

Kiwis Counting Kiwis:

Biodiversity Monitoring On Private Land In New Zealand

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Executive Summary

This thesis seeks to determine what monitoring will measure the effectiveness of public funding for the protection and enhancement of biodiversity on private land in New Zealand. To establish this, four questions have been asked:

Is monitoring of biodiversity change on private land a requirement to provide information for biodiversity status reports? With biodiversity loss such a critical world issue, New Zealand has committed to its protection along with many other nations. The country's obligations and strategies for protecting, monitoring and reporting biodiversity change on private land are provided. Current reporting practices are critiqued and conclude that key data are not being collected and that private land is not well covered. As a result, biodiversity reports include very little biodiversity outcome data from private land.

Are there are a core group of biodiversity monitoring methods suitable for landowners to measure the success of their conservation actions and to measure improvements to biodiversity on their land? 19 landowners and monitors who are engaged in conservation work and biodiversity outcome monitoring on private land have been interviewed in 12 case studies. These landowners and monitors are using 31 different monitoring methods. The methods have been assessed to see how landowners use the data and assessed against a set of criteria to determine their suitability. A core group of nine biodiversity monitoring methods emerge as the most useful in these cases.

Do agencies which fund biodiversity protection and enhancement on private land need to measure the success of their funding initiatives? 18 agencies have given funds to these 12 case studies to support the conservation of some of the country's most threatened and endangered species, ecosystems and habitats that are found on their land. Results show that few quantitative indicators are used to measure improvements to biodiversity which may result from these grants. This research suggests ways for agencies which fund biodiversity protection on private land to

measure the success of their funding initiatives so the effectiveness of these funds can be assessed.

What biodiversity information do landowners need in order to make decisions about management on their land and to inform agencies which have funded biodiversity conservation on their land? The monitoring methods in use by landowners are considered in terms of their suitability to inform land management decisions and to inform funding agencies of the outcomes of the funds. This leads to a recommended core group of methods that can meet the needs of both parties.

The research found that monitoring is as much a social event as a scientific exercise. Landowners found the social resources they needed to support their monitoring included having others to work with, having others to talk to like mentors, financial support, getting rewards from their monitoring results and gaining confidence to give it a go. All landowners and monitors identified barriers to monitoring they had to overcome, and these are discussed.

This thesis recommends a list of core monitoring methods that are suitable for landowners to measure progress towards their biodiversity goals, improvements to biodiversity and can assist with land management decisions. They can also be used by funding agencies to judge the effectiveness of their funding towards the protection and enhancement of biodiversity on private land in New Zealand. This investigation highlights eight issues with funding goals, biodiversity monitoring and reporting on private land and provides 17 recommendations to address the issues.

With 70% of New Zealand in private ownership, it is vital that landowners understand how their land contributes to the survival of native vegetation, habitats, ecosystems, species and their genes, which live on their land. The landowners in these 12 cases understand. They undertake conservation work and biodiversity monitoring, which demonstrates that landowners could provide information and evidence to measure the effectiveness of public funding for biodiversity protection on their land. These kiwi landowners are counting kiwis, and other biodiversity indicators, to measure the effect of their conservation work and its impact on restoring New Zealand's unique flora and fauna.

Dedication

To my miel. Thanks for staying sweet when I was not. Your support has meant the world to me.

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Thank you to all the landowners, monitors, funding agency staff and other professionals who took time to talk and to share with me your knowledge, dreams and passion for New Zealand's nature. I so appreciate all the work you are doing and that you are taking the time to measure your success as well.

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Chapter 1 - Introduction

I am blessed to be a citizen of Aotearoa - New Zealand. I grew up playing on white sandy beaches, and swimming in the dumpy waves of the East Coast. I rode horses in paddocks down the road, and kayaked in isolated rivers from source to sea. I sat quietly beside rivers to watch whio, and waited below towering rimu to see kaka at their nest. I climbed mountains and saw below me turquoise lakes and emerald forests. I have been under the earth in the sparkling wonderland of marble caves and under the sea to collect paua. I have seen the sun rise over the Pacific and the moon set over the Tasman. These are memorable, wondrous experiences, ones I do not take for granted. I know I am a very lucky woman.

This thesis is about these blessings, about taking notice and care of the landscapes and biodiversity that makes this country so great. It is about paying attention to the forests, beaches, tussock lands, rivers, sea, flora and fauna. It is about monitoring as a way to focus on and investigate the health and status of the ecosystems, species and genes around us, encouraging observation of our world, and inviting action to make changes for the better.

This introduction presents the philosophy behind my research and its goal. It describes my research questions, the purpose of indicators and monitoring, types of monitoring, and explains the focus of this research.

1. Research goal

The research goal is to establish what monitoring will measure the effectiveness of public funding for the protection and enhancement of biodiversity on private land in New Zealand.

Interest in this topic arose from multiple sources and life experiences:

- Working in local government administrating an incentive programme which aimed to improve local biodiversity. However, no quantitative monitoring

was undertaken to measure the outcomes of the programme.

- Wanting to justify increased government spending on biodiversity protection.
- Reading the five year review of the New Zealand Biodiversity Strategy, which reported its achievements and shortcomings. Being able to report on tangible successes was highlighted as a shortcoming.
- Owning a piece of bush and not knowing how ‘healthy’ it is. Is it another piece of New Zealand cared for with benign neglect?
- The need to have solid facts about biodiversity on private land to build awareness of biodiversity issues amongst the general public.
- A strong interest in the ‘mainland island’ approach to biodiversity conservation that is occurring in New Zealand, including on private land.
- Believing in the benefits of a grass roots approach to sustainable management and development. This requires empowering landowners to make informed decisions. Monitoring by landowners is one way to provide this information.

2. Research Questions

In order to achieve the research goal, four research questions have been posed and have been answered primarily in specific chapters as referenced in Table 1.

Table 1: Research questions and their location

	Research question	Chapter
1	Do agencies which fund biodiversity protection and enhancement on private land need to measure the success of their funding	7
2	Is monitoring of biodiversity change on private land a requirement to provide information for biodiversity status reports?	4
3	Are there are a core group of biodiversity monitoring methods suitable for landowners to measure the success of their conservation actions and to measure improvements to biodiversity on their land?	6
4	What biodiversity information do landowners need in order to make decisions about management on their land and to inform agencies which have funded biodiversity conservation on their land?	6

3. The purpose of monitoring

Monitoring is a way of measuring a system or state to observe and measure changes over time, using an indicator or measuring device. Indicators are a way of reducing the complexity of an ecological system into a simpler form, to make a complex system more easily understood and communicated (Kurtz *et al.*, 2001).

The United States National Academy of Sciences (2000, p. 1) summed up the purpose of indicators and monitoring by saying:

“Developing indicators and monitoring them over time can help to determine whether problems are developing, whether any action is desirable or necessary, what action might yield the best results, and how successful past actions have been. To develop and implement sound environmental policies, data are needed that capture the essence of the dynamics of environmental systems and changes in their functioning”.

According to Lynch (2004) the purpose of monitoring is to answer the question:

What management action will this information inform or change? In other words, monitoring provides information about a current management action, or lack of action. In the context of this thesis, a monitoring programme can answer the question: “is my current conservation practice effective, or do I need to change it?”

Lee *et al.*, (2005, p. 75) identifies three separate monitoring purposes:

1. *Monitoring for changes in ecological status and integrity.* Here the question is: Are things changing and to what extent? It provides the bulk of the figures and indices for state of the environment reporting and policy development.
2. *Monitoring for management action.* This sort of monitoring answers questions such as: When should we intervene? What might we need to do? Have we been successful? How can we do better? When aggregated and assessed, these data provide basic information for audit purposes.
3. *Monitoring for fundamental understanding.* This type of monitoring attempts to answer the questions: What is going on? How can we predict the future? Can we apply this knowledge to biodiversity management? It is focused on multiple or generalised objectives and often the collection of long time-series data.

Monitoring is important to:

- Measure achievement and impact as a project progresses.
- Evaluate learning, practice adaptive management and practice learning by doing.
- Report on progress and results to members, funders and the wider community and supporters. Describing the benefits is important to maintain support for conservation projects.
- Demonstrate returns and accountability for the funds invested in conservation projects.

- Demonstrate and describe real and tangible benefits that result from the efforts of conservation workers.
- Track progress over time, as many conservation projects will take many years to achieve the desired outcomes and goals. (Handford, 2006, p. 3)

An essential first step of the monitoring process is to establish a clear monitoring question and, therefore, the purpose of monitoring. A monitoring question needs to be short and specific, relevant to the management situation and to have an end use. If the question can be answered by other information then use it. Don't try to prove the obvious with monitoring (Lynch, 2004).

4. Types of monitoring

In addition to the various purposes monitoring can be used for, there is an array of types of monitoring. Short definitions of different types are given here from Lee *et al.* (2005, p. 76):

- Inventory monitoring – the goal is a comprehensive documentation of the elements and complete coverage of the area. No particular re-measurement time frame is given. Includes rapid assessments and casual surveys.
- Status and trend monitoring – regular re-measuring of elements is intended from the outset. Plots are often used, but not essential. The target may be an organism, or a range of ecological elements.
- Surveillance monitoring – is focused on a few organisms or processes where the problem is well understood and the threat is immediate. It is based on specialised survey techniques to detect presence. Routine biosecurity surveillance is an example.
- Management monitoring – can be divided into two categories:
 - Pre-intervention – is made up of 'trigger' and 'assessment' monitoring, to detect and assess a pressure or problem. Trigger monitoring determines if intervention is necessary and assessment monitoring quantifies the success of the intervention.

- Post-intervention – is ‘action’ and ‘outcome’ monitoring. Action monitoring assesses the success of the management action in reducing the pressure or altering the immediate situation. This is also called ‘result’ monitoring. Outcome monitoring assesses the improvements to biodiversity as a result of the action taken.
- Research monitoring – is often an intensive, multi-dimensional, long term research programme. All long-term ecological research involves careful investigations, usually at sites chosen to provide unambiguous results.

5. Monitoring constraints

Some of the constraints faced by monitoring, (especially management monitoring, which is one of the focuses of this research), are funding, expertise, timing and political processes (Lee *et al.*, 2005). Funding is often not available for monitoring, as it is not seen as an important project cost. Expertise is needed to formulate effective monitoring questions and methods to provide answers. Timing is often a constraint when decisions have to be made based on results, which often have political implications and pressures. Because of these pressures there is often a trade off between quick and simple monitoring and effective monitoring. The result of this trade off is often ambiguous results that solve or prove nothing (Lee *et al.*, 2005).

6. The focus of this research

In this research, the focus is on a group of landowners who are not only protecting biodiversity on their land, they have received public funds to assist them in this work, and they are monitoring their results. Therefore, they are excellent case study examples to explore the four research questions.

As an example; a landowner has robins (*Petroica australis*) on her property and she wants the population to survive and grow. She has just initiated a pest control programme on her property, and received public funds to help with the set up costs.

The pest control aims to reduce possum numbers to a 5% residual trap catch¹ and rats to a 5% tracking tunnel index² by the first of November each year. The landowner can measure the success of her pest control goal and monitor her management action by monitoring possum numbers with leg hold traps and rat numbers with tracking tunnels before the first of November. She can also monitor robin nests over a few seasons to see if the population goal of stability or growth is being achieved. If it has, she can decide to continue with the current management, as it has achieved the desired target. If the robin population or pest control targets have not been reached, she now knows a change is needed. It could be the current pest control plan is inadequate or there may be other factors that need investigating. She can make an informed decision about changing the management action to try and achieve the goal next year. The monitoring results can also be passed to the funding agency that has supported this work, to let them know the biodiversity gains that the funds have helped to achieve.

In another example, a landowner with a stream wants to know he has a healthy stream habitat. He hears about the Stream Health Monitoring and Assessment Kit (SHMAK) (Biggs *et al.*, 2002) from his local Federated Farmers meeting and decides that a 'good' rating according to SHMAK will equate to his goal of a healthy stream habitat. After completing his stream health assessment he finds he does not achieve a 'good' score because the stream water temperature is too high, conductivity is too high and he has low diversity of fresh water invertebrate species sensitive to polluted water. He makes decisions about his land management based on his results; to reduce the water temperature of his stream and reduce the nutrients entering his stream, with the aim that his stream health will improve. By carrying out his management action, such as fencing off the riparian margin and planting native trees, and repeating the same monitoring each year, he can see if his land management practices are moving him towards his goal of a 'good' SHMAK rating and hence a healthy stream. Data from landowners such as this could be combined by an agency

¹ Residual trap catch is an index of possum abundance computed as the percentage of traps that have caught a possum, or have been sprung, but have not caught a possum.

² Tracking tunnel index is the proportion of tracking tunnels containing rodent foot prints to provide an index of rodent abundance

that is supporting stream restoration such as Federated Farmers, to produce national reports on the outcomes.

The landowners in these case studies are role models for the country. They have bridged the gap between policy and practice. They have put into action best practice conservation on their land. This research is looking at ways to measure that success to enable effective reporting of progress on halting biodiversity loss and to encourage more landowner participation.

Chapter 2 - Biodiversity Loss in New Zealand

1. Biodiversity on Planet Earth

Humans have had a huge impact on biodiversity on a global scale. Habitat loss and degradation, introduced invasive species, environmental pollution, the spread of diseases and unsustainable use of species and ecosystems are key causes (MfE, 2000b; Smith, 1998; Spray & McGlothlin, 2003).

Many reports stress that biodiversity is essential for maintaining life on Earth, and recognise that preserving biodiversity is the basis for sustainable development (Hooper *et al.*, 2005; Millennium Ecosystem Assessment, 2005; UNEP, 1992; Young *et al.*, 1996). These documents outline the threats imposed by human activity to ecosystems, ecosystem services, functions and goods, species and genetic diversity.

Some of the special features of biodiversity management that make it different to other forms of resource management include the fact that any loss of a species is irreversible. Species and their genes cannot be replaced, many species have not even been discovered yet, let alone named or understood, so species can be lost to humanity before they are even known. Ecosystems are easily degraded and lost. They can collapse once the stresses from environmental degradation become too great and can become resistant to restoration, despite our best efforts (Suding *et al.*, 2004).

The paradox is that most biodiversity has little perceived economic value, yet it is essential to human life. Many species and ecosystems now require active, positive and usually very expensive ongoing management to survive as so many species and sites are on the threshold of collapse (Diamond, 2005; Millennium Ecosystem Assessment, 2005; Wilson, 1992). The situation for indigenous biodiversity in New Zealand is no different to the rest of the world.

2. Indigenous Biodiversity Loss in New Zealand

An assessment of the state of indigenous biodiversity outside crown conservation lands in New Zealand for the preparation of the proposed National Policy Statement on Biodiversity concluded that indigenous biodiversity was in crisis or seriously threatened on private land (Davis, 2002). The decline of New Zealand's indigenous biodiversity was described as the country's most pervasive environmental issue back in 1997 (MfE, 1997). The two main causes of biodiversity decline were identified as introduced pests and habitat loss in 2000 (DoC & MfE, 2000).

New Zealand developed in isolation from other land masses and the flora and fauna became highly endemic (Binning, 2000; MfE, 2000b). The New Zealand Biodiversity Strategy (NZBS) says that in the last 750 years humans and introduced pests have made extinct at least 12 invertebrates, 3 frogs, 32% of indigenous terrestrial birds, and 18% of sea birds. Over 2,500 native land-based and fresh water species in New Zealand are listed as threatened (MfE, 2007)

New Zealand has a very high rate of publicly protected land with around 32% in the 'conservation estate'. That still leaves almost 70 % of New Zealand in private ownership. Private landowner involvement in biodiversity protection is therefore critical if we are to reverse the decline of indigenous biodiversity (DoC & MfE, 2000).

2.1. Animal and Plant Pests

The largest single threat to our remaining indigenous biodiversity and ecosystems are introduced invasive pests (Craig *et al.*, 2000; DoC & MfE, 2000; Veitch & Clout, 2002). Mammalian predation is the key limiting factor of small or declining populations in New Zealand (Innes *et al.*, 2007)

Introduced animal and plant pests prey on and compete with native species. They spread disease, hybridise with native species and disrupt entire ecosystems (Mack *et al.*, 2000). Mammalian predators were confirmed as the primary cause in the widespread decline of kiwi (McLennan *et al.*, 1996) and kokako (Innes *et al.*, 1999)

on the mainland of New Zealand. According to King (1990) cats have been implicated in the extinction of at least six species of endemic birds (cited in Mack *et al.*, 2000, p. 696), and evidence that possums predate birds and eggs is given by Brown *et al.* (1993).

It is very hard to model or define what species will become invasive, but generalisations include:

- Generalists tolerant of wide habitat, climatic range or foods
- Good dispersal rates of seeds or highly mobile animals
- High reproductive rates and short generation time
- High genetic variability
- Human facilitation; the number of individuals released and the number of releases

Legal protection is not enough in most situations in New Zealand to protect biodiversity. Covenants are “*not worth the paper they are written on unless councils monitor them on an ongoing basis and carry out recommendations from a monitoring programme*” (Kessels, 2004). Active management and integrated pest animal and plant control is required and essential to reduce the impacts of invasive plant and animal species (DoC & MfE, 2000; Perley *et al.*, 2001; Saunders & Norton, 2001) The NZBS recognises the need to provide support to landowners to maintain the biodiversity values on their land, through actions such as effective pest management and fencing. Animal pest control has been recognised as the primary requirement for biodiversity management in the Bay of Plenty region (Hall & Shaw, 2000).

2.2. Habitat Loss

Around the world, habitat loss is a major driver of species loss (Foley *et al.*, 2005) Many species have severely reduced ranges in New Zealand. The range reduction is a symptom of the pervasive loss of habitat and ecosystems, especially lowland and wetland ecosystems. A key action identified in the Biodiversity Strategy is to

protect, conserve and maintain rare and under-represented natural areas and habitats of indigenous species, including those on private land (DoC & MfE, 2000).

Most people in New Zealand live in low lying regions, especially around the coast (Gunston, 2008) and these areas have experienced substantial indigenous habitat loss and are the least represented in the conservation estate (Walker *et al.*, 2005). Habitat loss is greatest in these areas and there are even greater pressures on the remaining native flora and fauna in highly populated districts such as the upper North Island. Many of the countries most rare and threatened species and ecosystems now exist solely on private land. Their long term survival is now dependent on the kaitiakitanga or guardianship of landowners (MfE, 2007).

The resulting reduced and fragmented mosaic of the original native vegetation has played an important part in the decline of indigenous flora and fauna. The speed and scale of the disturbance is alarming, and further localised extinctions are likely in small remnant habitats (Coopers & Walters, 2002; Reed, 2004).

The pressures of human population are seen in the reduced and highly modified indigenous cover in the lowlands. These remnants now support a disproportionate amount of threatened species, habitats and ecosystems. Protection of these vitally important sites is essential to the goal of halting the decline of New Zealand's biodiversity (Walker *et al.*, 2005) and will rely on the actions of the landowners who own these properties.

Conservation in New Zealand began with the creation of reserves, often for scenic reasons, and offered only passive protection to habitats and species. However protecting land by placing it in a reserve, or under a conservation covenant is not enough to prevent further flora and fauna decay, because of the threats from introduced pests.

The involvement of multiple private landowners in biodiversity conservation fits the idea that biodiversity protection should not be limited to the public conservation estate. Habitat needs to flow from one property to the next, be it public or private land. This is in contrast to past models which have separated the conservation estate

from people and productive landscapes, with the country being managed as two separate and distinct land uses.

Land use types include pastoral farms for dairy, beef and sheep, native and plantation forests, crop land, regenerating scrub, residential areas, lifestyle rural lots, or coastal settlements. All of these land uses can provide areas of safe habitat for indigenous flora and fauna with appropriate management.

There is a need to understand the way indigenous species react with various management regimes on private land, and how they utilise new mixed and modified ecosystems as often found on private land. Most land in New Zealand is in private ownership but only 19% of biodiversity studies were carried out on private land compared to the research undertaken on public land (65%) (Norton, 2001).

Saunders *et al.* (1991) and Fahrig & Merriam (1994) discuss the physical effects of fragmentation such as changes in sunlight, wind and water, especially around the edges of remnants. They contend that landscape spatial structure effects the survival of populations in fragmented habitat. The dispersal ability of species, the time since fragmentation, the spatial arrangements of habitat patches and the inter-patch matrix are important considerations when addressing habitat loss and fragmentation.

Chapter 3 - Methodology

This research includes a literature review and the results of qualitative case studies to investigate the four questions that underpin my research goal: “to establish what biodiversity monitoring will measure the effectiveness of public funding for the protection and enhancement of biodiversity on private land in New Zealand”.

1. Literature review

A literature review of two main topics was undertaken. The first is germane to the questions: 1) - Do agencies which fund biodiversity protection and enhancement on private land need to measure the success of their funding initiatives? 2) - Is monitoring of biodiversity change on private land a requirement to provide information for biodiversity status reports? The literature review focuses on biodiversity monitoring and reporting, specifically around New Zealand legislation, policy, international treaties and national strategies to clarify biodiversity reporting requirements at an international, national and local level. The literature review included an overview of biodiversity loss in New Zealand and government assistance for biodiversity protection on private land in New Zealand.

The second literature review provided background to the questions: 3) - Are there are a core group of biodiversity monitoring methods suitable for landowners to measure the success of their conservation actions and improvements to biodiversity on their land? and 4) - What information do landowners need in order to make decisions about biodiversity management on their land?

Research on the current state of biodiversity monitoring in New Zealand was undertaken. This includes the State of the Environment reports, some investigation of the Natural Heritage Monitoring System and Tool Box under development by the DoC, and various monitoring manuals, tool kits and papers.

Social science papers addressing landowner engagement, motivation and community

monitoring were reviewed. Resource management, including biodiversity management, is thought of as an exercise in managing a resource, but it is in fact about managing people and their behaviour. Educating and demonstrating to people how they can have positive impacts on biodiversity in all sorts of ways, including on their own land, and on a daily basis, can turn people from being the problem, into being the solution. In many cases human behaviour can be influenced with incentives, education and laws (MfE, 2000b).

This philosophy is an important premise of this thesis – that is – to improve the state or condition of biodiversity in New Zealand requires working in the social as well as the natural realm.

The literature sourced for this research included peer reviewed published papers, government documents, policy reports and strategy documents, annual reports and advertising material. Information from the websites of funding agencies and landcare groups were assessed if they were part of a case study.

The literature review and background reading undertaken prior to the interviews and observations in the field helped to develop a broad awareness of biodiversity issues. These core issues were combined with the research goal to create a well defined and focused line of questioning for the case study interviews and investigations.

2. Case study methodology

Why use case studies? Case studies are a useful research method when the aim of the study is to understand the contextual conditions behind an issue. Case studies favour ‘how’ and ‘why’ type questions, which are explanatory or causal questions. Case studies can explain, describe, investigate and evaluate. This allows all the detail and variety of each case to be examined and described (Yin, 2003).

Case studies are an exploratory, illustrative and evaluative research method where the aim of the study is to gain insight and delve into a topic that is not well understood. Exploratory research tries to identify the causes and effects of a subject and is interested in the outcomes or results of a programme or policy (Ruane, 2005).

Tolich & Davidson (1999, p. 6&7) identify the features and describe the key characteristics of qualitative research, which make it suitable for this research topic, as:

- Participant observation – describes people, places and events in their actual and natural setting.
- First hand information – allows the researcher to probe into complex issues through direct contact with the respondent.
- The researcher as learner – the researcher is not the expert, the respondent is. The researcher is gathering information to learn from the person actively involved in the activity in question.
- Qualitative research is interested in relationships and how a problem fits into the wider environment, as opposed to quantitative and reductionist approaches which aim to reduce complex matters into their component parts and study the parts, in an attempt to understand the whole.
- Dynamic and flexible – research evolves as the topic and information unfolds. It is self-correcting in that information gathered redirects the future research. Qualitative researchers deliberately select essential and typical units to study, which leads to generalisations based on typical cases. Snowballing is one interview leading to another based on suggestions from one interviewee suggesting another. Quantitative takes a random selection representative approach.
- Reflective and critical – the research is not just descriptive, but it reflects critically the aspects of reality that form the basis of the practical problem being investigated. The inductive logic of qualitative research begins with observations, describes situations, and then develops theories. It reflects the qualities of things.
- Quantitative methods, such as surveys, are reliable, as the methods can be replicated again and again, with the same results, which allow generalisations to the whole population. Qualitative does not attempt to be reliable but valid, *i.e.* to provide a precise and valid description of what people said and did in a

research location. Validity is strengthened by triangulation, using multiple sources of information, methods and techniques to get data on the social issue being investigated. Case studies use an eclectic approach – using many sources of information, data collection techniques and multiple sources of evidence to cross check and back up findings and concepts.

- Qualitative – these methods look for the qualities in the world, not the quantities. It looks for explanations and interpretations of behaviour and is based on differing world views, not strict universal causal laws.

Case studies answer questions through data collection, data analysis and interpretation, and by seeking causal relationships. The data or evidence collected in case studies are documents, archival records, direct observations, participant observations, interviews and physical artefacts (Ruane, 2005; Yin, 2003).

The principles of case studies include the use of multiple sources of evidence, a case study database, which formally compiles the evidence from each case study separate from the final case study report and a chain of evidence, which are explicit links between the research questions, the data collected and the conclusions drawn (Yin, 2003). Two components of case study research design that need to be established before the research begins are study propositions and units of analysis.

2.1. Study propositions

A study proposition is the reason, rationale or purpose behind a hypothesis or research question (Yin, 2003). The rationale behind this study is that biodiversity monitoring on private land by landowners is useful, insightful and educational for the landowner, as well as for fund providers and policy makers who are concerned about biodiversity loss in New Zealand.

A subset of landowners, namely those receiving public funds for biodiversity conservation on their land, are thought to be highly motivated candidates interested in biodiversity information from their land and may have reason to collect figures and records as a requirement of the funding they receive. The reasoning is that biodiversity outcome monitoring provides evidence of the benefits achieved from the spending of public funds. This study assumes that knowing about the state of

biodiversity on private land is good for the landowner, the country, for national policy direction, and for funding allocations.

2.2. Unit of analysis

A unit of analysis defines the ‘case’ in the case study. There can be a main unit of analysis and other sub units ‘embedded’ in this main unit. Case studies can appraise a single case, or multiple cases, or use multiple embedded units in a single case (Yin, 2003).

This study is a multi-case design, where each group of properties, and a single property in one case, are linked in some way or are working together on a conservation project. Most often the linkage is neighbouring or adjacent properties, but in one case the properties are linked by the funding agency that supports and monitors the lands. The research as a whole covers 12 projects or cases.

The main unit of analysis in these case studies is the private property or properties. All the private properties are involved in some level of biodiversity conservation management and monitoring. The monitoring on these properties is done by one or many individuals, either the landowner/s themselves, external contractors or volunteers.

There are two embedded units of analysis assessed within the main unit of analysis in this research. An embedded unit of analysis is a specific monitoring method, (*e.g.* foliar browse index) the landowners are using and how the results obtained from each method are used by the landowner. Another embedded unit of analysis is the social environment and process landowners went through to establish a monitoring programme on their property.

2.3. Selecting case studies

It is not the intention of case study research to represent the complete picture on a topic but to select a balanced variety of typical and characteristic cases at a point in time and to identify what can be learnt from them (Stake, 2003).

Funding applications that were publicly available were assessed to see if any monitoring information was provided with the funding application. If there was, the funding agency was asked to approach the applicant to see if they would be interested in participating in this research. Peter Handford & Associates were asked to contact landowners who have lodged data with the FORMAK database (Handford & Associates Ltd, 2004) and who may be interested in being interviewed. Landcare Trust field staff were asked if they knew landowners who were monitoring on their land who may like to be interviewed. Contact was made with two monitors at the Sanctuaries of New Zealand workshop run by Landcare Research in Silverstream in October 2007. A request for participants was posted on the Sanctuaries of New Zealand website (Sanctuaries of New Zealand, 2007).

The landowners identified were contacted by phone and email and after initial consultations, twelve case studies of existing biodiversity monitoring practices on private land have been undertaken to establish and assess what monitoring is currently in use in these cases and what is working well.

3. Case Study Methods

The case study methods used in this research include semi-structured interviews, participant observation, and reading of written material provided by participants. Phone conversations and email correspondence were also used. Semi-structured interviews gave vast amounts of information and formed the bulk of the research data and results.

3.1. Semi-structured interviews

Semi-structured interviews allow the interviewer to investigate complicated issues by asking directly about the subject and make it possible to collect many variables of interest (Yin, 2003). A semi-structured interview is a flexible and open 'purposeful conversation' between the researcher and the research subject (Kvale, 1996). Semi-structured interviews use interview guides to direct the interview along the lines of

the research questions while still allowing the interview to be adapted to the issues and concerns of the interviewee (Dunn, 2000; Patton, 2002).

In this research, semi-structured interviews allowed for a range of questioning around landowners conservation work, aspirations and their monitoring methods. In depth questions were asked about the methods they used, what they did with the information and the benefits and barriers they experienced with monitoring.

A pilot interview, case study protocols (Appendix A) (Yin, 2003) and interview and observation guides (Appendix B) (Tolich & Davidson, 1999) were used and developed to guide the interview process and questions. Case study protocols for both funding agencies and landowners were developed.

Two pilot interviews were conducted, to find out if the draft interview questions were suitable and covered the range of issues to be addressed. Lessons were learnt through this process, such as the issue of back ground noise when recording interviews and refinement of the questions, which were applied to future interviews.

The questions for landowners developed in the case study protocols were simplified after the first three interviews into the interview and observation guide for the remaining interviews. The case study protocol method seemed too cumbersome once the interview process was familiar, and the interview and observation guide allowed for a more open ended questioning and interview process.

While the case study protocols and interview guides were developed and used to maintain consistency and to ensure key issues were covered in each case, there were variations in the interviews based on the preferences and situations of the interviewees.

3.1.1. Interviews with funding agencies

Staff at selected organisations who fund biodiversity protection on private land were interviewed for information on the funds they administer. The reporting and monitoring requirements of the funds were identified, along with the goals and outcomes of the funds.

Staff at the Department of Conservation, Nga Whenua Rahui, Landcare Trust and Queen Elizabeth the Second Trust were interviewed. All interviews took place in person except Landcare Trust which was a phone interview. Interviews were recorded with the permission of the interviewee and transcribed after the interview.

3.1.2. Interviews with landowners and monitors

Landowners were told of the purpose and nature of the research, namely a Masters thesis on biodiversity monitoring on private land, and asked to participate on a voluntary basis. They were informed that the information they provided would be anonymous. The interviews took place in five peoples' homes, a Landcare office, two cafés, a funding agency field centre, a picnic table at a reserve and on the phone in two cases. Interviews were recorded with the permission of the interviewee and transcribed after the interview. The two pilot interviews, with a landowner and a monitor, took place in October 2007 and the remaining ten interviews were conducted between Feb 3rd and March 19th 2008. The interviews lasted between one and two hours.

3.2. Participant observation

Observations provide a context of the case study situations, and first hand impressions of the people involved (Davidson & Tolich, 2003). Participant observation has been used to describe the landowners or monitors, their conservation work and their properties as they were at the time of the interviews. The participant observation is limited to general descriptions and basic facts gleaned from the interview setting and process as time constraints did not allow site visits around the properties in question except in a couple of cases.

3.3. Written case study material

Funding organisations were asked for written material on their funds, such as application forms, advertising material and annual reports. Websites were also assessed for this type of material.

A selection of Biodiversity Condition Fund applications, which included monitoring results in their application for funds, were viewed in the office of the Department of Conservation. The Department of Conservation staff asked for permission from the applicants before I looked at their applications. A request was made for monitoring reports or results from the case studies and seven cases supplied these.

3.4. Case study analysis

The interview transcripts were analysed using negative and positive coding to identify themes and patterns related to the research themes and objectives. Coding identifies the data that is important to the research theme and highlights emerging patterns from the responses. *“Coding identifies and aggregates areas of theoretical and empirical interest in the field notes and interview transcripts”* (Davidson & Tolich, 2003, p. 169).

Negative coding is used to note errors in the interview process such as missed opportunities to ask relevant questions or missing details that were important. Positive coding identifies the emerging themes, relationships and patterns in the interview transcripts and flags follow up tasks and ideas (Davidson & Tolich, 2003).

Once the transcripts were coded and the emerging themes were identified, files were made to store the notes and transcripts grouped into relevant and logical order. Files are made to transform field notes into major and functional categories (Ruane, 2005). A master file kept the original transcript material and field notes in case study order, a file on monitoring collated the notes on methods and results, and a file on social themes grouped coded notes on the monitoring process and attitudes to monitoring. Patterns in the files were identified that related to the research goal and questions.

This research uses case studies to answer research questions 3 and 4, namely “what monitoring methods are landowners using to monitor biodiversity on their properties?”, and what information can monitoring offer that would be useful to landowners conservation outcomes?

Case studies are used to investigate and examine, and this study asks what does it take to get a landowner interested enough in monitoring to do it on top of all the

other voluntary conservation work they are involved in. I am interested in how landowners got started with monitoring, what hurdles they had to overcome, what are the benefits and to find the social conditions under which this monitoring occurs.

The results of the case studies are presented in chapter 5, but first research question 2 is investigated, to find out if there is a need or obligation to monitor on private land.

Chapter 4 - New Zealand's Biodiversity Commitments

Are there national reporting requirements that call for information about the state of biodiversity on private land in New Zealand?

The New Zealand government has made commitments, in international treaties and national legislation, to the principles of sustainable resource use and the conservation of biodiversity. Under these laws and agreements New Zealand is obliged to protect and maintain biodiversity.

If the New Zealand government must report on compliance, progress or success of conventions and policies then there must be measures of change to support claims of success and there is clearly a need to know what is occurring on all land in this country, and in the seas around.

In this chapter, these laws and treaties are listed and the obligations for biodiversity protection, monitoring and reporting are identified. I examine some of New Zealand's current biodiversity reports and discuss their content and limitations regarding private land and biodiversity outcomes.

1. New Zealand's obligations for biodiversity status reporting

1.1. International Obligations

New Zealand is currently party to 48 Multilateral Environmental Agreements (MEAs) which cover global environmental issues such as protection of the marine environment, hazardous substances and the conservation of natural resources. MEAs are the main way the international community works together to tackle global environmental problems that extend beyond single county boundaries (Controller and Auditor-General, 2001).

The main MEA's that relate to biodiversity conservation include the Convention on Biological Diversity, UNESCO National Protection and International Protection of Cultural and Natural Heritage, Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar), International Convention on Trade in Endangered Species (CITES), the Antarctic Treaty, the Convention on the Conservation of Nature in the South Pacific (Apia Convention), the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), Agenda 21, Forest Principles, The Global Strategy for Plant Conservation, the Rio Declaration on Environment and Development, the Montreal Process and the IUCN threatened species Red list (Lee *et al.*, 2005).

Of these, the most important and wide-ranging with regard to New Zealand's commitment to biodiversity protection is the Convention on Biological Diversity.

1.2. Convention on Biological Diversity

New Zealand ratified the Convention on Biological Diversity (CBD) in 1993. The objective of the CBD is the conservation of biological diversity and the sustainable use of its components.

Under this legally binding convention, New Zealand has an international responsibility to “*prepare national strategies, plans or programmes and to set national goals to conserve and sustainably use biodiversity*” (CBD Article 6). This includes an obligation to “*proactively manage biodiversity*” for moral and scientific reasons. The New Zealand Biodiversity Strategy 2000 (NZBS) (DoC & MfE, 2000) was produced as part of New Zealand's commitment to the CBD.

Key sections of the CBD that relate to biodiversity monitoring and reporting on private land include:

- Article 7- Identification and Monitoring
- Article 8- In-situ conservation of biodiversity,
- Article 26 – Reporting.

1.2.1. Identification and Monitoring

Article 7 requires, among other things, that member countries “*identify components of biological diversity important for its conservation*” and “*monitor, through sampling and other techniques, the components of biological diversity identified pursuant to subparagraph (a) above, paying particular attention to those requiring urgent conservation measures*” (UNEP, 1992). It also requires monitoring of biological diversity which is representative, unique or associated with key evolutionary or other biological processes and of species and communities which are threatened.

1.2.2. In-situ conservation of biodiversity

The CBD stresses the need for in-situ conservation of biodiversity in Article 8. It requires states to develop a system of protected areas, as well as requiring countries to regulate or manage biological resources within or outside protected areas. It aims for “*the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings*” (UNEP, 1992).

1.2.3. Reporting

Article 26 requires countries to “*present to the Conference of the Parties reports on measures which it has taken for the implementation of the provisions of this Convention and their effectiveness in meeting the objectives of this Convention*”. (UNEP, 1992).

The importance and detail required for a country to meet its international reporting obligations under MEA's is demonstrated by the 30 page guide for writing the National CBD report provided to member countries to follow (CBD, 2008). New Zealand's third national report is 177 pages (Rae & Scott, 2007). The Ramsar Convention is another example. The Ramsar Strategic Plan operational objective 11 details the management planning and monitoring requirements of Ramsar sites and a detailed Ramsar wetland monitoring manual has been developed for countries to assist them to achieve this objective (RAMSAR, 2008).

1.3. National Obligations

Legislation in New Zealand that relates to biodiversity management, terrestrial conservation and sustainable use of the environment at a national level include the Resource Management Act (1991), the Resource Management Amendment Act (2003), the Biosecurity Act (1993), the Forest Amendment Act (1993), the Conservation Act (1987), the Environment Act (1986), the National Parks Act (1980), the Reserves Act (1977), the Wild Animal Control Act (1977), the Wildlife Act (1953) and the Forests Act (1949).

Of these Acts, three with a significant focus on biodiversity, conservation and the associated obligations on private land are the Resource Management Act (RMA) and its amendment, the Conservation Act and the Environment Act. The RMA is mentioned here in a national context, and is considered again in the next section on local obligations to protect biodiversity.

1.3.1. The Resource Management Act

The RMA plays a key role in protecting biodiversity on all land in New Zealand as most forms of resource use and management affect the environment, either directly or indirectly. Parts of Sections 4, 5, 6, 7, 30, 31 and 35 of the RMA demonstrate the sustainable management principles of the RMA and are directly relevant to biodiversity protection (MfE & DoC, 2007). These include the intrinsic values of ecosystems, the maintenance of biological diversity and the protection of significant indigenous vegetation and habitats of indigenous fauna.

Section 5(1)(b) refers to “*safeguarding ecosystems*”, Section 6(c) concerns the “*protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna*” and Section 7(d) refers to the “*intrinsic values*” of ecosystems. Many of these significant areas are on private land.

1.3.2. The Conservation Act

The Conservation Act, which established the Department of Conservation (DoC), provides the mandate for the activities of the Department of Conservation which includes *“To advocate the conservation of natural and historic resources generally”* and *“to promote the benefits of the conservation of natural resources generally, and of New Zealand in particular”*. This advocacy relates to all land in New Zealand, not just the conservation estate.

A key function of DoC under the Conservation Act, section 6(b) is to encourage or require others to protect places and species with natural values that lie outside the formal protected area network. This is critical to ensuring a full range of natural places are protected (DoC, 2007).

DoC has the legislative mandate to conserve indigenous biodiversity, and is responsible to ensure *“New Zealand's natural and historic heritage entrusted to the Department of Conservation is protected and restored”* (DoC, 2004, p. 22; Lee *et al.*, 2005, p. 57). *“The Wildlife Act provides State ownership of indigenous fauna. Flora is not owned by the Crown and thus is only protected where it resides on lands managed by the Department of Conservation”* (Rae & Scott, 2007). For this reason, the Department of Conservation can only advocate for the protection and conservation of threatened plants on lands in private ownership (CBD, 2008).

1.3.3. The Environment Act

The Environment Act established the Ministry for the Environment (MfE) and the Parliamentary Commissioner for the Environment (PCE). Section 31 contains the functions of the Ministry, which includes (a) (iii) *“ways of ensuring that effective provision is made for public participation in environmental planning and policy formulation processes in order to assist decision making, particularly at the regional and local level”*, and (c) *“To provide the Government, its agencies, and other public authorities with advice on—(i) The application, operation, and effectiveness of the Acts specified in the Schedule to this Act in relation to the achievement of the*

objectives of this Act and (ii) Procedures for the assessment and monitoring of environmental impacts”.

The Ministry for the Environment has an advocacy, reporting and education role, rather than an active role in biodiversity protection on private land. The Act does not spell out any clear or specific obligations for private land, but Section 17 for example provides the matters to which regard be given, and includes (a) *“The maintenance and restoration of ecosystems of importance, especially those supporting habitats or rare, threatened, or endangered species of flora or fauna”* and (b) *“Areas, landscapes, and structures of aesthetic, archaeological, cultural, historical, recreational, scenic, and scientific value”* which include private lands.

1.3.4. Government Policies and Strategies

Significant national government policy documents and strategies for biodiversity protection in New Zealand include The NZBS, The Environmental Performance Indicators Programme: Signposts for Sustainability, The Sustainable Land Management Strategy and Protecting Our Places: The Statement of National Priorities for Protecting Rare and Threatened Biodiversity on Private Land. The NZBS (DoC & MfE, 2000) is the major policy document for biodiversity protection in New Zealand and is examined in more detail along with the latest policy document – Protecting Our Places.

- **New Zealand Biodiversity Strategy**

The NZBS (DoC & MfE, 2000) is an example of how New Zealand's high level international obligations have been translated into a national strategy and work plan to achieve the goals set out in the CBD. It is used in this research as an example of the need to integrate the conservation work being done at the landowner level and the obligations the New Zealand Government has at local, national and international levels. The goals and themes of the NZBS that relate to biodiversity protection on private land are identified to establish what biodiversity information from private land is needed to meet national obligations for biodiversity status reports.

The NZBS aims to “*halt the decline of New Zealand’s indigenous biodiversity*”. It describes biodiversity as “*everybody’s business, including biodiversity in “all our back yards and neighbourhoods”*”.

The NZBS has thirteen principles and four goals at the highest ‘visionary’ level. All of the principles are relevant when considering the importance of biodiversity protection on private land, for example – “*respect for property rights*” and “*collective and ethical responsibilities*”. The framework for achieving the four NZBS goals is set out in ten themes, each of which has an action plan incorporating objectives and actions. Goals 1 and 3, and themes 1, 6, 8 and 9 of the NZBS are highly relevant to biodiversity protection, monitoring and reporting on private land.

Goal Three: Halt the decline in New Zealand’s indigenous biodiversity

Goal three – “*Halt the decline in New Zealand’s indigenous biodiversity*”- is the “*bottom line*” of the NZBS. The goal is to ‘*maintain and restore a full range of remaining natural habitats and ecosystems to a healthy functioning state, enhance critically scarce habitats, and sustain the more modified ecosystems in production and urban environments; and do what else is necessary to maintain and restore viable populations of all indigenous species across their natural range*’

Theme 1: Biodiversity on land

One of the objectives of theme 1 is to “*promote and encourage initiatives to protect, maintain and restore habitats and ecosystems that are important for indigenous biodiversity on land outside of protected areas*”. Half of the actions associated with this objective relate directly to private land.

Theme 6: Governance

Objective 6.1 Governance and biodiversity, action c), is to “*monitor and report on the implementation of actions and achievement of goals and objectives in the New Zealand Biodiversity Strategy on an annual basis*” and action d) is to “*monitor and report on the state of New Zealand’s biodiversity as part of the national state of the environment monitoring programme*”. Many of the actions and objectives revolve around the need to establish monitoring systems that are robust, cost-effective and

comparable, as well as sharing information and building capacity amongst the community and agencies responsible for collecting biodiversity information.

Theme 8: Community participation and awareness

This theme seeks better understanding and appreciation of biodiversity by the community. The intention is to integrate biodiversity considerations into land management practices and for more community involvement in environmental care.

Theme 9: Information, knowledge and capacity

Theme 9 focuses on the need to *“learn lessons by monitoring and reporting progress”* and acknowledges that *“most of our existing monitoring data is of limited use”* but that *“information, knowledge and capacity underpin the effective implementation of all biodiversity management actions proposed in this Strategy”*. It also points out that *“monitoring and state of the environment reporting provide relevant and widely available feedback on the status of, and trends in, indigenous biodiversity”*. Systems are needed to aggregate local monitoring information and report it using agreed indicators to provide a local, regional and national picture of the extent and condition of, and trends in, our indigenous biodiversity.

These NZBS goals, themes, objectives and actions clearly identify obligations and intentions to protect biodiversity on private land, as well as the intention and need to monitor and report on progress of such protection work. Biodiversity data needs to be collected from private land to be able to report on the outcomes of the NZBS.

- **Protecting Our Places**

‘Protecting Our Places’ (MfE & DoC, 2007) outlines the Statement of National Priorities for Protecting Rare and Threatened Biodiversity on Private Land. This non-statutory document has been produced in place of the proposed statutory national policy statement for biodiversity under the RMA.

The aim of Protecting Our Places is to provide a decision-making framework and national guidance for regional and local councils to prioritise conservation efforts on private land and to *“support and inform councils’ biodiversity responsibilities under the RMA”*. The legislation that provides the statutory context for these national

priorities is summarised in section seven of the document.

'*Protecting Our Places*' provides a national perspective, identifying rare and threatened environments across New Zealand as a whole and identifies four national priorities for protection on private land, namely the protection of native vegetation associated with:

- Land areas with only 20 per cent of their original native vegetation cover left
- Wetlands and sand dunes
- Ecosystems that have always been limited in extent, such as in geothermal areas, along coasts and on limestone formations
- Protection of the habitats of New Zealand's most threatened species.

The progress of the MfE and DoC work programme, to strengthen biodiversity work on private land, which includes this statement of national priorities, "*will be monitored over the coming five years, and the whole programme will be re-evaluated at the end of this period*" (MfE & DoC, 2007).

1.4. Local Obligations

Legislation in New Zealand that requires the sustainable use of the environment at a local level is the Local Government Act 2002 (LGA) and the Resource Management Act (RMA) and the Resource Management Amendment Act 2003 (RMAA).

1.4.1. The Local Government Act

The purpose of the Local Government Act 2002 (LGA) is to "*provide for democratic and effective local government and for local government to play a broad role in promoting the social, economic, environmental, and cultural well-being of their communities, taking a sustainable development approach*".

Local councils must, at least every six years, determine the community outcomes for their region (s 91). *Under the LGA local authorities must prepare Long Term*

Council Community Plans. LTCCP's must state how the local authority will monitor and report on the community's progress towards achieving the community outcomes (including environmental outcomes), not less than once every three years" (Quality Planning New Zealand, 2008)

The LGA requires monitoring as under section 92 of the LGA *"a local authority must monitor and not less than once every 3 years, report on the progress made by the community of its district or region in achieving the community outcomes for the district or region"* as stated in the LTCCP for the region or district. In addition, a local authority *"may decide for itself how it is to monitor and report under subsection (1), but the local authority must seek to secure the agreement of organisations and groups identified under section 91(3)(a) to the monitoring and reporting procedures, including the incorporation of any research, monitoring, or reporting undertaken by those organisations and groups"*

The obligations outlined here are clear on the need for councils to develop community outcomes and to consider, monitor and report on them and sustainable development, including the environment, every three years.

1.4.2. The Resource Management Act

Part 4 of the RMA (1991) covers the functions, powers, and duties of local authorities. Section 30 explains the functions of regional councils under the Act and includes (1) (ga) *"the establishment, implementation, and review of objectives, policies, and methods for maintaining indigenous biological diversity"*.

Section 31 explains the functions of territorial authorities under the Act and includes (1)(b) *"the control of any actual or potential effects of the use, development, or protection of land, including for the purpose of (iii) the maintenance of indigenous biological diversity"*.

Section 35 says *"Every local authority shall monitor (a) The state of the whole or any part of the environment of its region or district to the extent that is appropriate to enable the local authority to effectively carry out its functions under this Act; and*

(b) the efficiency and effectiveness of policies, rules, or other methods in its policy statement or its plan”.

Subsection (2A) requires councils to provide a public review at least every five years on the results of its monitoring under subsection (2)(b).

The RMA devolves responsibility for environmental management and development to local government. The Resource Management Amendment Act 2003 (RMAA) clarified that it is an explicit function and an obligation of both regional councils and territorial authorities to manage and maintain indigenous biodiversity and enhance ecosystems in their area via policies and plans. It is now a “*function of regional councils to establish, implement and review objectives, policies and methods for the purpose of maintaining indigenous biodiversity*” and for “*territorial authorities to control the effects of land on the maintenance of indigenous biological diversity*”

Territorial local authorities operate independently and each council writes its own regional, district and city plans, and hence each plan has different biodiversity obligations, reporting and monitoring requirements.

As well as these formal obligations under international and national laws, we have a moral obligation to conserve and protect the biological diversity of New Zealand. We have inherited an environment with its own intrinsic values, from our ancestors, and we are responsible for how we pass it onto the next generations (DoC & MfE, 2000).

2. Biodiversity reporting performance

The biodiversity obligations and reporting requirements are clearly spelt out in some of the examples given above, and they are ambiguous in other cases. The need to report on the CBD is plainly described, while national state of the environment reporting is not clearly mandated in legislation. The content of the reports is also variable. Article 26 of the CBD requires not only a description of the actions taken by countries to protect and sustainably use biodiversity but a report on the effectiveness of those actions. To report on the effectiveness of actions, it is

necessary to measure the effect or outcomes for biodiversity from the actions taken. The CBD points out the need to include private land in reports while reporting under the LGA will vary council by council, depending on the regional, district or city plans and the LTCCP's they have developed.

2.1. International reporting performance

Being a member of these MEA's means New Zealand has a range of international reporting requirements (Wiser *et al.*, 2001). As a signatory to 48 MEA's New Zealand is required to gather accurate and meaningful information and data to report on compliance of agreements and progress towards the goals of conventions it is a party to.

Using the CBD as an example, New Zealand has provided 11 reports on its CBD commitments, including three national reports between 1998 and 2006. The 3rd National Report (Rae & Scott, 2007) explains that *"New Zealand is proactively addressing requirements of the CBD via its commitment to delivering the objectives of the NZBS"*. However, the same report admits that *"the NZBS lacks measurable targets"* and that *"To date, information derived from robust monitoring programmes demonstrating progress made on achievement of desired outcomes for protection of biodiversity has not been provided at a national level"*.

The 3rd National Report to the CBD (Rae & Scott, 2007) is low on evidence of the outcomes achieved. For example, *"New Zealand spends about \$330 million annually on aspects of biodiversity protection"*, but there are few examples of any biodiversity outcomes to show for this. Saying how much you spend on biodiversity is not good enough. It is not a measure of effectiveness or achievement. The 3rd National Report admits that *"to date, information derived from robust monitoring programmes demonstrating progress made on achievement of desired outcomes for protection of biodiversity has not been provided at a national level"*.

In a review of four MEA's (Ramsar, Cities, Kyoto Protocol and the Montreal Protocol) the Office of the Auditor General (2001) found that *"reporting to Parliament of issues and progress on MEA's generally is not adequate"*

2.2. National reporting performance

The two main national reports on biodiversity are the annual NZBS Programme Performance Report and the state of the environment report, which has been compiled twice in the last decade.

2.2.1. New Zealand Biodiversity Strategy Reporting

Overall responsibility for implementing the NZBS lies with the Minister of Conservation and Local Government, supported by a Central Government Coordinating Group of Biodiversity Chief Executives. One of the functions of this group is to ensure “*appropriate provision for information gathering, reporting and monitoring*” (DoC & MfE, 2000, p. 130). Lead agencies are responsible for each action in the NZBS, including determining suitable “*performance measures and expected project outcomes*” (DoC & MfE, 2000, p. 130)

The funds available to support biodiversity conservation on private land include \$48M, or 26% of the total \$184M, funding packages associated with the NZBS was allocated for activities outside central government departments, mostly for protection of biodiversity on private lands (Green & Clarkson, 2005). Another \$40.6 million has been provided through agencies like the QEII Trust and Nga Whenua Rahui to help people covenant private land and over \$10 million has been given in grants for conservation work on private land (MfE & DoC, 2007).

The main aims of the NZBS are ‘Biodiversity Outcomes’ as illustrated in Figure 1. If biodiversity outcomes are the main aim, there needs to be emphasis on measuring them. This figure from the NZBS also illustrates the intention to have monitoring, research and state of the environment reporting as part of the implementation cycle of the NZBS.

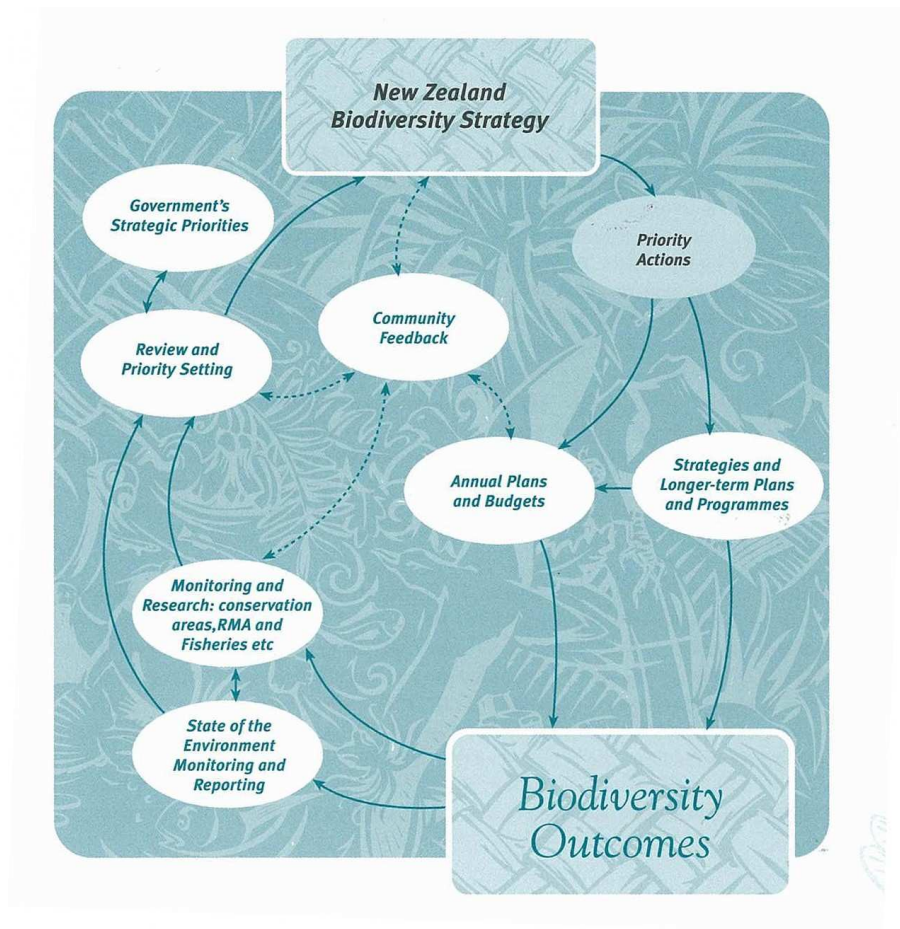


Figure 1: Monitoring and Review of the New Zealand Biodiversity Strategy.

(Source DoC & MfE, 2000, p. 131)

However, the NZBS Annual Reports on Programme Performance (Central Government Coordinating Group of Biodiversity Chief Executives, 2002; 2003; 2004) do not provide any outcomes or results for biodiversity from the money provided to private land, they just detail how the funds were spent. There appears to be no reporting requirements to measure the biodiversity gains that result from this expenditure.

- **New Zealand Biodiversity Strategy Themes Review**

Five years after the implementation of the NZBS the ten themes were independently reviewed (Green & Clarkson, 2005; 2006). A major shortcoming identified in the review was the lack of quantifiable and time-linked targets set in the NZBS against which to measure progress. For example the NZBS provides no specific targets on the proportion of New Zealand's habitats and ecosystems that need to be protected to

maintain a representative example of the full range of ecosystems. The review found that it was hard to measure progress on the NZBS because there was a paucity of data to compare the situations between 2000 and 2005. A rewording of the goals, themes, objectives and actions in the NZBS is required to ensure they are written in a way that makes their achievement measurable (Green & Clarkson, 2006).

The review found a comprehensive state of the environment reporting system and indicators for biodiversity and biosecurity, linked to regional and national monitoring and reporting systems was needed and concluded that current *“monitoring and reporting systems are presently insufficient to meet the reporting requirements of the Strategy”* (Green & Clarkson, 2005, p. 3). It also noted that *“Individual success stories are easy to point to but patchy monitoring and reporting systems make it difficult to assess what overall difference is being made”* (Green & Clarkson, 2005, p. 40).

The strength of national leadership and responsibility for biodiversity monitoring and reporting was called into question. *We would have expected more evidence of leadership through the governance mechanisms with a stronger emphasis on whole-of-government coordination on the cross-cutting issues such as indicator and monitoring programmes.”* (Green & Clarkson, 2005, p. 37). The authors felt that progress during the first five years of the NZBS on the development of consistent national monitoring methods and national reporting at a variety of scales, had been slower than expected and noted that if these reports were available they would have met other statutory requirements, such as those under the RMA and the LGA.

2.2.2. State of the Environment reporting

The Ministry for the Environment plays an important role advising and reporting on environmental issues, including biodiversity on private land (MfE, 2000a; MfE, 2000b; MfE & DoC, 2007). It also produces state of the environment reports, but it does not have a statutory reporting function or a legal requirement to do so. The Ministry for the Environment recognise that regular environmental reporting is important to track progress (MfE, 2007) and has been involved in developing environmental indicators for over ten years.

The first state of the environment report, *'The State of New Zealand's Environment 1997'*, (MfE, 1997) identified indigenous biodiversity decline as New Zealand's "most pervasive environmental issue". The second national state of the environment report *'Environment New Zealand 2007'* (MfE, 2007, p. 401) says that "In 2007, New Zealand's biodiversity faces the same pressures as 10 years ago". New Zealand has experienced one of the highest extinction rates in the world (Hitchmough, 2002) and our levels of threatened native species are among the highest in the world (Hitchmough *et al.*, 2007).

The 455 page document has more quantitative data than the primarily qualitative 1997 report (MfE, 2007) but while more quantitative data are presented, there is still little on biodiversity outcomes. An example is that 4,800 private landowners have received biodiversity condition or advice funds, to undertake biodiversity protection work on their property, but there is no data on the biodiversity outcomes from these 4,800 properties. In another example, "All threatened indicator species discussed in this chapter have shown a decline in their habitat range" (p 401) but the significance of the data are not discussed, examined or analysed further.

In addition to these two main biodiversity reports, national monitoring and reporting on the effectiveness of the Statement of National Priorities *Protecting our Places* will be undertaken by the Ministry for the Environment after five years to see how it has been applied by central and local government and what it has achieved. In addition to *'Protecting our Places'* the Ministry for the Environment is working on a second 'guidance note' under the RMA for local government on biodiversity, landscape and rural land use issues.

The premise of the priority areas in *Protecting our Places* is that protecting rare and threatened native vegetation and habitat is vital in itself and an essential component of protecting the indigenous fauna associated with that vegetative habitat. However, the findings of Walker *et al.* (2005) find that voluntary measures, education, some formal protection of remaining biodiversity and the RMA have all failed to halt the decline in indigenous vegetation, so the strength of this additional non-statutory document to halt this decline is questioned. It will be interesting to read the monitoring report in 2012.

The OECD (2007) said that national-level aggregates of data and indicators on the state of the environment and environmental pressures are scarce, so efforts to improve outcome-oriented environmental policy-making were hampered. It recommended a commitment to outcome-oriented environmental policies and to the collection and analysis of information and data to assess if policies were effective and efficient.

2.3. Local reporting performance

The RMA requires councils to report on RMA compliance, monitor the state of their environment and measure the effectiveness of their policies and plans (Beanland & Huser, 1999). To fulfil these requirements, local government needs environmental indicators and monitoring programmes to assess and test the effectiveness of their environmental policies, to improve management decisions and practices, to gauge the performance of incentive programmes and improve budget distribution and accountabilities (Green & Clarkson, 2006).

Territorial local authorities write their own regional, district and city plans and LTCCP's, and so the reporting differs around the country. While it is appropriate for councils to monitor and report on issues relevant to their area, it does mean local council biodiversity plans and reports are not consistent or comparable across the country and it is not straight forward to compile a national report from the multitude of territorial local authority reports.

While most council's prepare state of the environment reports, a review of 14 of these (Quality Planning New Zealand, 2008) confirmed that few of them include biodiversity outcome data, and none provide data on the trends of biodiversity on private land. The community outcomes in an LTCCP should include biodiversity goals or other means of promoting environmental well being (Curran, 2004).

According to the OECD (2007) one of the reasons for councils struggling to comply with RMA requirements to a satisfactory level could be a lack of statutory guidance, in the form of national standards and policy statements, from central government to councils, on how to implement the RMA and how to monitor environmental

conditions. Territorial local authority's reports are not audited, but they can be by the Minister for the Environment under section 24 of the RMA.

3. Critique of reporting performance

The previous section has outlined the obligations for biodiversity monitoring and reporting that exists at various state levels, and provided a summary of the reports that are produced and if they contain biodiversity data from private land. Key issues that have been identified from this are: key data are not being collected; private land is not well covered; and landowners are not involved in reporting.

3.1. Key data not being gathered

One cannot determine a programme or strategies achievement, or if a law or convention is being upheld, if data is not collected to measure that success. It is easy to access monthly economic indicator reports for New Zealand (New Zealand Treasury, 2008) and annual environmental health indicator reports (Ministry of Health, 2008), however there has been a ten year lull between the two state of the environment report for the country.

The economy of New Zealand, which is based on primary production and tourism, and the health of our people, including our national identity and recreation, are reliant on the long term health of our environment, therefore national reports on the state of biodiversity and the environment should be given a much greater priority (Green & Clarkson, 2006; MfE, 2007).

The NZBS identified the weaknesses in our current national monitoring data back in 2000, which includes: *“a lack of consistent methods means information cannot be compared or aggregated, that monitoring is not linked to biodiversity goals, so biodiversity outcomes are not measured and the benefits of monitoring are often not understood”*. Terrestrial indigenous biodiversity indicators that are in use around the country are mostly inconsistent and incompatible. Standard and consistent indicators need to be agreed and implemented between central and local government to provide a coordinated and integrated monitoring and reporting system. This system must be

suitable for local, regional and national reporting (Green & Clarkson, 2006).

In addition to these weaknesses, there are not enough explicit targets in the NZBS. Even if there were, there is inadequate monitoring in place to measure any achievements. Without this information we cannot be confident a real change is being made.

To measure the achievements of the NZBS will rely on data and information to be collected from many sources on the ground, such as central and local government departments, non-government organisations, community groups and individuals.

The NZBS states “*good information is critical for targeting efforts effectively and enabling New Zealanders to make informed choices about biodiversity and its future*” (DoC & MfE, 2000, p. 10). It also recognises the wide range of methods available to encourage and support the protection and maintenance of important habitats and ecosystems on private land, such as education, voluntary protection mechanisms and economic incentives. These tools, which include existing national funds for this work, such as Condition Funds, do support the protection work that is vital to the achievement of the NZBS goals.

The issue is that the outcomes from these methods, either biodiversity outcomes or social outcomes, are not measured. Measuring the effectiveness of the funds to protect, maintain or restore important habitats is needed. Without monitoring there is no way of knowing if an objective has been achieved or what difference these tools have made to biodiversity on private land. Simple and realistic monitoring to measure biodiversity outcomes would provide this information.

Central government needs to support its departments and funding agencies to resource the collection of key biodiversity monitoring data. Choosing cost effective and consistent monitoring methods and planning how to collect and analysis the information needs to be coordinated and supported at a national level. Funding agencies, local government and government funded non-government organisations are the link between government and landowners. All of these agencies and

ecological professionals need to be part of supporting and collecting biodiversity information with landowners.

Guidance and support, from a national level, must be provided to the community and landowners so they know what key data are useful and necessary for them to collect. Leadership, assistance and encouragement for landowners to monitor and measure biodiversity values on their properties are excellent ways to increase local understanding of natural resources. An aware and informed community will make educated land management choices and decisions, decisions which often impact on biodiversity.

The maintenance and protection of biological diversity is a critical measure and central to the sustainable development model of integrated social, environmental, cultural and economic well being that underpins the LGA (Curran, 2004). For a local authority to report on its achievement towards sustainable development under this act requires factual data on biodiversity trends in its area. With simple yet accurate biodiversity information they can determine if, at a local level, they are achieving their biodiversity goals and commitments.

Additional benefits of having monitoring data and state of the environment information is the ability to close the circle of effective conservation planning. Planning, monitoring and reporting are the three consecutive steps of conservation planning, with monitoring feeding back into the planning cycle. Currently, key data are not collected so it is not available to close the loop. Project planning and monitoring are essential precursors of reporting success or compliance. *“Data not only provide the foundation for science, they will increasingly provide the basis for many of our management decisions”* (Wiser *et al.*, 2001). The NZBS spells out the need to continually improve management practices through an adaptive management approach. Adaptive management requires information gathering, especially via research, monitoring of biodiversity outcomes and recording management action.

3.2. Private land is not well covered

The CBD, the NZBS and the RMA all include an obligation to protect and report on biodiversity on private land.

The CBD goal is to conserve natural environments, maintain a full range of habitats and viable species populations across their natural range, in their natural surroundings, that is - in-situ conservation. This will require working with the owners of the two thirds of the country in private ownership. The NZBS goal of enhancing critically scarce ecosystems and modified ecosystems in production and urban environments also takes the task back to private land and landowners. The components of significant indigenous vegetation and habitats, and representative, unique or threatened biological diversity found on private land, must be identified, conserved, protected, monitored and reported on, regardless of land tenure, to satisfy the responsibilities faced under the CBD, NZBS and the RMA.

Goals 1 and 3; and themes 1, 8 and 9 of the NZBS highlight the essential role that private land and landowners may need to play in supporting indigenous biodiversity. Theme One, Biodiversity on Land, received 67% of the Biodiversity Package allocation, in recognition that more funds were needed for work on private land and for existing core programmes such as species recovery and pest control if the tide of biodiversity decline was to be turned (Green & Clarkson, 2005).

Knowing if the trend of biodiversity loss in New Zealand is reducing or reversing will require information on the health and functioning of ecosystems and species found on private land. Biodiversity monitoring on private land can contribute condition and trend data to allow reporting on the success of this vitally important goal.

There is a significant challenge to address the ongoing loss of rare and threatened biodiversity from private land. Land legally protected for conservation in New Zealand does not fully represent the variety of ecosystems found here, being biased towards high altitude lands (Norton, 2001; Walker *et al.*, 2006) and the species found there (de Lange *et al.*, 2004). Many ecosystems, natural habitats and populations of species only occur naturally in lowland or coastal habitats of New Zealand (MfE

& DoC, 2007). These areas are also the most highly modified, the least protected and primarily in private ownership. According to Walker *et al.* (2005) indigenous biodiversity is virtually extinct in some warm, eastern, flat, fertile lowland areas, which corresponds to the amount of human population and pressures in these areas. They are also home to a disproportionate number of threatened species (Walker *et al.*, 2006).

If biodiversity information is collected from private land, it is by remote access such as aerial or satellite photos. But habitat condition and threats to biodiversity values cannot be assessed this way. Images need to be ground-truthed. The literature review undertaken for this research could find few reports or papers which included data on biodiversity conditions or outcomes from private land. Therefore, this research has attempted to find out what biodiversity monitoring landowners are undertaking and if the information they are gathering can be used to support the obligations and requirements the New Zealand government has for biodiversity reporting.

The questions remains how can landowners be encouraged to protect, conserve and restore indigenous biodiversity on their land and how can we measure the success of these international, national and local goals without a comprehensive and consistent monitoring programme in place on private land? Any national monitoring system must include provision for funding agencies and landowners to participate and measure the success of their on the ground conservation projects. This monitoring data from private land can then provide information for biodiversity status reports.

3.3. Landowners are not involved

Goal one of the NZBS: community and individual action, responsibility and benefits, recognises that '*community and individual actions to conserve biodiversity depend on adequate understanding, information, motivation and support*'. One of the ways to achieve this goal is to work closely with individuals who are already committed to biodiversity protection on their land. These people are the '*real powerhouse of positive change*' and incentive funds to support conservation action by these people go a long way to achieving the goal of '*widespread community action to conserve biodiversity*'. With no monitoring undertaken to determine the biodiversity

outcomes of the work already occurring in New Zealand, an opportunity to '*enhance individual understanding, inform and motivate*' is being lost (DoC & MfE, 2000).

Many local and regional councils contribute significant amounts of contestable funds for biodiversity protection on public and private land; \$28 million was spent on weed and animal pest control in 2003/04 (Green & Clarkson, 2006), and more than \$4.26 million per annum for biodiversity protection on public and private land (MfE, 2007). However, it is hard to determine the indigenous biodiversity outcomes from these funds because of the inconsistent nature of monitoring programmes across agencies. One suggestion is that monitoring and reporting requirements are built into the Biodiversity Condition and Advice Funds (Green & Clarkson, 2006).

It is suggested that councils work with willing landowners, who voluntarily approach councils for advice and support, and are already engaged in biodiversity protection on their land. By encouraging and supporting biodiversity monitoring on these private properties councils can determine the biodiversity outcomes of the incentive schemes and gather biodiversity information for other reporting requirements, such as those outlined above in the LGA and RMA.

Encouraging biodiversity outcome monitoring of conservation work supported by public funds is a way to inform and motivate these environmental leaders and key players in our community. This information on biodiversity improvements can then be used to report on the achievement of this goal at an international and national level.

The use of monitoring in these projects is an ideal way to capture the results of conservation work. Sharing information and experiences between community groups and landowners involved in conservation work will increase the efficiency and effectiveness of their work. With an estimated 3,000 to 5,000 community and landowner environmental protection or restoration projects in New Zealand (Green & Clarkson, 2005), this is a great knowledge base to expand from.

The statutory requirements of the Local Government Act and the Resource Management Act amendments to report on the state of the environment are a good opportunity for cooperation and collaboration between central and local government

to make progress on centralised and consistent environmental and biodiversity indicators and monitoring systems (Green & Clarkson, 2005). To successfully implement the NZBS will require collaboration with the community and landowners as well as coordinated efforts with central and local government and iwi (DoC & MfE, 2000).

4. Conclusion

This research concludes that monitoring of biodiversity change on private land is a requirement to provide information for international, national and local biodiversity status reports. Without biodiversity outcome monitoring there is no way to know what real trends in biodiversity occur on private land. Nor is there anything but anecdotal evidence or isolated case study information to use for national biodiversity reporting. Without such information we are unable to evaluate achievements in reversing the biodiversity decline in New Zealand.

This chapter has demonstrated there are many laws and conventions which require government and its agencies to report on biodiversity on private land in New Zealand. It has also highlighted many gaps and issues that currently exist to accomplish this obligation at a national and more local level.

This research is concerned with the issues of how to involve landowners in the much needed indicators and monitoring programme to include information about biodiversity on private land, and the need to use consistent and standard indicators and monitoring methods to allow for comparison of data at a regional and national level, to provide data for national state of the environment reports.

Monitoring can be used to measure progress toward a key goal in the biodiversity NZBS, that is: halting the loss of biodiversity, especially from private land. To achieve this goal, strategic partnerships are required, to connect landowners, local government, non-government organisations and central government to attain this essential outcome.

Our society relies on a long term fully functioning healthy ecosystem for our economic and social well being, and most people attach importance to the intrinsic

values of our biodiversity. For these reasons, laws have been passed and conventions signed that acknowledge the significance of biodiversity to society at large. National reporting is a mandatory requirement under the numerous laws, conventions and policies to conserve biodiversity. These reports cannot be accurate or truthful if there is no information on the condition and trend of flora and fauna on both public and private land. Without information we cannot meaningfully report on the state of our environment, on the success or otherwise of our policies and plans or use adaptive management to improve conservation practices.

Monitoring and reporting on the results of national policies, strategies and laws is a two way street. They are reliant on information and data coming from numerous sources, on, or close to, the ground. Guidance and support must be provided to landowners so they know what information is useful and necessary to collect. Monitoring can be supported financially and as part of a requirement of the funding provided to landowners to support and subsidise the work they do on their land which protects biodiversity for the nation.

Chapter 5 - The case study results

1. Introduction

Monitoring is a research and information tool to measure change. It helps answer questions about change following events or actions. This research focuses on landowners who are protecting biodiversity on their land and are monitoring the outcomes of their work. They provide valuable examples of people monitoring to measure change. For a landowner, a key general query may be “Am I succeeding in my endeavours to improve biodiversity on my land?” Biodiversity monitoring can be used to answer this question.

Two of the four research questions have been investigated through interviews with landowners, namely:

3. Are there a core group of biodiversity monitoring methods suitable for landowners to measure the success of their conservation actions and to measure improvements to biodiversity on their land?
4. What biodiversity information do landowners need in order to make decisions about management on their land and to inform agencies which have funded biodiversity conservation on their land?

During the literature research and interviews a fifth research question emerged around the social conditions of monitoring. What got these landowners involved in monitoring and what keeps them going? How did they get their monitoring programme up and running and how is their monitoring used in a social context?

In this chapter the results from the case study interviews that answer these questions are presented. An overview is given of the people interviewed, the land involved, the conservation work, the monitoring carried out and the funds received to assist with this work.

The biodiversity monitoring methods used by the landowners in these cases are presented to help answer question three by looking at how these landowners are measuring the success of their conservation actions and how they are measuring improvements to biodiversity on their land.

Question four is answered by looking at how landowners are using their monitoring results to make their own land management decisions and if this information is used to inform funding agencies.

The social features of monitoring that emerged from the interviews are presented to answer question five. The process these landowners undertook to become active monitors on their land, such as finding support and resources in their community and working together are discussed. Another social outcome of the monitoring is how the biodiversity data are used by landowners to inform the wider community in which the landowners live. The results reveal landowner motivations, the social supports needed to monitor, as well as the rewards gained from monitoring and the barriers that had to be overcome.

Direct quotes from the interviews are added in quotation marks and italics throughout the text to highlight relevant points and results. The research revealed that successful monitoring is multifaceted. Biodiversity goals and action plans need to be prepared, the monitoring methods chosen need to be practical and not overly technical and the social resources including support and confidence need to be in place.

The data presented here are a snapshot in time at each case study site, when the interviews took place. The information does not include all the variables that have occurred at a site, but gives a picture of the range and type of conservation and monitoring activities and events that have occurred. For example, 75 overseas visitors monitor in one case, but this figure can vary each year. Another landowner monitored full time for a year on her land and neighbouring properties, but even though this was a 'once off', it is a significant component of that case study's monitoring history.

This chapter reports on what monitoring landowners are using to answer these

questions, the features of successful monitoring and concludes with a look at the barriers to monitoring that landowners identified.

1.1. The people

Nineteen people were interviewed in the 12 case studies undertaken for this research (Table 2). Each case study varied a lot with regard to the number of people involved and their status, role and relationship to the property and the conservation and monitoring project. For example, in seven of the 12 case studies the landowner or owners are monitoring their own land, five cases have contractors or staff employed to monitor the private land, three cases use local community group members to monitor and one case study uses both students and overseas visitors to monitor. In total, over 180 people have been involved in monitoring at the properties associated with the 12 case studies.

Table 2: Status of the person carrying out the monitoring

	Case study	Status	Voluntary or paid	Number of monitors
1	Far North	Independent contractor	Partially funded	1
2	Northland	Landowners	Voluntary	2
		Landowner	Fully funded	1
3	Southwest Auckland	Independent contractor	Fully funded	1
4	Southeast Auckland	Landowners	Voluntary	2
5	Great Barrier Island	Employees	Fully funded	4
		Landowners & Trustees	Voluntary	3
6	Coromandel north	Community group employees	Fully funded	8
		Landowners	Voluntary	10
		Overseas visitors	Voluntary	75
		Students	Voluntary	50
7	Coromandel south	Landowners	Voluntary	2
8	East Cape	Government employees	Fully funded	2
9	Wairarapa	Community group	Voluntary	5
10	Kapiti Coast	Community group employee	Fully funded	1
		Community group	Voluntary	9
11	Banks Peninsula east	Landowners	Voluntary	2
12	Banks Peninsula west	Landowners	Voluntary	3
		Community members	Voluntary	5

In these case studies there is often a mix of people doing either voluntary monitoring work or paid or partially paid monitoring. Twelve cases have people monitoring on a voluntarily basis, six cases have fully funded monitors and one case has a partly funded monitor.

In nine of the 12 cases the monitoring is done by two or more people. In three of the seven case studies where the monitor is paid or partially paid, the monitor does this work alone. Only two landowners in these cases work alone on monitoring. The average age of the interviewee is over forty, with a good number in their fifties and sixties.

1.2. The land

The case studies are predominantly located in the North Island (ten); with two in the South Island, both on Banks Peninsula, Canterbury. All cases involve a group of private properties, except case study nine - Wairarapa - which is one property. Ten of the 12 projects are centred on bush remnants, although the size of the remnant and surrounding fragmentation varies widely. Ten cases are lowland sites, and eleven are located near the coast. This distribution roughly reflects the human population distribution in New Zealand, with three quarters of residents living in the North Island (Statistics New Zealand, 2008), predominantly on low lands, near the coast (Gunston, 2008).

The document Protecting our Places (MfE & DoC, 2007) describes the national priorities for protecting rare and threatened biodiversity on private land in New Zealand (Table 3) and emphasizes the environments of main concern for biodiversity protection on private land.

Table 3: National priorities for protecting rare and threatened biodiversity on private land

National Priority 1	To protect indigenous vegetation associated with land environments (defined by Land Environments of New Zealand at Level IV), that have 20 percent or less remaining in indigenous cover.
National Priority 2	To protect indigenous vegetation associated with sand dunes and wetlands; ecosystem types that have become uncommon due to human activity.
National Priority 3	To protect indigenous vegetation associated with 'originally rare' terrestrial ecosystem types not already covered by priorities 1 and 2.
National Priority 4	To protect habitats of acutely and chronically threatened indigenous species. At December 2006, 668 species were considered to be acutely threatened and 257 were listed as chronically threatened.

(Source MfE & DoC, 2007)

All case studies have at least one 'environment' listed as a national priority in "Protecting our Places" (Table 4). All 12 cases have priority 4 environments, supporting habitat for acutely or chronically threatened indigenous species; eight cases have some priority 1 indigenous vegetation and three cases have wetland or dune habitats.

Table 4: National Priority Environments at the case study sites

	Case study	National Priority Environments
1	Far North	4 - kiwi (<i>Apteryx mantelli</i>), kukupa (<i>Hemiphaga novaeseelandiae</i>), kauri snail (<i>Paryphanta busbyi</i>), green gecko (<i>Naultinus grayii</i>), fern (<i>Todea barara</i>).
2	Northland	1 - small area around Harbour. 2 - wetland. 4 - kiwi, kukupa, bittern (<i>Botaurus poiciloptilus</i>), pateke (<i>Anas chlorotis</i>).
3	South west Auckland	1 - most of peninsula in this category. 4 - kereru, bittern, kaka (<i>Nestor meridionalis septentrionalis</i>), many plant species including <i>Myriophyllum robustum</i> , <i>Pellaea falcata</i> , <i>Ranunculus macropus</i> , <i>Sonchus kirkii</i> .
4	South east Auckland	4 - kereru, kaka, possibly Auckland green gecko (<i>Naultinus elegans</i>).
5	Great Barrier Island	4 - kereru, bittern, kaka, chevron skink, (<i>Oligosoma homalonotum</i>), pateke.

	Case study	National Priority Environments
6	Coromandel north	1 - coastal lowlands. 2 - wetland and sand dunes. 4 - kiwi, kereru, kaka, Archey's frog (<i>Leiopelma archeyi</i>), Coromandel striped gecko (<i>Hoplodactylus stephensi</i>), giant kokopu (<i>Galaxias argenteus</i>).
7	Coromandel south	4 - kiwi, kereru, kaka, Archey's frog, possibly Coromandel striped gecko.
8	East Cape	1 - small areas of coastal vegetation. 4 - kiwi, kereru, kaka, kokako (<i>Callaeas cinerea wilsoni</i>), whio (<i>Hymenolaimus malachorhynchus</i>), long tail bat (<i>Chalinolobus tuberculata</i>), dactylanthus (<i>Dactylanthus taylori</i>).
9	Wairarapa	1 - lowland forest remnant - formally protected. 2 - wetland. 4 - kereru, brown mudfish (<i>Neochana apoda</i>).
10	Kapiti Coast	1 - much of Kapiti Coast. 4 - kereru, possibly Whitakers skink (<i>Cyclodina whitakeri</i>).
11	Banks Peninsula east	1 - much of Banks Peninsula 4 - jewelled gecko (<i>Naultinus gemmeus</i>), white flipper penguin (<i>Eudyptula minor albosignata</i>), yellow eyed penguins (<i>Megadyptes antipodes</i>), spotted skink (<i>Oligosoma lineocellatum</i>), falcon (<i>Falco novaeseelandiae</i>).
12	Banks Peninsula west	1 - much of Banks Peninsula 4 - kereru, North Island rifleman (<i>Acanthisitta chloris granti</i>), jewelled gecko, Canterbury gecko (<i>Hoplodactylus</i> "Canterbury").

1.3. The protection

Conservation action in the twelve cases included legal protection of the land, pest plant and animal control, wetland and terrestrial revegetation, fencing, bird translocations, nest box supply, community education and advocacy (Table 5).

Table 5: The number of private properties involved in each case study, the private land area protected and the forms of legal protection or conservation action undertaken

	Case study	Number of private properties	Area protected (hectares)	Form of legal protection, pests controlled and other conservation action
1	Far North	29	720	QEII covenant
			1,600	Stoat, possum, cat, pig, dog, rat, hedgehog
			800	Stoat, possum, cat, pig, dog
2	Northland	30	60	QEII covenant = 3 ha, council covenant = 57 ha
			800	Rat, possum, stoat, cat
			-	Translocated pateke
3	Southwest Auckland	80	146	QEII covenant
			22,000	Possum
			2,000	Deer
4	Southeast Auckland	40	1,000	Possum
5	Great Barrier Island	14	130	QEII covenant
			450	Cat, rat, pig, magpie (No stoats or possums on the island).
			-	Translocated robins
6	Coromandel north	250	450	QEII covenant
			8,500	Stoat
			2,000	Possum
			450	Rodents
7	Coromandel south	5	20	QEII covenant
			600	Mustelid, possum
8	East Cape	10	50,000	Kawenata (covenant)
			70,000	Goat control
			25,000	Possum control
			1,300	Mainland island site: stoat, possum, rat, goat, deer, less intensive buffer zone
			475	Mainland island site: stoat, possum, rat, goat, deer, intensive pest control in core area

	Case study	Number of private properties	Area protected (hectares)	Form of legal protection, pests controlled and other conservation action
			-	Translocated kokako
9	Wairarapa	1	32	Legally protected reserve
			32	Possum, mustelid, rat
10	Kapiti Coast	2	88	Deed of right with QEII
			88	Possum, mustelid, environmental weeds
11	Banks Peninsula east	6	30	QEII covenant
			3,000	Stoat, ferret, cat
12	Banks Peninsula west	12	83	Stoat, possum, rat, hedgehog
			16	Mix of native and non-invasive exotic tree species planted into eroding pasture
Total		479	51,676	

There are 479 private properties involved in these cases, and over 51,000 hectares have legal protection through Ngā Whenua Rahui kawenata (covenant), QEII covenants, or a Council covenant. Ten different animal pests are controlled at the sites and revegetation and weed control is carried out on 106 hectares in three cases (Table 6).

Table 6: Total number of private properties and the total number of hectares protected by legal means or animal pest control

Number of private properties	479	
Number of hectares protected	Hectares	
Legal protection	QEII	1,499
	Ngā Whenua Rahui Kawenata	50,000
	Council Covenant, Private Reserve or Deed of Right	177
Animal pest control	Goat	70,000
	Possum	54,003
	Stoat	17,278
	Rat	5,190
	Cat	6,650
	Pig	2,850
	Deer	3,775
	Hedgehog	1,683
	Dog	2,400
	Magpie	450
Revegetation and weed control		106

1.4. The funds

The funds received for conservation action from funding agencies at the case study sites ranged from approximately \$2,000 to \$850,000 (Table 7). The funds were received from eighteen different funding sources. This list does not cover all funds for all years, and does not include the many and varied ‘in-kind’ support and contributions these projects receive from other sources, such as advice, volunteer labour, administration and wholesale rates for products. This list gives an indication of the funding sources available and utilised in these cases and demonstrates the range in size and scale of the case studies.

Table 7: Funds received for biodiversity protection at the case study sites

Case study	Far North	Northland	South west Auckland	South east Auckland	Great Barrier Island	Coromandel north	Coromandel south	East Cape	Wairarapa	Kapiti Coast	Banks Peninsula east	Banks Peninsula west	Totals
Government Funding / Dept of Conservation						\$6,500		\$850,000					\$856,500
Biodiversity Advice and Condition Funds	\$30,000	\$31,000	\$40,000		\$60,000	\$90,000							\$251,000
Lotteries					\$89,000					\$56,000			\$145,000
Royal Society		Year fellowship											Unknown
Regional and local councils	\$8,000			\$8,000	\$13,700	\$8,000			\$5,000				\$42,700
BNZ Save the Kiwi	\$8,000					\$30,000							\$38,000
Community Organisations Grant Scheme (COGS)			\$23,000										\$23,000
Community Trusts				\$10,000						\$12,000			\$22,000
Membership, donations and fundraising						\$3,000				\$12,000			\$15,000

Case study	Far North	Northland	South west Auckland	South east Auckland	Great Barrier Island	Coromandel north	Coromandel south	East Cape	Wairarapa	Kapiti Coast	Banks Peninsula east	Banks Peninsula west	Totals
Pacific Conservation and Development										\$15,000			\$15,000
Transpower		\$4,700		\$2,000		\$1,500	\$2,000				\$2,000	\$1,000	\$13,200
Banrock Station via Ducks Unlimited		\$12,000											\$12,000
Landowner Contribution				\$10,000								\$1,500	\$11,500
Private bequest									\$10,000				\$10,000
Income									\$10,500				\$10,500
World Wildlife Fund		\$8,000											\$8,000
F.O.R.S.T.											.	\$5,000	\$5,000
Ron Greenwood Trust									\$2,000				\$2,000
													\$1,480,400

2. Biodiversity monitoring methods

This research asks if there is a core group of biodiversity monitoring methods suitable for landowners to measure the success of their conservation actions and to measure improvements to biodiversity on their land.

Interviews were conducted with 19 landowners and monitors to find out what biodiversity monitoring methods were in use in these 12 case studies, what the purpose of the monitoring was and what landowners did with the data.

Questions were asked about what monitoring methods landowners use to measure change and progress towards goals and biodiversity improvements and how they measure the success of their conservation actions, with questions on their biodiversity project goals and whether they have any written project plans.

2.1. Measuring the success of conservation goals

Landowner's were asked if they use monitoring to measure the success of their conservation goals. Landowners said yes, they want to know that what they are doing is making a difference. They commented that monitoring allows them to see the progress they are making with their conservation work, and monitoring results gives them direct feedback and demonstrates the changes. Monitoring results provide landowners with satisfaction and gives them an incentive to keep going with their work, to maintain their commitment and feel good about the outcomes.

*“Success is a very comforting thing; it’s the payback for all my hard work.
That’s what the monitoring gives me”*

“We hope we’re doing the right thing, monitoring should tell us”

“Our monitoring results tell us we’re on the right track”

- **Project goals**

An essential precursor to using monitoring to answer questions or to measure change or success in a conservation project is to have goals that describe the desired

outcomes or objectives the project is working towards. In this way, an appropriate monitoring method is linked directly to the desired outcomes.

Landowners were asked if they had goals for their project and whether they could describe the outcomes they wanted. The style or structure of goal setting ranged from organic and evolving with time, to formal written strategic plans. In two cases landowners used reports on the ecology of their land and area to provide baseline data or guidance for their goals and monitoring programme.

Four sites could be described as having strong project and monitoring goals, such as strategic and operational plans, and clearly defined questions the monitoring is designed to answer, such as:

- Are native bird numbers, including kiwi, stable or increasing through current management?
- Is forest canopy health improving following possum control?
- Are possum numbers being maintained below the 5% Residual Trap Catch rate target by the current management?

Two sites have medium strength project and monitoring goals, for example a clear and easily measured goal such as maintaining possum numbers below 3%, which is measured using the residual trap catch (RTC) method, but they do not have clear biodiversity outcome aims.

Six cases could be described as having weak project and monitoring goals. These goals are vague or could change over time, such as 'improving forest health'. The goals are not clearly defined or easily measured or linked to monitoring data. In one case the goals were articulated solely to suit a funding application.

2.2. Measuring improvements to biodiversity

Landowners were asked questions about how they measure change in biodiversity on their land. Everyone interviewed is using at least one biodiversity outcome method, with 20 of the 31 total monitoring methods recorded being biodiversity outcome methods. For instance:

- Weta tracks in tracking tunnels on the ground have increased over time in the Coromandel north case which is thought to be a response to the intensive rat control that is taking place there.
- Improved stream or wetland habitat is an objective in four cases, and six different biological outcome variables such as indicator fish and native frogs are monitored to look for trends in abundance.
- Five types of vegetation monitoring are used at ten sites to measure changes in native plant regeneration, the impact of possums on foliage and revegetation plant survival.
- All but one site is measuring the outcomes for birds, using eight monitoring methods.
- The nesting success of three endangered birds is measured at three sites, and one case measures kiwi population structure.

In ten cases, landowners have goals of improving forest health and their measures include pest animal tracking tunnels, possum residual trap catch, five minute bird counts and foliar browse index to act as indicators of improving forest condition.

“So long as this monitoring is a long term thing, not petering out after 5 years, the true worth of the monitoring and conservation work will show. Otherwise we’re only guessing what happens when the bush is fenced and the possums are gone”.

- **Iconic species**

Eight cases included an iconic faunal species in their monitoring programme. Kiwi featured in five cases, with landowners participating in the National Annual Kiwi Call Count Programme. Small, local or isolated populations such as mud fish, weta, birds and lizards also featured and made good local indicators.

“We get tremendous support from the landowners around here because they hear kiwi on their land. It is a real buzz for them”.

“The landowners have a great personal connection with the kiwi, as they keep them awake at night with their calls”

“We set up weta motels to increase the interest in weta and build up the personal connection landowners have with native species on their properties”.

2.3. Monitoring to inform

A key role for monitoring is to inform decision making. Monitoring can answer questions about conservation actions and land management to allow people to make informed decisions. What biodiversity information do landowners need in order to make decisions about management on their land and to inform agencies which have funded biodiversity conservation on their land? Landowners and monitors were asked what they did with their monitoring data and how they used the information to see if their results are used to inform their land management decisions.

- **Informing land management decisions**

Results from the interviews found that the information gained from monitoring was used by three quarters of these landowners to inform some of their land management and conservation decisions (Table 8).

Table 8: Examples of monitoring results used to inform land management decisions at each case study

	Case study	Land management decision example
1	Far North	Wax blocks and small mammal tracking along with species recovery data provides a basis on which to make management decisions and management changes.
2	Northland	Transmitters to track pateke survival. Lead to reconsideration of further translocations, research into other translocations and reassessment of the pest control grid.
3	Southwest Auckland	Chewed wax tags used to inform landowners of need to refill bait stations.
4	Southeast Auckland	RTC used to pay contractors and to know if RTC goal achieved.
5	Great Barrier Island	Want to use forest health results to establish tolerance levels – What are the maximum pest levels native species can tolerate and still achieve a conservation outcome. May alter control regime to test this.
6	Coromandel north	Used tracking tunnels to assess pest numbers following rat control. Now see they have a mouse problem so have made decisions about how to deal with this.
7	Coromandel south	No examples given.
8	East Cape	Monitoring results presented to landowners to get agreement to continue with intensive pest control on their land. RTC and pellet lines used to determine where possum and goat control is needed each year.
9	Wairarapa	No examples given.
10	Kapiti Coast	No examples given.
11	Banks Peninsula east	Penguin nest success declined in areas of rank grass, possibly due to increased pest habitat, so decision made to return stock and shorten grass. Will see if penguin nest success increases again with this management.
12	Banks Peninsula west	No examples given.

Two landowners are using monitoring results to plan their future work and to make their project more efficient, so resources are used most efficiently.

“By recording which traps were the most effective I could reorganise the trap layout to reduce the density but trap a larger area”.

“We use our monitoring results to plan the next years work. It’s essential and a priority with our limited resources to use the money where it is needed most”.

Landowners said they needed information from monitoring because they were trying new things and need to know they are getting the desired results. For example, they used the data to improve new pest control programmes and to educate and inform themselves and other landowners.

“The monitoring results were clear. We have to do something different next time, or we’ll get the same result, and we don’t want that”.

“If we hadn’t had the tracking tunnels it wouldn’t have been as obvious that the mice numbers had increased so much. Now we can plan some action around that issue”.

“We use graphs to show the monitoring results to about 200 Annual General Meetings each year. Without the data we wouldn’t have measurable stuff to show them. Some people don’t see the need for pest control, so the data is good for education. The results get the story across and help to justify the intense pest control programme”.

“The wax tag results are passed to the landowners, and if they’ve been chewed by a possum, the landowners are encouraged to refill their bait stations to get rid of them.

Not all landowners use the monitoring information they gather to inform their conservation and land management decisions. Four cases did not provide examples of how they are using their monitoring results to make decisions on their conservation work.

Overall most landowners use at least one of their monitoring methods to inform their land management decisions but in the majority of cases only one of the monitoring methods they undertake is used for this purpose. For example, four monitoring methods are used at one property case study, but only one is considered (RTC) in relation to any future works or land management decisions.

- **Informing funding agencies**

What biodiversity information do landowners need in order to inform agencies which have funded biodiversity conservation on their land? Do agencies which fund biodiversity protection and enhancement on private land ask for data to measure the success of their funding initiatives? Are there built-in reporting requirements attached to the grants provided to landowners? Do funding agencies have goals or targets attached to the funds they provide, and do they know if their fund goals are being met? The assumption is that feedback from landowners about biodiversity improvements would show how effective the funds are at achieving conservation outcomes.

All case studies have received funds from one or more funding agency to support their conservation project (Table 7). Interviewees were asked if there were any monitoring or reporting requirements from funding agencies attached to the funds they received towards the project and if they needed to evaluate their biodiversity achievements for any external reasons. The respondents said no, they don't have to do monitoring for external reasons. They undertake biodiversity monitoring for their own needs, not because they have to or because there is any requirement to, such as reporting obligations for a funding agency.

Most projects provide progress reports to the funding agency, based on completion of the agreed work, or evidence of approved equipment being purchased. One case study report back to a funding agency included subjective evidence of improvements to biodiversity.

“I’m required to write a report to the funding agency, based on my ‘personal assessment’ of possum abundance, using a decrease in scratch marks on trees or a general increase in seedlings as an assessment”.

Landowners are using 24 biodiversity outcome methods and five result monitoring methods to assess the effectiveness of their work. Despite this, in only one case was there a requirement to report quantitatively on biodiversity outcomes. In all other cases there was no need for any quantitative reports on the biodiversity outcomes of their conservation work to be provided to a funding agency, although five projects do provide monitoring results on a voluntary basis. No evidence was found that landowners need to measure the success of their conservation actions to satisfy the requirements of funding agencies.

- **Informing others**

An interesting finding from the interviews was the amount of information these landowners pass on to others in their communities about their project and the associated monitoring. In ten of the 12 cases the landowners want the benefits of their conservation action to spread beyond the boundaries of their property. To do this they use their monitoring data to publicise their successes, to inspire others into conservation action and get more people involved. In this way, these landowners may be influencing the land management decisions of others in their communities.

“We see ourselves as a role model for the community on conservation ideas and want to share this with others”.

“Others in my community were asking how the monitoring was going, so we put an article about our results in the local newsletter”

“I loaned a Timms trap to my niece and talked to her about her bush block after the FORMAK training”

In one example, a ripple effect spread through the neighbourhood and to external organisations when a landowner started trapping.

“Our neighbour started trapping, and that influenced us. Then the Department of Conservation saw how well we were doing and they came on board. Now lots of us around here are involved in pest control”.

Landowners said that having monitoring data to illustrate the conservation benefits of a simple yet consistent conservation programme can engage and influence neighbours and the wider community, by demonstrating how feasible biodiversity improvements are. According to one person, persistence is everything.

“If you put the results and information in front of people often enough they eventually take notice”.

Many landowners and monitors interviewed came across as well liked and respected members of their community. They are an integral part of the neighbourhood, and have easy relationships with others in their community. These landowners talked passionately to others about their experiences and results and people listen to them. One landowner said:

“There is a strong undercurrent of support for the environment from the landowners in this area. We are well supported when we go out and do advocacy work”.

Other landowners and monitors had difficulties. In two cases conflict arose between the conservation aspirations of some landowners and the differing opinions of other landowners, such as views over the use of toxins to control pest animals and plants.

The main use of monitoring data in these cases is to find improvements to biodiversity, mostly at a species level through biodiversity outcome monitoring and to measure the level of success of pest control. This is related to measuring progress towards project goals. Using monitoring data to make land management decisions is not the most important use of monitoring for the landowners in these cases. However, the data are discussed with others and this may lead to changed land management decisions by other people in the community.

To recap, during the interviews the landowners confirmed that they do not need to monitor as a requirement of any funding they receive, but rather they want to undertake biodiversity monitoring for their own information needs, and used this information in their land management decisions. They also shared their results and knowledge with their communities.

3. Monitoring methods used by landowners

Thirty one different monitoring methods or measures are used by the landowners in the case studies (Table 9), with the number of methods used per case study ranging from two to 13.

Table 9: Monitoring methods used in the twelve case studies

	Case study	Trap catch records	Pre and post pest control monitoring	Possum residual trap catch	Tracking tunnels	Wax tags	Bird counts	Kiwi call counts	Insect pit fall trapping	Photo points	Vegetation plots	Baseline monitoring	Control site	Other methods
1	Far North	✓	✓		✓	✓	✓	✓		✓		✓		Kiwi population and age structure monitored, foliar browse index, weta motels.
2	Northland	✓			✓	✓	✓	✓		✓	✓	✓	✓	FORMAK site assessment, wetland bird survey, adaptive management.
3	Southwest Auckland		✓	✓ ³	✓	✓	✓	NA			✓		✓	Foliar browse index.
4	Southeast Auckland			✓ ⁴				NA			✓	✓		FORMAK site assessment.

³ Residual Trap Catch index undertaken by ARC.⁴ Residual Trap Catch index undertaken by ARC.

	Case study	Trap catch records	Pre and post pest control monitoring	Possum residual trap catch	Tracking tunnels	Wax tags	Bird counts	Kiwi call counts	Insect pit fall trapping	Photo points	Vegetation plots	Baseline monitoring	Control site	Other methods
5	Great Barrier Island	✓	✓	NA	✓		✓	NA	✓				✓	Seedling plots, fresh water invertebrates, weta, lizards, robin breeding success, adaptive management.
6	Coromandel north	✓	✓	✓	✓		✓ ⁵	✓	✓	✓	✓	✓ ⁶	✓ ⁷	Annual wetland bird survey, stream fish survey, frog survey.
7	Coromandel south	✓						✓						
8	East Cape	✓	✓	✓	✓		✓	✓	✓ ⁸			✓	✓ ⁹	Foliar browse index, seedling transects, kokako nesting success.

⁵ One off five minute bird count

⁶ Wetland baseline

⁷ Wetland control site

⁸ One off insect pit fall trap survey

⁹ Only five min bird count has a control site.

	Case study	Trap catch records	Pre and post pest control monitoring	Possum residual trap catch	Tracking tunnels	Wax tags	Bird counts	Kiwi call counts	Insect pit fall trapping	Photo points	Vegetation plots	Baseline monitoring	Control site	Other methods
9	Wairarapa	✓			✓		✓	NA	✓	✓	✓			Mud fish, water levels, water quality, freshwater inverts, bait take, plant survival, adaptive management.
10	Kapiti Coast	✓					✓	NA		✓				Bait take, plant survival.
11	Banks Peninsula east	✓					✓	NA						Jewelled gecko, Banks Peninsula tree weta, common skink, penguin nest success.
12	Banks Peninsula west	✓	✓		✓	✓	✓	NA	✓	✓				Adaptive management

The monitoring methods landowners use most frequently are five minute bird count and trap catch records, in use at ten case studies; and tracking tunnels, used in eight cases. Also popular were photo points, used at six sites; vegetation plots, at five sites; and kiwi call counts, at five properties. Five cases have control sites, and another five monitor pre and post pest control numbers.

Bird count methods are the most common biodiversity outcome method used in the case studies, with nine of the 12 cases using five minute bird counts. Five case studies use kiwi call counts, four measure a specific bird population, and two record wetland birds.

All case studies involve pest control of at least one introduced mammal and all projects record control results using one of six methods. The most frequently used result methods to monitor the effectiveness of pest control were trap catch records, used in ten sites, and tracking tunnels at six sites. Pre and post pest control monitoring is used five times, residual trap catch and wax tags are used in four cases and bait take is recorded at two projects.

“Wax tags showed the change in abundance of possums down the peninsula as the control progressed from north to south. Then the wax tags showed an increase in rodents following the possum control”.

Vegetation rehabilitation is a major goal of six case studies and four of these are using vegetation plots to measure progress. Two sites measure changes in seedling plots and three use a foliar browse index. Plant survival in restoration planting is recorded in two sites.

Another six sites use photo point methods. Five landowners took photos of their vegetation plots, including one of coastal vegetation, and one case had aerial photos of their land pre and post revegetation planting.

Five landowners established control sites for their project to measure differences between their treatment and an area not receiving treatment. Four projects recorded baseline monitoring data prior to any control work at their site, to allow for comparisons over time at the site. Adaptive management or some form of experimentation was used in five cases, although the methodology was not

witnessed. Examples included: comparing tracking tunnels and wax blocks; monitoring plant survival; trying to determine minimum pest densities for native birds, penguin nest success under different grass conditions and developing community self reliance with regards to pest control.

“There’s a remarkable difference in bird numbers between the control site and the mainland island site. It’s scary really”.

“A control site outside the pest control zone was set up to answer the question ‘how do we know if we’re meeting our objectives?’ It is part of our search for information on tolerance levels; what are the levels of pest predators that are acceptable so that the native species in question can survive and increase”?

Of the six most commonly used methods, four are biodiversity outcome methods (five minute bird count, kiwi call count, vegetation plot, photo point) and two are result methods (trap catch record, tracking tunnel). Two methods focus on birds, two on vegetation and two on pest control.

“Now we’re measuring the positive changes and outcomes for the fauna around here, not just the reduction in pest numbers”.

3.1. Non-quantitative monitoring

All landowners in these cases gave at least one example of non-quantitative monitoring which they use to assess their projects. These include:

Common sense:

“I have a gut feeling of how it’s all going”

“I know there are pests all around here, this remnant is a magnet for them”.

“My experience tells me.....”

“The inlet comes from stocked paddocks and the sweet-grass tells me the water nutrient levels are high”

Observations:

“I keep a close eye out”.

“That’s a good sign”

“I’m very aware of changes and what’s going on”

“I’m curious about changes so look out for them”

“When new species turned up I knew we’d made a difference”

“If you go down there you’ll see the difference from last year”

“I keep a notebook and jot down notes in there”

Anecdotal information and stories from others:

“People call us up and say they saw kiwi”

“A neighbour said their pohutukawa flowered for the first time this year, since the possum control”

“We looked at pateke survival at Moehau as a guide”.

The amount of non-quantitative monitoring or intuition was substantial and the pros and cons of this are discussed in the next chapter.

3.2. Monitoring results

Written monitoring results from half the cases were provided with information from public newsletters, web sites and monitoring reports. All cases had some information from their monitoring, but in half the cases the results are not written up into finished reports or the landowners did not want to share the information with me in written form. For example, in one case, the monitoring results are *“in a box some where in the back room”*. I asked for a copy, but they were not sent due to more pressing priorities (three children under three).

In four cases the monitoring projects are newly established and in six cases a monitoring method has yet to be repeated, so there are not yet enough data or results for analysis or reporting. For example, Banks Peninsula west has just finalised its bird count monitoring protocol. In another case, the use of trained sniffer dogs to find kiwi and assess the population structure has been done once, and will be repeated in five years. Panoramic shots of coastal vegetation to assess condition were taken and will also be repeated every five years. This means there are no monitoring results to report yet in these examples, apart from the baseline information.

Information about the monitoring results from the interviews with landowners reveals that in all but one case the landowners are using the information from their monitoring. The monitoring is used to measure and publicise their achievements and success to the wider community and to be better informed about the natural environment on their land. They are using the monitoring results to guide their decision making and management choices. However, it could not be established from the written monitoring results provided that the monitoring programmes are having a significant impact on the management regime in these case studies.

4. Social conditions of successful monitoring

A fifth research question emerged from the literature review and interviews around the social resources needed for monitoring. Through the literature review it seems there is enough information about monitoring and enough monitoring tools. It seems the uptake of monitoring is the limiting factor. What are those limiting factors? Is it that people don't see a need or reason to monitor? There has been no compulsion to monitor from funding agencies and biodiversity monitoring has been criticised as lacking relevance for policy makers and managers and as unsuccessful at incorporating ecological information into decision making (Danielsen *et al.*, 2005).

A research premise is that landowners are well placed to undertake monitoring to report on the effectiveness of publicly funded biodiversity protection on private land, especially their own land. The landowners in these case studies are doing the monitoring, so what makes them different?

Through the interview process these landowners were asked about their reasons for doing conservation work, along with their motivations, aspirations and the rewards they gain from the project. The monitoring methods used are only one issue. The other is - what does it take for people to be concerned and motivated to start monitoring?

What attracts these landowners to monitoring and what do they hope to gain from it? Where did the interest in monitoring come from and what got them going? What social situations is their monitoring is used in? The interviews explored how landowners got involved with monitoring, how their interest was initiated, what attracted them to it, and what supports they had received, and their views on the benefits and barriers to monitoring. Their answers have been summarised into the themes of: work together, support systems, monitoring rewards and barriers to monitoring.

4.1. Work together

In all but one case, where landowners are carrying out monitoring, they are working with another person on the project. A landowner said that working as a team, not in isolation, provides them with good motivation and is more time efficient. Good partnerships and complementary monitoring teams have developed. These quotes from landowners illustrate the point.

“I don’t think I would have done monitoring by myself. I may have started, but don’t think I would have kept it up”

“I said I’ll do the field work, but I’m not interested in the database stuff, but the committee said, ‘not a problem, we’ll find someone to do that part’. So the support and team work has been great, otherwise it wouldn’t have happened”.

Only one landowner said they preferred to work alone on monitoring, as it aided concentration and was a contemplative time alone.

All of these landowners are working with others in their community that they have met through their interest in conservation and monitoring. Through word of mouth and networking they meet other people with a similar interests and knowledge. They share their enthusiasm for their land and the environment with others and examples were given of this passion snowballing and inspiring more action.

“I thought I was alone with my ideas for conservation here, until I went out into the wider community and got to know what others were doing. It’s been great positive reinforcement”.

“There are loads of people getting involved in conservation around here. We can see mistakes new groups make that we have already worked through, so we’re passing on our experiences and monitoring results to them”.

“There are over 40 land-care groups in Northland now; we liaise with them and the Kiwi Recovery Group a lot”.

One landowner has employed over 13 people from her local community, with good results.

“Being able to employ locals has been a great factor in changing attitudes in the community towards the project. When we employ staff or contractors from the community it has a big impact on attitudes and values, it converts people to the idea of conservation”.

The types of support these landowners get comes from a variety of levels, from one-on-one support from a friend or mentor, to a few neighbours working together, to large community networks, with paid and unpaid people working together on complex conservation projects. In ten cases, landowners are working with organisations with responsibilities and interests in biodiversity in their regions. As shown in Table 7 over 18 organisations have provided direct funding to landowners. Other organisations provide advice and contacts.

“I have had good advice and help from all over the place, people have fallen over backwards to help”

“I never would have dreamed the project would get this far, this quick, once everyone came together. It’s stunning”.

In one case, where an agency carries out monitoring on behalf of a landowner, joint decisions are made between the two parties on what data the agency will collect.

“We went to the trustees and asked them what flora and fauna information they wanted us to collect”.

- **Working together issues**

As with all human relationships, there are bound to be issues at some time when it comes to working together. The main concerns raised in the interviews is the need for consultation between stakeholders, ownership of monitoring data and the ebb and flow of energy for projects.

Issues around consultation between experts and landowners occurred in five cases, when the expectations of both sides varied and needed to be reconciled. Landowners said they want advice and assistance on monitoring, but it had to be practical, to match their skills, and they don’t want to be told what to do, or to lose ownership of their programme.

“Landowners don’t want to be told what to do on their land. All you can do is suggest or lead by example, then let the desire come from the landowner”

In a couple of cases, where either a contractor was monitoring on behalf of landowners or landowners were monitoring and collecting data in conjunction with an agency, there seemed to be a lack of ownership of the monitoring programme and the information it gathered by the landowners. One monitoring contractor said that none of the property owners would do the monitoring themselves, even though they are capable and some of them come out with her when she monitors on their land, so it seems they have the time. Another monitor said:

“We collect the data and pass it to the agency, but it takes forever to get any information back. It’s pretty annoying and sometimes I wonder why we bother”.

Questions were asked of landowners around the energy and availability of people to monitor these projects. In half of the cases there seemed to be enough human resources for the project, and new recruits were available from the community. In the other half of the cases, they seem less able to engage new members, and these projects may struggle to maintain monitoring in the long term. Like most parts of human society, energy and priorities wax and wane for individuals, therefore, the monitoring teams have to change as well.

The findings from the interviews show that landowners are working together and getting support at a variety of scales for their monitoring. They like to work together, and this seems to be a central factor to their successful monitoring programme. This includes working with individuals and organisations in the community. Landowners want advice and assistance on monitoring, but don't want to be told what to do, or to lose ownership of their project. The significance of these findings is discussed in the following chapter.

4.2. Support systems

During the course of the interviews three types of supports or resources were mentioned as essential components of these monitoring programmes. There were: people supports, such as mentoring; financial support, both direct funding and in-kind support; and using existing monitoring resources and kits.

4.2.1. Support from people

A subject that often came up in the interviews is that landowners can lack confidence when first embarking on monitoring but getting support from others builds their confidence. Their self-assurance grows through getting support and gathering resources. This support and feedback from others is a key to building monitoring confidence.

“My mentor gave me a push and said “you can do it”. When we went in to the bush together and started recording birds I realized – hey, I do know what I’m doing. It gave me the confidence I needed”.

“We held a workshop on bird monitoring and the team got training on the bird count method. The trainer came back later to assess the accuracy of the data collected and gave us feedback on the results”.

An important first step is to know where to go to get support. Landowners found experienced and skilled people in their local community to mentor them in monitoring methods. Word of mouth and informal networks was the most common way landowners made contact with others. Both professional and amateur ‘specialists’ were consulted. Landowners got help setting up their monitoring programme, choosing monitoring methods, analysis of data and discussed the implications of monitoring results with others. Landowners said that having local mentors, support people and training, as close to them as possible, was very helpful.

“It’s good they’re so close and helpful or maybe we wouldn’t have bothered trying to find the answer out”

“Some of us landowners may not have the scientific background or capacity to know how to analyse the data collected. For example, looking at the relationships between variables and seeing the significance. Students help us here, taking the data collected and analysing it for us”.

Over half the landowners said they needed to have somewhere to go to have questions answered as they practiced monitoring and came up with questions or problems. They said it was useful to talk about monitoring with others, to discuss the methods, the theory and concepts behind monitoring techniques. Being able to ask for feedback and constructive criticism was also helpful.

“It’s been good to talk about monitoring in general and our monitoring problem. Now I understand the significance of that method and measurement”

4.2.2. Financial support

All landowners in these cases have received funding for their project, and eight of the twelve cases have received funds or in-kind support for either monitoring equipment, monitoring training or for people to do monitoring on their behalf.

Other practical supports received include in-kind support from agencies to support monitoring programmes, such as agencies teaching monitoring skills, or paying for landowners to attend training, or providing monitoring tools. One landowner suggested applying to local funding organizations first, then wider a field.

“The cost of tracking tunnels and monitoring were built into funding applications. It costs about \$6,000. We have funding to carry on monitoring for another year”.

Some projects have found ways for the conservation and monitoring programme to become fully or at least partially self sustaining and self reliant. Examples include: forming a charitable trust to receive grants from a wider range of sources, earning income from summer programmes, membership and donations, and receiving bequests that earn interest. One case study inherited land for grazing that is leased and generates income to support the conservation and monitoring work.

4.2.3. Monitoring resources

Existing monitoring resources landowners have used in these cases include the Forest Monitoring and Assessment Kit (FORMAK) (Handford & Associates Ltd, 2004), Stream Health Monitoring and Assessment Kit (SHMAK), (Biggs *et al.*, 2002), Bush Vitality Assessment (Janssen, 2006) and Turning the Tide - An estuaries toolkit (Robertson & Peters, 2007).

“If we hadn’t had FORMAK we wouldn’t have thought of doing monitoring for ourselves. It was great to have the kit altogether. The manual reads well. It’s not too labour intensive and you can ‘follow the dots’. Any one with a college education should be able to handle it”.

“We really like the estuary monitoring book, it’s easy to read and understand, it’s very hands-on and you get measurable results”

“I found the Bush Vitality book really useful, it spoke my language, and I thought it was very realistic.”

“The stream health kit was fantastic, we got a lot out of it, and I think the kids see the stream differently since then, it’s a lot more interesting to them now.”

Once landowners have basic monitoring information they are keen to get out and practice themselves. One monitor said:

“Landowners learn more by trying monitoring than worrying about getting it absolutely right the first go”.

All of the landowners interviewed could be described as practical ‘number 8 wire’ people, who were keen to just get out there and give monitoring a go. They told of using practical ways to test and practice their monitoring skills, such as learning bird calls by listening to CDs, using guide books to learn vegetation, and practicing their identification skills in the botanical garden or on walks.

“I learnt bird calls by making a C.D. of the calls I was most likely to hear and I play them over and over during the day or when I’m in the car”

Landowners identified people support, financial support and monitoring kits or information as essential tools for their monitoring project success. Having mentors or support people helped them gain monitoring confidence. Financial support is valuable and influential and can include funds for monitoring, mentors or equipment. There are useful and practical monitoring resources and kits available for landowners in New Zealand, such as those referenced above and all of these landowners were aware of at least one of them.

4.3. Monitoring rewards

During the conversations with landowners, it became apparent that monitoring results allowed them to see the progress they were making with their conservation work. Landowners said this was very satisfying, to feel they were making a difference. It was one of the main benefits of monitoring.

“Over the three years following rat control we saw large increases in weta and skink numbers in our tracking tunnels. We thought – wow, this is real; this is not just a quirk. We’re starting to make a difference”.

“It’s encouraging to have monitoring data to share with others. It gave me confidence in what we’re doing”

Another reward landowners identified is the learning they get from monitoring, about their environment and how it works, from their own experiences and talking to others about their new knowledge.

“I certainly have more awareness now and an increased sense of responsibility for my precious piece of bush”

“The more I know the more I enjoy my time in the bush. I have a new appreciation and look at it more critically. I see so much more now”.

“The biggest benefit of this work is for the kids. It was a dying world before, but now the taonga are coming back and they’re interested. A kaka turned up last month. We had to ask someone what it was!”

4.4. Barriers to monitoring

During the interviews landowners were asked to provide feedback on some of the barriers and problems they experience with monitoring (Table 10). The top four barriers to monitoring identified were the lack of time to monitor; that monitoring is a physically difficult task; that monitoring requires skills and dilemmas over which monitoring methods to use.

Table 10: Monitoring barriers and issues raised by landowners and monitors in the case studies

Case study	Far	Northland	Southwest	Southeast	Great	Coromandel	Coromandel	East	Wairarapa	Kapiti	Banks	Banks
Issue	North		Auckland	Auckland	Barrier Island	north	south	Cape		Coast	Peninsula east	Peninsula west
Lack of time	✓	✓		✓		✓			✓		✓	✓
Physically hard		✓	✓	✓			✓		✓	✓	✓	
Lack of skills			✓	✓	✓		✓		✓	✓		✓
Choosing methods	✓	✓			✓				✓			✓
Data variability / waiting for trends		✓				✓			✓	✓		✓
Lack of labour	✓	✓							✓	✓	✓	
Lack of funds	✓	✓		✓						✓		
Observer bias	✓					✓						✓
No data or lack of change		✓							✓	✓		
Data privacy	✓			✓				✓				
Weather		✓		✓			✓		✓			
Lack of technical support				✓					✓			

The landowners or monitors who raised these problems were not necessarily the person with the issue, but they were aware that these barriers had existed for some people in the project, or they had been issues at some time in their project.

4.4.1. Lack of time

Shortage of time was a barrier for seven monitors and included having to make time to monitor on top of the conservation work and fund raising, having many other responsibilities in life, such as families and full time work and the size of the properties to monitor.

“We intended to do the monitoring every year, but in reality, with limited resources, this may not happen. But at least we have our baseline data, and future progress can be measured against this”.

4.4.2. Physical difficulties

In seven cases, the physical difficulties of monitoring were an issue, from either the scale of the property to be monitored or the steep and rugged terrain to be covered. Landowners found the initial set up of permanent plots, transect lines and marker points was hard work when it required bush bashing along a compass bearing, as random plots or transects will not be along existing paths or contour lines.

“I thought we’d put out 10 vegetation plots, but we only got around to 2. They were harder than we expected”.

4.4.3. Monitoring skills

The need for more or better monitoring skills was a barrier in six case studies. This included feelings of inadequacy; not understanding some monitoring methods; not having data analysis knowledge and not recognising bird calls.

“I think some people felt inadequate at the training, because they couldn’t identify the plant species, and this put them off”.

“The Department of Conservation sets the monitoring protocols and its standards and accountability are very high, as it needs to be with public budgets. But it’s not practical to transfer these same standards and accountabilities directly onto to untrained landowners and community groups and expect them to deliver”.

4.4.4. Monitoring methods

In five cases landowners mentioned the frustration around choosing the right monitoring methods, saying there were unclear and contradicting messages associated with the accuracy and methodology of some monitoring methods, such as bird counting methods and that the expectations between professionals and lay people differed.

“It’s not that easy to train volunteers to be sufficiently accurate to a level acceptable for scientists. We need to agree on a system that suits lay people but are also scientifically valid”.

4.4.5. Data analysis

In four cases landowners said they had difficulties with data analysis; two did not have the skills to confidently analyse and use the data and another two passed their data to others as they did not feel confident with data analysis.

4.4.6. No data

Issues were raised by three landowners relating to having no data to collect or a lack of change in data over time. One landowner said there are lots of times when there is no data to record, like clean tracking tunnels and empty traps. Another two said there was very little change to record in their vegetation plots. This lack of data or change was raised as it made them think the monitoring was a bit meaningless.

“We’ve gone from catching around 30 stoats a year to less than two a year. Recording all that nil data can get a bit boring.”

4.4.7. Observer bias

Another three landowners mentioned observer bias or a lack of objectivity amongst monitors. For example one monitor said she had to watch out for her own observer bias, as she was aware of her tendency to become complacent and expect to get certain results, which would limit the accuracy of her results. Another case used outsiders to monitor their project to remove their own potential observer bias. In the final case a monitor questioned the objectivity of landowners monitoring their own projects.

4.4.8. Data privacy

Another concern in three cases is that the landowners do not want to make their monitoring results public. As these projects occur on private land, the landowners prefer to keep the data private too. In one case, the project has been very successful, but the landowners do not want this success to lead to people coming onto their land to find kiwi for example. In another case the monitors were not sure of the accuracy of some figures, so preferred to keep their data to themselves, rather than share it publicly.

4.4.9. Bad news

Another reality landowners had to face was that not all of their monitoring results were good news. Bad results were hard on their morale. One landowner used bad monitoring results to push for more resources, in order to turn the results around. Another landowner used poor results to reconsider the pest control regime and to hold off a planned reintroduction until the monitoring results were more consistent.

5. Conclusion

The people interviewed in these case studies have been active or interested in conservation for a long time and are now also involved in monitoring their work. Over 180 people have been involved in monitoring at these twelve sites; most are volunteers working with another person. Each property has at least one environment

listed as a national priority for protecting rare and threatened biodiversity on private land in New Zealand, so these landowners are protecting some of the country's most vulnerable species and ecosystems. Animal pest control and legal protection of the land are the primary forms of protection in these twelve cases and each case study has received financial support for some of this work from at least one of 18 different funding bodies.

These landowners are making good use of monitoring to measure the success of their conservation goals, especially those with clearly defined project plans. Biodiversity outcome monitoring is also well used, with 20 outcome methods in use.

However, monitoring was underutilised as a tool for helping with decision making and practically unused by funding agencies. All the landowners in the case studies are gathering monitoring data which could be used to inform funding agencies of the success of the landowners work. This information could have been used by the funding agency to determine if its own fund goals have been achieved and to report on the level of effectiveness of the funds as a tool for improving biodiversity on private land.

Through the interviews with landowners and monitors some of the social factors of successful monitoring emerged that helped landowners to become active monitors on their land. These attributes are: finding excellent support systems, including working together and mentors, getting practical support from others in the local community to build confidence and getting rewards from the monitoring. Other key supports identified include organisational and financial support and using existing monitoring resources and kits. Under these conditions, it seems people are more likely to get involved and actively participate in monitoring.

Barriers to monitoring identified include a lack of time and skills for monitoring. Issues around inconsistencies with monitoring methods, difficulties with data analysis and choosing the right methods were raised and caused problems for some projects. The physical difficulties of monitoring in uncharted bush and a lack of experience and confidence with monitoring were also identified as barriers.

However, all the landowners in these cases have overcome the hurdles they initially encountered with monitoring, and now biodiversity monitoring is providing a measure of success towards their conservation goals as well as being informative, rewarding and fun. They are able to learn from their mistakes, measure biodiversity outcomes, and make informed decisions. These landowners are better informed about the success of their conservation programmes as a result and know they are making a difference for biodiversity in New Zealand.

In the following chapter, these results are assessed and considered against the research goals and objectives, to determine if the methods these monitors and landowners are using are suitable and effective to measure their project goals, improvements to biodiversity following conservation action and help with their land management decisions.

The social conditions that are occurring around these case studies are also examined, to clarify what resources need to be available if we intend to support landowners to collect biodiversity data from private land, to meet the requirements of New Zealand to report on biodiversity through out the country.

With this information, we can establish what biodiversity monitoring will measure the effectiveness of public funding towards the protection and enhancement of biodiversity on private land in New Zealand.

Chapter 6

Core biodiversity monitoring methods and social resources

1. Introduction

Do the monitoring methods used in the case studies form a core group of biodiversity monitoring methods suitable for landowners to measure the success of their conservation actions and to measure improvements to biodiversity on their land? What biodiversity information do landowners need in order to make decisions about management on their land and to inform agencies which have funded biodiversity conservation on their land?

The results of the case studies are discussed here to consider these questions. The results of the interviews showed there are 31 monitoring methods used by landowners and monitors in these 12 cases. These 31 methods are assessed against nine criteria to determine if they form a core group of biodiversity monitoring methods suitable for landowners.

The vast extent of biological diversity presents just as many possibilities for monitoring so how do we narrow down the options and select the indicators or methods that are the best or most appropriate? What methods are suitable and what makes them suitable? If we want to encourage landowners to carry out monitoring, what data are useful for them to gather and what are the best ways to collect the information? Which methods are versatile and suitable for landowners, while also being effective at gathering the appropriate information?

Monitoring is a tool to evaluate and measure change, progress, results or outcomes over time or space. It needs to be designed for an explicit purpose. For monitoring to measure progress the methods must be linked and related to the goals of a project. For monitoring to measure improvements in biodiversity the methods must describe the outcomes for biodiversity following a management action. For monitoring to provide information to answer management questions and helps with decision making, it has to be designed to answer that particular question. For monitoring to

be effective the methods must be selected specifically for their purpose. Monitoring is not an end in itself.

Perhaps most importantly, suitable monitoring methods are those that are easily appreciated and applied by landowners. The perfect monitoring method has to also be accessible and manageable for people in the community. There has to be a connection between the scientific methods and the people in the community using the method, to make monitoring useful, constructive, fun and rewarding.

The additional fifth research question that surfaced about the social conditions of monitoring is discussed. The amount of information on the social aspects of monitoring that came out in the interviews demonstrates the importance of the social environment to monitoring. There is a parallel need to provide information on the most relevant biodiversity monitoring methods and to provide community supports to landowners to get them going. The main themes of working together to gain confidence and getting rewards from monitoring that keep people going are examined. How these landowners overcame barriers to monitoring is presented, which illustrates the importance other people played in these people becoming biodiversity monitors on their land.

2. The suitability of monitoring measures

What defines a monitoring method or indicator as suitable? This question has been discussed by many authors, (Froude, 2003; Lee *et al.*, 2005; National Academy of Sciences (USA), 2000), but in the context of this research, the monitoring methods have to be suitable for New Zealand landowners. They need methods that can establish their biodiversity gains, progress towards their project goals or answer management questions, and they need to be appropriate for landowners, who are not usually scientifically trained.

The most suitable methods are those that:

1. Are relevant to the biodiversity goals of a project and measure progress towards those goals.

In the four cases with clear project goals, it is easy to see the relevance of the

monitoring to their biodiversity goals and how the monitoring measures progress towards their goals. For instance one of the Northland case studies objectives is to recover and stabilize the kiwi population in the area. The group established the baseline population through kiwi call monitoring and completes kiwi call counts each year. In this way they have established that the kiwi population is currently stable in the area. On the East Cape, an aim is to halt the decline of representative bird species, and the project has achieved this through reduced pest levels so that existing bird species are beginning to recover in numbers, as measured through five minute bird counts.

2. Measure the results and biodiversity outcomes of conservation work.

All case studies in this research use at least one result method to measure the effectiveness of their animal pest control and they all use biodiversity outcome methods to measure improvements to biodiversity. Having a starting point is essential to measure biodiversity improvements or changes against following conservation action. Eight landowners used a control site or a baseline survey of their site. The baseline surveys included FORMAK site assessments and bird surveys. Control sites were areas without pest control in the main, allowing for comparison with the pest controlled area.

3. Help landowners to make land management decisions.

The purpose of monitoring is to be informative and to help make decisions. Three quarters of the landowners use some of their data to make land management decisions, which suggests that the monitoring results are informative and effective as a decision making tool.

4. Are designed to answer questions that will improve conservation best practice.

A major influence on the effectiveness of any monitoring programme is whether a question is being asked in the first place, and if it is, is it the right question? Then, can the monitoring methods chosen answer that question? Five of these landowners have been involved in conservation research, and all used monitoring to answer questions about a conservation technique or a

monitoring method, adding to the pool of conservation knowledge or best practice.

5. Are practical, non-technical and simple

Three of the nineteen people interviewed had some technical or scientific training, but even still, all nineteen sought support of some kind when establishing their monitoring. Biodiversity monitoring on private land has to use methods suited to landowners without scientific training, be practical and straight forward, while retaining precision and accuracy. Methods have to suit busy people who are already juggling their private lives with their conservation work, other commitments and monitoring.

6. Are consistent across the country

The benefit of consistent standard monitoring methods and techniques throughout the country is that data comparisons with other areas and national coordination of results can occur, allowing for national reporting. All of the case studies counting kiwis use the same standard method, and forward their results to the Department of Conservation for inclusion in national reports. This example demonstrates the benefits of having a nationally coordinated and defined method.

7. Integrates and informs the needs of many stakeholders, including landowners, trustees, funding agencies and policy makers and politicians.

Biodiversity monitoring results from private land are needed by local and national government to report on and to satisfy the requirements of numerous laws, policies and conventions. If suitably arranged, the monitoring data collected by these case studies could be used by the government to report on their policies outcomes and biodiversity obligations.

8. Have sound but simple statistical properties

Methods need to be able to be measured in ways that provide accurate, precise, credible, robust and reliable data that is easily understood by landowners. The methods need to be sensitive enough to be able to distinguish normal variation from variation outside the natural range. The

measuring techniques need to be well understood, widely applied and technologically undemanding (Lee *et al.*, 2005).

9. Suitable monitoring methods are those that are easily applied and appreciated by landowners.

The most important suitability criterion is that a monitoring method has to be easily applied, relevant and satisfying for landowners. The biodiversity monitoring carried out by these landowners and monitors is rewarding and fun; it is significant and provides satisfaction. Their results provide them with measures of success and keep them committed to biodiversity outcomes. Their results are an incentive; they motivate and stimulate them towards their conservation goals.

Being easily applied and appreciated by landowners is the key criteria for suitability. The recommended methods that follow may not meet all the other criteria listed here, but they all have to meet this final one.

3. The case study projects

The people

Overall impressions of the landowners and monitoring volunteers or staff interviewed for this research is that they are organised and resourceful people, who are well educated and have long term visions for their properties. They have been active in conservation for a long time, but monitoring was never the first conservation activity they undertook. They came across as level headed and practical people, with a love of the land. They live where they do and conserve and monitor because they really enjoy nature and are enthusiastic about the natural environment, especially New Zealand's native flora and fauna.

The land

All of the case study sites are lowland or coastal sites, areas of New Zealand which have experienced substantial indigenous habitat loss and support disproportionate

percentages of the country's most threatened species, habitats and ecosystems (Walker *et al.*, 2005). As all of the land in these case studies is considered a national priority for biodiversity protection in one or more category in *Protecting our Places* (MfE & DoC, 2007) these landowners are in the very important position of supporting threatened indigenous flora and fauna for the country.

The protection

The legal protection of over 51,500 hectares of land in these 12 case studies is a significant achievement by these landowners. The Nga Whenua Rahui kawenata examples are the largest blocks of protected land (50,000 ha), and are owned by multiple Maori owners or Trustees.

Legal protection of land is important because it is less likely to have its vegetation damaged or destroyed (Walker *et al.*, 2005; Walker *et al.*, 2006). However, legal protection of land without pest management does not equate to safe or healthy habitat. Native vegetation, protected or not, is not synonymous with habitat (Miller, 2000). Because of the vulnerability of native biota to invasive species (Atkinson & Cameron, 1993) land without active management of pest plants and animals is not likely to be a safe environment in which to sustain populations in the long term (DoC & MfE, 2000; Fitzgerald & Gibb, 2001; McLennan *et al.*, 1996; Sanders & Maloney, 2002; Towns, 1997).

A condition of a Nga Whenua Rahui kawenata is the inclusion of selected animal pest control on the land, carried out by Nga Whenua Rahui staff or contractors on behalf of the landowners or Trustees. This transforms the kawenata from passive protection to active protection.

One interviewee gave examples of private land being covenanted by Council covenants as part of the subdivision resource consent process, allowing for smaller rural subdivision lots. Once the lots are sold, most new landowners ignore the covenant, many don't know they have a covenant, and few people are managing pests in the blocks. Therefore, it shouldn't be extrapolated that all protected land is being safeguarded and managed for the future, because some covenants are neglected. However, that was definitely not the case for these properties. All but

two have some form of legal protection and all are controlling some animal pests on their properties.

Other forms of protection carried out in the cases, such as translocations and ongoing pest control are valuable and important achievements by landowners which contributes significantly towards biodiversity improvements on their properties.

4. The core group of biodiversity monitoring methods

The 31 monitoring methods used by landowners in these case studies are analysed and discussed to establish their effectiveness as a core group of biodiversity monitoring methods suitable for landowners to measure the success of their conservation actions; improvements to biodiversity on their land and to help with land management decisions.

Each method has been assessed as it was used in these case studies against nine criteria (Table 11). The number of times each method was used is recorded, along with its score out of nine. For example, all 31 methods were relevant to the project goals of at least one case and all methods measure the results of conservation action or improvements to biodiversity in these cases.

Table 11: The 31 monitoring methods in use by landowners in the 12 cases, the frequency of use, if they are recommended as a core monitoring method and if they meet the nine criteria for suitability

Monitoring method	Times used	Core monitoring method	Score	Criteria of suitability								
				1	2	3	4	5	6	7	8	9
Trap catch record	10	Yes	6/9	✓	✓	✓	✗	✓	✗	✗	✓	✓
Bird counts	9	Yes	6/9	✓	✓	✗	✗	✓	✗	✓	✓	✓
Iconic species population counts	8	Yes	7/9	✓	✓	✓	✓	✗	✗	✓	✓	✓
Tracking tunnels	7	Yes	8/9	✓	✓	✓	✓	✓	✓	✗	✓	✓
Photo points	6	Yes	5/9	✓	✓	✗	✗	✓	✗	✗	✓	✓
Vegetation plots	5	No	3/9	✓	✓	✗	✗	✗	✗	✗	✓	✗
Kiwi call counts	5	Yes	7/9	✓	✓	✗	✗	✓	✓	✓	✓	✓
Adaptive management	5	Yes	7/9	✓	✓	✓	✓	✓	✗	✓	✗	✓
Insect pit fall trapping	5	No	2/9	✓	✓	✗	✗	✗	✗	✗	✗	✗
Pre and post pest control monitoring	5	No	5/9	✓	✓	✓	✓	✗	✗	✗	✓	✗
Control site	5	No	6/9	✓	✓	✓	✓	✗	✓	✗	✓	✗
Baseline monitoring	4	Yes	6/9	✓	✓	✗	✗	✓	✓	✗	✓	✓
Possum residual trap catch	4	No	6/9	✓	✓	✓	✗	✗	✓	✓	✓	✗
Wax tags	4	No	6/9	✓	✓	✓	✗	✓	✓	✗	✗	✓
Weta motels	3	No	3/9	✓	✓	✗	✗	✓	✗	✗	✗	✗
Foliar browse index	3	No	4/9	✓	✓	✗	✗	✗	✓	✗	✓	✗

Monitoring method	Times used	Core monitoring method	Score	Criteria of suitability								
				1	2	3	4	5	6	7	8	9
Lizard monitoring*	2	No	3/9	✓	✓	✗	✗	✓	✗	✗	✗	✗
FORMAK site assessments	2	Yes	6/9	✓	✓	✗	✗	✓	✓	✗	✓	✓
Wetland bird survey	2	No	2/9	✓	✓	✗	✗	✗	✗	✗	✗	✗
Seedling plots	2	No	3/9	✓	✓	✗	✗	✗	✗	✗	✓	✗
Fresh water invertebrates	2	No	5/9	✓	✓	✗	✗	✓	✓	✗	✓	✗
Bait take	2	No	5/9	✓	✓	✓	✗	✓	✗	✗	✗	✗
Plant survival	2	No	5/9	✓	✓	✓	✓	✓	✗	✗	✗	✗
Frog survey*	1	No	2/9	✓	✓	✗	✗	✗	✗	✗	✗	✗
Mud fish*	1	No	3/9	✓	✓	✗	✗	✓	✗	✗	✗	✗
Kokako nest success*	1	No	5/9	✓	✓	✓	✗	✗	✗	✓	✓	✗
Penguin nest success*	1	No	7/9	✓	✓	✓	✓	✓	✗	✓	✓	✗
Robin nest success*	1	No	4/9	✓	✓	✗	✗	✓	✗	✗	✓	✗
Kiwi population structure	1	No	3/9	✓	✓	✗	✗	✗	✗	✗	✓	✗
Stream fish survey	1	No	3/9	✓	✓	✗	✗	✗	✗	✗	✓	✗
Water levels	1	No	3/9	✓	✓	✗	✗	✗	✗	✗	✓	✗
Water quality	1	No	4/9	✓	✓	✗	✗	✗	✗	✓	✓	✗

Note: the methods marked with an asterisk * are components of the iconic species population method.

Criteria of Suitability numbers: 1 =measures goals; 2 = results and outcomes; 3 = decision making; 4 = improve best practice; 5 = practical; 6 = consistent; 7 = informs many stakeholders; 8 = statistically sound; 9 = easily applied and appreciated.

Those methods that scored six points or more, including scoring yes for criterion nine, being easily applied and appreciated by landowners, were included in the core methods.

Exceptions include wax tags, photo points and penguin nest monitoring. Wax tags scored 6/9, including criterion 9, but landowners in two cases said they were not reliable for them. It was known that rats and possums were present at one site, as bait was taken from three baited but unset Timm's trap, but wax tags were not touched in three fine nights. Other case studies liked them, so this method should be considered and tried on a site by site basis.

Penguin nest success scored 7/9, including criterion 9, but this method would be included in the iconic population monitoring method. It would not make it as a core method on its own as penguins are not widespread enough as a species.

Photo points scored 5/9, including criterion 9, but they are recommended as a core method as a new standardised photo point module has been added to the FORMAK kit, which would increase the method score to 6/9 if a standard method had been used in these case studies.

This section outlines the monitoring methods most suitable and likely to succeed for landowners that form the core group of nine recommended techniques. The methods chosen were often the methods most widely used in the case studies

It is recommended that these nine monitoring methods should be encouraged for use by the community and private landowners and the methodology should become standardised throughout the country if it is not already.

It must be kept in mind at all times that it is not the methods that are important, but the question the monitoring method is designed to answer. These core methods however are versatile and will have wide application for a number of different purposes.

4.1. Measuring progress towards conservation goals

“It’s really important to know if you’re achieving what you set out to do”.

The cases varied widely in their goal setting. Those with clear project goals and with monitoring tied to the goals know where they are heading. The Wairarapa case for example has a 50 year long term goal and a clear work programme to follow. Case studies with weak project goal planning found it difficult to measure progress. It is unlikely their monitoring is effective at measuring the success of their work in terms of achieving their conservation goals.

Effective planning by landowners is crucial, and if necessary, partnerships between professionals and landowners can be beneficial. The combination of landowners with a vision and understanding of their land and a professional with experience in restoration and monitoring can work together to crystallise the projects biodiversity goals, clarify the purpose of monitoring and identify the questions monitoring can answer. The last step is to determine the most appropriate monitoring methods to measure progress towards goals and develop any skills and resources required by the landowner to undertake the monitoring.

Goals must be the starting point when designing ways to monitor progress or outcomes of a programme or policy (Atkinson, 1994; Lee *et al.*, 2005; Lynch, 2004). No monitoring method can be effective or achieve the task of measuring progress towards conservation goals if there are no clear measurable goals or targets in place to measure progress against. Not having plans including a clear vision, achievable goals and measurable objectives is a weakness for conservation projects, as goals provide a direction and a destination, against which to measure achievement. Monitoring needs to be tied directly into the desired outcomes of a project to measure them effectively (Ehrenfield, 2000; Hobbs *et al.*, 2006).

4.1.1. Baseline monitoring

The recommended core method to measure progress towards conservation goals is baseline monitoring. Baseline data are crucial to track changes through time.

“We’re in this for the long haul. It’ll be good to look back on that baseline data in a few years”.

Along with the requirement for clear goals is the need for baseline monitoring to measure progress against. Baseline monitoring was used in five cases. Methods included FORMAK site assessments, professional ecological assessments, oral histories from kaumatua and three forms of bird baseline monitoring.

Baseline information can be used as an inventory, to describe the current condition of a site. Baseline information is essential for landowners to establish prior to any conservation work at the site if they want to compare before and after results, to show the effectiveness of their work or progress towards goals. Baseline information on where ecosystems, habitats and species are at a point in time is needed, so that increasing or decreasing trends can be measured in the future. The presence or absence of key indicator species, or the extent of habitat in hectares, which can be tracked between periods are examples.

FORMAK site assessments are recommended as a standard baseline survey of native bush for forest health, which was often a project goal in these cases. This assessment rates forest condition by giving scores to features or threats encountered. A report can then be run providing subtotals, totals and a summary of the scores, which provides a bench mark of forest condition. This bench mark can be used to make comparisons of the same site in the future, can be used to compare the project site with another site, with different management, and can track trends at the site.

Otherwise, baseline data will be based around a particular project goal. This could be an indicator species such as mistletoe or rata for example, where a mistletoe population would be mapped and counted or rata flowering assessed, prior to any conservation control work being carried out. Progress can then be measured in the future and the achievement of the goal assessed.

The site reports in these cases highlighted the special features of the land and location by describing the natural features of the area. It explained characteristics such as the representativeness of the ecosystems present, the importance of the faunal habitat and botanical features or species present as well as the threats and issues the

site faced. From this baseline study the landowners were able to measure progress towards their goals. While baseline monitoring is a very important first step, it does not give any information on change or trends that may have been brought about by the conservation work done by the landowner until it is compared with results in the future.

4.1.2. Control sites

If landowners have questions about the changes that have come about due to their actions and they want monitoring to answer that question, then either a control site or baseline monitoring is essential to measure any change. Control sites are an important component of monitoring programmes and when possible, should be used by landowners as well as baseline studies.

However, control sites are less suitable for landowners if they have small holdings, as the effects of the treatment or conservation action may not be able to be separated by enough distance from the control site on smaller properties. The scale of many private properties may make it unfeasible to have a control site that is not influenced by the protection work. In these cases, where it is not possible to carry out both methods, baseline monitoring before protection work and after is the best option and should be done in all cases.

One landowner said her monitoring results may have been influenced by poor positioning of the control site. The control site needs to be far enough away from the treatment site so it is not influenced by the conservation action, while still mirroring as many environmental features with the treatment site as possible.

“The bird results have shown the least difference between the two sites.

This may be because the control site is too close to the treatment site”.

Baseline monitoring meets the criteria given in Section 1 of this chapter by being able to measure progress towards goals, can be designed to be relevant to the biodiversity goals of a project, it is practical, non-technical and simple, it can inform many stakeholders and it is easily appreciated and applied by landowners.

4.2. Measuring biodiversity outcomes

4.2.1. Outcome monitoring

“We’ve got to know what effects our efforts are having on biodiversity”.

Of the six most commonly used methods in the case studies (refer to Table 9), four are biodiversity outcome methods; two focused on birds and two on vegetation. Outcome monitoring looks for biodiversity changes due to a conservation action, for example, increases in the number of bird species or the abundance of birds in five minute bird counts over the years following pest control (Lynch, 2004).

The recommended core methods to measure biodiversity improvements are five minute bird counts, kiwi call counts where kiwi populations exist, population surveys of other iconic species, and photo points.

4.2.2. Bird monitoring

It is not surprising that various forms of bird counts are the most commonly used monitoring technique in these cases, with birds the largest and most visible mega fauna in New Zealand. The high use of bird monitoring by landowners in these cases suggests that bird monitoring is a popular and suitable indicator of biodiversity improvement for landowners. Birds are iconic and they play a significant role in the identity of New Zealanders or ‘Kiwi’s’. Birds are large and visible compared to the other fauna options, such as frogs, lizards, insects or bats. There is a higher public awareness about the threat status of indigenous birds than that of fish, insects or plants for example.

Birds are used in many countries around the world as environmental indicators, as they are conspicuous and sensitive to environmental change (Spurr, 2005). New Zealand has several monitoring schemes with standard monitoring methods for specific birds or groups of birds but there is no scheme for monitoring the populations of common land birds (Spurr, 2005).

For these reasons, bird monitoring is recommended as the key indicator for fauna monitoring, even though bird counting has been described as *“a distressingly*

imprecise science” (DoC, 2008a). Other fauna monitoring, such as invertebrates, lizards or frogs, should be monitored if they are a more appropriate species to monitor at the site because they are iconic to the area (see 4.2.5 below).

4.2.3. Five minute bird counts

Of the eight bird monitoring methods used by landowners, five minute bird counts were the most frequent (Table 12). Other bird count variations used in these cases include a three minute, ten minute and fifteen minute bird counts. All nine cases using bird counts are using the method as a general indicator of over all forest health, and as such, they are a measure of the biodiversity outcomes from the project.

Table 12: Bird monitoring methods used by case studies

	Case study	Bird count method	Protocol provided by:	Comments
1	Far North	Five min	Wendy Sporle	Modified five minute count, done in conjunction with wax tag checks, no longer standard method.
		Kiwi call counts	National Standard	Monitor is national trainer in the method.
2	Northland	10 minute bird count	Ray Pierce	Annual
		Kiwi call counts	National Standard	
		Cryptic wetland and coastal bird survey	Ray Pierce	Baseline cryptic bird survey for coastal and wetland birds. To be repeated in 5 years.
3	Southwest Auckland	Five min	Formak	
4	Southeast Auckland	Presence and categorical abundance	Formak	Don't feel skilled enough to do five min counts. Would need in the field training.
5	Great Barrier Island	3 min	Sam Ferreira	3 min with 5, 10, 15, 20 and 25 m radius distance recorded There are 18 transects of 4 stations. Each station is counted six times twice a year in June and Dec.
6	Coromandel north	five min	D.o.C.	Five min bird call count done once in bush.
		Kiwi call counts	National Standard	
		Cryptic wetland bird survey	Self	Do annual wetland survey of fern bird and banded rail Tried D.o.C. method but didn't suit so developed their own method

	Case study	Bird count method	Protocol provided by:	Comments
7	Coromandel south	Kiwi call counts	National Standard	D.O.C provide protocol
8	East Cape	Five min count	DOC	Five min count and five min count with squeaker
		Kiwi call counts	DOC / National Standard	
		Kokako population	DOC/Kokako Recovery Group	Translocated population
9	Wairarapa	Five min	Dawson & Bull (1975).	Wellington Regional Council / Dawson & Bull
10	Kapiti Coast	15 minute	Formak / WWF	Adapted Formak and WWF to suit.
11	Banks Peninsula east	4 yearly census of penguins	Chris Challies	
12	Banks Peninsula west	Five min	Formak	Five min count with additional notes on other species noted between counts.

Point counts, such as five minute counts, provide estimates of relative abundance, but they are not a census method. Five minute bird counts give an index of abundance and identify the species present in an area. Results over the years can provide trends, with changes in species abundance or species diversity evident. Point counts for counting birds, are commonly used in the United States and Europe and have been widely used in New Zealand since the 1970's paper by Dawson & Bull (1975).

The method described by Dawson & Bull (1975) should be used as the standard as it is the most widely used method in New Zealand, allowing the most comparison with other data. By using the method described by Dawson and Bull means landowners can compare their data to over 500 studies amounting to over 80,000 counts that have been collected over the years (DoC, 2008a). Five minute bird counts are recommended, using an unbounded count, that is, with no cut off distance, as this has become the norm.

“Our bird count method is not compatible with the five minute bird count method, which is a shame. We’ll adapt ours to try and compare our data with the rest of the area. I would go with the standard method if I was starting again”.

Five minute bird counts meets many of the suitability criteria by being able to measure bird diversity outcomes and they are often relevant to the biodiversity goals of a project. Five minute counts are a practical, non-technical and simple method. While monitors do require bird identifying skills, it is a skill that can be learnt using recordings, practice and develops with experience.

Counts and trends are easily appreciated and applied by landowners and the data can be used by many stakeholders. The frequent occurrence of the five minute bird count method implies it is suitable for landowners. Five cases are using the standard method and one case is using a modified version.

4.2.4. Kiwi call counts

“Hearing kiwi calls is a stimulant, we love going back every year to do the monitoring”.

Kiwi call counts are a recommended core method where kiwi populations exist. Five of these case studies are using kiwi call counts and many other private landowners in areas with remaining kiwi populations are supporting the national kiwi monitoring programme. For example, nearly 80% of the kiwi call schemes monitoring sites in Northland are on private land. The same percentages of kiwi call scheme monitors in Northland are community volunteers, including landowners. In one area of East Taranaki 3,000 hectares of kiwi habitat on twenty two adjoining private properties is under predator control to protect kiwi. Six of these landowners also undertake bi-annual kiwi call count surveys on a voluntary basis, along with a paid contractor. These examples demonstrate that landowners are already playing a significant part in collecting data for national databases.

The five cases doing kiwi call counts were all using the same standard method which demonstrates the benefits of having a nationally coordinated and defined method that provides a consistent method. Landowners pointed out that by using national monitoring systems, with standard protocols, meant that everyone follows the same practice. There was no confusion around the methods and these landowners felt confident with the technique.

“We send the kiwi call data to the local DoC office. We love to be part of the programme each year – it is very rewarding and fun”.

Having landowners and professionals working together at a national level demonstrates to participants how their conservation and monitoring work contributes to a large national project. The involvement of volunteers and private landowners in the kiwi call count scheme illustrates the significance of private land in protecting kiwi and the willingness of landowners to be involved in monitoring. Participation by landowners in national monitoring programmes should be encouraged because there are benefits for landowners and the nation. Benefits include standard methods and networks, data that is consistent with other monitoring records throughout the country, allowing for comparisons with other areas, national coordination of results and building a national data resource. Being part of a national monitoring programme is highly regarded by those interviewed. One landowner said: *“It’s good*

to share our data with others. We send results off to the translocation database at Massey University”.

Kiwi call counts are suitable as a core method because landowners engage easily with the iconic bird, the method is simple, non-technical and is nationally standardised. Kiwi calls counts are not too time or skill demanding for participants once they can distinguish kiwi calls from other night noises (Colbourne, 2008). The data can be used by many stakeholders, such as the Department of Conservation and the Ministry for the Environment, as well as local government in areas that have kiwi.

4.2.5. Population surveys of iconic species

For areas without kiwi populations, monitoring an iconic local indicator species is recommended as a core method. In these cases, six are monitoring an iconic or rare species important to their property.

“I love monitoring the jewelled gecko and penguins. They’re so special”.

An iconic, endangered or rare species is a good monitoring focus for landowners or a community group, as they engage landowners and the public. They are also useful because the survival of each restricted population is influenced by the landowner’s management. Endangered species like kokako are a taonga that inspires a community to work together to protect them.

“The mainland island site is great for education and advocacy. We have loads of people up here and they are really interested in what we’re doing, especially with the kokako”.

The Ministry for the Environment is using the distribution of the seven threatened indigenous species as indicators to illustrate the changing extent of native habitat over time (MfE, 2007).

Population surveys of iconic species meet half the suitability criteria by being relevant to biodiversity goals and outcomes. Landowners connect with threatened species which live on their land and population data should help landowners make

decisions about their land management decisions. There is opportunity for landowners to work with professionals to contribute to the quest for best practice conservation for our most threatened species and any distribution or population status data would be useful to other agencies.

Population surveys are not necessarily simple or practical, and they can take a lot of time. In addition, there may be issues to overcome with regard to getting consistency across the country on population count methods. The Department of Conservation currently has 57 Threatened Species Recovery Plans that often provide standard or recommended population survey methods (for example Lawrence, 2002).

4.2.6. Photo points

Photo points are the monitoring method recommended for landowners to quantify their contribution to vegetation protection goals and to measure biodiversity outcomes. Half the case studies have used photo points as a monitoring method.

“The seedling growth was so dramatic after pest control the photo points became swamped after just a few years. It was amazing”.

Photo points are useful for identifying medium to long term vegetation trends and are easy to carry out. Photo points can answer questions such as “is vegetation on this hill side changing since the fencing to remove stock?” Photos can be taken at the landscape scale or of vegetation composition (Norton, 2006).

To be effective, photo points must include permanent reference markers, such as permanent posts or markers or hill profiles behind the vegetation plot being monitored. Having people or a scale ruler in the photos is useful. Photo points can become redundant because the vegetation they are designed to monitor outgrows the photo plot. This needs to be considered when choosing the plot location, by ensuring there will always be enough foreground or clear space to capture the plot photo, no matter how high the vegetation grows.

The photo points used in these case studies do not provide quantitative data, but they are none the less very informative and provide an objective visual evidence of change over time. Photo points, while not producing quantitative data, can still

illustrate condition and trends of vegetation (Mark *et al.*, 2007) and are an excellent educational and public relations tool (Atkinson, 1994).

It is possible to quantify digital photos using computer image analysis software (Richardson *et al.*, 2001) and this technology may soon be practical for landowners to use from their home personal computers. In the mean time, the FORMAK photo point module is adequate for the home user and is the recommended standard method.

Photo points meet a number of the suitability criteria by being simple to perform, they measure changes in vegetation easily and they are an appropriate method for landowners. If landowners use the FORMAK guidelines, this will provide consistency across the county.

4.2.7. Other biodiversity outcome methods

Four of the seven most commonly used biodiversity outcome methods used by landowners in these cases are recommended as the core monitoring methods; five minute bird counts; kiwi call counts or monitoring a different resident threatened species and photo points. Three other commonly used methods; vegetation plots, foliar browse index and insect pit fall traps are not recommended for the following reasons.

Vegetation plots are an important monitoring method (Allen, 1993), but they are not recommended for landowners because they do not meet the criteria of being easily applied or appreciated by landowners. Ten cases are using one of five vegetation monitoring methods as an indicator of biodiversity improvement and over all forest health, such as foliar browse index. Five cases are using vegetation plots and seedling plots are used in two cases. While these levels of use make the methods seem suitable for landowners, it was found that landowners were using lots of different methods and there was no consistency among them. For example, comments were made by some landowners who attempted vegetation plots using the FORMAK kit that they were too hard and complicated for them.

The foliar browse index was developed as a quantitative way of measuring possum impacts on indigenous forest canopies in the 1990's by using highly palatable indicator species, which are susceptible to possum browse (DoC, 2008b; Payton *et al.*, 1999). A minimum of 50 monitoring plots is recommended, with each plot at least 100 meters apart. This means five kilometres of bush is needed, and this makes the method unsuitable for most private land owners. However, it could be undertaken by a group of adjoining landowners.

Insect pit fall traps were used in five cases, but the landowners were usually sending the samples off for expert advice to accurately identify the species, meaning they are not easily applied by landowners.

These three methods are considered less suitable than the recommended methods because they do not meet the key criteria of being easily employed and rewarding for the majority of landowners and do not meet enough of the other criteria for being a suitable method.

Many of the other biodiversity outcome methods used, such as weta motels, frog and lizard monitoring, may fit into the category of an iconic, rare or threatened species that would be appropriate for a landowner to monitor if that species is special and important to them, and the data the landowner collects can show trends over time that demonstrates improvements for that species in terms of numbers or distribution.

This research has not included an assessment of the accuracy or precision of the monitoring data the landowners in these cases have collected and it does not include an assessment of the biodiversity gains that these landowners may or may not have made on their properties. I did not obtain any raw data from these cases and I obtained monitoring results from half the landowners, so I can not judge the quality of the collected data or the biodiversity outcomes that may have occurred.

4.3. Making conservation and land management decisions

Monitoring is designed to provide information and answer questions to assist with management decisions. Well chosen and effective monitoring methods will give information to guide decision making and management choices. Are the methods

these landowners are using suitable and effective to help with their land management decisions?

The core methods recommended to help with decision making are the animal pest control result monitoring methods of trap catch records and tracking tunnels. Result monitoring looks at the result of a conservation action. For instance residual trap catch rates measure the relative abundance of possums following possum control. The information gathered from other core monitoring methods could be used for decision making, as the information monitoring results provide can be used for more than one purpose. For example, robin breeding success results may be measuring both biodiversity outcomes and helping with management decisions.

4.3.1. Animal pest control result monitoring

All case studies involve animal pest control of at least one introduced mammal and all projects record pest control results using one of six methods (see Table 8 or Table 11). Trap catch records and tracking tunnels are the two most frequent result method used to monitor the effectiveness of pest control. Pre and post control monitoring, residual trap catch, wax tags and bait take were also used. Ten landowners record the animals they trap. Seven landowners are using tracking tunnels. With all of these projects involved in animal pest control, landowners need a monitoring method they can rely on to provide an indication of pest numbers, the effectiveness of their control and the impact their results will have on future land management decisions.

Trap catch records are a simple record that landowners can keep when they check traps and bait stations, making it a time efficient method. Trap catch records can show a reduction in pest numbers over time.

“After analysing the trap catch data we realised we needed tracking tunnels to see what we weren’t catching”.

Tracking tunnels give an index of abundance for mustelids and rodents, and all of these cases are all using the same method, as provided by Gillies and Williams (2001). Tracking tunnels also show tracks of other small mammals, lizards and

insects, which is of interest to landowners. Landowners feel confident using tracking tunnels, as they are straight forward.

Some projects have minimum pest numbers as a goal, and use trap catch records and tunnels as an indicator of pest numbers and therefore as a measure of success for the project. The results are used in management decisions, for example deciding if the current control regime is sufficient or needs alteration. Pest control results are often used by landowners in these cases to inform their pest control decisions and actions, including placement of traps, the type and amount of poison to use and payment of contractors for performance.

Trap catch records and tracking tunnels result monitoring meets the suitability criteria by being directly relevant to many conservation projects undertaken by landowners on their properties as well as being practical and straight forward. The results help with decision making, and the Gillies and Williams method is widely used in New Zealand.

Low pest numbers are not a direct measure of biodiversity outcomes, but they are used as an indicator of safe habitat for species predated by pest animals. Experience over the years has suggested that possum levels should be <5% RTC, and rat numbers should be <5% Tracking Index (Beaven *et al.*, 2000; Flux & Innes, 2001; National Possum Control Agencies, 2000).

Because they do not directly measure any changes to biodiversity, it is suggested that at least one biodiversity outcome method is also used to measure changes or success. Including both result and outcome monitoring in a programme allows an assessment of both the impacting pressure on biodiversity and the response of biodiversity to the control. However, pest control is not carried out primarily to reduce pest numbers, it is carried out to reduce the impact the pest has on indigenous biodiversity, therefore, biodiversity outcome monitoring should be a priority for landowners over result monitoring if they cannot do both.

4.3.2. Other result methods

The Residual Trap Catch method was used in 4 cases, but the actual work was carried out by contractors in 2 cases. The method of using leg hold traps for RTC measures is not necessarily acceptable or tolerable for landowners. Alternative kill traps, such as Timm's Traps could be used instead. Wax tags were used in 4 cases, and these could be used as an alternative to RTC by landowners, but they are not recommended as a core method. Bait take can also be recorded by landowners when they are refilling bait stations, but the method does not provide a particularly robust monitoring data.

4.3.3. Informing land management decisions

Landowners were asked if and how they used monitoring results in their project management. The results showed that eight of the 12 landowners are using their data to plan or change current practice but that usually only one of the monitoring methods per case was used for this purpose. In five cases landowners used adaptive management to test or learn about the conservation practices they were using or a monitoring method they were using.

A good example is the use of possum traps and faecal pellet lines in the East Cape case to determine when and where to undertake possum and goat control. The results have a direct link to the work programme. In the Southwest Auckland case, if possums were found to be present in a forest block through wax tag chews, the landowner was informed and asked to refill their bait stations with the free bait supplied by a local agency, meaning bait was only put out when it was needed.

When landowners were asked if their results have an influence on their work programme, it seems that most information is not used to make changes to the programme. The over all impression is that informing management decisions through monitoring information is not the primary use of the data in most cases.

Monitoring is not a data gathering exercise for its own sake, it needs to be tied directly to a question or management decision. For this reason, monitoring may run for a set period, until the required information is gathered and the management

decision is made. Once a conservation system or method has been well established and proven by monitoring it is not necessary to carry on monitoring the outcomes.

“In the early days of pest control we didn’t have the knowledge we have now, on the ideal spacing for bait stations for example. Once we had been doing pest control for a few years and monitored the results and knew the method was working there was no need to continue monitoring that part of the project”.

“Kiwi work has been going on for a long time in Northland and we know that certain formulas, if they are followed, work well. We know if we do this kind of pest control to this level we will get these results. There should be an audit of the methodology to ensure this is correctly followed, rather than each individual project having to carry out monitoring”.

4.3.4. Non-quantitative monitoring

“I’ve seen the bait take drop right off”

Non-quantitative assessments and comments about the case study projects were common in the interviews. There are two sides to non-quantitative monitoring. On the one hand, all science starts with observation and contemplation. Qualitative methods such as observations are the basis for further enquiry and gets people paying attention and collecting information to help with decisions, for example keeping a diary and reflecting on what’s going on around them.

“We encourage and collect anecdotal reports from the area, such as environmental changes, new species or increases in species. It encourages people to take notice of nature around them. Not just scientific information is important”.

“Never underestimate observations by volunteers. It keeps people interested, observant and their input is really valuable”.

On the other hand, implicit monitoring and anecdotal information is based on assumptions, is subjective and often not checked or tested. Making decisions on the basis of assumptions is not ideal.

The monitoring or assessments of environmental factors based on categories such as 'good', 'improving', 'poor' are problematic. They are based on the judgment of the person monitoring at that point in time. Unless there are very good explanations of how to define each ranking or category we cannot know if real change has occurred. Some agencies use subjective monitoring to assess projects. If staff members change between assessments then each evaluation is based on the opinion of different people, with no way to know if the judgment has been made using the same criteria. Subjective monitoring also relies on our memories, which are not failsafe by any means.

However, no monitoring method is always error free and quantitative results also vary, influenced by many variables. Therefore, qualitative methods should be encouraged along with quantitative monitoring. There is a big difference between assuming your conservation work is effective and knowing it is. Knowing can be provided by a simple and effective monitoring programme. Because so little quantitative data are collected by landowners or agencies about biodiversity on private land there are assumptions being made about the effectiveness and outcomes for biodiversity from the funds supplied.

Using monitoring data to help with conservation and land management decisions does not seem to be the most significant use of monitoring for the landowners in these cases. However, the data are discussed with others and this may lead to changed land management decisions by other people in the community.

The way that best practice methods have been established for many conservation practices is that research and monitoring of the method and outcomes has been ongoing in New Zealand and around the world. Monitoring has lead to new knowledge and it would be a mistake to think that all the learning has been done. There are still many more questions to answer on how best to reverse the biodiversity decline and monitoring is essential to continue this development.

5. Social attributes of successful monitoring

A strong theme that emerged from the interviews was that the social aspects of monitoring are very important to landowners and the social support systems each landowner has tapped into or established for themselves is what encourages them to be involved with biodiversity monitoring. The two key social features are work together and get rewards.

5.1. Work together

Analysis of the interviews has revealed that landowners benefit from working together in all but one case. The benefits landowners gained include positive reinforcement from others and the knowledge that they are not alone on the job. The strengths of working in partnership, as part of a team, are the motivation and moral boost it provides. It is more efficient; it halves the work load and offers encouragement, support and back up. Working together allows landowners to share information, resources and learn from each others experiences.

Landowners talked about needing mentoring and support when they began biodiversity monitoring. They sought practical support with the learning process which gave them the confidence to carry out monitoring. They learnt faster when they had people to discuss monitoring issues with.

Knowing where to go to get support was an essential first step, followed by practice and commitment. A couple of landowners made the point that they need to have experts to ask for help if they can't find the answer to monitoring problems. The issue of developing confidence and finding support for monitoring was seen as essential for successful monitoring.

Amongst the landowners interviewed, some were keen to get weeding or trapping, others wanted to plan and monitor. The monitoring partnerships work with the skills and preferences of the team members. In this way, people are confident in their ability to carry out the job.

Landowners are working together and getting support at a variety of scales and in a range of ways. Support networks often included neighbours and other people interested in conservation from the local community or region. Landowners often worked with organisations with responsibilities for biodiversity, such as local government.

Landowners said they want advice and assistance on monitoring, but don't want to be told what to do, or to lose ownership of their project. Ownership and control of the monitoring process needs to remain with the landowner.

5.2. Monitoring rewards

A major benefit of monitoring was the rewards it gave landowners. As one landowner said, "*Success breeds motivation*". Good monitoring results motivated and stimulated those involved and kept them involved. They're an incentive to people to keep up their work, to maintain the commitment and feel good about the outcomes.

Monitoring allows landowners to learn from successes and failures. Without results there is a risk of burn out and failure, failure to know if a real difference has been made or not. For example, with pest control projects, the motivation to carry on with the control needs to be maintained in the long term. Getting good rewards from monitoring results will keep landowners motivated and inspired in their conservation work. As one community monitor put it:

"Unless you have monitoring to track how you're doing, people will run out of steam, they'll drop out".

An outcome of the interviews was the fact that monitoring results not only benefit landowners, but the information benefits others around them. These landowners share their monitoring results and success stories with others in their communities. Passing on their knowledge is an effective way to influence landowners' friends and family. It will get more people interested in the environment and the work these landowners are doing, and increase their awareness of conservation issues.

If this networking and grass roots education is transferred into more conservation action, this will have additional benefits. For example, the larger the area or buffer under conservation management the greater the benefits. One illustration of this is stoat control to protect kiwi is more effective in areas larger than 200 hectares (Colbourne, 2008). In addition to the social and educational benefits of networking, the importance and value of landowners working with other individuals and organisation in their regions is that integrated conservation programmes that incorporate landscape issues will have a greater effect than small, isolated site based projects.

Some of the motivations for participation in monitoring, participatory research and adaptive management by landowners include pride, stewardship, better market access for sustainable products, community responsibility and a desire for better understanding of local land dynamics. (Allen *et al.*, 2001a; Allen *et al.*, 2001b).

These interviews have highlighted the idea that working together and getting useful rewards from monitoring are the two main social resources that are occurring around these case studies and as such they are significant community supports that need to be recognised and provided to encourage and support landowners to collect biodiversity data from their land.

5.3. Overcoming barriers to monitoring

It is important to understand how these landowners overcame barriers to monitoring because the barriers are likely to be similar for other people who may like to take up monitoring. For example, a lack of confidence was often cited in the interviews as a block landowners had to overcome and the way these landowners gained confidence through working together and finding support in their community can be used by others.

The barriers presented by landowners relate to both the monitoring methods themselves, such as how to do the data analysis on their results, and societal issues, such as not having enough time to do monitoring on top of all their other work. Some of the difficulties and shortcomings of monitoring landowners identified in the interviews are discussed below. These landowners came across barriers to

monitoring when they first started out and are now realistic about the resources required to do monitoring. These examples illustrate the importance social capital played in these people becoming biodiversity monitors on their land.

5.3.1. Learning monitoring skills

These landowners overcame the barrier of a lack of monitoring skills by using the support systems that were identified in chapter 5, *i.e.*: mentors, financial support and using existing monitoring tools, to support their learning process and to build their confidence.

Landowners need to determine their programme goals and work out what information from monitoring they need to measure their progress or to assess change, or what questions they need answers to that monitoring can provide. This will determine the kinds of monitoring methods they need to learn.

Once it is established what questions need answers and which monitoring methods are appropriate to answer the questions, it is suggested that simple methods, with interesting and quick results are established first. This staging of the monitoring learning process, breaking it down into manageable pieces, starting with the most straightforward and step by step methods, will give rewards and feedback quickly and provide satisfaction. Examples include trap catch records, tracking tunnels, wax blocks, site assessments and photo-points.

“We only carry out two monitoring methods. It’s enough to show progress towards our main goal”.

After the first monitoring methods are mastered, move onto reasonably simple yet interesting methods like bird counts and stream assessments.

“So long as this monitoring is a long term thing, not petering out after 5 years, the true worth of the monitoring and conservation work will show. Other wise we’re only guessing what happens when the bush is fenced and the possums are gone”.

When landowners are confident with the above methods, other more technical methods like vegetation plots, foliar browse index and insect pit fall traps can be used, if appropriate to the management questions.

Monitoring is a skill that requires time and practice to develop and landowners need support to become confident monitors and readers of the ecology of their land, so they can make informed land management and conservation decisions.

5.3.2. Time issues

Landowners in seven cases said they had underestimated the time needed for monitoring. If landowners take on too much to start with they may become overwhelmed and move monitoring to the 'too hard basket'. They said they had to reassess and start with one or two simple monitoring methods and realistic expectations.

Because monitoring needs to be done over and above the other chores of a conservation programme, it can be hard to find time for both. It is also seasonal, with busy periods and quiet times. Overcoming the issue of a lack of time can be addressed by having a clear purpose for monitoring, so the benefits of monitoring are seen to outweigh the time cost.

Monitoring is required to measure outcomes and keep motivation up, but it is hard to make it a priority on top of the other challenges individuals and community groups face when taking on conservation projects, such as finding funds and labour (Handford, 2006).

5.3.3. Data collection difficulties

The amount of data that needs to be collected to account for natural variation and 'data noise' in environmental monitoring was raised in interviews and needs to be considered. Monitoring is by nature repetitious and tedious, which doesn't suit some individuals. Some of these projects have set up monitoring to measure long term change, and the landowners are collecting data they cannot initially work with in the short term, as the samples are too small or not enough time has passed. Patience is

required, keeping records safe until enough data are available to identify trends. Landowners need to be aware of these matters to keep data accuracy and precision levels as high as possible.

5.3.4. Method difficulties

Three landowners mentioned issues around the science of monitoring, both around the methods and the validity of the results. There is still a lot of debate about how effective and robust many indicators and monitoring methods are and hence which methods landowners should use. The realities and practicalities of monitoring by landowners or scientists to get scientifically and statistically valid results can be complex.

Partnerships and effective consultation between landowners, mentors or professionals working together, can clarify the purpose of monitoring, the most appropriate methods, and the skills and resources the landowner will require to use the method effectively.

5.3.5. Data analysis and objectivity

Two interviewees pointed out that in some cases it may be hard for landowners and community groups to analyse monitoring data, to use results effectively, or to be objective about their projects. Data analysis is a crucial component of monitoring. Without it monitoring comes to a standstill. Analysis can include graphs, maps or statistical analysis (Lynch, 2004). Landowners may not have the experience to use monitoring results to make management decisions about their conservation programme. They may not have the technical skills to know what the results show, or how to link monitoring results with ways to improve their project. They may lack the objectivity to critique their plan or to step back and make changes if that is what monitoring results indicate is needed.

For these reasons data analysis is another area where some landowners may need support. It can be beneficial to have an external mentor to peer review and provide a neutral critique of the data and results, as well as providing advice on how to

interpret results and implement change if required. External monitors can also provide an objective eye and reduce bias.

5.3.6. Physical difficulties

Landowners said that monitoring can be hard physically, so they have to be realistic about the fitness and stamina needed. Taking time to set up permanent monitoring locations properly in the first place will make it easier for landowners to go back and re-measure in the future, but the physical work this entails can be an initial hurdle for landowners to overcome. Health and safety issues also need to be taken into account.

5.3.7. Bad news

Bad monitoring results were a wake up call in two cases; leading to a reassessment of current practice, to do something different or for more conservation action. The only real error landowners may make is not to learn from monitoring results, good or bad. Monitoring conservation work doesn't guarantee it will succeed. Failures still happen to the best planned and monitored project. Monitoring won't change the world, but it can measure change in part of it.

One of the decisions of this research was to interview people already successfully monitoring, even though one of the questions behind this research is what would it take to get more people to monitor, so it may have been beneficial to interview people not monitoring. However, barriers to monitoring were identified by these landowners, as well as how they over came them, so it was effective to study these successful monitors.

Barriers to monitoring and involvement identified in other literature include the costs of conservation and participation, when the costs are bourn by individual landowners, but the benefits are widespread and public, misuse of data and information, low commodity prices and an unwillingness to acknowledge that there is a problem (Allen *et al.*, 2001a; Allen *et al.*, 2001b).

These landowners have all overcome the barriers they initially encountered with monitoring. Now, biodiversity monitoring is rewarding, fun and provides the desired measures of success towards conservation goals, biodiversity outcomes or information for management decisions.

6. Discussion

These 31 methods have been assessed against the nine criteria believed to make a method suitable for landowners. From the 31 monitoring methods used in the case studies, nine have been chosen to form a core group of biodiversity monitoring methods suitable for most landowners. These are:

- Trap catch record
- 5 minute bird counts
- Iconic species population
- Tracking tunnels
- Photo points
- Kiwi call counts
- Baseline monitoring
- FORMAK site assessments
- Bait take

All methods have been assessed in terms of their suitability to measure the success of conservation actions, improvements to biodiversity on land or to help make decisions about biodiversity management. The nine methods are simple and non-technical and standards for the monitoring method are either easily available, or widely used throughout the country. In addition, the core methods had to meet the key criteria of user-friendliness and relevance to landowners.

The suitability criteria that each method was assessed against that are not being met often are: (1) using monitoring to improve best practice in conservation, and (2) for the monitoring information to be used by multiple stakeholders. The two cases that

are meeting the first criterion are collaborative projects between landowners in the Banks Peninsula west case and the Great Barrier Island case, and crown research institutes, two universities, private business and a local government agency. These projects aim to improve community self reliance and pest control best practice by landowners and to establish pest tolerance levels for selected fauna.

“We ran an experiment to compare tracker tunnels with wax blocks to see which were more effective in our area”.

“An experiment was done in the control area where there are plenty of rats to see if rats track multiple tunnels”.

Monitoring is used in conservation research to compare alternative management options. As there are many gaps in knowledge about biodiversity and its management, especially on private land, it is constructive for these partnerships to take place. Using private land as a study site for research or an adaptive management programme benefits the landowner, science and conservation nationally.

The second criterion is not being met because agencies are not engaging with landowners on biodiversity monitoring. If we had monitoring information from those biodiversity projects supported by grants we could establish how effective the public funds are towards the protection and enhancement of biodiversity on private land in New Zealand and we could meet New Zealand’s requirements to report on biodiversity throughout the country. Furthermore, it would inform other people doing biodiversity conservation on private land. This is discussed further in the next chapter. Both of these criteria are important to make the most of the effort put into monitoring and to gain a better understanding of biodiversity issues on private land.

There are many options when it comes to choosing indicators and monitoring (for example Allen *et al.*, 2003; DoC, 2008b; Froude, 2001; Lee *et al.*, 2005; MfE, 2007). This research has focused on the methods that landowners are already choosing to use on a voluntary basis. While monitoring methods need to be chosen to meet the needs of the user and their questions, a standard core set of indicators would create some continuity, cohesion, consistency and clarity. This core set should be chosen to

meet the needs of many users, from landowners, the public, scientists, government employees and politicians.

An attribute of the successful monitoring programmes is that landowners have chosen practical and realistic methods. Landowners make monitoring as efficient as they can by building it into their daily life or conservation work routine. They perfect their methods when they find a better way to do something, without compromising the consistency of the data collection methods.

“We have a circular track we get to on quad bikes. It would take far too long to cover this much ground on foot”.

It is practical to make monitoring multi-purpose. There can be more than one benefit to monitoring and having multiple uses for monitoring data will make it more useful and therefore a greater priority to collect. Uses include; measure progress toward goals, use the results in funding applications, educate others with the results, make management more efficient, inform decision making and keep motivation up.

The amount of information that came out of the interviews about the social aspects of monitoring highlights the importance of mentors, supports from the community and the resources that are needed to establish monitoring and to sustain monitors.

Working together helps landowners to gain confidence and getting rewards from monitoring keeps people going. Working together on conservation monitoring can be a great social or group event that builds community relations and capital. With networking, many people can share ideas, issues, information, resources and learn from each others experiences and expertise. Many of the landowners work with others in their communities. They have built, used and supported networks with other people interested in conservation in their community or catchment.

It is appropriate to examine human social behaviour when interested in the conservation of biodiversity because it is the actions, beliefs and behaviours of humanity which has the greatest impact on biodiversity. Habitat loss, habitat degradation, pollution and biosecurity breaches are actions caused directly or indirectly by humans, that have major impacts on biodiversity.

Knowing how and what to monitor is well known and understood by the scientific community, but it is not implemented by the wider community. Why? Is it because biodiversity monitoring is not important to the public or because the scientific community does not have the capacity to mentor, train and assist people to apply their knowledge? Perhaps it is because the scientific community does not communicate well?

“Researchers have this curious, implicit assumption that knowledge is the constraint, that is, once you know - people will apply the knowledge. But what we have learnt is that knowledge is only part of it. People won’t just read your reports and apply these things, you have to work hand in hand with them” (Garrity, 2006)

This quote enforces the importance of contact and partnerships between various parts of the community concerned or responsible for biodiversity conservation, so skills can be shared and passed on, not just through brochures or the internet, but over a cup of tea or leaning on the farm fence.

This research has found similarities with others (Handford & Associates Ltd, 2006; Mog, 2006; Parminter & Wilson, 2002) regarding the need for monitoring mentors. Conclusions in common are:

- Landowners need support from mentors, peers and role models, especially in the set up stage.
- People need to develop their confidence, and having support and positive experiences build this confidence.
- Monitoring needs to be relevant to the project goals and the abilities of the people involved.
- Experts should be on hand to help identify flora and fauna and to answer questions if landowners lack experience with monitoring and identifying species.
- Councils could be using monitoring results from private land in state of the environment reports.

The barriers to participation are not necessarily technical; they are as much organisational and social. It is the process of getting people involved, of providing encouragement and support to people to undertake a conservation action or pest control technique and gaining collaboration and trust building that is needed.

7. Conclusion

The nine recommended monitoring methods form a core group of biodiversity monitoring methods suitable for landowners to measure the success of their conservation actions, to measure improvements to biodiversity or to make decisions about biodiversity management on their land. The methods are practical, easily applied, consistent across the country and relevant to landowners.

This still requires landowners to establish their management goals, carefully plan their conservation work, and design their monitoring programme. Undertaking monitoring for its own sake is a waste of time. There needs to be a reason or purpose to monitor. Landowners need to work out that purpose or reason, as this will directly dictate what monitoring is ultimately suitable for their needs and their project. One well chosen method with a clear purpose is better than an extensive and pointless data gathering exercise.

Monitoring is a way to demonstrate progress, outcomes and success. Success is very effective at maintaining motivation and momentum. Many of these landowners shared their successes with their peers, spreading their enthusiasm and learning with the wider community. This may lead to more involvement in conservation and protection, and at least a wider understanding of the issues facing biodiversity.

There is a corresponding need to provide information on biodiversity monitoring methods and to provide community supports to landowners to get them going with monitoring. It is not just a question of what to monitor but how to encourage people to monitor. All of these landowners overcame barriers to monitoring, many of which

were social barriers, such as a lack of confidence. It was through the support of other people and public resources that these landowners started monitoring biodiversity on their land.

Biodiversity monitoring won't change the world, but it can measure change in part of it.

Chapter 7 - Recommended Monitoring for Agencies

“We do monitoring for our funding applications. We want to let them know there is a benefit from the work we’re doing and they’re helping to fund”.

Do agencies which fund biodiversity protection and enhancement on private land need to measure the success of their funding initiatives? This research aims to answer this question and to establish what monitoring will measure the effectiveness of public funding for the protection and enhancement of biodiversity on private land in New Zealand.

In the case studies presented in chapter 5, 18 different funding agencies were identified as having financially supported the conservation work of these landowners (see Table 7). Two of these public funds are the Biodiversity Advice Fund and the Biodiversity Condition Fund. These funds are part of the \$187 million Biodiversity Package provided by central government to support the NZBS when it was launched in 2000. The Biodiversity Condition Fund (Condition Fund) gives grants of over \$1,500,000 per annum to landowners to improve and maintain the condition of areas of native vegetation, species and habitats on their land. The Condition Fund is used as an example in this chapter to test the research question and goal as it is a major national fund for biodiversity protection on private land and a contributor to five of these case studies.

This chapter asks if there is a need to monitor and report at a funding level, keeping in mind the conclusions of chapter 4 which points out numerous obligations at an international, national and local level. The issue of quantifying goals is addressed, followed by an assessment of the monitoring methods.

The 31 monitoring methods landowners are currently using in the case studies (see chapter 5) have been narrowed down to a core group of nine monitoring methods suitable for landowners to either measure progress towards their goals, improvements to biodiversity, or to help them make land management decisions (chapter 6). If there are a core group of monitoring methods suitable for landowners to measure

improvements to biodiversity, could these same methods be suitable for funding agencies to measure their goals?

1. Defining the need to monitor for the Condition Fund

Is there a need for monitoring at a funding level? If there is, what information do Condition Fund managers need in order to report on the Fund's achievements? The number of grants given? The amount of money spent? Or the biodiversity gains achieved? The Condition Fund carries out random audits on projects to ensure the funds are used as agreed between the agency and landowners. Checks are made to ensure physical work such as fences have been built for example. This financial accountability is important and should remain when public funds are provided, but should this be the limit of its evaluations?

The Condition Fund application form (DoC, undated) asks "*how will the project be monitored*" and asks "*what are the likely outcomes of the project?*". However, the Condition Fund does not require landowners to provide any data or results from monitoring or evidence of biodiversity outcomes. The Condition Fund puts out a press release from the Minister of Conservation each funding round outlining the types of projects that have been funded and how much has gone to each region. It does not report any quantitative biodiversity data in this press release, or in any annual report. Therefore, we do not know if the Condition Fund is achieving its aims or if the funds have been effective at protecting and enhancing biodiversity. This chapter addresses the issue that there is currently no requirement for landowners who receive Condition Funds to measure the outcomes of their work.

In chapter four I reported that around \$48M has been allocated for the protection of biodiversity on private lands from the Biodiversity Package. However, the NZBS Annual Programme Reports do not include quantitative biodiversity outcome information from private land. There appears to be no measure or reporting of the biodiversity gains that have resulted from this Biodiversity Package expenditure on private land.

This thesis suggests a solution to this issue whereby landowners who receive funds are supported to collect biodiversity outcome data from their projects. These data can be given to the funding agency to see if its aims have been met, using methods that are suitable to both parties. If there is a need for monitoring at a funding level then the Condition Fund aims will need to be quantified and have timeframes attached. It would also be useful to know if the fund contributed to the goals of the NZBS.

1.1. The need for monitoring

Chapter 4 listed the obligations for biodiversity monitoring and reporting at international, national and local levels. Is there a need to monitor at a funding level? A typical and simplified management planning cycle says there is (Figure 2). Goals, Action, Monitor and Review are the essential components of this cycle. When undertaking project planning, high level project goals are established and quantitative objectives are determined that are measurable and time referenced. To implement the plan, an action is undertaken to achieve the objectives. Monitoring questions and methods are chosen to allow a review of the projects implementation and check if objectives have been met or not. Monitoring is a necessary, indeed an essential, part of this cycle.

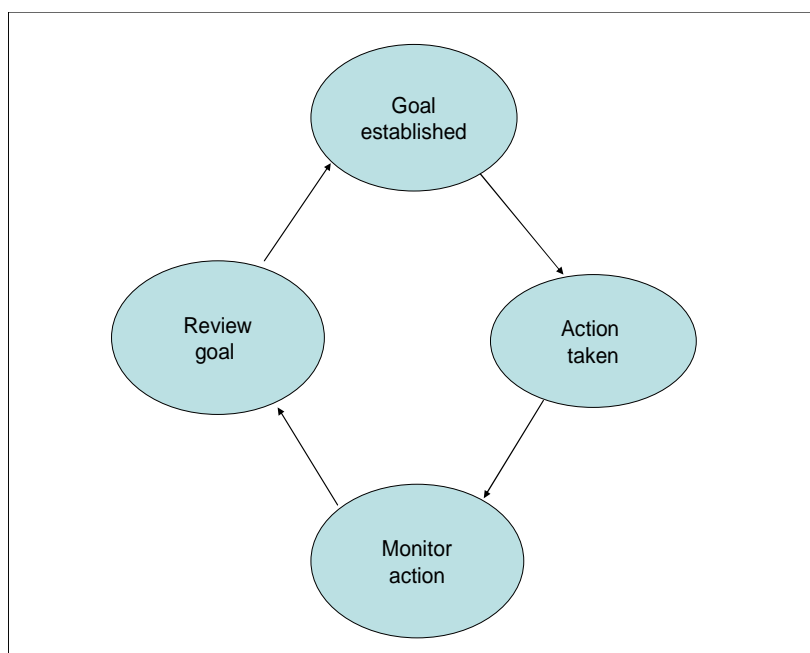


Figure 2: Diagram of the planning cycle.

The current lack of monitoring with Condition Fund projects means the circle is incomplete (Figure 3). There is no information available to check if the aims have been achieved.

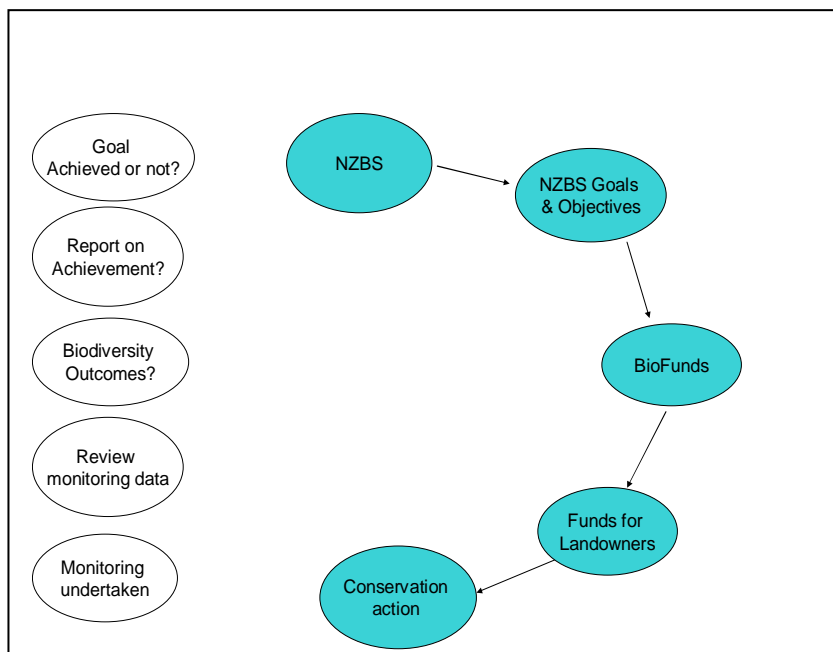


Figure 3: The incomplete circle of current Condition Fund planning.

In addition to the planning cycle, it would be very useful if the monitoring data supplied to the Condition Fund could be used for other purposes, such as informing policy makers and for other reporting requirements. There is a lack of information for policy makers to help them make informed decisions about New Zealand biodiversity (Allen *et al.*, 2003; MfE, 2000b). Monitoring resources are needed to provide information to managers, at all levels, from fund managers to politicians, to help them with decisions that impact on biodiversity and ecosystem management. Monitoring data are also needed for other reports, such as the NZBS Annual Report on Programme Performance and National Reports to the CBD.

The potential for data that integrates and informs the needs of many stakeholders will be enhanced if landowners are using consistent monitoring methods throughout the country. If they do, their data can be combined from many private property reports into national reports. For example, 4,800 private landowners have received biodiversity condition or advice funds since the programme began in 2001. Data

from all of these projects would be a significant and useful data set for reporting obligations.

1.2. Quantifying actions and aims

Strategies, policy and legislation usually frame biodiversity goals and visions in high level qualitative terms that need to be translated into more specific and measurable quantitative values (Lee *et al.*, 2005). The measurable targets should be ‘*SMART*’ – *simple, measurable, achievable, relevant and timely* (Beanland & Huser, 1999). Do the aims of the Condition Fund need to be translated and quantified into measurable targets?

The NZBS is the key policy driver for the Condition Fund, which are administered by the Department of Conservation. The Condition Fund aims to:

- a) *Improve and maintain the condition of areas of native vegetation, species and habitats;*
- b) *Broaden community involvement in the management of the country’s indigenous biodiversity; and*
- c) *Seeks to complement landholder contributions and leverage contributions from other sources.*

These aims are *simple, achievable and relevant*, but they are neither *measurable* nor *timely*. As such, they do not provide quantifiable, timely or measurable targets for biodiversity outcome reporting. For example:

- a) ***Improve*** and ***maintain*** the ***condition*** of areas of native vegetation, species and habitats;
- b) ***Broaden*** community ***involvement*** in the ***management*** of the country’s indigenous biodiversity; and
- c) *Seeks to* ***complement*** landholder contributions and ***leverage contributions*** from other sources.

All of the bolded words require clarification or quantification before they can be used as they are widely interpreted. This chapter uses aim a) to explore how landowners

could provide biodiversity data to determine if this aim has been achieved using Condition Fund money. But first the aim has to be rewritten in quantifiable terms.

To **improve** is to enhance or recover, or to change from an existing state into a desired state. A reference site or an existing comparable site may be useful in these cases to determine what the improvement is aiming for (Atkinson, 1988; Van Andel & Grootjans, 2006). Alternatively, improve could be defined in semi-quantitative terms such as more (wetlands or weta for example,) or less (weeds or weasels for example) relative to the existing state.

Maintain is to keep the current situation or status quo, or maintain something to a certain standard. For example the extent of native vegetation does not decrease. Even the maintenance of the status quo requires monitoring.

Condition is a term used in the name of the Condition Fund itself. It means state of repair or health, or ability to function. In the opinion of Lee *et al.* (2005) the word condition “*fails to adequately convey the multiple dimensions or the potential outcome of a national biodiversity conservation strategy*”. “*The terms ‘health’ or ‘condition’ which rely on analogies with human health, are inappropriate for a biological systems and biodiversity assessments*” (Lee *et al.*, 2005, p. 100).

The maintenance of ecosystem integrity has been chosen by Lee *et al.* (2005) as the primary national outcome of conservation management. Ecosystem integrity is defined as the “*full potential of indigenous biotic and abiotic features and natural processes, functioning in sustainable communities, habitats and landscapes*” (Lee *et al.*, 2005, p. 100).

Achievement of goals can be better evaluated if a time frame indicates the anticipated life of the project. For example, the NZBS is a 20 year strategy, and it lists desired outcomes for 2020. The Condition Fund has no timeframe attached, but 20 years is suitable for this project too, as the NZBS and Condition Funds are linked. Shorter milestones along the way would be appropriate for these actions.

For example: Condition Fund aim a) can be re-phrased as:

a) All projects receiving Biodiversity Condition Funding will *improve and maintain the condition of areas of native vegetation, species and habitats* on their properties. Improvements and maintenance of the condition of areas of native vegetation, species and habitats will be measured by an agreed and appropriate baseline assessment and a follow up assessment two years later.

2. The monitoring methods

Can the nine core monitoring methods be used to demonstrate changes in biodiversity condition on private lands where the funds have been distributed?

The suitability of monitoring methods to meet the needs of landowners was assessed in chapter 6 as those which were:

1. Relevant to the biodiversity goals of a project and can measure progress towards goals.
2. Able to measure the results and biodiversity outcomes of conservation work.
3. Able to help landowners to make land management decisions.
4. Designed to answer questions that will improve conservation best practice.
5. Practical, non-technical and simple
6. Consistent technique used across the country
7. Able to integrate and inform the needs of many stakeholders, including funding agencies and policy makers
8. Have sound but simple statistical properties
9. Easily applied and appreciated by landowners

The nine recommended core methods have been assessed against these same criteria, but with minor modifications to suit funding agencies (Table 13).

Table 13: The core recommended monitoring methods are tested to assess if they meet the nine criteria for suitability for use by Condition Fund reporting

Monitoring method	Core method landowners	Core method Condition Fund	Score for Condition Fund	Criteria of suitability								
				1	2	3	4	5	6	7	8	9
5 min bird counts	Yes	Yes	8/9	✓	✓	✓	x	✓	✓	✓	✓	✓
Kiwi call counts	Yes	Yes	8/9	✓	✓	✓	x	✓	✓	✓	✓	✓
FORMAK site assessments	Yes	Yes	7/9	✓	✓	x	x	✓	✓	✓	✓	✓
Possum residual trap	No	Yes	7/9	✓	✓	✓	x	✓	✓	✓	✓	x
Iconic species population counts	Yes	Yes	6/9	✓	✓	✓	x	x	x	✓	✓	✓
Vegetation plots	No	Yes	6/9	✓	✓	✓	x	x	✓	✓	✓	x
Baseline monitoring	Yes	Yes	5/9	✓	✓	x	x	✓	x	x	✓	✓
Tracking tunnels	Yes	Yes	5/9	✓	✓	✓	x	✓	✓	x	x	✓
Photo points	Yes	Yes	5/9	✓	x	x	x	✓	✓	✓	x	✓
Adaptive management	Yes	No	4/9	x	✓	x	✓	x	x	x	✓	✓
Trap catch record	Yes	No	3/9	x	✓	x	x	✓	x	x	x	✓

Criteria of Suitability numbers: 1 =measures Condition Fund aims; 2 = measures conservation results and outcomes; 3 = helps fund managers decision making; 4 = improves best practice; 5 = practical; 6 = consistent; 7 = informs many stakeholders; 8 = statistically sound; 9 = easily applied and appreciated by landowners.

Criteria 1 and 3 have been changed, to fit the Condition Fund needs, rather than landowner's needs. These changes are:

1. Relevant to the biodiversity *aims of the Condition Fund* and can measure progress towards those *aims*.
3. Able to help *Fund managers to make funding* decisions.

Criterion 1 – being relevant to the biodiversity aims of the Condition Fund – had to be passed for inclusion. Criterion 6 – the consistency of the methods - is considered as the likelihood of the monitoring technique to be carried out in a consistent way across the country, even if it is not currently in these case studies.

The threshold has been lowered to five points minimum out of nine (5/9), including scoring yes for criterion one, being relevant to the aims of the Condition Fund, and criterion nine; being easily applied and appreciated by landowners. Criterion nine is once again essential as landowners will be the ones collecting the data and forwarding it to the Condition Fund. This selected seven monitoring methods that are most suited to both landowners and the Condition Fund.

In addition, vegetation plots and possum residual trap catch have been assessed, even though they did not make it as core recommended methods for landowners as they were not easily applied or appreciated by landowners. Their exclusion from the recommended methods for landowners leaves a gap in the core group, as photo points are the only vegetation outcome monitoring method. Photos do not provide enough information to assess the condition of native vegetation, so this gap needs to be resolved.

It is recommended that standard vegetation plot methods such as 20x20 plots or the transect method suggested by FORMAK are refined and further adapted to be more user-friendly for landowners. In addition, it is suggested that kill traps are used for possum residual trap catch monitoring rather than leg hold traps. Some landowners commented that having to kill possums in leg hold traps was a problem for them. If these two issues can be resolved it would take the recommended core list up to nine recommended methods.

The statistical properties criterion may rank higher for an agency than an individual landowner. Data that is publicly reported, and can potentially be incorporated into reports at an international level, needs to be very robust (*i.e.* collected by appropriate methodology) and to stand up to public scrutiny.

Agencies have to be careful that their monitoring systems are:

- *Based on a principled approach to conservation issues*
- *Transparent, as based on clearly identified and articulated measures around which there is a consensus as to their validity*
- *Credibly carried out and analysed by trained professionals*
- *Reported in a full and honest manner.*

The latter two issues concern trust by government and the public in the agency reporting biodiversity statistics and conservation achievement. Without this trust, monitoring is a waste of time and money (Lee et al., 2005, p. 94).

While I agree with Lee *et al.* about the importance of trust, I don't agree that monitoring has to be carried out by trained professionals. For example, at the moment landowners are trusted with a grant of up to \$60,000 of Condition Fund money for their projects, with no requirement to report on biodiversity outcomes. Audits are carried out on projects as mentioned previously. Why wouldn't landowners be trusted with outcome reporting? These landowners carry out hundreds of volunteer hours to protect, restore and monitor biodiversity on their land, for no financial gain. In fact, they spend plenty of their own time and money on this work and want to know they are being effective (see chapter 5, 2.1)

What confidence is there in the Condition Fund with no outcome information available? Would there be more or less confidence if the Fund could report biodiversity outcome data that had been independently collected from all landowners who receive funds?

Adaptive management and trap catch records do not meet the key criterion of being relevant to the aims of the Condition Fund, so have not been included in the core

group. The aims do not mention the need for adaptive management, or for pest control data.

Adaptive management is the only method which meets the criterion of improving conservation best practice. It is a concern that not much emphasis is being placed on monitoring as a tool for continual improvement of best practice. Many experienced scientists have said that monitoring is an essential part of the learning gained from conservation and restoration ecology activities (Atkinson, 1994; Danielsen *et al.*, 2005; Dickinson *et al.*, 1992; Handford & Associates Ltd, 2004; Lee *et al.*, 2005; Lynch, 2004).

“Whenever a threatened species is translocated to a new habitat, we are making a trial” and *“historically, trials or management experiments have been our principal source of new understanding of restoration processes”* (1994, p. 24). The benefit of monitoring and recording such trials, by landowners or scientists, is of paramount importance as it allows for better conservation decisions that may increase the effectiveness of the work and hence the outcomes of the funds.

3. Measuring biodiversity outcomes

Quantifiable objectives can be turned into monitoring questions. For example:

a) What proportion of projects that received Biodiversity Condition Funding have *improved or maintained the condition of areas of native vegetation, species and habitats* on their properties?

Or, a statement of explanation can be attached to each aim, to define its key terms and intent. For example:

Aim a) implies that a change in condition has occurred. The change could be in the abundance of a key species, in the condition of native vegetation or a change in the condition of habitat, as measured and detected by a selection of monitoring techniques agreed between the recipient and the Condition Fund.

The achievement of this aim can be measured by having prescribed biodiversity abundance or condition monitoring methods deliver quantified information about

biodiversity change over a set time period (annually, triennially *etc*) and those projects demonstrating the necessary level of change simply summed.

The 31 biodiversity monitoring methods used by landowners in the case studies have been assessed against criteria believed to make a method suitable for landowners. Nine methods were chosen to form a core group suitable for most landowners. These nine methods were then assessed against the same criteria, slightly modified, to reflect the needs of the Condition Fund. Seven core methods are likely to suit both the needs of landowners and are appropriate for the Condition Fund to measure biodiversity outcomes under its aim a). The seven core methods favoured by landowners in these case studies also serve the information needs of the Condition Fund. These are:

- 5 minute bird counts
- Kiwi call counts
- FORMAK site assessments
- Iconic species population counts
- Baseline monitoring
- Tracking tunnels
- Photo points

The biodiversity outcomes of Condition Fund aim a) namely: *improved or maintained condition of areas of native vegetation, species and habitats* can be measured by:

- Five minute bird counts can reveal positive trends in bird numbers or diversity over time following pest control. The Far North, Northland, Southwest Auckland, Great Barrier Island, and Coromandel North are all receiving Condition Fund support. They all undertake bird counts but none of them use the same method (see Table 12), and they all want to improve the condition of their land for indigenous birds. By using a standard five minute bird count, the landowners and the Condition Fund will collect data to see if this aim has been achieved at these five sites.

- Kiwi call counts are used in the Far North, Northland, and Coromandel North cases, which have goals around kiwi on their land and receive Condition Fund support to achieve these goals. As well as providing the annual kiwi call data to the national kiwi call scheme, this information can be used by the Condition Fund to report on the success of their funds to support these goals.
- FORMAK site assessments calculate the condition of areas of native bush and habitats by ranking various aspects of condition such as canopy density, pest damage and seedling regeneration. The Northland case study has undertaken an extensive FORMAK site assessment. This site can be monitored every two or three years to measure the condition of the site to find evidence of maintained or improved vegetation, habitats and species. FORMAK is for bush assessment and monitoring, so similar products need to be used for other ecosystems such as estuaries, tussock grasslands and coastal cliffs for example.
- Population monitoring of an iconic species is undertaken by the Northland, Great Barrier Island, and Coromandel North cases. Two cases have translocated populations of iconic threatened species to their properties. Monitoring the population of these species is not only important to the landowners, it is important to the Department of Conservation. The data could be used by the Condition Fund as well to report quantitatively on the effectiveness of the fund to support this threatened species protection work on private land.
- Baseline monitoring is an obvious choice to measure improvements and maintenance as it sets a bench mark for progress to be measured against. The Far North, Northland, and Coromandel North cases undertook baseline studies of wetlands, bush and bird populations prior to conservation work. Baseline surveys should be conducted prior to conservation work beginning to measure changes. A baseline survey should be a condition of receiving funding and can be submitted as part of the Condition Fund application process. The survey can be redone over time to measure improvements and to report on outcomes.

- Tracking tunnels are an effective way of comparing the relative abundance of animals from a treatment and non-treatment control site, or before and after treatment at a single site, or both. All the five case studies which received Condition Fund money are using tracking tunnels to judge the effectiveness of their rodent or mustelid control programme. The Condition Fund could report tracking tunnel index results from properties which use their funds for this purpose.
- Photos and aerial photos can show the extent of vegetation has been maintained or has increased. The Far North, Northland and Coromandel North cases are already using photos to track changes and monitor the condition of vegetation. These include photos of canopies, of coastal forest and of regenerating bush. Photos of intact permanent fences and regenerating native plants once stock have been excluded can also be used in Condition Fund reports to show progress towards its aims.

4. Recognizing the social aspects of monitoring

As discussed in chapter 5 and 6, monitoring for landowners in these case studies is a social activity as much as it is a scientific one. Results from these case studies show that monitoring created many social benefits, such as collaboration amongst neighbours, informed decision making, increased motivation and sharing of tasks and resources.

Taking an active part in conservation and monitoring of biodiversity on one's own land can increase a sense of pride, wonder and appreciation of the land. These personal experiences are a primary motivation for conservation action, and once some conservation action has been taken, it is more likely to lead to more action in the future. Active participation in conservation decision making has been shown to remove opposition to conservation policies. *“Active management seems to strengthen the caring relationship with the land more than passive setting aside of habitats”* (Paloniemi & Tikka, 2008).

The involvement of key community players in monitoring and participatory research gives them new ideas that they are likely to share with others in their community, leading to changed community thinking (Allen *et al.*, 2001a; Allen *et al.*, 2001b).

There are many good examples that demonstrate the benefits of social involvement and community based monitoring from overseas. One case is the involvement and participation of the community in the National Forest Policy in India. The indicators for the Bhopal–India process are simple, robust and the information can be collected by involving the community at the forest management unit level (Kotwal *et al.*, 2008). The indicators include ecological, social and economic measures, to provide a holistic approach to management and monitoring.

In the Philippines research found the most effective conservation outcomes were generated through focus groups, when local people got together to talk about an issue, and then took action based on the group discussion. An important component of the decision making process was the monitoring data they considered (Danielsen *et al.*, 2005).

A Finnish case study describes the planning process of a biodiversity programme where private forest owners and other interest groups equally represented their perspectives in the process. *“All participants together succeeded in including the aspects of both nature (i.e., the outcome of conservation) and people (i.e., the process and methods of conservation) in the Biodiversity Program. Both aspects are important if conservation is to become a legitimate social and political process”* (Paloniemi & Tikka, 2008).

The contribution of local communities and other stakeholders in management and monitoring is an important means to an end and an end in itself (Kangas *et al.*, 2006).

5. Social benefits to funding agencies

How can funding agencies recognise the social aspects of monitoring to better support landowners? The Condition Fund is part of the package designed to achieve the goals of the NZBS. The issues raised in the NZBS are complex and difficult to resolve, and it acknowledges that community involvement is a key to achieving its

goals. The complexity of environmental issues, resource use, and information management, which all have social, cultural, ecological and economic facets or components, illustrates the importance and strength of joint participation in monitoring programmes. Such multifaceted issues require a collaborative and participatory approach, as science alone cannot solve such complex issues (Allen *et al.*, 2001a).

Stakeholders will have many reasons for being involved in conservation. A key to success in collaborative ventures is to clearly identify everyone's different goals and objectives, recognising that individuals are all co-researchers with differing worldviews, so cooperation is more realistic than consensus (Allen *et al.*, 2001a).

6. Recommendations

This thesis has used case studies to demonstrate how landowners are undertaking biodiversity monitoring which can provide information and evidence about biodiversity and its protection on private land.

Nearly \$1.5 million has been given to these 12 case studies to support the conservation of some of the country's most threatened and endangered species, ecosystems and habitats that are found on their land.

These landowners are spending money, resources and hours of time, to achieve significant and valuable improvements for biodiversity. Not only that, these landowners are monitoring to measure their outcomes. But these cases are exceptions to the rule. In general there is no information or data on the biodiversity outcomes of the money invested in such an important task as saving the biodiversity of the country.

This thesis has provided a recommended list of core monitoring methods that are suitable for landowners to measure progress towards their biodiversity goals that can also be used by funding agencies to judge the effectiveness of their funding towards the protection and enhancement of biodiversity on private land in New Zealand.

The outcome of my investigation shows that there are numerous issues to address with regard to biodiversity monitoring and reporting on private land. The issues are listed here along with recommended solutions:

- Funds for biodiversity protection on private land, such as the Condition Fund, have goals, but many are not quantified or time referenced. The goals are mostly not measurable or not measured, so funding agencies do not know if they are achieving their goals.
 - Quantify fund goals by defining them as measurable and time referenced outcomes that can be assessed with monitoring.
 - Resource landowners to collect data to determine if the fund goals have been met.
- The Condition Fund reports on actions undertaken, but does not provide biodiversity outcome data in their reports.
 - A baseline survey should be a condition of receiving funding and can be submitted as part of the Condition Fund application process. The survey can be redone over time to measure improvements and to report on outcomes.
 - Resource landowners collect biodiversity outcome data for reports.
- Some funding agencies do not provide money to fund monitoring even though there are multiple benefits, including: broader understanding by the public of biodiversity issues, information for national and fund reporting and ability to engage in adaptive management.
 - Change funding agency policy to fund monitoring by landowners to collect biodiversity outcome data.
- Private land is under-represented in monitoring statistics. Key biodiversity data are not being collected because the mandate to collect data from private land is not clear. We do not know what is happening to biodiversity on private land in New Zealand with any certainty.
 - Clarify government roles, responsibilities and resources for biodiversity monitoring on private land.

- Provide avenues for landowners to participate in the collection of biodiversity data from their land and to share their data with the wider community, to create a clearer picture of biodiversity throughout the country.
 - Participation can include ground-truthing aerial images of vegetation and habitat on private land to improve the accuracy of this data.
- Inconsistent and incomparable monitoring methods are used around the country.
 - Choose and confirm a core set of indicators at a national level that can meet the needs of many users, from landowners, the public, scientists, government employees and politicians.
 - Advertise and promote the standard, consistent national monitoring methods throughout the country to increase their use by the public.
 - Encourage landowners to use the core group of monitoring methods to maximise the ability to compare data from around the country.
- Landowners are keen to monitor, but there are barriers they have to overcome.
 - Resource landowners to overcome barriers to monitoring they may encounter, such as a lack of confidence, by providing social supports such as mentors and an advice service to improve their monitoring effectiveness.
 - Promote the use of existing monitoring tools such as FORMAK, SHMAK, Bush Vitality and the Estuary Monitoring Kit which suit non-professionals.
 - Use national funds for the protection of biodiversity on private land to train landowners how to carry out biodiversity outcome monitoring
- Monitoring data are not used to its maximum potential by landowners as a decision making tool. Some cases are engaged in adaptive management projects, but only on minor tasks.

- Engage professionals to work with landowners to maximise the benefits of monitoring as a decision making tool and to develop best practice conservation methods through adaptive management practices.
- Monitoring and review are essential components of planning, at all levels. New Zealand is not meeting its international, national, local or funding monitoring and reporting requirements with regard to biodiversity on private land. There is little quantitative biodiversity data for reports because the funds and resources to gather data from private land are very limited.
 - Quantify international, national, local and funding biodiversity goals by defining them as measurable, time referenced outcomes that can be assessed with monitoring.
 - Support and resource landowners to be part of the team that collects biodiversity data for these reports.

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Appendix A – Case study protocols for pilot landowner interview

(Adapted from Yin, 2003)

Each case has its own case study protocol.

Landowner's name: _____

Monitor's name if not the landowner: _____

Address of property: _____

Are more properties involved? _____

✂ Introduction to the case study and the purpose of the protocol

★ Role of the case study protocol

- * Establish consistent protocols and procedures for each case
- * Keep the questions targeted on the subject of the case study
- * Focus on the issues and a description of the study, including hypothesis, propositions and theory, not just background information
- * Identify the case study report audience
- * Justify case study methodology (Tolich & Davidson, 1999; Yin, 2003)
- * Anticipate problems or criticisms

★ The research goal

- * The research goal is to establish what biodiversity monitoring will measure the effectiveness of public funding towards the protection and enhancement of biodiversity on private land in New Zealand.

✂ Background

★ Biodiversity loss

- * Biodiversity loss is a huge issue in New Zealand as it is around the world (DoC & MfE, 2000; MfE, 1997; UNEP, 1992). This is the primary context and perspective behind this thesis, that it is essential to get private landowners, who own 70% of New Zealand, on board with conservation action on their land to reverse this trend.

★ Priority areas for conservation

- * Priority areas for conservation work on private land have been identified (MfE & DoC, 2007).
- * This property (does or does not) fall within one of these priority areas, namely _____. (Check map supplied by MfE from Protecting our Places).
- * The priority areas are _____ (add description of priorities).
- * A brief ecological description of the property is attached.

★ Conservation issues

- * List any particular issues here _____

✂ About the project

- * The main conservation issues are: _____
- * The main conservation actions have included: _____
- * Biodiversity outcomes have included: _____
- * Any particularly special or odd features of this case study? (For example Great Barrier Island is possum and mustelid free, which reduces the suite of animal pests to control).

✂ Funding

- * The landowner received funds from _____ of \$ _____ to carry out biodiversity protection on their land. Follow up with landowner for the details.
- * Other issues include the need for ongoing income for costs, such as paying staff to manage the property (pest control, track maintenance, education roles).

✂ Goal setting:

★ Importance of goal setting

- * Goals have been described as an essential component of conservation planning (Ehrenfield, 2000; Hobbs *et al.*, 2006). Monitoring needs to be tied to goals, as it is not an end in itself, but part of project planning and evaluation.

✿ The project goals

- * The projects main goals are: _____(take from interview transcript)

✿ **Research questions:**

In order to achieve the research goal, four research questions have been posed:

1. Do agencies which fund biodiversity protection and enhancement on private land need to measure the success of their funding initiatives?
2. Is monitoring of biodiversity change on private land a national requirement to provide information for national biodiversity status reports?
3. Are there are a core group of biodiversity monitoring methods suitable for landowners to measure the success of their conservation actions and improvements to biodiversity on their land?
4. Do landowners need to inform their land management decisions and inform funding agencies?

✿ **Propositions:**

- * Biodiversity monitoring helps to informs landowners land management decisions and is insightful and educational for landowners.
- * Monitoring on private land is necessary to gain a national picture of biodiversity.
- * Establishing and maintaining a monitoring programme has multiple barriers
- * Monitoring on private land, by landowners or by professionals with the permission of landowners, can be established and maintained with the right support from external sources and agencies, including funding agencies.
- * Landowners get a net benefit from monitoring.
- * Conservation action should be informed, robust and follow best practice.
- * Biodiversity outcome, trend and condition monitoring is an essential component of conservation action, to ensure the work undertaken delivers the expected and desired results.

✿ **Theoretical framework:**

- * Monitoring needs a clear purpose, such as informing management decisions, measuring change or looking for understanding (Lee *et al.*, 2005; Lynch, 2004).

- * Good ecological information leads to informed ecological decisions (MfE, 2000b).
- * Monitoring is rewarding, measures success and educates (Young *et al.*, 1996).
- * Incentives and rewards lead to longer and deeper involvement in biodiversity protection and influence others in the landowners' wider community (Carr & Wilkinson, 2005; Craig, 1997).

✂ Data collection procedures

- * Date of interview: _____
- * Place of interview: _____
- * Time of interview and time taken for interview: _____
- * Interview process: (*e.g.* - informal chat after dinner at workshop. Interview was recorded and transcribed).
- * Preparation prior to interview: (Normal preparation prior to interview includes: reading of funding application forms and monitoring results or reports if available).
- * Sources of evidence:
 - ☆ interview transcript _____
 - ☆ observations _____
 - ☆ documents _____

✂ Outline of case study report

- * The 'case' is a property or group of properties and key informant interviews are held with the people involved with biodiversity monitoring on that property, be they the landowner or a person monitoring on the landowners' behalf.
- * Outline of the property and project, including goals and funds received
- * Current reporting and monitoring practice and requirements
- * Management of monitoring programme, its establishment and maintenance
- * Summary of biodiversity monitoring results.
- * Attitudes to monitoring and reporting
- * Suggested improvements to further interviews, learning from the pilot interview and all previous interviews to improve the next interviews:

- ★ vacuum cleaner on in the background made listening to transcript difficult
- ★ find a quiet private place if possible so as to not get interrupted,
- ★ have spare batteries for recorder,
- ★ have something for the recorder to sit on closer to the interviewee,
- ★ when reading and coding interview transcripts think of improvements to research design, questions and the field procedures
- * Include real quotes from interviewees to illustrate key points
- * The final report of all the case studies generalises at a high level, it does not include personal names and transcripts are not included as appendices.
- * Attachments: transcript of interview, funding application forms, monitoring results or reports.

✧ Case study questions

(Case study protocol questions are directed at me, not the interviewee).

- ★ Background information
 - * Collect details of the **individual** doing the monitoring, the project and property, including **funds** received.
- ★ Landowners need to measure the success of their conservation actions
 - * Verify the project **goals**, objectives, aims or targets
 - * Summarise the conservation **action** taken to date
 - * Define any current reporting and monitoring **requirements**
 - * Has the landowner **measured the success** of their work? If yes, how?
(Anecdotal stories, photos, comparisons, monitoring?)
- ★ Are there are a core group of biodiversity monitoring methods suitable for landowners to measure the success of their conservation actions and improvements to biodiversity on their land?
 - * Define reporting and monitoring current practice, *e.g.* what, when, why of monitoring. Methods, types (trend, outcome, result), time frames?
 - * Determine the steps taken to establish and maintain the monitoring. What supports were needed or given? What hindered the process? What improvements could be made?
 - * What changes have been measured?

- * Evaluate the effectiveness of current monitoring, project evaluation and reporting. The assessment of effectiveness and landowners attitudes to monitoring and reporting are based on responses to the interview questions.
- * Identify appropriate improvements to monitoring, evaluation and reporting focusing on measuring achievement of project goals, N.Z. Biodiversity Strategy goals, informing management decisions and practical options for the landowner.
- ★ Do landowners need to inform their land management decisions and inform funding agencies?
 - * What is done with monitoring results?
 - * Has this information been used by the landowner to inform any land management decisions?
 - * Have you changed any management practices due to monitoring?
 - * Any adaptive management projects?
- ★ Landowners get a net benefit from monitoring.
 - * What are their attitudes to conservation work, including motivations and aspirations and rewards?
 - * Establish various attitudes to monitoring and reporting, including benefits, motivations, rewards.
 - * Identify the barriers to monitoring and the supports needed.
- ★ Find out if establishing monitoring is a barrier issue, such as no expertise or time, no money available for equipment, or if establishing monitoring is an attitude issue, such as ‘there is no need to monitor’?

✠ Case study protocol and Interview Guide References:

Appendix B – Interview and observation guide

(Adapted from Tolich & Davidson, 1999)

Introductory questions

1. Tell me about your conservation project, what have you've been doing?
2. How did you get involved with monitoring?
3. What expectations did you have about monitoring?
4. How would a typical monitoring session go?

Theme questions

- ☆ How do you measure the success of your conservation work?
 - * Looking for evidence of 'monitoring is rewarding, measures success and educates'
- ☆ What biodiversity monitoring methods do you use?
- ☆ Have you used the monitoring results in any way?
 - * Looking for any evidence of 'monitoring informs management decisions' and 'good ecological information leads to informed ecological decisions'.
- ☆ Do you think that monitoring and its results have influenced you or others around you?
 - * Looking for evidence that 'the rewards gained from monitoring lead to longer and deeper involvement in biodiversity protection and influences others in the landowners' wider community'.
- ☆ What supports have you had with regards you monitoring and conservation project, including funding?
- ☆ What implicit monitoring and anecdotal information have you used?
- ☆ Where there any barriers to monitoring you had to overcome to get started or to keep going?

Prompts

- Can you give me another example of that?
- How did that happen?
- Can you explain that a bit more, I don't understand?
- Can you elaborate on that for me?
- Does that happen all the time?
- Tell me more.
- How does that compare with.....?