Identifying Ecological Corridors for the Manu Metropolis

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SPONSORED BY

Victoria University of Wellington and Forest & Bird New Zealand

WPI

TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI VICTORIA UNIVERSITY OF WELLINGTON

Forest & Bird

Identifying Ecological Corridors for the Manu Metropolis

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Abstract

Our project assesses the value of the Silverstream Spur in Upper Hutt, New Zealand as an ecological corridor for native birds. We surveyed local residents to assess their relationship to their environment, and conducted interviews with ecology experts, developers, and government officials to understand the motivations for and against development of the Silverstream Spur. We found that only certain birds would utilize the Spur's corridor function, but all could benefit from larger habitat area and predator control. Using surveys, we found residents have overall positive attitudes towards conservation, the land, and the region's native birds. Any future development on the Spur would warrant a complex legal process that allows the opportunity to incorporate the proposed ecological corridor.

Executive Summary

Introduction

Biodiversity provides ecological benefits that allow for the natural sustainability of this planet. However, biodiversity is vulnerable to human-caused threats such as habitat loss, invasive species, and overall human impact. Protecting species diversity from these threats is a necessary part of wildlife conservation. Island species are particularly at risk, due to their isolated evolution and confinement to small habitats. Ecological corridors are among many tools implemented worldwide to combat biodiversity loss. They are designated linkages of land meant to facilitate movement of populations between green spaces, and therefore mitigate habitat fragmentation and increase ecological diversity over large areas.

New Zealand is a nation that has employed ecological corridors among other tools such as reforestation, pest control and land preservation, to combat the decline of avian biodiversity over the last century. However, the implementation of corridors has not always been straightforward, since balancing economic needs and conservation is often a difficult process. The organization Forest & Bird Upper Hutt has proposed an ecological corridor between green belt reserves surrounding the region of Upper Hutt, New Zealand to aid the movement of the region's native birds. However, a potential land-swap has been negotiated between Upper Hutt City Council and the development firm Guildford Timber Company (GTC). This proposal is outlined in a document called the Memorandum of Understanding (MOU); this document is not legally binding and simply indicates intent. If acted upon, the agreement would transfer land important to the corridor's implementation to GTC for potential urban development. The goal of our project was to investigate the potential and actual value the ecological corridor could provide to the region's native birds, determine its desirability by Upper Hutt residents, and learn about the attitudes of various stakeholders towards its implementation. This information is intended to help Forest & Bird determine the feasibility of the corridor, and subsequently help UHCC make an informed land-use decision that will encourage conservation efforts specific to our project and beyond.

Methodology

The successful completion of this project required us to divide our main goal into four objectives: (1) determine how native birds in the green belt land could benefit from the presence of an ecological corridor, (2) evaluate the attitudes of key stakeholders towards the ecological corridor concept, (3) assess the public's perceptions of their relationship to their environment, and (4) create awareness materials for the public and Forest & Bird. These objectives were completed using three methods: interviews, surveys, and field studies at the site of interest. To fulfill our first objective, we conducted interviews with various avian and eco-corridor experts in the region, including individuals at the Te

Papa Museum, the team at Wildlife Management International, and facilitators of a corridor across Auckland, New Zealand. We asked about bird species present in our region of interest, bird behavior, and existing conservation efforts to increase the presence of native birds in semi-urban areas. Additionally, we conducted site assessments of the Silverstream Spur and all areas involved in the land-swap proposal. The second objective was completed through a series of interviews with stakeholders in the land, including members of the city council, the company interested in developing on the Silverstream Spur, and our sponsor Forest & Bird. The third objective was mainly fulfilled through an innovative Facebook paid-advertising campaign. We targeted Hutt Valley residents with a survey meant to assess their attitudes towards conservation, the development proposal, and the region's native birds. The results of these three objectives culminated in deliverables for our sponsors. We were asked to create awareness materials via a pamphlet and research-style poster, to help educate Forest & Bird members and the public about the corridor effort.

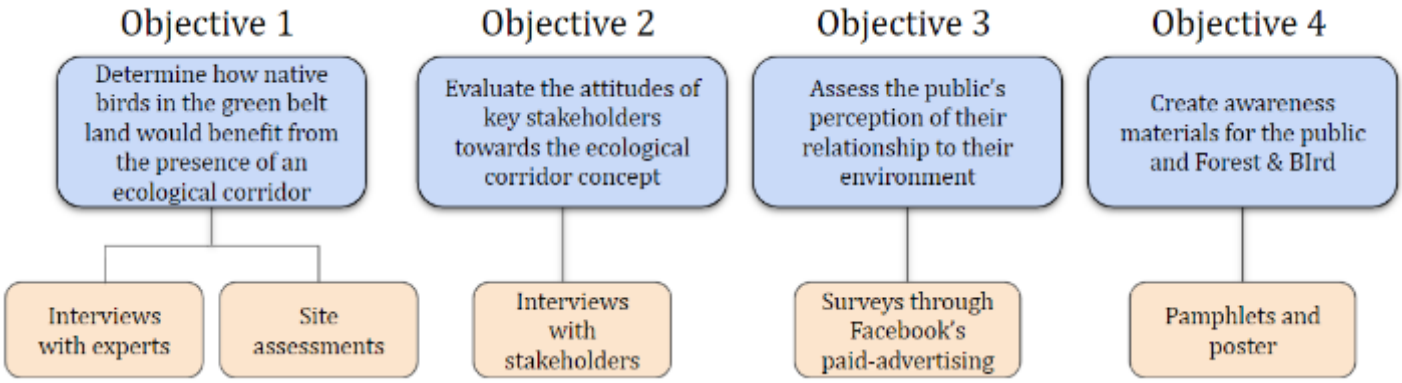

Figure 1: Objectives and methods

Results and Analysis

Objective 1: By conducting site assessments and speaking with ecology and biodiversity experts, we were able to further understand the impact an ecological corridor could have on the native birds in the Hutt Valley. We determined that corridor implementation and maintenance in New Zealand requires extensive pest control to be successful. Additionally, we learned of specific species that could depend on a corridor for movement, including the whitehead and the rifleman. We also found that species such as the tui and kererū may not depend on continuous forest cover but would benefit overall from a larger habitat area. The site assessments revealed that the Silverstream Spur does have relevance as a key element of connectivity; without the Spur, keeping the corridor continuous would be extremely difficult. However, we could not assess the extent of the impact on movement that development on the Spur would have. We concluded that while the corridor, in theory, would aid in the dispersal of native bird populations, this claim would have to be supplemented by more research to truly prove a corridor's actual value.

Objective 2: In our semi-structured interviews, we spoke with a representative of the GTC, members of Forest & Bird Upper Hutt, and several local authorities. Each interview helped build a comprehensive profile of the points of view that surround the central issue of our project. In our conversation with Ralph Goodwin, the representative of GTC, we learned that his long-term ownership of land in the Hutt Valley and forestry background has formed the basis for his strong environmental conscience. He demonstrated his commitment to revegetation efforts on the land he hoped to designate as a public reserve in exchange for the Spur. He shared Forest and Bird's vision for an ecological corridor, but admitted that the trade was only economically viable if some form of development occurred on the Spur. He explained his vision for an access road and small hamlets of housing that could still preserve the native bush and scenic landscape.

We next interviewed members of Forest & Bird Upper Hutt to gain their perspective on the corridor and land-swap proposal. Many members were concerned about losing native bush, as from experience they had learned regenerating native forests was an arduous and long process. They also maintained that the Silverstream Spur was crucial to the passageway of native birds, drawing on their past efforts of replanting and removal of invasive species to show their impact on avian populations. We learned members were not completely unified on their beliefs for the Spur's future land-use. Our sponsor, Pat van Berkel advocated for complete protection of the Spur, whereas Graham Bellamy, the current chairperson of the Upper Hutt branch, accepted the idea of minimal development, such as an access road. Other members were not previously aware of the Memorandum of Understanding regarding the land-swap, and voiced their desire for more transparency in its initial creation. We concluded the organization does not have consensus on the requirements for the ecological corridor to be viable.

Our third set of interviews was with the mayor, chief executive, and the policy planning manager of the Upper Hutt City Council (UHCC). We confirmed the council places a high importance on conservation, which is supported by Upper Hutt legislation. The council members we interviewed referenced many policies that require the council to provide for the wellbeing of communities with sustainable, environmentally-conscious actions. We also determined the UHCC does support the land-swap but has not come to any concrete determination of its details. Since there is no precedent to base this proposal on, we became aware that there was no defined next step or timeline upon which to proceed. However, the council members believed that through the rigorous process warranted by legislation, the land-swap agreement would eventually consider and minimize negative environmental impact. When asked about taking into consideration the public's feedback, the council members responded that they would be receptive to the public's feedback during the community engagement phases of the proposal. Additionally, we concluded the council could benefit from a greater understanding of ecological corridors and why they should be a priority for consideration.

Finally, we interviewed people of Māori descent to understand how cultural considerations can be addressed when making land-use decisions. Our interviewees emphasized the sense of guardianship, rather than ownership, one should have with land. They also explained how understanding one's history and *whakapapa* (genealogy) was a primary step in making land-use decisions. We learned that Māori are given consideration in matters brought up in New Zealand's environmental court.

Objective 3: Our survey was primarily distributed on Facebook using a series of advertisements. The survey targeted adults within a ten-mile radius of Upper Hutt, with various interests (such as environmentalism, wildlife, video games, and rugby) to obtain the most comprehensive results possible. We spent $290 USD/$410 NZD and collected 553 responses at an average cost of $0.35 USD/$0.51 NZD per response. Most respondents valued conservation greatly, but did not rank themselves as highly with regard to their knowledge of conservation issues face by native birds in New Zealand. Respondents were given the opportunity to mention other conservation threats they were aware of, which included habitat loss, pollution, pests, and various forms of pest control. One of the more prevalent themes was 1080 poison; the majority of the mentions of 1080 were highly negative. However, governmental bodies like the New Zealand Department of Conservation (DOC) and the Greater Wellington Regional Council (GWRC) advocate for the use of 1080, arguing that it is the only effective tool for large-scale pest removal at the moment.

We found most survey respondents (79%) were not aware of Forest & Bird Upper Hutt's desire to conserve the Silverstream Spur, and even more were unaware (84%) of the Memorandum of Understanding (MOU) between UHCC and GTC concerning the land-swap. Of the respondents who were aware of the MOU, 44% listed various concerns including development, lack of transparency between UHCC and the GTC, and flood risk to the surrounding communities. When assessing how the respondents felt about their local native birds, we found that the tui, kererū, and fantail all had a very positive impact on individuals' daily life. Respondents shared many stories about their interactions and relationships with these birds.

Objective 4 (Awareness Materials): The purpose of the pamphlet was to provide a brief explanation about ecological corridors, the value of bird corridors, and how Silverstream Spur could function as a corridor to benefit Upper Hutt's native birds. This pamphlet was designed for the general public as well as Forest & Bird members. The research poster was a display of our project, including the background, objectives, results, and recommendations intended for Forest & Bird members or others familiar with the Silverstream Spur and conservation efforts in Upper Hutt. These materials were presented at Forest & Bird's annual meeting following our presentation.

Figure 2: Pamphlet layout

Recommendations

Our recommendations for Forest & Bird are as follows:

Public Outreach

1. Increased public education efforts about the proposed corridor project and current methods of conserving native vegetation and wildlife.

The Ecological Corridor

1. Consult biodiversity/ecology experts who can provide substantive evidence for the corridor's potential effectiveness.
2. Begin a public campaign towards securing the corridor.

The Land-Swap

1. Maintain the amicable relationship that currently exists between their branch and GTC representative Ralph Goodwin.
2. Propose a reassessment of the land-swap to the UHCC, including the incorporation of an ecological corridor or land set aside for conservation.

Conclusion

The purpose of this project was to identify how the ecological corridor concept would impact the region's birds, and to understand the attitudes of key stakeholders and the public towards the potential land-swap. We found that while conservation of the Silverstream Spur could be helpful, the evidence was not conclusive that birds would benefit from this corridor. Fortunately, all stakeholders seemed receptive to the corridor, despite development that may occur on the Spur. Our sponsors also wished to know how the general public viewed these topics. Our findings indicate that the public has favorable views towards conservation, and that many people are aware of and concerned by threats to native bird species. This information can be used by Forest & Bird to promote the potential ecological corridor.

The consensus from the stakeholders is that this land-swap and potential development is a slow-moving process. We recommend that the involved parties continue their cooperative efforts and maintain open lines of communication. A renegotiation of the land-swap is possible, and may result in a more agreeable compromise among the stakeholders. We believe that the parties can come to an agreement that is both ecologically favorable and commercially viable.

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1. Introduction

Biodiversity provides ecological benefits including fresh water and clean air, allows for the natural sustainability of this planet, and holds intrinsic value: "a value that is neither conferred or revocable, but springing from a species' long evolutionary heritage and potential" (Soulé, 1985). Unfortunately, human actions pose growing threats to biodiversity, from exploitation of natural resources to habitat loss. Biodiversity on islands is especially vulnerable; high specialization and evolution in the absence of mainland predators make island flora and fauna extremely susceptible to disruptions. Furthermore, island species are often confined by small habitats and population sizes, so the relative impact of human action is often higher and harder to recover from (UN Environment, n.d.).

Conservation efforts in the last few decades have worked to preserve areas of natural habitats and their native species. Connecting these habitats is especially important to allow for movement, genetic interchange, and long-term continuation of species. Ecological corridors are designated linkages of land that have been implemented to facilitate movement of populations between green spaces (Thomas, 1991). They can be straightforward, such as the wildlife bridges spanning the Trans-Canada highway, (Dickie, 2017) or complex, such as the wind corridors in South Carolina that aid seed dispersal of plants (Damschen, 2006). These corridors are valuable tools, as they have been found to increase ecological diversity over large areas and mitigate habitat fragmentation (Guynup, 2011).

However, conservation efforts are not always welcomed, especially when the comprehensive model—the use of expert planners to make singular decisions about development of a land area—is employed (Brown and Harris, 2004). This approach is especially limited when the beliefs of planners differ from those of stakeholders and the people in the area, such as whether land should be used for conservation or development. When these beliefs are not taken into consideration, resentment can arise and be expressed through disregard for conservation policies, protests, and even violence (Kideghesho, 2006). To avoid conflict, alternative planning models that utilize citizen participation are encouraged, as "incorporating the concerns of stakeholders [is] thought to enhance planning both by softening public opposition and by bringing useful knowledge into the decision-making process" (Brown and Harris, 2004). This process can be useful for the implementation of eco-corridors, especially when there are differing opinions on the usage of the land.

Conservation strategies including ecological corridors are among several tools being used in New Zealand to protect its unique flora and fauna. New Zealand's native ecosystems have suffered an immense decline in indigenous biodiversity over the last century. This is a direct result of human actions, causing habitat fragmentation and the introduction of invasive species. To combat these issues, New Zealand has established

several conservation-based programs, including the Predator Free by 2050 initiative and the Zealandia eco-sanctuary (New Zealand Department of Conservation, n.d., and Karori Sanctuary Trust, 2018). In conjunction with these efforts, an ecological corridor, known as the North-West Wildlink, has also been established in Auckland, enacted by New Zealand Forest & Bird (Forest & Bird, 2018c). The goal of this corridor is to support native birds across the city by creating connections between existing conservation areas. A similar plan has been suggested to connect two areas of forests in Upper Hutt.

Upper Hutt is a small city belonging to the Wellington metropolitan area. Forest & Bird New Zealand note that the city is characterized by natural features and "green belt" land that remains largely undeveloped. As a result, the organization identified Upper Hutt as a location where an ecological corridor may be implemented to promote the passage of native birds—especially those with poor dispersal capabilities—between various habitats (personal communication, October 15, 2018). An area known as the Silverstream Spur has been designated as a corridor candidate, but the potential and actual value of such a pathway at this point is unknown (Forest & Bird, personal communication, October 15, 2018). Our sponsors were concerned as to the legal feasibility of establishing this corridor, given the current ownership of the land in question. They also wished to learn about the perceptions residents have towards these native birds, and their attitudes towards coexistence (Forest & Bird, personal communication, October 15, 2018).

The goal of this project was to determine the benefits that the introduction of an ecological corridor in Upper Hutt would provide for the native birds, the broader biodiversity, and for the community as a whole. We conducted site assessments of the land in question and interviewed ecological experts to evaluate its potential as a corridor. We also interviewed key stakeholders to understand their perspectives on the project. Finally, through surveys we tried to better understand the value that New Zealanders—specifically Upper Hutt residents—place on their interactions with their ecosystem and its inhabitants. Our sponsors hope that these research projects will help the Upper Hutt City Council make an informed land use decision and that it will encourage conservation efforts specific to our project and beyond.

2. Background

The purpose of this chapter is to expand upon the topics and concepts we deemed necessary for evaluating the feasibility and potential benefits of an ecological corridor in Upper Hutt. We begin by examining biodiversity on a global scale, paying particular attention to existing threats to biodiversity and the uniqueness of island biodiversity. We then discuss the existing research on ecological corridors, because they are one of several strategies used globally to help preserve biodiversity. We also acknowledge the potential conflicts that can arise when establishing conservation efforts. We narrow our focus to New Zealand, and describe the specific threats that target the nation's flora and fauna. By reviewing the current conservation efforts in place, including how ecological corridors are currently functioning, we can recognize gaps that our project is designed to fill. Next, we learn more about the city of Upper Hutt, its demographics, and the native bird species that we will consider when conducting site assessments. Finally, we analyze the specific land ownership issue faced by the city and how land use factors into our project's specific goals.

2.1 Biodiversity on a Global Scale

Biological diversity, often shortened to biodiversity, is defined as the variety of all biological life (animals, plants, fungi, and microorganisms) and their genetic variability within a particular habitat. It is the foundation for healthy ecosystems, which provide fundamental services to life: clean air, water and food, nutrient cycling, pollution and climate control, and landscape maintenance (National Research Council, 1999). Overall, the greater diversity of life results in greater potential for economic development, medical advancements, and adaptive responses to complex problems including climate change and overpopulation (National Research Council, 1999). The importance of any single species cannot be undermined, because it is the interdependency between flora and fauna that makes ecosystems productive and sustainable. Above all tangible benefits, biodiversity has an intrinsic value. This idea is often emphasized in cultural beliefs, and allows us to respect species' evolutionary heritages and justify the responsibility to preserve them.

2.1.1 Threats to Biodiversity

Unfortunately, human actions pose threats to biodiversity. Ecologists recognize that the Earth is currently undergoing its sixth mass extinction. The natural "background" rate of extinction is around one to five species per year; species loss is occurring 1,000 to 10,000 times faster than this background rate (Center for Biological Diversity, n.d.). Species loss is a result of many human-caused factors, including habitat loss, pollution and climate change, exploitation of natural resources, and the introduction of non-native species (National Research Council, 1999). A threat of particular interest is habitat fragmentation, defined as "transformation of a continuous habitat into habitat patches, i.e. fragments that

differs [*sic*] in size and configuration," and is one method by which populations become isolated (Ćurčić and Đurđić, 2013). When habitat fragmentation occurs, "populations can become locally extinct...they infrequently exchange members, and when they do, the passage between local populations is generally hazardous" (National Research Council, 1999). This situation can be caused by a variety of disruptions to the natural environment, including human-caused deforestation for the purposes of urban development. It is considered to be "one of the main threats to richness and diversity of wildlife" (Ćurčić and Đurđić, 2013). The breaking apart of large populations through habitat fragmentation threatens species' ability to survive and their biodiversity as a whole.

2.1.2 Island Biodiversity

The defining characteristic of an island is its isolation from other landmasses, allowing evolution to play its hand in remarkable ways. In fact, ecologists often use islands to understand how organisms can diversify to fulfill different ecological niches, and how insularity can result in restricted gene pools and the emergence of highly specialized species (UN Environment, n.d.). Darwin's finches are a classic example of island evolution at work. In 1835, ecologist Charles Darwin observed that selection pressures on the Galapagos Islands resulted in the evolution of fourteen distinct bird species, an example of adaptive radiation within a lineage. These birds had a variety of beak form and function that were highly adapted to the food sources to which they were exposed (Galapagos Conservancy, 2018).

While the presence of new traits can indicate evolution and speciation, the loss of original traits is equally comparable. Many native island species are known for vestigial traits and lack of survival skills compared to their mainland counterparts. This evolutionary phenomenon is called relaxed selection (National Evolutionary Synthesis Center, 2009), where traits that were once advantageous become expendable. The most prominent example is the evolution of flightless birds, such as the Galapagos cormorant (Galapagos Conservancy, 2018). In a study from the University of Montana, researchers concluded "islands with fewer predator species were associated with more dramatic shifts toward flightlessness" most likely due to "lower predation pressure on islands," that could "release landbirds from the need for large, powerful flight muscles that facilitate rapid escape" (Wright, Steadman, and Witt, 2016). Other examples include animals who undergo "island tameness," a term describing the loss of defensive behaviors needed to deal with potential predators. In a research study by Brock et al. (2015) of Aegean wall lizards on Greek islands, it was concluded "anti-predator responses were most dramatically lost on small, predator-poor islets" and therefore stood "at the highest risk from invasive predators" (Erickson, 2014).

Overall, islands have the highest rate of endemism in the world, and make a sizable contribution to global diversity (The Law Foundation, 2018). This attribute is not only

beneficial for eco-tourism and scientific research, it is the basis from which islanders derive food and job security, economic services, and overall well-being. Islands' "small size, remoteness from large markets…[and] limited economic diversification possibilities" (Boto and Biasca, 2012) make islanders especially dependent on the environment around them (UN Environment, n.d.). Unfortunately, the characteristics that make island biodiversity unique also make it fragile, and "among the most threatened in the world" (United Nations, 1994). As island species are already restricted to a limited habitat and population size, further stressors like invasive species and habitat loss can be insurmountable. In fact, of the 700 or so recorded animal extinctions in the last 400 years, about half were from islands (UN Environment, n.d.).

2.2 Ecological Corridors as Tools for Protecting Biodiversity

Ecological corridors, also called wildlife corridors, are one method used by ecologists and conservation biologists to combat habitat fragmentation. Despite their popularity as tools for facilitating the movement of species, there is no universal strategy for defining, creating, and evaluating them. Reports from the 1980s and 90s provide similar but varying definitions of these corridors. The general consensus is that a corridor establishes connectivity; Merriam explains that it may do this via "a continuous narrow patch of vegetation that facilitates movement among larger habitat patches and prevents their isolation" (as cited in Rosenberg, Noon, and Meslow, 1995). However, within this definition, a corridor may have several functions. They can "connect like habitats and permit the movement of organisms between habitat patches (often reserves), or they may connect unlike habitats and permit the transfer of organisms from one habitat type to another" (Thomas, 1991). This can allow "individuals to re-colonize habitat patches from which populations have been locally extirpated" (Bond, 2003). An ecological corridor may also "contain various habitats that permit organisms to pass along them (transit corridors) or live in them (inhabited corridors)" (Thomas, 1991).

Beier and Loe (1992) developed a checklist that can be used when creating and evaluating a corridor. The first two steps are to "identify the habitat areas the corridor is designed to connect" and to select the species of interest, also known as the target species (Beier and Loe, 1992). The relevant needs of each target species must be analyzed, so that the corridor's potential for accommodating the movement of each species can be determined. The corridor should then be drawn on a map. Additional considerations, such as land use policies in or adjacent to the corridor that would affect its function, can be outlined at this stage. Finally, a monitoring program should be designed to assess if the corridor is facilitating wildlife movement as desired (Beier and Loe, 1992). This monitoring program is important because determining the potential value of an ecological corridor requires a system for measuring its success. Unfortunately, such systems are often inadequate. As a result, "the case for corridors has been built more on intuition than on

empirical evidence" (Tewksbury et al., 2002). While there is a "large body of research confirming that corridors promote wildlife movement", there is minimal "evidence that such movements occur often enough to promote genetic connectivity and patch occupancy across longer distances in human-dominated landscapes" (Beier and Gregory, 2012). With this knowledge in mind, it is useful to look at specific examples of established wildlife corridors to understand where, why, and how they may be implemented, and how they are evaluated.

2.2.1 Examples of Existing Ecological Corridors

Ecological corridors have been employed in various locations around the globe with the overall purpose of encouraging the movement of target species between smaller patches of habitat. Something to consider when assessing the value of a corridor is the long-term consequences it will have on the surrounding environment. Corridors have been shown to have ecological effects that extend beyond the target species. In Jasper National Park in Alberta, Canada, a wildlife corridor was established through a golf course. Before this corridor was created, "elk congregated in the golf course where they were relatively safe from wolf predation" (Shepherd and Whittington, 2006). The inclusion of the corridor increased the movement of wolves through the golf course, and so "the abundance of elk decreased within the corridor" (Shepherd and Whittington, 2006). The researchers concluded that "corridor restoration has [the] potential to affect the broader ecology of the study area" (Shepherd and Whittington, 2006). Another study investigated the indirect effects of corridor-facilitated animal movement on plant dispersion by examining how pollen movement and fruit production were affected by the creation of a corridor for butterflies. They found that "fruit set (a function of pollen movement) and seed dispersal were higher in connected than unconnected patches" (Tewksbury et al., 2002).

Examining corridors that have been designed specifically for bird species will provide us with insight as to how our particular project might proceed. Most "monitoring efforts...have a sample size of 1 corridor" (Beier and Loe, 1992), so the few studies that compare multiple corridors are of particular value in understanding optimal design parameters. By examining twenty-four corridors in the Chilean rainforest, Sieving, Willson, and De Santo (2000) were able to draw conclusions regarding what characteristics of corridors were highly associated with use by the target bird species. They found that "corridor width was a strong predictor of species presence and abundance" (Sieving et al., 2000). Their data also suggest that "relatively long corridors...are not useful for birds seeking either living and foraging space or travel path" (Sieving et al., 2000). They then developed inferences as to how corridor dimensions affected their ability to fulfill habitat and travel functions. The authors of this paper stated that the length-to-width ratio of a corridor should be less than 10 for the corridor to be suitable for both territory establishment and travel. For example, if a corridor was to be 5 km in length, it would need

to be a minimum of 500 meters in width. Additionally, "regular nonterritorial use (e.g., foraging, traveling) may be supported by corridors at least 10 or 11 m wide" (Sieving et al., 2000). However, conclusions from a single study are not enough to make general assumptions about corridors for all bird populations.

2.2.2 Considerations for Corridor Development

Conservation efforts such as ecological corridors are not always welcomed by the public. When two or more parties are in disagreement over conservation objectives and "one party is perceived to assert its interests at the expense of another", the result is a conservation conflict (Redpath et al., 2013). These conflicts can arise when a conservation-minded group has goals that differ from those of other stakeholders, including governmental authorities, landowners, developers, or everyday citizens. There are often trade-offs between conservation and development, because "balancing resource conservation and economic needs is inherently difficult" (Delgado-Serrano, 2017). The "political, social and economic costs of wildlife conservation" can then lead to community resentment towards conservation policies (Kideghesho, 2006). This resentment may be expressed in a variety of ways, including protests; in extreme cases, African communities have reacted with violence when conservation policies are believed to threaten their livelihoods (Kideghesho, 2006). While we do not anticipate such a strong response, it is still important to consider the complex social issues that may affect the potential of our project.

Focusing specifically on ecological corridors, land-use policies and conflict over land ownership are the most common factors that impede their establishment. Research on conservation conflicts in Tanzania found that poverty and population growth both contribute to communities violating land conservation policies. Farmers who cannot afford modern agricultural technology are left with "no option, but to open new farms in the wildlife sensitive areas such as protected areas [and] migratory corridors" (Kideghesho, 2006). Population growth similarly results in "increased pressure from local people to open protected lands for community use" (Kideghesho, 2006). In more urban areas, policies that "restrict urban development...are unlikely to be widely implemented", despite the fact that such policies are likely to benefit conservation (Hamilton et al., 2013). Even when corridors and other protected areas are established, the "effectiveness of [such] areas for conserving biodiversity is influenced" by the land use in the surrounding areas, including "settlements that typically eliminate, degrade, and fragment habitats"(Hamilton et al., 2013). This specific issue is heavily relevant to the purpose of our project, and is discussed further in section 2.5.

A 2004 study investigated whether "planning for ecological preservation [would] be more successful... if it accommodate[d] citizen concerns and relie[d] on voluntary cooperation rather than focusing on enforced protection of biological habitat" (Brown and Harris, 2004). This study focused on the proposal for an "ecological corridor linking

Algonquin Provincial Park in southern Ontario to the Adirondack Park in northern New York", henceforth referred to as A2A. Gathering the perspective of landowners was considered important to the feasibility of the corridor because most "of the land in A2A is private property" (Brown and Harris, 2004). The researchers surveyed residents and "asked how they felt about habitat protection in a general way", including comparing the importance of biological habitat preservation to cultural and historical preservation (Brown and Harris, 2004). They also wanted to determine the community's level of awareness about the proposed corridor. Their results indicated that corridor proponents would be benefited by understanding local concerns about land restrictions and encouraging effective communication between residents and project designers (Brown and Harris, 2004). Community involvement, which can be increased by encouraging voluntary citizen participation, was concluded to be a key factor for estimating the potential success of an ecological corridor (Brown and Harris, 2004). We view this paper as a case study that represents how the social and ecological aspects of a wildlife corridor are intertwined, and referred to it when designing and evaluating our research methods.

2.3 Biodiversity in New Zealand

The unique evolutionary history of New Zealand is crucial to understanding its rich biodiversity. Around 65 million years ago, the land that makes up New Zealand broke off from a larger landform to become independent islands. For reasons unknown, the fauna became dominated by birds and insects (University of Waikato, 2018). Evolution occurred in isolation for millions of years, resulting in peculiar phenomena like flightlessness and gigantism in native species (Department of Conservation, 2018). Eventually, New Zealand became home to an estimated 80,000 endemic species, and became a global hotspot for biodiversity (The Law Foundation, 2018). The nation remained untouched by humans until the arrival of the Polynesians in the 1300s, followed by the Europeans in the 1800s (Karori Sanctuary Trust, 2018).

Today, biodiversity still contributes heavily to the identity of New Zealand, from the ecosystem services provided by the islands to the unique species that represent the nation. The cultural beliefs of the Māori are deeply rooted to the environment: core values include "common whakapapa (ancestry) with other animals and plants" and "kaitiakitanga- or guardianship...responsibility of people to other living things" (DOC, 2018c). Beyond a cultural perspective, biodiversity is considered to have inherent economic value as well. In 1994, the "annual value of indigenous biodiversity on land...was estimated at $46 billion" (DOC, 2018c). This estimate was composed of $9 billion from direct uses (agriculture, horticulture, and lumber industry), $30 billion from indirect use of ecosystem services, and $7 billion from passive values (derived from its existence and future potential) (DOC, 2018c).

Bird-dominated systems are unique to New Zealand, as no other country is known for birds fulfilling the roles of predators, scavengers, herbivores and insectivores. (University of Waikato, 2018). As resources were abundant and mammalian predators were lacking, many species lost the ability to fly and became permanent ground-dwellers or hopping species (able to 'hop' from tree to tree) (DOC, 2018b). Examples include the kiwi, an endemic flightless bird serving as the nation's beloved icon and flagship species for conservation. Other species, such as the kakapo—the world's only flightless parrot—and the bellbird (famous for its song), are well-known identifiers of New Zealand.

2.3.1 Threats to New Zealand Biodiversity

Biodiversity decline has been a prominent issue in New Zealand ever since humans inhabited the islands 700 years ago. The first phase of decline occurred during settlement by the Māori, when megafauna like the Moa were hunted to extinction and the introduction of the kiore (Pacific rat) wiped out smaller animals (Te Ara, n.d.). A second larger phase of biodiversity loss occurred when Europeans settled in the 1850s. European colonization was accompanied by forest destruction, accidental and intentional introduction of mammalian predators, and exploitation of the land and resources (DOC, 2018c). Disruption to native species was great and rapid. Over hundreds of years, the list of extinct species grew to over 50 birds, 12 invertebrates, and large numbers of plants and insects (Karori Sanctuary Trust, 2018).

Habitat loss through urbanization continues to be a prevalent issue throughout all of New Zealand, as it contributes heavily to the loss of biodiversity (The Law Foundation, 2018). According to the New Zealand Biodiversity Strategy published in 2016, 63% of the country's land area has been converted into farms, exotic forests, settlements, and roads. This percentage of land area loss is especially detrimental to ground-dwelling and hopping birds, who become highly susceptible to predation and displacement. The New Zealand Department of Conservation (DOC) has concluded that 34% of endemic land birds are extinct, and another 37% are currently threatened species. The people of New Zealand have recognized this predicament and have invested heavily into mitigating human impact.

2.3.2 Current Conservation Efforts in New Zealand

To combat the issues of invasive predator species and habitat fragmentation, the New Zealand DOC has initiated several conservation projects meant to protect native wildlife. One example is the Predator Free 2050 campaign. This effort is working to eliminate "New Zealand's most damaging introduced predators: rats, stoats and possums" (DOC, 2018d). These animals kill an estimated 25 million New Zealand birds annually (DOC, 2018d). The DOC believes "going predator free will bring [New Zealand] a huge range of environmental, cultural, social and economic benefits" (DOC, 2018d). This initiative has brought together groups from all areas of New Zealand politics and society in

an effort to use backyard trapping methods as a tool for success. Participation by the general public, through donations and volunteer work, is one important aspect of the project. The government has also made clear its commitment to Predator Free 2050 by increasing conservation funding to $466 million in 2017/18. This compares to $417.5 million that was spent on conservation in 2008/09 (DOC, 2017). The increase in funding includes $21.3 million towards "Battle for Our Birds pest control programmes" (DOC, 2017).

In an effort to reduce the prevalence of mammalian pests on large land areas, one strategy employed by DOC is the application of sodium fluoroacetate, a poison commonly known as 1080 (DOC, 2019a). DOC uses aerial drops of 1080 "baits" to control the populations of possums, rats, and stoats in "large rugged and remote areas" where "trapping, shooting and other ground-based poisons" are not effective" (DOC, 2018a). The poison is particularly effective on mammals, which makes 1080 beneficial in New Zealand; wild mammals, with the exception of native bats, are pests being targeted for removal (DOC, 2018a). A single aerial drop of 1080 is said to be capable of "kill[ing] over 95% of possums and close to 100% of rats in the targeted area" (Forest & Bird, 2018b). Additionally, studies show stoat populations greatly decline after 1080 drops due to feeding on rats that were killed by 1080 (Forest & Bird, 2018b). Unfortunately, a population of rats can recover in as soon as one or two years after an aerial application of 1080, but "birds and other native species can benefit greatly from having one or two good breeding seasons without large-scale predation by rats"(Forest & Bird, 2018b).

Another benefit of 1080 is that it is a biodegradable poison, and it will break down and become non-toxic after application. In warm, humid conditions, breakdown can occur in one to two weeks, but it can take up to several months in dry, cold conditions (Forest & Bird, 2018b). To avoid 1080 lingering in an environment, most applications are conducted in wet winter or spring conditions (Forest & Bird, 2018b). The use of 1080 in large areas of land has faced opposition. Concerns about the use of 1080 include the poisoning and death of "non-targeted animal species" such as "native reptiles, birds, fish, and insects" (Palmer, 2018). Additionally, dogs can be killed if they directly ingest 1080 or consume the carcasses of animals killed by 1080 (Forest & Bird, 2018b). Despite the concerns surrounding the use of 1080, DOC supports the continued use of the poison because "there are no practical alternatives to aerial 1080 pest control over vast, remote and rugged terrain"(DOC, 2019b). Research efforts to find alternatives to 1080 drops include "researching new technology, such as self-resetting traps and genetic techniques"; however, according to DOC, "right now, [New Zealand] need[s] to use 1080 to protect our native species" (DOC, 2019b). They argue that if 1080 operations were halted, "progress would be lost, and many native species would face a grim future" (DOC, 2019b).

One noteworthy step towards conservation and habitat protection in Wellington is Zealandia. This wildlife sanctuary was established from land in the Karori reservoir that had been decommissioned by the Greater Wellington Regional Council (GWRC) when

deemed an earthquake risk (Karori Sanctuary Trust, 2018). In the early 1990's, a local committee member for Forest & Bird New Zealand envisioned the "the world's first fully-fenced urban ecosanctuary", with the goal of restoring the land "to the way it was before the arrival of humans" (Karori Sanctuary Trust, 2018). Conservation NGOs, the Wellington City Council, GWRC and local DOC staff "formally endorsed the proposal and were enthused about the vision" (Karori Sanctuary Trust, 2018). With the construction of a specially-designed fence and the eradication of all mammalian pests, Zealandia became a place where native wildlife could thrive. Since its conception, eighteen species have been reintroduced to the area, and "forty different species of native birds have been recorded in [the] valley, twenty-four of them endemic" (Karori Sanctuary Trust, 2018). The project has many sponsors and partners who contribute to its success, including the Wellington City Council, the Victoria University of Wellington and the New Zealand Department of Conservation. Volunteer efforts and donations also keep the sanctuary up and running. While these projects help provide safe spaces for birds, they do not provide the widespread habitats required to support large populations and long-term survival of a species. Similar to eco-sanctuaries, ecological corridors are also being used to protect native species, especially birds, from external threats.

2.3.3 Ecological Corridors in New Zealand

The South-East Wildlink (SEW) is a corridor in South Auckland that was established by Forest & Bird New Zealand in December 2017. The purpose of the project is to "create safe corridors for birds to travel, feed and breed within the SEW project zone", specifically "kaka…[the] native bellbird, kererū and tui" (Forest & Bird, 2018d). These corridors are of particular importance because "the majority of [New Zealand's] native birds will only fly 2.5km or less between habitats" (North-West Wildlink Partnership Group, 2017). Designating the land as a corridor does not appear to require any transfer of ownership. In fact, the Forest & Bird Organization encourages "local landowners...to become involved" in the project (Forest & Bird, 2018d). For example, volunteers can help "local landowner[s] to do predator control on their property" (Forest & Bird, 2018d). Predator control is the major objective of this corridor project. This corridor supports a larger-scale project known as the North-West Wildlink, which "focuses on migration between [other] biodiversity hotspots" across Auckland (Forest & Bird, 2018d). One major focus of this project is restoring the vegetation of the region by promoting the planting of "native plants and additional exotics" (Forest & Bird, 2018c).

The research we conducted in Upper Hutt, New Zealand serves as a case study for the social impact of implementing an eco-corridor. We determined how citizens of Upper Hutt perceive birds and the idea of coexisting with birds through wildlife corridors. This research can serve as a basis for further corridors and bird conservation efforts.

2.4 Upper Hutt

Upper Hutt is a city in the Wellington region of New Zealand. According to the most recent census 40,179 people live within the city (Stats NZ, 2013). The population increased by 4.6% in the seven year period between censuses (Stats NZ, 2013). The land of Upper Hutt is 59% indigenous native forest made up of both original forest and regenerating forest (Boffa Miskell, 2012). Production pine forest covers another 8% of the land (Boffa Miskell, 2012). With a growing population, the urban and residential areas of the city are expanding. The majority of the urban areas are not located on the steep slopes of the hills surrounding the city, but are located in the valley and the more gentle slopes surrounding it (Boffa Miskell, 2012). The area of Upper Hutt that is of interest is the Hutt Valley: the valley floor surrounding the Hutt River and some of the surrounding hills. This area was once swampy marshlands, but as of 2012, 59% of this area was classified as residential development (Boffa Miskell, 2012).

The governing body of Upper Hutt, the Upper Hutt City Council (UHCC), has a history of conservation. Several conservation efforts have been established by the UHCC, and over half of the total land area in Upper Hutt is publicly owned and administered as regional parks, forests, and water collection areas (Boffa Miskell, 2012). The UHCC has 548ha of parks and reserves, with 35% of that land being bush covered. Of the bush covered land, 12.65ha is fenced to protect the native wildlife from invasive predators (UHCC, 2018c). The council also supports the national "Predator Free" efforts by supporting the trapping of invasive species that threaten the survival of native bird species (Tso, 2018). The city's sustainability plan includes restoration of the Hutt River, planting alongside the Mangaroa River, the Hulls Creek restoration project, community education, promotion of sustainable business practices, and sustainable urban areas (UHCC, 2012). The Open Space Initiative seeks to create green areas that allow the citizens of Upper Hutt to have access to a network of recreational areas (UHCC, 2017). Overall, Upper Hutt is a city that is invested in the continued health of the animals and land in the region.

Part of the Sustainability Strategy of Upper Hutt is to promote the biodiversity of the parks and reserves through a series of ecological corridors (UHCC, 2012). The strategy states that progress has been made by Forest & Bird in "establishing the beginning of an ecological corridor at the Hulls Creek/Hutt River confluences" (UHCC, 2012). The vision of the project is to increase the city's natural areas and as a result, "significantly improve the biodiversity value of the valley floor" (UHCC, 2012). While the Hulls Creek planting has been a successful effort, no further action for the establishment of ecological corridors has progressed, as it "requires additional support from government agencies and other stakeholders," such as UHCC, landowners, developers, and Forest & Bird. (UHCC, 2012).

In addition to conservation, the UHCC places high importance on anticipating and planning for the growth and development of its population. The UHCC has relied on the

projections of population growth written in the Local Government Act of 2002, which states that from 2013 to 2043, the population of Upper Hutt is expected to increase from an estimated 41,200 to between 46,400 to 49,400; over this period, the number of properties is anticipated to grow between 3,300–4,500 (UHCC, 2018b). The Urban Growth Strategy claims that the city does not have the significant capacity for this projected growth in current areas zoned for residential development (UHCC, 2007). The National Policy Statement on Urban Development Capacity requires councils to provide in their plans enough development capacity to meet the projected demand (Ministry for the Environment, 2016). Therefore, the council must identify new areas for growth or investigate the redistribution of property in existing housing areas (UHCC, 2007).

The governing body of the council consists of a mayor and ten elected councilors; decisions are made by passing resolutions by the vote of a majority of members present and voting. Land-use policy decisions are guided by the Resource Management Act of 1991, meant "to promote the sustainable management of natural and physical resources," and protect natural landscapes from inappropriate subdivision, use, and development (Ministry for the Environment, 2018). According to the Significance and Engagement policy, land-use decisions are often deemed to be of high significance, which warrants a high level of community engagement. Community engagement can take place through a large range of pre-engagement phases such as "online activities, submissions, holding hearing meetings, focus group workshops (may involve subject matter or community experts), and surveys," followed by discussion and formal consultation phases. (UHCC, 2018d). The discussion phases take place at council and committee meetings, which are open to the public and include a public forum. (UHCC, 2018a).

2.4.1 Birds of Upper Hutt

The bird species of interest are those present in the Upper Hutt Region on the North Island. Upper Hutt is home to roughly 26-37 bird species, and between 10% and 19% of these species detected each year are native species ranked as either 'Nationally Threatened' or 'At Risk' under the New Zealand Threat Classification System (McArthur, Walter, and Govella, 2018). The following group of birds is not limited to all the species present in Upper Hutt. We chose to focus on species that were symbolic to the region (for example, the fantail is on the UHCC's website logo and Upper Hutt's city badge) (UHCC, 2012), as well as species that are relatively poor fliers and have limited dispersal abilities (McArthur et al., 2018).

There has been little change in native forest bird populations in the Upper Hutt area since 2011, although some species of native birds are at greater risk than others. Two of these species include the rifleman *(Acanthisitta chloris)* and the whitehead (*Mohoua albicilla*). The rifleman (seen below in Figure 3) is likely to be the rarest native resident in the Hutt Valley, as it was spotted in 2016 in very small numbers for the first time in ninety

years. Ecologists believe this species may not be present in sufficient numbers to maintain viable populations in the long term. Recommendations have been made to install rifleman nest boxes in Upper Hutt parks such as Keith George Memorial Park and Wi Tako Reserve, to give these birds a higher chance of nesting success (McArthur et al., 2017). While the rifleman is not threatened nationally, it is a threatened species in the Upper Hutt area (New Zealand Birds Online, 2013). In contrast, the whitehead (shown in Figure 4) is not threatened regionally, but carries the conservation status of "at risk, declining" nationally. The whitehead is a small songbird that is only found in the forests of the North Island of New Zealand. In recent history, whitehead numbers have declined dramatically due to predation by introduced mammals (particularly ship rats and stoats) and forest clearance (New Zealand Birds Online, 2013).

Figure 3: Rifleman (Tim Rumble, 2012). Reproduced with permission from New Zealand Birds Online.

Figure 4: Whitehead (Oscar Thomas, 2018). Reproduced with permission from New Zealand Birds Online.

Another species of interest is the tomtit *(Petroica macrocephala)*, as it has been observed at high rates in the regions surrounding the land of interest. According to bird monitoring reports, tomtits appear to be "exclusively restricted to mature forest habitat" in the Hutt Valley and are "largely absent from suburban habitats" (McArthur et al., 2018). Tomtits (seen below in Figure 5) are not considered a threatened species, but they are said to be especially vulnerable to invasive predators and have limited dispersal abilities. The number of sightings of tomtits have largely varied in the past eight years, suggesting to ecologists that they may be responding to local mammalian control efforts (McArthur et al., 2018).

Figure 5: North Island Tomtit (Paul Shaw, 2015). Reproduced with permission from New Zealand Birds Online.

An additional species that is frequently located on the land of interest is the bellbird (*Anthornis melanurma).* This species is known for their vocal abilities and distinct olive color found in males. Bellbirds (shown below in Figure 6) reside in native and regenerating forest, thriving in areas with dense vegetation. When ship rats and stoats arrived to the island in the 1860's, bellbird numbers declined sharply, but they have since made a comeback and are not considered threatened (New Zealand Birds Online, 2013). In recent years, bellbird encounters have not varied significantly in the Hutt Valley (McArthur et al., 2018). Bellbirds are territorial breeders, so they require dense foliage and local food sources during breeding seasons. At other times, they are known to move distances upwards of 10km to find concentrated food sources (New Zealand Birds Online, 2013).

Figure 6: Bellbird (Craig McKenzie, 2009). Reproduced with permission from New Zealand Birds Online.

One of the most common species encountered in Upper Hutt is the grey warbler (*Gerygone igata),* a slim songbird that is New Zealand's most widely distributed endemic species. Grey warblers (depicted below in Figure 7) usually reside "in woody vegetation, in mid to high levels of the canopy," and tend to fly short distances, flitting from branch to branch (New Zealand Birds Online, 2013). The warbler is a host species for the shining cuckoo (*Chrysococcyx lucidus),* an endemic subspecies of the cuckoo found in Australia. According to ecologists, sightings of the grey warbler have varied quite significantly over the past nine years (McArthur et al., 2018). They are not considered a threatened species.

Figure 7: Grey Warbler (Rebecca Bowater, 2015). Reproduced with permission from New Zealand Birds Online.

A well-known species in the Upper Hutt area is the fantail (seen below in Figure 8), or piwawaka *(R.f placabilis),* recognized for its distinctive fanned tail and vocal ability. While their conservation status is not currently threatened, they are vulnerable to cold weather and predation from pests, particularly ship rats. This species is not particularly deterred by the presence of humans; they will continue to forage along the ground or build nests within a meter or two of people. (New Zealand Birds Online, 2013). The fantail was encountered at a very low rate in 2011 after heavy snowfall events, suggesting this species is vulnerable to severe weather episodes However, they have undergone a massive increase since then, proving they can recover fairly easily (McArthur et al., 2018).

Figure 8: Fantail (Ormond Torr, 2012). Reproduced with permission from New Zealand Birds Online.

Another species of interest is the parson bird, commonly known as the tui (*Prosthemadera novaeseelandiae)*. Tui (seen in Figure 9) are dark, mid-sized birds known for their aggressive behavior. These birds are commonly seen along with the kererū, (*Hemiphaga novaeseelandiae*), or wood pigeon, shown below in Figure 10. Both of these birds play a very important role in the dynamics of New Zealand forests. They are one of the most common pollinators of flowering plants, and distributors of seeds of trees (New Zealand Birds Online, 2013). While tui can disperse seeds of medium sized fruits, the kererū is the only native bird big enough to swallow and disperse the large fruit of endemic trees including karaka, miro, tawa and taraire (Forest & Bird, 2018a). The seed dispersal ability of these birds provide benefits to help maintain the habitat of other New Zealand bird species that are more vulnerable to loss habitat and habitat fragmentation. The kererū and tui populations are classified as stable; however, the kererū population is in danger of becoming locally extinct in some areas where there is a lack of predator control (New Zealand Birds Online, 2013). In addition, kererū often swoop low in urban areas and have a substantial incidence of roadkill along Hutt City motorways (McArthur et al., 2018).

Figure 9: Tui (Craig McKenzie, 2009). Reproduced with permission from New Zealand Birds Online.

Figure 10: Kererū (Craig McKenzie, August 2009). Reproduced with permission from New Zealand Birds Online.

The Upper Hutt branch of Forest & Bird is invested in creating a migratory ecological corridor for the area's native birds. According to our sponsor, birds in this area are restricted in their ability to cross the river valley, since the middle of the valley is too populated with housing to promote bird movement (Pat van Berkel, personal communication, November 15, 2018). Birds are more likely to cross at pinch points where there is more direct access between the reserves. Our sponsor has identified the area through the Silverstream Spur, shown in Figure 11, as a viable pinch point and would officially like to designate land located above and below the Spur as an eco-corridor. Forest

& Bird Upper Hutt hopes this designation can initiate planting and pest control projects like those in the North-West Wildlink (personal communication, November 15, 2018).

Figure 11: Map of Upper and Lower Hutt. These maps highlight how the area of interest (red) is a "pinch point" or bottleneck region between green belt land. Map data from 2018 Google

2.5 Land Use Debate

The land in question for this project is the 35-hectare Silverstream Spur in the Upper Hutt region, located on the ridge southwest of the suburbs Silverstream and Pinehaven, across from Hulls Creek. In times of initial settlement, the Spur was cleared of forests and used as farmland, but has since been replaced with patches of pine and native bush. Geographically, one edge borders Lower Hutt and the other connects the green belt land to urbanized areas, as shown below. It is located midway between Keith George Memorial Park and Wi Tako Reserve. Figure 12 shows that the Spur is located so that birds

would have the shortest distance to travel between these green spaces. This makes the Spur an ideal candidate for an ecological corridor.

Figure 12: Map of Upper Hutt that highlights the potential eco-corridor (represented by arrows) connecting through the Spur. Map data adapted from GWRC Web Map Viewer

Currently, the Silverstream Spur is owned by the Upper Hutt City Council and remains an undeveloped, largely unused area. The land southeast to the Spur is owned by the Guildford Timber Company Limited (GTC) and is used for production timber (seen in Figure 13 below). The surrounding green areas are under private ownership.

Figure 13: Map of area of interest. The Silverstream Spur, owned by the UHCC, is outlined in blue and the surrounding areas owned by GTC are highlighted in red. Map data from GWRC Web Map Viewer

2.5.1 Land Use Agreement and Current Land Status

In 2016, the GTC formally expressed interest in acquiring the Silverstream Spur currently owned by UHCC, envisioning that "residential housing would be developed on parts of the ridge beyond the forested slopes" (Boffa Miskell, 2015). GTC claimed that the Spur has topographical features ideal for "low-impact clustered housing," within the visual backdrop the forested hills provide. Additionally, GTC recognizes the Spur as having particular value because it is "the most suitable location to develop a road link from the valley" (Boffa Miskell, 2015). In exchange, GTC offered to retire sections of their property as commercial pine forest and have them be placed under public reserve. In March of 2016, a Memorandum of Understanding (MOU) was written between the two parties for the purpose of transferring land ownership of certain areas. Since the MOU was a preliminary planning document rather than a formal development proposal, public feedback from citizens and organizations such as Forest & Bird was not solicited and incorporated into the document. In the memorandum, UHCC claimed the land areas marked A on Figure 14 below could enhance forest cover and provide stormwater control, offer visual appeal to the

community, and afford an opportunity to become an "outdoor recreation attraction" (GTC and UHCC, 2016). In the map below, areas marked as A would be transferred from GTC to UHCC ownership, and the Silverstream Spur (marked as B) would be transferred from UHCC to GTC ownership. Areas marked C would remain in the ownership of GTC. This memorandum articulated the intent for the land exchange, but warranted no legal commitment from either party at the time or for any definitive date in the future (GTC and UHCC, 2016).

Figure 14: Upper Hutt forest overlaid with land allocation diagram. The allocation diagram is adapted from the Memorandum of Understanding. Map data from GWRC Web Map Viewer

The potential land-swap is acknowledged in the Land Use Strategy 2016-2043, and is stated as an opportunity to meet Upper Hutt's projected housing demand. The document states that in order for the development to occur, "a Plan Change would be required to rezone the land for residential use". This would call for a full assessment of development issues, including (but not limited to) "land stability, traffic/roading, servicing, design and layout including regard to visual and natural amenity values, earthworks, hydrology and staging" (UHCC, 2016a). The report also acknowledges that there are ecological and

topographical features of the site that require “sensitive development considerations”. As currently stated, none of these steps have proceeded (LUS, 2016) (UHCC, 2016a).

Our sponsor, Forest & Bird Upper Hutt, believes that Silverstream Spur is integral to the eco-corridor, and allowing development to occur on that region could limit the effectiveness of the potential corridor (Pat van Berkel, personal communication, November 15, 2018). Fortunately, GTC appears to be a conservation-minded company. In the Land-swap Discussion Document of 2015, GTC claims to understand the importance of the land, stating “[the] Guildford ridge is strategically located at a pinch point in the Hutt valley,” and “this proximity gives the ridge importance as an ecological corridor, connecting natural areas on the east and west sides of the Hutt valley” (Boffa Miskell, 2015). We investigated if this was truly the case, and if this perspective influences the company’s development plans.

2.6 Summary

Biodiversity is important to the sustainability of life on Earth, and can be especially vulnerable on islands. Protecting diversity against decline from habitat loss, invasive species and overall human impact is a necessary part of wildlife conservation. Ecological corridors are tools utilized to combat habitat fragmentation and promote the movement of populations. There are various ecological corridors that have been implemented to conserve New Zealand species, by means of reforestation, pest control and land preservation. In the Upper Hutt region of Wellington, an ecological corridor has been proposed to aid movement of bird species such as the fantail, kererū, and whitehead between green belt reserves surrounding Upper Hutt. However, the corridor is at risk due to ownership concerns of the land connecting the corridor. It is important to determine the value, actual and potential, that an ecological corridor could provide and its desirability by the residents of Upper Hutt. Additionally, determining the perspectives of the various parties involved in the creation of the corridor could be beneficial to its implementation.

3. Methodology

The primary goal of our project was to determine the value that an ecological corridor would provide to native bird species if one were established along the green belt land in Upper Hutt. We have a particular focus on the Silverstream Spur as it is the site of a pinch point in the Hutt Valley, and is therefore crucial to maintaining habitat connectivity across the valley. To accomplish our goal, we completed the following objectives:

- Determined how native birds in the green belt land could benefit from the presence of an ecological corridor
- Evaluated the attitudes of key stakeholders towards the ecological corridor concept
- Assessed the public's perceptions of their relationship to their environment
- Created awareness materials for the public and Forest & Bird

Fulfilling these objectives involved several different research and data collection methods, including interviews, surveys, and field studies at the site of interest. These methods are described in detail below. We designed our methodology to gain an in-depth understanding of the enablers and barriers to securing this eco-corridor, as well as both widespread and specific perceptions towards its implementation. A breakdown of the weeks that were spent on each action item is visualized in Figure 15.

Figure 15: Timeline of methodology execution

3.1 Objective 1: Determine how native birds in the green belt land could benefit from the presence of an ecological corridor

In order to understand why the Silverstream Spur is considered an optimal candidate for an ecological corridor, we first conducted site assessments with our sponsor, a longtime resident of Upper Hutt. These assessments allowed us to consider how the Spur functions in the context of the surrounding area. We first visited a trail in Keith George Memorial Park (a section of green belt land), then hiked through the Silverstream Spur. We recorded our observations about the nearby landmarks, urban structures, and bird presence nearby. We also gathered a sense of the environment (noise level, potential predators, etc.) and speculated on how it may impact the movement of the birds in the area. These observations supplemented the information we already had concerning property boundaries and the land that the GTC owns/is looking to develop.

To determine the value an eco-corridor would have for Upper Hutt's native birds, it was important to understand which species are currently living on or near the land of interest. Bird and ecology experts from the Greater Wellington Regional Council prepare a report on the "diversity, abundance and distribution of birds in Upper Hutt City" each year (McArthur, Govella, and Walter, 2018). We referred to the 2018 report to identify the birds we would encounter. Additionally, as the authors claim "larger and better connected reserves such as Wi Tako Reserve and Keith George Memorial Park support the greatest diversity of native forest bird species,"(McArthur, Govella, and Walter, 2018) we spoke with ecologist Nikki McArthur to hear his expert opinion on the corridor as a connection.

We conducted semi-structured interviews with biodiversity and environmental experts, Sara Moylan and Colin Miskelly, to ascertain how exactly the species of interest would benefit from the presence of an eco-corridor. We wanted to know more about the flight behavior of these species, and how the designation of a corridor would improve the effectiveness of the actual habitat. Finally, we talked to Nick Beveridge, manager of Forest & Bird Auckland, to see how the North-West Wildlink could serve as a case study for the efforts on the Silverstream Spur.

3.2 Objective 2: Evaluate the attitudes of key stakeholders towards the ecological corridor concept

The land we are investigating as a potential ecological corridor is being considered for urban development. The purpose of our project is to gain a detailed understanding of the issue which takes into consideration the priorities and standpoints of all of the involved parties. We felt it would be beneficial to hear from the key stakeholders, so that we have a comprehensive understanding of the perspectives surrounding this issue. We conducted semi-structured interviews with selected individuals who represent the various positions

on this matter. For the purposes of our project, we defined key stakeholders as the specific groups and organizations that are a part of the land-swap process. While we do believe the viewpoints of the public are important to include, we felt this was too broad a group to classify as one stakeholder. We instead assessed the public's attitudes and perceptions as a separate objective, discussed in section 3.3.

Our sponsoring organization, Forest & Bird New Zealand, is one significant stakeholder in this land-use issue, because they promote the idea of preserving the Silverstream Spur to be used as a migratory ecological corridor. In Wellington, we conducted semi-structured interviews with our main contacts, Mr. van Berkel and Dr. Mercier, that clarified their position on this project. We also interviewed Graham Bellamy, the chairperson of the Upper Hutt branch of Forest & Bird. Our interactions with the members of Forest & Bird Upper Hutt indicated that they had detailed knowledge pertaining to the region and its wildlife they were willing to share; we considered them a valuable local resource.

Land ownership and use is a significant factor that could impede the ability of Forest & Bird to secure the Spur as an ecological corridor. The landowners who were most important to consider were the Guildford Timber Company (GTC) and UHCC. In the Guildford Timber Land-swap Discussion Document of October 2015, it is stated GTC is "mindful of the importance the community places on protecting and restoring Upper Hutt's biodiversity and open spaces" (Boffa Miskell, 2015). If development were to occur on the Spur, "slopes would also be retained in open space on which regeneration of native bush would be encouraged – for both visual amenity and to bring the ecological corridor...as close as possible to the Hutt River corridor and western escarpment" (Boffa Miskell, 2015). While these are very promising statements for the corridor's implementation, it was important to determine the validity of these claims and if perspectives have changed in the past three years. We met with Ralph Goodwin, one of the directors of the GTC who was suggested to us by our sponsors. He took us on a tour of the land his company currently owns, and during this time we conducted a semi-structured interview to learn more about his perspective.

Finally, it was necessary to consider how local authorities view the proposed corridor. An independent assessment of the Upper Hutt City Council, conducted in May 2018, concluded that the council "maintains open and effective communication channels" and "has invested heavily in understanding the needs and preferences of the community" (CouncilMARK, 2018). For this reason, we conducted a joint interview with Upper Hutt Mayor Wayne Guppy and Chief Executive Peter Kelly. We also interviewed the Planning Policy Manager James McKibbin, on behalf of the Director of Planning Richard Harbord, since Harbord has been involved in other aspects of the Guildford Land-swap proposal (Vance, 2018).

3.3 Objective 3: Assess the public's perceptions of their relationship to their environment

While our project is meant to have a specific focus on the birds of Upper Hutt, our sponsors also felt it would be valuable to gain a broader understanding of the attitudes Upper Hutt residents have towards conservation and their relationship to their ecosystem. In order to do this, we designed a survey that allowed us to gather data from the larger population of Upper Hutt. We believed the greater outreach of a survey was more useful compared to more time consuming data collection techniques such as observations and in depth interviews, which may result in a smaller sample size (Billis et al., 2017). Our survey was created using Qualtrics online survey software and was active from January 23 to February 13, 2019. A preview of the survey is located in Appendix A.

Our survey contained several sections. The first section aimed to assess people's relationship to nature and conservation, and included questions that helped gather people's perspectives on efforts to conserve the Silverstream Spur. The second section asked questions about specific species of birds that could be affected by the presence or absence of this corridor. Next, the participants were asked to rank the value of specific bird species and the importance of these species in their daily lives. The final portion of our survey was for collecting demographic information so we could analyze the data to determine if different subsets of the population responded differently about certain topics.

Before distributing the survey to the public, it was pre-tested by Forest & Bird Upper Hutt committee members, Victoria University of Wellington staff, and individuals who were not associated with the project. Pretesting allowed us to ensure that the survey was easily comprehensible by both experts and the general public. We analyzed the answers of participants to ensure that their responses aligned with our design's intent. We encouraged participants to critique the survey as they took it and to provide feedback for improvements. They provided feedback on formatting, questioning, survey length and clarity that allowed us to improve the survey.

We distributed our survey using a variety of Internet-based methods. By using a combination of strategies to share the survey, we reached a larger audience. In 2018, a research team from Worcester Polytechnic Institute found that "email [and] Facebook...were [two of] the most effective means of soliciting responses" and that email "had the most continuous flow of responses...days after the initial distribution" (Billis et al., 2017). Furthermore, the statistics resource Statista estimates that 73% of people in New Zealand use Facebook; it is the second-most-used social media site after YouTube (Statista, 2018). Based on this data, and input we received from Forest & Bird Upper Hutt members, we chose to post the survey on Upper Hutt community Facebook pages. Our focus was to survey Upper Hutt residents, so targeting community groups allowed us to solicit relevant responses. Graham Bellamy, the chairperson of Forest & Bird Upper Hutt, also included the link to our survey in an email to the branch's membership list.

One of our more innovative plans to reach the public of Upper Hutt was through Facebook's paid advertising platform. An advantage of this strategy is that Facebook's location-based advertising features allowed us to target our responses in and around the Silverstream area. We ran an advertisement with a link to our survey through the Facebook page of Forest & Bird Upper Hutt. By split-testing a variety of different ads, we determined those which resulted in the highest rates of response, and scaled the most successful ads. Split testing, also known as A/B testing, involves changing one variable of an advertisement and running the two versions. Then specific metrics such as "Cost/Conversion" are used to determine which advertisement does the best. The difference in performance of the advertisements must be due to the changed variable. The lesser-performing advertisement could then be turned off, and usage of the advertisement that is more successful can be increased. An example of how this works can be seen below in Figure 16.

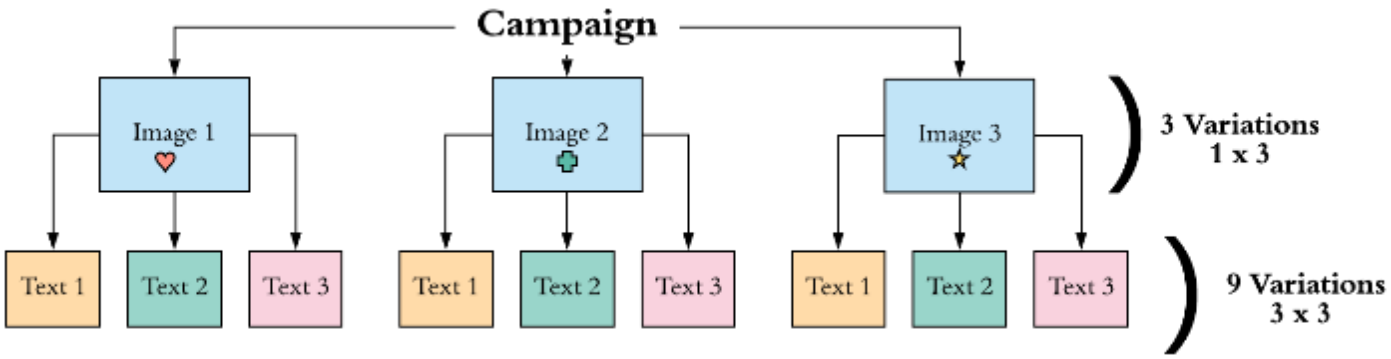

Figure 16: Split Testing Display

While the ads ran, we were able to view the demographics (men, women, age, interests, etc.) that had the highest response rate using Facebook's "Audience Insights" tool. We used a carefully monitored spending plan to find the most effective and unbiased targeting for our ads. We split tested a total of eight interests as well as a "no interest" group in which the ad was targeted to Facebook users independent of what they showed interest in. We targeted interests we thought would be relevant to our project, including wildlife, outdoor recreation, environmentalism, and conservation biology. We also ran ads that targeted rugby, TV, video games, and urbanization in an effort to see if non-conservation-related interests would result in a different rate of response. These interests and the no interest group made up our nine different ad sets. Under each ad set, we tested one ad with short text and one ad with longer text that gave a bit more detail about our project. We began with eighteen advertisements; if the response rate appeared promising, we increased the spending and response pool of this campaign. If not, we looked at our

audience insights for each ad set and specifically targeted the demographics that were most likely to respond (for example, women aged 18-54). We also installed a Facebook pixel on our survey, which is a tool to track events on a web page such as page views (Facebook Business, 2019). From there we installed a specific "view content" pixel code on the last question of the survey. By doing so, we were able to create a custom audience of those who had finished our survey and then exclude this audience from all of our running advertisements. We received funding from Forest & Bird Upper Hutt for up to $500 NZD/$350USD for our Facebook ad campaign. To see an example of this method, including the short and long advertisements, refer to Appendix K.

Finally, we wished to incorporate a cultural perspective into our understanding of how people view their relationship with nature. In our interview with Sara Moylan, she spoke about Māori connections to the environment, which inspired us to pursue this concept further. We reached out to Ihaia Puketapu, a local Māori woodcarver who was able to provide new insight on the historic and intrinsic value of nature. Māori views on conservation, while not directly associated with the Silverstream Spur, are important for our sponsors to consider when proposing and promoting an eco-corridor project.

3.4 Objective 4: Create awareness materials for the public and Forest & Bird

Our sponsors expressed a desire for educational materials that could be distributed in order to raise the profile and public desire for the ecological corridor. We have chosen to create two deliverables, one that is targeted more towards the general public and one that will be more effective for those who have a baseline understanding of the concepts at play in our project. For the general public, we have designed a pamphlet that informs them of the proposed ecological corridor and the impacts it could have on the region's native birds. This pamphlet could be distributed at the monthly meetings and other events held by Forest & Bird Upper Hutt. We used more accessible language when referring to the corridor, in an attempt to convey the message about connecting habitat as explicitly as possible. The brochure includes a map of the potential ecological corridor, pictures of birds found in the local area, and information about Forest & Bird Upper Hutt's conservation projects related to the corridor.

For members of Forest & Bird, we created a research poster that summarizes the key elements of our project. This poster can be used to inform members of the work we have done, giving them context for the status of the proposed ecological corridor. Pat van Berkel has suggested than an accompanying poster may be produced in a few months time to provide a further update on the work Forest & Bird is doing to help secure the corridor.

4. Results and Discussion

4.1 Objective 1: Determine how native birds in the green belt land could benefit from the presence of an ecological corridor

4.1.1 Results of Objective 1

By conducting site assessments and speaking with ecology and biodiversity experts, we were able to further understand the impact an ecological corridor would have on the native birds in the Hutt Valley. The common themes indicating the importance of a corridor had to do with pest control and maintaining or replanting native bush in the area of interest.

The experts we interviewed described mammalian predators—most notably rats, cats, possums, and stoats—as major threats to native bird populations. Environmental scientist Sara Moylan explained that pest control is a key part of maintaining any preserved land in New Zealand, including corridors, sanctuaries, and reserves. When such land is set aside, the next step is to create a safe haven for native species by reducing the number of predators. Nick Beveridge, regional manager for Forest & Bird Auckland, gave several examples of biodiversity restoration projects in which the primary initiative was pest control, including the Ark in the Park and Pest Free Peninsula programs. These projects supported the North-West Wildlink, an eco-corridor in Auckland, which lists predator control as one of their primary objectives. Senior ecologist Nikki McArthur asserted that a corridor could not be successful without pest control, and firmly believed that predation by invasive mammals was a more "serious and urgent threat" than habitat fragmentation. He explained that a corridor's success was contingent on the presence of productive (reproducing) populations, which is only possible if pests are not endangering the growth of the population. This claim is echoed in Colin Miskelly's research on the recolonization of forest birds in Wellington, where he states the establishment of resident bird populations in Wellington is "a tribute to effective animal pest control" (Miskelly, Empson, Wright, 2005). Both Moylan and McArthur claimed that an increase in bird abundance was the best indicator of success for pest control efforts.

Across the valley from the Silverstream Spur, Keith George Memorial Park has a network of rat tunnels that are maintained and monitored in an effort to trap invasive predators (shown in Figure 17). Along with Wi Tako Reserve, the park has a number of bait stations to poison pests and lower their populations. Zealandia is another example: the eco-sanctuary is committed to "keeping out introduced mammalian predators", and the birds that live within the fence "remain thriving safely in the sanctuary" (Karori Sanctuary Trust, 2018). The success of the species introduced to Zealandia is evidence that pest control truly makes a positive difference to the welfare of bird populations.

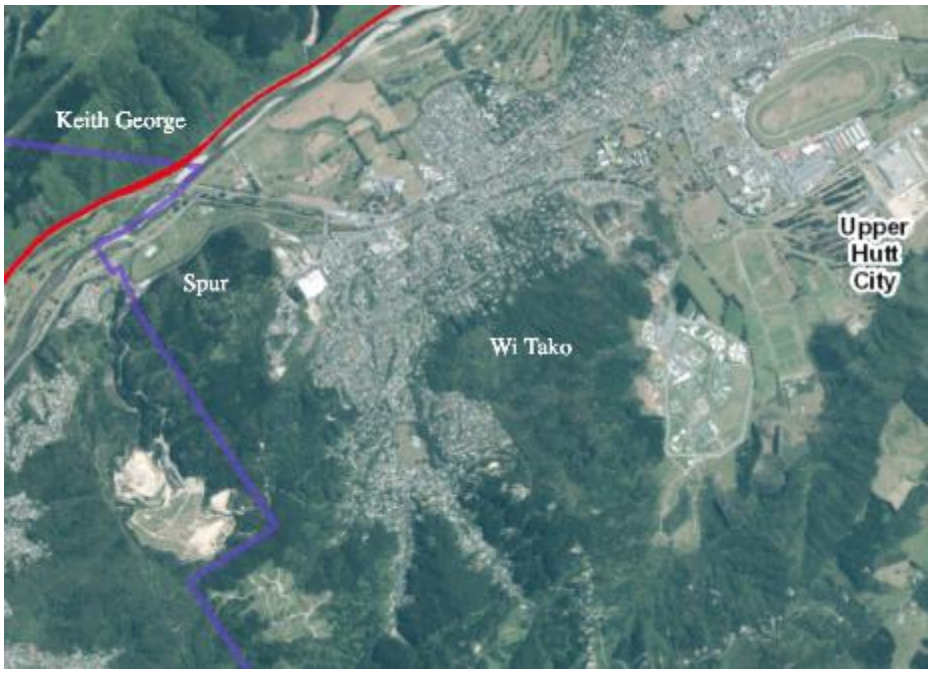

Figure 17: Keith George Memorial Park and Wi Tako Reserve

Corridor maintenance also frequently involves planting projects. This serves two purposes: it increases the proportion of native bush in the area, and expands the amount of forest cover. The presence of native bush provides a few advantages, the first being a more reliable food source to birds compared to what is available within exotic pine forest (Clout and Gaze, 1984). As a result, many native bird species are more prevalent in native bush. Literature states that riflemen are "absolutely restricted to native forests" while kererū, bellbirds, and tui are all present in higher numbers within native bush than within exotic pine forest (Clout and Gaze, 1984). However, Miskelly refuted this claim in the context of the Spur, stating that pine forests were acceptable to all native birds since they could utilize the "diverse subcanopy of native shrubs".

If a corridor is meant to connect two reserves of native habitat (in our case, Keith George and Wi Tako Reserve), McArthur believed that maintaining a singular habitat type would increase the corridor's usage. In his past research he observed a psychological barrier, one where bird species were reluctant to cross between different forest types. While there was no clear explanation, McArthur theorized birds would conform to the habitat they were hatched in, and be disinclined to travel to unfamiliar environments. Miskelly explained that another advantage of native bush was permanence. As mature pine forests are at risk of being "chopped down every 30 years," it benefits the long-term viability of populations to invest in planting projects of native vegetation. Additionally, Graham Bellamy has observed that native bush is more fire-resistant than pine, contributing to its projected longer lifespan. Aside from these benefits, one caveat mentioned by McArthur was that native bush supported higher densities of ship rat

populations. This may give pine forest a natural advantage an avian habitat, because it may contain fewer predators. This information is summarized in Figure 18 below.

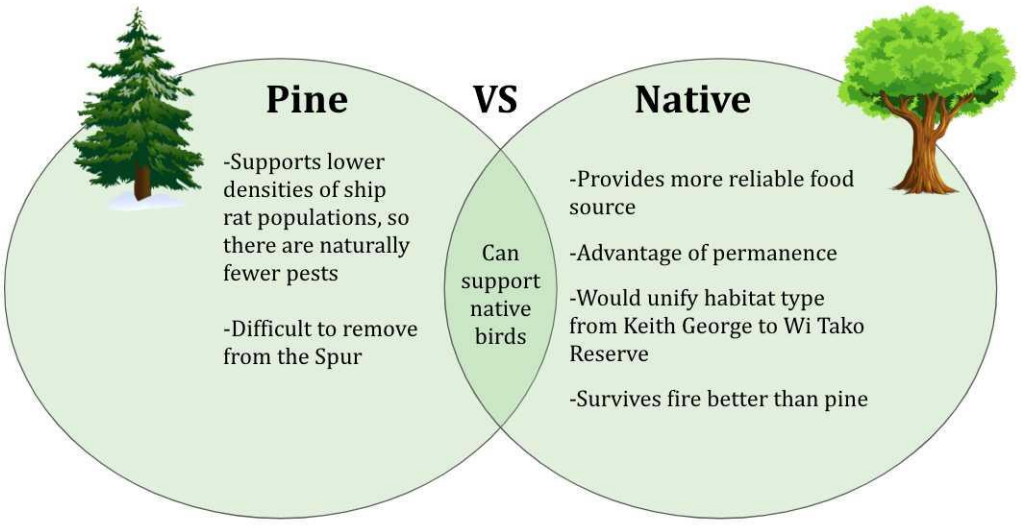

Figure 18: Venn diagram summarizing results of pine vs. native tree benefits to birds

During our site assessments in Upper Hutt, we observed a number of birds and took notice of their flight behavior. We also examined the Hutt River (shown in Figure 19), which McArthur considers an obstacle to bird movement. This claim is corroborated by our sponsor, who believes the width of the river is the maximum distance that some species are willing to fly without tree cover. The planting of trees right up to the river's edge would therefore benefit these bird species by reducing the distance that they must cover in one flight, and allowing them to remain in the bush for as long as possible before making the flight across the river. Our observations supported the claim that a corridor would promote bird movement across the area—we visually confirmed that the fantail does indeed hop from tree to tree, tui and kererū perch in the taller trees, and whiteheads hide in the cover provided by the bush. We hypothesized all of these species would benefit from the dense foliage that a corridor would maintain.

Figure 19: Examination of the Hutt River

Through our discussions with avian experts Miskelly and McArthur, we gained an expert perspective on how individual bird species present in the Hutt Valley could benefit from a corridor. Many conclusions were not primarily based on empirical data, but were educated assumptions based on their knowledge of bird distributions. Both experts stated that the rifleman was a poor flier that would most benefit from continuous canopy cover. However, McArthur had reservations that a functional rifleman population was even present in the Hutt Valley, and added that even if there were, the Hutt River and motorway may be too significant of a barrier for this species to cross. The second species mentioned was the whitehead. Miskelly described the whitehead's dependence on habitat continuity as a subject of debate between him and staff at Zealandia; while he believed the whitehead was capable enough to cross open ground, others believed it depended on continuous forest cover. McArthur claimed the whitehead had higher flying proficiency than the rifleman but could still benefit from a connected landscape.

Both experts listed the bellbird as the next species on the gradient of corridor dependency (approximated in Figure 20), claiming that this species is physically capable of dispersing, but for some reason did not possess the tendency to. Miskelly hypothesized that birds possessed a "fear of flying," referencing past literature that attributed local distributions of New Zealand birds to the psychological barrier of flying across open areas (Diamond, 1984). Both experts stated that species including the tui, kererū, fantail, grey warbler, and tomtit were proficient fliers and would not benefit as directly from corridor connectivity. However, they continued to say that if the Silverstream Spur was not only considered as a corridor, but rather as breeding grounds or an extension of habitat, these

species were very likely to confer benefit from the Spur. McArthur described how he had witnessed various birds, such as tomtits, recently breeding on the Spur.

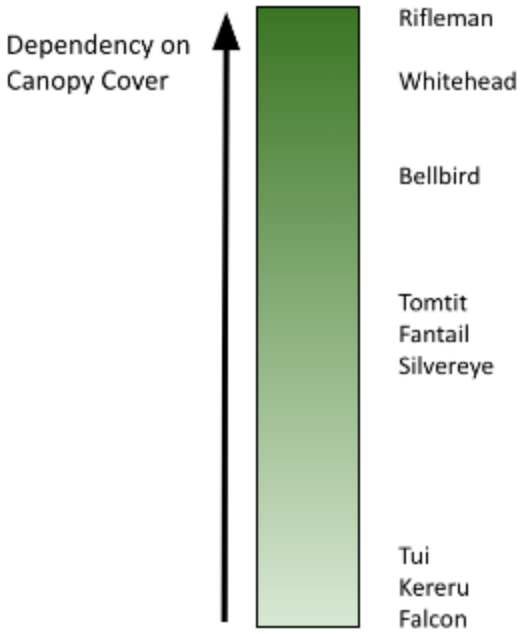

Figure 20: Spectrum visualizing native birds' dependency on canopy cover. This spectrum is approximate and based on species information as described by avian experts.

4.1.2 Discussion of Objective 1's Results

Our findings prove that neither the designation of nor benefits derived from an eco-corridor are straightforward. While in theory, we can conclude that the designation of an ecological corridor on the Silverstream land would benefit bird populations, there is a lack of empirical evidence. Part of the reason is that according to our experts, the definition of a corridor as solely a connection between habitats would not be enough of an advantage; it must be accompanied by predator control and appropriate planting efforts. Connecting habitats is viewed a secondary objective after controlling invasive pests, because pests limit the viability of productive populations. According to ecologists, the benefit that comes from population movement is contingent on there being a productive population to begin with.

From our site assessments, we concluded the Silverstream Spur does have relevance as a key element of connectivity; without the spur, keeping the corridor continuous would be extremely difficult. However, the Hutt motorway and river may be an insurmountable barrier for some birds, in particular, the rifleman. It is difficult to determine if a corridor created by the Spur could be helpful without further assistance for crossing the river and road. In any case, the species that could most benefit from connectivity may not have functional populations in the Hutt Valley. There exists a discrepancy between the potential

and actual value of a corridor to birds, since populations that could eventually recolonize the area with the presence of a corridor are not currently present in substantial populations.

While we did gather expert opinions on how a corridor could benefit native birds, we could not conclude how exactly the species of interest would be affected if development did proceed on the Spur. Part of the controversy surrounding the corridor concept is that "the acceptance of corridors as a concept for biodiversity conservation has outpaced scientific understanding and the collection of empirical data" (Bennett, 2003). This idea is mirrored by other researchers who say although eco-corridors are a "promising conservation intervention" the evidence that they promote the biodiversity of connected flora and fauna "is generally lacking" (Beier and Gregory, 2012). The avian experts we interviewed agreed that in theory, a corridor could benefit target bird species. However, there is a lack of quantitative evidence regarding the effectiveness of established corridors. This makes it difficult to prove that one would be successful in Upper Hutt.

We resonated with both Miskelly and McArthur's belief that the Silverstream Spur should not only function as a corridor, but an extension of habitat. While there was no clear consensus as to whether the habitat should remain as mixed pine and native bush or be replaced with total native vegetation, experts recognized the Spur as feasible habitat and breeding grounds. The Silverstream Spur was comparable to adjacent areas Keith George Memorial Park and Wi Tako Reserve, suggesting that with adequate conservation efforts, it could provide the same benefits as other protected reserves.

4.2 Objective 2: Evaluate the attitudes of key stakeholders towards the ecological corridor concept

4.2.1 Results of Objective 2

Our primary method for gathering the perspectives of the relevant parties was semi-structured interviews. We spoke with a representative of the GTC, members of Forest & Bird Upper Hutt, and several local authorities. Each interview helped build a comprehensive profile of the points of view that surround the central issue of our project.

Through our conversation with Ralph Goodwin, one of the directors of Guildford Timber Company, we learned of his vision for the Guildford-owned land and the Silverstream Spur. In his responses, Goodwin leaned heavily on his family's long-term ownership of the land (95 years) and forestry background. He stated that the land-swap could be a "one-time opportunity to achieve connectivity between Silverstream and Pinehaven", and "create both ecological and recreational opportunities". A map of the two suburbs is depicted below in Figure 21. When asked about his environmental viewpoint, he emphasized his strong intentions to make a positive environment impact, while urging us to recognize his position as a developer, including his need to "balance [his] environmental conscience with what has to be a commercial outcome". He proceeded to demonstrate his

vegetation management efforts on areas proposed for public reserve, which included harvesting pine trees and replanting native ones, such as kamahi, beech, rata trees, and manuka.

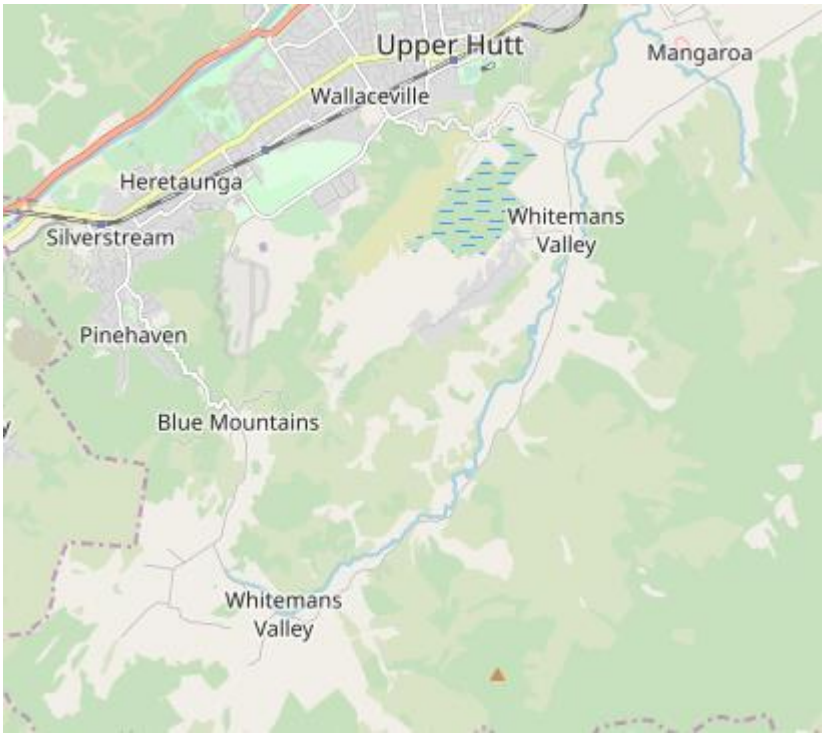

Figure 21: Silverstream and the surrounding suburbs © OpenStreetMap contributors

When asked about his rationale behind the land-swap, Goodwin explained how GTC land was a "wonderful resource," where land close to "135 ha…[is] currently privately owned but very well used for [the] public...hiking, mountain biking, walking, horse riding". This information builds off the benefits described in the MOU, which states GTC land could enhance forest cover, provide stormwater control, and become an outdoor recreation attraction (GTC and UHCC, 2016). Goodwin went on to explain his vision for the Spur, which included goals to "preserve the native bush, [provide] access to open space, make small clusters of housing with a beautiful view". He stated that specific details about the development would emerge once the land-swap was formally proposed; such details would be finalized after public consultation. However, previous discussion in a Pinehaven Focus Group meeting claimed that after the land-swap "GTC will have 165 ha, about 40% of that used for residential development...outcome is approx. 1000 homes" (UHCC, 2016b).

Our next question was about his mindset towards the ecological corridor in the context of larger conservation efforts. Goodwin explained that his goal after acquiring the land was to "to create a green belt from Silverstream right over the top of Whiteman's Valley," although he admitted that for "benefits that flow to both parties, eventually part of Silverstream Spur will need to be developed". As seen above in Figure 21, a corridor could

create a linkage that stretches down from Silverstream into the valley. Goodwin explained his previous land purchases from private owners in which he introduced native species, and suggested he may try to acquire additional land to mitigate bottleneck regions in and around the Guildford property. He also acknowledged the community's desire to preserve green spaces and identified himself as having the same goals, which he hoped to prove by demonstrating his revegetation efforts to the public. As a Forest & Bird member, he showed great respect for their efforts, and when asked about creating a 100m wide corridor through the Silverstream Spur, he suggested it was achievable.

We attended several meetings of the Forest & Bird Upper Hutt branch to speak with active members of the organization to learn about their conservation work in Upper Hutt and gain an understanding of their views of the future of the Silverstream Spur. Many members had concerns about losing native bush in the Silverstream Spur if it were to be developed, as it would not be able to be recovered. Additionally, they firmly maintained that the Silverstream Spur was crucial to the passageway of birds between green belt reserves. However, members were not completely unified on their beliefs for the Spur's future land-use. Pan van Berkel advocated for completed protection of the Spur, whereas Graham Bellamy, the current chairperson of the Upper Hutt branch, consented to the idea of minimal development. When asked about the idea of creating an access road through the Spur, he responded "we're happy with that, as long as he doesn't want the Spur for residential development, we're happy for him to use it". Other members voiced their displeasure at the MOU being a private undertaking between UHCC and GTC, wishing there was more transparency in the initial stages of its creation. Overall, both Bellamy and van Berkel were positive about their relationship with Goodwin; they felt he was supportive of Forest & Bird's efforts and had a strong conservation attitude. When asked about 1080, a controversial topic that could affect the success of Forest & Bird's campaign, Bellamy stated that after seeing its benefits, the organization recognized the poison as the most useful tool to eradicate pests. He clarified that the organization would "never propose that 1080 should be used on a block like the Spur," as it is "too close to residential areas".

Our interviews with local authority in the Upper Hutt City Council (UHCC) provided insight into the goals of UHCC and the procedures required to initiate the land-swap and development. The viewpoints of government members had a notable environmental focus; it was clear that UHCC has a strong desire to protect their city's indigenous flora and fauna. Planning Policy Manager James McKibbin confirmed their goals aligned with the Sustainability Strategy, which requires "a balance between providing for future housing/growth and natural values". McKibbin emphasized the Resource Management Act, especially sections about the functions of territorial authorities under the act as relevant to the issue. The document states that such authorities have the responsibility to control "any actual or potential effects of the use, development, or protection of land, including for the purpose of prevention or mitigation of any adverse effects of the development," and "the maintenance of indigenous biological diversity" (Ministry for the Environment, 2018).

McKibbin mentioned these sections in the context of the "rigorous process of looking at natural [and] ecological value" required by UHCC when considering development (personal communication, January 24, 2019). Mayor Wayne Guppy and Chief Executive Peter Kelly echoed these sentiments, claiming that to rezone the Spur for development would be a very "rigorous process," mentioning details like hydrology and traffic flow. Both authorities stressed that the Memorandum of Understanding was nothing more than a concept, a starting point for discussion; in fact, Kelly stated "there's no definition to what this project is until [Goodwin] comes forward with a firm proposal and design". When asked about their opinion on the corridor itself, Kelly expressed his doubt about its benefits. He believed that corridors were only useful to ground mammals or birds nesting in exclusive geographical areas, and wished to know more about how a corridor could benefit the region's birds.

4.2.2 Discussion of Objective 2's Results

The beliefs of the key stakeholders in this project fall into a spectrum of balancing conservation with urban growth of Upper Hutt. Members of Forest & Bird Upper Hutt believe that conservation is a necessary step to establishing an eco-corridor, as it will facilitate pest control and revegetation efforts. In turn these projects will encourage the presence of birds—a phenomenon which many volunteers witnessed in past conservation projects. Of all stakeholders, Forest & Bird are farthest on the conservation side of the spectrum, and advocate for the protection of as much of the Silverstream Spur as possible for the purpose of the eco-corridor. The Upper Hutt City Council (UHCC) places a high importance on conservation, as proven by our interviews with the mayor, the chief executive, and the planning policy manager. Their viewpoints are supported by documents such as the Resource Management Act and the Sustainability Strategy, which explains the responsibility to provide for the wellbeing of communities with sustainable, environmentally-conscious actions. The UHCC does support the land-swap and believes that through the rigorous process warranted by legislation, the land-swap will consider and minimize negative environmental impact. However, officials are not clear on the advantages of an eco-corridor, and could benefit from education efforts to help them understand if and why the corridor should be given consideration. Finally, the Guildford Timber Company, as represented by director Ralph Goodwin, is a conservation-minded developer that identifies the Silverstream Spur as an opportunity to create a connection between two suburbs with "small clusters of housing with a beautiful view". In return, he would provide 132 ha of reserve land, which is home to regenerating native bush due to his company's efforts. As stated in the results, the presence of native bush can encourage native bird populations.

Since details for development depend on the completion of the land-swap, any plans GTC may have for building on the Silverstream Spur are uncertain. In our interview with

James McKibbin, he expressed his understanding that the Spur would only be used to create an access road through the Spur and Guildford property. However, the land-swap discussion document outlines that in addition to a "new road that would run up the ridgetop", the Spur would be also be used for a "medium density village neighborhood", and "small hamlets and clusters [of houses]" (Boffa Miskell, 2015). When we inquired about the potential size of the housing development, Goodwin claimed he hadn't considered how many homes would be built. Minutes from previous meetings about the land-swap suggest that the considered "outcome is approx. 1000 homes" (UHCC, 2016b). These contradictions may be based on the perspective that each party is speaking from. James McKibbin acknowledged that he is new to the position of Policy Planning Manager of UHCC, so it is possible he is not yet entirely informed of the intentions for development. Ralph Goodwin may not be fully disclosing his plans, either, in the interest of retaining information until he is ready to move forward.

One additional consideration regarding the understanding among these stakeholders is that any agreements in place are not legally binding. While intent may be signified, there are no guarantees that future proceedings will align with the beliefs of the current stakeholder authorities. Forest & Bird members expressed concern that a change of leadership in GTC could lead to a drastically different outcome, one where conservation is not prioritized or even considered. Ralph Goodwin himself acknowledged that many of the constraints the company has put in place regarding what land may be developed stem from his own "environmental conscience". Another landowner or developer may not be so environmentally minded. This may influence the intensity with which Forest & Bird pursues the proposed ecological corridor.

In terms of the Silverstream Spur, UHCC, GTC, and Forest & Bird Upper Hutt have differing priorities concerning the land. However, common ground exists between the stakeholders in this situation. All involved parties support conservation of Upper Hutt's natural resources, such as native bush and native birds. They have each executed efforts to reduce the number of invasive pests that reside in Upper Hutt, supported the regeneration of native bush, and worked to protect existing native bush. Each stakeholder has also acknowledged that the potential access road would not inherently inhibit the eco-corridor. The size of the Silverstream Spur allows for the existence of both, but it is ultimately up to the landowners to decide how the corridor is prioritized.

4.3 Objective 3: Assess the public's perceptions of their relationship to their environment

4.3.1 Results of Objective 3

Our primary tool for gauging the attitudes and feelings of Upper Hutt residents towards conservation and the area's native birds was an online survey. The survey was primarily distributed using paid Facebook ads. We created two versions of the ad: one with

a shorter introduction to the survey that we refer to as “short text” and one with a longer, more in depth description of the survey that we refer to as “long text”. The two ads are included in Appendix K.

Facebook ads are targeted towards users based on what pages they like, what they comment on, and what posts they interact with. This information is sorted into categories called “interests”. We selected interests that we thought would garner the greatest rate of response, such as environmentalism and wildlife. Doing so did create a potential bias in the responses we collected. To better account for this bias, we later performed a split-test tailored to interests that were not conservation-based (for example, video games and TV). We also ran an ad-set with no interest targeting, in an effort to reach as many people as possible. For each interest, we ran both the short text and long text ad, and then compared the response rates of each ad to determine which were most effective. A flow chart of how this split test was structured can be seen below in Figure 22.

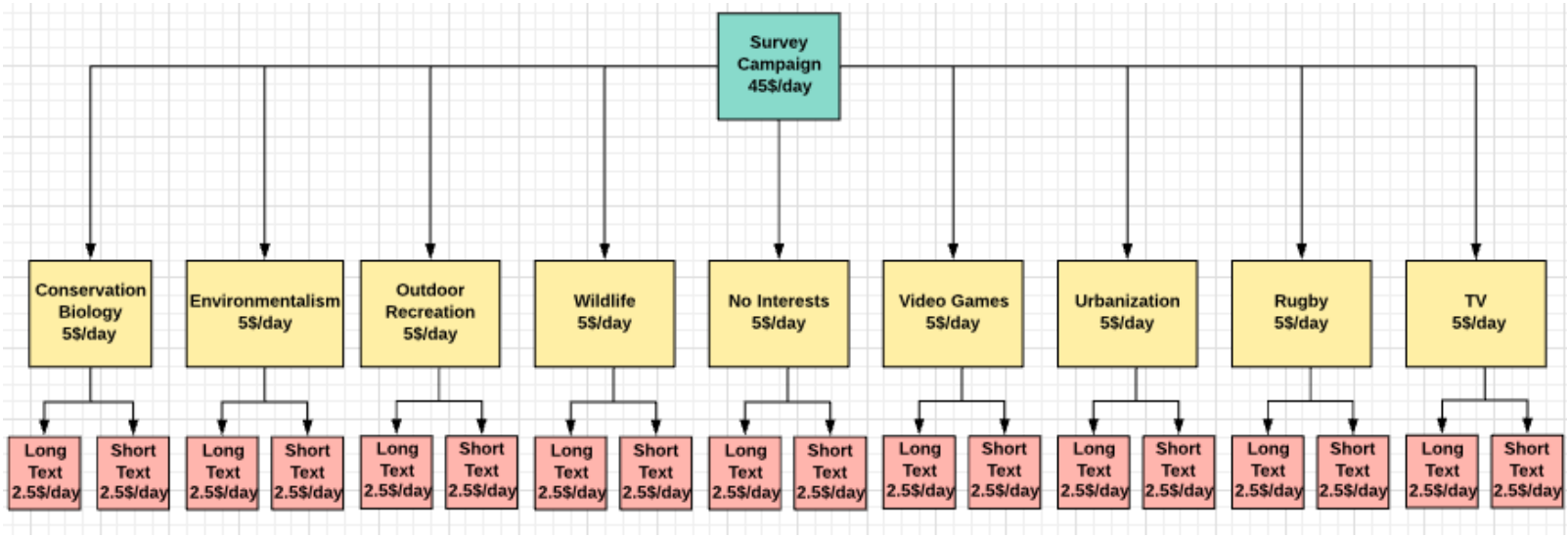

Figure 22: Flow chart of interests that were split tested in Facebook campaign

One metric we used to determine the efficacy and efficiency of the ads was cost per response. Our goal was to spend no more than 30 cents USD per response, because this is a typical benchmark of success for Facebook advertising; however, this benchmark represents ads used for marketing purposes, not survey response collection, so the choice was somewhat arbitrary. We measured this metric using the Facebook Ads Manager tool shown in Figure 23 below.

Amount Spent	Cost per Unique Link Click	Results	Reach	Impressions
$284.95	$0.35	571 Views Cont...	18,694	31,429

Figure 23: Facebook ad campaign data

Our responses came in at an overall average of about 35 cents per response (USD). While this was higher than our initial goal, we felt it was important to keep some of the more costly ads running in order to minimize the response distribution bias. The only interests at the ad set level that converted under 30 cents per response were conservation biology (28 cents per response), wildlife (27 cents per response), and video games (28 cents per response). Interests that converted at a notably high price were rugby (41 cents per response) and no interest (44 cents per response). Every other interest converted somewhere in between these costs per response. The cost per response for each ad set is depicted in Figure 24 below. After we completed our split-test, we looked to see which demographics resulted in the greatest response rate. We found that women aged 18-54 were a majority of our respondents; this encouraged us to add another ad set targeted to women of this age group. This ad set converted at 36 cents per response.

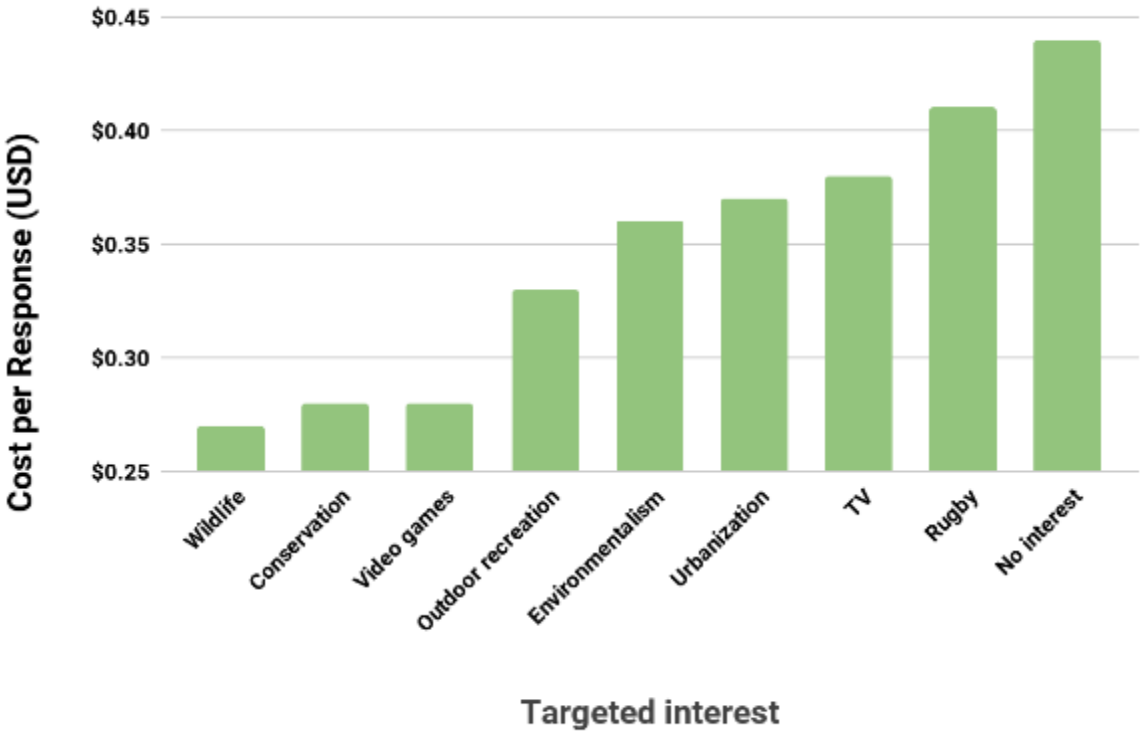

Figure 24: Cost of ad sets based on which interest they targeted

One of the best performing ads was the long-text version targeted to conservation biology interests. This ad came in at 22 cents per response and earned a Facebook relevance score of 9/10. A Facebook relevance score is "a rating from 1 to 10 that estimates how well your target audience is responding to your ad...shown after your ad receives more than 500 impressions" (Facebook Ads Manager, 2019). Other ads that performed well were wildlife/short text (26 cents per response), TV/short text (26 cents per response), video games/long text (28 cents per response), and urbanization/long text (29 cents per response). Each of these ads earned a relevance score of 8/10. The cost per response of each ad is shown below in Figure 25.

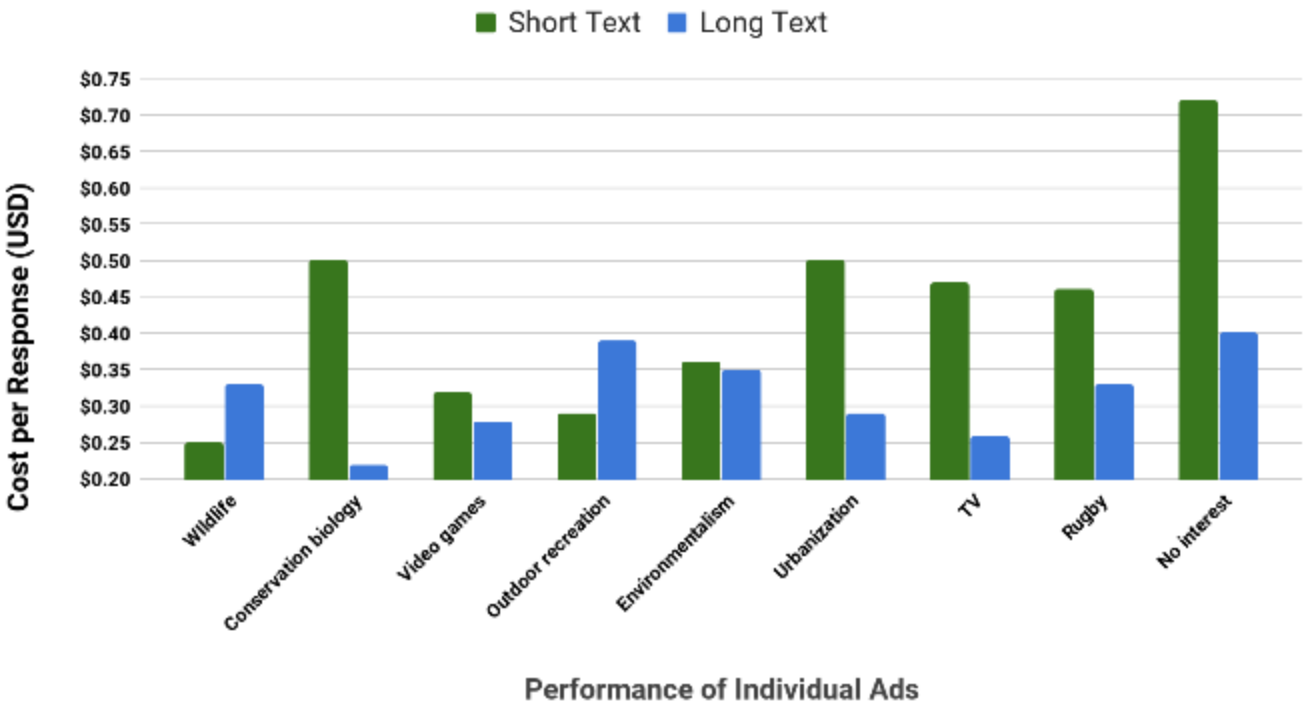

Figure 25: Cost per response of individual ads

Of the 553 responses we gathered, 450 answered our questions pertaining to demographics. More women than men completed the survey: 66% (295/450) of respondents were female and 31% (141/450) were male. The majority (71%, or 271/381) of total respondents were aged 35-65, while only 15% (58/381) of respondents were aged 18-34. 40% of respondents were females aged 35-65. Graphs showing the age and gender demographics of our survey respondents can be found in Figures 26 and 27, respectively.

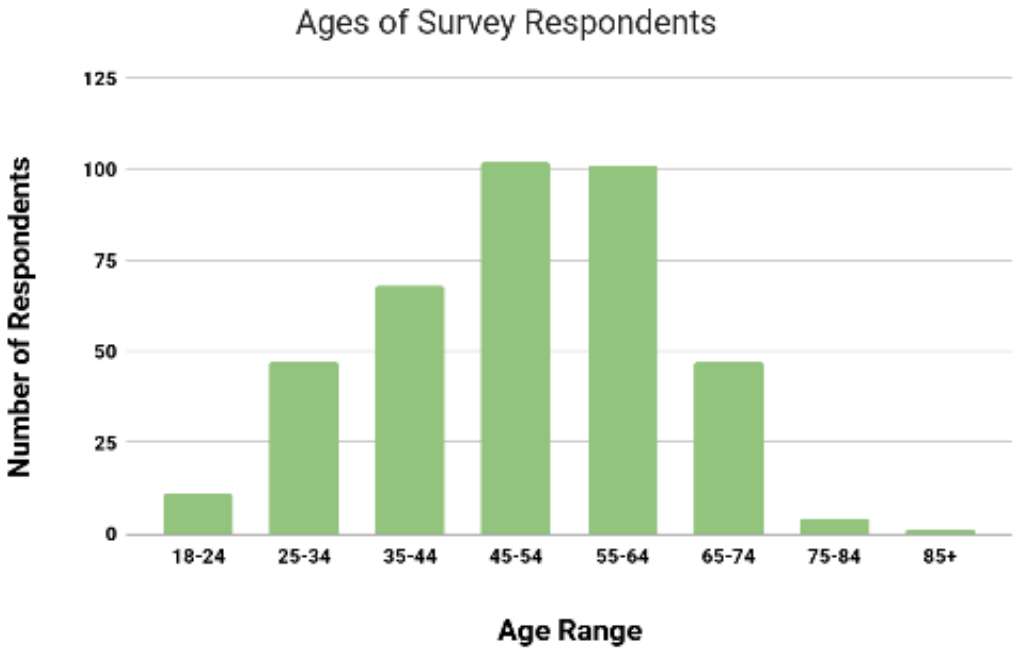

Figure 26: Age range breakdown of survey respondents

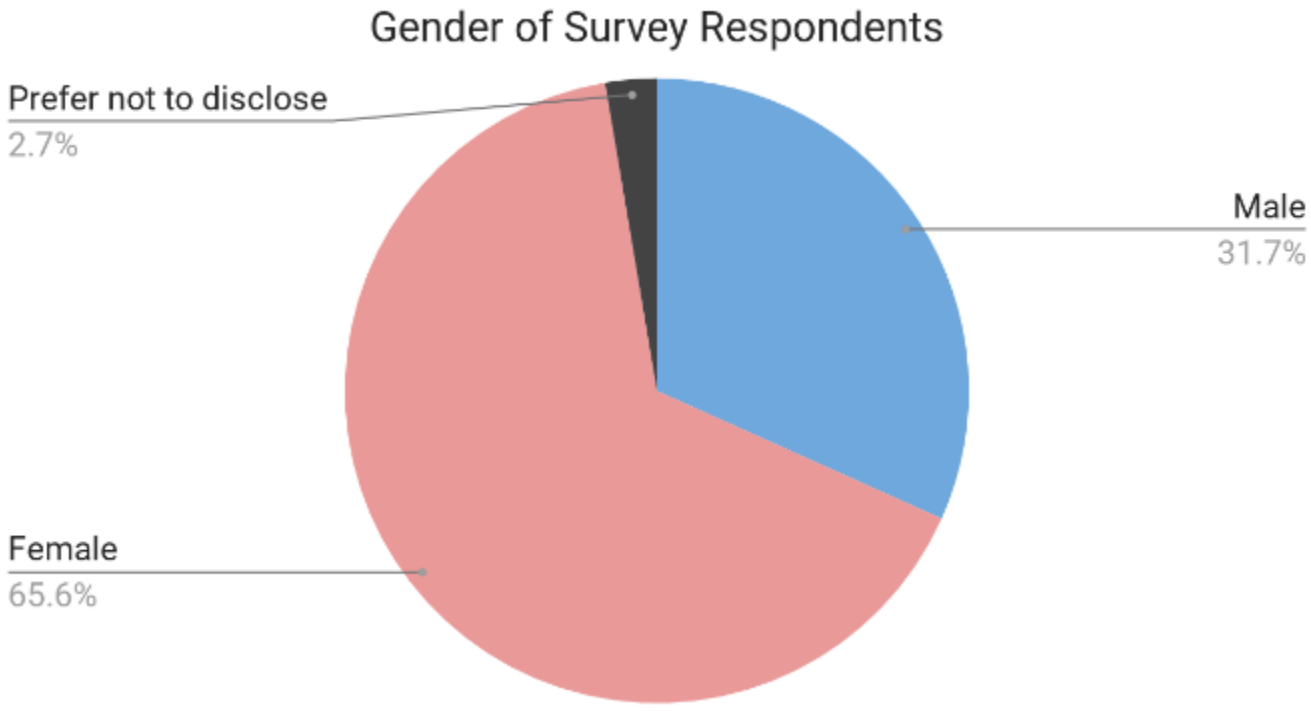

Figure 27: Gender breakdown of survey respondents

When respondents were asked about the importance of conservation in their daily lives, the average ranking was 4.24/5. The ranking results of this question are depicted below in Figure 28. Of the 549 respondents to this question, 279 (51%) ranked the importance of conservation in their daily life as 5/5.

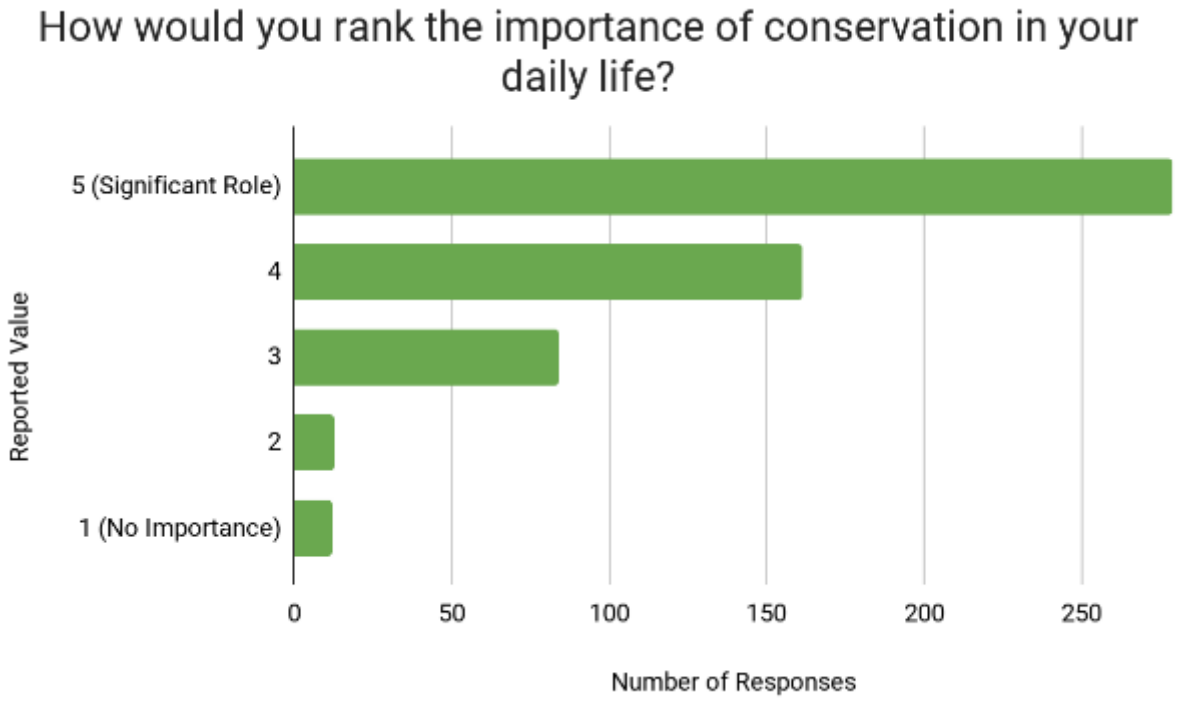

Figure 28: Distribution of responses for reported value of conservation in daily life

Although most respondents value conservation, they did not rank themselves as highly with regard to their knowledge of conservation issues faced by native birds in New Zealand. The average ranking of respondents' knowledge of these conservation issues was 3.42/5. 34% of respondents aged 65-74 ranked their knowledge of conservation issues as a 5/5 while only 20% or less of every other age bracket ranked their knowledge of conservation issues as 5/5. A comparison of respondents' age to their self-reported knowledge of conservation issues is included below in Figure 29.

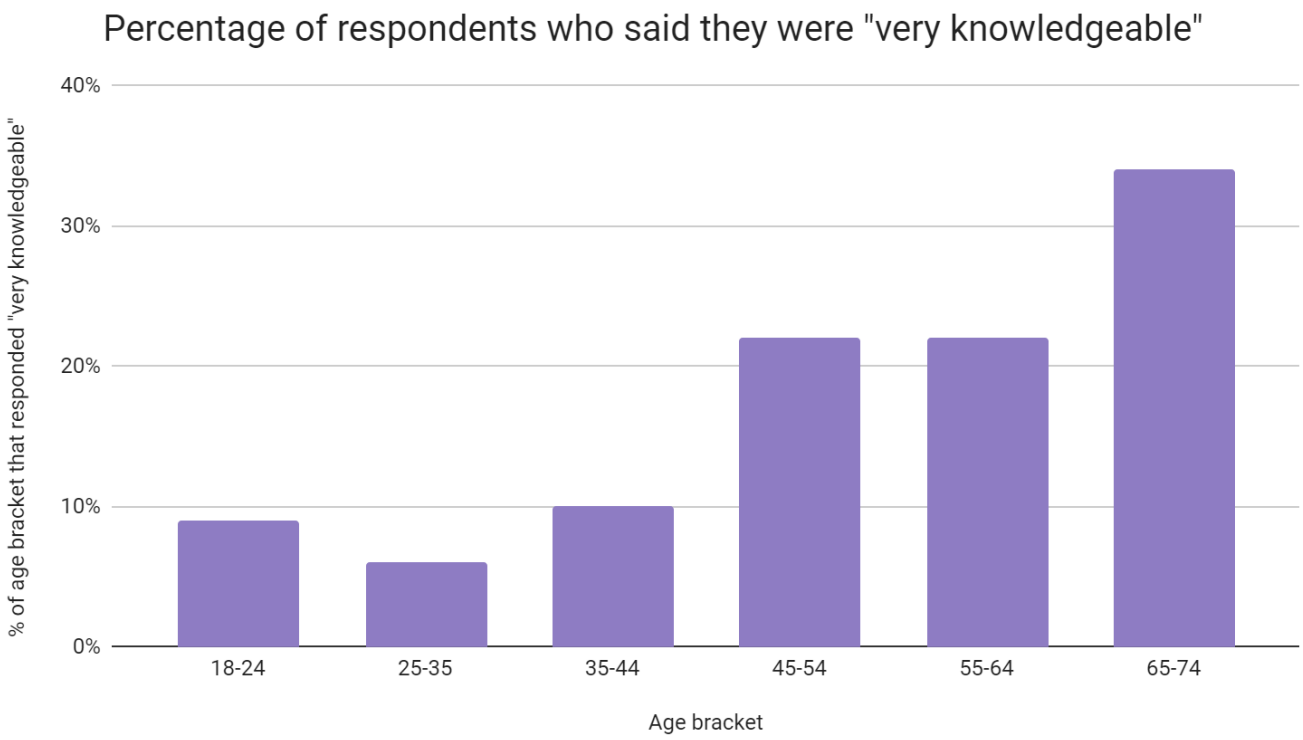

Figure 29: Age compared to self-reported knowledge level

Of the respondents, 96% (526/549) reported they are aware of the threats posed to native bird species by invasive predators and habitat loss. Survey takers were also posed the question “What do you know about these threats (invasive predators and habitat loss) and what are your thoughts on them?” Answers to this question frequently included topics beyond the two listed, and so responses were analyzed for a number of conservation themes. In the 360 responses we received to this question, a total of 731 concerns were given. Pests made up 34% of the concerns. Respondents stated that they believed pests such as rats, possums and stoats posed risks to native birds; this theme was the most common throughout the responses. Answers related to habitat loss, housing development and deforestation made up approximately 24% of listed threats to native birds. Specific comments included beliefs that habitat loss is “by far the biggest single cause of decline of birds” and “the primary threat to New Zealand's native species”. Other frequently cited topics included concerns about cats threatening native birds and waterway pollution caused by poisons meant for pests. The most common concerns and the percentage of responses that included these concerns are shown below in Figure 30.

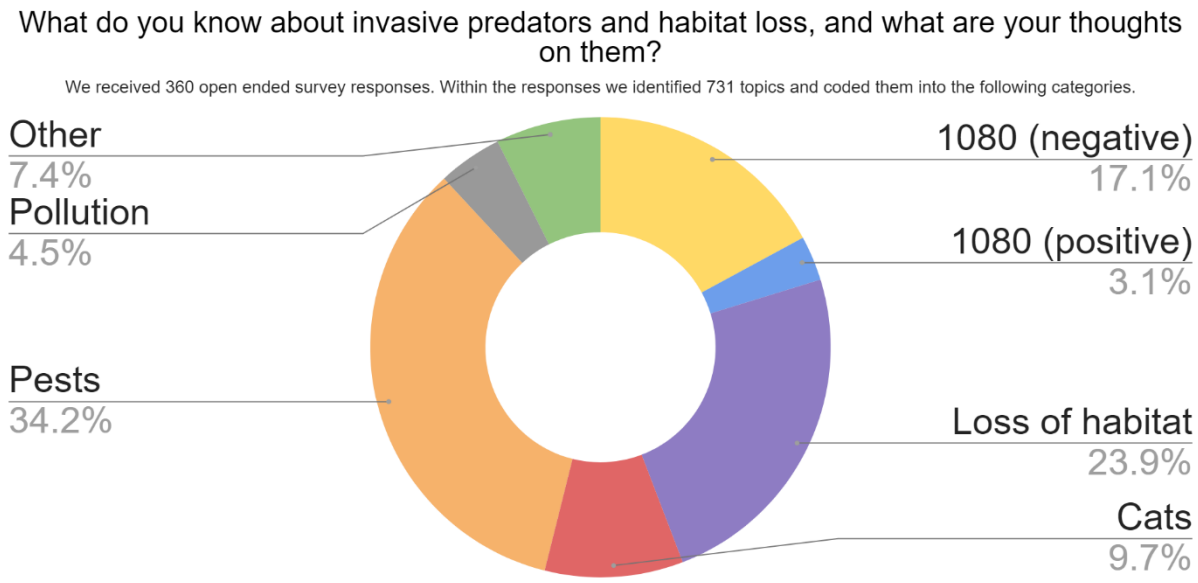

Figure 30: Percentages of threats to birds reported in survey responses

References to the poison 1080 made up 20% of the themes, with 17% of respondents sharing their opinion against the use of 1080. Mentions of secondary poisoning and off-target effects were found in 3.5% of our survey responses. Some claimed that cats, dogs, and predatory birds are poisoned as a result of consuming pest mammal carcasses. Others argued that native birds were being unintentionally poisoned by insects that had ingested 1080 bait. One respondent cited the kea and karearea (the New Zealand falcon) as two species that are particularly affected; the kea may be "eating baits directly" while the karearea may suffer from "secondary poisoning from carcasses killed by poisoning". Indeed, even the top manufacturer of 1080 (Animal Control Products LTD) acknowledges that such carcasses "may remain dangerous to dogs or cats for an indefinite period", and that a "single mouse poisoned by 1080 may contain enough poison to kill an adult dog" (Animal Control Products, 2018).

While many respondents were against 1080, there were also those who supported its usage. One respondent commented "I don't think 1080 is being used in my area but I do believe it's beneficial, most of our native birds get taken out by rodents and possums so our native wildlife needs all the help they can get". The Environmental Protection Authority of New Zealand calls 1080 "an important weapon in the current armory of measures to combat the impact of animal pests—mainly possums, rats and stoats—on our environment and economy" (Environmental Protection Authority, 2019). These sentiments were echoed in several of our interviews with conservation officials. Sara Moylan expressed her belief that "it's working and we need to do it". Graham Bellamy acknowledged that the use of 1080 may require "sacrific[ing] a few for the benefit of the whole", but that it is "the only

tool that we have at the moment to reduce pests on significant areas of native bush and reserve".

When assessing awareness of the proposed land-swap between UHCC and GTC (the results of which are shown in Figure 31), we found that 79% (373/470) of respondents were unaware of "Forest & Bird's desire to designate the land in and around the Silverstream Spur for conservation". Additionally, 84% (394/469) of respondents were unaware of the Memorandum of Understanding (MOU) between UHCC and GTC concerning the land-swap of property in and around the Silverstream Spur. Of the 64 respondents (16%) who were aware of the MOU, 33 people listed various concerns including development, lack of transparency between UHCC and the GTC, and flooding concerns. One respondent commented on the negative impacts development could have, claiming "there should be no development of ridgeline skylines. These should be preserved as natural bush habitat to maintain a feeling of Upper Hutt being a rurally connected community, and also to provide migration pathways for native fauna between larger blocks of protected land". Of the remaining responses, 14 people were not fully aware of the details of the MOU, 19 people had no opinion, and 9 people had no concerns about the agreement. One response mentioned the potential positive impacts of the development, claiming "a well planned mix of houses and green space made up of mixed planting of natives (with proper land management to remove forest litter and reduce fire risk) would enable ground stability, enable wildlife and reduce long-term risks associated with wildfires occurring on the spur".

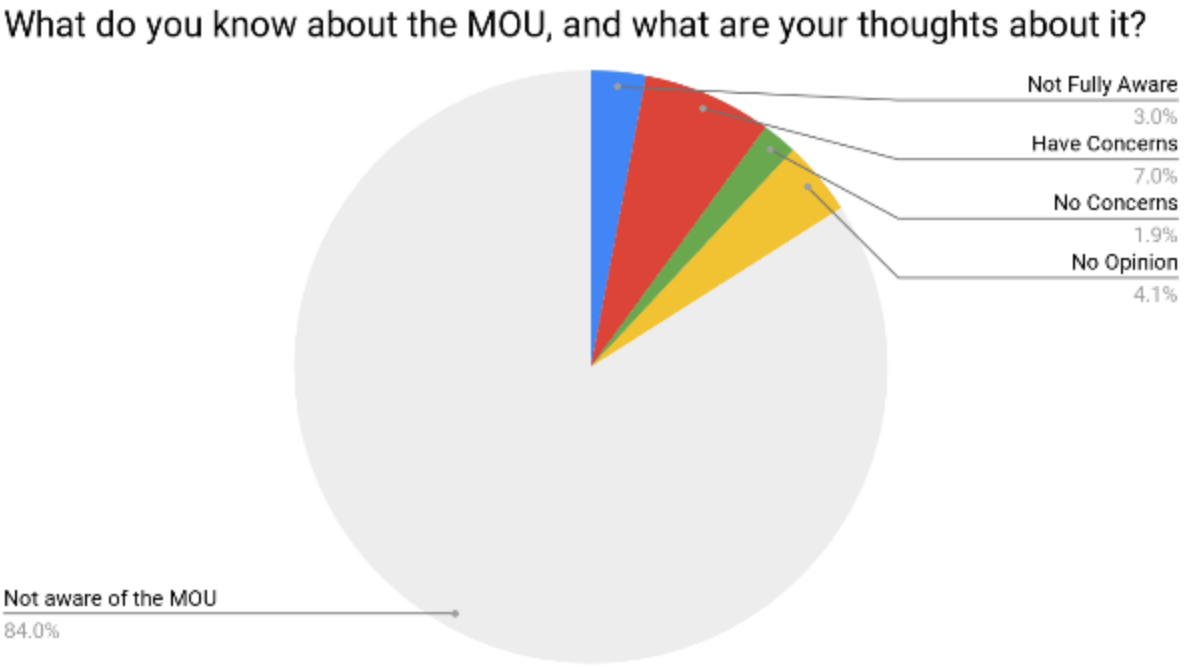

Figure 31: Awareness of and concerns about the Memorandum of Understanding

When assessing how respondents felt about their local native birds, the tui was most commonly ranked as having an "extremely positive" impact, with an average impact score of 4.64/5. One survey respondent said, "we love it in the springtime when [the tui] visit our Kowhai trees in great numbers. A joy to see and hear". The kererū's average impact on daily life was found to be 4.15/5, suggesting the kererū typically has a "positive" impact. One survey respondent said "Love kererū! There are often multiple birds in the forest and trees near our house. They often fly quite close and make a lot of noise. They're a pleasure to watch". A conversation with a member of Forest & Bird Upper Hutt also revealed that she has witnessed a kererū roosting in her trees and dropping seeds, effectively reforesting her land. The fantail's average impact on daily life was found to be 4.5/5, suggesting the fantail typically has a "positive" or "extremely positive" impact. One survey respondent said "I love pīwakawaka! I see them on hikes in the bush. I love them, they make me happy" and another said "(the fantail) visits when important memories are needed. They represent a lost loved one". The reported impact of each bird on respondents' daily lives are included in Figure 32 below.

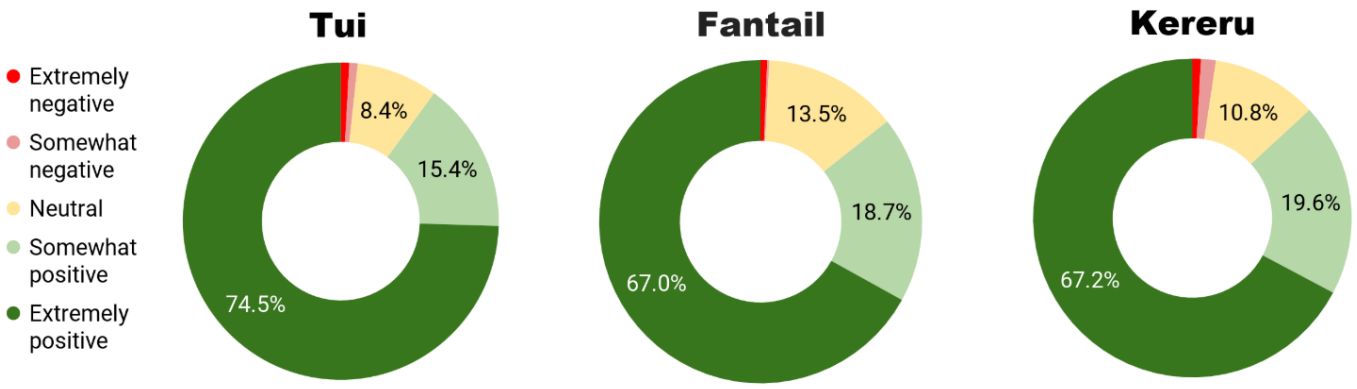

Figure 32: Reported impact of birds on daily life

In addition to our surveys, we conducted interviews with individuals of Māori descent to understand cultural attitudes towards land use. In our discussion with Sara Moylan, she explained how *whakapapa*, or genealogy, is an important principle in Māori culture that not only applies to the people but the land itself. She explained that the relationship between man and land begins at birth: one is born into an *iwi* (tribe) that owns the responsibility to protect the land (not the land itself) and that connection "can never be severed". She emphasized that understanding one's *whakapapa* in context with everything else is a primary step in making land-use decisions. Moylan also mention how *wairoa*, meaning spirituality and "metaphysical things about the environment," *taniwha* (guardians), and *patupaiarehe* (fairies) were all Māori indicators for the status of land. This sense of environmentalism was echoed by Ihaia Puketapu, who emphasized land was not to be owned but shared. He also acknowledged the negative impact humans have had

since settlement: “even though we’re not an old country and we’ve got a small population, we’ve ripped the place [apart]”. He expressed a hope that people would learn from their mistakes, stating “we should know better”. Continuing from a more functional standpoint, he explained how nationally, the Māori viewpoint is often represented by the environmental parties. Puketapu described how oppositions to new legislation can be brought up in New Zealand’s environmental court, which requires government to give consideration to the Māori.

4.3.2 Discussion of Objective 3’s Results

The purpose of our survey was to learn how residents of Upper Hutt felt about conservation topics that pertained to the land-use issue that is central to our project. We wished to understand the roles that conservation and native bird species play in their daily lives, which would allow Forest & Bird to gauge the level of public support the eco-corridor project might receive.

The age demographics of our survey respondents closely matched the age demographics of Upper Hutt (Greater Wellington Regional Council, 2013b). The gender makeup of the survey respondents showed that we had a higher percentage of female respondents that the demographics of Upper Hutt would suggest. Approximately 64% of the survey respondents identified as female, whereas the 2013 census reported that approximately 51% of Upper Hutt is female (Greater Wellington Regional Council, 2013a). In general, our survey demographics are not unexpected and therefore give us confidence that our responses came primarily from Upper Hutt residents.

One survey question asked respondents to rank the importance of conservation in their daily lives. The average score was 4.25/5, suggesting that respondents highly valued conservation. These numbers are self-reported, though, and may not entirely reflect attitudes towards actions and/or the willingness to take actions consonant with these values. The next step in verifying such assertions made by survey respondents would be to investigate how people respond to specific conservation-based scenarios. Valuing conservation does not necessarily mean that people are willing to change their behavior in ways that promote conservation. With regard to the proposed ecological corridor, Forest & Bird should be encouraged that respondents placed a high value on conservation, but could benefit from learning how Upper Hutt residents view this particular project.

Survey respondents were asked what they knew about invasive predators and habitat loss and how they felt about these threats to biodiversity. Unexpectedly, answers to this touched on topics far beyond the scope of the original question. One of the more prevalent themes was 1080 poison; the majority of the mentions of 1080 were highly negative. Governmental bodies like DOC and the GWRC advocate for the use of 1080, arguing that it is the only effective tool for large-scale pest removal at the moment. Experts cited having seen bird populations rebound after 1080 drops were used to eliminate

possums. In contrast, many survey respondents argued that 1080 was ineffective, or too dangerous to be useful. The top manufacturer of 1080 in New Zealand does acknowledge that species killed by ingesting the poison can pose a threat to other animals that may consume the carcasses. Taking all of this into consideration, it appears that misinformation surrounding the use and safety of 1080 is rampant among citizens. This is corroborated by our interview with Nikki McArthur, who claimed that "concerns raised by the general public are not supported by evidence". Balancing conservation efforts with public opinion requires clear communication of both the objectives and the methods being used to achieve them. Controversy can arise when the public believes information is being withheld or misrepresented.

The survey also aimed to gauge awareness of the proposed land-swap between the UHCC and the GTC. Our results indicate that a majority of people were unaware of Forest & Bird's desire to designate the land in and around the Silverstream Spur for conservation and an even larger majority of people were unaware of the Memorandum of Understanding (MOU) between the UHCC and the GTC. Of the survey respondents that were aware of the MOU, a significant portion had concerns about development. These findings allowed us to conclude that residents of Upper Hutt are not well informed about this land use decision. Mayor Guppy explained that while the MOU is now public, UHCC and GTC did not solicit feedback while it was being prepared, because "until there's something quite concrete on the table there's not a lot to discuss". However, several survey respondents mentioned their displeasure with what they felt was a "backdoor deal". This suggests a need for greater transparency between the UHCC, the GTC, and the conservation minded public, in order to build trust between these parties.

The findings relating to both 1080 and the MOU connect to the larger theme of setting environmental policy while managing public feedback. Policy makers must do what they believe is best given the specific goals they have for the community, but residents may have their own convictions that are at odds with governmental procedures.

When assessing how respondents felt about their local native birds, we found that the tui, kererū, and fantail all had a very positive impact on individuals' daily lives, suggesting the prosperity of these birds should be prioritized when making public land use decisions, including this one. Forest & Bird Upper Hutt can use the knowledge that residents have favorable attitudes towards their native birds to promote the eco-corridor proposal.

4.4 Objective 4: Create awareness materials for the public and Forest & Bird

4.4.1 Results of Objective 4

Our primary method to raise awareness about the ecological corridor in context with the land-use situation was an informational pamphlet and a research poster. The

pamphlet (depicted in Figures 33 and 34 below) was designed to be distributed to Forest & Bird members at our final presentation and to the general public. Its purpose was to provide a brief explanation about ecological corridors, the value of such corridors for avian species, and how the Silverstream Spur could function as a corridor to benefit Upper Hutt's native birds. The back panel of the pamphlet also includes opportunities to learn more about the Forest & Bird organization, their projects, and ways to get involved. The research poster (included below in Figure 35 and in greater detail in Appendix L) was a display of our project, including the background, objectives, results, and recommendations intended for Forest & Bird members. The poster had a greater depth of information and was created to explain our project to people familiar with the Silverstream Spur and conservation efforts in Upper Hutt.

Figure 33: First page of trifold pamphlet

WHAT IS AN ECOLOGICAL CORRIDOR?

An ecological corridor, sometimes called a wildlife corridor, is a stretch of land designed to link other, larger areas of habitat. Connecting habitats helps target species (birds, insects, lizards) move throughout the land. Corridors can help promote a large, genetically diverse population.

IS THERE A CORRIDOR IN UPPER HUTT?

An area of land called the **Silverstream Spur** has been identified as a candidate for a corridor. Designating the Spur as a corridor will help connect the green belt land on both sides of the Hutt River.

HOW DO CORRIDOR PROJECTS WORK?

Beyond the advantage of having land set aside for wildlife movement, additional projects contribute to making the corridor a safer, better habitat for target species. In Silverstream, pine tree removal and pest control efforts would provide an ideal habitat for our birds.

Upper Hutt is on track to becoming a sustainable city of the future.

The ecological corridor project is a significant part of Upper Hutt's Green Belt, starting with **Hull's Creek Restoration Project.**

Forest & Bird members have been hard at work to restore the health of Hull's Creek by planting native bush along its banks. The addition of native bush can encourage bird species to cross the river and move between reserves.

HOW CAN THIS HELP OUR NATIVE BIRDS?

There are many bird species native to Upper Hutt that have poor dispersal capability (i.e. do not fly long distances), and would benefit from a corridor. Other bird species, such as the tūī and the kererū, may not depend on continuous canopy cover but can benefit from greater habitat area. These species play a critical role in aiding the reforestation of native bush.

Figure 34: Second page of trifold pamphlet

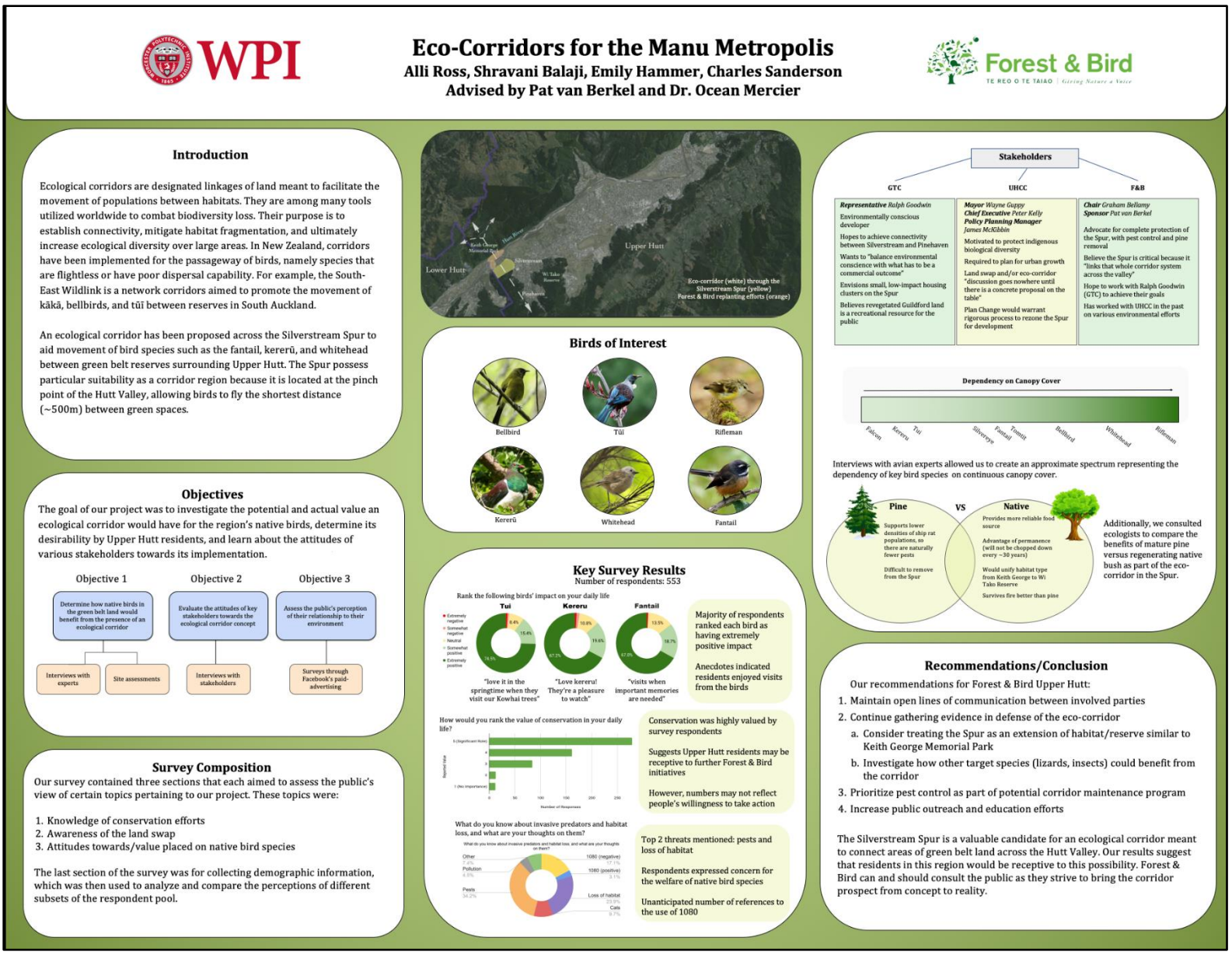

Figure 35: Research poster (shown in more detail in Appendix L)

4.4.2 Discussion of Objective 4's Results

The design of both of our educational deliverables was based on the results of our site assessments, interviews, and surveys, as well as sponsor feedback. The pamphlet is meant to be quick and simple to read, providing a brief overview of the key concepts pertaining to an ecological corridor in Upper Hutt. Rather than use the words "ecological corridor" in the title, we opted for "bird corridors" instead at the suggestion of our sponsor, in the hopes that this language was more accessible for the average reader. We included a map of the region to help readers gain a sense of the geography that pertains to this project, so that they may visualize how the corridor would connect the surrounding green

belt reserves. While the pamphlet focuses primarily on the corridor as it pertains to birds, mentions of other potential target species, such as the green gecko, were added at the behest of Pat van Berkel. This is meant to raise awareness of the fact that corridors can be beneficial to a wide range of species. We hope the pamphlet inspires those who read it to support Forest & Bird's projects, and maybe even reach out to get involved. Copies were brought along to our final presentation, and Forest & Bird members commented that it presented an informative summary of the issue at hand.

The poster is a more comprehensive outline of our project, with the potential to be presented at Forest & Bird conferences. It includes less background about the Silverstream Spur and the land-use issue, because the proposed audience is likely to be familiar with these topics. We outline the format of our survey and the key results from the survey responses, so that Forest & Bird members can understand how we assessed the public's perceptions of conservation and Upper Hutt's native birds. Another section of the poster details the relevant findings from our interviews with stakeholders and ecology experts. Summarizing the positions of each interviewee allows anyone who reads the poster to get a sense of the different perspectives that factor into land use decisions like this. We included this poster at our final presentation to Forest & Bird Upper Hutt, and received positive responses. Members suggested that it could be presented in schools as a way to inform the younger generations about conservation issues.

5. Recommendations and Conclusion

5.1 Recommendations

5.1.1 Recommendations for Public Outreach

The research we have conducted using surveys, interviews, and site assessments has allowed us to make recommendations to our sponsor, Forest & Bird Upper Hutt. Based on analysis of our survey responses, we believe that **our sponsor would likely benefit from increased public education efforts about the proposed corridor project and current methods of conserving native vegetation and wildlife.** We designed a pamphlet that can help inform the public about the key issues at play. The pamphlet could generate interest in Forest & Bird as an organization and the ecology of the region. It also serves as an introduction to the specific land-use issues surrounding the Silverstream Spur. This interest could garner more involvement in the land-swap negotiation process when opened to the public. The pamphlet can be handed out at events Forest & Bird organizes that are open to the public. Additionally, we designed an informational poster with in-depth information about the corridor project and land-use debate targeted to Forest & Bird members. This poster was displayed at our final presentation, and could be brought along to other Forest & Bird meetings or conferences to reach more members. Forest & Bird expressed a desire to attract the interest of a younger demographic. As a result, we suggest that electronic versions of the awareness materials could also be shared through Facebook. This platform has been shown to have considerable success in reaching users aged 18-44, with this demographic making up 33% of our survey responses.

Our sponsors also described how it would be useful to gather public opinion on other proposed projects, and were impressed with the success of our survey, suggesting they may seek to replicate our methodology in the future. We endorse the use of the Facebook advertising platform as a way to reach a large potential respondent pool for relatively low cost.

While only tangentially related to our specific project, the controversy surrounding the use of 1080 came up frequently in our open-ended survey questions. While Forest & Bird already contributes to efforts to better educate the public on this issue (they are part of a joint initiative called “1080: the facts”), the more that is done to justify their stance, the better. This promotion could be executed in a manner similar to DOC’s “Battle for our Birds” Campaign, in which the science and the success behind 1080 is written in informational reports/articles. Publicizing these articles and reports will help to clarify common topics of misinformation; these include the poisoning of off-target animals, the effects 1080 may have on insects as a food source for birds, and the potential environmental impact on waterways.

5.1.2 Recommendations for the Proposed Ecological Corridor

If Forest & Bird would like to make a formal case for the eco-corridor, **we recommend they consult avian ecology experts who can provide conclusive evidence for the corridor's potential effectiveness**. Our expert interviews indicated that there are both potential benefits and drawbacks to the proposed corridor project; Forest & Bird should further investigate these nuances to determine the net effects the corridor would have. Throughout our project, we compiled names of researchers who we attempted to contact and believed could be of further help. Such experts include Dr. Margaret Stanley from the University of Auckland who currently studies the impact and mitigation of urban development of terrestrial species, and Dr. Yvan Richard, an ecologist specializing in metapopulation dynamics in fragmented habitats. Another set of experts to continue consulting would be the ecologists who prepare the report on the "diversity, abundance and distribution of birds in Upper Hutt City" each year (McArthur, Govella, and Walter, 2018), as they are extremely familiar with the birds of interest. Additionally, there is an ongoing study by Forest & Bird Auckland into the success of the North-West Wildlink, we think it would benefit the Upper Hutt branch to stay informed about this process. Information about the Wildlink could support the broader efforts of ecological corridors in New Zealand.

If the corridor is deemed a worthwhile initiative, **Forest & Bird could begin the necessary action towards securing the corridor.** These steps will likely include gathering publicity and promoting the ecological corridor project proposal. One potential step would involve securing a 'no housing agreement' for the land in the Silverstream Spur. This agreement would assert that the Silverstream Spur will only be used to build an access road, and not residential development. If this agreement is accepted, then we recommend Forest & Bird initiate pest control and revegetation projects in the Spur. This project can mirror the initiatives taken in the North-West Wildlink project, which includes dissemination of pest control material and advice, and volunteer-led planting of native bush. However, the organization may want to proceed with caution; if they intend to be proactive in initiating change, their actions may be seen as infringing upon the cooperative relationship they currently have with Ralph Goodwin. The further implications of this are discussed in the following set of recommendations. It is important to note that conservation initiatives including pest control are not mutually exclusive with the development of housing on the Spur. There are a range of potential outcomes, and Forest & Bird should look further into how different levels of development (an access road vs. urban housing) could still allow for some degree of corridor function.

5.1.3 Recommendations for the Land-swap

We found that there were ambiguities in the next steps to be taken between various stakeholders on the land use decision. If the land-swap is to move forward, the mayor and

chief executive of Upper Hutt assert that the next step is for GTC to submit a formal proposal to the UHCC. The submission of this proposal will trigger a process that includes soliciting public opinion and confirming that the development complies with the Resource Management Act as well as other Upper Hutt City Council policies. However, Ralph Goodwin and Forest & Bird contend that with an urban development decision like this, government is the reason for the slow-moving process. Each group agrees that at this time, there is no guaranteed design in place for the land in question. In this phase of the process, no elements of the project are finalized. **Forest & Bird Upper Hutt should maintain the amicable relationship that currently exists between their branch and GTC representative Ralph Goodwin**. The flow of ideas, concerns, and information between the two groups is key to finding a solution that meets the requirements of both parties.

We suggest a **reassessment of the Memorandum of Understanding.** This reassessment could allow compromise by all parties so that a section of the Silverstream Spur could be excluded from the land-swap and instead put aside for conservation as part of the eco-corridor. Extensive discussion would likely be needed to assess if this is truly feasible given the interests of each stakeholder, but all parties did imply that an action like this was possible. Since only 16% (75/469) of the Upper Hutt residents surveyed were aware of the current MOU, this reassessment should be conducted in a highly transparent manner and allow public input and recommendations from ecological experts. The concerns stated in our survey responses suggest that residents would like to be informed earlier in the planning process than is currently dictated by policy. The updated memorandum could then initiate the creation of a formal proposal by GTC.

5.2 Limitations and Conclusion

5.2.1 Limitations

While we are satisfied with the results of our research, there were some limitations caused by our methods. We discuss these limitations here so that potential future project teams may be better informed. As mentioned in Chapter 3.3, our survey was conducted solely online and primarily distributed through Facebook. Although the majority of New Zealanders have access to the Internet, and Facebook is one of the most commonly used social media sites, we may have neglected a potential respondent pool by not utilizing other survey outreach methods. In-person surveys, conducted on paper or on a mobile device, could be a useful way to access the demographic that does not frequently use Facebook or access the Internet.

The survey itself also had opportunities for improvement. We felt it was valuable to interview residents of Māori descent to gain a cultural perspective of land use and conservation, but did not include a survey question asking respondents if they identified as Māori. Comparing the results of the Māori demographic to other survey responses, and seeing if there were any notable differences, could have provided additional context for

how Māori residents view these issues. In addition, we were unable to determine the level of influence that Māori land philosophies would have on land-use decisions such as this one.

Our survey also lacked a question asking respondents which region they lived in. There was no way for us to confirm if the responses we gathered are truly from residents of Upper Hutt. While we targeted our Facebook ads to the Hutt Valley area, the survey was also shared organically and likely reached people beyond our desired range (location data suggests some responses came from as far away as Auckland). Another drawback of the survey is that it was perhaps too generalized to draw conclusions about the land-use of the Spur. As mentioned in the discussion, a respondent could answer positively about the value they place on conservation but we would not know if they were willing to favor conservation of the Spur over housing development. Additionally, it was suggested that the specific birds we gathered data on may not be affected by the loss of an ecological corridor, so there is no solid relation between the birds we ask about and those most heavily affected by development on the Spur. We believe that the progression of the land-swap proposal will allow for more specific questions to be presented to the community for feedback.

Our interviews revealed that the land-swap was still not a guarantee, and that any plans to move forward were still in the beginning stages. This meant that we did not get a clear legal picture of the process. The lack of definitive answers required us to speculate as to the possible next steps that the proposal might take.

Finally, our original project description mentioned the potential to investigate ecological corridors for kararehe (insects). This was not something our group was able to accomplish, but we think it may be worth examining. Target species of a corridor do not exist independently of their ecosystem, and the movement of insects and birds throughout Upper Hutt's green belt land may be correlated.

5.2.2 Conclusion

As a conservation-based organization, Forest & Bird proposes that an ecological corridor linking the green belt land in Upper Hutt would benefit the area's native bird populations. A particular piece of land called the Silverstream Spur is considered a critical part of this corridor, because it connects the two sides of the Hutt Valley. However, this land could potentially be traded to a development company, leaving it open for urbanization. The purpose of this project was to identify how the ecological corridor concept would impact the region's birds, and to gain a comprehensive understanding of the positions key stakeholders hold with regard to the potential land-swap. We found that while conservation of the Spur could be helpful, the evidence is not definitive that birds would benefit from this corridor. Fortunately, all stakeholders seemed receptive to the corridor, despite development that may occur on the Spur. Our sponsors also wished to know how the general public viewed these topics. Our findings suggest that the public has

favorable views towards conservation, and that many people are aware of and concerned by threats to native bird species. This information can be used by Forest & Bird to promote the potential ecological corridor. Our findings also indicate that many people in the conservation-minded public would appreciate greater transparency in decision-making. The consensus from the stakeholders is that this land-swap and potential development is a slow-moving process. We recommend that the involved parties continue their cooperative efforts and maintain open lines of communication. A renegotiation of the land-swap is possible, and may result in a compromise agreeable to most stakeholders. We believe that the parties can come to an agreement that is both ecologically favorable and commercially viable.

On a broader scale, it is clear that the people of New Zealand recognize the importance of biodiversity. The nation's ambition to eradicate predators and create safe environments for indigenous flora and fauna is only possible with local legislation that works towards this goal. As a result, conservation efforts, like eco-corridors, wildlife sanctuaries, and ecological research are heavily valued. These efforts are meant to not only preserve environments but to actively counteract detrimental human impact. While there is the ever-present need to balance conservation and development, it appears that landowners, lawmakers, and communities are willing to prioritize conservation. The results gathered from this project can serve as a case study for the nuances in corridor implementation, and as encouragement to conservation efforts worldwide.

Reflections

Shravani Balaji

Throughout my time in New Zealand, I have met many people and had encounters that made this project such a rich experience. We were met with passion and kindness from bird experts, F&B volunteers, and community members that inspired me to put a lot of effort into this project. Hearing about people's positive relationships with their native birds and environment made our work all the more meaningful. I am grateful for my group members for all of our teamwork, and I hope to stay updated on the progress of the eco-corridor.

Emily Hammer

I am incredibly grateful for all of the people willing to spend time speaking to us and helping us with our project. Spending time with all these incredible people who were truly passionate about their professions, and getting a glimpse into their lives was a great experience that I am very grateful for.

Allison Ross

My experience completing this project has taught me a great deal, both about the complexities of balancing conservation and development as well as how to successfully accomplish a long-term group project. When it came to both our informal interviews and surveys, I was pleasantly surprised at how passionate everyone was. I never would have expected the number of survey responses we gathered, nor the time some people took to complete it (many were upwards of an hour!). I truly enjoyed the conversations and interviews we had out in the field; they made me feel like what we were doing had real impacts beyond the paper we were writing. I hope we remain in contact with our sponsors so that we can receive updates about the eco-corridor proposal.

Charles Sanderson

This IQP project has shown me all the complications and difficulties there can be when trying to do what's right for the environment. From the publicly unsupported use of poison to making the right land use decisions, I learned it is not an easy thing to do. I have a better understanding what difficulties conservation groups face, and how hard they work. The passion and dedication that I've seen from the members of F&B has been truly inspiring for me, and motivates me to dedicate myself to doing what I love.

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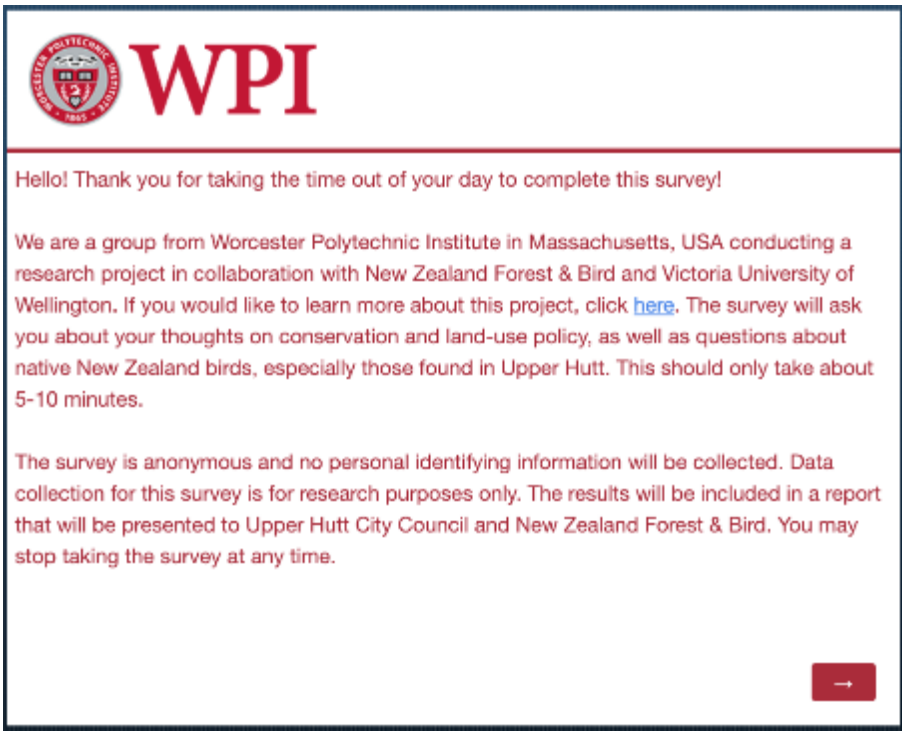
Appendices

Appendix A: Survey



WPI

How often do you spend time in green spaces (parks, reserves, the bush)?

- ○ Never
- ○ A few hours per week
- ○ A few hours per day
- ○ Almost all day, every day

How would you rank the importance of conservation in your daily life?
1 indicates it has no importance, 5 indicates conservation plays a significant role

1	2	3	4	5
○	○	○	○	○

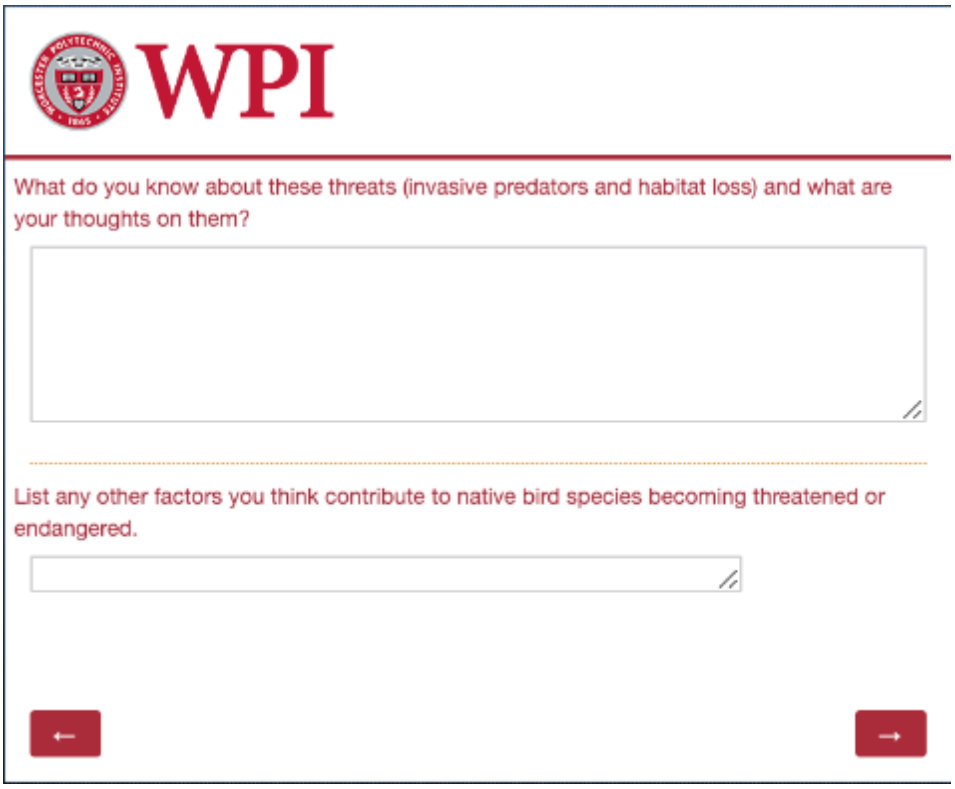
How would you rank yourself in knowledge of conservation issues that face birds in New Zealand?
1 indicates you have minimal/no knowledge, 5 indicates you are very knowledgeable

1	2	3	4	5
○	○	○	○	○

Are you aware of the threats posed to native bird species by invasive predators and habitat loss?

- ○ Yes
- ○ No

← →


WPI
What do you know about these threats (invasive predators and habitat loss) and what are your thoughts on them?
List any other factors you think contribute to native bird species becoming threatened or endangered.
←
→

WPI

These next few questions will ask you about a piece of land known as the Silverstream Spur that is being considered for development. A map of this land and the surrounding area (adapted from the GWRC Web Viewer) is included below for reference.

Are you aware of Forest & Bird's desire to designate the land in and around the Silverstream Spur for conservation, particularly for the region's native birds?

- ○ Yes
- ○ No

Are you aware of the memorandum of understanding (MOU) between the UHCC and the Guildford Timber Company (the developers) concerning the land-swap of property in and around the Silverstream Spur?

- ○ Yes
- ○ No

← →


WPI
What do you know about the MOU and what are your thoughts on it?
←
→
WPI
Next you will be shown images of several birds native to the Upper Hutt region. For each bird, rank your familiarity with it and the frequency of your encounters with this bird.
←
→

WPI

Tui

How familiar are you with this bird?
1 indicates you have no/minimal knowledge, 5 indicates you have detailed knowledge

1	2	3	4	5
○	○	○	○	○

How often do you encounter this bird species in your daily life?
1 indicates you never encounter this bird in your daily life, 5 indicates you encounter it daily

1	2	3	4	5
○	○	○	○	○

Can you describe any of these encounters? Where do you most often encounter this bird?

Rank this bird's impact on your daily life.

Extremely negative	Somewhat negative	Neither positive nor negative	Slightly positive	Extremely positive
○	○	○	○	○

WPI

New Zealand Wood Pigeon/Kereru

How familiar are you with this bird?
1 indicates you have no/minimal knowledge, 5 indicates you have detailed knowledge

1	2	3	4	5
○	○	○	○	○

How often do you encounter this bird species in your daily life?
1 indicates you never encounter this bird in your daily life, 5 indicates you encounter it daily

1	2	3	4	5
○	○	○	○	○

Can you describe any of these encounters? Where do you most often encounter this bird?

Rank this bird's impact on your daily life.

Extremely negative	Somewhat negative	Neither positive nor negative	Somewhat positive	Extremely positive
○	○	○	○	○

WPI

Fantail/Piwakawaka

How familiar are you with this bird?
1 indicates you have no/minimal knowledge, 5 indicates you have detailed knowledge

1	2	3	4	5
○	○	○	○	○

How often do you encounter this bird species in your daily life?
1 indicates you never encounter this bird in your daily life, 5 indicates you encounter it daily

1	2	3	4	5
○	○	○	○	○

Can you describe any of these encounters? Where do you most often encounter this bird?

Rank this bird's impact on your daily life.

Extremely negative	Somewhat negative	Neither positive nor negative	Somewhat positive	Extremely positive
○	○	○	○	○

WPI

Please describe the value that native birds contribute to your daily life (positive or negative) under one or more of the following categories.

Aesthetic:

Cultural:

Environmental:

Other:

←

→

To what age bracket do you belong?

With what gender do you identify?

- ○ Male
- ○ Female
- ○ Other
- ○ Prefer not to disclose

Which of the following best describes the highest level of education you completed?

- ○ No secondary schooling
- ○ Secondary school
- ○ Technical or trade qualifications
- ○ University/tertiary/professional qualifications, e.g. Bachelor's degree
- ○ Postgraduate studies e.g. Masters/PhD

← →

Appendix B: Interview with James McKibbin

Key quotes/notes from interview with James McKibbin on Jan. 24, 2019
James McKibbin is the Planning Policy Manager of the UHCC, and spoke to us in place of an interview with Richard Harbord (the Director of Planning)
Interviewer: EH Notes: AR

How does UHCC take conservation into consideration when making plans for land development?

-with regard to Spur, any future development would need to meet test and assessment process that is specified by the Resource Management Act
-intention for future development would go through rigorous process of looking at natural value, ecological value, natural amenity, stormwater, and water quality
-big process around it

With regard to population growth, how much new housing do you anticipate to need in the next two decades? How does the Spur compare to other areas of land as candidates for development?

-there is a balance between providing for future housing/growth, and natural values
-Guildford was identified as somewhere would houses need to go, as an area key for housing development. In potential housing supply terms, it is a significant potential site, because of its scale.
-National Policy Statement for Urban Development Capacity, monitoring future growth and forecasting population growth, looking more in detail at what we think we need and need to work with the council on where
-Spur identified as important for access to other land for development

Does the council work with local iwi when making decisions about land use policy?

-definitely required to engage with Maori/iwi, that's set out in the RMA
-we have a couple (2 or 3) iwi that have an interest in the development of Upper Hutt

How does the UHCC take into account the future of native species, specifically birds, when making land policy decisions?

-We definitely would have an interest in protecting habitats of indigenous flora and fauna
-that's also one of the council's requirements at the moment, which comes directly from the regional council
-councils in Wellington region have to identify significant natural areas, areas of natural biodiversity as outlined in the RMA
-council has Sustainability Strategy developed 6 or 7 years ago
-he can send us references to resource management act (that's the RMA), as well as link to regional and national policy
-provides for future housing growth while still maintaining natural value of the environment
-assessment of effects process on the effects of development has to be quite rigorous

What would it take to change the MOU?

-that would really come as subsequent to more detailed investigations
-what's in land use strategy and MOU is just signal of intent
-from his reading of the MOU, the Spur isn't marked for housing development, it's key to provide that access
-the primary importance of the Spur is to provide access

Appendix C: Interview with Nick Beveridge

Notes/transcript from interview with Nick Beveridge on Jan. 24, 2019
Nick Beveridge is the listed person to contact regarding the North-West Wildlink in Auckland
Interviewer: EH Notes: AR, supplemented by SB

Can you tell us more about the native birds that the wildink is supposed to help protect?
Well, it was initiated by a project "Ark in the Park", an ecological restoration program, a long-term situation, which has involved a lot of pest control and introducing native species that have become extinct in that area, kokako
-was intended to help that process by connecting up the ark in the park area with areas that would be a source of native birds, a north-to-west connection, and that would involve creating habitat patches and corridors that would connect them
-particular creature that we wanted to introduce was the bellbird, into the Waitakere ranges
-initial concept was to allow the bellbird to recolonize the Ark in the Park area of its own accord
-goes back to 2004
-as a result, another biodiversity restoration project was initiated in the wildlife linkage, another area adjacent to that, between the ark in the park area and a large bush reserve called (Matuki) reserve, helping do pest control on the buffer zone
-at the other end of the wildlink is a peninsula, local branch doing pest control program there called pest free peninsula, has involved some bush reserve, a lot of urban type restoration involving local landowners and doing pest control
-one big gap is near the Whenuapai airbase, because there is virtually no habitat there apart from mangroves and a bit of swamp, been working to try, through the resource management process, and get some vegetation introduced there to provide a bit of a connection
-looking at an area between the airbase and state highway 18, which they also did some restoration planting on too
-didn't get as much habitat as they wanted, potential areas of future development to the north of the airbase
-we are part of a partnership group including the council, NGOs, Auckland university, has been providing advice as well
-have been doing monitoring on individual projects but haven't been doing monitoring on the wildlink overall, that's one of their goals for the new year, to get that underway
-it's a long term thing, has been around for a while now, F&B has been involved with it right from the start
-bellbirds haven't gotten to the Ark in the Park yet but that's an end goal ("one day, hopefully")
-birds are a very good indicator of habitat health, doing bird counts to monitor their own projects that they've been doing
-annual bird counts to see how effective pest control has been, if birds are increasing it's an indicator of success in that regard

-rat tunnel monitoring, ongoing monitoring to see how pest control is controlling rat populations

Can you tell us about the success of the corridor so far? Have any studies been done on its effectiveness?
-where could we find the information that has been recorded re: monitoring?
-reports have been done on the various aspects of it
-he could send it to us, there's a map showing the extent of it, report done by Boffa Miskell in 2015, Wildlink report "NW Wildlink prioritization", looking at the components of the wildlink, Wildlink Wonders, all the things we're trying to capture and build on
-info on the district plan, zoning, regarding ecological areas, where public preserves are
-has been quite a bit of analysis done on the wildlink, but there is a big gap that needs to be filled, come back to him if we have any questions/clarification
-he can forward us that info
-working in the dark a little bit in terms of how wide does a connection have to be
-borrowed the term wildlife linkage, borrowed this term
-"Linkages in the Landscape" =IUCN report, written by Australian, has some Aussie and NZ content, subtitle = the role of corridors and connectivity in wildlife conservation
-standardizes terminology to define what is a linkage and corridor
-corridor tends to be narrow connectors between larger habitat areas called linkages, linkages can be made up of patches of habitat that are connected by corridors
-corridors can be quite narrow…street trees, riparian planting
-mammal based, apart from bats (which do exist in NW Wildlink), quite a different setup/situation here, birds can fly from patch to patch
-didn't introduce kiwi b/c they can't fly
-a lot of this is new ground, got someone from Auckland involved who has knowledge on urban connectivity and has students working on those projects (how wide does a wildlife corridor/linkage need to be to be effective)
-how big does a habitat patch have to be, depends on what you're trying to achieve
-there's a lot that needs to be sorted out, in theory it's quite a simple concept but when you get to the nitty gritty there's a lot of unknown

Was the land in the corridor itself all publicly owned, or was some under private ownership?
-it's a real mixture
-largest component is probably private land use, you've got tracts of public land as well
-Waitakere Ranges next to Ark in the Park
-local reserves, forest is quite a significant part of the wildlink, he thinks that's all privately owned
-a lot of privately owned, rural land, apart from that peninsula project area which is mainly urbanized
-right on the edge of Auckland's metropolitan area, skirts right around it, NW of us
-gradually encroaching though
-as land is developed, that's an opportunity to do restoration

-big gap has been zoned for future development and housing but if they can get some reasonably large and connected areas of habitat restored they can re-vegetate as part of the development and that would enhance and contribute to the wildlink
-not having a lot of success, it's a challenge, it's easier to retain existing habitat than it is to create new habitat
-you're better off saving what you've got, really important to keep what you've got
-you might have a nice bit of bush but it might be infested with pests, rats and stoats and possums so you're not getting any benefit from it, need to do a lot of predator control in that habitat and by doing that you're enhancing it
-fairly simple concept, it's quite a significant tract of land

Have you found that the greatest accomplishment/successes come from convincing private landowners to contribute or getting local government to work with you and be on your side?
-local government is on our side right from the start, right behind us, not a lot of funding though
-there are other sources of funding though for projects within the wildlink
-free advice and free materials to private landowners for pest control goes a long way
-people know that it's free, they are more willing to say yes, let's do that on our property when they understand what it is you're trying to achieve and see how what they're doing on their property how what they do contributes to the big picture
-funding is pretty critical, if you haven't got any funding you don't have a lot of buy-in
-funding can be one of the biggest challenges, can be a deciding factor if the project will succeed or not

Do these bird reports have species of birds that have made a comeback? Can you give us more examples of birds that have been positively affected?
-involved in a project called Heaven's Nation, he can see what he can dig out, they had a database that they built upon every year that gave them trends, such as certain things increasing
-tui are one of the most common birds in that area
-grey warblers, silvereye, fantail perhaps, got quite a few kereru around
-it's all been piecemeal, project area based, haven't gotten around to doing the overall monitoring even though they have the funding for it, they're hoping to get to that soon, information is a few years away

Are you comfortable with your name and responses being mentioned in our project report? As per school policy, we can provide you the opportunity to approve the publication of all quoted material.
Absolutely! And if you have any more questions email me, and I'll send you those documents. He can send us the contact info for Margaret Stanley, she's an expert on the role of cat issues in the urban area
-used her an expert witness at resource hearings, got cat-free subdivisions as a result of that

Appendix D: Interview with Ralph Goodwin

Ralph Goodwin is one of the directors of the Guildford Timber Company and took us on a tour of the land the company currently owns
Interview took place Jan. 29, 2019
Notes: SB and EH
These quotes are included in place of the full interview transcript.

We are harvesting pine trees and replanting native ones in areas that will be a reserve

We're a great believer there's a wonderful resource here, 135 ha we're proposing to put into this reserve that's currently privately owned but very well used for public (hike, mountain biking, walk, horse riding). They can only do that through the generosity of the current owners. We're saying through exchanging the Silverstream Spur, it's all around having a one-time opportunity to achieve connectivity between Silverstream and Pinehaven, and create both ecological and recreational opportunities, that's really what drives us, you can have that thought process more so when you've owned it for a very long time, that whole vision evolves, we've been thinking about this for 25 years and talking to UH city for 14 maybe 15 years

We know we have to balance our environmental conscience with what has to be a commercial outcome.

We are immensely proud of the native we have and what we're doing with the revegetation program

We want to achieve something here: preserve the native bush, access to open space, making clusters of housing with a beautiful view

We're able to be in a position where we can equally develop some really cool urban design that allows people to live in clusters in hamlets and just immediately look out on open space

As a family we have a strong forestry background, we can reach forestry consultants with a phone call, we can reach Boffa Miskell who have a strong focus in ecology, the default would be if we took a pine tree out we'd replant it with a native tree.

We've got really strong beliefs that we want to make this place better environmentally

I know that the community wants to preserve the green, and as someone's who's fortunate enough to own the native bush, the pine trees in the Silverstream Spur are very low quality, the green includes gorse, if we can demonstrate what we do with pine trees, take them out and we replant and accelerate that revegetation, we respect what Forest and Bird want and we're helping them, that will assist in the process of saying where can we develop and where can we preserve

Appendix E: Interview with Sara Moylan

Sara Moylan, Senior Environmental Monitoring Officer of the Greater Wellington Regional Council, and a Maori ecologist
Interview conducted Jan. 29, 2019
Interviewers: EH and AR Notes: SB and AR
Note: This interview has been edited and condensed for clarity.

Can you tell us more about the birds you've encountered in your work?
I've seen a lot working in the Upper Hutt area and have done a lot of work with a number of territorial authorities over the years. Lower Hutt is a good corridor because the urban areas are surrounded by forested areas including: the eastern hills, western hills, and the Remataka, Akatareru, Wainui Ōmata, Kai toke and Pakuratahi forests. Places like Matua Somes Island (which has a source population of kakariki) Keith George Memorial park and Wi Tako are habitat for native birds and we have recorded kakariki and bellbirds there. Waitako Reserve, beech, rifleman in there once. Silverstream and Stokes Valley connect to the Wainuiomata Water Collection Area. There has been a story of a kiwi released in the Rimutaka forest park at Catchpool, South of Wainui coming up and over into Silverstream and being killed by a dog. Kaitoke Regional Park, Pakuratahi Forest in the Rimutaka Hills are at the head of the Hutt Valley, Kaitoke on the left and Pukurathai on the right.
We have found some of the larger birds such as kereru and tui are increasing with big increases in kereru, tui, and bellbird. We have noticed more tui in Wellington than in the Hutt, tui and bellbird don't seem to get on together. We have been doing pest control in these areas for over 20 years, some of the areas have bait station networks and the larger forest areas get aerial 1080 drops. There is a "mainland island" in Whanui mainland island which receives intensive baiting, traps and bait stations serviced every 3 months. Larger areas get 1080 drops

Do you get any concerns about 1080?
Yes we do, we get physically attacked, depot shot at in the past, abused, protesters outside the depot, as far as I'm concerned it's working and we need to do it. We cannot let these birds die out.
Kaitiakitanga is the Maori term for manage and caring for our land.
There's been a lot of research about possum control. This research has allowed us to reduce the amount that we put out, how we it is dispersed and delivered and how to distribute it smartly. LandCare research worked on and developed a virus to vaccinate possums making them infertile. They achieved this but found the problem is getting it out into the population
Possum monitoring in the Akatarawa.

Wax Tag possum monitoring: possums bite the wax tag, and we use the bite rate to assess abundance calculating an index similar to the index we get from using leg hold traps. We found possums are quite high again. Possums are omnivorous and eat bird eggs.
The trouble with 1080, is that because they only do it every 5-7 years on a rotation, rats come back within 3-6 months. So you can get the possum population under control but you can't get the rats under control and rats are just as bad for the birds. We actually need to do more of it. Controversial, I know.

One of the criticisms is that it's been banned everywhere else in the world, true, but the reason it doesn't need to be banned here is because it's a really good poison for mammals and New Zealand doesn't have any native mammals. So we've got nothing that we need to worry about in that regard. (very different from the U.S. which has many other mammals…). Here we've got nothing, all we've got is birds, we were a bird paradise.
Kiwi, kakapo and kea all evolved to fill niches that mammals usually fill.
Maori in particular do not like poisoning the land but it's just the only way to do it, it's the only feasible option. Hunting doesn't do it. We can't get enough hunters in there, especially in the really rugged backcountry (and you've seen how rugged our country is).

How do ecological corridors work as another tool to help bird populations bounce back?
The management tools we use includes setting aside sanctuaries, reserves. To do that there are several methods such as covenanting or territorial authority ownership. The next thing is controlling the pests in there, and sometimes that extends into replanting. Nothing I can think of that is specifically done to manage native corridors apart from protecting the land and getting rid of the pests. Quite a bit of weed control is done in managed areas because pests include plants. Wilding pines control is big. We have key native ecosystems, and have a network of them all the way through the region. These are key habitat and management areas for biodiversity

Going back to the Maori perspective on the environment, for example not poisoning animals, are there any other cultural considerations that come into play when making these kinds of decisions?
Lots, there is a suite of Maori indicators. There is whakapapa- your genealogical relationship with the land. You are born into an iwi that owns responsibility to protect the land (doesn't own the land itself), that connection can never be severed even if you weren't born there. We consider that everything on that land has a whakapapa to the land as well. You have got to make sure you understand your connection and where your whakapapa sits in relation to everything else that's there.

Introduced species don't whakapapa to the land. We've lost a lot things that used to whakapapa to the land, we have to figure out how we're going to bring those species back without overriding that whakapapa responsibility.
Waiora: which is spirituality, metaphysical things about environment, mountains, rivers are your ancestors, mythical things called taniwha (guardians), patupaiarehe (fairies) that live in the forest. Mauri stones are a cross between guardian stones, totem poles and geographical markers. We have to know where they are because they mark boundaries of certain things, sacred spiritual sites (wahi tapu) which are special places to do things like cleansing, burying placenta, cemeteries, special areas. Lots of rules around that sort of stuff and lots of stories around landforms. Certain mountains that look like giants lying down, there is a story about how Mount Taranaki ended up over there. There's a lot of stories explaining geological things as well. There's a story about a stream that looks like a lizard with two branches coming down, the story about how when it floods when it's thrashing its tail.

All of those the stories have a grain of information in them that is being passed down. When they say don't anger the taniwha because it'll flick its tail, and then it does, it floods. There are different rules, when you put a rāhui on something, it is a temporary ban from harvesting, it's an exclusion so you can't go in there. When dotterels were nesting down near Baring Head, they put a rahui to stop people from going near nesting sites.
There are also rules to protect kereru from overharvest. There are lots of ways that Maori use to manage environment. Maori used to know where all the food trees are. They used to deliberately plant groves of karaka, grow kumara, harvest flax, and knew everything about how to grow flax. There's a lot of knowledge there about resource management.

In your role as [an environmental scientist], have you influenced any land use policies in the past, either from the Maori side of things, the cultural side, or as your role here?
Environmental scientists provide information and recommendations to the biodiversity team that they can include that sort of thing in their management decisions. They also work a lot with iwi. We also have a thing at Greater Wellington called whaitua committees. These whaitua committees are made up of iwi, scientists, politicians, biodiversity officers, landowners, Forest and Bird...and they all get around a table and discuss what they'd like to see done in that catchment. We have 5 catchments, 5 whaitua, in the region, the Rua māhanga and Eastern Wairarapa in the Wairarapa and the Hutt/Wellington, Porirua Harbor and the Kapiti Coast in the Western coast. Science team provides information to them as well.
Started 4 years ago, last one is just starting now. The biggest one is the Rua māhanga in the Wairarapa. This one has presented its actual plan now we are figuring out how to implement it.

I do a lot of work monitoring the outcomes of pest control work providing feedback to the bioworks team who does the possum control. Apart from providing data saying that this work should be done I don't have any direct influence on management, but I can recommend things such as it would be a good idea to do birdwatching. We are currently doing a wetland conservation program and are providing science for that at the moment. Providing science is where my input comes into it, and I rely on my manager to take my ideas higher.

Birds as traditional indicators of ecosystem health: is that something that's true for Upper Hutt in particular?
It used to be true in the past. I would say that in NZ birds are pretty much one of the only indicators that you had because we have no mammals. For Maori, if your birds aren't doing well your iwi isn't doing well. Having kereru come back is a good thing. With snowfall a lot of the small birds died, completely gone, and it took them 2 or 3 years to recover so we could see that happening as an indicator. We use fish, the health of the fish in the streams is an indicator of fresh water health as well. Maori can tell how healthy the water is based on what the tuna (eel) are looking like.

We read a profile that said you were the vice president of the New Zealand Biosecurity Institute, is that still true and how does NZBI work?
Biosecurity Institute is made up of all the industry players who do pest control work, animals and plants, and they come together and network. We usually work separately but this is one organization where we all come together as group of practitioners. We have an annual conference, the Technical Exchange and Learning Conference. We talk about latest practice, best practice, and talk about issues that arise out of pest control. Because more and more we're realizing that pest control is not just pest control, it's actually biodiversity management. It [our conference] covers a lot of pure ecological content, and marine biosecurity. We look at biosecurity from pre border to post-border. People from each regional council, contractors and researchers come to this conference.

Do you have any favorite bird stories or experiences you'd like to share, because part of what we're doing is understanding how people here have a relationship to the birds?
A contractor helping me [doing a rodent line] once saw a ruru nest. We put trapping around the nesting site to keep them safe.
Years ago, I was at Zealandia sanctuary, radio tracking the kaka, had a saddleback perch here and a tomtit here
When doing monitoring, I found a dead yellow eyed penguin from the South Island, and saw that it had a tag [flipper ID tag] so I cut the tracker off, that was not so pleasant, and

then I called the number and they told me it was only two years old and that they knew the bird. They asked if I could go back and get the rest of it?
I have also found an albatross skull, found a cat's skull, heard pigs squawking

Concerns when land is being developed in terms of impact on ecosystem
When council is giving consent to build something, they look at just the individual house, and they reckon "oh that's okay, it's not going to cause much damage", but they don't realize that there's been 10 others that have been put in 2 years previously, it's like death by a thousand cuts
NZ has lost 90% of lowland forest and drained 90% of wetlands as well, happened in the first 100 years of colonization

Appendix F: Interview with Graham Bellamy

Graham Bellamy, the current chairperson of the Upper Hutt Forest & Bird Branch
Interview conducted February 5, 2019
Every group member participated in the interview and asked questions
Notes: AR

How did the ecological corridor concept get started?

A number of us looked across the valley and thought we've got Keith George Memorial Park over on the western hills, we've got Hull's Creek that we were working on and then we've got the Spur going up into Pinehaven and it was identified as the narrowest corridor across the valley.

You've got natural habitat on one side and natural habitat growing on the other side so we thought "this is a place to get a good link for birds to migrate across the valley". And then we looked at the Hutt River and there's a triangle piece of land between the northern end of the Manor Park golf course and the intersection of Silverstream and the road and we identified that as a potential planting area. And then we looked at our side where we were working with Hull's creek along the Hutt River there we decided that we could plant that as well so we're getting a very good corridor. At the moment Lower Hutt branch are planting the section at the northern end of Manor Park golf course, and they've been working on that for about 6 years. So we've got Hull's Creek and also got beside the river, we've got a corridor of natives growing there. It's an absolute ideal spot for having that link.

My son came down one Christmas and I took him down there--he's done quite a bit of ecological work--and he looked at it and said "yep that's a very natural place to do it" and did an initial summary of it that he wrote up. From there, we've been talking to the regional council, Upper Hutt City Council, to try and sort of move it along.

But I feel Silverstream Spur is critical to it. The other thing with the Spur I've identified is that it makes a fantastic entrance and exit from Upper Hutt because you've got Keith George Memorial Park and the reserve on one side and the Spur, planting natives, it's a fantastic natural looking entrance and exit to Upper Hutt. But it is pretty critical because it's a significant area of land that links that whole corridor system across the valley.

Forest and Bird, before I joined them, must have been about 20 years ago, the chairman negotiated with the Council over removing the pines, and they started on the northern end and just found it too difficult. So our approach, about 10 years ago, approached a forestry training group that were in Upper Hutt and asked them to take it on as a project for their students as a training area and they had a look and said it was too dangerous, too difficult. So the biggest problem, the two problems, are getting the land re-designated as reserve land and the next problem is removal of the pines. It's gonna be a pretty horrendous job. And the other problem is protecting the Silverstream Steam Rail project, because we don't really want to drop them [the trees] on the train lines right there. But they've already removed some close to the railway lines because their problem was, sparks from the train were catching fire on the scrub underneath and then the pines were catching fire.

Is it less of an issue with the native bush than the pines?

Yes, native bush will survive fire better than the pines, because the pine has a resin and the pine needles dry off so it's a natural, like Australian eucalyptus trees, they just whoosh. Natives have a reasonable resistance against fire.

Are there other advantages that native vegetation has compared to the pine trees? (especially talking about the birds)
We just want to encourage the bird life and the more natural environment of NZ with the natives. What we're saying to the council is we don't want to set it aside as a no go reserve area, we're proposing that we have walkways and maybe even cycleways through there and turn it into a public resource. [kind of like Keith George?]

Pat showed us some pines that they poisoned a while back, is that not an option there?
It is, but basically because it's council land we can't go in and poison it. We'd have to get the approval of the council to do it. Poisoning is an option, we used it with the willow trees in Hull's Creek, what we did is, is we poisoned them and when they're at a stage right before they're falling we went in and had a contractor go through and cut them down. The advantage there was that if you cut willows with a chainsaw you get all the small chips and if they get into a waterway or anywhere where there's moisture, they just take off and you end up with where there was one big willow, you end up with 50,000 small ones. So we tried that poisoning, when they cut the trees down, the wood was already dead, and it worked, it was very very successful. So we've sort of promoted that throughout Forest and Bird as a way to remove willows, particularly in wetland, river, stream areas.

Were you involved when the memorandum of understanding came about between UHCC and GTC? Did Forest and Bird have any involvement?
Uh, no. It was done before we knew anything about it, unfortunately. Ralph Goodwin, I don't know if you've spoken to him yet, he's very supportive of us. [He's a member]. Yeah, he's actually a member of the branch. So there's no conflict there with him. We thought, when we initially made contact with him that we were gonna end up in a confrontational situation, because we knew that he had this memorandum with the city council on swapping the land in Pinehaven for the Silverstream Spur. But he's--when we met him and discussed everything with him, we discovered he was extremely supportive. And the document that was made public by the council showed a road going along the top of the Spur with a couple of, 2 or 3 sort of side roads going off with houses on them. And he said to me, that was never his intention. That was not part of his proposal for the Spur. All he wanted the Spur for was to get a road access up to Pinehaven.
[And that's what James McKibbin, the Policy Planner said]
So what I've said to him is, we're happy with that, as long as he doesn't want the Spur for residential development, we're happy for him to use it. Particularly in the southeastern corner, there is a way of getting up there, through the corner of the Spur and up into his land. So we're talking to him, and discussing these options with him. We hope that he doesn't turn coat and say "oh, if I'm not going to get the land, I'm not going to swap"-
[and that's what I can't tell, what's the best case scenario, the worst case scenario, and the most likely scenario. I feel like they're all different]

So would your ideal situation be that the land-swap goes through, the land that Ralph is offering goes into reserve, but the Silverstream Spur is only used to put in a road?
A road, an access road to the subdivision, yes. I don't know whether he'll accept that option, because what he's looking at is ownership of the Spur. And what we're saying is, we want it to remain public council reserve land. So whether he will, whether it's important enough for him to use part of it for the road and still give the council the land in Pinehaven, I'm not sure. We haven't sort of discussed the detail, that much detail. We're sort of treading carefully with him to make sure we don't get on the wrong side and upset him, for him to turn round and say "oh bugger you, if you're not going to agree to what I want". But we're not sure--some people say that the MOU that he has with the council is expired.
[It does not have an expiration date on the document] No, that's what I thought. That's what I've seen. [I don't believe that it--]
So whether it goes on infinite, I'm not sure.

Talked about the conflicting information, about what exactly the Spur will be used for (housing, an access road), and how many houses are planned to be built. Ralph himself couldn't give us a clear answer, the documents don't say where these numbers of houses will be going exactly.
From what I've seen, the housing development will be on the Pinehaven hills. There's a lot of talk about whether it's gonna be 2000, 1000, 500...I don't think Ralph even knows at this stage. I think it's a concept that they've got and they haven't really worked out the details. Because the good thing, from our point of view, is that he wouldn't be planting natives in the gullies, and on some of the hillsides above Pinehaven, if he was planning to clearfill it and just [build] housing all over.

He did show us a lot of the replanting efforts that they're going through and [we were] pleasantly surprised by that.
We were, when we went for the first walk with him through there, and discovered, "oh, he's planting a lot of manuka", but that's semi-commercial for the beekeeper that's got the land. It's an advantage to him. But manuka is a very good initial native plant, nursery plant, to get others. And he's planted hundreds of ratas in there. He's very supportive of native forestation. We've also spoken to him about how he's gonna take out, commercially log the area. Is he just going to clearfill it, and just [have] roads and tracks everywhere, and he said no. He will do one area, selectively log, and [have] minimal tracks and road access. And then he'll move to another area and do the same there. He's not just gonna clearfill the whole lot in one go.

Mentioned Ralph's awareness that he might have to leave certain patches of pine because getting it out would be too damaging to the native surrounding it
We believe we're on a winner, yeah, but unfortunately if something happens to Ralph and somebody else takes over from the company, they might just decide--[not everyone shares his point of view] No, but he's--I understand he's the major spokesman and owner of the company.

He mentioned several times that his family having the land for 95 years made it a special connection, influences his motivations.
My son, my family, were involved in the planting there at one stage.

The Goodwin-Chichester trust set up the whole planting years and years ago. They were actually involved in planting some of the pines. So I jokingly said to Ralph one day, "what do I get out of it?" And he said, "oh, probably one pine tree if you're lucky!"

We're really quite surprised with the attitude that he's got and really amazed at the conservation attitudes [Ros is not surprised at all because at the council meeting they announced that any new development or roads would be hydraulically neutral; we go on about hydraulic neutrality]
[A quote from her: "they're not talking about ripping into it", talks about a sustainable future, how everything lags from the local council to the regional council to central government]

One of the problems is that it came up at the same time as this plan change 42, which was about flood protection in Pinehaven and [something] valley. [goes on about flood risks in Pinehaven but he believes Ralph will honor what he's said in the initial planning with the council]

I believe it's very early stages, I don't think it's going to be until at least 10 years before anything positively is started up there. I think he's got a lot of work to do and a lot of thinking. I think the initial plans were just concept plans that he put [together] for the council. I think it's going to change quite dramatically from what he initially put up.

Is there anything in the near-ish future, say the next year or two, that you would like to see done that would make you more confident in what's being proposed?
I think we just need to keep liaising with him. We don't want to push him and say, "what are your plans", because as I said, I don't think he really knows what the final project is going to be at this stage. So I think we just tread carefully and work with him and have him working with us and just try and influence what he's doing. [Maintaining open lines of communication?] Yeah, yeah, very much so.
Pat seems to have a good relationship with him, with his orienteering and biking and everything. Our kids, we lived in Silverstream years ago, our kids used to walk through that land every week. He's open to people using it as an access for tramping, walking. When we walked through it with him there were people walking, people on bikes, and he just said "G'day!" As long as they don't abuse it, he will maintain the open policy that he's got with it, which is fantastic.

One thing that's come up in our survey a lot is 1080. There seems to be a lot of people who have a very strong connection between 1080 and Forest and Bird.
Initially, I found out a couple of weeks ago, Forest and Bird opposed 1080. But since they've seen the benefits of it, they've come out very strongly in favor of it. The main reason is, it's the only tool that we have for eradicating pests from large areas of land. We would never

propose that 1080 should be used on a block like the Spur, it's too close to residential areas. There's been a lot of misinformation about 1080, that it kills birds and it kills animals. I'm of the opinion that it does kill some native birds, and there's proof with kea down on the West Coast where they've done significant drops of 1080. They have found a few kea killed, died from obviously 1080. But my attitude is you sacrifice a few for the benefit of the whole. 1080 is the only tool that we have at the moment to reduce pests on significant areas of native bush and reserve. But unfortunately there are a group who are very opposed to it. There is a strong association between the pro-1080 group and Forest and Bird, and that's just something that we have to work through.

I think any Forest and Bird related correspondence like you're doing will attract that anti-1080 group. And I think we've just got to work through that. Hopefully it won't impact what we're looking at.

Appendix G: Interview with Wayne Guppy and Peter Kelly

Wayne Guppy is the mayor of Upper Hutt, and Peter Kelly is the Chief Executive of Upper Hutt City Council
Interview conducted Feb. 5, 2019
Interviewers: EH, SB, and AR Notes: SB
Note: This interview has been edited and condensed for clarity.

How did you come to the agreement found in the land-swap document? (What things did you think it was particularly important to consider?)
Guppy: A generalized discussion for what might be the best outcome for everyone, for the city, conversation...best approach in the point of view for traffic flows, if that proposal proceeds, there's a lot of work that needs to be done as far as what are the consequences, what are the issues with traffic, what is acceptable about the development, a lot of work needs to be done, initial talk about the future use of the Spur land, talk about harvesting crop that was planted by the city 20+ years, long before my time here but it was never even looked after, the council viewed it at some stage as a source of potential income for, there's now no chance for the city to get a return from it. It was never looked after.

What would the next steps be?
Guppy: First a proposal would have to be put forward
Kelly: With any sort of development like that it would be seen as reasonably significant, that's something we'd have to go out and consult with the community, typically means we'd have to go with information, people have the opportunity to review that and make submissions, based on that the council would have to review it and say if it's possible/not possible/possible with some changes, all things have to be weighed
Guppy: Impact of traffic flow, hydrology neutrality etc., would need to be addressed, some of the issues that's been banded around the community/ it's been misinformation is that any sort of development that would take place (ex. water flow/neutrality).
Kelly: There is a very rigorous process that must be put forward, which looks at the hydrology, looks at the traffic flow

Has anything like this [land-swap] historically happened before?
Guppy: Not in my time here. Processes are there to follow but you look at each project separately.
Kelly: There are strict caveats, what the land is allowed to be used for, to change the status of the land/enable it to be used for another function is in itself a process, you may even have to go to the Minister of Conservation. The thing about the MOU, there's an understanding that this is a potential use of the land, but before we get to that stage there's so much that has to occur under legislation so it's hard to give a definitive answer.

How long does this process take?
Kelly: The process takes a while. We're working through a simple one with the local marae here, iwi, essentially gifting land to the marae that they can use for a kura maori, a school for the children te reo languages, there's some legal titles that need to change, that is a 12-18 month process for what is considered a simple process.

Guppy: There's been a discussion about this for 12+ years but the discussion goes nowhere until there is a concrete proposal on the table. That's really the trigger. And that stage there has been a lot of talk but nothing has proceeded

What is the current status of the land?
Kelly: I couldn't tell you other than that it belongs to City Council

One of F&B's goal is to have a connected ecological corridor, for conservation. What is the best way for them to have a say in that process?
Guppy: If a concrete proposal comes forward and we trigger the public process that'll be part of that process. There was some discussion before (nothing about the Guildford development) the council was going to sell the land off long before Guildford, that would potentially been a full- blown subdivisions, council backed off, there were better ways of using the land. Then there was talk about taking the trees down and replanting. F&B may have been involved in that. When Council backed away from selling directly, when Guildford discussion started they thought this is probably the best way of preserving and keeping it green as possible.

With the land that would be traded to the city, what land status would that go into?
Guppy: That would go into reserve, include walking and cycling trails, it would be about preserving land

Have you received any feedback from people who know about the MOU and have concerns about it?
Guppy: Yeah it's public, like any area where there's some sensitivity there's people getting out of it what they want. There's certainly an array of opinions. Any suggestion in an area like that, there's always going to be discussion and opinion.

Is it challenging to respond to that?
Guppy: Well, no until there's something quite concrete on the table there's not a lot to discuss. There's concepts we're discussing with Guildford but that evolves and changes too. There's one thing we do know over the last 10 or 12 years a suggestion that there could well be future development
Kelly: A challenge for all local authorities, the affordability is really expensive, the further up the Valley you get the more affordable it is. The pressure for local authorities is how do you plan for the growth because this region is growing, how do you plan for the growth for the families coming in. When you look into the Valley now, pretty much what you see is the usable land. All councils are grappling with this, where is the next potential development and talking to developers. It's just one of those tensions exist in a growing country.

How does the Spur compare to other areas of land as a candidate for potential development?
Kelly: This part of NZ we're quite comfortable living on hills that shake a bit, the earthquake fault comes right up this valley. But our engineering and design has taken that into account. Of course a flat bit of dirt is quite appealing for a builder. In Lower Hutt, you

have the real issue about earthquakes and tsunamis and liquefaction. So in this part of Wellington you've got quite a bit of stable rock, parts of it is actually quite good place to build on, the ridges present their own unique challenges because of the natural terrain but as you've seen in Wellington that's not insurmountable. I wouldn't expect it to be like Wellington- incredibly close-knit on the steep hills
Guppy: GTC is planning on a unique type of development, quite futuristic, quite environmentally sensitive. Not a mass produced type subdivision. It's about fitting into the environment up there.

How does that tie into building an access road to Pinehaven?
Guppy: We haven't really got to that, there's been a number of suggestions on that and the effects it will have on the existing population and area, in general discussion it was seen that maybe the entrance would be somewhere through the pine forest there on the Spur.

Are there any projects with Upper Hutt that are conservation or bird oriented that is significant to you?
Guppy: Forest and Bird has done a lot of work on that, the Hull's Creek area, the work of the western hills- Old Man's Beard, and plantings we do with them throughout the city. For instance on Maidstone Park the native bush caught fire. Within a short period of time, with Council and F&B that's been replanted. A lot of our park areas have significant amount of native bush that we work with F&B on

Kelly: There's a lot of wide support across NZ for goals of Forest and Bird. They use part of our facilities, certainly regional and territorial authorities should have good relationships with them, because they have a strong influence
Guppy: They have good strong leadership. If the development proceeds there, what we do as a council from the point of view of that Spur, how do we preserve that Spur and work through what everybody wants. If you think about our community here in Upper Hutt, people enjoy living here, they enjoy the environment, it's part of them. That's why working through developments is important. There are going to be extremes but that's not how the world operate. How can things take place in a way that doesn't damage the environment. If it was left to us and we let grisly old engineers do it we'd get it wrong. We're in the area, that yes, the area is up for development.

What is that next step for the Plan Change to go through?
Guppy: The next step would be if they come forward with a proposal. I've been around here for a few years and there's been a lot of talk and discussion but nothing's come through concrete. Nothing will get triggered from here, it'll get triggered when they come and say let's start the process
Kelly: Like anything, people are so busy, and there's no definition to what this project is until he comes forward with a firm proposal and design. And what it looks like and then we can consider this whole due process. And then the types of changes we have to make to the land designation, until then it's just speculation. The onus is on the landowner to come up with a proposal they want to take forward, that we can then consider. If he wants to develop it it's a lot of money he has to spend upfront. The cost is all of the developer initially.

How would UHCC feel about having an ecological corridor and setting aside some of this land for conservation? What is your stance on F&B's desire on setting aside the Spur for conservation?
Kelly: I'm not a rate payer, I live in Wellington city. I only have an opinion, when Council makes a decision and it's gone through due process I implement the decision. So really, I would see myself as apolitical to the situation, but if I talk about ecological corridors in general, I think they're a good idea in general. I've seen how they work in South East Asian countries where there's been massive urban development at the expense of ecological areas. And how they tried to factor in ecological bridges it's quite clever and successful. So the concept is well founded, particularly for ground based animals that have traditional migration routes or access ways to parts of their habitats. And so ecological corridors make a lot of sense.

Guppy: Upper Hutt is more green than anything, eh?
Kelly: It is interesting, where I live in Wellington I don't see kereru. But out here you'll see them all the time. I see two big fat Kereru sitting on the big overhead lights. Right astride the motorway. Yeah, I understand ecological corridors for ground based, but for birds I would have thought you wouldn't have to have them for the bird concept unless they are nesting in particular geographical area, that is really small and confined only then you'd have to protect them.

Guppy: Last night I was sitting outside and the morepork was sitting in the tree.

Has F&B formally tried to present their case?
Guppy: Yes, they've discussed it with us. It was part of strategies that we've been developing as Council. It was part of how we might preserve some of those areas.
Kelly: When a formal proposal is put forward and it comes out to public consultation they will actually come up with a written response to that. They're very active on a whole range of issues.

Appendix H: Interview with Colin Miskelly

Colin Miskelly is the curator of vertebrates at the Te Papa Museum, and is an ornithologist
Interview conducted Feb. 8, 2019
Interviewer: SB Notes: AR and SB
Note: This interview has been edited and condensed for clarity.

Are there any species in the Wellington region that depend on the bush as their primary environment (wouldn't survive in semi-urban areas)?
Zealandia's bird counts paper from the Notornis website, which allows free access to papers older than a year, but it was published September of last year so I don't think it'll be up.
-it's almost the other way around, some native birds seem to be quite good dispersers and don't require continuous canopy (kakariki in Zealandia and Matiu/Somes, tui, kereru)
-paper 10 yrs ago about forest birds returning to Wellington
-more recent one on the birds of Zealandia based on 5 min bird counts, published last year, more info on what birds are in the Wellington region
-used the counts done by Wildlife Management International (Nikki MacArthur)
-100 count stations around central Wellington in council reserves that they count every November shows birds dispersing out of Zealandia
-the ones that didn't go as far are the ones that would be more dependent on the corridor
-kakariki, tui, kereru, kaka don't really need continuous cover
-falcon doesn't need corridor
-which species do need continuous cover: whitehead, rifleman
-pretty much dependent on almost continuous canopy cover, don't cross open ground really at all
-bellbird is in between, don't see it away from forest but have managed to fly across water gaps of up to 30km, suspect they can move around more than we give them credit
-they'd readily move backwards and forwards through the type of forest that whitehead or rifleman would benefit from

Is native bush better for the birds than production pine or invasive species of plants? If so, can you elaborate on how?
There has been some research on use of plantation pines by NZ native bird, Notornis or the NZ Journal of ecology would be the best places to look. In general, pine forests are perfectly okay for native birds. Depending on how they've been managed, most pine forests have native understory, and so it's not so much the pine forest the birds have been using it's the diverse subcanopy of native shrubs. Whitehead and rifleman readily use pine forest so there's no doubt that if pines were a part of the corridor a lot of species would move through that kind of habitat.

I suppose one of the main advantages is permanence, because a managed pine plantation will be chopped down every 30 years, and then there'll be a time period it could be turned into a dairy farm or housing that would be less suitable for a corridor. It just occurred to me there's another species we haven't touched on- the tomtit, probably group that in with bellbird as a species that is capable of dispersing but you don't often see it away from

forest. Whereas some of the others I mentioned- the tui, kereru, falcon, kaka are quite common to see them flying over open space. I look out my office window and I see tui right there reasonably often, and I see them flying over the city. Whereas those other species you'd be very unlikely to see over that urban area. So they're much more dependent on forest cover.

What can you tell us about the movement of NZ birds? Do any of these birds have migratory behaviors?
When bellbirds reach Tawharanui and Shakespear parks, that was colonization rather than migration. None of the species have recognized migration pattern. Migration is pretty unusual in NZ, which I know will be quite foreign to where you come from. So probably the nearest thing, in some parts of NZ there's been suggestions of altitudinal migration because we have got high altitude forests, heavy snowfalls, low productivity of insects in winter. It seems like birds coming down to lower altitudes but the sites you're talking about there wouldn't be enough of a gradient for that to be noticeable. So probably the only species are the cuckoo species. There are 2 NZ species of cuckoos that breed here and I'll mention some of their host species. So the whitehead is the local host of the long-tailed cuckoo and the grey warbler which is quite a common species through NZ suburbia is the host of the shining cuckoo. Clearly, they are quite capable of travelling long distances so it's unlikely that the corridor will make much a difference to them. The other species in the Wellington region that uses forests seasonally is the kingfisher which is a hole-nester in spring, in banks or road cuttings, coastal cliffs, or in dead trees, they'll make a hole in the tree trunk. So they'll turn up in Wellington forests in the spring, and they're really obvious because they'll call a lot. But they'll move out to coastal areas, particularly estuaries in the winter to hunt crabs. They're called kingfishers but not many of them in New Zealand catch fish. During the breeding season they're mainly taking insects and lizards. And in the winter they seem to specialize in mudflats and take crabs at low tide. They will be a species that would be present in Upper Hutt in the spring, but then again they're not really dependent on corridors because they're clearly moving distances of tens of kilometers to get between the coast and breeding grounds. I don't think corridors make much difference.

The species that corridors wouldn't affect, would they still benefit from having bigger uninterrupted patches of wilderness?
In effect, a corridor is larger patch of habitat, reminds me of report I co-authored many years ago, there hasn't been much literature on corridors in NZ
The context for the report was essentially making a case for protecting some areas that were going to be felled for forestry, back then native forests were still able to be felled. Legislation has changed now you can only fell forests in a sustainable way, so very few native trees are now felled. It was making a case for turning forest that might have been felled into reserves to link to big forest patches, so long ago. The suite of forest birds in this would have been different, including weka and kiwi.

Could you tell us more about flying capabilities of birds in the Wellington region?
It's not only poor fliers, there are some birds who have a...fear of flying. It reminds me of another paper about bird dispersal between islands and Fjordland. (association with a novel, Fear of Flying). Jared Diamond wrote a paper about NZ birds and fear of flying. The

concept there is some birds may have a psychological barrier to flying across open areas, it's not that they can't do it it's that they don't do it. But the upshot is the sign that some birds seem to not disperse readily so what Jared Diamond was looking at was on the larger scale, he was looking at dispersal to Chatham Islands, which is different than the one I did last year on birds moving between islands in Fjordland, what we did there is we landed on about 50 islands, and some of them had had species like robins and mohua (yellowhead) and saddleback introduced to them, after pest eradications and we found that some of them particularly robins were dispersing up to 1.5 km across water gaps, but the other two species weren't moving more than a hundred meters or so. So that model of using islands to assist dispersal ability, there's not many places around the country you can do that The robin, I suppose it could be on your radar, it's not currently present in Upper Hutt but they are in Zealandia and Kapiti Islands. They haven't persisted after release to other catchments. If you're talking about what could happen in the future with better pest control, robins could be a potential species to consider.

A lot of species are doing well inside the fence but there's very few of the birds introduced there that have spread out into the wider city, the kaka is the exception and tui were already here, and so Zealandia has contributed to their recovery. But if you look at all the others that are really common inside the sanctuary, like whitehead and robin, and to a lesser extent bellbirds, it's quite rare to see them outside the fence. And those reports Nikki McArthur coauthored gave quite a bit of data about how often those species have been recorded outside the fence, they show which species have been picked up a few hundred meters from the fence. And there are a few others that have been picked up from much further away. Those reports will be really relevant to what you're doing, with respect to dispersal abilities. I've had this debate with Zealandia staff, species like whitehead would be capable of moving through the suburban areas. I think there is enough, not really forest cover, but continuity and vegetation that they should be able to do it. Not in the inner city, but older established suburbs, like up around Zealandia I think there's enough, also down the steeper gullies and hillsides, but I think whiteheads should be able to move around. I don't think habitat continuity is the problem for whiteheads I think it's the predation.

Appendix I: Interview with Ihaia Puketapu

Ihaia Puketapu is a local Maori woodcarver
Interview conducted Feb. 11, 2019
Interviewers: EH and SB Notes: AR and SB
Note: This interview has been edited and condensed for clarity.

Can you talk about Maori history and land-use?

-A lot of people like to talk about our strict environmental management, traditional management, but they don't like to talk about what led to that beforehand, which was mistakes, which is pretty normal for culture
-The problem for Maori is with a dominant culture coming in over the last 100 or so years, two questions: has this dominant culture learned from its mistakes

Can you tell us about Maori wards?

-For the first time, there is a district council that is going to have Maori wards (Hawke's Bay has 63% Maori population)
-Had to have community referendum

Would you say local government is receptive to Maori mindset? Do they consult?

-Yes and no, intermittently, at times when it suits them
-His father was deputy mayor for some years, he was the first Maori to be elected as a city councillor
-local politicians have to put on a front
-We understand why they local gov't politicians do what they do because if they know their constituents, generally they're not too bothered about us, to get voted in they have to do what they're told
-Government departments trying to honor the treaty
-A lot of their top managers can't stomach the change
-mayor talked about wanting to increase Maori involvement
-He's genuine! It's a slow reversal of the time when people were punished for speaking te reo Maori

Do you know where the Silverstream Spur is? Do you know anything specific about how land in that area has been used in the past or if there are any cultural considerations you would have with the Maori mindset when making land use decisions?

-The land is council land right now, then there's an area of timber company owned land
Pine is worth nothing now
-They want to put in developments *they laugh*
-They have to apply for an environmental consent which brings with it all sorts of rules that they have to comply with
-They could end up in environment court if you get enough people opposing what's proposed

-In the environmental, governmental legislation there's clause 2 where they have to give consideration to Maori in terms of environmental matters that might affect Maori people
-They can't avoid it, they have to talk to Maori people and ask what do you think about what we're doing
-In some ways it means absolutely nothing but in terms of things like fresh water they have to argue what it means

Can you tell us about the RMA?

-We're only mentioned in it in a very small way
-2 phrases: "taken into account" and "give effect to"
-No laws requiring they "give effect to" Maori
-It's always take into account "hm what do you reckon? Oh that's nice"
dairy farms, we say "hell no!", they say oh let's go take them into account "what do you think Mr. Maori man" "thank you for your input, we've ticked that box, taken them into account" and then they discharge it
-environmental party we have in Parliament in coalition with other 2 parties
Starting to have some influence

Are businesses becoming more environmentally conscious?

-Some yes, but some ignore that and plow ahead as long as they're making money
-Full cost accounting, general progress index formulated in America in mid 90s
-Simon Kuznets
-Misuse of GDP
-ecological economists created GPI
-This is what we should be doing to measure our nation's well-being
-Unleash a volcano of activity in terms of policy creation
-growing GDP just for the sake of it
-Culture of consumerism
-Maori are represented unfairly in demographic statistics

Is there a lot of Maori land in the Hutt Valley?

-Our marae and another building over there is what we call Maori free hold land; land we own
-Still under the government but it's something
-The forest we're talking about, what they call the wastelands, the water catchment, to us that's Maori land because it's all indigenous forest that we never sold
-Our view is we share it with everyone
-Our people feel like they've contributed to our country pretty well, with not a hell of a lot of recognition, isn't it?
-The government paid large sums of money, like 70 or a hundred million dollars to the tribes for what they did to them, and but the value of what's given on those claims is only 2% max of what they lost.

-Maori have never been financially rich anyway. If rich, you would need to look after your tribe. Poverty here is nothing like the rest of the world. This country's paradise.

Appendix J: Interview with Nikki McArthur

Nikki McArthur is a Senior Ecologist at Wildlife Management International
Interview conducted by email on Feb.14, 2019 (in italics) and by phone Feb.18, 2019 (normal text)
Interviewers: EH and SB Notes: AR and SB

Are there any species that depend on continuous canopy cover for dispersal?

In these Upper Hutt reserves, the species that would most benefit from continuous canopy cover would be rifleman (as you correctly identify in your report). However, there are three caveats to add here.
Firstly, I'm not convinced that either Keith George or Wi Tako actually contain functional rifleman populations at present, so there may not be anything there that would benefit from increasing connectivity at present.
Secondly, I'd assume that depredation by invasive mammals is the more serious and urgent threat to this species within these reserves and beyond, rather than a lack of connectivity, so increasing connectivity in the absence of adequate predator control may not confer much of a benefit anyway. This is actually a general situation likely to apply to the majority of endemic birds breeding in these reserves, so worth us spending some time discussing on Monday.
Thirdly, because riflemen are such poor dispersers, the Hutt Motorway (and possibly the Hutt River) is likely to continue to act as a pretty impermeable barrier to dispersal, even if it were possible to create a continuous canopy cover right to the boundaries of these two features.

Taking predator control bit out of equation, there's probably a bit of a gradient, a continuum in terms of how dependent some of these native species are on continuous cover
-highly dependent = rifleman, very poor gap crossing ability
They almost certainly need unbroken corridor, or some sort of vegetation to get from one patch to another. It may not be possible to create a good enough corridor for them in the Silverstream area b/c of river and motorway.
The next one would be the whitehead, surprisingly reluctant to cross large open gaps. They could certainly hop over gaps that rifleman couldn't but they'd still need a relatively continuous corridor
The others are tui, kereru, bellbird, fantail, grey warbler, pretty good at crossing gaps (surprisingly so in the case of grey warbler). These are the species doing good, they can hop across gaps and use what vegetation is already in the area, such as riparian (willows?), suburban gardens that sort of thing
-tomtits--there's not a huge amount of empirical data out there, some of the speculation is based on our knowledge of the distribution of birds in the Hutt Valley, but there's some evidence that they are remarkably good at crossing open gaps
-but they may be reluctant to do so in Wellington area
-color-banded tomtit released on Tiritiri Matangi Island was found back at its capture site in the Hunua Ranges, which would have involved the bird flying over 70km, atleast 2-3 km over water

-Hutt River would not be so much of a problem for the tomtit to cross
-should be quite capable of getting from Keith George to Spur without much difficulty, but they might not actually disperse that way
-tui and kereru can fly across the valley no worries
-"I am one of the few people who is skeptical of the use of corridors, the utility of corridors if that corridor is not accompanied by adequate predator control"
-most areas that don't have good mammalian pest control, in the form of rat and mustelid control are being reproductive in terms of producing, juveniles coming into the population
-if you don't have a productive population with lots of juveniles being produced, there won't be many dispersing and using the corridor to travel among habitats
-corridors should ideally be accompanied by pest control
-predator control is going in some of these reserves, Wi Tako and Keith George, but one of the results that is coming out of the bird counts is that pest control is not currently at the level it needs to be to improve productivity of populations
-results suggest that pest control may need to be intensified in those regions

Where is pest control easier? Reserve or neighborhood?

-probably two answers to that questions
-would technically be easier in a suburb for rat and stoat control, since there is easier access, in practice in terms of generating the outcome you want with bird populations it's harder and less efficient in suburban habitats compared to forested reserves
-2 reasons: there's a lot of urban pest control going on but all of those programs focus on controlling rat and mustelid populations but nobody's game to tackle cats (wild cats, stray cats, pet cats)
-likelihood of doing bird control in suburban areas and increasing bird populations is low
-trapping in bush is more difficult (time consuming and cost) because of the terrain but the further you get away from suburban habitats the easier it is to tackle cats as well as rats and mustelids, more likely to get a beneficial outcome for local birds
- the major meter for success is the increase in bird abundance, but it does not get measured very often and even when it does we're not seeing it happen, the Upper Hutt reserves are good examples of that
-I think it's great the level of pest control that is happening in Wi Tako and Keith George, but it's not yet generating beneficial outcome for bird populations that we hoped for, in terms of increasing abundance
-bird species vary in their vulnerability to mammalian predators
-wouldn't expect to see much of a change in abundance in grey warbler or silvereye (they are spread all over NZ which means they're already coping reasonably well with predators), but tomtit and rifleman are more restricted in distribution throughout NZ and are limited by predation and secondary, habitat fragmentation
-there's possibly room for improvement in the level of pest control going on in those reserves

Can native bush provide any advantages over pine for birds?

As corridor habitat, it's likely that native forest habitat acts as a more effective dispersal corridor than pine forest. This is because there's some evidence from radio-tracking studies that some native bird species (e.g. North Island robins) are reluctant to cross the boundary between one forest type and the other, even when the two forest types are adjacent to one another (why this reluctance should exist, we don't know). As 'source' habitat however, in the absence of intensive mammalian predator control, the opposite may in fact be the case. We know that native forest birds often reach higher abundances in mature pine plantations than in native forest, and there's a hypothesis that this is caused by an observed difference in rat abundance between the two habitats (native forests support higher ship rat densities than mature pine forest). This latter point might be worth having a think about, because it's probably a bit simplistic to simply divide native bird habitats in the Hutt Valley into "source" vs "corridor" habitats. The reason for this is that the Silverstream Spur ("corridor") almost certainly supports breeding populations of some native species (e.g. I've observed tomtits on the spur during the breeding season, so this species is almost certainly breeding on the spur). So in a situation where forest habitat is being maintained on the Silverstream Spur primarily as a corridor, but secondarily as breeding habitat in its own right; and there's no plan to implement intensive rat control, then I'd be tempted to advocate for the forest habitat to be maintained as mature pines, rather than native forest.

Can you tell us more about the trends you've seen over the years in bird abundance and if they can be attributed to certain events?

In Upper Hutt reserves, we haven't seen many trends in native bird distribution or abundance since we started monitoring in 2011. This is probably because we've seen no real change in habitat management (in particular, no real improvement in mammalian predator control) over this time. Given this, I wouldn't really expect to see much of a trend…

The only conspicuous pattern we've seen is a major reduction in fantail numbers in 2011, followed by a multi-year recovery. This was almost certainly due to a severe weather event that occurred during the winter of 2011. At first glance, this may not be terribly relevant to your investigation of the utility of dispersal corridors, however increasing levels of connectivity between Upper Hutt reserves may aid the recolonization of these reserves by fantails following the catastrophic declines that this species periodically goes through as a result of severe weather.

Do you know of any past corridor efforts that have been successful for NZ birds?

Not off the top of my head, but I'll have a bit more of a think on this. As I mentioned above, although many people assume corridors are a good thing for native birds (and a fair bit of planting goes on NZ with the aim of creating corridors), I think most NZ ecologists would argue that the provision of corridors is unlikely to provide a measurable improvement in the health of native bird populations unless these corridors link healthy and productive 'source' populations. On the NZ mainland, a healthy source population would need to be receiving intensive mammalian predator control, and many corridor planting projects just don't take this requirement into account.

Interestingly, I can think of a number of examples where increased connectivity has been detrimental to NZ birds, at least in the short-to-medium term. For example, the most common cause for bird reintroductions to fail on the NZ mainland is high rates of post-release dispersal from highly-connected release sites. In other words, it's much more difficult to reintroduce locally extinct birds to sites which have good habitat connectivity, than it is to highly isolated patches of habitat! Secondly, a major study of the metapopulation dynamics of North Island robins in fragmented habitat in the central north island suggested that local populations had higher intrinsic growth rates in habitat patches with either very high or very low connectivity, but had lower intrinsic growth rates in habitat patches with intermediate levels of connectivity. The possible reason for this is that when connectivity was very low, most juveniles produced in a habitat patch would be retained in that patch, and when connectivity was high, rates of immigration and emigration were equal. But in patches with intermediate levels of connectivity, rates of emigration frequently exceeded immigration, so these local populations suffered lower recruitment rates in most years. So in New Zealand there is some growing empirical evidence that increasing habitat connectivity may not necessarily be a good thing for native birds, at least in certain circumstances.

To be honest, my view would be that the argument for retaining forest on the Silverstream Spur to provide a bird dispersal corridor would be fairly weak at present, because:

- *Unless mammalian predator control is improved in adjacent reserves, the corridor may not actually have much potential to be used by dispersing birds. If the adjacent source populations aren't productive (i.e. aren't generating lots of juveniles), then where are these dispersing birds supposed to come from?*
- *A number of the native species currently present in the Hutt Valley, including kereru and tui, have strong dispersal and gap-crossing abilities, so are unlikely to benefit from such a corridor – they can just fly straight across the valley in one hop as it is (you can actually stand on the Hutt River bank and watch both tui and kereru flying clear across the valley from one side to the other)*
- *A number of other species (rifleman and whitehead) may not have the ability to cross the Hutt Motorway or Hutt River, so would be unlikely to be using the Silverstream Spur to cross the Hutt Valley*

But…I think the argument for retaining forest habitat on the Silverstream Spur becomes a great deal stronger if we recognise that this habitat will act as both a corridor (for some species, under some circumstances), but also as breeding habitat in its own right, particularly if it retains its current cover of mature pines, or intensive mammalian predator control is implemented on the spur, as well as in the adjacent reserves.

What would you recommend for pest control in the Spur?

-majority of what goes on, GWRC does majority of the control, it's a combination of poison to control rats (poison bait stations) and in Wi Tako there's a network of traps which target mustelids, stoats in particular

-Keith George I believe it's just poison bait stations

-either technique works fine, it's a question of whether the layout of the bait stations and if they're checked frequently is enough

-poison bait station tends to be more efficient way to control rats especially

-as far as killing more animals per month, GWRC relies more heavily on bait stations than traps
-recommendations to intensify that control, would like to get it to a point where we're seeing a positive response in the distribution and abundance of birds
-look at grids, number of bait stations may need to increase and may need to be checked more frequently

Do you think loss of insects as a food source is an issue for these birds? Possibly due to the European wasp?

-it's something we know does occur but probably not in the Hutt Valley from what I've seen
-it occurs in the pure beech forests on the South Island
-North Island beech forests don't reach the same level of honeydew so not as significant as a food source for birds here
-wasp populations not as high on North Island either
-don't think that's a very important consideration for our project

In our survey responses we've read stories of individuals believing their cats are "a secret weapon" for combatting pest species because the cats are much more likely to kill pests than birds. Do you have any thoughts on this?

-a bit speculative, not a lot of evidence out there
-net impact of cats on native wildlife is probably negative when you take into account their role as top predators
-using cats as a mean to control rodent populations is risky
-in an ideal world everyone would get rid of their cats and we'd using trapping and poison for pest control
-cat owners can be rather biased in terms of the effect they think their cat has on native wildlife
-looking at how successful some of the highly vulnerable species have been since being introduced to Zealandia
-some species: North Island robin and North Island saddleback
-introduced a decade ago, established large, productive populations within Zealandia with many juveniles
-however, no success in establishing bird populations beyond the predator proof fence, we pick these species up at count stations 100m from the fence but no further than that
-points to predation being the major problem, esp. Cats
-other predators (rats, mustelids) are being controlled but cats are not
-proof that cats are doing a lot more harm to local wildlife than any benefit

Can you talk more about birds' reluctance to cross different types of forest habitats?

-2 answers to that question
-given that the reserves you're trying to connect, Wi Tako and Keith George are native forests, it would likely be better for the Spur to also be under native forest

-there is empirical that some native bird species (North Island robin) that are hatched in one type of habitat appear to be reluctant to cross the boundary from type of forest to another, even when there's no physical barrier
-it's a observed pattern that may extend to other birds
-if birds are born in native forest, more likely to want stick to that habitat
-look at what forest type the reserve is and make the corridor the same forest type
-"just thinking about the Silverstream Spur as a corridor is probably too simplistic"
-he knows from walking through the Spur, especially mature pine, that is not only a corridor but a breeding habitat in its own right
-If there is no pest control to be undertaken on the Spu, there may be an advantage keeping the Spur under mature pine forest
-top predator is ship rats followed by mustelids
-ship rat density is extremely low in mature plantation vs native forest, hypothesis is that mature pine provides a habitat refuge for native bird populations, birds have more productive breeding populations than in native forest habitat
-if the Spur is conserved and there's no immediate plan to implement pest control, recommends keeping the pine forest any birds tending to breed in that habitat would be more likely to be successful than if it is converted to native forest
-if pest control is implemented there are benefits converted pine forest to native forests to remove any sort of barrier

Can you send us these papers?

-rifleman are not functional
Recommendations:
1. Supplementary translocation to grow populations, about 40-60 birds, sounds like a big job, but there are healthy populations nearby
2. Try to connect the two reserves so there is a healthy populations in both reserves with ability to cross the Valley
-worried about the barrier imposed by Hutt Motorway, Hutt River, such poor fliers, even if you did manage to revegetate right to the boundaries
-populations are so tiny
-connectivity alone won't solve the problem for rifleman

45 min How does the abundance of birds in the Spur compare to the abundance in Keith George/Wi Tako

-in general it's about the same
-5 minute bird counts every 300m, data in eBird, extract this information even though it'll be a coarse comparison
-5 minute bird counts in the Spur were in July/August but in Wi Tako/Keith George were done in November so there'll be a major seasonal difference
-tui, grey warbler, tomtit, fantail were quite good on the Spur
-whitehead do quite well on pine forest, but he did not encounter them
-bellbirds were not detected or in quite low abundance
-shining cuckoo were detected but not in our focus (migratory species)

A common theme among our responses was a negative attitude towards the use of 1080 due to off target effects of the poison. This included runoff pollution into waterways and secondary poisoning of predatory birds. What are your thoughts on these concerns relative to Upper Hutt?

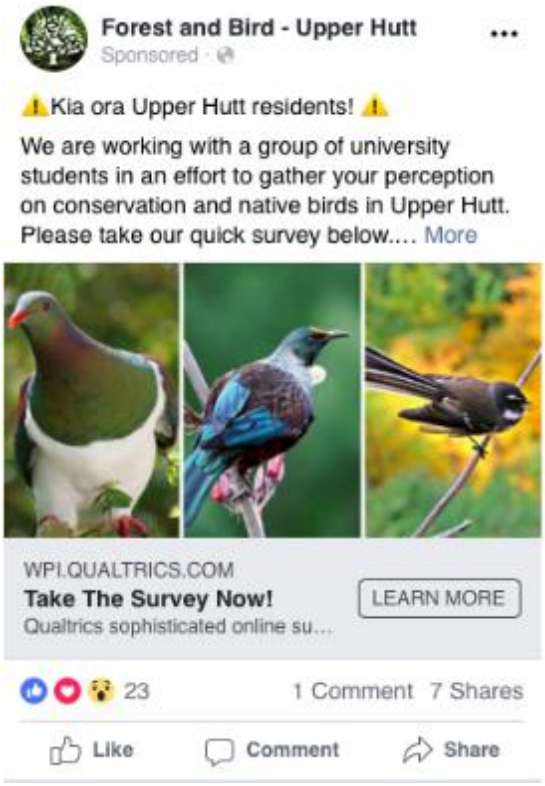
-all of the concerns raised by the general public are not supported by evidence
-a lot of outdated information, misinformation
-very frustrating
-spreading a great deal of misinformation about the risks of toxins, creating quite a lot of fear dn concern
-what's motivating the anti poison people is not concern about native wildlife
-using toxins, applying them aerially, by-kill includes deer, key motivator for people against 1080 is people who enjoy hunting those animals
-talk to nearly any ecologist, professional ecologist or someone who's employed in pest control, they'll give you an opposite answer [compared to the crazies]
-the benefits vastly outweigh the negative effects of by-kill
-empirical evidence demonstrates that survival rates of birds through poison operations are high
-"The loss of any individuals due to that poisoning is many times outweighed by the improvement in the recruitment rate in subsequent breeding seasons"
-people are concerned about the aerial application of 1080, is one of the least risky toxins out of all that are used in NZ because of its break down to non toxic compounds
-brodifacoum is much more toxic poison as it is highly stable and can persist in environments for a long time, most people don't know it exists but it's used quite widely (even in Hutt Valley and Wellington)
-concerned about dropping toxins on helicopters
Continual use of bait stations are higher risk that occasional use of aerial drop
-not only a logistical or technological challenge, but a social challenge, trying to explain to local communities is difficult because there will be some people who will not accept it
-really tricky social challenge
-In the Hutt Valley, (ask staff from GWRC) not a great deal of opposition to poison used in bait stations, like ones in Keith George or Wi Tako, if GW decided to drop 1080 aerially there would be protests
Aerial application is good for very large tracts of forests but the reserves in question are not large enough to really warrant the use of a helicopter up there

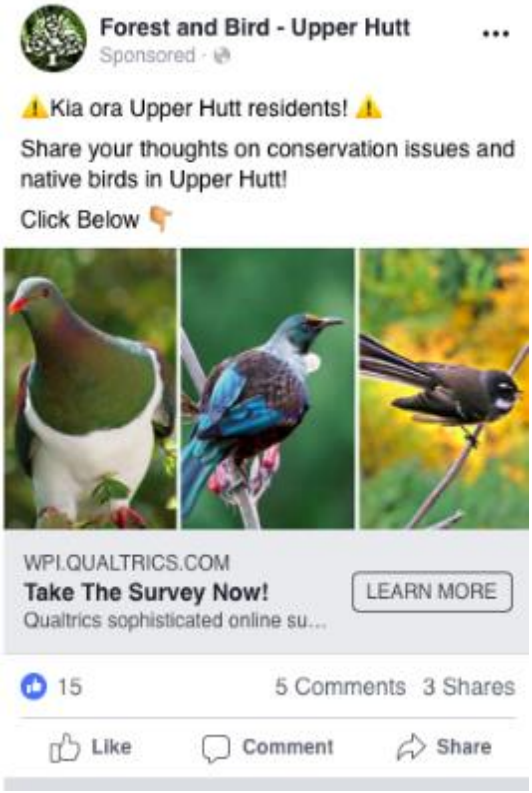
Can we quote you in our report?

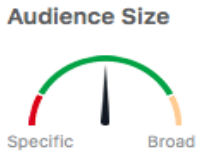
Yes, and he would be happy to receive a copy of our report when it's done :)
Takeaway: good pest control is important, corridors are not a priority for him
Creating a corridor between two populations that are productive is helpful
Don't have migrant land birds in NZ
-birds that are moving around our landscape are usually juvenile birds
Corridors are useful when you're linking up productive populations (dispersal for juveniles)
If the breeding populations aren't productive they're not going to be used

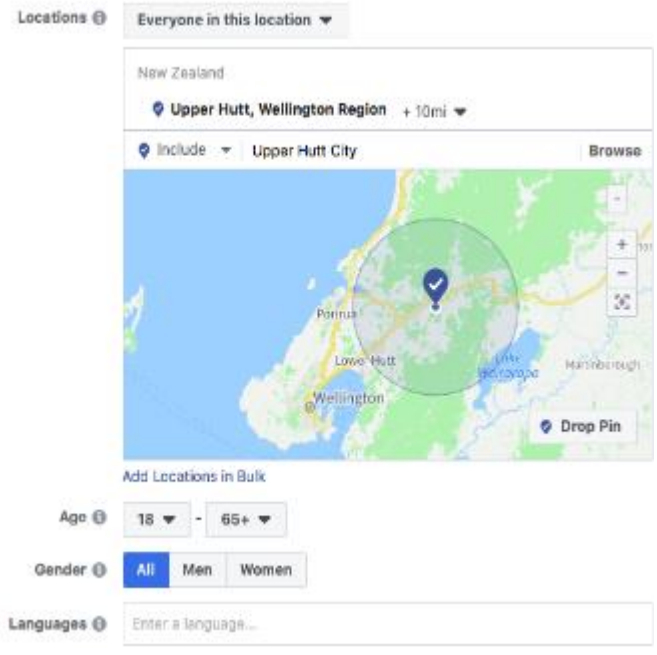
-related is isolation/habitat fragmentation = increased inbreeding/genetic factors/genetic drift
-predators will make more of an impact before those factors can
Corridors are a secondary step after predator control
-not going to see much of an improvement
-he would advocate for retaining habitat on the spur because it can increase breeding habitat on the Silverstream Spur
-If its key role going to be corridor or breeding habitat, pest control is still important
-incubating birds, key targets of pest control is implement it during breeding season
-probably not useful during off-breeding
-if corridor doubles as a breeding habitat, the argument for pest control is much higher
-however, If it's only ~ 10m wide, wouldn't consider pest control to be a high priority.

Appendix K: Facebook Post and Social Media Advertisement Example









Appendix L: Research Poster Up Close

Introduction

Ecological corridors are designated linkages of land meant to facilitate the movement of populations between habitats. They are among many tools utilized worldwide to combat biodiversity loss. Their purpose is to establish connectivity, mitigate habitat fragmentation, and ultimately increase ecological diversity over large areas. In New Zealand, corridors have been implemented for the passageway of birds, namely species that are flightless or have poor dispersal capability. For example, the South-East Wildlink is a network corridors aimed to promote the movement of kākā, bellbirds, and tūī between reserves in South Auckland.

An ecological corridor has been proposed across the Silverstream Spur to aid movement of bird species such as the fantail, kererū, and whitehead between green belt reserves surrounding Upper Hutt. The Spur possesses particular suitability as a corridor region because it is located at the pinch point of the Hutt Valley, allowing birds to fly the shortest distance (~500m) between green spaces.

Objectives

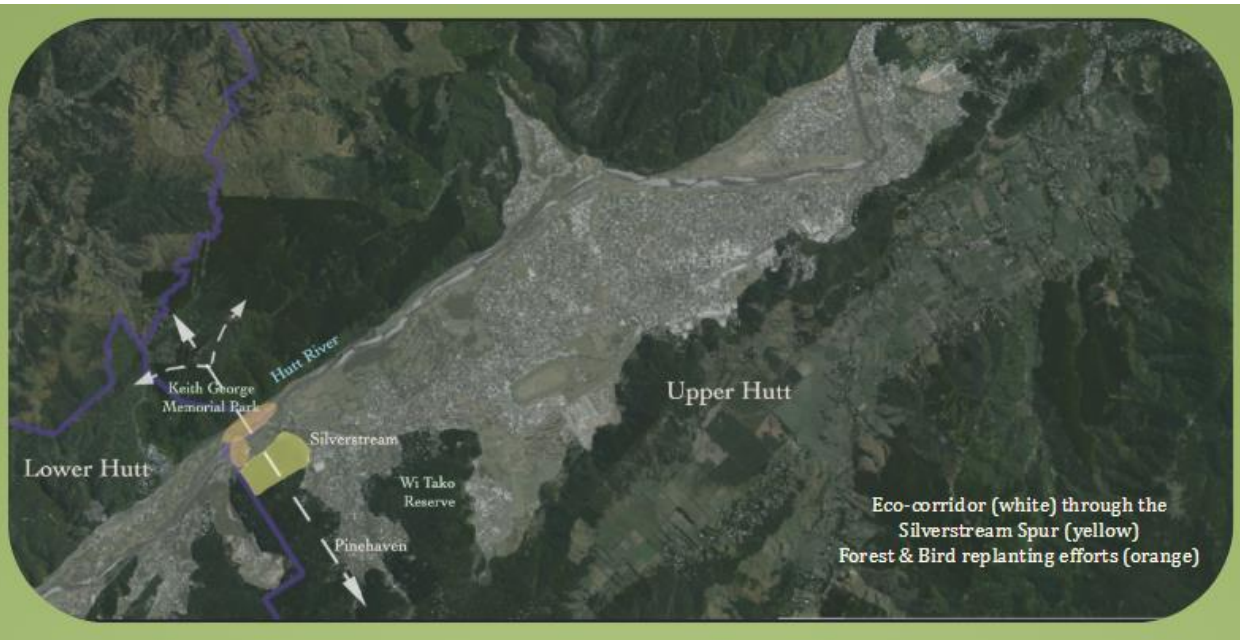
The goal of our project was to investigate the potential and actual value an ecological corridor would have for the region's native birds, determine its desirability by Upper Hutt residents, and learn about the attitudes of various stakeholders towards its implementation.

Survey Composition

Our survey contained three sections that each aimed to assess the public's view of certain topics pertaining to our project. These topics were:

1. Knowledge of conservation efforts
2. Awareness of the land swap
3. Attitudes towards/value placed on native bird species

The last section of the survey was for collecting demographic information, which was then used to analyze and compare the perceptions of different subsets of the respondent pool.



Birds of Interest


Bellbird


Tūi


Rifleman


Kererū

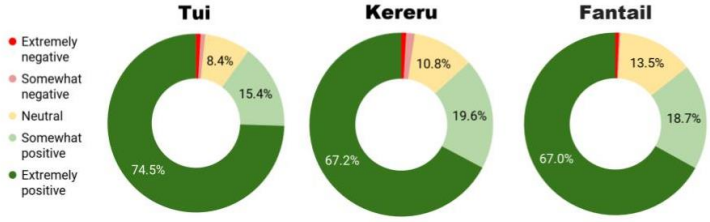

Whitehead


Fantail

Key Survey Results

Number of respondents: 553

Rank the following birds' impact on your daily life



"love it in the springtime when they visit our Kowhai trees"

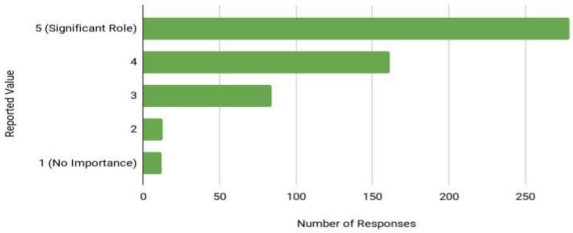
"Love kereru! They're a pleasure to watch"

"visits when important memories are needed"

Majority of respondents ranked each bird as having extremely positive impact

Anecdotes indicated residents enjoyed visits from the birds

How would you rank the value of conservation in your daily life?

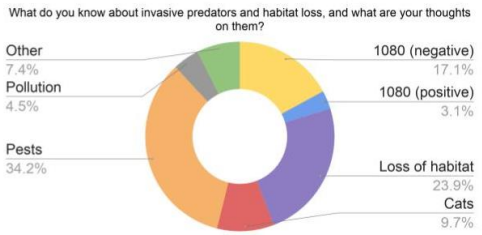


Conservation was highly valued by survey respondents

Suggests Upper Hutt residents may be receptive to further Forest & Bird initiatives

However, numbers may not reflect people's willingness to take action

What do you know about invasive predators and habitat loss, and what are your thoughts on them?



Top 2 threats mentioned: pests and loss of habitat

Respondents expressed concern for the welfare of native bird species

Unanticipated number of references to the use of 1080

Stakeholders

GTC

Representative *Ralph Goodwin*

Environmentally conscious developer

Hopes to achieve connectivity between Silverstream and Pinehaven

Wants to "balance environmental conscience with what has to be a commercial outcome"

Envisions small, low-impact housing clusters on the Spur

Believes revegetated Guildford land is a recreational resource for the public

UHCC

Mayor *Wayne Guppy*
Chief Executive *Peter Kelly*
Policy Planning Manager *James McKibbin*

Motivated to protect indigenous biological diversity

Required to plan for urban growth

Land swap and/or eco-corridor "discussion goes nowhere until there is a concrete proposal on the table"

Plan Change would warrant rigorous process to rezone the Spur for development

F&B

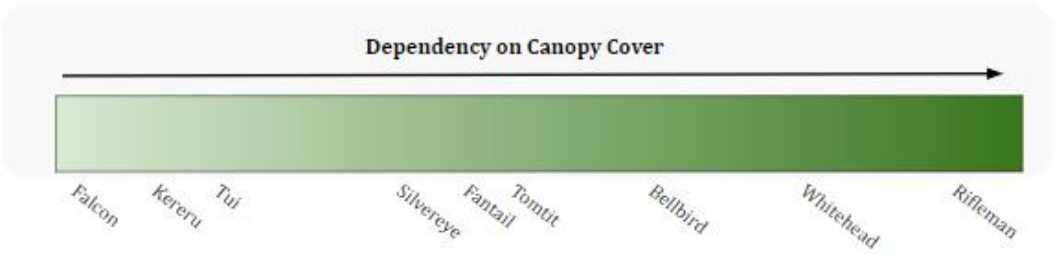
Chair *Graham Bellamy*
Sponsor *Pat van Berkel*

Advocate for complete protection of the Spur, with pest control and pine removal

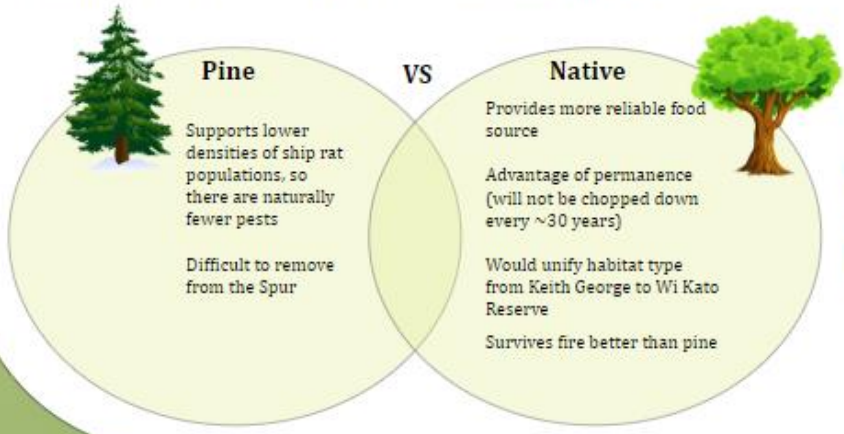
Believe the Spur is critical because it "links that whole corridor system across the valley"

Hope to work with Ralph Goodwin (GTC) to achieve their goals

Has worked with UHCC in the past on various environmental efforts



Interviews with avian experts allowed us to create an approximate spectrum representing the dependency of key bird species on continuous canopy cover.



Additionally, we consulted ecologists to compare the benefits of mature pine versus regenerating native bush as part of the eco-corridor in the Spur.

Recommendations/Conclusion

Our recommendations for Forest & Bird Upper Hutt:

1. Maintain open lines of communication between involved parties
2. Continue gathering evidence in defense of the eco-corridor
   a. Consider treating the Spur as an extension of habitat/reserve similar to Keith George Memorial Park
   b. Investigate how other target species (lizards, insects) could benefit from the corridor
3. Prioritize pest control as part of potential corridor maintenance program
4. Increase public outreach and education efforts

The Silverstream Spur is a valuable candidate for an ecological corridor meant to connect areas of green belt land across the Hutt Valley. Our results suggest that residents in this region would be receptive to this possibility. Forest & Bird can and should consult the public as they strive to bring the corridor prospect from concept to reality.