The Nature of Compliance:

Biodiversity Compensation under the Conservation Act 1987

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Laurien Anne Heijs

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Biodiversity compensation is an increasingly popular policy tool that has the potential to balance conservation and development goals. It purports to enable continued development with the proviso that any residual effects of development on biodiversity are compensated for. Biodiversity compensation is controversial. Some argue that it is a useful policy instrument, whilst others consider it does little but facilitate inappropriate development and pacify those with an interest in protecting the environment.

One issue that is considered detrimental to the use of biodiversity compensation as a policy tool, is inadequate monitoring and compliance. Non-compliance can mean failure to deliver the anticipated compensation and consequently can lead to biodiversity loss. This research project focused on compliance with biodiversity compensation on public conservation land in New Zealand, under the Conservation Act 1987. A mixed methods approach was used to investigate variations in, and predictors of, compliance.

A total of 20 concession case studies from around the South Island of New Zealand, involving 28 compensatory conditions, were assessed in this study. Results show that concessionaires complied with approximately two-thirds (68%) of biodiversity compensation conditions. This rate of compliance is similar to what was found under the New Zealand Resource Management Act 1991, and it is a vast improvement on overseas studies. Compliance was also observed to be non-uniform. Some variables, such as the duration of the compensatory action, had a statistically significant correlation with compliance. Other qualitative factors, observed during the data collection process, also had an effect on compliance. These include the *ad hoc* way in which compensation measures were implemented, monitored and enforced, as well as the Department of Conservation’s approach to compliance reporting and data management.

Continued research into this area is vital to ensure compensatory conditions lead to efficient and effective biodiversity management. This research has been important in providing the first insight into the use of, and compliance with, biodiversity compensation under the Conservation Act, and it paves the way for further exploration and discussion.

Keywords: Biodiversity compensation, compliance, Conservation Act, concession, conditions, Department of Conservation (DOC), New Zealand, offset, monitoring.

“Here is your country. Cherish these natural wonders, cherish the natural resources, cherish the history and romance as a sacred heritage, for your children and your children's children. Do not let selfish men or greedy interests skin your country of its beauty, its riches or its romance.”

— Theodore Roosevelt

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ACRONYMS

BBOP	Business and Biodiversity Offsets Programme
CBD	Convention on Biological Diversity
DOC	Department of Conservation
EIA	Environmental Impact Assessment
GDP	Gross Domestic Product
GIS	Geographic Information Systems
ICMM	International Council on Mining and Metals
IFC	International Finance Corporation
IUCN	International Union for Conservation of Nature
LCDB	Land Cover Database
LENZ	Land Environment New Zealand
NGO	Non-Governmental Organisation
NIMBY	Not-In-My-Backyard
NZBOP	New Zealand Biodiversity Offsetting Programme
NZBS	New Zealand Biodiversity Strategy
NZLRI	New Zealand Land Resource Inventory
OECD	Organisation for Economic Cooperation and Development
RMA	Resource Management Act 1991
RobOff	Robust Offsetting
QEII	Queen Elizabeth the Second Trust
US	United States

Chapter 1

Introduction

New Zealanders have an extraordinary natural heritage. More than 8 million hectares of ancient native forests, spectacular mountain ranges, wide open tussock expanses, sweeping coastlines, cascading rivers, fertile wetlands, and tranquil lakes form New Zealand's conservation estate – public conservation land managed by the Department of Conservation (DOC) under a mandate derived from the Conservation Act 1987 (hereon referred to as the Conservation Act). New Zealanders are the Kaitiaki, or guardians, of this land. The land is our birth right and our legacy.

Unfortunately, New Zealand's conservation estate is under threat. A rampant pest invasion, the effects of climate change, and habitat degradation and fragmentation are well-known culprits. This research, however, uncovers a lesser-known and until now unquantified threat, that of "broken promises." These promises concern an increasingly popular policy mechanism called "biodiversity compensation." The aim of biodiversity compensation is to counterbalance losses in biodiversity, as a result of residual, unavoidable impacts of development, with biodiversity conservation gains (Bull, Suttle, Gordon, Singh, & Milner-Gulland, 2013; Burgin, 2008; Gordon et al., 2011; Kiesecker, Copeland, Pocewicz, & McKenney, 2010; Maron et al., 2012; Overton, Stephens, & Ferrier, 2013; Pilgrim et al., 2013; Ten Kate, Bishop, & Bayon, 2004). The idea is that biodiversity compensation facilitates biodiversity accounting, and integrates biodiversity value and conservation into the consideration and cost-benefit analysis of development projects (Bull, Suttle, Gordon, et al., 2013).

Whilst there is support for the use of biodiversity compensation in New Zealand (Brown, Clarkson, Barton, & Joshi, 2014), the theory and practice are still considered controversial (Brown, Clarkson, Stephens, & Barton, 2014; Christensen & Barnes, 2009; Gillespie, 2012; McKenney & Kiesecker, 2010; Norton & Warburton, 2014; Walker, Brower, Stephens, & Lee, 2009).

The focus of this research is on a major criticism of the concept, that of low levels of compliance or, "broken promises." Low levels of compliance tend to be perpetuated by a general lack of post-implementation compliance monitoring and enforcement (Bull, Suttle, Gordon, et al., 2013; Gibbons & Lindenmayer, 2007; Matthews & Endress, 2008; Quigley & Harper, 2006; Race & Fonseca, 1996; Tonkin and Taylor, 2012). Without rigorous compliance monitoring, there is no way to know whether the biodiversity losses associated with development projects have been adequately compensated for (Bull, Suttle, Gordon, et al., 2013).

This research provides the first insight into the use of, and compliance with, biodiversity compensation on New Zealand's conservation estate. A mixed methods approach combined spatial, archival, and field ecology methods to assess:

1. The levels of compliance with biodiversity compensation requirements in concessions granted under the Conservation Act.
2. How variations in compliance might be explained.

The hypothesis was that compliance with biodiversity compensation requirements is influenced by:

- Conservation land category;
- Habitat type;
- Condition type;
- Applicant type;
- Activity type; and
- A range of other variables within the concession application process, the concession contract and social circumstances surrounding the concession.

This thesis is structured into six chapters. Following on from this chapter, Chapter 2 delves into the literature, providing a review of biodiversity compensation and then narrowing in on its application in New Zealand. Chapter 3 provides a description of the methods used in this study and chapter 4 and 5 are the results and discussion. Chapter 4 and 5 expand on the variations in, and predictors of, compliance with biodiversity compensation. This detail should help DOC, and other regulatory agencies, to address instances of non-compliance in a more resource-effective manner. As such, the results of this study, and the conclusions and recommendations provided in chapter 6, should lead to more effective and efficient biodiversity management and facilitate a better understanding of the appropriate application and management of biodiversity compensation.

This research adds to the growing global body of literature on biodiversity compensation and sheds light on the variations in, and predictors of, compliance. To date, evaluations of the use of biodiversity compensation in New Zealand have been limited. Whilst several authors have discussed its use within resource management, focusing typically on case studies or instances within case-law (Christensen, 2010; Department of Conservation, 2014b; Norton & Warburton, 2014; Rive, 2013), only Brown (2014) has done a systematic and empirical analysis. Brown's (2014) research was on ecological compensation under the Resource Management Act 1991. Within her research Brown (2014) identified the need for a similar study, which would look at biodiversity compensation on New Zealand's public conservation estate, under the Conservation Act. This research addresses this knowledge gap and facilitates a future cross-policy comparison of biodiversity compensation between public and private land in New Zealand. As such, the layout of this research is similar to the layout of Part 1 (Ecological compensation: an evaluation of regulatory compliance in New Zealand) of Brown's (2014) research.

The ultimate question this research asks is whether any level of non-compliance, with biodiversity compensation on New Zealand's public conservation estate, is acceptable. Non-compliance, or "broken promises," represent failure to deliver the anticipated compensation, the result of which is an uncertain outcome for biodiversity. New Zealand is a global biodiversity hotspot (Organisation for Economic Co-operation and Development (OECD), 2007), so it is important that the approach to biodiversity compensation is deliberated on, and potentially better regulated.

Chapter 2

Literature Review

2.1 The Biodiversity Crisis

Our world is in the midst of a biodiversity crisis. Widespread consensus indicates that we are now experiencing a 6th mass extinction event (Barnosky et al., 2011; Novacek & Cleland, 2001). Novacek and Cleland (2001) characterise this mass extinction event by the unprecedented rate at which biodiversity is being lost and habitat degradation is occurring. Extinction rates are estimated to be several orders of magnitude higher than background rates (Cullen & White, 2013; Novacek & Cleland, 2001). The International Union for Conservation of Nature (IUCN) have determined that of 63,837 species assessed for the IUCN Red list of 2012, 19,817 were threatened with extinction, including 41% of amphibians, 33% of reef building corals, 30% of conifers, 25% of mammals and 13% of birds (International Union for Conservation of Nature, 2012). Barnosky et al. (2011) state that humans are the cause of this (the 6th) mass extinction event, through resource depletion, habitat loss, habitat fragmentation and degradation, the introduction of non-native species, hunting, the spreading of pathogens, and changes to global climate. Of these, habitat loss and the fragmentation and degradation of habitat are considered to be the primary drivers behind the extinction crisis (Balmford & Bond, 2005; Gillespie, 2012; Janetos et al., 2005).

The international community has responded to the biodiversity crisis by setting targets, both nationally and internationally, to reduce the loss of biodiversity, increase the number of protected areas and restore any degraded habitat (Balmford & Bond, 2005; Gillespie, 2012). Unfortunately, these targets are not being met and impacts appear to be intensifying (Gillespie, 2012; Secretariat of the Convention on Biological Diversity, 2010). Reasons for failure exist in escalating consumption patterns and the continued pursuit for economic growth by a growing and increasingly prosperous human population (Secretariat of the Convention on Biological Diversity, 2010). Consumption patterns are such that the world's ecological footprint now exceeds the earth's biological carrying capacity by more than 40% (Secretariat of the Convention on Biological Diversity, 2010).

Our continued desire for development appears to be in direct conflict with the conservation of our biodiversity. Janetos et al. (2005) remind us that ecosystem services rely on interactions between elements of biodiversity. As humans we are wholly reliant on ecosystem services, which means we have an interest in halting the biodiversity crisis. As the Convention on Biological Diversity (CBD) (2005; cited in Brownlie, King, & Treweek, 2013, p. 25) describes it, biodiversity is "the life insurance of life itself." We thus need to learn to balance our growing resource needs and our development imperative with successful biodiversity conservation (Kiesecker et al., 2010).

2.2 Biodiversity Compensation

Biodiversity compensation is a tool that is used to strike a balance between development and biodiversity conservation. The purpose of biodiversity compensation is to enable continued development with the proviso that any residual effects of development projects on biodiversity are compensated for (Bull, Suttle, Gordon, et al., 2013; Burgin, 2008; Gordon et al., 2011; Kiesecker et al., 2010; Maron et al., 2012; Overton et al., 2013; Pilgrim et al., 2013; Ten Kate et al., 2004). Biodiversity compensation has become increasingly popular in recent years (Curran, Hellweg, & Beck, 2014; Maron et al., 2012; Ten Kate et al., 2004), despite receiving widespread criticism in terms of its theoretical underpinnings and implementation record (Maron et al., 2012; McKenney & Kiesecker, 2010; Walker et al., 2009). The concept of compensating for environmental harm has been around for a long time (Ten Kate et al., 2004). Under the rubric of tradable development rights, biodiversity compensation was first formalised in the United States (US) in the 1970s for wetland mitigation; the US water Resources Act of the 1970s required development-oriented wetland loss or degradation in one location to be offset by establishing equivalent wetlands elsewhere (Bull, Suttle, Singh, & Milner-Gulland, 2013). Biodiversity compensation is now being used all around the world (Burgin, 2008). Madsen, Becca, Carroll, Kandy, and Bennett (2011), in their 2011 update of offset and compensation programs worldwide, estimated that there were 45 existing programs globally, with another 27 in various stages of development. Wotherspoon and Burgin (2009) also noted a number of demonstration projects, or pilot case studies, occurring throughout the world.

2.2.1 Goals of Biodiversity Compensation

The main goal of biodiversity compensation is to counterbalance losses in biodiversity with biodiversity conservation gains (Maron et al., 2012). McKenney and Kiesecker (2010), in a review of offset and compensation frameworks globally, found that policy goals ranged from general statements about the need to address adverse impacts to more rigorous goals of "no net loss" of biodiversity and potential "net gain." Brazilian forest policy, for example, has an implied goal of no net loss of forest habitat by requiring private landholders to retain a defined minimum vegetative cover (McKenney & Kiesecker, 2010). Australia goes one step further in advocating for net environmental gains, where native vegetation regulations in New South Wales require that compensation measures improve or maintain environmental outcomes for particular environmental values (McKenney & Kiesecker, 2010). Goals of biodiversity compensation tend to be illustrated in country policies, but also in the performance standards of financial institutions like the International Finance Corporation (IFC) and multinational businesses such as Rio Tinto (Brownlie et al., 2013). The specifics of these goals are complex and dominate a whole research area (Gordon et al., 2011; Matthews & Endress, 2008), with some authors (Walker et al., 2009) arguing that goals of "no net loss" or "net gain" are impossible to achieve.

The goal of alleviating residual, unavoidable impacts of development projects on biodiversity (Gardner & Von Hase, 2012; McKenney & Kiesecker, 2010; Ten Kate et al., 2004) relies on biodiversity compensation being firmly anchored within the mitigation hierarchy (Kiesecker et al., 2010; Ten Kate et al., 2004). Projects must first avoid, remedy and mitigate biodiversity onsite, before considering compensation for residual impacts (Brownlie & Botha, 2009; Brownlie et al., 2013; Kiesecker et al., 2010; Saenz et al., 2013; Ten Kate et al., 2004; Villarroya & Puig, 2010). Demonstrating this, is often mandatory as part of the Environmental Impact Assessment (EIA) process (Brownlie & Botha, 2009). Figure 1 illustrates the appropriate place of biodiversity compensation (here referred to as "offset") within the mitigation hierarchy. Whether or not this goal of alleviating residual, unavoidable impacts of development can be successfully achieved, is debated in the literature (Bekessy et al., 2010; Quétier & Lavorel, 2011; Walker et al., 2009). There is a clear understanding however that there are limits to what can be compensated or "offset."(Brownlie et al., 2013; International Council on Mining and Metals & International Union for Conservation of Nature, 2012; Pilgrim et al., 2013; The Biodiversity Consultancy, 2012). Biodiversity will continue to be lost to development pressure if these limits are not adhered to.

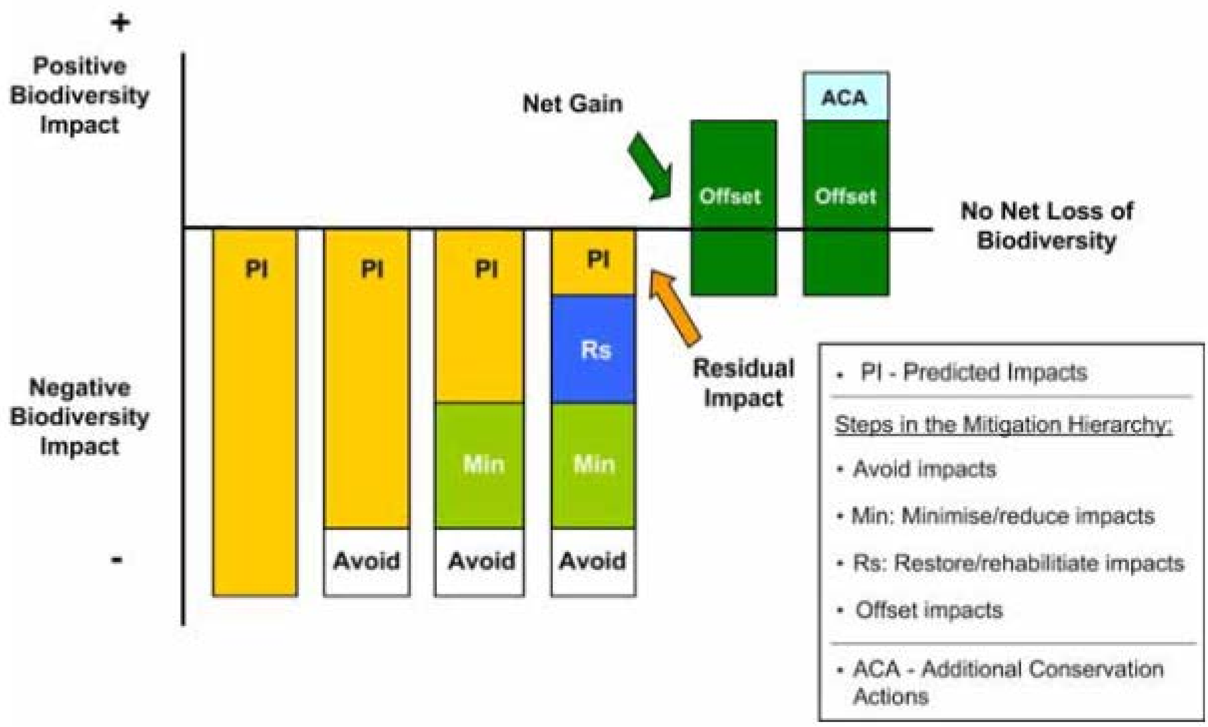

Figure 1. Biodiversity compensation or "offsetting" within the mitigation hierarchy (Gardner & Von Hase, 2012, p. 3).

The Business and Biodiversity Offsets Programme (BBOP) can be considered a source of biodiversity compensation and offsetting goals. BBOP is an international alliance of public, private and NGO sectors, which has laid out 10 fundamental principles for offsetting as well as guidelines for design and implementation (Business and Biodiversity Offsets Programme, 2012c). Figure 2 illustrates that if BBOP goals have been met, this suggests an "offset" form of compensation has been achieved. Otherwise the positive conservation action is just referred to as compensation.

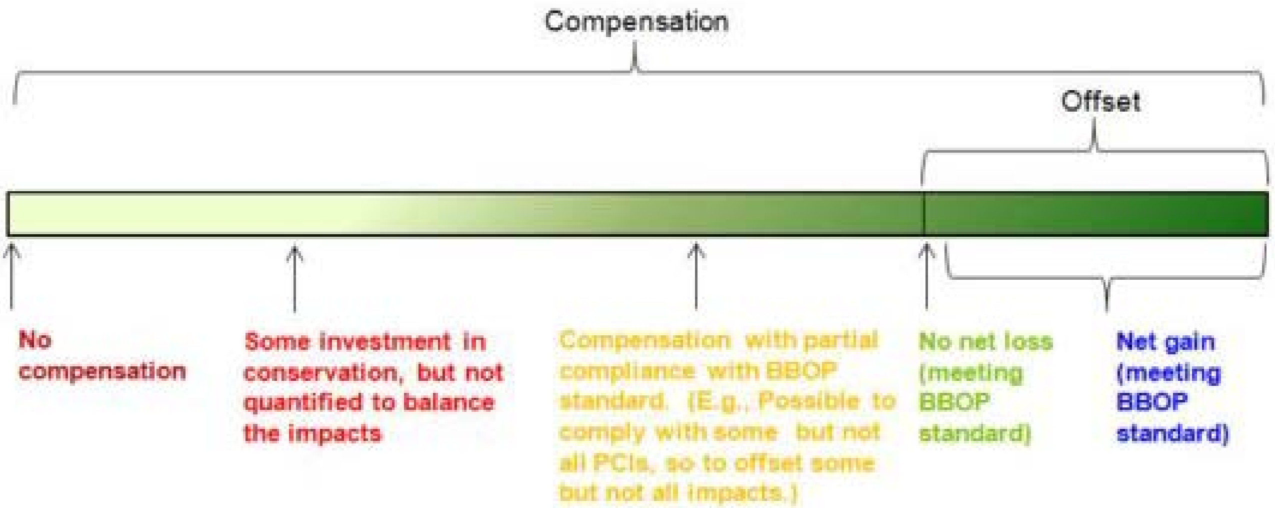

Figure 2. The compensation-offset spectrum (Business and Biodiversity Offsets Programme, 2012c, p. 14).

2.2.2 Defining Biodiversity Compensation

The term "biodiversity" evolved from "biological diversity" which is defined by the CBD as "the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems" (Secretariat of the Convention on Biological Diversity, 2005, p. 5). This is the definition for biodiversity that will be used throughout this study.

Biodiversity compensation has multiple forms and labels such as: biodiversity offsets, ecological compensation, compensatory mitigation, environmental compensation or net conservation benefits (Gordon et al., 2011; Maron et al., 2012). The concept includes negotiated one-off exchanges, referred to as mitigation or compensation as well as "biodiversity offsets," which are a more formal and quantitative form of biodiversity compensation. Defining terms in this topic area is difficult due to the variation between jurisdictions and amendments over time, which are a result of the progression of policy, case law and wider discourse (Briggs, Hill, & Gillespie, 2009; Brown, 2014; Ten Kate et al., 2004). However, all terms are used to describe, somewhat interchangeably, the same concept: of counterbalancing the adverse effects of development on biodiversity with positive biodiversity conservation measures (Bull, Suttle, Gordon, et al., 2013).

In New Zealand definitions are no less ambiguous. Local commentators believe this is serving as somewhat of a barrier to coherent discussion and implementation (Brown, Clarkson, Barton, et al., 2014; Christensen, 2007; Memon, Skelton, & Borrie, 2004; Rive, 2013). Whilst internationally the most commonly cited term is "biodiversity offsetting," this is not appropriate for the context of this study as "offsetting" includes goals which are not part of New Zealand's legal system (Brown, Clarkson, Barton, & Joshi, 2013). Observation of the mitigation hierarchy (explained in Section 2.2.1.), for example, often occurs in practice yet it is not a legal requirement in New Zealand (Brown et al., 2013). "No net loss", which is an explicit objective of biodiversity offsetting, is also not part of New Zealand legislation (even though it is referred to occasionally in case law) (Brown et al., 2013).

The term "compensation" is somewhat broader than "offsetting" and is more appropriate for the New Zealand context. Compensation refers to the act of compensating, to give something as recompense for any harm, damage or loss (Voogd, 2009). In New Zealand the term "environmental compensation" is what is commonly denoted in the Courts (Christensen & Barnes, 2009). Environmental compensation however, refers to a much broader range of environmental and amenity values which are not specifically biodiversity related (Christensen & Barnes, 2009). As most of the international literature focuses specifically on biodiversity values, the term that will be used in this study is "biodiversity compensation." For the purpose of this study the definition of biodiversity compensation is:

"Positive conservation actions, intended to compensate for the residual adverse effects of development and resource use"

2.2.3 Types of Biodiversity Compensation

There are various approaches to biodiversity compensation: regulatory, voluntary, market-based, *ad hoc,* or hybrid (Ten Kate et al., 2004). Regulatory biodiversity compensation is becoming increasingly popular (Madsen et al., 2011). Countries with regulatory biodiversity compensation programmes include Australia, Canada, the European Union, South Africa, Brazil and the United States (Gibbons & Lindenmayer, 2007; Morris, Alonso, Jefferson, & Kirby, 2006). In Canada, for example, the Canadian Fisheries Act 1985 regulates for no net loss in fisheries habitat, with government guidelines specifying legal requirements for compensation measures (Ten Kate et al., 2004).

Voluntary biodiversity compensation is gradually becoming more common (Bull, Suttle, Gordon, et al., 2013), with Madsen, Carroll, and Moore Brands (2010) revealing a modest but growing number of corporate volunteer initiatives. In most cases voluntary biodiversity compensation is initiated on an *ad hoc* basis, driven by business interest or personal enthusiasm of staff members at a site (Maron et al., 2012). Voluntary biodiversity compensation then includes a significant amount of negotiation between stakeholders to arrive at a solution that is socially acceptable (Brown, 2014). Corporations such as Rio Tinto, choose to undertake voluntary biodiversity compensation in order to implement their own environmental or sustainable development policies (McKenney & Kiesecker, 2010), and also simply because it is good for business (Ten Kate et al., 2004). Debate exists on whether voluntary biodiversity compensation measures alone can be relied upon to meet conservation goals or whether voluntary biodiversity compensation is just in anticipation of a forthcoming regulatory regime (Burgin, 2008; Maron et al., 2012; Ten Kate et al., 2004).

In addition to regulatory and voluntary biodiversity compensation, market-based biodiversity compensation has also been proliferating globally, with countries such as the US setting up credit markets for trades in biodiversity value (Bull, Suttle, Gordon, et al., 2013). These market-based strategies are promoted as neoliberal governance solutions to dealing with biodiversity loss (Pawliczek & Sullivan, 2011). They aim to internalise negative ecological externalities into the costs of development projects (Bull, Suttle, Gordon, et al., 2013), and rely heavily on the monetisation of biodiversity through quantitative metrics and ratios (Reid, 2012). This idea of attaching a value to biodiversity is central to the Environmental Economics discipline (Nunes & van den Bergh, 2001; Polasky, Costello, & Solow, 2005), where a key discernment is that when a commodity has no price it is perceived of as free (Edwards & Abivardi, 1998). Monetising biodiversity is thus seen as a necessary way of ensuring that damage to biodiversity, as a result of development projects, is not ignored (Edwards & Abivardi, 1998; Reid, 2012). Market-based approaches to biodiversity compensation have, however, been significantly critiqued (Bull, Suttle, Gordon, et al., 2013; Reid, 2012; Salzman & Ruhl, 2000; Walker et al., 2009). One concern is that using a market approach entails a commodification of nature, where some elements of value are not wholly captured (Reid, 2012; Walker et al., 2009). Another concern is that, although market-mechanisms may allow for more actors to take initiative in protecting biodiversity (compared to regulatory systems), they may also reduce public accountability as compensation measures now exist as private agreements (Reid, 2012).

A combination of all of these approaches is being used globally, with each approach to biodiversity compensation characterised by different goals, structures and methods of implementation and each accompanied by its own opportunities and challenges.

2.3 The Promise of Biodiversity Compensation

The purpose of biodiversity compensation, to balance development and conservation goals, is its main temptation. Numerous authors have detailed the benefits and opportunities offered by biodiversity compensation (Bedward, Ellis, & Simpson, 2009; Burgin, 2008; Gillespie, 2012; Quintero & Mathur, 2011; Ten Kate et al., 2004). They describe biodiversity compensation as a useful policy instrument (Gibbons & Lindenmayer, 2007), one that suits existing legal frameworks and has the potential to advance biodiversity conservation goals (Gillespie, 2012).The attraction of the concept can really be seen, however, through the proliferation of biodiversity compensation programs worldwide (Madsen et al., 2011). In this section the promise of biodiversity compensation will be discussed in terms of the benefits to stakeholders and to environmental management.

2.3.1 Stakeholder Benefits

Research by Ten Kate et al. (2004) suggests biodiversity compensation provides a wide array of benefits to various stakeholders. For businesses, biodiversity compensation can strengthen a company's ability to operate by securing support from regulatory organisations, local communities, and non-governmental organisations (Ten Kate et al., 2004). Biodiversity compensation is receiving widespread interest from businesses for this reason (Burgin, 2008; Ten Kate et al., 2004; Virah-Sawmy, Ebeling, & Taplin, 2014). Biodiversity compensation can also create new markets, create regulatory good-will (thus speeding up the permit process and saving businesses time and money), lower costs of compliance, lead to employee satisfaction, create access to capital, help businesses meet performance standards and demonstrate good environmental stewardship, as well as allow businesses to manage regulatory risk (Saenz et al., 2013; Ten Kate et al., 2004; Virah-Sawmy et al., 2014).

For regulatory authorities, biodiversity compensation presents a way to balance development and conservation imperatives. Regulatory authorities can use biodiversity compensation to make progress towards conservation goals at a range of spatial scales, whilst also enabling them to support development projects (Bedward et al., 2009; Burgin, 2008; Ten Kate et al., 2004). Biodiversity compensation involves a more collaborative decision-making process (as opposed to a yes or no decision), which allows regulatory authorities to maintain a good working relationship with all stakeholders (Ten Kate et al., 2004). Another benefit for regulatory authorities is that biodiversity compensation can draw funds towards conservation, an area that is often struggling in resources (Burgin, 2008; Kiesecker et al., 2010; Quintero & Mathur, 2011; Ten Kate et al., 2004).

Conservation groups can use and influence biodiversity compensation to secure more and better conservation outcomes and obtain extra funding for conservation projects (Ten Kate et al., 2004). For instance, they can push for biodiversity compensation to be integrated into landscape-level planning; thus moving conservation practice beyond piecemeal mitigation towards the creation of wider conservation gains (Kiesecker et al., 2010; Saenz et al., 2013). Furthermore, biodiversity compensation can be a tool for ensuring that regional conservation goals are integrated into government and business planning (Saenz et al., 2013).

For local communities, Ten Kate et al. (2004) suggests that biodiversity compensation includes a collaborative decision making process, which means communities are kept involved and decision outcomes are more likely to be socially acceptable. Biodiversity compensation also provides communities with a way of ensuring functional and productive ecosystems during and after development projects (Ten Kate et al., 2004). It can ensure that developers not only rehabilitate project sites, but also provide for additional conservation gains for the community; gains that can support livelihoods and provide amenity (Ten Kate et al., 2004).

2.3.2 Environmental Management

Biodiversity compensation is perceived as an attractive tool in environmental management as it negotiates and integrates the needs of multiple stakeholders (Pilgrim et al., 2013; Ten Kate et al., 2004). Through this process, biodiversity compensation seeks to avoid costly and politically challenging arguments that would be the result of attempting to put bans on further development, whilst also striving for biodiversity conservation goals and maintaining natural capital (Bedward et al., 2009; Overton et al., 2013). Biodiversity compensation's biggest attraction is that it can mobilise large funds for conservation (Kiesecker et al., 2010). Funds would be created on a developer-pays basis, taking pressure off public funds and allowing for fair considerations of liability (Bedward et al., 2009; Gillespie, 2012). Gillespie (2012) states that biodiversity compensation would also be an improvement on traditional environmental management as it introduces the idea of boundaries, "red-flags," to development; measures of irreplaceability that should not be transgressed.

There is an opinion within the literature that, when biodiversity compensation is viewed with a degree of flexibility and comprehensive planning of conservation goals, it can lead to conservation benefits that would otherwise be unachievable (Gillespie, 2012; Norton & Warburton, 2014; Quintero & Mathur, 2011). One source goes so far as to say that biodiversity compensation has the potential to result in increased accountability, rigour, and transparency in relation to monitoring and compliance, decreased financial risk to regulatory authorities and consent applicants, potential for improved stakeholder relationships, better environmental outcomes through accountability and process improvements, further incentives for the development and continued improvement of supporting systems (reporting systems and integrated regional and national State of the

Environment monitoring programmes and databases), and the setting of national or regional targets for the protection of indigenous species and habitats (Tonkin and Taylor, 2012).

2.4 The Peril of Biodiversity Compensation

Although biodiversity compensation, as a practice area, is growing rapidly, the field is riddled with complications (Brownlie et al., 2013; Maron et al., 2012; Walker et al., 2009). According to Harper and Quigley (2005) habitat compensation, as currently implemented in Canada, is slowing down but not stopping the rate of habitat loss, and according to Walker et al. (2009), biodiversity compensation in the form of "offsets" have facilitated development and increased biodiversity loss. In this section the limitations of biodiversity compensation will be discussed in terms of technical issues with the concept, issues of fairness and governance, issues of risk and uncertainty, and issues of monitoring and compliance. The latter issue is the focus of this research.

2.4.1 Technical Issues

If biodiversity compensation is going to mitigate the biodiversity crisis, there are several challenges it must first overcome. Technical issues, which some see as impassable barriers (Walker et al., 2009) and others as mere hurdles to overcome (McKenney & Kiesecker, 2010; Moilanen, 2013; Moilanen, van Teeffelen, Ben-Haim, & Ferrier, 2009; Norton, 2009; Pilgrim et al., 2013), represent one such challenge. The literature on biodiversity compensation is riddled with technical issues, yet common ones appear to be: issues of equivalence, biodiversity accounting, additionality, and the setting of appropriate thresholds.

Equivalence

Ecological equivalence is frequently noted in the literature as being a requisite of biodiversity compensation (Quétier & Lavorel, 2011; Ten Kate et al., 2004). Equivalence can be broken down into equivalence in type, space, and time (Brown, 2014; Race & Fonseca, 1996).

Equivalence in type is often worded as a requirement for biodiversity compensation, particularly in the form of "offsets," to be "like-for-like" or "in-kind" (Ten Kate et al., 2004). This means that damage to a particular habitat would require the protection or creation of a similar habitat with the same specific elements of biodiversity (Reid, 2012). This is a requirement that is especially important and contentious for elements of biodiversity considered to be irreplaceable (Reid, 2012). Although this requirement for type-equivalence is easier for the public to understand and for conservationists to measure (Ten Kate et al., 2004), it is underpinned by the belief that restoration ecologists can restore or recreate ecosystems (Maron et al., 2012). Given the complexity and variability of natural systems, and the relatively young discipline of restoration ecology, there is increasing recognition that this may be impossible, especially within any reasonable time-frame (Curran et al., 2014; Hobbs, Hallett, Ehrlich, & Mooney, 2011; Morris et al., 2006). Maron et al. (2012) believe that through this requirement, biodiversity offsets in particular push the limits of both scientific knowledge and practical feasibility. Habib, Farr, Schneider, and Boutin (2013) counter this with a suggestion that: more flexible, "out-of-kind" compensation measures, although perhaps more difficult to measure, may allow for damage to one habitat type to be balanced by support of a quite different, yet equally (or more) valuable habitat type, which may better support regional conservation priorities. Norton and Warburton (2014), for instance, make the suggestion that invasive species control could be an appropriate "out-of-kind" offset applicable to the New Zealand biodiversity management context. "Out-of-kind" offsets are gradually becoming more acceptable (McKenney & Kiesecker, 2010), despite ecological equivalence still being quite difficult to prove (Bull, Suttle, Gordon, et al., 2013). There is little support, however, for very out-of-kind offsets such as funding for conservation training and education (McKenney & Kiesecker, 2010).

Equivalence in space refers to the distance of the compensation measure or offset from the site impacted. Research by Ten Kate et al. (2004) shows that, from a public perspective, distance matters. The closer the compensation measure is to the impact site the more socially acceptable it is, as local communities can see the benefits, otherwise you could end up with a reverse-NIMBY (not-in-my-backyard), where locals loose out (Ten Kate et al., 2004). Onsite compensation also has the greatest potential to minimise the disruption to remaining biodiversity and ecological functions (Race & Fonseca, 1996). There are many biodiversity compensation programmes and policies around the world that limit the distance of compensation activities for these reasons (Gordon et al., 2011). A limitation to maintaining equivalence in space, however, is that it restricts compensation to (or close to) the impact site, thus creating often highly fragmented and isolated habitats that may not be able to ensure long-lasting conservation benefits (Ten Kate et al., 2004). A more flexible approach of compensating at distant sites, is thus often advocated for (Habib et al., 2013; Underwood, 2011), and becoming increasingly common (McKenney & Kiesecker, 2010). This landscape level approach is often recommended as a more efficient and effective use of conservation funds (Naidoo et al., 2006) and can lead to larger, more consolidated conservation areas (Ten Kate et al., 2004). Overall, equivalence in space is an issue of divergent opinion, which is still receiving much attention.

Lastly, equivalence in time is widely cited as a requisite for biodiversity compensation, as any time-lag between the loss of biodiversity and the delivery of the compensation measure can have significant ecological implications (Bekessy et al., 2010; Gibbons & Lindenmayer, 2007; Maron et al., 2012). Gordon et al. (2011) show that equivalence in time is in fact a critical determinant of success, outweighing the importance of spatial proximity. Maintaining and demonstrating time equivalence is, however, proving a major challenge (Bekessy et al., 2010; Gordon et al., 2011). The literature is full of attempts to deal with the issue of time equivalency (Bekessy et al., 2010; Carpenter, Brock, &

Ludwig, 2007; Moilanen et al., 2009; Overton et al., 2013), yet it continues to be an issue of debate, affecting the viability of biodiversity compensation (Maron et al., 2012).

Biodiversity Accounting

Measuring ecological equivalence, or the more rigorous goal of no net loss, requires consideration of biodiversity value (Bull, Suttle, Gordon, et al., 2013; Reid, 2012). Simplified metrics, encapsulating multiple values and time differences, are increasingly being employed in order to measure biodiversity value and weigh up biodiversity losses against biodiversity gains (Gibbons & Lindenmayer, 2007; Maron et al., 2012). Some authors (Habib et al., 2013; Reid, 2012; Salzman & Ruhl, 2000) advocate for such metrics, emphasising their benefits in terms of balancing scientific detail and ease of measurement and for keeping transaction costs low and adoption simple. However, there is a lot of evidence in the literature that these simplified metrics are limiting and lead to a failure in terms of equivalence; losses or gains in individual components can be masked by the single value of the metric, the metric could exclude important values such as ecosystem function, or the metric may not accurately account for uncertainty over time (Maron et al., 2012; Palmer & Filoso, 2009; Walker et al., 2009). Addressing this limitation requires improved methods for measuring biodiversity value (Maron et al., 2012). This is an area receiving increased research attention (Bruggeman, Jones, Scribner, & Lupi, 2009; Carpenter et al., 2007; Maron et al., 2012; McCarthy et al., 2004; Overton et al., 2013), however, Maron et al. (2012) states that fundamental problems still remain.

Aside from methodology issues involved with establishing successful biodiversity compensation, there is also a dilemma of whether biodiversity could and should, be traded at all. Walker et al. (2009) express that viable trading requires simple and easily measurable and interchangeable commodities, traits that are seldom found when it comes to biodiversity. There is thus the threat that, whilst simple individual elements of biodiversity might be compensated for, more complex or process-oriented elements could be lost (Burgin, 2008). Walker et al. (2009) suggest that, for this reason the concept is fundamentally flawed and unworkable and that whilst some authors propose fixes, the overall trading of biodiversity will result in poorer biodiversity outcomes than traditional approaches (policies, rules and prohibitions) (Walker et al., 2009).

Additionality

Additionality denotes that biodiversity compensation actions are new contributions to conservation and would not have occurred under the status quo (McKenney & Kiesecker, 2010; Reid, 2012). Additionality is articulated in the 5th principle of the BBOP (Business and Biodiversity Offsets Programme, 2012c) and is a key consideration of most biodiversity compensation frameworks. In the US for example, guidance for conservation banking states, that "land used to establish conservation banks must not be previously designated for conservation purposes (e.g. parks, green spaces, municipal watershed lands)" (US Department of the Interior, 2003, p. 6).

The difficulty with additionality is reliably forecasting the future, status-quo, level of management (Maron et al., 2012; Reid, 2012). Doubts are expressed about the methodologies used and their effectiveness in assessing additionality (Reid, 2012). Some types of biodiversity compensation are at particular risk of not abiding by additionality requirements. Market-based approaches, such as biodiversity banks, risk eroding additionality requirements as restoration actions that would have been done outside of biodiversity markets, can be used to generate biodiversity credits (Maron et al., 2012). Ways of dealing with additionality focus mostly on the creation of new projects (Ten Kate et al., 2004). Some authors, however, believe that biodiversity compensation which supports existing projects leads to a higher chance of success, as long as background rates of habitat and biodiversity loss are demonstrably high and no strong protection measures are yet in place (Bull, Gordon, Law, Suttle, & Milner-Gulland, 2014; Curran et al., 2014; Gibbons & Lindenmayer, 2007; Maron et al., 2012; Norton, 2007; Ten Kate et al., 2004). In the end, the level of additionality is subject to the current level of management and protection of the habitat (at a range of scales), and the inherent vulnerability of that habitat type (Brown, 2014). It is imperative that issues with assessing additionality are addressed, because otherwise the result of any biodiversity compensation will be a net loss in biodiversity (International Council on Mining and Metals & International Union for Conservation of Nature, 2012). To this end, it is worth noting Walker et al. (2009), who question whether the issue is addressable at all.

Thresholds

Defining appropriate thresholds is critical to ensuring biodiversity compensation does not result in inappropriate trade-offs (Brownlie et al., 2013; Business and Biodiversity Offsets Programme, 2012b; The Biodiversity Consultancy, 2012). Some impacts of development are so large they simply cannot be compensated for, either in a sufficiently equivalent (i.e. no net loss) or a socially acceptable way (International Council on Mining and Metals & International Union for Conservation of Nature, 2012). Species extinction is the most commonly cited example of an impact that cannot be compensated for (International Council on Mining and Metals & International Union for Conservation of Nature, 2012). Thresholds, "red-flags," for what can be manageably offset or compensated for tend to reflect levels of biodiversity loss that are unacceptable to society (Bull, Suttle, Gordon, et al., 2013; Pilgrim et al., 2013). Decisions are made based on the reversibility of the change, the risk in achieving the compensation measure, the irreplaceability, vulnerability and substitutability of biodiversity elements affected, as well as how society depends on and perceives, these elements of biodiversity (Brownlie et al., 2013; Business and Biodiversity Offsets Programme, 2012b). Thresholds are then ideally defined in regional or national conservation plans, strategies or policies (International Council on Mining and Metals & International Union for Conservation of Nature, 2012; Pilgrim et al., 2013).

Within the literature there are some examples of policy guidance documents which define upper limits for biodiversity compensation (International Finance Corporation, 2012), and of decision frameworks for developers and regulators to identify limits to offsetting (Business and Biodiversity Offsets Programme, 2012b; Pilgrim et al., 2013; The Biodiversity Consultancy, 2012). The 2nd principle of the BBOP, for instance, is about limits to offsetting (Business and Biodiversity Offsets Programme, 2012c). What defines an appropriate threshold and how this is decided and implemented, is still considered a contentious issue (International Council on Mining and Metals & International Union for Conservation of Nature, 2012). Some authors, for example, criticise the decision-making process, stating that thresholds seem to be based more on political decisions than on scientific evidence (Matcham, 2012). Ultimately, the value of any policies or guidance documents on this subject depends on their integration with existing national-level biodiversity policies and plans, which detail conservation goals and seek to address cumulative impacts (Pilgrim et al., 2013). Biodiversity loss will continue to occur if appropriate limits to biodiversity compensation, and especially "offsetting," are not rigorously implemented (The Biodiversity Consultancy, 2012).

2.4.2 Issues of Fairness and Governance

Despite the array of methodologies and decision-support tools, either existing or in development, the decision of what determines a fair and acceptable compensation measure or offset is a social one. So who determines what compensation measure is both fair and acceptable? Several authors suggest this decision is tipped towards development interests, who represent the motivated few against the disorganised many (Matcham, 2012; Salzman & Ruhl, 2000; Walker et al., 2009), with Walker et al. (2009) stating that public choice theory predicts this.

When it comes to responsibility for biodiversity compensation, regulatory authorities tend to be perceived as the key decision makers, even with voluntary compensation measures (Ten Kate et al., 2004). Often consensus between stakeholders will not be easy to achieve, and regulatory authorities are given the role of the arbiter as they are eventually responsible for granting the licenses for development projects (Ten Kate et al., 2004). For biodiversity compensation measures to be fair, conservation priorities must be clearly laid out and communicated by regulatory authorities, through appropriate law and policy and through case-by-case negotiations. The issue that Walker et al. (2009) and Matcham (2012) put forward is that regulatory authorities are often forced into making efficient and speedy decisions, favouring the "yes with conditions" approach over the "no" which can result in an expensive court battle. Incentives for officials also frequently align with development interests. Winter (1985) even proposes that regulatory authorities often neglect to fund full enforcement, and that officials are sometimes actively discouraged from frustrating powerful vested interests. In the end, biodiversity compensation appears to be more of a political process than a technical and scientific act (Voogd, 2009).

The unfortunate outcome of this perceived bartering process for biodiversity compensation is that the playing field is typically tipped towards development interests (Walker et al., 2009). Biodiversity protection interests have only a limited capability to engage in a bartering process, often due to a lack of funds, and rely on regulatory authorities to uphold robust exchange measures (Walker et al., 2009). Unfortunately, political theory predicts that, in trading biodiversity, officials are likely to relax safeguards and facilitate trading at the expense of biodiversity (Walker et al., 2009). The result is that developers gain the upper-hand and that, unless developers have their own stringent biodiversity protection goals, biodiversity compensation agreements will be so watered down they are essentially useless at protecting biodiversity.

2.4.3 Issues of Risk and Uncertainty

Biodiversity compensation is riddled with risk and uncertainty. This is due to the complexity of biodiversity as well as the relatively young and undeveloped science in this field (Bull, Suttle, Gordon, et al., 2013; Business and Biodiversity Offsets Programme, 2012a). It seems impossible to prove, in practical terms, that the more rigorous goal of no net loss (or net gain) of biodiversity can be achieved through biodiversity compensation and many projects appear likely to fall short of this goal (Business and Biodiversity Offsets Programme, 2012a).

Compensation measures often involve certain biodiversity losses for uncertain gains (Business and Biodiversity Offsets Programme, 2012a; Maron et al., 2012). Furthermore, according to Business and Biodiversity Offsets Programme (2012a), these losses and gains will always, irrespective of the quality of baseline data available, be at some level biologically dissimilar.

Another layer of uncertainty is added by the dynamic nature of the environment. Changing conditions, including the effects of climate change, can alter species population sizes and their preferred distributions (Harris, Hobbs, Higgs, & Aronson, 2006; Reid, 2012; Tal, 2014). The idea, therefore, of identifying new sites for biodiversity compensation becomes challenging, and even more so when taking into account the long time it takes to restore or recreate a habitat (Maron et al., 2012; Reid, 2012). Reid (2012), however, believes that biodiversity compensation could actually play a valuable role in providing for the new or enhanced areas of habitat that species will need as they are forced to adapt to changing climatic conditions. This belief is supported by an increasing confidence in the literature about the responses of natural systems to climatic changes (Parmesan & Yohe, 2003; Walther et al., 2002).

In the end, areas of uncertainty and risk need to be carefully considered (Business and Biodiversity Offsets Programme, 2012a). So far, there is no refined framework for the treatment of uncertainty (Bull, Suttle, Gordon, et al., 2013). Proposed frameworks for incorporating risk, such as the RobOff software (Pouzols, Moilanen, & Isaac, 2013) and the frameworks put forth by Gardner et al. (2013) and Moilanen et al. (2009), have begun to address this. Common approaches to dealing with risk and uncertainty have focused on the use of multipliers. Multipliers increase the amount of biodiversity gain required, to account for uncertainty in biodiversity loss and the success of the compensation measure itself (Bull, Suttle, Singh, et al., 2013; Maron et al., 2012; Moilanen et al., 2009). A study done by Moilanen et al. (2009), however, on the level at which a multiplier provides a guaranteed favourable outcome, found that very large multipliers would be needed to comprehensively account for uncertainty, and that these would likely be considered politically and economically unacceptable.

Advice for addressing issues of uncertainty and risk revolves around strengthening these exchange rules and regulating rigorous adherence to the mitigation hierarchy and to the BBOP principles (Gardner et al., 2013). Several authors also note the importance of a precautionary approach, one that is accompanied by long-term monitoring and funding (Business and Biodiversity Offsets Programme, 2012a; Gardner et al., 2013; Maron et al., 2012). Monitoring and funding will help guarantee biodiversity compensation projects are protected in their longevity, ensuring no temporal losses in conservation value (McKenney & Kiesecker, 2010). Walker et al. (2009) however state that regardless of any of these proposed fixes the concept of biodiversity trading is inherently flawed.

Active adaptive management, where dual objectives of learning and conservation are set at the outset can further help address issues of risk and uncertainty (Gardner et al., 2013; McKenney & Kiesecker, 2010). According to Maron et al. (2012), most restoration projects today simply implement current best-practice, with no experimentation and monitoring of alternative strategies, and monitoring only until failure or more fashionable options emerge. Gibbons and Lindenmayer (2007) state that management of biodiversity compensation projects must be flexible enough to allow for some change if outcomes are not being achieved. Lastly, there is a clear need also to support more research in the field of restoration ecology as biodiversity compensation policies raise the stakes for restoration projects (Maron et al., 2012).

2.4.4 Monitoring and Compliance issues

The success of biodiversity compensation projects ultimately relies on adequate monitoring and compliance (Tonkin and Taylor, 2012). Non-compliance is the failure to deliver the anticipated compensation and thus the result is an uncertain outcome for biodiversity. International experience shows a severe lack of post-implementation evaluation in the field of conservation (Ferraro & Pattanayak, 2006). Reviews of biodiversity compensation indicate low levels of compliance accompanied by low enforcement rates; with failures to adequately monitor and enforce perpetuating low levels of compliance (Bull, Suttle, Gordon, et al., 2013; Gibbons & Lindenmayer, 2007; Matthews & Endress, 2008; Quigley & Harper, 2006; Race & Fonseca, 1996; Tonkin and Taylor, 2012). Mitigation banking, in the US and Canada for example, has been affected by high levels of non-compliance with permit conditions (Harper & Quigley, 2005; Race & Fonseca, 1996). In Canada, Harper and Quigley (2005) have determined that compensation conditions were followed in only 17 of 124 developments affecting fish habitat. Low levels of monitoring may have exacerbated this, and have led to further unknown or unsuccessful biodiversity compensation project outcomes (Bull, Suttle, Gordon, et al., 2013). In addition to this, biodiversity compensation projects in Canada were only monitored for an average of 3.7 years post construction (Harper & Quigley, 2005).

The main reasons for poor monitoring and compliance with respect to biodiversity compensation include: an absence of a regulatory framework that adequately provides for biodiversity compensation; a lack of, and motivation for providing, resources and funds for monitoring; confusion about the burden of proof (who is responsible for monitoring); an absence of guidelines, standards and training in the field of biodiversity compensation monitoring, and; technical difficulties involved with measuring biodiversity (Matthews & Endress, 2008; Rega, 2013; Tonkin and Taylor, 2012). Principle 8 of the BBOP recognises these difficulties and attempts to address them with a series of criteria and indicators (Business and Biodiversity Offsets Programme, 2012c).

Many authors suggest more information is needed on the outcomes of biodiversity compensation projects, as even though compensation projects might comply with permit conditions, there is no surety on whether biodiversity outcomes are being met (Bull, Suttle, Gordon, et al., 2013; Matthews & Endress, 2008; Quintero & Mathur, 2011). Measuring the outcomes of biodiversity compensation projects is complicated by the difficulties in measuring biodiversity value and the lack of a comprehensive biodiversity currency (see Section 2.4.1“Biodiversity Accounting”) (Bull, Suttle, Gordon, et al., 2013). Some parties might also evaluate project success quite differently, depending on their motivation and the methodologies and analytical techniques they use (Bull, Suttle, Gordon, et al., 2013).

In the end, rigorous post-implementation monitoring and enforcement of compliance is the only way to ensure biodiversity losses have been balanced by biodiversity gains (Bull, Suttle, Gordon, et al., 2013). Monitoring should enable adaptive management, allowing the biodiversity compensation process to be continually improved (Tonkin and Taylor, 2012). Bull, Suttle, Gordon, et al. (2013) suggest that a publicly available global register of the outcomes of biodiversity compensation projects would aid our understanding of their long-term effectiveness. Independent review is also encouraged, to enable quality assurance on the scientific accuracy and sufficiency of any biodiversity compensation measures (Brownlie et al., 2013).

2.5 The New Zealand Context

In New Zealand, biodiversity compensation is increasingly being looked to as a policy tool for addressing biodiversity decline (Brown, Clarkson, Barton, et al., 2014; Denny, 2011; Madsen et al., 2011). This section will describe the New Zealand biodiversity crisis and current biodiversity policy. This will be followed by a close-up examination of biodiversity compensation in practice in New Zealand.

2.5.1 The New Zealand Biodiversity Crisis

New Zealand is an isolated archipelago in the south-western Pacific, whose evolutionary history diverged markedly from the rest of the world's around 65-80 million years ago, when it separated from the southern continent of Gondwanaland (Cooper & Millener, 1993; Craig et al., 2000; Schneider & Samkin, 2012). New Zealand's long geographic isolation means the country is home to a distinct range of indigenous flora and fauna (Anon, 2000). High levels of endemism (endemic species make up 80-100% of most groups), unusual forms (e.g. flightlessness), and many missing functional groups (most notably mammals) are common characteristics amongst New Zealand's biota (Lee, McGlone, & Wright, 2005). These characteristics make New Zealand's biota especially vulnerable to change (Anon, 2000).

New Zealand was the last large land mass to be occupied by humans (Anon, 2000; Craig et al., 2000). Polynesian ancestors of the modern Maori arrived in New Zealand some 700-1000 years ago and Europeans arrived about 200 years ago (Craig et al., 2000). Since colonisation, New Zealand's landscape has undergone significant changes (Craig et al., 2000). These changes were enough to cause New Zealand to have one of the world's worst records of indigenous biodiversity loss (Anon, 2000). At least 32% of indigenous land and freshwater birds are now extinct, 18% of seabirds are extinct, 3 out of 7 frogs, at least 12 invertebrates, 1 fish, 1 bat, up to 3 reptiles and approximately 11 plants are also extinct (Anon, 2000). Many species of plant and animal continue to be threatened today, or data is insufficient to determine their status (Anon, 2000).

The main causal factors behind this ongoing biodiversity loss are habitat destruction, habitat fragmentation and degradation, and the introduction of non-native species (Balmford & Bond, 2005; Craig et al., 2000; Norton & Warburton, 2014; Saunders & Norton, 2001). To date, approximately 63% of New Zealand's land-area has been converted into farms, exotic forests, settlements and roads, turning a once continuous range of distinctive ecosystems into a patchwork quilt of isolated fragments (Anon, 2000; Walker, Price, Rutledge, Stephens, & Lee, 2006). The issue with these fragments is that most of them are found in steeper, unproductive, mountainous areas, areas that have been allocated to New Zealand's conservation estate mostly due to reasons of aesthetic appeal (Anon, 2000; Green, 2006; Norton & Overmars, 2012; Walker, Price, & Rutledge, 2008). There is thus a lack of habitat for indigenous biodiversity in the lowlands, in river margins, wetlands, dunelands and in coastal areas (Anon, 2000; Craig et al., 2000; Norton & Miller, 2000; Norton & Overmars, 2012), and ecosystem functions are being compromised (Green, 2006). Aside from this, there is the threat of non-native species. Invasive (non-native) species smother, compete with, or prey on native species and are arguably the single biggest threat to New Zealand's indigenous biodiversity (Craig et al., 2000; Parliamentary Commissioner for the Environment, 2011). Biota have suffered range contractions and extinction and ecosystems have undergone pronounced changes in structure and composition as a result of invasive species (Saunders & Norton, 2001). The impact of introduced species has been so catastrophic that some authors have described the result as an "ecological collapse" (Towns and Atkinson, 1991; cited in Saunders & Norton, 2001).

2.5.2 New Zealand Biodiversity Policy

New Zealand is recognised as a global biodiversity hotspot. The Organisation for Economic Co-operation and Development (OECD) (2007, p. 5) has noted that "New Zealand has a special responsibility for biodiversity conservation, since a high percentage of its 90,000 native species are endemic and unique." On a national level New Zealand's biodiversity is part of the nation's sense of identity, the health and well-being of the population, and it underpins the country's economy (Norton & Cochrane, 2000; Schneider & Samkin, 2012). In 1994, the annual value of New Zealand's indigenous biodiversity was estimated by economists to be $230 billion, almost three times the GDP for the same year (Patterson and Cole, 1999; cited in Schneider & Samkin, 2012). The value of New Zealand's biodiversity is recognised through a range of legislative instruments.

Figure 3 illustrates the legislation which underpins biodiversity conservation, management, and use on public and private land in New Zealand. This legislation is noted to be both fragmented and complex (Schneider & Samkin, 2012).

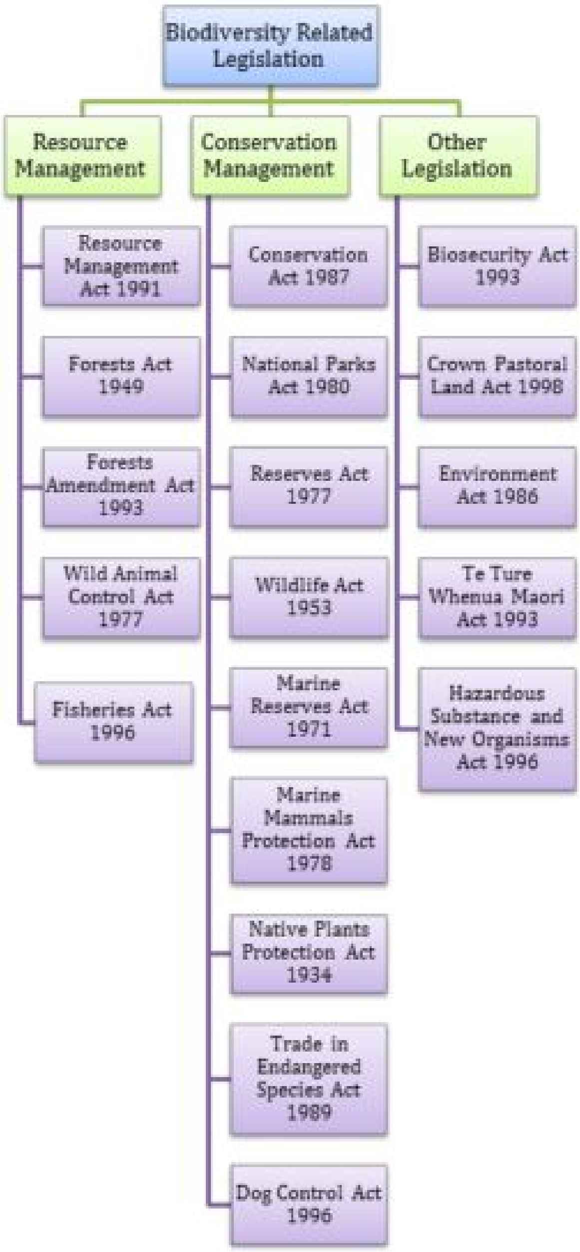

Figure 3. Legislation relating to the protection of New Zealand's biodiversity (Schneider & Samkin, 2012, p. 15).

The Conservation Act 1987 and the Resource Management Act 1991 (RMA) are New Zealand's leading pieces of biodiversity-related legislation. The Conservation Act is administered by the Department of Conservation (DOC), the lead agency for conservation at a central government level (Binning, 2000). This Act applies to all public conservation land (known as the conservation estate), about a third of New Zealand's terrestrial land area (Binning, 2000; Craig et al., 2000; Norton & Miller, 2000; Organisation for Economic Co-operation and Development (OECD), 2007). The RMA has a much wider jurisdiction; it governs the use of all New Zealand's natural resources, with almost all forms of resource use affecting biodiversity (Schneider & Samkin, 2012).

In addition to the biodiversity related legislation identified in Figure 3, a number of national policies and non-legislative accords, strategies, international conventions, treaties and commissions also influence biodiversity conservation in New Zealand. The Convention on Biological Diversity (CBD), for example, is an international legally-binding treaty that New Zealand has ratified (Schneider & Samkin, 2012). As part of the country's commitment to the CBD, and as a response to ongoing biodiversity decline, New Zealand has prepared the New Zealand Biodiversity Strategy (NZBS) (Anon, 2000). The NZBS sets out a range of national goals to conserve and manage New Zealand's biodiversity and it is considered an important milestone for biodiversity conservation (Green, 2006). Critics of the NZBS, however, argue that as the NZBS has no legal mandate and it will be ineffective unless it is supported by legislation (Green, 2006; Seabrook-Davison, 2010). Seabrook-Davison (2010) adds, that existing legislation in New Zealand only has provisions for the protection of indigenous wildlife, not a directive for their conservation. A comparison with wildlife legislation in Australia and the US suggests New Zealand urgently requires a similarly dedicated threatened species legislation (Seabrook-Davison, 2010).

The development of biodiversity policy in New Zealand has been done in most part by DOC, the Ministry for the Environment (responsible for setting environmental standards and guidelines), the Ministry for Primary Industries (lead Crown agency for terrestrial biodiversity), the Ministry of Fisheries (lead Crown agency for marine biodiversity), and the Ministry of Business, Innovation and Employment (Binning, 2000; Norton & Cochrane, 2000). The delivery of biodiversity outcomes also falls on several agencies, including DOC, the Ministry for Primary Industries, local government (both regional and city or district councils), research institutes and a range of NGO, community and iwi groups (Norton & Cochrane, 2000). A number of government-administered trusts and contestable funds (e.g. QEII National Trust, the Nature Heritage Fund, and the Nga Whenua Rahui fund) also assist with delivering biodiversity outcomes, specifically on private land (Binning, 2000; Schneider & Samkin, 2012).

This evolving range of policies, organisations, and funds should be leading New Zealand towards more successful biodiversity conservation, however, the literature suggests otherwise (Brown, Stephens, Peart, & Fedder, 2015; Department of Conservation, 2014c; Green & Clarkson, 2005; Schneider & Samkin, 2012). Brown et al. (2015) state that the present structures in place to deliver biodiversity outcomes have not been sufficient and that more effective and robust solutions must be found – solutions which address both the fundamental and proximal divers of biodiversity loss.

One reason for continued biodiversity decline is insufficient funding (Brown et al., 2015; Green, 2006). Current shortfalls mean that DOC cannot adequately oversee and maintain all of New Zealand's conservation estate nor fulfil its other functions effectively. Local and regional councils face the same issue and private landowners and community groups have limited or no financial incentive to undertake biodiversity conservation. The need for a more coordinated and collaborative approach to biodiversity management has been echoed in the literature over the last 15 years (Binning, 2000; Brown et al., 2015). This is already occurring to some degree through DOC's new shift to a partnerships model (Department of Conservation, 2014c), however, Brown et al. (2015) state that much more change is needed. Brown et al. (2015) also state that, whilst New Zealand has a comprehensive suite of legislation and regulatory tools available to safeguard biodiversity, these are often poorly implemented and the results inadequately monitored and complied with. Policy directions in some areas have also yet to emerge (e.g. for indigenous biodiversity under the RMA, for Bio-prospecting, and for the management of genetic resources) (Green, 2006).

Lastly, the power of private interests to override public interests in biodiversity conservation is a foremost contributor to environmental and biodiversity decline (Brown et al., 2015; Walker et al., 2009). Brown et al. (2015) believe that it is the reconciliation of these interests, and the broad alignment of their goals, that will lead the way to an enduring and flourishing native biodiversity. Biodiversity compensation offers one way in which to do this.

2.5.3 Biodiversity Compensation in New Zealand

In New Zealand, variations on biodiversity compensation have been around for a long time, however the concept has not yet been formalised into any regulatory system (Brown et al., 2013; Christensen, 2010; Norton, 2009). This has elicited critique from several authors who suggest that the lack of policy framework and the inconsistent application of biodiversity compensation is having negative effects on the environment and on biodiversity (Christensen, 2010; Memon et al., 2004). Rive (2013) adds that the resulting *ad hoc* litigation, such as that incited by Buller Coal Limited's Escarpment Mine Project on the Denniston Plateau, will also continue to occupy the time and resources of all stakeholders; something, he suggests, is of no benefit to anyone involved.

The New Zealand Department of Conservation (DOC) has been addressing the inconsistent approach to biodiversity compensation, in its more rigorous form of "offsetting," by taking the lead in a Cross Departmental Research Pool project, supported by four other government agencies. This project, known as the New Zealand Biodiversity Offsets Programme (NZBOP), outlines methods for conducting and assessing biodiversity compensation or "offset" measures (Department of Conservation, 2014b). The NZBOP is, however, only a guidance document. There is still a considerable perceived need for a legal framework to regulate biodiversity compensation in New Zealand (Brown, Clarkson, Barton, et al., 2014).

Regardless of these concerns, biodiversity compensation is currently occurring in New Zealand under the Conservation Act and the Resource Management Act (Madsen et al., 2010), and to some degree also under the Crown Minerals Act 1991 (Department of Conservation, 2014b).

The Conservation Act 1987

The Conservation Act formed, and is administered by, the Department of Conservation (DOC). The Act governs the use of New Zealand's conservation estate – about a third of New Zealand's total land area (Binning, 2000). There are no explicit policy goals for biodiversity compensation within the Conservation Act, yet biodiversity compensation has been used and promoted at various times by DOC (Salmon, 2013). The only mention of any form of biodiversity compensation within the Act is in section 17X(d) where the Minister is given the option of imposing conditions such as "the payment of compensation for any adverse effects of the activity on the Crown's or public interest in the land concerned, unless such compensation has been provided for in the setting of rent." To date, no research has been completed on the extent to which biodiversity compensation is being used under the Conservation Act.

The Conservation Act (1987, s17O) states that: "Except as provided in subsection (3) or subsection (4), no activity shall be carried out in a conservation area unless authorised by a concession." The concessions regime thus governs what activities can or cannot take place on public conservation land. According to the NZBOP, biodiversity compensation in the form of "offsets" can only be considered on public conservation land as part of conditions attached to a concession that aim to address any remaining adverse effects of the proposed activity (Department of Conservation, 2014b). Any concession application must first attempt to avoid, remedy, or mitigate any adverse effects of the activity that has been applied for; biodiversity compensation cannot be used as a substitute for this process (Department of Conservation, 2014b). Furthermore, public conservation land is held, and intended to be managed, for the purposes of conservation: any activity that does not comply with, or is inconsistent with, this purpose, or the provisions of the Conservation Act, or any other relevant conservation management planning document, should be declined by the Minister of Conservation (Department of Conservation, 2014b).

Despite the strict provisions of the Conservation Act, there has been increasing commercial pressure on public conservation land and DOC officers have often felt obliged to issue concessions and mining access arrangements regardless (Salmon, 2013). According to Salmon (2013), biodiversity compensation and evidence of "net conservation gain" are increasingly part of the consideration of concession applications. This is despite the fact that the Conservation Act does not facilitate the balancing of conservation and development imperatives.

Whilst biodiversity compensation, as a concept, is not mentioned in the Conservation Act examples of regulated biodiversity compensation have already been exposed in the media. The Lake Matiri power scheme is a recent example. DOC approved this concession under the condition that the environmental and recreational impacts of the scheme were to be reduced to acceptable levels. Conditions were included which provided for additional conservation and recreation gains (Department of Conservation, 2011). The concessionaire, New Zealand Energy Ltd, was obliged to pay $105,000 to DOC to offset the residual impacts of the scheme. This money is going, amongst other things, towards enhancing the terrestrial habitat in the catchment, enhancing the freshwater aquatic habitat in the Buller River catchment and towards riparian planting to compensate for the loss of natural forest (Department of Conservation, 2011). Regulated biodiversity compensation measures, such as these, are currently occurring in an *ad hoc* fashion under the Conservation Act. A more formalised approach is recommended to reduce risk to biodiversity through the inappropriate implementation of compensation measures (Salmon, 2013).

DOC appears to be actively researching the field of biodiversity compensation. The NZBOP guidelines have already been released and DOC staff are assigned to progress the science of biodiversity offsetting (Department of Conservation, 2014b). Other schemes such as conservation credits, where concessionaires are granted fee reductions as a reward for implementing additional conservation gains (Conservation Act, 1987, s17X(f)), also exist. In addition, biodiversity compensation measures are implemented on a voluntary basis by some concessionaires. Tourism concessionaires in particular are known to actively contribute to conservation (Thompson, 2005). Real Journeys, for instance, one of New Zealand's largest tourism enterprises and the primary concessionaire within Fiordland National Park, undertakes a multitude of conservation initiatives. These include financial support for the Les Hutchins Conservation Foundation, stoat trapping, fundraising for DOC, and financial support for DOC's endangered whio (Blue Duck) program (Thompson, 2005). These conservation initiatives can be seen as voluntary compensation for their operations within Fiordland National Park.

The Resource Management Act 1991

The Resource Management Act 1991 (RMA) is New Zealand's primary piece of legislation regulating how the environment is to be managed. The RMA promotes the sustainable management of natural and physical resources on both private and public land, where sustainable management means:

> "managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well-being and for their health and safety while –
>
> (a) sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and

(b) safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and

(c) avoiding, remedying, or mitigating any adverse effects of activities on the environment" (Resource Management Act, 1991, s5).

The RMA does not explicitly address the concept of biodiversity compensation. Section 5(2)(c) of the RMA requires adverse effects on the environment to be avoided, remedied, or mitigated, with case law and policy statements and plans differing on whether a hierarchy exists in these terms (Department of Conservation, 2014b). Compensation measures have commonly been confused with mitigation (Brown, 2014), however, the High Court recently decided that compensation measures should not be viewed as mitigation, but as positive environmental effects (Department of Conservation, 2014b). As such they should be considered under Section 104(1)(a) and Section 5(2) (Department of Conservation, 2014b).

Research by Brown (2014) illustrates that biodiversity compensation is being utilised under the RMA, with requirements for biodiversity compensation secured through resource consent conditions or, less commonly, through a side-agreement between the applicant and a third party (Brown, 2014; Tonkin and Taylor, 2012). Some examples of trades to date are illustrated in the literature (Christensen, 2007; Christensen & Barnes, 2009; Norton, 2007, 2009; Rive, 2013). "No net loss" is not considered a requirement in the RMA for a resource consent to be granted (Department of Conservation, 2014b). Instead, decision-makers weigh up a range of societal goals and make an overall judgement on whether the particular application meets the requirements of the RMA (Department of Conservation, 2014b).

Although the RMA makes no explicit mention of biodiversity compensation, some Regional Plans, District Plans and Policy Statements do (e.g. Horizons One Plan). Councils also often employ internal practice notes to help them assess proposals under the RMA that include biodiversity compensation (e.g. Waikato Regional Council). Worth mentioning is the Proposed National Policy Statement for Indigenous Biodiversity (Ministry for the Environment, 2011), a much awaited national guidance document which provides leadership on biodiversity compensation and, in particular, offsetting. This Policy Statement will be similar to legislation in terms of its strength under the RMA and would compel local authorities and councils to implement biodiversity compensation appropriately (Madsen et al., 2011).

The Crown Minerals Act 1991

The Crown Minerals Act 1991 promotes the "prospecting for, exploration for, and mining of Crown owned minerals for the benefit of New Zealand." (Crown Minerals Act, 1991, s1A). The Act deals with Access Arrangements, which regulate land access for mining and require either permission from the relevant land owner or a concession under the Conservation Act if on public conservation land (Department of Conservation, 2014b). The Crown Minerals Act contains no statutory criteria for biodiversity compensation. Whether biodiversity compensation can be considered an appropriate and sufficient mechanism for counterbalancing the effects of mining developments on biodiversity, in terms of a proposed access arrangement, is the decision of the Minister of Conservation and/or other ministers (Department of Conservation, 2014b). To date, no systematic review has looked at the use of biodiversity compensation under the Crown Minerals Act.

2.5.4 Evaluating Biodiversity Compensation in New Zealand

Although there is widespread support for biodiversity compensation in New Zealand (Brown, Clarkson, Barton, et al., 2014), extensive concerns about policy ambivalence, poor implementation and administration, uncertain outcomes, non-compliance, and a lack of enforcement, reflect international experience (Bull, Suttle, Gordon, et al., 2013; Ferraro & Pattanayak, 2006; Gibbons & Lindenmayer, 2007; Maron et al., 2012; Matthews & Endress, 2008; Quigley & Harper, 2006; Race & Fonseca, 1996; Walker et al., 2009).

The evaluation of biodiversity compensation in New Zealand has been limited to date. Only a few authors have studied how biodiversity compensation can be, and is being, used in New Zealand (Christensen, 2007; Denny, 2011; Department of Conservation, 2014b; Memon et al., 2004; Murphy, 2006; Norton, 2007, 2009; Norton & Warburton, 2014; Overton et al., 2013). To date, the only systematic and quantitative evaluation of biodiversity compensation has been done by Brown (2014). Brown (2014) looked in depth at the outcomes associated with ecological compensation under the RMA and how variations in outcomes might be explained. Findings showed that the present practice of ecological compensation under the RMA is characterised by high levels of non-compliance (35.2% of ecological compensation requirements identified in RMA resource consent conditions were not met), non-linearities in compliance (compliance varied significantly between activity, applicant, and condition types), and a range of implementation issues. Despite significant stakeholder concerns, Brown (2014) identified strong support for the concept and support for a more robust, formalised approach.

The evaluation of biodiversity compensation in New Zealand is regulation driven, although proponents are often required to self-monitor to some extent (Tonkin and Taylor, 2012). Under the RMA, for example, the issuing agency has a statutory duty to monitor whether consent conditions have been met and to undertake enforcement measures under the circumstance that compliance has not been achieved. The Ministry for the Environment also has a legal duty to carry out environmental monitoring and reporting under Section 31 of the Environment Act (1986) and Section 24 of the RMA.

There is a lack of information on the evaluation of biodiversity compensation under the Conservation Act. Conditions in concessions entailing some form of biodiversity compensation are enforceable (Conservation Act, 1987, s43), yet the enforcement process is perceived to be inconsistent (State Services Commission, Treasury, & Department of the Prime Minister and Cabinet, 2010). The Controller and Auditor-General (2006) has expressed the need for a stronger, more centralised approach to compliance monitoring under the Conservation Act.

2.6 Summary

Biodiversity compensation promises a new way of addressing biodiversity loss, a way in which decisions regarding economic development are compelled to take into account biodiversity values. The growing body of literature on biodiversity compensation is, however, full of criticism on the validity of the concept and the limitations affecting its use. Some regard biodiversity compensation, in its rigorous form of "offsetting", as a symbolic policy, that whilst being theoretically attractive, has shown to be ineffective in practical terms (Walker et al., 2009). This belief, that biodiversity compensation is simply not realistic due to structural, economic, and institutional factors, and that it does little but facilitate inappropriate development and pacify those with an aim to protect the environment, has cast significant doubts on whether improvements in methods and stronger legislation can help convalesce the concept, and ultimately on whether we should be supporting the concept at all (Burgin, 2008; Morris et al., 2006; Walker et al., 2009). However, despite overwhelming attention within the literature on the shortcomings of biodiversity compensation, most researchers conclude with tentative support for the concept and express an interest in working towards the resolution of any concerns (Gardner et al., 2013; Gibbons & Lindenmayer, 2007; Gillespie, 2012; Kiesecker et al., 2010; McKenney & Kiesecker, 2010; Norton, 2009; Overton et al., 2013; Pilgrim et al., 2013; Quintero & Mathur, 2011; Rega, 2013; Ten Kate et al., 2004; Virah-Sawmy et al., 2014).

In New Zealand, evaluations of biodiversity compensation have focused almost solely on biodiversity compensation under the RMA (Brown et al., 2013; Christensen, 2010; Memon et al., 2004; Norton, 2009). There is very little or no literature, which has evaluated biodiversity compensation under any other legislation in New Zealand. Brown (2014), in her research, identified the need for a study similar to hers, which would look at biodiversity compensation on public conservation land, under the Conservation Act. This study aims to fulfil this need by providing the first systematic evaluation of biodiversity compensation under the Conservation Act.

This study will parallel part 1 of Brown (2014) and look at regulatory compliance with biodiversity compensation under the Conservation Act. Part 2 and 3 of Brown (2014), which look at practice and stakeholder perspectives, will not be replicated in this study.

Chapter 3

Methods

Biodiversity compensation is a technically complex, multifarious, imprecise and uncertain science (Burgin, 2008; Race & Fonseca, 1996; Walker et al., 2009). As such, a single method approach to assessing compliance with biodiversity compensation requirements in this study was abandoned in favour of a more comprehensive, mixed-methods approach. Such an approach addresses the complexities of biodiversity compensation by enabling various forms of inquiry to be used together (Bergman, 2008; Greene, 2005). This enriches research findings and enhances the overall understanding of the research area (Creswell, 2003; Creswell & Clark, 2011; Greene, 2005).

For this study, the main purpose of the mixed methods approach was triangulation. Triangulation is where multiple research methods are used to converge on and verify the results of a study (Creswell & Clark, 2011). This enhances the validity, precision, and credibility of research findings (Creswell & Clark, 2011; Greene, 2005). A mixture of field assessments, independent reviews of agency records, spatial analysis, and interviews with key stakeholders enabled triangulation in this study.

3.1 Information Gathering

This research used a case study approach to examine levels of compliance with biodiversity compensation requirements. The use of case studies is a well-established research design method, often applied to complex, multi-faceted issues (Cassell & Symon, 2004; Crowe et al., 2011). Given the technically complex nature of biodiversity compensation, and the multifarious way in which it is employed in New Zealand, a case study approach was considered appropriate.

Case studies in this research represent DOC concession contracts which specify some form of biodiversity compensation, typically within the special conditions section of the concession contracts. A minimum of 20 case studies, from within the South Island of New Zealand, were sought for the purpose of this research. This number fitted within the time constraints of the study, yet allowed variations in compliance to still be captured. The decision to restrict case studies to the South Island was also a result of time and budget constraints.

Case studies were initially requested from DOC. A list of case study criteria (Table 1) was sent to DOC and they were asked to identify relevant case studies from within their concessions database. This approach to information gathering gave rise to several difficulties: 1. The information was considered quite dispersed; 2. concession contracts were not well defined or documented as including biodiversity compensation; 3. there was, within DOC, a lack of awareness about the term “biodiversity compensation” and what did or did not constitute compensation; 4. some of the relevant information was potentially commercially sensitive, and; 5. DOC had limited resources available to collate the information.

Table 1. Case study criteria for data requested from DOC.

1	A concession contract for an activity, structure or facility located within the South Island of New Zealand
2	A concession contract issued between 1 January 1992 and 31 December 2013 under the Conservation Act
3	A concession contract which included negative effect(s) on the biophysical environment, including, but not limited to: resource extraction, species loss, vegetation clearance, land alteration and/or discharges to land or water
4	A concession contract which included a negotiation for biodiversity compensation* under the Conservation Act
5	A concession contract in which biodiversity compensation requirements are specific and enforceable
6	A concession contract for which reasonable time has elapsed, such that the activity, structure, or facility, for which permission was granted, should have been carried out

* Biodiversity compensation can include, but is not limited to, species translocations, habitat restoration or creation, plantings, financial contributions, and weed or pest control

Despite these drawbacks DOC maintained interest in this study. In order to gain access to the data within the constraints identified above, an agreement was obtained with DOC. This agreement allowed access to a workstation within the Christchurch DOC office and authorisation to search the Permissions database for 20 relevant case studies. The Permissions database was searched for 20 concessions which included biodiversity compensation related conditions. This process was by no means straightforward as DOC’s concessions database contains information for several thousand concessions from all over the country. Also, no search function was available within the database which could identify concessions with biodiversity compensation related conditions.

The process for identifying case studies involved first using the available search options in the database. These were used to limit concessions to those from within the South Island, those approved between 1 January 1992 and 31 December 2013, and to “active” concessions (criteria in Table 1). The other criteria in Table 1 had to be searched for manually. The total number of concessions resulting from the automated search was over 2300.

A systematic search of every single concession for specific and enforceable biodiversity compensation requirements was not possible due to time constraints. The process for selecting concessions instead involved a stratified random search where four concession activity types (telecommunications, structures, access and grazing) were first chosen. These activities were chosen for two reasons: first, they dominate concession figures (Figure 4); and second, they were advised by DOC staff to be those concessions most likely to include requirements for biodiversity compensation.

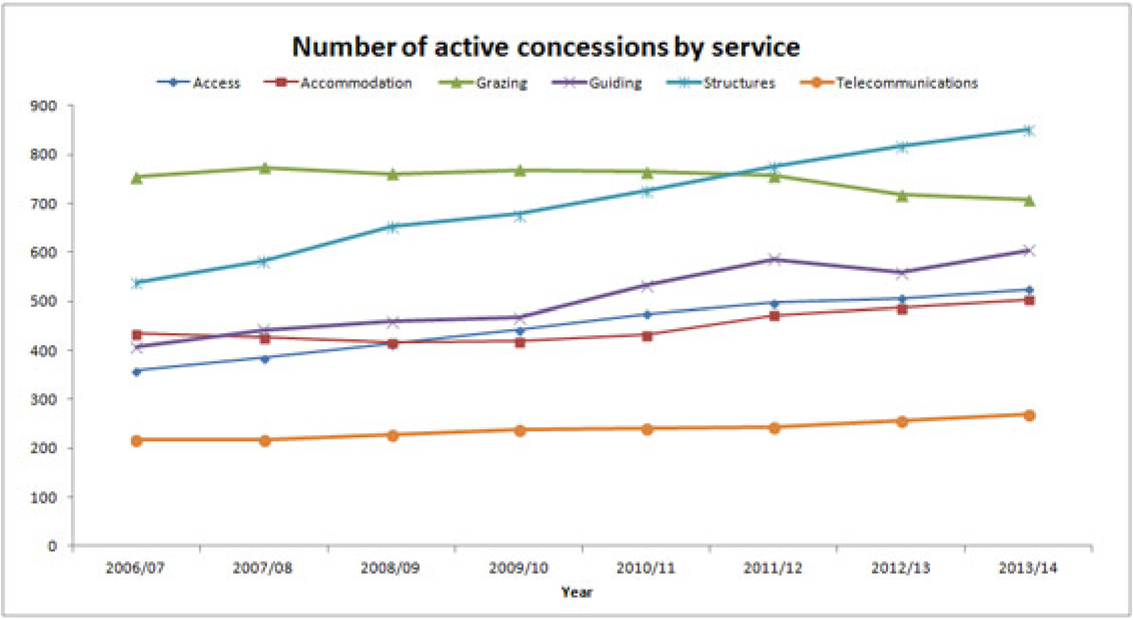

Figure 4. Number of active concessions by service or activity type (only those service or activity types where at least 250 concessions were granted in the 2013-2014 year) (Department of Conservation, 2014a).

It was considered statistically optimal for case studies to be both representative and random. As such, each activity type was systematically searched through in order to find five relevant concession case studies. A random search proved necessary as there were hundreds of concessions classified under each activity type. The random search involved manually searching through 10% of concessions under each activity type. This was extended by another random 10% if five relevant case studies had not yet been identified. If the random search resulted in more than five relevant concessions for a particular activity type, then this was narrowed down to five by favouring those concessions which included multiple biodiversity compensation conditions (as this would increase the overall sample size) and by favouring conditions with a variety in types of compensation.

What did or did not comprise “biodiversity compensation” was at the discretion of the researcher and the supervisory team. Compensation clauses typically referred to additional conservation actions that went beyond what would be required under the traditional avoid-remedy-mitigate hierarchy. In some cases, it could be debated whether the action was “additional” or not, yet due to the loose definition of biodiversity compensation in New Zealand, the research time-frame, and the relatively low occurrence of definitive cases of compensation, these cases were included. Assessing compliance with those conditions which marginally passed as compensation (e.g. species monitoring or transfer, which can be considered more as "avoidance" rather than compensation), was still considered useful for determining what selection of factors cause a concession holder to be more or less compliant. In total, of the concessions searched, approximately 15% included some form of compensation.

The final 20 concession case studies were formally approved by DOC. DOC had the right (as part of a signed contract) to decline provision of certain information if it happened to be commercially sensitive, however, this was never exercised. Concession contract(s) and available monitoring files for each identified case study were provided by DOC.

3.2 Assessing Compliance

In order to identify levels of compliance with biodiversity compensation requirements, reliable measurements of outcomes were required. Measuring outcomes relied on having specific and enforceable goals, either policy-based or project based (Lee et al., 2005; Matthews & Endress, 2008). In New Zealand, as there are a lack of policy goals relating to biodiversity compensation (Brown, Clarkson, Stephens, et al., 2014; Christensen & Barnes, 2009; Memon et al., 2004), including within the Conservation Act, typical policy evaluation methods (Laurian et al., 2010) could not be used. To mitigate this, and to support a quantitative approach, the conditions accompanying each concession case study formed the goals against which compliance was assessed. Concession conditions have commonly been used in compliance monitoring as a reliable proxy for project goals, as they are both specific and enforceable. Conditions can compel actions, set timeframes and outline performance standards (Brown, 2014).

In total, for the 20 concession case studies used in this study, there were 32 conditions compelling some form of biodiversity compensation. This ranged between one and five conditions per case study. Four conditions were excluded during the research process, due to the compensation action not yet being required or due to lack of information. As such, the final number of conditions assessed was 28.

Compliance levels were assessed against these concession conditions, using an independent review approach. This approach stemmed from widespread critique that the field of conservation is characterised by a lack of post-implementation monitoring and evaluation (Ferraro & Pattanayak, 2006). Low levels of routine compliance monitoring, poor agency record keeping and low enforcement rates are common, both overseas (Bull, Suttle, Gordon, et al., 2013; Gibbons & Lindenmayer, 2007; Hornyak & Halvorsen, 2003; Matthews & Endress, 2008; Quigley & Harper, 2006; Reiss, Hernandez, & Brown, 2009) and in New Zealand (Brown et al., 2013; Lee et al., 2005; Tonkin and Taylor, 2012). An independent review approach thus reduced the reliance on DOC records and allowed for a fairer and more consistent assessment of compliance. The merits of independent review are frequently noted within the literature (Brownlie et al., 2013).

Levels of compliance were independently assessed using a range of methods. Firstly, a desktop assessment of compliance was completed using the concession contracts and monitoring files. This desktop assessment included simple spatial analysis using GIS, and was followed by consultation with key DOC staff involved with administrating and monitoring individual concessions. Field visits were then completed where practical, to confirm the extent of compliance. The intention was also to interview concessionaires, in order to verify information, however time constraints meant this was no longer feasible.

A compliance scale was used to assess the degree of compliance concessionaires achieved with each biodiversity compensation condition. This method of assessing compliance was chosen as it has the support of regulatory agencies in New Zealand (Tonkin and Taylor, 2012) and it has also been used before in academic studies (Breaux et al., 2005; Brown, 2014). A scale, rather than a simple "yes or no" binary also makes results more meaningful (Brown, 2014). The compliance scale used in this study assessed compliance on a 0-3 scale, as illustrated in Table 2. It is important to note here that the term "complied" only applies to those conditions which were fully complied with (score 3), the other compliance categories simply reflect varying degrees of non-compliance.

Table 2. The compliance scale used to assess each compensatory condition in this study (adapted from Brown (2014)).

Compliance scale	Description
0 – No compliance	No level of compliance apparent with the stated condition
1 – Low level of compliance	Minor or insignificant achievement of compliance
2 – Medium level of compliance	Significant level of compliance with the stated condition, but falls short of full compliance
3 – Satisfactory compliance	Acceptable compliance that is within a practical margin of error and minor flexibility

For the sake of consistency, the compliance score reflected compliance only with the condition in question. It did not translate to the seriousness of the adverse effect and it did not assess the sufficiency of the condition itself. A condition for instance may still have allowed for considerable vegetation loss, yet if the condition was met then the result was still a 3 on the compliance scale.

3.3 Assessing Variations in Compliance

In New Zealand, variations in compliance with biodiversity compensation requirements on the conservation estate are poorly understood as there exists a general lack of information, empirical data, and peer reviewed literature on the subject. The present research has addressed this knowledge gap through an examination of the relationship between compliance and a number of spatial and non-spatial variables.

The non-spatial variables used in this study were condition type, activity type, and applicant type. The spatial variables used were conservation land category and habitat type. The non-spatial variables were chosen as a reflection of the concession planning and management process. They were also similar to the variables used by Brown (2014), and variables used in overseas studies (Matthews & Endress, 2008; Quigley & Harper, 2006; Shimshack, 2007), thus facilitating a national and international comparison. The choice of spatial variables originates from concerns and observations within the literature that some land types (be it due to their legal status, or land cover type) are more vulnerable to lower levels of monitoring and compliance (Breaux et al., 2005; Neyer & Zurn, 2001; Quigley & Harper, 2006). The aim of this assessment was that these variables might provide a clearer understanding of the intricacies of non-compliance and potentially lead to an improvement of land and biodiversity management practices.

3.3.1 Condition Type

Compliance levels are known to vary between types of conditions and condition goals (Brown, 2014; Matthews & Endress, 2008; Quigley & Harper, 2006). This might be due to resourcing, the availability of expertise, or other variables.

To investigate the relationship between condition type and compliance, conditions specifying biodiversity compensation were grouped into two categories: administrative and non-administrative. Administrative conditions were paper-based conditions, such as compensation payments or the creation of a conservation covenant. Non-administrative conditions were action-based, such as planting or weed and pest control. Conditions were then further split into groups that broadly aligned with their goals or purpose (Table 3). Levels of compliance accompanying these different condition goals were compared to assess which types of biodiversity compensation measures were more likely to be complied with and which required attention to enhance levels of compliance.

Table 3. Biodiversity compensation concession condition types.

Administrative	**Non-administrative**
Compensation payment	Planting
Conservation covenant	Species management programme
Environmental premium	Species monitoring or transfer
Financial contribution	Weed and/or pest control
Plan content	

3.3.2 Activity Type

Compliance levels are known not to be uniform across various activity types (Brown et al., 2013; Shimshack, 2007). Brown (2014) found that throughout New Zealand, expert practitioners could easily recount which activity types dominated consent application figures under the RMA and which were known to be more non-compliant. Under the Conservation Act in New Zealand, structural and grazing concessions dominate concession applications (Figure 4), but it is unknown which activity types are associated with higher or lower levels of compliance.

To examine differences in compliance between activity types, conditions were grouped into activity types and compared. The activity types chosen were: telecommunications, structures, access, and grazing. For each of these activity types there is a slightly different concession application process (Department of Conservation, 2015) which may have an effect on compliance.

3.3.3 Applicant Type

Compliance levels in previous studies were shown to vary recognisably between applicant types (Brown et al., 2013; Hornyak & Halvorsen, 2003; Shimshack, 2007). To assess whether this held true for concession applicant types under the Conservation Act, concession applicants were assembled into three categories: individuals, private companies and organisations, and public companies and organisations. Compliance levels were then compared between these three categories.

3.3.4 Conservation Land Category

There are many different types of conservation land, some of which are: wilderness areas, national parks, conservation parks, ecological reserves, marine reserves, wildlife areas and stewardship areas. Each type of conservation land has a legal status that reflects its value and explains why it is protected. National parks, for instance, are protected "for their intrinsic worth and for the benefit, use, and enjoyment of the public, areas of New Zealand that contain scenery of such distinctive quality, ecological systems, or natural features so beautiful, unique, or scientifically important that their preservation is in the national interest" (National Parks Act, 1980, s4(1)). In contrast, "every stewardship area shall be so managed that its natural and historic resources are protected" (Conservation Act, 1987, s25). This definition is much vaguer and translates into weaker legal protection (Parliamentary Commissioner for the Environment, 2013).

The legal status of conservation land affects what activities can take place there and how the land is managed. There has been some controversy with this recently, as the Parliamentary Commissioner for the Environment (2013) has identified that many areas of stewardship land actually warrant higher legal protection. Stewardship areas seem to be threatened more than any other conservation land category by developmental and political pressures (Salmon, 2013). The Parliamentary Commissioner for the Environment (2013) noted that, because stewardship land is not held for a specific purpose, concessions are perceived to be easier to gain. Whether this lower legal status correlates with lower levels of monitoring and compliance is unknown.

It is thought that increasing legal protection enhances compliance (Neyer & Zurn, 2001). The legal status of conservation land types is therefore hypothesised to correlate with compliance. Each concession case study, in this research, has been identified according to which conservation land category it is located within. The categories used are a reflection of DOC's land classification categories (1-4), which are used to calculate environmental premiums for telecommunication concessions (environmental premiums are intended to reflect the environmental impact of the Concession Activity on the Land). These categories fall along a scale of legal protection (Category 1 most protected and Category 4 least protected):

- Category 1: National Park, nature reserve, ecological area, national reserve, wilderness area, wildlife sanctuary or sanctuary area.
- Category 2: Conservation (forest) park, scientific reserve, historic reserve, wildlife management reserve, scenic reserve or wildlife refuge.
- Category 3: Recreation reserve, government and local purpose reserve, other reserves, stewardship areas, water course areas or marginal strips.
- Category 4: Open pasture under grazing in Category 3 land status and unprotected or non-reserve land held for administrative purposes.

The aim was to find out whether a correlation exists between compliance and conservation land category, as a result of variations in legal protection. Figure 5 illustrates the distribution of these conservation land categories within the study area with the exception of Category 4 land which has been grouped with Category 3 land for the purposes of mapping.

Figure 5 and Table 4 also show the distribution of concession case studies across these land category types.

Figure 5. The distribution of concession case studies across conservation land categories within the conservation estate on the South Island of New Zealand (study area).

Note. Scale is kept small to retain anonymity of Concessionaires.

Table 4. The number of concession case-studies specific to each conservation land category type.

Conservation Land Category	Number of case-studies
Category 1	4
Category 2	4
Category 3	7
Category 4	5

3.3.5 Habitat Type

Biodiversity compensation projects worldwide have shown that compliance varies with habitat type (Breaux et al., 2005; Quigley & Harper, 2006; Race & Fonseca, 1996). Most of these projects have focused on varying wetland habitats. In this study the effect of habitat type on compliance has been assessed at a much broader scale, as the public conservation estate of New Zealand contains a vast array of habitat types.

Several land classification systems were considered for defining habitat type: The New Zealand Land Resource Inventory (NZLRI), the New Zealand Land Cover Database (LCDB) and Land Environments of New Zealand (LENZ). Both LENZ and the LCDB were considered in detail. The NZLRI was dismissed as it focuses on land use capability and the ability of land to sustain agriculture, not on defining habitat type. LENZ is a classification of New Zealand terrestrial environments. It uses 15 climate, landform, and soil variables to group together areas with similar environmental conditions (Leathwick et al., 2002). These areas are then considered likely to have similar potential ecosystem character (Leathwick et al., 2002). LENZ does not consider existing land cover while the LCDB does. The LCDB is a digital map of New Zealand's land surface, created by grouping together similar land cover classes identified from satellite images (Grüner, Thompson, & Gapare, 2003). Currently there are 4 versions of the LCDB available, each version represents land cover at a different point in time. The latest, version 4, is based on satellite imagery from the summer 2012/2013 and was released in June 2014.

The LCDB was chosen for this study as the most appropriate land classification system for defining habitat type. The LCDB focuses on existing habitats, not those that could potentially exist (LENZ). Also, the spatial resolution of habitat types was considered more meaningful for the size of the study area with the LCDB.

In this study, concession case studies were identified and grouped according to which LCDB version 4 category they were located within. This was accomplished using a spatial join in GIS. Compliance levels were then assessed and compared between these different habitat groups. The distribution of concession case studies across the various habitat types within the study area are illustrated in Figure 6. Grüner et al. (2003) explain these habitat types in more detail.

Figure 6. The distribution of concession case studies across habitat types (LCDB4) within the conservation estate on the South Island of New Zealand (study area).

Note. Scale is kept small to retain anonymity of Concessionaires.

3.4 Assessing Predictors of Compliance

This research project explored the role that variables within the concession process, the concession document itself, and social circumstances surrounding the concession have on predicting and affecting eventual levels of compliance. The majority of variables chosen for this research are variables over which DOC has some influence. As such, DOC has had input into their selection. An understanding of these variables and their effect on compliance was considered important in providing DOC with useful information to assess the effectiveness of their concession administration, monitoring, and management processes. It was hoped that this would allow DOC to manage the risk of trade-offs and target monitoring to ultimately reduce the risk to biodiversity and increase positive biodiversity outcomes associated with compensation measures.

This research project examined a range of “process variables” related to the concession application process (Table 5) and “concession variables,” which related to each concession’s requirements and the nature of the compensatory action(s) (Table 6). A range of social variables were also examined as to their relationship with compliance (Table 7). These variables were all identified either in the literature or by DOC staff as potentially affecting compliance and the implementation of biodiversity compensation.

To understand each variable’s importance in predicting or otherwise influencing compliance, an assessment of correlation with compliance was undertaken.

Table 5. Process variables that may impact levels of compliance.

Process Variable	Explanation
Professional ecologist	Was a professional ecologist engaged by the applicant during the process of applying for concession?
Early mention	Was the compensation action mentioned early in the process, or late in the process in response to DOC or submitter concerns?
Applicant proposed	Was there evidence that the applicant proposed the compensation?
Notification	Was the concession a notified concession?
Head office	Was the application processed in the Christchurch, Dunedin or Hokitika head office?
Date of approval	Was the concession granted a long or short time ago?*
Review	Has the concession undergone review?

** A long time ago is 2010 or earlier, a short time ago is after 2010.*

Table 6. Concession variables that may impact levels of compliance.

Concession Variable	Explanation
Timing	Was the compensation action required prior, during or following the activity that had been granted concession?
Bond	Was a bond required as part of the concession?
Monitoring	Was monitoring required as part of the concession?
Location	Was the compensation action required onsite or offsite?
Concession duration	Was the concession of short, medium, or long duration?*
Compensation duration	Was the compensation action a "one-off" or did it require ongoing intervention and maintenance?

** Short= 0-10 years, medium= 11-30 years, long= 31+ years.*

Table 7. Social variables that may impact levels of compliance.

Social Variable	Explanation
Enforcement	Does the concessionaire have a record of enforcement actions being taken against them by DOC?
Pending concessions	Does the concessionaire have any pending concession applications or renewals?
DOC visitations	Does the area relevant to the concession get visited frequently by DOC?*
Public visitations	Does the area relevant to the concession get visited frequently by members of the general public?**
Concessionaire change	Has the concession been transferred to a new concessionaire?

** Frequently= at least one visit or drive-by a year.*
***Frequently=at least one visit or drive-by a week.*

3.5 Data Analysis

The Fisher's exact test was used in this study to determine statistically significant relationships between the variables mentioned in sections 3.3 and 3.4, and compliance. The dataset used in this study consists of multiple nominal independent variables and one ordinal dependent variable (compliance). The Fisher's exact test, whilst not ideal for this dataset (it is typically only applied to nominal data), was still considered the most suitable statistical test.

Many environmental compliance studies use the Pearson's Chi-squared test which compares counts of categorical responses between two (or more) independent variables (Bailey, Hobbs, & Saunders, 1992; Brown, 2014; Hornyak & Halvorsen, 2003; Wild & Seber, 1999). However, the Chi-squared test, as well as the similarly popular G-test of independence, rely on nominal data and are considered inaccurate when expected numbers are small (Agresti & Finlay, 2009; McDonald, 2014; Simonoff, 2003). The Chi-squared test relies on the assumption that no more than 20% of the expected counts are less than five and all individual expected counts are one or more (Yates, Moore, & McCabe, 1999). The presence of ordinal data plus the small expected counts in this study thus discounted the use of these types of independence tests.

Several other well-known statistical tests, such as the Kruskall Wallis test, the Mann-Whitney U test, and a linear regression model and anova, were also considered but rejected. The Kruskall Wallis test, for instance, works well for when there is one nominal and one ordinal variable and the data is not normally distributed, which it would have to be for a one-way anova (McDonald, 2014). The Kruskall Wallis test also extends the Mann-Whitney U test to more than two groups, which is necessary for this study, however, it does not work when distributions are heteroscedastic, which is the case in this study. A linear regression model and anova were also discounted in this study as the dataset is too small and the ordinal scale too short (McDonald, 2014).

The Fisher's exact test was chosen as an appropriate and well regarded compromise (McDonald, 2014; Wild & Seber, 1999). It is an independence test similar to the chi-squared test but more suited towards smaller sample sizes (McDonald, 2014). It is also a statistical hypothesis test used to determine whether observations on two or more variables, expressed in a contingency table, are independent of each other, with the null hypothesis stating that they are (McDonald, 2014; Wild & Seber, 1999). In doing this the Fisher's exact test does not, unlike many other tests, calculate the probability of a test statistic value, but instead it calculates the probability of getting the observed data, and all data with more extreme variations, under the null hypothesis that the observed and expected data are the same (McDonald, 2014).

In this study, the Fisher's exact test was used to assess whether variations in compliance, with different spatial and non-spatial variables (Section 3.3) as well as predictor variables (Section 3.4), were statistically significant (i.e. the variable had a significant relationship with compliance). As the Fisher's exact test applies to nominal data, the ordinal variable (compliance) had to be treated as if it was nominal. This means that, whilst the results show whether or not there is a significant correlation between each variable and compliance, information in the ordering is ignored. Results in this study were considered significant, and the null hypothesis was rejected, when the Fisher's exact test resulted in a probability (p value) smaller than 0.05 (Wild & Seber, 1999). This p value refers to a 5% level of significance commonly used in statistics (Wild & Seber, 1999).

The Fisher's exact test relies on two assumptions. First, like any independence test, it assumes individual observations are independent. Second, unlike other independence tests, it assumes that row and column totals are fixed. The latter of these assumptions has caused some critique and controversy amongst statisticians as row and column totals cannot always be fixed (McDonald, 2014; Upton, 1992). In this study we know from the start the number of conditions for each variable (row totals), however, we are not dealing with fixed compliance scores (column totals). McDonald (2014) states that, in this case, the results of the Fisher's exact test are more conservative than exact. McDonald (2014) goes on to say that, despite this, the Fisher's exact test is still the favoured approach when dealing with categorical data and small sample sizes. The limitations of the Fisher's exact test for this study mean that significant analysis will also be done using just observations.

3.6 Summary

This study used a mixed-methods approach, combining spatial, archival and field ecology data, to assess levels of compliance with biodiversity compensation requirements. This approach was considered appropriate as it ensured a range of data was available to verify and triangulate on what is considered a complex research area (Bergman, 2008; Creswell & Clark, 2011).

The mixed-methods approach was applied to 28 biodiversity compensation conditions, sourced from 20 concession case-studies throughout the South Island of New Zealand. These case-studies were obtained from DOC's Permissions database.

A compliance scale was used to assess the degree of compliance concessionaires achieved with each biodiversity compensation condition. This approach has the support of regulatory agencies in New Zealand (Tonkin and Taylor, 2012) and it has also been used before in academic studies (Breaux et al., 2005; Brown, 2014). The compliance scale assessed compliance on a 0-3 scale; a score of 3 equalled full compliance and scores of 0-2 equalled varying degrees of non-compliance. This was considered a more descriptive way of reporting on compliance than a simple "yes or no" binary.

The Fisher's exact test was subsequently used to determine any statistically significant relationships between a number of variables and compliance. The Fisher's exact test was considered appropriate, as the study deals primarily with multiple nominal categorical variables and a small sample size (McDonald, 2014). The variables examined in the study include a range of spatial and non-spatial variables as well as variables within the concession process, the concession itself, and social circumstances surrounding the concession. The aim was to determine if any of these variables had a significant effect on compliance. This hypothesis originates from findings in the literature which illustrate non-uniformities in compliance across a range of variables (Brown et al., 2013; Dasgupta, Hettige, & Wheeler, 2000; Matthews & Endress, 2008; Quigley & Harper, 2006; Shimshack, 2007). The limitations of the Fisher's exact test, and the statistical restrictions of a small sample size, mean that this research has also placed significant emphasis on the observed patterns and trends within the data.

Chapter 4

Results

Of the 28 conditions assessed, 19 were complied with (Figure 7). This translates to an overall compliance rate of approximately 68%, or two-thirds. The flip-side of this is that a third of conditions were, to varying degrees [0 (7%), 1 (7%), and 2 (18%)], not complied with.

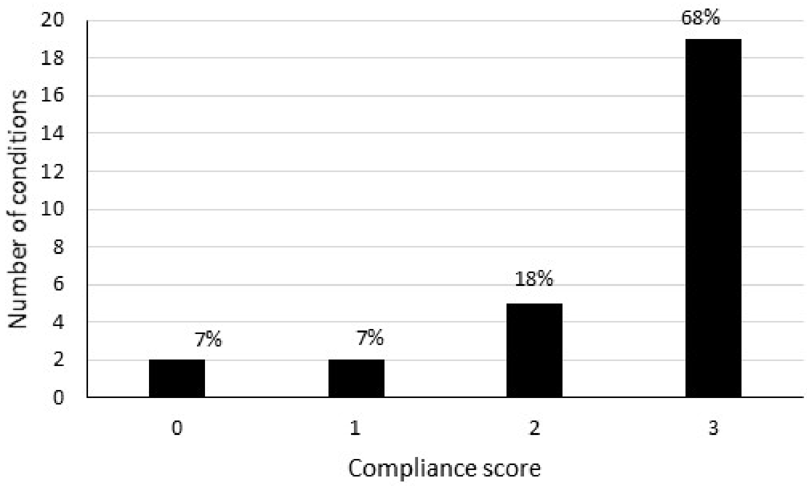

Figure 7. Overall level of compliance with conditions specifying biodiversity compensation under the Conservation Act.

4.1 Variations in Compliance

4.1.1 Condition Type

Administrative conditions were complied with (score of three) more often than non-administrative conditions (73% versus 65% (Table 8)). However, some level of compliance was always attained with non-administrative conditions, whereas 18% of administrative conditions were not complied with at all.

The Fisher's exact test yielded a result of 0.056. Whilst this result is statistically insignificant, it is highly suggestive of a relationship between condition type and compliance. Rossi (2010), for example, states that a borderline *p* value provides only weak evidence for accepting the null hypothesis, especially when combined with a small sample size. Future research may thus want to follow up on the significance of variations in compliance with condition type.

Table 8. The distribution of cases (%) along the compliance scale for condition types.

Condition Type	Number	0	1	2	3
Administrative	11	18	9	0	73
Non-administrative	17	0	6	29	65

Note. All (%) cases along the compliance scale have been rounded to zero decimal places, as a result, scores do not always add to 100%.

Condition types were further broken down into condition goals (see Section 3.3.1). Five, out of a total of nine, condition goals exhibited full compliance (Table 9). Compensation payments exhibited the lowest level of compliance. Weed and/or pest control measures were by far the most common form of compensation. These weed and/or pest control measures often just fell short of being complied with.

The Fisher's exact test revealed no significant relationship between compliance and condition goals (p = 0.398). The small expected counts in each condition goal category make it unlikely that these results accurately depict expected compliance.

Table 9. The distribution of cases (%) along the compliance scale for condition goals within administrative and non-administrative condition categories.

Condition Goal	Number	0	1	2	3
Administrative					
Compensation payment	3	67	0	0	33
Conservation covenant	1	0	0	0	100
Environmental premium	2	0	0	0	100
Financial contribution	3	0	0	0	100
Plan content	2	0	50	0	50
Non-administrative					
Planting	2	0	0	50	50
Species management programme	1	0	0	0	100
Species monitoring or transfer	3	0	0	0	100
Weed and/or pest control	11	0	9	36	55

Note. All (%) cases along the compliance scale have been rounded to zero decimal places, as a result, scores do not always add to 100%.

4.1.2 Applicant Type

Public organisations and companies were the most compliant (75%), followed by individuals (67%), and then private organisations and companies (64%) (Table 10). Interestingly, whilst public organisations and companies exhibited the highest rate of compliance, they also exhibited the highest rate of zero compliance (Table 10).

The Fisher's exact test yielded a result of 0.734. This indicates that whilst differences in compliance are apparent (Table 10), there is no statistically significant relationship between applicant type and compliance. Just because public organisations and companies exhibit a higher rate of compliance in this study, does not mean they exhibit a greater likelihood of attaining compliance.

Table 10. The distribution of cases (%) along the compliance scale for applicant types.

Applicant Type	**Number**	**0**	**1**	**2**	**3**
Individual	6	0	0	33	67
Private organisation or company	14	7	7	21	64
Public organisation or company	8	13	13	0	75

Note. All (%) cases along the compliance scale have been rounded to zero decimal places, as a result, scores do not always add to 100%.

4.1.3 Activity Type

Conditions which formed part of structural concessions were the most complied with (88%), followed closely by conditions for telecommunications concessions (86%) (Table 11). Conditions for grazing concessions were complied with the least (40%). Interestingly, those grazing conditions which were not complied with all received a score of two, indicating they were only just short of being complied with. Access concessions were the only activity type for which some conditions were not complied with at all (score of zero).

Despite the variation in compliance (Table 11), the Fisher's exact test found no statistically significant relationship between activity type and compliance ($p = 0.097$).

Table 11. The distribution of cases (%) along the compliance scale for activity types.

Activity Type	**Number**	**0**	**1**	**2**	**3**
Access	8	25	13	13	50
Grazing	5	0	0	60	40
Structure	8	0	13	0	88
Telecommunications	7	0	0	14	86

Note. All (%) cases along the compliance scale have been rounded to zero decimal places, as a result, scores do not always add to 100%.

4.1.4 Conservation Land Category

Compliance was highest with conditions relevant to concessions on category 1 conservation land; 100% of condition requirements were complied with (Table 12). The lowest level of compliance was with conditions from concessions on category 4 conservation land (40%). Category 4 conservation land consists mainly of open pasture under grazing in category 3 land status. As such, the compliance results are identical to the compliance results in Table 11 with conditions from grazing concessions.

Variation in compliance was the highest with conditions relevant to concessions on category 3 conservation land (includes stewardship land). The majority (67%) of condition requirements, however, were complied with (Table 12).

The Fisher exact test yielded a result of 0.218. This indicates that, despite the range in compliance, no statistically significant relationship exists between compliance and conservation land category.

Table 12. The distribution of cases (%) along the compliance scale for conservation land category types.

Conservation Land Category	Number	0	1	2	3
Category 1	6	0	0	0	100
Category 2	5	0	20	20	60
Category 3	12	17	8	8	67
Category 4	5	0	0	60	40

Note. All (%) cases along the compliance scale have been rounded to zero decimal places, as a result, scores do not always add to 100%.

4.1.5 Habitat Type

The majority of conditions (13) applied to concessions within the Indigenous Forest LCDB category and almost all of these were complied with (92%) (Table 13). Conditions relevant to three of the eight habitat categories featured in this study (Marine, Built-up Area, and Sub Alpine Shrubland) were 100% complied with. Unfortunately, not much weight can be placed on these scores as each of these habitat categories is represented by only a single condition.

The habitat type category that performed the poorest was High Producing Exotic Grassland. 0% of condition requirements were complied with (Table 13).

The Fisher's exact test yielded a statistically significant result of 0.034. This indicates that compliance varied significantly with habitat type. The small expected counts, however, confound rejection of the null hypothesis. Future research is recommended to follow up on this particular variable.

Table 13. The distribution of cases (%) along the compliance scale for habitat types (LCDB4).

Habitat Type (LCDB4)	Number	0	1	2	3
(Marine)	1	0	0	0	100
Broadleaved Indigenous Hardwoods	2	0	0	50	50
Built-up Area (settlement)	1	0	0	0	100
Deciduous Hardwoods	3	0	33	33	33
High Producing Exotic Grassland	3	33	0	67	0
Indigenous Forest	13	8	0	0	92
Low Producing Grassland	4	0	25	25	50
Sub Alpine Shrubland	1	0	0	0	100

Note. All (%) cases along the compliance scale have been rounded to zero decimal places, as a result, scores do not always add to 100%.

4.2 Predictors of Compliance

4.2.1 Process Variables

Seven process variables were identified as potentially having an impact on compliance (Table 5). Two of these variables (whether the compensation action was mentioned early or late in the application process and whether the compensation action was proposed by the applicant or not) had to be removed from the analysis due to insufficient information.

Table 14 illustrates that conditions from notified concessions were complied with more (78%) than conditions from non-notified concessions (50%). When a professional ecologist was involved the level of compliance was also higher (75%) versus when one was not involved (63%).

No statistically significant relationships were found between compliance and any of the process variables assessed in this study (Table 14). None of these variables can thus be considered predictors of compliance.

Table 14. The distribution of cases (%) along the compliance scale for process variables.

Process variable	**Number**	**0**	**1**	**2**	**3**	***p* value (Fisher)**
Professional ecologist involved	12	8	8	8	75	0.834
Professional ecologist not involved	16	6	6	25	63	
Concession notified	18	6	6	11	78	0.393
Concession non-notified	10	10	10	30	50	
Application processed by Christchurch Office	6	0	33	17	50	0.180
Application processed by Dunedin Office	10	10	0	30	60	
Application processed by Hokitika Office	12	8	0	8	83	
Concession approved long time ago	23	9	9	13	70	0.684
Concession approved short time ago	5	0	0	40	60	
Concession undergone review	9	11	0	22	67	1.000
Concession not undergone review	19	5	11	16	68	

Note. All (%) cases along the compliance scale have been rounded to zero decimal places, as a result, scores do not always add to 100%.
$*p < .05$.

4.2.2 Concession Variables

Six concession variables were identified as potentially having an effect on compliance (Table 6). One of these (location), was left out of the analysis as it linked directly to condition type (administrative conditions were not site-related and non-administrative conditions required compensation only onsite) and therefore did not reveal anything new.

A statistically significant relationship exists between compensation duration (whether the action was one-off or ongoing) and compliance. One-off compensation actions are more likely to be complied with than ongoing compensation actions (p = 0.037) (Table 15).

Whilst there are no other statistically significant relationships between the remaining concession variables and compliance, Table 15 shows some interesting variations. For instance, there appears to be quite a difference in compliance between cases where monitoring was required (59%) and not required (82%). Intriguingly, compliance was higher for cases where monitoring was not required.

Compliance was also higher with cases which included the requirement for a bond (75%), versus those which did not (65%).

Table 15. The distribution of cases (%) along the compliance scale for concession variables.

Concession variable	**Number**	**0**	**1**	**2**	**3**	***p* value (Fisher)**
Action required prior to activity	11	18	9	0	73	0.258
Activity required during activity	12	0	8	33	58	
Activity required following activity	5	0	0	20	80	
Bond required	8	13	0	13	75	1.000
Bond not required	20	5	10	20	65	
Monitoring required	17	6	6	29	59	0.185
Monitoring not required	11	9	9	0	82	
Concession duration long	8	13	13	13	63	0.788
Concession duration medium	9	0	0	11	89	
Concession duration short	11	9	9	27	55	
Action one-off	13	15	8	0	77	0.037*
Action ongoing	15	0	7	33	60	

Note. All (%) cases along the compliance scale have been rounded to zero decimal places, as a result, scores do not always add to 100%.
$^*p < .05$.

4.2.3 Social Variables

Five social variables were identified as potentially having an effect on compliance (Table 7). One variable (enforcement) was left out of the analysis as 100% of cases involved concessionaires with no history of enforcement actions taken against them by DOC.

Table 16 shows a large difference in compliance exists between cases where a concessionaire had pending concession applications and/or renewals (100%) and where they did not (61%). Table 16 also shows that cases with frequent DOC visits exhibited a higher level of compliance than cases with infrequent DOC visits. Cases with frequent DOC visits also never scored a zero on the compliance scale, as opposed to those cases rarely visited by DOC. Whilst those cases frequently visited by DOC staff exhibited a higher level of compliance, those visited frequently by the general public did not.

The Fisher’s exact test yielded no statistically significant relationships between any of the social variables and compliance. None of these variables can thus be considered predictors of compliance.

Table 16. The distribution of cases (%) along the compliance scale for social variables.

Social variable	**Number**	**0**	**1**	**2**	**3**	***p* value (Fisher)**
Pending concession applications and/or renewals	5	0	0	0	100	0.803
No pending concession applications and/or renewals	23	9	9	22	61	
Frequent DOC visits	12	0	0	25	75	0.487
Infrequent DOC visits	16	13	13	13	63	
Frequent public visits	11	0	18	27	55	0.168
Infrequent public visits	17	12	0	12	77	
Concession transferred to a new concessionaire	7	14	0	14	71	0.885
Concession not transferred to a new concessionaire	21	5	10	19	67	

Note. All (%) cases along the compliance scale have been rounded to zero decimal places, as a result, scores do not always add to 100%.
$^*p < .05$.

4.3 Summary

The results of this study show that overall compliance with biodiversity compensation conditions under the Conservation Act is about 68%. This means that approximately a third of biodiversity compensation conditions were, to varying degrees [0 (7%), 1 (7%), and 2 (18%)], not complied with.

Compliance varied suggestively with condition type (p = 0.056) and significantly with habitat type (0.034). With regards to habitat type, the small expected counts confounded rejection of the null hypothesis. Further research, involving a larger sample size, would be required to follow up on this.

Compliance did not vary significantly with any of the other spatial and non-spatial variables, however, some interesting patterns in compliance did emerge. Public organisations and companies, for instance, demonstrated a higher rate of compliance than other applicant types. Conditions from structural and telecommunications concessions exhibited a much higher compliance rate than conditions from grazing and access concessions. Variations in compliance also emerged as a result of the variable “conservation land category.” Compliance was highest with conditions relevant to category 1 conservation land and lowest with conditions relevant to category 4 conservation land. This reflects the level of legal protection.

18 “predictor” variables, which formed part of the concession process, the concession itself, and social circumstances surrounding the concession, were hypothesised to have an impact on the eventual level of compliance. Of these 18 variables, 14 could be analysed. One of these, “compensation duration,” had a statistically significant relationship with compliance. One-off conditions were complied with significantly more than conditions requiring ongoing intervention and maintenance.

Other predictor variables showed some interesting, yet statistically insignificant, variations in compliance. Compliance was higher, for instance, with cases where the concession was notified as well as with cases where the concession included a bond. Compliance was lower with frequent public visits and, surprisingly, with cases where monitoring was required. Considering the limits of the Fisher’s exact test (Section 3.5) and the small sample size, these descriptive results are worth consideration.

Chapter 5

Discussion

5.1 Compliance

The overall rate of compliance with biodiversity compensation conditions under the Conservation Act was 68%. This means approximately a third of biodiversity compensation conditions were, to varying degrees, not complied with. These rates of compliance and non-compliance are similar to the 64.8% rate of compliance found by Brown (2014) for ecological compensation conditions under the RMA in New Zealand. Compliance with compensation requirements appears to be just marginally higher under the Conservation Act as opposed to under the RMA. The sample size in this study is, however, much smaller. It follows that the margin of error involved would render the results approximately similar. Compliance was expected to be higher under the Conservation Act as this Act applies to public conservation land and the RMA primarily to private land. Compliance on public land was expected to be higher due to public scrutiny (Dasgupta et al., 2000) as well as due to the strict, conservation focused, provisions of the Conservation Act.

Whilst a 32% level of non-compliance should never be considered acceptable, this level of non-compliance is comparable to, and even an improvement on, what has been reported in various international studies. For example, a study of compensatory wetland mitigation in Massachusetts US found 54.4% of wetland projects did not comply with the State of Massachusetts wetland regulations (Veneman & Brown, 2001). Worse, a study of habitat compensation under the Canadian Fisheries Act 1985 found that more than 85% of 124 developments associated with fish habitat were non-compliant with conditions (Harper & Quigley, 2005). Closer to home, in Western Australia, an environmental auditing study of artificial waterways found a more similar non-compliance rate of 37% with conditions related to the mitigation of adverse effects (Bailey et al., 1992).

A number of factors observed during the course of this study might be inhibiting compliance with biodiversity compensation requirements under the Conservation Act. Firstly, there does not appear to be a systematic and coordinated approach to compliance monitoring of concession conditions. This observation reflects that of the Controller and Auditor-General (2006) (see Section 2.5.4). Observations showed that the level of monitoring varied according to the type and scale of the activity for which a concession had been granted. Grazing concessions, for instance, were seen to get monitored annually by DOC staff (although this was not always the case) whilst telecommunications concessions usually received only a single inspection. Large scale concessions, with substantial environmental impacts, sometimes had an assigned 3rd party compliance officer, or DOC staff member, routinely performing site inspections. Site access also tended to affect the level of compliance monitoring. Concessions along major state highways, for instance, received more frequent checks as a result of routine drive-bys. Anecdotal evidence adds that a lot of compliance monitoring is also done *ad hoc* and reactively as a result of observations and/or complaints made by the general public.

Aside from the inconsistent level of compliance monitoring there also seemed to be inconsistencies in compliance reporting and data management. Only seven of the 20 case studies had any record on file of compliance monitoring, with the conditions of interest for this research. As such, DOC staff members were heavily relied upon to provide additional insight and knowledge. This they were able to do for 16 out of the 20 case studies. Deficiencies in compliance reporting and data management were illustrated particularly with regards to one case study, where one of the compensation conditions required ongoing monitoring and maintenance, this particular concession was transferred to a new concessionaire, yet neither the new concessionaire nor DOC had any record of the concession activity or their obligations.

Compliance reporting and data management was further observed to be problematic due to a large reliance on concessionaires to self-monitor and report. Whilst this is understandable, as it alleviates pressure on DOC, self-monitoring can be poorly conducted and compliance information can be misrepresented (Tonkin and Taylor, 2012). Compounding this issue is an inconsistent approach by DOC to compliance reporting. For instance, at times DOC staff members were aware of a site inspection that had taken place, but there was no documentation of it. Staff member turn-over and subsequent loss of concession specific knowledge complicates this further. In addition, when compliance information was recorded, it was done in a number of different ways (i.e. email chains, invoices, memos, official inspection reports). These records were then kept either on paper file and/or on electronic file, with the former scattered between offices. The core concession files were generally kept at the main service centres, yet the monitoring files were sourced from various area offices. Financial records pre-2003 were also kept archived in an old finance system to which there is limited access. These approaches to data management made it very difficult to accurately undertake an assessment of compliance.

Lack of communication is another factor observed to be inhibiting compliance. Anecdotal evidence suggests that compliance with administrative conditions, such as compensation payments, might have been inhibited due to a lack of intra-departmental communication. Two compensation payments, for example, failed to get paid as a result of Permissions officers not communicating with finance staff. As a result of this, concession contracts were signed but invoices for the compensation payments were never sent out.

DOC's tolerance for less than full compliance might be another impeding factor. Winter (1985) states that regulatory agencies may choose to under-exploit their authority if the regulated parties agree to act as requested. In this way the regulatory agency gains some level of compliance and avoids time-consuming and costly enforcement procedures. The regulated entity, on the other hand, will avoid an embarrassing struggle against the law and may be able to barter with the agency in order to achieve less than full compliance (Winter, 1985); Winter (1985) notes that the legal powers given to regulatory agencies, such as DOC, are frequently used as bargaining chips in this way. Lack of resourcing might be another reason why DOC might under exploit their authority (Friesen, 2003; Scholz, 1984). Scholz (1984) explains that, by being more flexible with regards to acceptable levels of compliance, regulatory agencies can spread their limited resources much further (Scholz, 1984). An example of where this was witnessed was in regards to some of the weed and/or pest control conditions that formed part of this study. In some cases, DOC stated that concessionaires were in full compliance (albeit the last inspection often being several years ago) yet a site visit revealed that this was not so. Lack of resourcing cannot always be an excuse for low compliance as in some cases, concession contracts actually mentioned that DOC time towards monitoring was cost recoverable. This does not extend, however, to the cost of enforcement. Interestingly, game theory suggests that regulatory agencies are actually better off sacrificing legal requirements for full enforcement, as in this way they will more certainly achieve some level of compliance (Scholz, 1984; Winter, 1985).

Lack of resourcing and the cost of enforcement are further expanded on by Friesen (2003), who states that a regulated entity will only comply with a regulation when its compliance cost is less than the expected penalty associated with violation. Frequent monitoring and strict enforcement strategies, including high fines, are traditionally proposed as solutions (Friesen, 2003; Wu, 2009). This can be difficult for a resource limited agency like DOC. As such, this might be another factor inhibiting compliance with concession conditions. Eckert (2004), Earnhart (2004) and Rousseau (2008) all confirmed the deterrent effect of increasing inspections. Friesen (2003), however, makes the point that, even with low inspection probabilities and small fines, compliance can still be high. This requires research into innovative, non-traditional approaches, approaches such as targeted enforcement (Friesen, 2003; Scholz, 1984), something DOC could research further.

A final constraint, which might be impeding compliance and compliance monitoring of concession conditions, is the level of priority given to compliance monitoring and enforcement. The NZBS actively advocates the importance of monitoring: "Appropriate mechanisms to enforce policies and actions to conserve and sustainably use New Zealand's biodiversity need to be developed and consistently used by relevant agencies; these might include education, surveillance, compliance monitoring, enforcement programmes and appropriate sanctions for non-compliance" (Anon, 2000, p. 90), however, DOC does not yet appear to have a compliance monitoring and enforcement strategy. This might be something of importance for DOC to consider as there is in the literature a degree of dissatisfaction with DOC's perceived failure to consistently enforce concession requirements (State Services Commission et al., 2010).

5.2 Variations in Compliance

This research looked at the heterogeneity of non-compliance as a way of identifying how current practices can be improved in order to enhance the overall outcomes of biodiversity compensation. Compliance was found to vary suggestively with one variable, condition type, and significantly with another variable, habitat type.

A statistically significant relationship was found between habitat type and compliance ($p = 0.034$). Conditions relevant to Marine, Sub-Alpine Grassland, and Built-up Area LCDB4 habitat categories exhibited 100% compliance whilst conditions relevant to High Producing Exotic Grassland exhibited 0% compliance. Unfortunately, no robust conclusions can be drawn from these figures as several of the habitat categories were represented by only single observations. Regardless, the literature suggests that compliance does vary with habitat type (Breaux et al., 2005; Quigley & Harper, 2006; Race & Fonseca, 1996). A study of wetland habitat types by Quigley and Harper (2006), for instance, found that compliance varied significantly from poorest for riparian habitats and highest for standing water habitats. Observations throughout this research show that habitat type links quite strongly with activity type, condition type and goal. It tends to be grazing concessions which occur on Low and High Producing Exotic Grassland habitat, and it tends to be non-administrative weed and/or pest control measures which are required as compensation. Further research using a larger sample size, might want to follow up on these linkages and on the effect of habitat type on compliance.

A suggestive relationship was found between compliance and condition type ($p = 0.056$). Compliance was higher with administrative conditions than with non-administrative conditions. This finding reflects that of Brown (2014) who also found compliance to be higher with administrative conditions. This is thought to be a result of administrative conditions being less resource intensive to implement, monitor, and enforce. It is also related to the condition goal. For instance, all non-administrative conditions which were not complied with had a weed and/or pest control compensation goal. These were thought to be complied with less as a result of compliance being more difficult and time consuming to achieve. Weeds, for instance, had a tendency to prevail despite obvious effort by the concessionaire to remove them. Whilst other studies have honed in on the relationship between condition type and compliance (Bailey et al., 1992; Matthews & Endress, 2008; Quigley & Harper, 2006), none of these have focused on administrative versus non-administrative conditions.

Based on the Fisher's exact test, applicant type, activity type, and conservation land category had no significant effect on compliance. As explained in Section 3.5, however, the variations observed are still worth expanding on.

Public organisations and companies were found to comply about 10% more than individuals and private organisations and companies. This matches observations made by Dasgupta et al. (2000) and by Brown (2014), who also found compliance rates to be higher for public organisations and companies. Dasgupta et al. (2000) explain that this might be due to the effect of public scrutiny. In their study they found that publically traded Mexican firms and larger firms were more likely to adopt policies which would improve their environmental performance than smaller, privately held firms. The findings of Hornyak and Halvorsen (2003) contradict this. They found that the county road agency in Michigan, US (a 'public organisation' with a significant degree of interaction with the regulator) was less likely to comply with requirements (44%) than permittees that were part of the general public (either 'private companies' or 'private individuals'), whom had compliance levels of 60%. Nevertheless, the lack of a statistically significant relationship between compliance and applicant type in this study contrasts with previous studies (Brown et al., 2013; Dasgupta et al., 2000; Hornyak & Halvorsen, 2003; Shimshack, 2007).

In terms of activity type, compliance rates were considerably lower with conditions related to grazing concessions (40%) as opposed to structural (88%) and telecommunications (86%) concessions. This lower rate of compliance with compensatory conditions from grazing concessions can be compared to the results of Brown (2014) who also found that, for ecological compensation conditions under the RMA, agricultural consent conditions were the least complied with. Compliance with agricultural consent conditions under the RMA, however, was only 4.8% whereas for grazing concession conditions under the Conservation Act it was 40%. Further research is required into reasons why such a difference exists. In terms of variations in this study, the lower rates of compliance with compensatory conditions from grazing concessions and access concessions seem to relate to their condition goals. For grazing concessions, the compensatory conditions all involved weed and/or pest control. This condition goal was earlier described as complex to implement, monitor and enforce. For access concessions, the two compensatory conditions which were not complied with at all involved compensation payments, and these were not paid due to a lack of intra-departmental communication (see Section 5.1).

A trend was discovered in compliance with conservation land category. Compliance on category 1 conservation land (most protected) was 100% and compliance on category 4 conservation land (least protected) was 40%. This trend in increasing compliance with increasing legal protection reflects the predictions of Neyer and Zurn (2001). The Fisher's exact test, however, suggests that the trend is statistically insignificant. An observation of note is that all grazing concessions assessed in this study are on category 4 conservation land. The reasons for which compliance was low with grazing concession compensatory conditions thus also apply to conditions relevant to category 4 conservation land.

5.3 Predictors of Compliance

18 variables were hypothesised to predict expected rates of compliance. These variables were part of the concession process, the concession document itself and social circumstances surrounding the concession (see Section 3.4). Of these 18 variables, 14 were able to be assessed. The other four were left out of the analysis due to insufficient information. Of the 14, one variable significantly correlated with compliance. This variable was compensation duration. The data shows that one-off compensation conditions are more likely to be complied with than conditions which require ongoing intervention and maintenance. This may be because ongoing compensation conditions, such as weed and/or pest control, tend to be more complex and resource intensive to monitor and enforce. According to (Brown, 2014), one-off conditions were also significantly more likely to be complied with than ongoing conditions under the RMA.

It is somewhat surprising that none of the other variables had any significant correlation with compliance. Having a professional ecologist involved, for instance, is often considered to benefit the design and implementation of any conservation measures, including compensation (Binning, 2000; Denny, 2011). However, this variable had no significant impact on compliance. This might be because the professional ecologist was not always retained throughout the implementation of the compensation measure. Observations do show that compliance was about 12% higher when a professional ecologist was involved. Considering the statistical limitations of the dataset this trend would be worth further investigation.

Whether a concession was notified or not, also did not have a significant effect on compliance. This is despite compliance results being 28% higher for compensatory conditions from notified concessions versus non-notified. These results defy what was expected, which was that the increased public participation and scrutiny involved with notified concessions might lead to significantly higher rates of compliance. The observational trend in the data however matches what Brown (2014) found, except that for Brown (2014) the trend was statistically significant.

The presence of a bond was expected to enhance compliance. This is because a bond acts as an insurance measure, where, to get the bond back, a concession holder has a vested interest in complying with the conditions of their concession. Compliance was observed to be 10% greater in the presence of a bond; however, this difference was calculated as statistically insignificant. Reasons for why there was no significant relationship found between compliance and the presence of a bond might be because the bonds were either set too low or potentially the bonds themselves had not yet been paid. In this study the size of a compliance bond was relatively small, ranging from $1,000 to $100,000. The utilisation of bonds was also low. Only six concessions in this study included a requirement for a bond. Whilst bonds were not shown to significantly predict compliance, further research into improving the effectiveness of bonds is recommended as bonds present a simple form of insurance.

The presence of monitoring requirements within a concession contract did not correlate significantly with compliance. This is despite widespread research which emphasises the importance of monitoring in improving compliance (Bekessy et al., 2010; Brownlie & Botha, 2009; Earnhart, 2004; Maron et al., 2012; Quétier & Lavorel, 2011; Shimshack, 2007; Tonkin and Taylor, 2012). The observations in this study actually show compliance to be lower in the presence of monitoring requirements. An explanation for this is that, a requirement for monitoring does not necessarily narrate the extent and effectiveness of the monitoring. For example, in many cases in this research, requirements for monitoring were not met. Section 5.1 expands further on how inconsistencies in monitoring might actually be inhibiting compliance.

Compliance with biodiversity compensation conditions was observed to be 30% higher when concessionaires had other pending concession applications and/or renewals. This was expected as a consequence of concessionaires having a vested interest in regulatory goodwill. When cases received frequent visits from DOC staff compliance was also observed to be higher. Again, this was expected as frequent exposure to regulatory agents has been proven to increase the compliance of regulated entities (Friesen, 2003; Shimshack, 2007). In both cases, however, the Fisher's exact test came up with a statistically insignificant result. This may be due to the statistical limitations of the dataset, or because there are other factors contributing to compliance, such as those observed and described in Section 5.1.

A final variable worth expanding on is the timing of the compensation action. Biodiversity compensation is heavily critiqued for issues with time equivalency, with the timing of a compensation action seen as a critical determinant of success (Bekessy et al., 2010; Gibbons & Lindenmayer, 2007; Maron et al., 2012; Walker et al., 2009). The literature tends to support compensation actions which take place prior to a project taking place, as in this way the benefits of the compensatory action(s) are demonstrated in advance (Maron et al., 2012; McKenney & Kiesecker, 2010). In New Zealand, however, these advance mitigation programs are not supported under current policy frameworks (i.e. species banking and compensation credits). Brown (2014) found that, under the RMA the likelihood of compliance was significantly higher when compensatory actions were required before or concurrent with the consented activity. In this study, no significant effect was found but compensatory actions required following the activity were observed to be complied with the most.

5.4 Assumptions and Limitations

A major challenge for this research has been the lack of explicit treatment of biodiversity compensation in law and policy in New Zealand. This was evident in DOC's lack of knowledge around what biodiversity compensation is and how it has been applied on public conservation land under the Conservation Act. Without a clear definition and framework for how compensation measures are being considered and implemented under the Conservation Act, this study had to establish a definition as well as a broad approach to defining what is, or is not, compensation. These assumptions were justified through the data collection process, as concessions were not consistently documented or defined as including biodiversity compensation and no standard recording system exists in which concessions requiring compensatory actions are kept separately.

A research design limitation is that the study focused only on case studies from the South Island of New Zealand and only on a sample of 28 conditions. This limitation is a result of time and budget constraints. Whilst it would be ideal to have a larger sample, particularly for statistical reasons, as well as to have a sample representative of the entire country, this proved neither realistic nor feasible. The assumption was that each concession case study would include several biodiversity compensation conditions and that, as these conditions form the actual sample size, this would create a sample large enough for effective statistical analysis. In the end, however, the study involved a total of only 28 relevant conditions. This sample size was large enough to assess the statistical significance of some variables, but limited when it came to variables with multiple categories (e.g. habitat type). The Fisher's exact test was chosen over other statistical tests in order to deal with this limited sample size.

The Fisher's exact test comes with a number of assumptions and limitations. Section 3.5 explains these in detail and the extent to which they affect the dataset used in this study. Whilst the Fisher's exact test was weighted as the best option for this study, its limitations, and the limitations of a small dataset must be kept in mind. As such, the statistical results of this study are indicative only and some emphasis has been shifted onto the qualitative observations instead. A future study, using the same dataset, would perhaps be better off undergoing a purely qualitative analysis.

This study relied heavily on access to information. Case study files were provided by DOC and DOC staff were relied upon to provide additional information and knowledge. Assessments of compliance involved to a large degree a reliance on the information provided by DOC. This is a perceived limitation as the study assumes that all the information provided is both complete and accurate. To counter this limitation, field assessments were undertaken where possible (for 11 of the 28 conditions), allowing for result triangulation and therefore a more robust assessment of compliance. Interviews with concessionaires would have strengthened the robustness and depth of this study, however, they were not able to be carried out due to time constraints.

A further limitation is in regards to sample representativeness. DOC's concessions database holds several thousand concessions from all over the country. Whilst access was given to this database it was not possible to identify a sample of concessions in which each variable under investigation was equally represented. This was not only due to the number of variables under investigation but also due to the limitations of the concessions database. For instance, the database only has a narrow range of search options available and searching for biodiversity compensation was not one of these. Individual concession documents were also difficult and time consuming to search through as they were stored as image only *pdf's*.

In terms of the assessment of compliance, whilst considerable effort was made to ensure compliance scores were accurate and a reflection of multiple sources of information, compliance scores are to a degree subjective. For instance, the amount of blackberry and gorse present on an easement, where the concessionaire is obliged to remove all weeds, could qualify for any score along the compliance scale depending on the assessor's leniency. The approach here was simply one that aimed for consistency.

5.5 Summary

The ratio of compliance to non-compliance found in this study, was similar to what was found by Brown (2014) for ecological compensation under the RMA. This means that compliance with compensatory requirements is comparable on public and private land in New Zealand. This was unexpected, as it was thought compliance on public land would be higher as a result of public scrutiny (Dasgupta et al., 2000) and the strict, conservation focused, provisions of the Conservation Act.

In comparison to some overseas studies (Bailey et al., 1992; Harper & Quigley, 2005; Veneman & Brown, 2001), compliance was found to be a great deal higher in this study. Compliance was found to vary significantly with habitat type and suggestively with condition type. These outcomes reflect findings from the literature, confirming what was expected. The small sample size, however, has greatly limited statistical conclusions. As such, more emphasis has been placed on the observational trends. Compliance, for instance, was found to be considerably higher with conditions from structural concessions as opposed to from grazing concessions. This finding interlinks with the variable “condition type”, as grazing concession condition types were all non-administrative, and these were complied with less than administrative conditions. It also interlinks with the low level of compliance for conservation land category 4, as all concessions relating to this land are grazing concessions. Furthermore, it interlinks with the Low and High Producing Exotic Grassland habitat types as this is typically where grazing occurs. Evidently, all variables are all interlinked and it is the qualitative observations which have proven most useful.

Several trends were observed between compliance and variables which formed part of the concession process, the concession itself, and social circumstances surrounding the concession. These trends frequently matched what was expected from within the literature (Binning, 2000; Brown, 2014; Shimshack, 2007). Compliance, for instance, was higher in the presence of a bond, for notified concessions, and for concessions where the concessionaire had pending concession applications and/or renewals. Only one predictor variable, “compensation duration,” exhibited a statistically significant relationship with compliance. One-off conditions were more likely to be complied with then ongoing conditions. This was likely a result of ongoing conditions being more complex and resource intensive to monitor and enforce. Whilst this indicates where efforts should be focused in order to enhance compliance, it does not suggest that ongoing conditions should stop being utilised, as they might well be a more suitable form of compensation.

Several other qualitative factors, which extended beyond the variables quantified, were noted during the research process as potential inhibitors of compliance. These include: an inconsistent approach to compliance monitoring and enforcement, an inconsistent approach to compliance reporting and data management, deficiencies in intra-department communication, tolerance, a lack of resourcing, and the level of priority compliance monitoring and enforcement is granted. These have all also been expressed within the literature as reasons for poor compliance (Matthews & Endress, 2008; Rega, 2013; Tonkin and Taylor, 2012).

Chapter 6
Conclusions and Implications

This research has provided the first insight into the use of, and compliance with, biodiversity compensation under the Conservation Act in New Zealand. Whilst there is no explicit policy guidance for the use of biodiversity compensation as a tool under the Conservation Act, this study has found that compensation measures are being considered and implemented, mostly on a case-by-case basis. The results of this study show that approximately two-thirds of biodiversity compensation conditions are complied with. This rate of compliance is similar to the rate of compliance with ecological compensation conditions under the RMA (Brown, 2014), and a considerable improvement on various overseas studies (Bailey et al., 1992; Harper & Quigley, 2005; Hornyak & Halvorsen, 2003; Veneman & Brown, 2001).

The literature suggests that rates of compliance vary across different condition types, activity types, applicant types, habitat types, and conservation land category types (Brown et al., 2013; Matthews & Endress, 2008; Neyer & Zurn, 2001; Quigley & Harper, 2006; Shimshack, 2007). This study used a mixture of spatial, archival, and field ecology methods, as well as the Fisher's exact test, to determine if this was the case for compensatory conditions under the Conservation Act. Whilst the statistical results of this study did not reveal significant variations, observation trends in the data did. These observations have been granted more weight as a consequence of the limited size and statistical relevance of the dataset. An analysis of the effect of variables within the concession process, the concession document, and social circumstances surrounding the concession, also resulted in some interesting variations in compliance. Compliance, for instance, was significantly influenced by the duration of the compensatory action. These findings provide regulatory agencies with a deeper understanding of the nature of compliance, and how instances of non-compliance could be addressed. In addition to these findings, several institutional factors were observed to be inhibiting compliance. These factors include inconsistencies in compliance monitoring and reporting and the low level of priority afforded to compliance monitoring. The presence of these factors correlates with international findings (Bull, Suttle, Gordon, et al., 2013; Ferraro & Pattanayak, 2006; Tonkin and Taylor, 2012) and emphasises the need for a stronger approach.

The ultimate question this research poses is whether two-thirds compliance with biodiversity compensation concession conditions on New Zealand's conservation estate is good enough. Non-compliance, or "broken promises," result in uncertain biodiversity outcomes. These are often at the expense of net losses in biodiversity as a result of the concession activity for which permission was granted. The intended "win-win," where both concessionaires and biodiversity benefit (Kiesecker et al., 2010; Ten Kate et al., 2004), turns into a win-lose, where biodiversity ultimately loses.

Throughout this research the focus has been on compliance with biodiversity compensation conditions. However, out of the concessions searched, only around 15% included compensatory conditions. There are many concessions where an argument could be made for the inclusion of such measures. For those concessions which had a large ecological footprint, but did not utilise compensation measures, losses to biodiversity are less forgivable. Consequently, this study recommends the formalisation of biodiversity compensation under the Conservation Act, and a review of how it is, and can be, appropriately utilised.

6.1 Formalising Biodiversity Compensation

This research has struggled with the lack of explicit treatment of biodiversity compensation within law and policy in New Zealand. Biodiversity compensation measures are increasingly being considered as part of concession applications (Salmon, 2013), yet they are not being implemented and evaluated in a robust, consistent manner. Biodiversity compensation has the potential to contribute significantly towards biodiversity conservation and enhancement, yet the *ad hoc* use of biodiversity compensation appears to be constraining its potential. Formalising biodiversity compensation would have the effect of strengthening controls on its use and ensuring all forms of compensation are implemented robustly. It would also greatly enhance the capacity for compliance and outcome monitoring. Furthermore, the formalisation process would further present an opportunity to outline measurable goals for the use of compensatory measures (Bekessy et al., 2010; Memon et al., 2004) as well as evaluative tools for ensuring their ecological success.

Whilst some policy development within this area is occurring (Department of Conservation, 2014b; Ministry for the Environment, 2011), the focus has always been on biodiversity offsets, which are just one form of compensation. In order for biodiversity conservation goals to really be advanced through compensation, the stricter goals of offsetting (e.g. no net loss) should be legislated for, and applied to all occurrences of biodiversity compensation. To support the appropriate use of biodiversity compensation this research thus suggests:

- A formalised approach, including clear goals and guidelines, for the use of biodiversity compensation under the Conservation Act;
- Wider consideration of compensatory measures as a way of recompensing the residual, unavoidable impacts of concession activities and of negating the cumulative impacts of development and resource use on publically owned land and biodiversity;

- Staff training for DOC and DOC contractors in the appropriate use of, and monitoring of, biodiversity compensation measures.

6.2 Compliance Monitoring and Enforcement

This research found that compliance with biodiversity compensation requirements is monitored and enforced inconsistently. The responsibility for monitoring fell on numerous parties, and it was often not clear who was responsible or whether any monitoring had been carried out at all. The level of monitoring also varied markedly. Whilst DOC is known to carry out extensive monitoring of specific programmes and projects (State Services Commission et al., 2010), systematic compliance monitoring seems to be of low priority.

Rigorous monitoring and enforcement is the only way to ensure that the residual effects of a concession activity on biodiversity have been adequately compensated for (Bull, Suttle, Gordon, et al., 2013). This would be possible with a clear monitoring and enforcement strategy, something which DOC does not yet appear to have. Whilst this study has looked at compliance with biodiversity compensation requirements, a more thorough, nation-wide investigation into compliance monitoring and enforcement is suggested. Such a study would provide the opportunity for learning and adaptive management. Based on findings from this research and relevant literature (Matthews & Endress, 2008; Rega, 2013; Tonkin and Taylor, 2012), the following recommendations are put forward:

- A coordinated and systematic compliance monitoring and enforcement strategy;
- Guidelines for implementing the above;
- Training in the field of biodiversity compensation compliance and outcome monitoring;
- Prioritisation of monitoring and enforcement under the Conservation Act; and
- Resources and funds directed at compliance monitoring and enforcement; alternatively, research into creative solutions aimed at maximising compliance within limited resources (see Section 5.1).

6.3 Compliance Reporting

During the course of this study, inconsistencies in compliance reporting and data management were observed. Records of compliance were found to differ widely in their detail; some entailed comprehensive site inspection reports and others a single sentence in an email. In several cases there was no record at all of any compliance monitoring. The system for data management also left room for improvement. It is possible that this system might already be undergoing improvement, however, with thousands of concessions nationwide progress would no doubt be slow.

With regards to the RMA, a nationwide monitoring and reporting system has recently been established (Ministry for the Environment, 2015). Prior to this, compliance monitoring was reported on via a biannual RMA survey of local authorities (Ministry for the Environment, 2015). Whilst this reporting system does not specifically record compliance with compensatory conditions, no similar reporting system exists at all for the Conservation Act. The creation of such a reporting system would inform the public about what is happening on the public conservation estate and whether concessionaires are meeting requirements laid out under the Conservation Act and any other relevant legislation. Ideally such a reporting system would include a section on compliance with compensatory conditions, to enable DOC and the public to assess whether appropriate exchanges are being made. Observations from this research support the following recommendations:

- Research into a nationwide reporting system or survey of compliance under the Conservation Act; and
- A consistent approach to compliance reporting and data management.
- A recording mechanism for concessions which include biodiversity compensation.

6.4 Further Research

This research was only able to look at a small sample of biodiversity compensation conditions and these were limited to active concessions of particular activity types on New Zealand's South Island. These limitations have constrained the findings of this research. The implication of this is that there is still room for a broader nation-wide study, and/or a study which involves a larger sample size of compensatory conditions. Several variables, which were investigated during the course of this research and which had a statistically insignificant yet observable correlation with compliance, would benefit from such further analysis.

This research has paralleled Part 1 of the research undertaken by Brown (2014). To facilitate an even greater cross-policy comparison Part 2 and 3 of Brown (2014), which looked at the implementation of, and stakeholder perspectives on, ecological compensation under the RMA, should also be repeated under the Conservation Act. Such a comparison would highlight what social, cultural, and institutional dynamics lead to better biodiversity outcomes and improved compliance.

This research has focused on compliance with biodiversity compensation measures, however, compliance is not necessarily the same thing as ecological success (Bull, Suttle, Gordon, et al., 2013;

Matthews & Endress, 2008; Quintero & Mathur, 2011). The focus on “compliance” in this study was because compliance is much easier to measure. Measuring the outcome of a biodiversity compensation measure (whether the measure sufficiently compensated for the losses to biodiversity) is much more complex (Bull, Suttle, Gordon, et al., 2013). Research on this topic, however, is essential. Such research would establish the extent to which biodiversity compensation measures actually benefit biodiversity and whether appropriate exchanges are occurring (Breaux et al., 2005; Brown, 2014).

In addition, more research is required on the appropriate design of biodiversity compensation and offset measures. The concept is still riddled with complications which are undermining its use as a tool to prevent biodiversity decline. Social drivers, for instance, which cause compensation measures to be unfair for biodiversity require detailed investigation. In New Zealand, more research is also required into understanding what “no-net-loss” actually means at a site and landscape scale against regional and national biodiversity protection objectives. Research into accounting for time-lags between biodiversity losses and gains, into comparing projects with different time profiles (e.g. short term pest control as compensation for the loss of virgin forest), and into the appropriate use of out-of-kind offsets and compensation measures is also required. In terms of application, no research has yet been done looking into the use of biodiversity compensation under the Crown Minerals Act. The use of biodiversity compensation measures in the marine environment has also never been evaluated.

There is a plethora of research which could follow on from this study. The ideas mentioned here do not represent an exhaustive list. Whilst this research has provided new insight, it has also demonstrated that significant improvements are required if biodiversity compensation is to help mitigate the biodiversity crisis unfolding in New Zealand today.

Appendix A

Field Assessment Sheet

<table>
<tr><th colspan="4">Field visit – Compliance Assessment</th></tr>
<tr><td>Concession number:</td><td colspan="3" rowspan="5">Site address:</td></tr>
<tr><td>Condition number(s):</td></tr>
<tr><td>Date:</td></tr>
<tr><td>Time:</td></tr>
<tr><td>GPS/ map reference:</td></tr>
<tr><td>Concessionaire supervision?</td><td>Y</td><td colspan="2">N</td></tr>
<tr><td colspan="4">Concessionaire contact details:</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td>Activity type:</td><td colspan="3">Habitat Type:</td></tr>
<tr><td>Visitations by general public:</td><td>Low</td><td>Medium</td><td>High</td></tr>
<tr><td colspan="4">Activity description:</td></tr>
<tr><td colspan="4">Site description:</td></tr>
<tr><td>Compliance scale</td><td colspan="3">Description</td></tr>
<tr><td>0 – No compliance</td><td colspan="3">No level of compliance apparent with the stated condition</td></tr>
<tr><td>1 – Low level of compliance</td><td colspan="3">Minor or insignificant achievement of compliance</td></tr>
<tr><td>2 – Medium level of compliance</td><td colspan="3">Significant level of compliance with the stated condition, but falls short of full compliance</td></tr>
<tr><td>3 – Satisfactory compliance</td><td colspan="3">Acceptable compliance that is within a practical margin of error and minor flexibility</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td>Condition number:</td><td colspan="3">Condition text:</td></tr>
</table>

Compliance score:	Notes:
Condition number:	Condition text:
Compliance score:	Notes:
Condition number:	Condition text:
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Condition number:	Condition text:
Compliance score:	Notes:

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