middle. The value of these remaining patches of indigenous vegetation through the pastoral areas of the Mōtū catchment are high, as these patches may be the only connections linking the areas of conservation estate for particular species. Understanding how respondents in the Mōtū catchment feel about increasing the size of patches of indigenous vegetation as a management action plays an important role in the future of biodiversity protection. As emphasised in Chapter 2, the protection of patches of indigenous vegetation can be critical to the conservation of particular species, especially in landscapes that rely on a few patches of habitat located on private land (Erwin et al., 1995; Fischer & Lindenmayer, 2002; Flaspohler et al., 2010; Greiner, 2015b; Le Roux et al., 2015; Wintle et al., 2019). The positivity around increasing the size of patches of indigenous vegetation in the Mōtū catchment is reassuring, as this management action has been shown to help improve movement between remaining patches, and species richness within patches (Gibbs, 2001; Gurd et al., 2001; Krauss et al., 2010; Schmiegelow & Mönkkönen, 2002).

The positivity around an increase in patch size also reflects landowners' and managers' positive attitudes towards biodiversity protection in the Mōtū catchment as a whole. While data from the survey indicated that the majority of respondents felt positively towards increasing the size of patches of indigenous vegetation, interviews indicated that respondents would be most likely to do so in riparian or less productive areas. The consensus around the use of riparian margins for increasing habitat size is important, as targeted planting along the main body of the Mōtū river and its tributaries could be beneficial for reducing nutrient loss and act as an important indigenous habitat corridor that could link the public conservation estate at the top of the Mōtū catchment, with the public conservation estate at the bottom. This would be beneficial for species movement, diversity, richness and abundance (Wintle et al., 2019) while also helping to improve water quality through reduced nutrient and sedimentation losses (Osborne & Kovacic, 1993).

Alongside being able to assist in the creation of habitat corridors, increasing the size of patches of indigenous vegetation and creating linkages in the Mōtū catchment could assist in reducing patch isolation, which plays an important role in species richness (McCoy & Mushinsky, 1999; Rukke, 2000; Virgós, 2001; Wilson et al., 2016). Reducing patch isolation can increase within patch intra-specific interaction opportunities and ensure that species do not become functionally isolated, which is important for the safeguarding of genetic flow between populations and increasing resilience in degraded ecosystems (Donald & Evans, 2006; Hanski & Ovaskainen, 2000). Therefore, increasing the size of patches of indigenous vegetation, and developing linkages can act as an important management action that can support the protection of indigenous biodiversity in the Mōtū catchment.

When considering the size of patches of indigenous vegetation, it is important to highlight how this is relevant to the Mōtū catchment. As the Mōtū catchment is the only place in the North Island where kiwi and weka co-habit, it is important to protect this feature and ensure that space and linkages for habitat are available as populations grow (Gisborne District Council, 2021). Weka in the catchment rely on dense shrub and understorey along with riparian margins for maximal coverage and runs while whio also rely on riparian vegetation for survival (Baillie & Glaser, 2005; Carpenter et al., 2021; Carroll, 1963). Riparian planting can also provide shading to stream banks which is beneficial to creatures of interest such as the Hochstetter's frog (McLennan 1985) and species that may not have yet been recorded. As outlined in Chapter 5, it is reassuring that respondents in the Mōtū catchment feel positively towards increasing the size of patches of indigenous vegetation, especially along riparian margins, as this is valuable to the weka populations. While increasing the size of patches of indigenous vegetation is beneficial for weka populations, it is also beneficial for kiwi, as it provides important dispersal habitat (McLennan et al., 1987; Sporle, 2017; Taborsky & Taborsky, 1995). The positivity around increasing the size of patches of indigenous vegetation especially along riparian margins is similar to positivity found in other studies including Maseyk et al. (2021), and is key as this management action could not only act as an important linkage between the conservation estates but is beneficial to both flora and fauna.

6.2.2 Fencing and Planting

When considering the role of behavioural intentions as outlined in the conceptual framework (Figure 2.1), it is important to gauge what protection activities respondents are interested in; that way, positive perceived control factors can be used to target these behavioural intentions. The fencing and planting of waterways was the most commonly mentioned protection activity that respondents were interested in and it is a requirement for landowners and managers to fence off some low slope streams under the NPS-FM. Literature supporting this finding is limited; however, one study by Parminter et al. (1998) found mixed attitudes towards riparian management while a more recent study by McKergow et al. (2016) found an increase in riparian management practices. However, this could reflect the regulatory environment imposing riparian management as a protection activity on landowners.

While respondents were interested in riparian management activities, interviewees mentioned costs associated with the fencing and planting waterways and the difficulty in applying for funding. The reasoned action approach can explain this behavioural intention (Fishbein & Ajzen, 2011), where even though respondents are interested in the activity, negative perceived control factors,

including cost and resource barriers as outlined in the results are preventing participation. Understanding this behavioural intention to protect biodiversity through fencing and planting and the negative perceived control factors in the form of cost and resource barriers means that this behavioural intention can be stimulated through positive perceived control factors, which would be economic or financial enablers as shown in the results. This highlights how the TPB can be used alongside an understanding of the perceived motivators, barriers, and enablers to stimulate participation in biodiversity protection activities whereby the positive and negative perceived control factors can be determined by the motivators, barriers and enablers.

Respondents' willingness to fence and plant waterways with the help of a financial incentive aligns with conservation management actions as described in Chapter 2. The use of fences as a management tool is effective at assisting with biodiversity protection as they ensure large browsing animals such as deer have minimal impact on regenerating patches of indigenous vegetation (Burns et al., 2012). Strategic planting within fenced areas such as along waterways is also beneficial as it ensures browsing animals and stock have minimal impacts on the growth of plants and reduces stock impact on waterways. Strategic planting along waterways also aligns with respondents' openness to increasing the size of patches of indigenous vegetation and the potential for creating habitat corridors along riparian margins. The willingness of New Zealand landowners and managers to fence and plant waterways is supported in the literature (Maseyk et al., 2017; Yang & Sharp, 2017). This highlights a potential management action that can be employed to increase biodiversity in the Mōtū catchment, and which can be stimulated through positive perceived control factors.

6.2.3 Animal and Plant Pest Control

Although pest control is occurring in the catchment, the need for more trapping, shooting and poisoning was emphasised in the survey data, which showed that respondents were seeing various animal pests on the land they are involved with. This indicates that while pests are being controlled, the current level of control may not be enough. This is similar to what has been found in other studies which have determined that current pest control measures are not enough without further advancements in technology (Eason et al., 2017; Russell et al., 2015). While shooting was the most used method, this is not necessarily the most effective. As outlined in Chapter 2, when attempting to control pests across vast landscapes with limited access and steep terrain such as the Mōtū catchment, trapping and shooting is not as effective as aerial dropped poison such as 1080 (Elliott & Kemp, 2016; EPA, 2020; PCE, 2011; Robertson et al., 1999; Russell et al., 2015).

Three interviewees perceived the use of 1080 as being beneficial to the eradication and control of pests, as it can cover vast areas and target species of concern, especially within the public conservation estate in the Mōtū catchment (Figure 3.7) (Barlow, 1991; Goldson et al., 2015; Innes et al., 1999; Moorhouse et al., 2003). Other participants emphasised their dislike towards the use of 1080 due to the potential effects on working dogs, the importance of recreational hunting in the catchment, and concerns around the effects on weka populations; however, effects on deer and weka can be minimal if deer repellent is used and care is taken (Nugent et al., 2001; Nugent & Yockney, 2004; Veltman & Westbrooke, 2011). Results from some studies (Goh et al., 2005; Nugent & Yockney, 2004) align with concerns around the use of 1080 on hunting, dogs and native birds; while others (Morriss et al., 2020) have found no adverse impacts on animals such as red deer. This research did not determine the extent to which the benefits of the use of 1080 outweigh

the risks for landowners and managers in the Mōtū catchment; therefore, a consensus on its use cannot be made. While there was no consensus, the perceived need for an increase in current pest control methods was demonstrated. Increasing the current level of pest control in the Mōtū catchment would be needed to ensure remaining patches of indigenous vegetation and native species are not further degraded by animal pests.

Weka numbers in the catchment can be used to highlight the important role of pest control measures. The results from the survey indicated that respondents in the Mōtū catchment noted weka as being the most predominately noticed native animal. This result is interesting considering the historic information on weka numbers in the Mōtū catchment. As highlighted in Chapter 3, in the early 2000s, weka numbers dwindled and fell to approximately 2000 birds in the Mōtū catchment due to weka being hunted by pests (Pishief, 2006). It is reassuring that the results have indicated the strong weka presence in the Mōtū catchment. As the weka population first began to build back up, this was attributed to pest control measures in the Mōtū district (Pishief, 2006). Alongside weka, the Hochstetter's frog responds well to pest control measures (McLennan, 1985). This highlights the importance of pest control measures within the catchment and the positive effects they can have on the rehabilitation of native animal populations in the district.

While an increase in pest control is important for biodiversity in the catchment, so too is weed control. The survey and interview data indicated that the majority of respondents in the Mōtū catchment are already undertaking action in the form of weed control; however, similar to animal pest control, the need for more in the way of weed control was highlighted. This is consistent with what has been found in the literature (Ghanizadeh & Harrington, 2019) whereby weed control is being undertaken; however, more control and advancements are needed to address the full effects of invasive weeds in New Zealand (Department of Conservation, 2017). As emphasised in Chapter 2, the control of exotic weeds as a management action is beneficial as it ensures the diversity and abundance of indigenous vegetation is not outcompeted by the presence of exotic weeds (Barberi et al., 2010). The control of exotic weeds also ensures indigenous vegetation has adequate access to space, nutrients, water and sunlight (Williams & West, 2000). While it is reassuring that the majority of respondents in the Mōtū catchment are undertaking exotic weed control, the need for more will only further assist in increasing the quality and size of remaining patches of indigenous vegetation.

6.2.4 Catchment and Knowledge Sharing Groups

The results showed that the third most important enabler for biodiversity protection was the factor labelled 'catchment and knowledge sharing groups'. The role of catchment groups as an integrated approach for aligning management actions has been supported in the literature (Dodson, 2015; Memon et al., 2010) whereby such groups can support landowners and managers in undertaking protection activities. Catchment groups, such as some community-led groups supported by Beef and Lamb New Zealand have been proving successful in some parts of the country where farmers are being encouraged to take control of their own land management activities (B+LNZ, 2019). The role of catchment and knowledge sharing groups was further investigated through the interviews, which determined that all interviewees felt positively towards engagement with a catchment group focused on biodiversity protection and felt it would be beneficial. While two catchment groups already exist within the Mōtū catchment, these are largely focused on freshwater management and are not freely open to all landowners and managers within the catchment.

The form and structure of catchment groups plays an important role in participation, and if such groups are freely open and are relevant to landowners and managers own goals then these people are more likely to join and actively participate. Barkly Landcare and Conservation Association (BLCA) and Centralian Landcare Management Association (CLMA) are two examples of successful open and collaborative farmer-led catchment groups in Australia focusing on weed and pest management (Landcare NT, 2021a, 2021b). Alongside showing success in Australia, such farmer-led catchment groups ensure landowners and managers have some autonomy over what happens on their farm and within their catchment. It has been highlighted in the literature that farmers in community-led groups can often be more successful because top-down pressure can lead to resistance to collaboration where landowners and managers can feel forced into agreements (Jenkins, 2017; Waikato Regional Council, 2019). Literature supports community-led catchment-scale management as an approach to meet the challenges associated with integrating the several dimensions of biodiversity protection, including the consideration of multiple issues, stakeholders, disciplines, behaviours, and temporal and spatial challenges (Fenemor et al., 2011; Jakeman & Letcher, 2003; Memon et al., 2010; Warner, 2006). As highlighted by one of the interviewees, there is also value in coming together as a catchment when actioning biodiversity protection as it ensures alignment in management approaches and actions, and ensures that those who need the knowledge and support the most have access to this.

6.3 Motivators, Barriers and Enablers

It is important to address the behavioural characteristics of respondents in the Mōtū catchment and assess how perceived motivators, barriers, and enablers can assist in the uptake of conservation practices to ensure the success of biodiversity protection. Conservation behaviours play an important role in understanding how to get landowners and managers to successfully and willingly participate in conservation activities and implement required management actions. This Section addresses and discusses Objective 2 of this research as is a key component that influences the uptake and success of biodiversity protection activities.

6.3.1 Motivators

The results confirmed that respondents in the Mōtū catchment are intrinsically motivated to pursue biodiversity protection activities and are motivated by factors including 'passing on the land in great condition' and 'looking after the environment and native plants and animals'. The results also found that respondents were motivated less by financial motivations, including ‘earning a high income’. Respondents in this research were found to have similar motivations with no statistically significant differences found between gender, operation size or across land use and ownership types. These findings support an ever-increasing body of empirical evidence that landowners and managers are motivated by pursuing personal and family wellbeing motivations rather than reacting to financial incentives or being hindered by constraints (Brodt et al., 2006; Espinosa-Goded et al., 2010; Farmar-Bowers & Lane, 2009; Greiner, 2015b; Greiner & Gregg, 2011; Maseyk et al., 2021; Ruto & Garrod, 2009; Windle & Rolfe, 2005). Specifically, other studies done in New Zealand (Maseyk et al., 2021) also found that landowners and managers are strongly motivated by intrinsic motivations as opposed to financial incentives which aligns with the findings of this research. The results from this research also support the notion that landowners and managers are driven in their profession by a strong stewardship ethic more than by economic

and social goals, which can result in the demonstration of higher levels of conservation requiring extensive private contributions (Greiner & Gregg, 2011; Greiner et al., 2009; Reeson, 2008).

Results from the principal component analysis of motivating factors strongly aligns with the principal component analysis in Greiner and Gregg (2011). Both analyses explained 70% and 71% of the variance and found 'financial/economic motivation', 'conservation and lifestyle motivation' and 'social motivation' to be the three main components (Table 5.4). When comparing the results from the principal component analysis', Greiner and Gregg (2011) highlighted the importance of signals conveyed by society, including appreciation by society and respect by peers. While these factors were not the most important in this research, they did explain some of the variance within the data, especially component three, 'social and lifestyle motivation', which included these signals from society, including appreciation by peers and being amongst the best in the industry. The similarities in findings between this research and that done by Greiner and Gregg (2011) reiterates the importance of social and lifestyle factors as motivators for biodiversity conservation.

The conceptual framework (Figure 2.1) and the TPB can explain the motivations of respondents in this research. The TPB assumes that intentions and behaviours are driven by attitudes, subjective norms, and perceived behavioural control, which are influenced by an individual's evaluative beliefs about the outcomes (Fishbein & Ajzen, 2011). This means that higher-order goals and aspirations influence career choice and investment decisions, so it is not surprising that 'earning a high income' was not an important motivator for respondents in the Mōtū catchment. This aligns with studies that have determined that goals of making money are usually a reflection of, or a tool for achieving higher-order goals and aspirations (Ingram et al., 2013; Pannell et al., 2006). Respondents' motivations can therefore be explained by career choice and investment behaviours driven by higher-order goals and aspirations. When considering these findings and the importance of motivation factors on investment decisions and career choice, it is imperative that the creation of any future biodiversity protection schemes or incentives considers and takes advantage of these goals and motivations, as this will likely prove beneficial for success.

When considering what is to be gained from an understanding of the perceived motivators of biodiversity protection, it is important to emphasise that different types of motivation will influence the uptake of protection activities (Greiner & Gregg, 2011; Maseyk et al., 2021). Motivations act as the lens through which landowners and managers justify decisions and assess options. Therefore, these same motivations will influence the uptake of different types of biodiversity protection activities. The design and creation of incentives or schemes therefore needs to be informed by economic frameworks which consider the importance of intrinsic motivations if uptake is to be successful. This idea supports the creation of a framework by Pannell (2008), which was created to inform the choice of policy mechanisms based upon transaction costs and private benefits. Pannell (2008) noted that past government programs aiming to protect biodiversity on private land have failed due to a lack of recognition and consideration of private costs and benefits. It is important to consider respondents' motivations in the Mōtū catchment and the private costs and benefits that may be associated with future biodiversity protection incentives. It is also important to emphasise the value of recognising the strong stewardship ethic of landowners' and managers' in the Mōtū catchment which is already motivating many to participate in protection activities.

6.3.2 Barriers

The results of this study showed that on average, respondents in the Mōtū catchment found 'lack of time, staff and labour', and 'lack of government or financial incentives' to be the biggest barriers to biodiversity protection. Factors labelled 'it is not necessary to improve the environment' and 'conservation is not practical on your land' were the least important barriers. Respondents in this research perceived similar factors to be acting as the biggest barriers, regardless of gender, operation size, land use, or ownership type. These findings support a body of empirical evidence that landowners are impeded by resource constraints in the form of capital and labour (Greiner & Gregg, 2011) and through economic and financial constraints, including the cost of protection, lack of financial return and the potential distraction from the core of the business (Greiner & Gregg, 2011; Maseyk et al., 2021). The factors that were not shown to act as strong barriers to biodiversity protection in this research aligned with findings in Maseyk et al. (2021) and Greiner and Gregg (2011), in which respondents stated no disadvantages towards environmental considerations. The alignment of results between these studies is significant as similar to this research, Maseyk et al. (2021) included New Zealand hill country farms and Greiner and Gregg (2011) included pastoralists.

The principal component analysis for barriers strongly aligned with the principal component analysis in Greiner and Gregg (2011). Both studies explained 64% and 65% of the total variance in data across similar components, which included 'lack of industry support and guidance barriers', 'practicality and financial barriers', 'opportunity cost and resource barriers', and 'risk and uncertainty barriers' (Table 5.5). Literature has found that these lost opportunity costs can be reflected through the perception of low private benefits and resource constraints that influence the willingness to implement conservation activities (Greiner & Gregg, 2011; Pannell, 2008; Pannell et al., 2006). The principal component model also highlights the role of risk perceptions and recognises the social behaviours of landowners' and managers' whereby industry support and other landowner and manager involvement can either be encouraging or act as a constraint to participation in management actions (Farmar-Bowers & Lane, 2009; Greiner et al., 2009).

The perceived barriers of biodiversity protection for respondents aligns with, and can be explained by, the conceptual framework (Figure 2.1) and the TPB (Fishbein & Ajzen, 2011). The finding that environmental stewardship factors do not strongly constrain respondents highlights that the behavioural intention of conservation exists and that respondents do not perceive the actual protection activities themselves as barriers. Instead, it is negative perceived control factors of resource and finance constraints that prevent participation, despite the behavioural intention of conservation existing. Where conservation behaviours and perceived negative control factors coincide, the TPB suggests a positive perceived control factor is needed to push behavioural intention towards participation. This finding is supported by literature (Chapman et al., 2019; Delaroche, 2020; Maseyk et al., 2021; Mastrangelo et al., 2014) in which the TPB has been found to influence conservation behaviours in the form of negatively and positively perceived control factors. In this research, positive perceived control factors in the form of economic or financial enablers as suggested by the results would be needed to overcome existing barriers and negative perceived control factors. This is a key finding that explains why landowners and managers in the Mōtū catchment perceive the need for more biodiversity protection, despite already participating in some management actions.

6.3.3 Enablers

The results from this research highlighted that on average, for respondents in the Mōtū catchment, ‘government and financial incentives’ along with ‘personal motivation and goals’ are the most important enablers for biodiversity protection. Factors labelled 'government environmental regulation' and 'environmental management plans' were the least important enablers. This research also found no statistical significance or relationships between perceived enablers and gender, operation size, land use, or ownership type. These findings support an increasing body of empirical evidence that the most important enabling factors for biodiversity protection is in the form of financial or economic incentives, and that such incentives could play a catalytic role in increasing biodiversity protection to a suitable level (Greiner & Gregg, 2011; Hall & Lindsay, 2021; Maseyk et al., 2021; Pannell et al., 2006). These incentives could be in the form of direct financial support to cover biodiversity protection activities such as fencing and planting, or through economic schemes such as emissions trading when emissions are properly priced into economics (Tietenberg, 2010).

Much of this literature (Greiner et al., 2009; Jacobson et al., 2003; Kabii & Horwitz, 2006; Smithers & Furman, 2003) has also found balances between extrinsic and intrinsic motivations, highlighting that as well as wanting financial rewards, landowners, managers and farmers participate in schemes to satisfy personal goals and self-fulfilment. This is an important consideration to consider when tailoring any policy or biodiversity protection schemes to meet the needs of landowners and managers. This finding can also play an important role in the stimulation of more management actions as it determines what is needed by landowners and managers in the Mōtū catchment.

The role of financial and economic incentives as enablers can also be linked back to the conceptual framework (Figure 2.1) and the TPB (Fishbein & Ajzen, 2011). The perceived enablers of biodiversity protection by respondents in the Mōtū catchment strongly align with the idea of positive perceived control factors, which are needed to push behavioural intention towards participation. As previously mentioned, to overcome negative perceived control factors in the form of resource and finance constraints, positive perceived control factors are needed to initiate behavioural intentions. The TPB suggests that to overcome such barriers that exist for respondents, positive perceived control factors in the form of economic or financial enablers are needed. This directly aligns with what respondents have perceived as the strongest enablers for biodiversity protection to overcome barriers and stimulate action. This finding has been supported in the literature whereby for conservation enablers, policy mechanisms such as financial incentives have acted as positive incentives, and government regulation acted as negative incentives (Greiner & Gregg, 2011; Reeson, 2008). The role of government regulation as a negative incentive (Greiner & Gregg, 2011) could also explain why this factor was perceived as the weakest contributing enabler to biodiversity protection for respondents in the Mōtū catchment.

6.4 Future Management of Biodiversity in the Mōtū Catchment

It is important to recognise how motivators, barriers, and enablers can work together to influence successful participation in biodiversity protection. This research has found that participation in biodiversity protection activities is influenced by the perception that the practice will enhance the achievement of the landowner or manager's personal goals. Empirical evidence has supported this

finding, suggesting that while conservation and lifestyle motivations will translate into intrinsic motivation, option values can prevent the financially motivated from participating in biodiversity protection activities, and thus external incentives may be necessary (Chouinard et al., 2008; Greiner et al., 2009; Maybery et al., 2005). This links back to the conceptual framework (Figure 2.1), which suggests that external incentives may be necessary to ensure successful participation in the case of the financially motivated. Therefore, the creation of any policy or biodiversity protection schemes or incentives must have a high relative advantage as low or no adoption of such schemes or incentives have been aligned with failure to provide relative economic or financial advantage (Pannell et al., 2006). The financial or economic advantage is an integral part to consider as it has proven to be one of the most influential enabling factors for respondents in the Mōtū catchment.

When considering the future management of biodiversity in the Mōtū catchment it is important to emphasise the role of open-entry catchment groups. The establishment of an open-entry catchment group generates the benefit of acting as a collective and can address the barrier of needing assistance with funding applications. Participants from all land use operations and ownership types emphasised the need for assistance in funding applications, noting that while funding may be out there, they are unsure of where to find it or how to apply for it. Participants in both the survey and interviews highlighted that the need for assistance with funding could be achieved through the formation of a catchment group. Smaller catchment groups such as the Mōtū, or wider catchment groups such as the Gisborne region can put in joint applications for funding which could include funding for the smaller sub-catchments they contain. While there is minimal literature that supports the idea of collective funding applications through catchment groups in New Zealand, the New Zealand Government has confirmed that they are injecting $20 million into catchment groups across the country along with a further $6 million being given to farmer-led groups (New Zealand Goverment, 2020; RNZ, 2020). Therefore, an open-entry catchment group could be beneficial to address financial barriers even if alternative funding or incentives cannot be sought.

6.5 Limitations

6.5.1 Sample Size and Response Rate

Access to participants in this research created limitations to both the sample size and validity of data. While the researcher could obtain all addresses within the catchment, this did not cover access to all landowners and relevant personnel within the catchment. The lack of a comprehensive emailing list meant that a post out survey was employed, making it challenging to determine how many people from each address would participate in the survey. While it is known to the researcher that the survey was sent out to 154 addresses, it is unknown exactly how many people within the catchment had access to this survey.

In order to be able to generalise the results of this research to the wider population of the Mōtū catchment, the sample size and response rate must be large enough. The population of interest for this research was landowners and managers in the Mōtū catchment, and the sample is the group to be surveyed and interviewed. As the population of interest consisted of 154 households, it was decided that the sample would include the entire population of interest. All 154 households were used as the sample size to ensure as many responses as possible could be obtained.

In order to make the results of this research generalisable to the population of interest with a confidence level of 95% and margin of error of 5%, the sample size would need to be 111 (Junk, 1999). A sample size of 111 is large and would represent a response rate of 72%, which is considered to be very high, and unlikely in a mail-out survey (Groves, 2006). As this was not the case for this research, the sample size and response rates were limiting factors. The sample size for the survey used in this research was smaller than anticipated due to a lack of access to email lists and phone lists. The number of postal addresses in the catchment and the response rate was not large enough to make the results generalisable. While this is a limitation, the research still gives a good indication of the majority of the landowners' and managers' behavioural perceptions within the Mōtū catchment, especially from interview data where saturation was achieved.

6.5.2 Sampling Bias

For this research, given the use of a postal survey, it is important to highlight the potential for sampling bias. Sampling bias is related to the way survey participants are selected and can happen when the sample is not completely random. When the sample of participants is not completely random, you are less likely to get a representative sample of responses (Scheaffer et al., 2011). To reduce sampling bias in this research, an attempt was made to send the survey out to all postal address within the Mōtū catchment. A complete and representative emailing list could not be obtained, so it was decided that the most effective way of ensuring a representative sample was to use a postal survey. Although an effort was made to reduce sampling bias by including the whole population of interest, sampling bias still exists due to the mode of survey method. The use of a mail-out, online response method can create bias as it relies on the participant having access to electronic devices and being familiar with QR codes.

6.5.3 Sampling Procedure

The use of a self-administered postal survey and the self-selection of interviewees were limiting factors. Using a QR code for access to the online survey was also limiting as it may have excluded some people from participating in the survey. The use of a QR code requires participants to have access to electronic devices with a camera that willing participants may not have had. For this reason, it was decided that anyone wanting to participate in the survey that could not use the QR code would be able to contact the researcher via email or telephone to arrange an alternative way to complete the survey. One participant did get in touch with the researcher early on, explaining that they were interested in participating, but could not use QR code. An arrangement was then made to send the survey link out via email to ensure the survey could be completed.

The self-selection of interviewees before being selected by the researcher through maximum variation also created limitations. There is bias in self-selection as often the participants who will self-select have some motivation to do so. Bias arises in the form of self-selection as there is often an underlying motive for participants to self-select (Walter, 2019). While the impact of self-selection bias was minimised through purposive sampling and maximum variation, it still exists, creating bias in this research. However, the effect of self-selection bias on this research was not significant as no determination of causation was being made (Walter, 2019).

6.5.4 Scaled Questions Bias

Using Likert type questions in the survey can make the survey susceptible to acquiescence or dis-acquiescence response style biases. This refers to respondents who disproportionately use the positive side of the scale (acquiescence), or respondents who disproportionally use the negative side of the scale (dis-acquiescence) (Podsakoff et al., 2012). This can create bias as these tendencies can inflate estimates of reliability measures depending on the types of questions asked (Podsakoff et al., 2012). Bias towards scaled questions can also arise in neutral responding, whereby the participant chooses the neutral answer every time. Neutral responding can occur when a participant is not interested in the survey, so will aim to answer the questions as quickly as possible (Berg & Lune, 2017). In order to reduce response style bias, positively worded and negatively worded measures of each construct should be balanced (Podsakoff et al., 2012). Although balanced scales do not eliminate the bias, they do control it; therefore, measures of each factor used on ordinal scales in the survey were balanced to reduce response style biases.

6.5.5 Response Bias

Response bias must be considered when analysing and interpreting survey data. Respondents are often motivated in some way or another to participate in surveys and interviews, and therefore understanding what motivates respondents is an essential factor (Walter, 2019). Three broad categories of motivation exist, including altruistic responses, where respondents perceive the survey or interview to be beneficial to society or a community; egotistic responses whereby the respondent perceives the survey or interview to be personally beneficial; and responses whereby the respondent has a personal interest in the topic, organisation or finds ease in participation (Walter, 2019). Social desirability bias can also occur in social research where a participant wishes to portray themselves more favourably to the researcher, purposely distorting facts or withholding information (Berg & Lune, 2017; Fisher, 1993). To reduce this bias, it is recommended that conclusions from the findings are made after comparing the results with other information sources, including literature (Blankenship, 2010). This step to reduce bias was taken during the discussion of results. For this research, all three of the main motivating factors are present.

6.5.6 Nonresponse Bias

Even if precautions are taken to minimise sampling bias, the potential error of response biases remains. While considerations were made to ensure the survey for this research was equally distributed, this does not necessarily mean that there will be an equal number of responses as there will always be people unwilling to participate in surveys. Groups of people who do not respond to a survey will differ significantly and systematically to those who do respond (Groves, 2006). When this happens, the data can be subject to non-response bias. While there is no way to avoid non-response bias, it has been suggested that the most effective way to reduce this bias is to ensure the overall response rate of the survey is as high as possible (Groves, 2006). To ensure the response rate of this research was as high as possible, the underlying message of the research was communicated to participants. Communicating the message behind surveys can sometimes help with response rates, while this should also be considered alongside a reminder (Groves, 2006). For this research, to reduce non-response bias, a detailed information sheet was sent out with the survey, along with a follow-up survey and reminder.

6.5.7 Interviewer Bias

Interviewer bias may be present in this research due to the conduction of face-to-face interviews whereby interviewer expectations can create bias (Neuman, 2014). The six main types of interviewer bias, as highlighted by Neuman (2014) are outlined in Table 6.1.

Table 6.1: Table explaining main types of interviewer bias (Neuman, 2014).

Bias	**Example**
Respondent errors.	Embarrassment, forgetting, misunderstanding, or lying due to the presence of others.
Interviewer sloppiness or unintentional errors.	Contacting the wrong respondent, misreading questions, reading questions in the wrong order, or recording the wrong answer.
Intentional supervision by the interviewer.	Altering answers, rewording questions, or choosing different respondents.
Interviewer expectations.	Expectations of a respondent's answers from appearance, living situation, or other responses.
Interviewer probing.	Failure of an interviewer to probe or to probe properly.
Interviewer influence.	Influence on answers due to interviewers' attitude, tone, appearance, reaction to answers, or comments.

When considering interviewer bias, it is important that the researcher is aware of the potential for these biases to arise. In order to reduce interviewer bias, it is recommended that interviewers take care when constructing, conducting, and recording interviews; take care in the collection of data and the sampling; take care in probing; and take care in their influence on the respondent (Neuman, 2014). All of these steps were considered during the construction of the interview instrument and during the conducting of interviews.

6.5.8 Timeframe

Restrictions on time resulted in the researcher conducting fewer interviews. While it was initially thought that conducting fewer interviews would be a limitation as data would not be fully representative of the Mōtū catchment, this was not the case as data saturation was achieved. Data saturation is achieved when no new themes or addition information can be attained from further interviews (Fusch & Ness, 2015). Data saturation was achieved over the 10 interviews that were conducted whereby the researcher did not attain any new or additional information over the last three interviews that were conducted. This suggested that data saturation had been achieved and that all themes and information relevant to the Mōtū catchment had been exhausted.

6.6 Summary

This Chapter interpreted and discussed the results of this research, including new insights that had emerged. The current level of protection was discussed, and it was found that respondents were already participating in a range of different biodiversity protection activities; however, the need for more protection was clearly expressed. The TPB was used to explain the current level of

protection in the form of increasing patch sizes, fencing, planting, and pest control. The TPB was also used to explain the need for more protection, as public investment in the environment by landowners and managers will only occur to a point where environmental and production outcomes are balanced.

Behavioural characteristics were then discussed in terms of how motivators, barriers and enablers can influence participation in more protection activities and to understand what is needed to support them. The findings support a growing body of empirical evidence that landowners are intrinsically motivated by stewardship ethics, are hindered by financial and resource constraints, and need more in the way of financial support and incentives. The TPB was also used to explain the behavioural characteristics of respondents in the Mōtū catchment and emphasised the role of negative perceived control factors in the form of cost or resource barriers, and positive perceived control factors in the form of financial incentives in helping to remove barriers and stimulate more participation in conservation. The limitations of this research were also discussed including access to participants, the sampling procedure, the sample size, and the timeframe of the research.

7 Chapter 7: Conclusion and Recommendations

7.1 Conclusion

This thesis presents the results of an analysis of survey data and semi-structured interviews of landowners and managers in the Mōtū catchment. The objectives of the surveys and interviews were to determine the perceived motivators, barriers, and enablers of biodiversity protection with reference to the adoption of conservation practices and gauging an understanding into the current management actions already being undertaken. This research supports an increasing body of empirical evidence that assesses the conservation behaviours of landowners and confirms that respondents in the Mōtū catchment share the similar general motivations and perceptions on barriers and enablers as landowners do elsewhere in the world (Brodt et al., 2006; Farmar-Bowers & Lane, 2009; Greiner, 2015b; Greiner & Gregg, 2011; Maseyk et al., 2021). While this research supports current evidence, it also adds to the current body of literature by including the perspectives of landowners' and managers' across a range of different land use and ownership types in New Zealand.

The research concludes that landowners' and managers' are intrinsically motivated by environmental stewardship ethics alongside personal and wellbeing goals rather than economic or social goals and will make decisions based upon these intrinsic motivations rather than reacting to financial incentives or perceived barriers. This is an important finding that challenges current thinking around landowners being primarily profit-driven (Lute et al., 2018) and suggests that they are participating in conservation activities for environmental reasons rather than financial reasons. This research found that for respondents in the Mōtū catchment, perceived barriers around biodiversity protection were in the form of financial and resource constraints, which aligns with what has been found in other empirical studies (Greiner & Gregg, 2011; Maseyk et al., 2021). These perceived barriers were found to be influencing the uptake of biodiversity protection activities where despite respondents being motivated by strong environmental stewardship ethics, resource and financial constraints were inhibiting participation. This finding also supports the premise that generating income for livelihood is balanced with environmental protection efforts by landowners.

Enablers for biodiversity protection for respondents in the Mōtū catchment were found to be in the form of financial and economic incentives. The finding that a positive external incentive can stimulate conservation activities supports an increasing body of empirical evidence (Greiner & Gregg, 2011; Maseyk et al., 2021). The design of incentives and enablers for biodiversity protection needs to be informed by frameworks that go beyond conservation actions that involve economic trade-offs as this may neglect the important role of non-financial motivations for decision making, especially the environmental stewardship ethic, which may already be motivating respondents to undertake management actions on their land. There is a clear need for greater practical and financial assistance to ensure landowners and managers are supported in biodiversity protection endeavours. Without this, biodiversity outcomes will likely remain on the whim of landowners and managers.

The strong environmental stewardship ethic of landowners' and managers' explained the current level of biodiversity protection in various activities, while the perceived need for further protection despite current efforts was attributed to perceived constraints. When considering the future of biodiversity protection activities, respondents particularly wanted to see more in the way of fencing and planting of waterways, along with stronger pest control measures. While this research could not determine the best method of pest control moving forward, external incentives to stimulate further protection activities in the form of fencing and planting was recommended. The importance of protecting remaining patches of indigenous vegetation was determined to be important to the survival of species, including kiwi, weka, and whio, and landowners' and managers' felt positively towards the protection of these remaining patches.

The overall findings of this research can be explained by the conceptual framework (Figure 2.1) and the TPB, whereby landowners' and managers' motivations serve as a lens through which options are assessed and decisions and justified. While the behavioural intention of and motivation towards conservation practices already exists for landowners and managers, negative perceived control factors in the form of finance and resource barriers as explained by the TPB exist. While this is the case, this research supports the TPB in which the introduction of positive perceived control factors in the form of financial or economic incentives can stimulate motivations of biodiversity protection into participation and be used to overcome perceived barriers. Overall, this research supports the existing body of empirical evidence, confirming that perceived motivators, barriers, and enablers of biodiversity protection are similar to perceptions found in the literature and adds to it by confirming that no statistically significant differences exist in perceptions between different land use and ownership types for respondents in the Mōtū Catchment. This research has also illuminated the importance of catchment groups in bringing together the many parts of successful biodiversity protection actions and their value in applying for funding, ensuring project alignment, knowledge generation and support.

7.2 Recommendations

Several recommendations for management actions can be made for biodiversity protection in the Mōtū catchment, considering survey and interview results on perceived motivators, barriers, and enablers along with relevant literature. Recommendations are also based on actions that are supported by the majority of respondents in this research and these encompass natural resource management and environmental management recommendations alongside farmer-led and funding initiatives. Recommendations cover the fencing and planting of waterways, protection of remaining habitat, pest control, the expansion of an existing catchment group for biodiversity protection, external incentives, along with the potential implications of these recommendations. Recommendations have been targeted to particular groups or individuals, including community groups, policymakers, scientists, landowners and managers, and local government and aim to utilise and incorporate the strong stewardship ethic shown by landowners' and managers'.

7.2.1 Protection and Enhancement of Habitat

Improving habitat quality is one of the key actions in supporting biodiversity, and the survey and interview data showed that respondents in the Mōtū catchment were interested in participating in actions that would protect or enhance habitat. Such actions are also important as the remaining patches of indigenous vegetation within the agricultural zone of the catchment may be critical for

the survival of species such as weka, kiwi and whio. Respondents were open to the idea of increasing the size of patches of indigenous vegetation on their land and it is recommended that the planting programme emphasises patch size and linkage. To increase patch size, it is recommended that landowners and managers focus on streambanks as this zone was most frequently mentioned by respondents as an area for planting. Increasing indigenous vegetation along streambanks would also provide additional suitable habitat for weka and other species, help stabilise stream and riverbanks, contribute to on-farm diversity, and is less likely to encroach on productive land compared with other areas that were of concern to respondents.

Development of linkage, particularly within the agricultural land but also between that land and the surrounding reserve land, is a critical factor in joining the remaining patches of indigenous vegetation and increasing the functionality of the available habitat. The habitat corridors created will support indigenous flora and fauna and overcome many of the disadvantages of patch isolation. Given the respondents positivity towards patch protection, and the importance of the remaining patches, protection of these patches should be facilitated through fencing, planting, pest control and weed control.

7.2.2 Fencing and Planting Waterways

Landowners' and managers' in the Mōtū catchment thought that fencing and planting of waterways was the most important management action for biodiversity protection and as there was consensus on this issue, a focus on fencing and planting is recommended. Indeed, such fencing is a requirement for specific areas under the NPS-FM. In addition, fencing will ensure browsing animals do not damage regenerating vegetation, while planting will assist in improving the quality and size of patches.

Plant production through a community nursery was also supported by the majority of respondents, and it is recommended that such a nursery be developed and led by a community catchment group. The planting programme should use eco-sourced seed and local sources of seed should be investigated. Enacting this recommendation will facilitate habitat improvement by stabilising streambanks, reducing stock grazing on streambanks, increasing patch size, and improving linkage. Although the fencing and planting of waterways is recommended, these actions could make access to streams and rivers difficult for humans and stock. Therefore, it may be necessary to install water reticulation features which can be costly.

7.2.3 Pest Control

While the results have shown a strong need for animal pest control in the Mōtū catchment, there has not been consensus on the best approach for pest control. As there was no consensus around the use of 1080, maintaining current pest control methods by landowners, managers and DOC is strongly encouraged, including trapping, shooting, poisoning, goat mustering, and using a kiwi creche to protect kiwi chicks. If 1080 is to be introduced into the Mōtū catchment in the future, it is recommended that DOC or local government ensure aerial drops coincide with mast events for maximum results and that the use of deer repellent is considered alongside a trapping buffer to reduce the risk of poisoning to deer, dogs and stock. While maintaining current pest control efforts is recommended, this also means that pest levels are likely to stay the same; therefore, this recommendation does not address concerns around increasing pest numbers.

7.2.4 Weed Control

Alongside the need for animal pest control, it is recommended that landowners and managers in the Mōtū catchment undertake weed pest control. While this management action was not indicated by respondents as being the most important, it is recommended to ensure any native plantings have good survival rates and contribute to enhancing the quality of remnant patches of indigenous vegetation. It is recommended that weed control is undertaken in conjunction with native planting to ensure plantings are released, and to ensure exotic weeds do not outcompete planting for sunlight, water and nutrients.

7.2.5 Fauna Programmes

As the survey results indicated there to be several threatened and endangered species present in the Mōtū catchment including kiwi, weka and whio; participation in, or support for fauna programs is recommended. Involvement in, or support for fauna programs may include the existing kiwi protection and release initiative run by the Whinray Ecological Trust or the creation of new fauna programs to run alongside existing ones such as for the protection and enhancement of whio. While the creation of fauna programs can be a considerable task, support for such programs can involve something as small as landowners and managers donating flora for kiwi nest boxes or allowing scientists to look for fauna such as Hochstetter's frogs on their land.

7.2.6 Catchment Group

Interest in participating in a catchment group from all interviewees was positive. As two catchment groups already exist, it is recommended that one of the existing groups broadens its focus to include biodiversity protection and becomes easily accessible to all landowners and managers. Expanding the focus of one of the existing groups to also cover biodiversity protection can act as a natural progression given that increased planting is already occurring in some places as a freshwater management action. Future pressures as a result of greenhouse gas emissions are also likely to come and may involve planting as a management action which can be incorporated into the focus of a catchment group in the future.

One of the existing catchment groups is focused on the creation of a freshwater management plan for the Mōtū catchment and is led by the GDC and six stakeholders representing the catchment. The other catchment group is focused on erosion control and includes landowners and managers from land adjacent to the Mōtū River and its tributaries. If one of the two existing groups is to broaden its scope for the purposes of biodiversity protection, it is recommended that it is the latter of the two as this group already includes several landowners and managers from within the catchment. As this group is also focused on erosion control, it is working on the planting of native species as a management action which ties in with biodiversity protection actions and has the potential to naturally progress to include further biodiversity protection actions including the potential need for landowners and managers to find areas to plant due to the need for Farm Environment Plans. These actions can then progress onto actions such as weed and animal pest control which can assist in protecting native plantings and biodiversity. It is recommended that the group is led by the Mōtū catchment community to ensure a bottom-up approach, and could have support provided by the GDC or the Bay of Plenty Regional Council (BOPRC).

The formation of, or broadening of, a catchment group is beneficial for knowledge generation and can assist with funding applications, overcoming financial barriers, and to ensure alignment in management actions. Catchment-scale collective management is recommended and is well supported as an approach to meet the challenges associated with integrating the several dimensions of biodiversity protection, including the consideration of multiple issues, stakeholders, disciplines, behaviours, and the temporal and spatial challenges associated with different catchments (Fenemor et al., 2011; Jakeman & Letcher, 2003; Memon et al., 2010; Warner, 2006). The formation or broadening of an open-entry catchment group is also recommended to ensure alignment in protection activities such as the fencing and planting of stream and riverbanks and to ensure maximal benefit is achieved. Alongside this, a catchment group can give landowners and managers some control over their approaches to biodiversity protection rather than responding to regulation, which the results showed was not a strong motivator for participation.

7.2.7 External Incentives

An external incentive created by policy makers is recommended as a tool to support the protection of biodiversity in the Mōtū catchment. Although the survey results showed that government environmental regulation does not act as a strong motivator for biodiversity protection, the results also showed that if regulations harness landowners' and managers' motivations and environmental stewardship ethics alongside factors that are perceived as being positive enablers then external incentives could prove successful. External incentives can also work well if they coincide with landowner and manager led initiatives such as a catchment group as this ensures encouragement alongside individual control over participation and action.

While this research can confirm that respondents are already protecting biodiversity on their land, it has also been determined that this current level of protection is not enough. Based on the TPB and respondents perceived motivators, barriers, and enablers, the use of an external incentive is necessary to stimulate more action for biodiversity protection in the Mōtū catchment. It is recommended that policymakers should consider the creation of external incentives that harness self-interest in biodiversity protection efforts, as primarily financial incentives may fail if they undermine the fundamental values and motivations of what has led landowners and managers to undertake conservation efforts in the first place. This is supported by the conceptual framework and the TPB, which has determined that positive perceived control factors in the form of financial or economic incentives are needed to push behavioural intention, influenced by intrinsic conservation motivations towards participation. This fosters the idea that there is a critical role to play in the design and delivery of effective biodiversity protection incentives by policymakers due to the ability for these incentives to be tailored to harness the pre-existing intrinsic motivations of landowners' and managers', which contributes to the uptake of biodiversity protection activities.

The creation of an external incentive in the form of financial or economic enablers is needed to assist in the stimulation of previously mentioned recommendations and management actions. The use of a financial or economic incentive created by policy makers can assist in overcoming barriers that are currently preventing participation in management actions. The recommendation of a financial or economic incentive to support biodiversity protection in New Zealand has been supported by Hall and Lindsay (2021), who detailed the different types of biodiversity instruments that could be applied. These instruments include debt-for-nature swaps, paradise bonds, regional biodiversity funds, and biodiversity notes (Hall & Lindsay, 2021) which should all be considered

by policymakers in the creation of an external incentive. All of these instruments would be sufficient in harnessing the self-interest in biodiversity protection that respondents in the Mōtū catchment already have, alongside acting as an incentive to create a push towards more biodiversity protection efforts. The use of an instrument such as one described by Hall and Lindsay (2021) would serve as a good enabler that could help to overcome barriers where there is a perceived lack of financial support.

7.2.8 Evaluation of Research Methods

While the research methods of the study were suitable given the timeframe and resources available, the methods of this research would have been changed slightly if a longer timeframe was intended, and if more resources were available. Instead of using the Mōtū catchment as a case study area for this research, a larger area such as the Gisborne region would have been used if the length of the research was longer. Using a region as a case study area would have allowed the researcher to survey a wider variety of landowners and managers, including those from horticultural land use operations which were not present in this research. Alongside this, an urban perspective on biodiversity protection could have been included whereby a determination of the conservation behaviours of urban landowners could be better understood.

Using a larger case study area would also allow the researcher to work with a larger population size and therefore have the potential to generalise the findings of the research to the population of interest. A strong attempt would be made by the researcher to obtain enough survey responses if a regional case study area was to be used, to ensure the results could be generalisable. Alongside this, further information would be sought from respondents in survey and interview questions to determine the specific types of financial incentives that landowners and managers would be interested in.

7.2.9 Recommendations for Future Research

This research was intended to understand the perceived motivators, barriers, and enablers of biodiversity protection for landowners and managers in the Mōtū catchment. While this research was successful in doing so, it was exploratory and conducted over a short time frame therefore it could not cover all possible aspects that could be considered in the creation of a tailored approach to biodiversity protection; therefore, further research is recommended. Future research should look to replicate this research on a larger scale to ensure results are generalisable to a larger population of people such as a region of New Zealand. This will ensure that the perceived motivators, barriers, and enablers of biodiversity protection can be used by district and regional councils to tailor conservation schemes outside of the Mōtū catchment. Future research should also determine if any correlations exist between factors such as financial and economic incentives, and to determine if personal motivation and goals are correlated. This would enhance our understating of the behaviours associated with biodiversity protection and could determine whether single factors on their own are enough to enable biodiversity protection activities.

It is recommended that future research gains a better understanding of the role of pest control methods as biodiversity protection measures. This research did not determine the extent to which respondents perceived the benefits to outweigh the risk for different pest control methods, specifically regarding the use of 1080. In line with this, it is also recommended that alternative

pest control methods that have success over vast landscapes of dense forest are determined and proposed for use. Future research should also consider the use of spatial mapping to determine the farming implications of increasing patch size and linkages and how the plantation of riparian and unproductive land may affect the spatial mosaic of the landscape and farming operations. While this research has made recommendations around actions for biodiversity protection moving forward, it is recommended that further research is done to determine in more detail the specific actions, such as a specific financial or economic incentive that aligns with perceptions of landowners' and managers'.

7.3 Overall Summary

This research was conducted to address the gap in the management of indigenous biodiversity between public conservation estates and private land, and to understand the behavioural characteristics of landowners and managers to ensure targeted and aligned approaches to biodiversity protection. This research was derived from the premise that remnant patches of indigenous vegetation on private land can be representative of land environments that have been heavily deforested, and thus nationally underrepresented in conservation estates. The public conservation estate does not cover all vegetation types, yet useful bits of these types are found on private land, making the stimulation of management actions on private land desirable.

While there is currently a vast largely untapped potential habitat for biodiversity protection on private land in New Zealand, understanding how to manage this well when authorities have limited control over what happens on private land is challenging, so landowners and managers must be inspired to participate. The work done for this research outlines how to utilise this untapped resource well, and informs individuals, communities, local government, central government, and policy makers how to best manage and support biodiversity on private land.

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9 Appendices

9.1 APPENDIX 1: Survey Information Sheet

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

MANAGEMENT OF THE MOTU CATCHMENT, BIODIVERSITY SURVEY

Investigation of the motivators, barriers and enablers of biodiversity protection

Kia Ora,

Do you have **4 minutes** to help me find out how to manage biodiversity in our region, in a way that works for you?

My name is Britney Ford, I live in Motu, am part of the catchment group, am a Master of Environmental Management Student at Massey University, and I need your help! I am **seeking participants** who own, work on, manage, or live on property (lifestyle size land and upward) within the Motu catchment for a survey that will assist in the data collection process to fulfil the requirements of my Master's Degree. This research is being carried out to understand the perceived motivators, barriers and enablers of biodiversity protection and restoration. The findings of this study will be used in a master's thesis, and in a journal article that will interpret and present the overall outcomes of the research to an academic audience.

What's in it for you?

A greater understanding into the perceptions of biodiversity protection is needed to inform policy, protection schemes, and incentives at a regional and national level. **Your views** are necessary to ensure we know what **you want**, and, to ensure the creation of any future schemes and incentives are tailored to fit **your needs**.

Photograph: Neil Robert Hutton, 2018.
https://neilroberthutton.com/portfolio/kiwi-conservation/

Did you know that Motu is the only place in the North Island where Kiwi and Weka co-habit?

Photograph: Britney Ford, 2021.

Biodiversity provides life supporting systems that enable organisms, including humans to survive and is critical in supporting our natural environment. To **have your say** on how we should best be protecting biodiversity, scan the QR code below. In this survey, questions will be asked about your perceptions on the motivators, barriers and enablers of biodiversity protection along with some generic questions to determine the current level of biodiversity protection. This survey will only be available until the 28/03/2021.

Photograph: Kaspersky, 2021.

To participate, open the camera on your electronic device, hold it over the QR code and a notification link should take you to the survey.

Confidentiality:

You will not be identified in any way, and your name will not be disclosed in this research. All information collected from this survey will be kept strictly confidential and will only be accessible to myself and my two supervisors Dr. Marion McKay and Prof. Diane Pearson. The sumarised data from this research will be stored in a password protected computer at the School of Agriculture and Environment, Massey University, Palmerston North in New Zealand, and will be destroyed after the research project is completed.

Participant's Rights

Participation in this study is voluntary. You are under no obligation to accept this invitation; however I would be very grateful for your participation. If you decide to participate, you have the right to:

- decline to answer any particular question;
- withdraw from the study at any point;
- ask any questions about the study

Project contacts

You are welcome to contact the researcher and/or supervisors if you have any questions about the research.

Researcher:

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Co-supervisor:

Prof. Diane Pearson
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Tel: +6469517837
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This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research. If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Prof Craig Johnson, Director, Research Ethics, telephone: ext +6469518271, email *humanethics@massey.ac.nz.*

Thank you for your time and cooperation.

9.2 APPENDIX 2: Survey Questionnaire

Mōtū catchment Biodiversity Survey

Start of Block: Default Question Block

Management of the Mōtū catchment Biodiversity Survey: Investigation of the motivators, barriers and enablers of biodiversity protection.

I have read the Information Sheet and understand the details of this research. By clicking below, I agree to participate in this survey under the conditions set out in the information sheet.

- ○ I agree (1)

Page Break

For the purpose of this survey, the term biodiversity refers to the following:

"The variety of plant and animal life in the world or in a particular habitat, a high level of which is usually considered to be important and desirable" (Oxford Languages, 2021).

Page Break

What gender do you identify with?

- ○ Female (1)
- ○ Male (2)
- ○ Other (3)
- ○ Prefer not to say (4)

What ethnicity(s) do you identify with? *(please select all that apply).*

- [ ] New Zealand European or Pakeha (1)
- [ ] Māori (2)
- [ ] Other (please specify) (3) _____

Page Break

What is the size of your land management operation?

- ○ 0-4ha (1)
- ○ 5-50ha (2)
- ○ 51-500ha (3)
- ○ 501+ha (4)

What is your main role in the land management operation?

- [ ] Landowner (1)
- [ ] Land Manager (2)
- [ ] Employee (3)
- [ ] Stakeholder (5)
- [ ] Other (please specify) (4) _____

What is the land ownership type for your operation?

- ○ Private ownership (1)
- ○ Iwi or Māori freehold ownership (2)
- ○ Trust ownership (3)
- ○ Crown ownership (4)
- ○ Company ownership (5)
- ○ Other (please specify) (6) _____

How long have you been involved in the land management operation?

- ○ 0-9 years (1)
- ○ 10-19 years (2)
- ○ 20-29 years (3)
- ○ 30-39 years (4)
- ○ 40-49 years (5)
- ○ 50-59 years (6)
- ○ 60+ years (7)

What is the dominant land management activity on your land?

- [ ] Dairy farm (1)
- [ ] Sheep and beef farm (2)
- [ ] Plantation forest (3)
- [ ] Indigenous forest (4)
- [ ] Conservation land (5)
- [ ] Deer farm (6)
- [ ] Non productive land (7)
- [ ] Other (please specify) (8)

_____

Page Break

When you think about being involved with your operation, how unimportant or important are the following motivators?

	Unimportant (1)	Slightly important (2)	Moderately important (3)	Important (4)	Very Important (5)
Passing on the land in great condition (1)	○	○	○	○	○
Being appreciated by society and colleagues (2)	○	○	○	○	○
Being amongst the best in the industry (3)	○	○	○	○	○
Building up wealth and family/company assets (4)	○	○	○	○	○
Earning a high income (5)	○	○	○	○	○
Improving resource/land use (6)	○	○	○	○	○
Looking after the environment and protecting native plants and animals (7)	○	○	○	○	○
Other (please specify) (8)	○	○	○	○	○

Page Break

When you think about your operation, how strongly do you agree or disagree that the following factors prevent you from undertaking biodiversity protection and restoration?

	Strongly disagree (1)	Somewhat disagree (2)	Neutral (3)	Somewhat agree (4)	Strongly agree (5)
Conservation is not practical on your land (1)	○	○	○	○	○
There is lack of government or financial incentives (2)	○	○	○	○	○
There is lack of industry support (3)	○	○	○	○	○
There is not enough time, staff or labour (4)	○	○	○	○	○
It is not necessary to improve the environment (5)	○	○	○	○	○
Other landowners/managers may not change their ways (6)	○	○	○	○	○
There is uncertainty about the future of the property (7)	○	○	○	○	○
It is a waste of potential grazing or production land (8)	○	○	○	○	○
Regulatory framework (9)	○	○	○	○	○
Personal financial constraints (11)	○	○	○	○	○
Other (please specify) (10)	○	○	○	○	○

Page Break

When you think about your operation, how effective would the following measures be in enabling you to participate in biodiversity protection and restoration activities?

	Not effective (1)	Somewhat effective (2)	Effective (6)	Very effective (7)	Extremely effective (8)
Financial or economic incentive (1)	○	○	○	○	○
catchment and knowledge sharing groups (2)	○	○	○	○	○
Personal motivation and goals (3)	○	○	○	○	○
More research on biodiversity protection and restoration (4)	○	○	○	○	○
Community involvement in the groundwork (5)	○	○	○	○	○
Environmental management plans (6)	○	○	○	○	○
Increased public and peer acknowledgement of environmental achievements (7)	○	○	○	○	○
Government environmental regulation (8)	○	○	○	○	○
Other (please specify) (9)	○	○	○	○	○

Page Break

How important is it for you to have native biodiversity in the Mōtū catchment?

	Very unimportant (1)	Unimportant (2)	Neutral (3)	Important (4)	Very important (5)
Scale (1)	○	○	○	○	○

What changes to biodiversity (if any) have you noticed on the land since being involved? ***(e.g increase in riparian planting, increase in pests, decrease in fish ect)***

○ Please specify (1) _____

Page Break

What native vegetation do you know of on your land? ***(Please select all that apply).***

☐ Tussock (1)

☐ Forest (2)

☐ Shrub (3)

☐ Wetland (5)

☐ Other (please specify) (6)

_____

What native animals do you know of on your land? *(please select all that apply).*

- ☐ Bats (3)
- ☐ Insects such as weta and huhu grubs (4)
- ☐ Gecko and lizards (5)
- ☐ Freshwater fish (7)
- ☐ Kiwi (8)
- ☐ Weka (9)
- ☐ Whio (blue duck) (10)
- ☐ Hochstetter's frog (11)
- ☐ Other (please specify) (1) _____

What animal pests do you know of on your land? *(please select all that apply).*

- ☐ Stoats (1)
- ☐ Rats (2)
- ☐ Deer (3)
- ☐ Pigs (4)
- ☐ Possums (5)
- ☐ Feral cats (6)
- ☐ Goats (7)

- [ ] All of the above (8)
- [ ] Other (please specify) (9) _____

Page Break

What pest control measures are you currently undertaking (if any) on your land? *(please select all that apply)*.

- [ ] Trapping (1)
- [ ] Poisoning (2)
- [ ] Shooting (3)
- [ ] No pest control (4)
- [ ] Other (please specify) (5) _____

On a scale of 0 to 100, what percentage of the property you are involved with would you estimate is contributing to the protection of native biodiversity?

	0 10 20 30 40 50 60 70 80 90 100
Percentage ()	

Which of the following are you doing, or have done to manage and protect native biodiversity on your land? ***(please select all that apply).***

- ☐ Fencing of bush blocks and/or gully vegetation. (1)
- ☐ Fencing of wetlands and/or waterways (2)
- ☐ Legally protecting such as putting an area under a QEII covenant (3)
- ☐ Weed control (5)
- ☐ Planting native species (6)
- ☐ Other (please specify) (7) _____

Page Break

When thinking about your operation, how unlikely or likely would you be to increase the size of patches (areas) of native biodiversity on your land?

	Very unlikely (1)	Somewhat unlikely (2)	Neutral (3)	Somewhat likely (4)	Very likely (5)
Scale (1)	○	○	○	○	○

Are there any land management issues (irrespective of biodiversity) that are making owning/managing/working on your operation challenging?

○ Please specify (1) _____

Page Break

As part of the data collection process for this study, the researcher would like to do some short follow up interviews. If you are interested in participating, please enter your email address below.

_____

Page Break

Any final comments?

○ Please specify (1) _____

End of Block: Default Question Block

9.3 APPENDIX 3: Interview Information Sheet

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

MANAGEMENT OF THE MOTU CATCHMENT, BIODIVERSITY INTERVIEW INFORMATION SHEET

Investigation of the motivators, barriers and enablers of biodiversity protection

Kia Ora,

My name is Britney Ford, I live in Motu, am part of the catchment group, am a Master of Environmental Management Student at Massey University. I am **seeking participants** who own, work on, manage, or live on property (lifestyle size land and upward) within the Motu catchment for an interview that will assist in the data collection process to fulfil the requirements of my Master's Degree. This research is being carried out to understand the perceived motivators, barriers and enablers of biodiversity protection and restoration. The findings of this study will be used in a master's thesis, and in a journal article that will interpret and present the overall outcomes of the research to an academic audience.

Confidentiality:

You will not be identified in any way, and your name will not be disclosed in this research. All information collected from this interview will be kept strictly confidential and will only be accessible to myself and my two supervisors Dr. Marion McKay and Prof. Diane Pearson. The sumarised data from this research will be stored in a password protected computer at the School of Agriculture and Environment, Massey University, Palmerston North in New Zealand, and will be destroyed after the research project is completed.

Participant's Rights

Participation in this study is voluntary. You are under no obligation to accept this invitation; however I would be very grateful for your participation. If you decide to participate, you have the right to:

- decline to answer any particular question;
- withdraw from the study at any point;
- ask any questions about the study
- request that specific or all of the information you have provided not be included in the study;
- request for the audio recording to be stopped

Project contacts

You are welcome to contact the researcher and/or supervisors if you have any questions about the research.

Researcher:

Britney Ford
School of Agriculture and Environment Massey University
Palmerston North, New Zealand
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Email: [redacted]

Supervisor:

Dr. Marion McKay
School of Agriculture and Environment Massey University
Palmerston North, New Zealand
Tel: +6469517815
Email: M.B.MacKay@massey.ac.nz

Co-supervisor:

Prof. Diane Pearson
School of Agriculture and Environment Massey University
Palmerston North, New Zealand
Tel: +6469517837
Email: D.Pearson@massey.ac.nz

This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research. If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Prof Craig Johnson, Director, Research Ethics, telephone: ext +6469518271, email *humanethics@massey.ac.nz.*

Thank you for your time and cooperation.

9.4 APPENDIX 4: Interview Consent Form

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

Management of the Motu Catchment Biodiversity Interview Consent Form

This consent form will be held for a period of 5 years.

I have read the information sheet and had the details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I agree/do not agree to the interview being audio taped.

I agree to participate in this study under the conditions set out in the information sheet.

Signature……Date……....

Full Name (printed)……....

Contact Details (optional) ……....

9.5 APPENDIX 5: Interview Questionnaire

Interview Note Taking Template

Do you consider biodiversity to be important in this catchment?
Why/why not?
Which component of biodiversity is the most important?

Do you have any concerns around the protection of biodiversity in this catchment?
(Yes) What would help to ease these concerns?
(No) Next question

Do you currently undertake any biodiversity protection activities on your land?
(Yes) What actions are you taking to protect biodiversity on your land?
(Yes) Do you feel intrinsic value from the presence of biodiversity?
(No) Is there anything stopping you from doing so?

The results have shown that a barrier to protecting biodiversity in this catchment is a lack of government and financial incentives. Do you feel like there is lack of government and financial incentives?
(Yes) What would you suggest to overcome this barrier?
(Yes) What sort of government and or financial incentives would you like to see and how would you like to see these implemented?
(No) Why do you think some people see this is a barrier?

The results showed that many respondents suggested that animal and weed pests have been increasing over the years. When thinking about this, which weed, and animal pests stand out as having been increasing over the years?

What are your thoughts on the use of 1080 in the catchment as a pest control method?

Are you currently part of a catchment group?
(No) Do you feel like it would be beneficial to be a part of one?
(Yes) How beneficial do you feel this is in terms of knowledge gained for biodiversity protection?

How do you feel about increasing the size of patches of indigenous vegetation on your land?
(Positive) Are there certain areas that you would be most likely to do this and why?
(Negative) What concerns do you have around increasing the size of patches on your land and why?

What biodiversity protection actions do you think are the most important to undertake right now?
What would the on the ground actions be?

Would a local source of plant material be appealing such as a community nursery?

(Yes) would you be willing to provide seed from your land?
(Yes) would you be willing to be involved in the groundwork for this?

Any final comments?

9.6 APPENDIX 5: Survey Data

Q1	Q2	Q3	Q27	Q5	Q31	Q16	Q4	Q12_1	Q12_2	Q12_3	Q12_4
1	1	3	3	1	2	1	2	4	2	5	5
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1	2	1	4	2	1	2	1				

Q12_5	Q12_6	Q12_7	Q13_1	Q13_2	Q13_3	Q13_4	Q13_5	Q13_6	Q13_7	Q13_8	Q13_9
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5	5	5	2	2	2	4	1	2	2	4	4
5	3	5									
1	5	5	1	4	3	1	1	4	1	1	2

Q13_10	Q14_1	Q14_2	Q14_3	Q14_4	Q14_5	Q14_6	Q14_7	Q14_8	Q21_1	Q20_1	Q15_1
3	2	2	4	2	1	1	2	2	3	30	5
4	4	3	4	3	3	5	4	4	5	30	5
									5		
4	5	3	3	5	3	2	2	1	5	25	1
3	3	2	3	3	2	1	2	4		10	
3	5	2	4	2	2	2	2	2	5	21	3
3	5	3	4	3	2	3	2	2	3	20	3
4	4	4	5	4	5	3	5	3	5	41	5
3	5	2	5	2	4	4	5	5	5	100	5
4	5	3	2	3	2	2	2	1	5	20	4
3	3	2	3	4	2	3	3	3	5	48	3
3	3	4	4	4	2	4	4	2	5	30	4
3	5	4	5	3	2	2	2	2	5	20	4
4	4	4	5	5	4	4	2	4	5	70	5
1	1	4	2	4	3	5	3	2	5	40	2
3	4	3	3	2	2	2	5	3	4	65	4
3	5	4	5	2	2	2	2	2	5	90	5
1	5	4	4	3	2	2	2	4	4	40	4
4	3	3	3	3	3	3	3	3	5		
3	4	3	4	2	2	2	2	2	5	25	4
4	4	3	2	1	1	1	1	1	4	100	1
5	3	4	4	3	5	3	4	3	4	10	4
3	4	4	3	3	4	4	4	3	4	21	3
3	3	4	3	3	3	3	4	3	3	74	3
3	2	2	2	3	3	2	2	2	3	20	3
3	4	2	3	2	2	2	3	1	4	70	1
4	2	1	2	2	2	2	1	1	4	80	3
3	4	3	5	2	2	2	2	3	4	72	1
3	4	3	5	3	4	2	2	3	4	37	4
1	3	5	5	5	5	5	5	5	5	30	3
5	5	4	4	4	4	3	3	2	5	30	5
5	2	2	3	1	1	1	1	3	1	11	5
4	5	3	3	3	2	2	3	1	5	40	5
4	4	4	4	4	3	4	3	3	1	40	5
4	4	4	4	3	2	4	3	4	5	60	3
3	5	3	4	2	2	2	2	2	5	28	4
4	4	3	4	2	2	2	2	3	5	16	4
3	5	3	4	2	2	2	2	2	4	22	4
4	5	3	5	4	3	4	3	4	4	20	4
3	4	3	5	2	2	2	2	3	4	19	4
3	5	4	5	4	3	2	2	2	5	100	5
3	4	3	4	2	2	2	2	1	4	28	4
3	4	3	4	3	2	1	2	1	4	23	3
3	5	3	5	3	2	2	2	1	4	20	3
3	5	2	5	2	1	1	1	3	4	26	3
4	2	2	4	3	5	4	5	2	5	70	4
3	3	3	3	3	3	3	3	3	4	20	4
3	4	5	4	5	5	5	5	2	5	82	5
4	3	3	3	3	4	4	5	2	4		4
4	4	3	4	4	2	2	5	3	5	30	4
3	4	5	4	5	3	2	5	2	5	92	5
4	4	4	4	3	3	2	5	2	5	56	5
3	5	4	3	4	4	4	4	4	5	82	5
4	5	4	4	3	2	2	2	2	4	25	3
3											
										20	4
4	5	4	4	3	2	2	2	2	4	20	4
2	4	4	3	4	3	3	3	4	4	30	4
1	3	5	4	5	5	5	5	5		29	5

9.7 APPENDIX 6: Survey Data Code Book

Codebook

Q1: "Q1"

		Value
Standard Attributes	Position	3
	Label	I have read the Information Sheet and understand the details of this research. By clicking below, I agree to participate in this survey under the conditions set out in the information sheet
	Type	String
	Format	A190
	Measurement	Text converted to Nominal
	Role	Input
Valid Values	I agree	1

Q2: "Q2"

		Value
Standard Attributes	Position	4
	Label	What gender do you identify with?
	Type	String
	Measurement	Text converted to Nominal
	Role	Input
Valid Values	Male	1
	Female	2
	Other	3
	Prefer not to say	4

Q3: "Q3"

		Value
Standard Attributes	Position	5
	Label	What ethnicity(s) do you identify with? (please select all that apply).
	Type	String
	Measurement	Text converted to Nominal
	Role	Input
Valid Values	New Zealand European or Pakeha	1
	Māori	2
	Other (please specify)	3

Q27: "Q27"

		Value
Standard Attributes	Position	7
	Label	What is the size of your land management operation?
	Type	String
	Measurement	Text converted to Interval
	Role	Input
Valid Values	0-4ha	1
	5-50ha	2
	51-500ha	3
	501+ha	4

Q5: "Q5"

		Value
Standard Attributes	Position	8
	Label	What is your main role in the land management operation?
	Type	String
	Measurement	Text converted to Nominal
	Role	Input
Valid Values	Landowner	1
	Land Manager	2
	Employee	3
	Other	4
	Stakeholder	5

Q31: "Q31"

		Value
Standard Attributes	Position	10
	Label	What is the land ownership type for your operation?
	Type	String
	Measurement	Text converted to Nominal
	Role	Input
Valid Values	Private Ownership	1
	Company ownership	2
	Trust Ownership	3
	Iwi or Māori freehold ownership	4
	Other (please specify)	5
	Crown Ownership	6

Q16: "Q16"

		Value
Standard Attributes	Position	12
	Label	How long have you been involved in the land management operation?
	Type	String
	Measurement	Text Converted to Interval
	Role	Input
Valid Values	0-9 years	1
	10-19 years	2
	20-29 years	3
	30-39 years	4
	40-49 years	5

Q4: "Q4"

		Value
Standard Attributes	Position	13
	Label	What is the dominant land management activity on your land?
	Type	String
	Measurement	Nominal
	Role	Input
Valid Values	Sheep and beef farm	1
	Plantation forest	2
	Conservation land	3
	Indigenous forest	4
	Dairy farm	5
	Other (please specify)	6

Q12_1 "Q12_1"

		Value
Standard Attributes	Position	15
	Label	When you think about being involved with your operation, how unimportant or important are the following motivators? **Passing on the Land in Great Condition**
	Type	String
	Format	A156
	Measurement	Ordinal
	Role	Input
Valid Values	Unimportant	1
	Slightly important	2
	moderately important	3
	Important	4
	Very important	5

Q12_2 "Q12_2"

		Value
Standard Attributes	Position	16
	Label	When you think about being involved with your operation, how unimportant or important are the following motivators? - **Being appreciated by society and collages**
	Type	String
	Format	A161
	Measurement	Ordinal
	Role	Input
Valid Values		
	Unimportant	1
	Slightly important	2
	moderately important	3
	Important	4
	Very important	5

Q12_3 "Q12_3"

		Value
Standard Attributes	Position	17
	Label	When you think about being involved with your operation, how unimportant or important are the following motivators? - **Being amongst the best in the industry**
	Type	String
	Format	A156
	Measurement	Ordinal
	Role	Input
Valid Values		
	Unimportant	1
	Slightly important	2
	moderately important	3
	Important	4
	Very important	5

Q12_4 "Q12_4"

		Value
Standard Attributes	Position	18
	Label	When you think about being involved with your operation, how unimportant or important are the following motivators? - **Building up wealth and family/company assets**
	Type	String
	Format	A162
	Measurement	Ordinal
	Role	Input
Valid Values		
	Unimportant	1
	Slightly important	2
	moderately important	3
	Important	4
	Very Important	5

Q12_5 "Q12_5"

		Value
Standard Attributes	Position	19
	Label	When you think about being involved with your operation, how unimportant or important are the following motivators? - **Earning a high income**
	Type	String
	Format	A139
	Measurement	Ordinal
	Role	Input
Valid Values		
	Unimportant	1
	Slightly important	2
	moderately important	3
	Important	4
	Very important	5

Q12_6 "Q12_6"

		Value
Standard Attributes	Position	20
	Label	When you think about being involved with your operation, how unimportant or important are the following motivators? - **Improving resource/land use**
	Type	String
	Format	A145
	Measurement	Ordinal
	Role	Input
Valid Values	Unimportant	1
	Slightly important	2
	moderately important	3
	Important	4
	Very important	5

Q12_7 "Q12_7"

		Value
Standard Attributes	Position	21
	Label	When you think about being involved with your operation, how unimportant or important are the following motivators? - **Looking after the environment and protecting native plants and animals**
	Type	String
	Format	A188
	Measurement	Ordinal
	Role	Input
Valid Values	Unimportant	1
	Slightly important	2
	moderately important	3
	Important	4
	Very important	5

Q12_8 "Q12_8"

		Value
Standard Attributes	Position	22
	Label	When you think about being involved with your operation, how unimportant or important are the following motivators? - **Other (please specify)**
	Type	String
	Format	A140
	Measurement	Ordinal
	Role	Input
Valid Values	Unimportant	1
	Slightly important	2
	moderately important	3
	Important	4
	Very important	5

Q13_1 "Q13_1"

		Value
Standard Attributes	Position	24
	Label	When you think about your operation, how strongly do you agree or disagree that the following factors prevent you from undertaking biodiversity protection and restoration? - **Conservation is not practical on your land**
	Type	String
	Format	A216
	Measurement	Ordinal
	Role	Input
Valid Values		
	Strongly Disagree	1
	Somewhat Disagree	2
	Neutral	3
	Somewhat Agree	4
	Strongly Agree	5

Q13_2 "Q13_2"

		Value
Standard Attributes	Position	25
	Label	When you think about your operation, how strongly do you agree or disagree that the following factors prevent you from undertaking biodiversity protection and restoration? - **There is lack of government or financial incentives**
	Type	String
	Format	A225
	Measurement	Ordinal
	Role	Input
Valid Values		
	Strongly Disagree	1
	Somewhat Disagree	2
	Neutral	3
	Somewhat Agree	4
	Strongly Agree	5

Q13_3 "Q13_3"

		Value
Standard Attributes	Position	26
	Label	When you think about your operation, how strongly do you agree or disagree that the following factors prevent you from undertaking biodiversity protection and restoration? - **There is lack of industry support**
	Type	String
	Format	A207
	Measurement	Ordinal
	Role	Input
Valid Values		
	Strongly Disagree	1
	Somewhat Disagree	2
	Neutral	3
	Somewhat Agree	4
	Strongly Agree	5

Q13_4 "Q13_4"

		Value
Standard Attributes	Position	27
	Label	When you think about your operation, how strongly do you agree or disagree that the following factors prevent you from undertaking biodiversity protection and restoration? - **There is not enough time, staff or labour**
	Type	String
	Format	A215
	Measurement	Ordinal
	Role	Input
Valid Values		
	Strongly Disagree	1
	Somewhat Disagree	2
	Neutral	3
	Somewhat Agree	4
	Strongly Agree	5

Q13_5 "Q13_5"

		Value
Standard Attributes	Position	28
	Label	When you think about your operation, how strongly do you agree or disagree that the following factors prevent you from undertaking biodiversity protection and restoration? - **It is not necessary to improve the environment**
	Type	String
	Format	A220
	Measurement	Ordinal
	Role	Input
Valid Values		
	Strongly Disagree	1
	Somewhat Disagree	2
	Neutral	3
	Somewhat Agree	4
	Strongly Agree	5

Q13_6 "Q13_6"

		Value
Standard Attributes	Position	29
	Label	When you think about your operation, how strongly do you agree or disagree that the following factors prevent you from undertaking biodiversity protection and restoration? - **Other landowners/managers may not change their ways**
	Type	String
	Format	A225
	Measurement	Ordinal
	Role	Input
Valid Values		
	Strongly Disagree	1
	Somewhat Disagree	2
	Neutral	3
	Somewhat Agree	4
	Strongly Agree	5

Q13_7 "Q13_7"

		Value
Standard Attributes	Position	30
	Label	When you think about your operation, how strongly do you agree or disagree that the following factors prevent you from undertaking biodiversity protection and restoration? - **There is uncertainty about the future of the property**
	Type	String
	Format	A227
	Measurement	Ordinal
	Role	Input
Valid Values		
	Strongly Disagree	1
	Somewhat Disagree	2
	Neutral	3
	Somewhat Agree	4
	Strongly Agree	5

Q13_8 "Q13_8"

		Value
Standard Attributes	Position	31
	Label	When you think about your operation, how strongly do you agree or disagree that the following factors prevent you from undertaking biodiversity protection and restoration? - **It is a waste of potential grazing or production land**
	Type	String
	Format	A227
	Measurement	Ordinal
	Role	Input
Valid Values		
	Strongly Disagree	1
	Somewhat Disagree	2
	Neutral	3
	Somewhat Agree	4
	Strongly Agree	5

Q13_9 "Q13_9"

		Value
Standard Attributes	Position	32
	Label	When you think about your operation, how strongly do you agree or disagree that the following factors prevent you from undertaking biodiversity protection and restoration? - **Regulatory framework**
	Type	String
	Format	A194
	Measurement	Ordinal
	Role	Input
Valid Values		
	Strongly Disagree	1
	Somewhat Disagree	2
	Neutral	3
	Somewhat Agree	4
	Strongly Agree	5

Q13_10 "Q13_10"

		Value
Standard Attributes	Position	33
	Label	When you think about your operation, how strongly do you agree or disagree that the following factors prevent you from undertaking biodiversity protection and restoration? - **Personal financial constraints**
	Type	String
	Format	A204
	Measurement	Ordinal
	Role	Input
Valid Values		
	Strongly Disagree	1
	Somewhat Disagree	2
	Neutral	3
	Somewhat Agree	4
	Strongly Agree	5

Q14_1: "Q14_1"

		Value
Standard Attributes	Position	36
	Label	When you think about your operation, how effective would the following measures be in enabling you to participate in biodiversity protection and restoration activities? - **Financial or economic incentive**
	Type	String
	Format	A202
	Measurement	Ordinal
	Role	Input
Valid Values		
	Not Effective	1
	Somewhat Effective	2
	Effective	3
	Very Effective	4
	Extremely Effective	5

Q14_2 "Q14_2"

		Value
Standard Attributes	Position	37
	Label	When you think about your operation, how effective would the following measures be in enabling you to participate in biodiversity protection and restoration activities? - **Catchment and knowledge sharing groups**
	Type	String
	Format	A209
	Measurement	Ordinal
	Role	Input
Valid Values		
	Not Effective	1
	Somewhat Effective	2
	Effective	3
	Very Effective	4
	Extremely Effective	5

Q14_3 "14_3"

		Value
Standard Attributes	Position	38
	Label	When you think about your operation, how effective would the following measures be in enabling you to participate in biodiversity protection and restoration activities? - **Personal motivation and goals**
	Type	String
	Format	A200
	Measurement	Ordinal
	Role	Input
Valid Values	Not Effective	1
	Somewhat Effective	2
	Effective	3
	Very Effective	4
	Extremely Effective	5

Q14_4 "Q14_4"

		Value
Standard Attributes	Position	39
	Label	When you think about your operation, how effective would the following measures be in enabling you to participate in biodiversity protection and restoration activities? - **More research on biodiversity protection and restoration**
	Type	String
	Format	A227
	Measurement	Ordinal
	Role	Input
Valid Values		
	Not Effective	1
	Somewhat Effective	2
	Effective	3
	Very Effective	4
	Extremely Effective	5

Q14_5 "Q14_5"

		Value
Standard Attributes	Position	40
	Label	When you think about your operation, how effective would the following measures be in enabling you to participate in biodiversity protection and restoration activities? - **Community involvement in the groundwork**
	Type	String
	Format	A210
	Measurement	Ordinal
	Role	Input
Valid Values		
	Not Effective	1
	Somewhat Effective	2
	Effective	3
	Very Effective	4
	Extremely Effective	5

Q14_6 "Q14_6"

		Value
Standard Attributes	Position	41
	Label	When you think about your operation, how effective would the following measures be in enabling you to participate in biodiversity protection and restoration activities? - **Environmental management plans**
	Type	String
	Format	A201
	Measurement	Ordinal
	Role	Input
Valid Values		
	Not Effective	1
	Somewhat Effective	2
	Effective	3
	Very Effective	4
	Extremely Effective	5

Q14_7 "Q14_7"

		Value
Standard Attributes	Position	42
	Label	When you think about your operation, how effective would the following measures be in enabling you to participate in biodiversity protection and restoration activities? - **Increased public and peer acknowledgement of environmental achievements**
	Type	String
	Format	A242
	Measurement	Ordinal
	Role	Input
Valid Values		
	Not Effective	1
	Somewhat Effective	2
	Effective	3
	Very Effective	4
	Extremely Effective	5

Q14_8 "Q14_8"

		Value
Standard Attributes	Position	43
	Label	When you think about your operation, how effective would the following measures be in enabling you to participate in biodiversity protection and restoration activities? - **Government environmental regulation**
	Type	String
	Format	A206
	Measurement	Ordinal
	Role	Input
Valid Values		
	Not Effective	1
	Somewhat Effective	2
	Effective	3
	Very Effective	4
	Extremely Effective	5

Q21_1 "Q21_1"

		Value
Standard Attributes	Position	46
	Label	How important is it for you to have native biodiversity in the Motu Catchment?
	Type	String
	Format	A86
	Measurement	Ordinal
	Role	Input
Valid Values		
	Unimportant	1
	Slightly important	2
	moderately important	3
	Important	4
	Very important	5

Q7 "Q7"

		Value
Standard Attributes	Position	49
	Label	What native vegetation do you know of on your land? (Please select all that apply). - Selected Choice
	Type	String
	Format	A101
	Measurement	Nominal
	Role	Input
Valid Values	Tussock	1
	Forest	2
	Shrub	3
	Wetland	4
	Other (please specify)	5

Q8 "Q8"

		Value
Standard Attributes	Position	46
	Label	What native animals do you know of on your land? (please select all that apply). -
	Type	String
	Format	A86
	Measurement	Nominal
	Role	Input
Valid Values	Other (please specify)	1
	Bats	2
	Insects such as weta and huhu grubs	3
	Gecko and lizards	4
	Freshwater fish	5
	Kiwi	6
	weka	7
	Whio (blue duck)	8
	Hochstetter's frog	9

Q9 "Q9"

		Value
Standard Attributes	Position	46
	Label	What animal pests do you know of on your land? (please select all that apply).
	Type	String
	Format	A86
	Measurement	Nominal
	Role	Input
Valid Values	Stoats	1
	Rats	2
	Deer	3
	Pigs	4
	Possums	5
	Feral cats	6
	Goats	7
	All of the above	8
	Other	9

Q10 "Q10"

		Value
Standard Attributes	Position	46
	Label	What pest control measures are you currently undertaking (if any) on your land? (please select all that apply)
	Type	String
	Format	A86
	Measurement	Nominal
	Role	Input
Valid Values	Trapping	1
	Poisoning	2
	Shooting	3
	No Pest Control	4
	Other	5

Q11 "Q11"

		Value
Standard Attributes	Position	46
	Label	Which of the following are you doing, or have done to manage and protect native biodiversity on your land?
	Type	String
	Format	A86
	Measurement	Nominal
	Role	Input
Valid Values	Fencing of bush blocks and/or gully vegetation.	1
	Fencing of wetlands and/or waterways	2
	Legally protecting such as putting an area under a QEII covenant	3
	Weed control	4
	Planting native species	5
	Other	6

Q15_1 "Q15_1"

		Value
Standard Attributes	Position	60
	Label	When thinking about your operation, how unlikely or likely would you be to increase the size of patches (areas) of native biodiversity on your land? - Scale
	Type	String
	Format	A156
	Measurement	Ordinal or Interval
	Role	Input
Valid Values		
	Very unlikely	1
	Somewhat unlikely	2
	Neutral	3
	Somewhat likely	4
	Very likely	5