Ngā Manu o te Ngahere me te Moana

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WPI

ZEALANDIA
TE MĀRA A TĀNE

Wellington Bird Life Awareness

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by

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Abstract

Zealandia ecosanctuary, located in Wellington, New Zealand, is devoted to the conservation of the country's native environment, focusing mainly on bird species. Since the ecosanctuary's founding, the populations of these species have increased significantly and have begun to spread beyond the fence into the surrounding suburbs. This is known as the "spillover effect" and it has created a need to understand the awareness people have of native bird life. The goal of this project was to create a survey that measured the awareness people in Wellington have of the native bird life, to analyze the data gathered, and to give outreach recommendations to Zealandia based on the analysis performed.

Executive Summary

Introduction

Before the arrival of humans, bird and reptile species dominated the isolated islands of New Zealand. Due to the absence of mammalian predators, endemic species, only found in New Zealand, did not develop defense mechanisms. This left the native species vulnerable to the competitive, non-native species brought by humans.

In the middle of the 17th century, humans arrived in New Zealand by boat and brought invasive species along with them. The combination of these new species and the hunting practices of humans caused the extinction of approximately 51 bird species, and a significant number of amphibian species, and types of plants (Clarkson et. al., 2016; Zealandia, 2018). In the late twentieth century, the country began taking action to restore the native environment. Following this initiative, the Karori Sanctuary trust, a community-led non-profit organization, opened Zealandia ecosanctuary in Wellington (Zealandia, 2018).

Zealandia's purpose is to conserve and nurture the endemic wildlife of New Zealand, more specifically the bird populations. They do this by fostering the wildlife in a 225-hectare (556-acre) enclosed park that is free of predators or invasive species. Zealandia began operating in 1999 and since then has "reintroduced 40 species of native wildlife back into the area, some of which were previously absent from mainland New Zealand for over 100 years" (Zealandia, 2018). The reintroduced bird species are free to leave the sanctuary and spread into the Halo Region, the suburbs immediately surrounding Zealandia. This phenomenon is known as the "spillover effect" and causes an increase in interactions between birds and humans. With an increase in these interactions, there is an increased importance on educating the community on how to safely interact with birds. In order to further educate the community on bird life, Zealandia needs to gather data on Wellingtonians' existing awareness and knowledge of bird life. Thus, our project assisted Zealandia in collecting this data and analyzing the level of bird life awareness in Wellington.

Methodology

In order to assess previous studies and surveys, we reviewed surveys created by previous Interdisciplinary Qualifying Projects (IQP) completed with Zealandia and listed out repeatable questions. We developed a bird life awareness score and created a program that calculated score based on survey responses. Furthermore, we conducted semi-structured interviews with Professor Ingrid Shockey, Associate Interdisciplinary Teaching Professor at Worcester Polytechnic Institute (WPI), and our sponsors, Danielle Shanahan and Anastasia Turnbull. With these interviews, we gained an understanding of the process the previous IQP used for data collection and processing. We also conducted archival research on relevant case studies to learn about bird life knowledge awareness indicators.

In addition, we identified critical information missing from the previous studies. We did this by conducting a site assessment of Zealandia and participating in activities held at the ecosanctuary. We performed semi-structured interviews with members of the staff to learn which demographic groups have low participation at Zealandia, and what kind of information Zealandia deems valuable.

Finally, we created a survey based upon the previous IQP projects, the comments from our sponsor, and the missing awareness indicators we identified through our research. Our survey contained questions on demographics, bird identification, and kākā feeding habits. We pre-tested the survey on our advisors, sponsors and peers to make improvements

from their feedback. Our survey was distributed through *Facebook* ads, *Instagram* ads, *Reddit*, mailings lists, and snowball sampling.

Results

In total, our survey collected 2,860 responses. After reorganizing and reformatting the data to make it viable for analysis, we had a total of 2,403 responses. The data gathered provided us with a diverse sample of Wellington's population. Our demographics primarily consisted of non-Halo Region residents, people who achieved a bachelor's degree, Pākehā/New Zealand European people, people aged 30-39, and females.

We found the tūī to be the most accurately identified bird species. Conversely, we found that respondents had a difficult time identifying the tīeke. We furthered our findings through the generation and grouping of average bird scores. We found that those living in the Halo Region scored higher than those living in the non-Halo Region. Similarly, we found that those who saw greater increases in bird life near their home were also more knowledgeable. We also found that those who had achieved higher levels of education averaged higher bird scores. Finally, we found the older demographics were more aware of bird life.

We also identified trends between our data and the data of previous IQPs conducted with Zealandia. When comparing the data sets, we did not find any significant differences in bird identification. We found a slight decrease in correctly identifying a bird as native or non-native to New Zealand. We calculated an insignificant increase in species sightings for both the tūī and the tīeke. We also noted a slight decrease in kākā sightings. Kākā feeding decreased over time as well.

Conclusions and Recommendations

Through the analysis of our findings we developed various conclusions. We drew the conclusion that interacting with nature more frequently leads to an increase in bird life awareness. This is based on our finding that those who saw a large increase in bird life near their home had a higher average bird life awareness score.

We also drew the conclusion that those who have achieved higher levels of education have a higher bird life knowledge. This is supported by finding a positive relationship between the level of education and bird score. This conclusion may be attributed to those with higher levels of education having more specialized degrees possibly relating to ecology and access better educational opportunities.

Lastly, we found that residents in older age brackets have higher bird life knowledge. This was evidenced by the positive correlation between age and bird score. We assumed a possible explanation for this included having more time to partake in hobbies such as birding or maintaining a bird feeder.

From the conclusions we developed, we constructed four different recommendations for Zealandia. We recommend creating an automated data collection tool, increasing Māori collaboration with Zealandia, highlighting rarer bird species near Zealandia, and publishing a regional newsletter for those that cannot attend Zealandia often.

Authorship

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3.2.2 Identifying new knowledge indicators and valuable information	Abhijay Thammana	Antoinette Mavrotheris	Erik Reimert
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Chapter 1: Introduction

New Zealand was once a land flourishing with a wide range of biodiversity; birds, reptiles, and flora thrived in the absence of humans. Both the physical isolation of the islands and the lack of natural mammalian predators allowed for the growth of many endemic species over 60 million years (Figure 1). However, in the absence of predators, there was no need to evolve defense mechanisms; thus, human arrival to New Zealand in the mid-1600s had catastrophic results on native life, especially avian species (Zealandia, 2018). Human settlement introduced approximately 2,264 competitive non-native species, 30 mammal, 34 bird, and 2,200 plant species. These predators led to the extinction of approximately 51 bird species, a significant number of amphibian species and various plant species (Clarkson et. al., 2016; Zealandia, 2018).

Figure 1. The hihi is a threatened, endemic species found in Zealandia (Birds, 2018).

Beginning in the late twentieth century, the country shifted its focus towards protecting and increasing the native biodiversity of New Zealand through restoration practices. General practices include controlling pests (i.e., rats, stoats, possums), monitoring domesticated pets (i.e., cats, dogs) that hunt birds, and invasive weed removal (Clarkson et. al., 2016). Ongoing urban efforts include restoration involvements from governmental organizations such as the Wellington City Council and the National Department of Conservation (Clarkson et. al., 2016). Non-governmental and nonprofit organizations such as Forest & Birds, and the Royal Forest and Bird Protection Society also participate in conservation efforts. Additionally, Predator Free New Zealand and Polhill Protectors are examples of citizen run conservation efforts.

Wellington has outlined a vision they are coining, “Smart Capital,” dedicated to fostering a love for nature within the community and integrating the natural world into the urban sphere. This idea of Smart Capital coincides with Wellington City Council’s overall goal of increasing biodiversity by getting people to care about nature, and “allowing people to form a connection with the natural world” (Wellington City Council, 2015).

Another organization contributing to Wellington’s conservation efforts is Zealandia. Zealandia is a Karori Sanctuary Trust managed ecosanctuary with a mission to restore the land to its pre-human state, through developing a community of well-informed conservation

advocates. The sanctuary design includes nine kilometers of predator exclusive fencing that allows for the successful regeneration of many vulnerable species, most notably birds. The fence includes an extremely tight woven mesh, an aluminum cap to prevent climbing animals from making it over, and a perpendicular base, which is buried deep underground to keep out burrowing animals (Figure 2). More than 40 different endemic bird species, exclusive to New Zealand, have been recorded throughout the park (Zealandia, 2018).

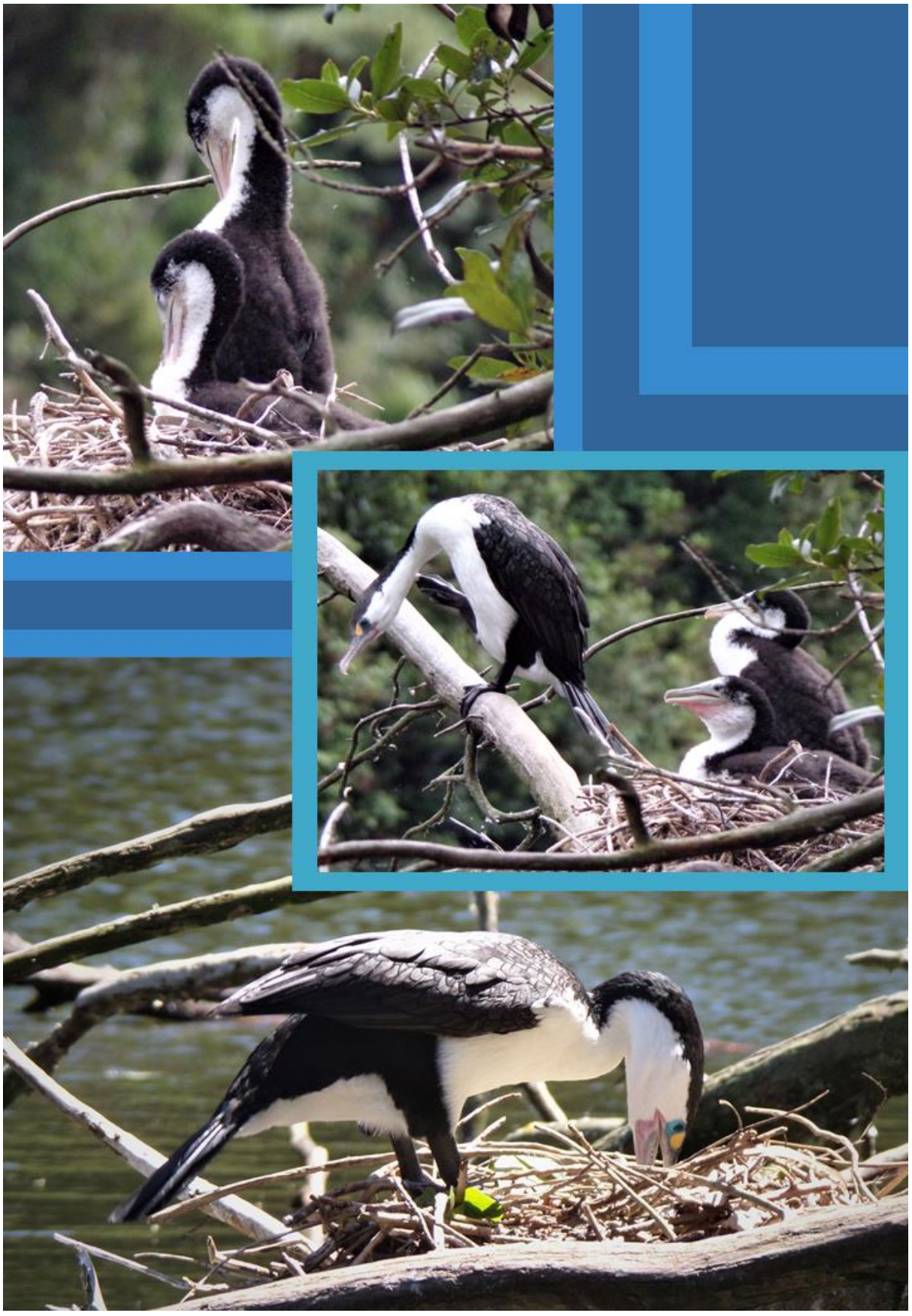
Figure 2. Zealandia's predator proof fence (May, H., 2018).

Since the early 2000s, the ecosanctuary has caused an increase in rate of the "spillover effect." This effect occurs when bird populations fostered within Zealandia's protection venture outside of the sanctuary fence into the surrounding urban sphere. The local population then has an opportunity to more frequently interact with a diverse array of bird life (Clarkson et. al., 2016). This increase in these interactions in the public domain has created a need to promote healthy coexistence.

Humans have a significant effect on the ecological systems around them, even more so from their own backyard (Parker, 2009). As the spillover effect increases the amount of bird-human interactions, there becomes a greater need for conservation practices and education on biodiversity. When people are not informed about these topics, they are unaware of any adverse effects of their nature habits. These habits include improper bird feeding or improper pest trap placement, and they present obstacles to conservation efforts. Improper feeding leads to different bird diseases, and possum traps often catch kiwi birds when incorrectly placed at ground level. However, increasing the level of bird life knowledge removes some of these conservation progress inhibitors, while also strengthening personal investment and passion to preserve the natural world. This allows for a more effective socio-ecological relationship that will sustain the longevity of the bird species Zealandia has worked so hard to preserve (Parker, 2009).

In order to further educate the community on bird life and further preserve this relationship, Zealandia needs to gather data on Wellingtonians existing awareness and

knowledge of bird life. Therefore, the goal of this project is to identify and analyze trends in Wellingtonian bird life awareness. To accomplish this goal, our team assessed previous studies and surveys, and identified critical information that is missing from them. The information gathered went into the development and execution of a survey which had similar questions to the previous surveys.



Chapter 2: Literature Review

This chapter begins with a discussion of Wellington's different landscapes and demographics. Within each of these different areas and demographic groups, there are different perspectives on the increasing biodiversity which are also investigated. Research on Wellingtonians' knowledge of nature, Zealandia, and related case studies follows the various perspective assessments.

2.1 The complexity of biodiversity in Wellington

Wellington is a region with large metropolitan and rural areas, both in close proximity to the natural world. However, the developmental pressures of city expansion have effects on both the fauna, and the residents of Wellington (Marques et al., 2019). This urbanization threatens wildlife with cats, dogs, pollution, and habitat destruction.

Although a significant portion of the Greater Wellington Region is urban, concentrated around the harbor, there still exists peri-urban and rural areas (Figure 3)(Marques et al., 2019).

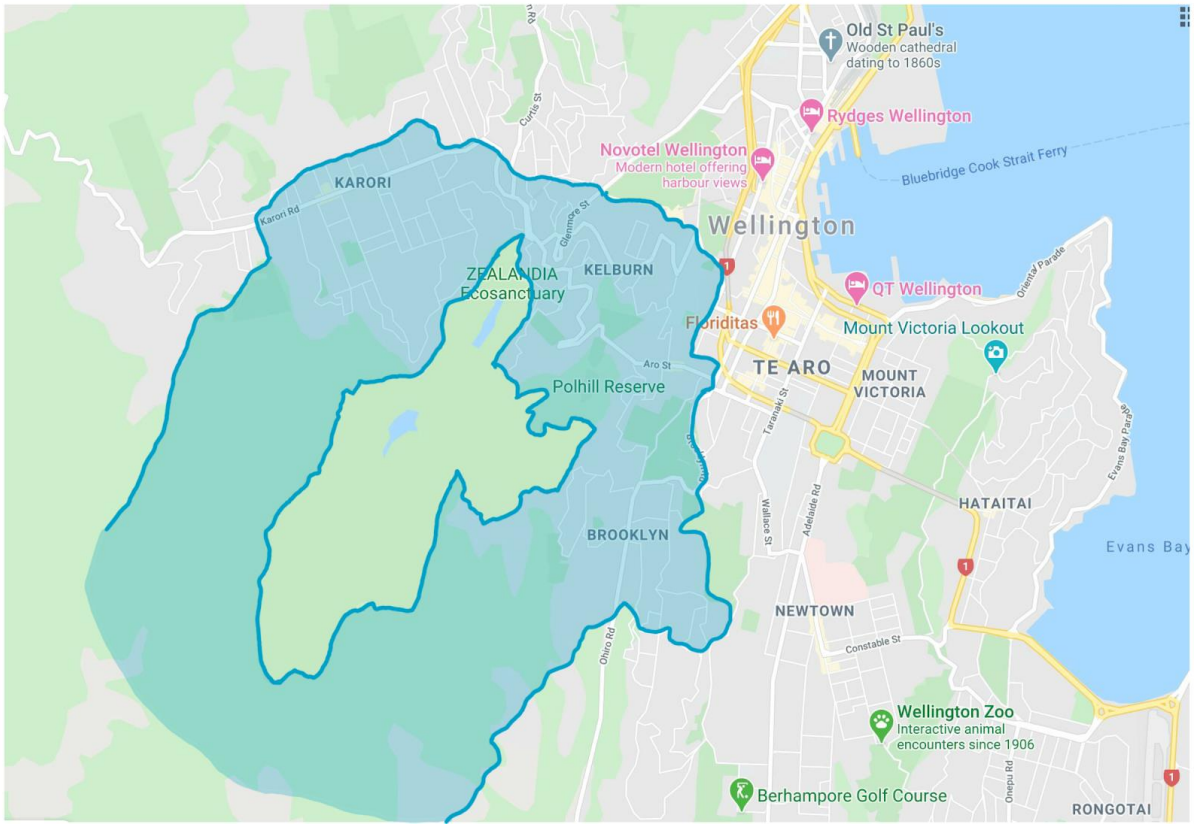


Figure 3. Satellite image of Wellington with the outline of Zealandia (Google, n.d.).

The region can be broken down into sections of higher population density, suburban housing, and rural environments (Figure 4) (Brinkhoff, 2019). Urban areas surround the harbor and include higher levels of industrialization. As settlements spread south and west, there are fewer commercial buildings and more residential plots of land and homes. This area

is classified as peri-urban, or the suburbs. Spanning between those two areas is a 5,000-hectare green belt of forest (Pollock, 2010). Even farther out to the west, the terrain becomes much more rural. Finally, a small but important sector to note is in the immediate vicinity around the Zealandia ecosanctuary. The term used to describe the more than 100 hectare section of land around the sanctuary's perimeter is the Halo Region, named for its periphery location to the ecosanctuary and the fact that it is the primary receiver of the "spillover effect" (Enhancing the Halo, 2014). Each of these areas are home to many different types of people with very different experiences and viewpoints on nature and biodiversity; these perspectives are further investigated in our research.

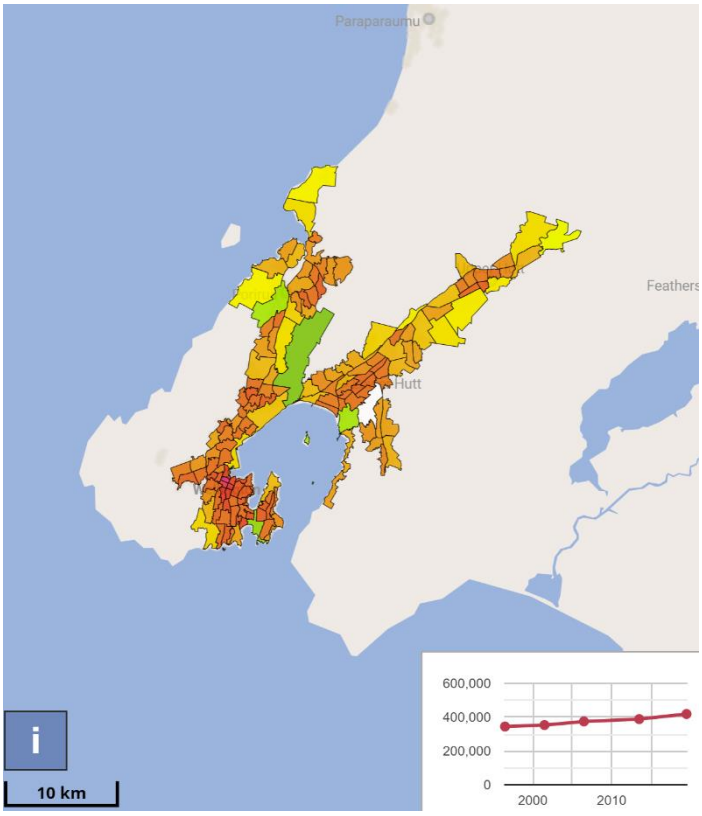


Figure 4. Distribution of population densities (Brinkhoff, 2019).

The 2019 census recorded 418,600 residents within the Wellington Region (Brinkhoff, 2019). The census found the most populous age bracket to be 20 to 29 years, and the most common ethnicity to be New Zealand European, or Pākehā. The data in the census gave us an idea of the proportions of various demographics we can expect to reach (Figure 5).

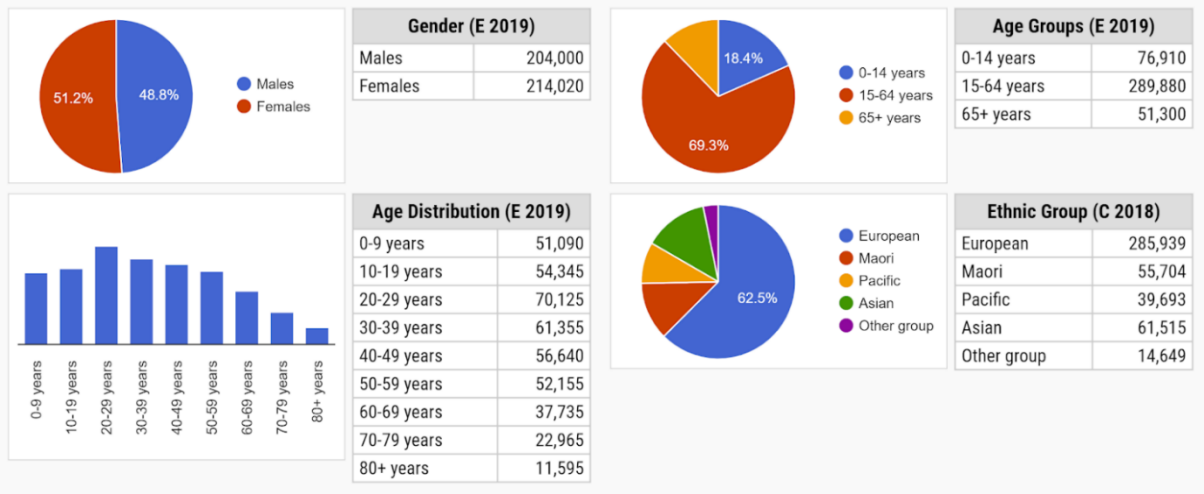


Figure 5. Demographic distribution of Wellington (Brinkhoff, 2019).

2.2 Perceptions of the spillover effect

Zealandia contains more than 40 flourishing bird species, 24 of them found only in New Zealand. Before the establishment of the ecosanctuary, many bird species existed only in small numbers, or almost at the point of extinction. However, since Zealandia's founding, the populations of these bird species have increased to the point where they are spreading beyond the predator proof fence. Most commonly, the tūī, kākā, and kererū leave the sanctuary and spread into the Halo Region.

As this spillover effect brings birds into residential backyards, the interactions between birds and humans have begun to change. Rather than actively going to the ecosanctuary to view the birds, local residents are now encountering them as a part of their everyday lives (A. Turnbull, personal communication, January 16, 2020).

As a study by the University of Trier, Germany concluded, nature interactions encourage people to take interest in and show concern for the environment (Kals et al., 1999). The University of Auckland drew similar conclusions when conducting a study to investigate bird feeding practices in six major New Zealand cities, including Wellington. When residents were asked about their feeding practices and motivations for doing so, people identified motives such as a chance to feel close to nature, a feeling of satisfaction, and a desire to have a beneficial ecological impact (Galbraith et al., 2014). The study also stated that people who had a positive perception of these bird interactions were more likely to participate in conservation support behaviors (i.e., planting trees, providing water baths). The majority of the people participating in such activities live in the suburbs with private backyards and a standalone house (Galbraith et al., 2014).

Conversely, during the same study, some people reported that they do not feed birds because of a concern of contracting avian diseases, the nuisance of bird defecation, and a concern that birds would become dependent on human feeding. The majority of participants who responded this way lived in apartments or owned domesticated pets, specifically cats and dogs (Galbraith et al., 2014).

These pets are a direct threat to bird life, yet 33% of New Zealand's population owns a cat (Ward, 2016). Feral cats are especially difficult to manage in urban settings as they are outdoors, uncontrolled, and in high numbers due to increasing levels of abandonment. Cats pose a significant danger to low-nesting birds such as the tīeke. When a single tīeke nest was spotted on the Polhill bike trail in 2014, Wellingtonians regarded it as a milestone in conservation efforts. As explained by a Dominion Post editorial, "at a time when the world's biodiversity is dwindling rapidly […] a single bird can seem like a victory" (Ward, 2016). Many cat owning residents, however, continue to allow their pets to have access to the

outdoors. “When residents decide their cat’s right to roam freely and kill at will trumps the tīeke’s (Figure 6) right to exist here, that’s sad,” explains Paul Ward, founder of Capital Kiwi (Ward, 2016). In Wellington, microchipping cats and keeping them indoors are starting common practices. However, many cat owners and cat lovers across Wellington still do not see a problem; they claim their cat “doesn’t hunt,” and that they prefer to give the cat “freedom” to roam outdoors while trying to avoid that it is a danger to bird biodiversity.

Figure 6. Tīeke (saddleback)(Ward, 2016).

Within the city center of Wellington, business owners often share a different perspective on increasing biodiversity. The resurgence of the cheeky kākā parrot, described as “boisterous, brainy” (Victoria University, 2017), has been problematic to urban areas as kākā are known specifically to destroy roofs, trees, and buildings. As the kākā populations have increased, people see an increased amount of destruction and have a decreasing tolerance for the species. A study by the Victoria University of Wellington further described the feeding habits of the kākā parrot and analyzed the damaging effects on trees (Figure 7) (Charles, K.E., & Linklater, W., 2013).

Figure 7. Two examples of feeding damage caused to trees in Wellington (Charles, K.E., & Linklater, W., 2013).

As this conflict between Wellingtonians and kākā rises, the need for “social research [investigating] residents’ attitudes to kākā and their experience of and tolerance towards

damage" also increases. This social research "will give an understanding of the extent and magnitude of conflict in Wellington City and may lead to social approaches to conflict mitigation" (Charles, K.E., & Linklater, W., 2013).

2.3 Bird life awareness and education

Before residents can act in favor of native bird species conservation, they need to identify the increasing bird biodiversity around them. It is important to understand people's awareness of their interactions with nature in order to better tailor conservation efforts to gain their support (Kals et al., 1999).

There is a question as to whether or not knowledge of local bird species and habitats will automatically engender positive attitudes and advocacy (Kals et al., 1999). Numerous studies have researched levels of environmental engagement and relevant knowledge of urban residents. A study by the Victoria University of Wellington evaluated the knowledge of ecological behaviors in the city. Surveys gathered information on how people interact with nature through bird feeding and tree planting for bird life (Parker, 2009). The study showed a positive correlation between the knowledge of native species and the interaction with them. The more knowledge a person has of the birds, the more likely they are to interact with them. The study evaluated bird life knowledge with three main aspects. These included identifying a bird in a photo, knowledge of birds in the neighborhood setting, and being able to list out bird species (Parker, 2009). The research also analyzed other factors that increased awareness such as education and proximity to nature (Parker, 2009). After collecting the data, they determined that the largest contribution to ecological knowledge was exposure to green spaces (Parker, 2009). However, the research also concluded that the knowledge of native bird life was substantially lower than that of exotic bird life (Parker, 2009). Exotic birds are often commonly mistaken for native ones, for example, the blackbird is often mistaken for the native North Island Saddleback and vice versa (Figure 8).

Figure 8. A picture of a blackbird (left)(Fitzgerald, 2013) and a North Island Saddleback (right)(Boyle, 2010).

A similar study by Kerry Charles and Wayne Linklater assessed the correlation between knowledge and interaction, again through planting trees; yet, they added an additional aspect, looking at negative experiences with birds (Charles, KE., & Linklater, W., 2015). Awareness was again measured through photo identification, but also by listing some of the greatest threats birds are facing (Charles, KE., & Linklater, W., 2015). Respondents were asked to mention whether birds had caused damage to any of their property and the severity of such. They found that as awareness and knowledge of bird species increased, so did their interactions. Adding the experience of a negative interaction barely influenced what was found to be an overall positive attitude (Charles, KE., & Linklater, W., 2015). Having a

predisposed positive attitude towards native birds is enough to counteract a minor negative experience; therefore, a negative experience does not dampen a person's desire to interact with wildlife or the support of conservation efforts (Charles, KE., & Linklater, W., 2015).

Moreover, those who are more knowledgeable of the natural world around them and the protective efforts being taken, according to Zealandia, will be more likely to take passionate efforts to help Zealandia's cause (Jorgensen, 2019). In 2019 however, Zealandia identified a significant lack of awareness of their organizations work amongst much of the local community. The ecosanctuary is unsure of Wellingtonians' awareness of the opportunities they offer at Zealandia, such as educational programs. In an attempt to gauge this knowledge gap and develop a strategy to increase marketing, a group of students from Victoria University of Wellington conducted a study for Zealandia. The team hoped to not only address Zealandia's research problem of not knowing people's knowledge level, but to also understand how demographic variables influence a person's perception of conservation efforts. The study provided conclusive information on how different groups of people feel about conservation practices and how much knowledge these different groups have (Jorgensen, 2019). Utilizing an online survey, the team collected 2,031 responses. They found that 78.38% of respondents found natural conservation extremely important and 90.05% claimed Zealandia's primary influence was educating the community on "wildlife and conservation" (Jorgensen, 2019). Respondents with a bachelor's degree or higher were more likely to know about Zealandia's impact (Jorgensen, 2019). The study also concluded that there is an obvious need to improve the community's knowledge of Zealandia's impacts (Jorgensen, 2019).

In cases where there is a lack of awareness, conservation progress can actually halt or reverse; a study conducted for the Victoria University of Wellington describes an example of such. The team analyzed improper bird feeding techniques, and they found that as a result, birds were damaging property (Charles, KE., & Linklater, W., 2013). The damaged property included trees, buildings, and outdoor furniture; the cost to repair these items was around NZ$3000 (USD$1920) (Charles, KE., & Linklater, W., 2013).

2.4 Zealandia ecosanctuary, their mission and supporters

Prior to the arrival of humans, New Zealand was isolated with a unique ecology which historians later referred to as "bird land." Human introduction to New Zealand resulted in a new set of challenges to native species (i.e., birds, amphibians and fauna) and forced many of their populations to dwindle. The 800 years that followed first human contact, sometime between 1250 and 1300 C.E., resulted in the extinction of approximately half of all vertebrate species (Marques et al., 2019). Bird life restoration efforts began to take shape in the early 1990's when Wellington established a nonprofit trust with the goal of reintroducing birds back to the region. This trust, the Karori Sanctuary Trust, developed an ecosanctuary around an abandoned water reservoir system with the hopes of sparking community involvement in restoration. Today this sanctuary is known as Zealandia (Marques et al., 2019).

Zealandia is the first fully fenced urban ecosanctuary in the world designed to exclude mammalian predators that are direct threats to the internally protected species (Figure 9). The 556-acre (225-hectare) ecosanctuary is home to more than 40 bird species and serves as a safe space for birds to replenish their populations (Zealandia, 2018).

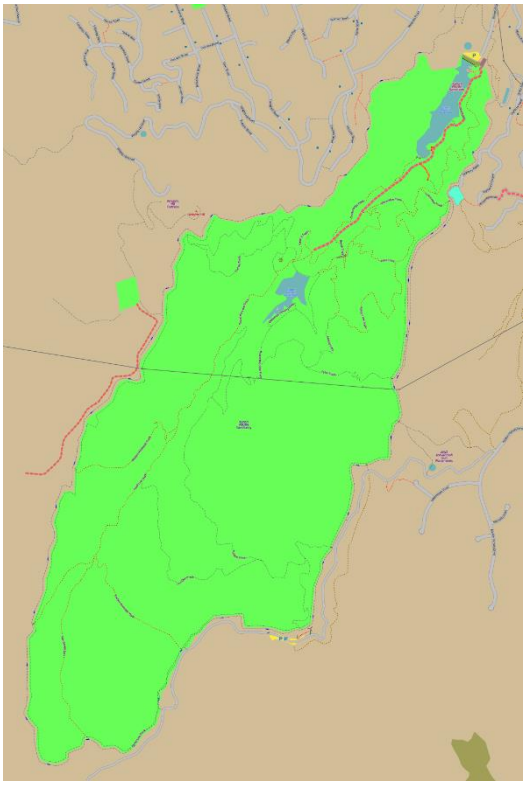


Figure 9. Area contained by Zealandia's nine kilometers of fencing (Zealandia, 2018).

Zealandia has a 500-year mission to restore the Greater Wellington Region to the state it existed in prior to the arrival of humans and non-native predators. For example, they are removing exotic trees that have conflicted with the native ecology and are encouraging the growth of local vegetation instead (Zealandia, 2018). Fostering local vegetation will restore the soil to its natural, native composition and will create a beneficial habitat for the species in the care of Zealandia. There is a symbiotic relationship between the bird species and the flora, with each helping the other flourish. By taking these actions, Zealandia hopes to "restore the indigenous character of the valley" (Zealandia, 2018).

The ecosanctuary relies on engagement from the residents of the Greater Wellington Region to achieve its goals. To encourage community involvement, the sanctuary includes 32 kilometers of walking tracks that are accessible to the public. Zealandia also provides volunteer opportunities, professional development, and educational programs through their research center (Figure 10)(Zealandia, 2018).

The ecosanctuary was recognized in 2019 by TIME Magazine as one of the World's 100 Greatest Places. Although people often regard entry prices as expensive (21 NZD for an adult, and 12 NZD for children), Zealandia still has a large number of attendees. In the 2018/2019 season, they broke their attendance record with 138,141 visitors (Zealandia, 2018).

Figure 10. Students participating in an educational program at Zealandia (Zealandia, 2018).

2.4.1 Synergistic organizations

The New Zealand Department of Conservation (DOC) is heavily involved in the monitoring and maintenance of biodiversity. In February 2000, they outlined a 20-year biodiversity strategy in response to the declining state of New Zealand's natural world. The Department of Conservation identified the impending extinction of endemic species as the "most pervasive environmental issue" in New Zealand (Department of Conservation, 2000). The DOC devised a plan for effective conservation and restoration of fauna and bird life. Various studies conducted by the DOC show an increase in bird biodiversity. In the "Conservation status of New Zealand birds, 2016," they analyzed the conservation status of 473 taxa of birds said to exist since the arrival of humans (Robertson et al., 2016). The Department of Conservation, with the help of community advocates and sanctuaries like Zealandia, improved the status of 34 of the 473 identified species, 57 of which were already extinct. The community and the DOC moved six species off of the "Threatened with Extinction" list and two off of the "Nationally Critical" list.

Like the goals of Zealandia, the DOC stated that encouraging community action and responsibility was one of their primary goals (Department of Conservation, 2000). The Department of Conservation continues to encourage biodiversity restoration and advocacy by educating the community on the ecology of New Zealand. To develop their next biodiversity strategy, set to take effect in 2020, the DOC sought cooperation from New Zealand residents. The residents directly participated in crafting the strategy by making revisions and suggestions to the proposal (Department of Conservation, 2019). While many efforts, such as those of Zealandia and the Department of Conservation, exist to increase biodiversity, more extensive regeneration of New Zealand's flora and fauna requires increased community participation and advocacy.

Furthermore, many of New Zealand's ethnic groups have special connections, beliefs, and rituals in relation to nature. For example, the Māori have a long, personal connection with Te Taiao, the natural world. As stated in Te Koiroa O Te Koiora, the DOC's newest proposal for a biodiversity plan, "the essential connection between people and the environment is a core part of cultural health - restoring the environment in turn restores people and our connections with the environment" (Department of Conservation, 2019).

2.4.2 Previous WPI IQP reports

Zealandia has sponsored two previous Interactive Qualifying Projects for WPI, one in 2017 and one in 2013. The 2017 project, "Identifying Public Knowledge, Behavior, and Perception of Native New Zealand Birds," had a goal of assessing both public awareness and knowledge of bird species (Bilis et al., 2017). In order to accomplish this, they conducted a site assessment of Zealandia and the surrounding urban and peri-urban residential areas. They identified current conservation and outreach practices in Wellington. The team then gauged public awareness, knowledge, and attitudes of bird life. They also analyzed local social media accounts and community participation to better understand the Wellington City Council's and Zealandia's sphere of influence. The team created a 34-question survey which they distributed to Wellingtonians, specifically in the Halo Region. The survey was distributed by means of e-mail, *Facebook* postings, and *Reddit* forums. Notable features of the survey included a section about bird recognition and a section about kākā parrot feeding habits. Survey respondents needed to identify four different avian species based on a picture and state whether or not the bird is native to New Zealand. For the kākā parrot feeding questions, if a respondent said they do participate in feeding, they then stated how frequently they do it and what they are feeding the kākā.

The 2013 project, "Evaluating the Interactions between Wellington Residents and the Threatened Kākā Parrot," sought to determine how Wellingtonians interact with the kākā parrot along with their attitudes towards the parrot (Cote et al., 2013). The project team identified locations where interactions were frequently occurring between kākā and people. The students collected data on both the actions and the attitudes of people involved in these interactions. They collected this data through focus groups, interviews, and a survey.

In both projects, the teams concluded that although there was support for protection of native bird species, safe feeding practices, and Zealandia's mission, most respondents had a low level of bird awareness and bird knowledge. Both teams recommended that Zealandia improves their educational programs and enhances their community outreach. The 2017 project incorporated kākā questions from the 2013 project and set a foundation for more teams to continue to build upon and show changes over time.

2.5 Relevant Case Studies

Case studies helped our team gain a better understanding of where and why educational gaps exist. Through our research, we also became better informed about the interface between humans and nature.

2.5.1 Case Study One: Urban Reserves in the Buenos Aires metropolis

To aid in our research, we found it critical to understand socio-ecological interactions and the benefits of fostering a good relationship between humans and nature. A 2012 study conducted in Buenos Aires, Argentina, entitled, "Use of visitors' perception in urban reserves in the Buenos Aires metropolis" (Perelman et al., 2012), found that there is a strong

correlation between pro-environmental behavior and biodiversity knowledge. This relationship is a building block for our project; it is also one of the primary reasons Zealandia is invested in determining people's knowledge of the natural world around them.

Using a "perception-based approach" the Buenos Aires team analyzed to what degree various urban nature reserves were being used in accordance with their conservation missions (Perelman et al., 2012). The survey included demographic and natural reserve perception questions. The researchers distributed the survey in various urban reserves in the Buenos Aires region (Perelman et al., 2012).

While they found that the two principal motives for people to visit reserves are nature immersion and walking, they also found a strong correlation between biodiversity knowledge and pro-environmental behavior. Respondents in Buenos Aires, across all the reserves, claimed that nature enhances their quality of life and that they had genuine concern for biodiversity. Most importantly, the team directly related environmental attitude and environmental knowledge. They concluded that more active participation in local conservation efforts, such as nature reserves, led to a higher appreciation of nature. "All evidence suggested that visitors' opinions and attitudes can be used as tools to assess the compliance of the conservation and educational mission of nature reserves and could be helpful for their improvement" (Perelman et al., 2012). A similar phenomenon is seen in Zealandia where the spillover effect has created a sort of "urban reserve" in Wellington City. Similar to our team goal, the study from Argentina attempted to better understand the relationship residents in urban and peri-urban areas had with nature reserves.

2.5.2 Case Study Two: Emotional Affinity Towards Nature

Zealandia strives to foster a community of invested advocates who will help them in their 500-year goal of restoring the Greater Wellington valley to its pre-colonized state. In order to do this, they need to understand what creates an advocate and what motivates them to be interested in and concerned for nature. A study completed by the University of Trier, Germany titled, "Emotional affinity toward nature as a motivational basis to protect nature," investigated emotional motivations for protective environmental behaviors (Kals et al., 1999). Specifically, the authors addressed two research questions: "Does emotional affinity have an impact on pro environmental activities? And is it possible to add a bit of knowledge about its origins by taking present experiences with nature into account" (Kals et al., 1999)?

The team argued that experiences in nature foster both emotional affinity and interest in nature. They found these experiences also resulted in strongly negative sentiments towards insufficient nature protection. Overall, they believed this emotional connection would ultimately result in "nature protective willingness and behavioral decisions." The relationships between these factors is displayed with the use of arrows in Figure 11 (Kals et al., 1999).

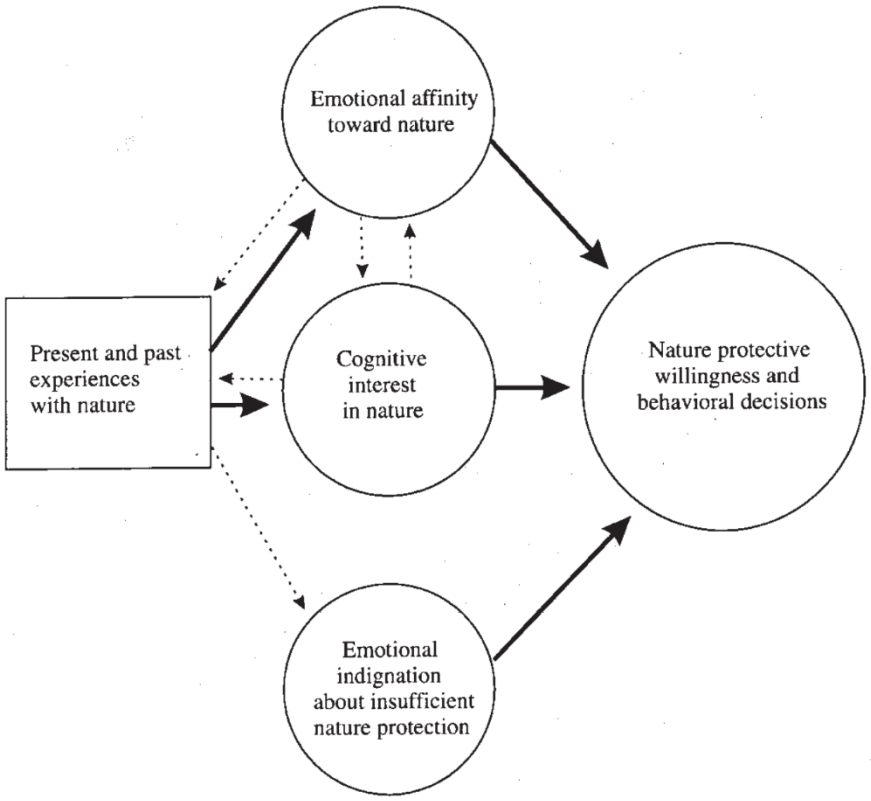


Figure 11. Outline of the hypothesis tested by the University of Trier, Germany (Kals,1999).

The team collected 281 responses throughout Germany mainly through public appeals and snowball sampling. The data identified that emotional affinity toward nature was indeed an important predictor of one's protective environmental behaviors. They additionally found a positive correlation between positive experiences in nature and a desire to protect it. According to the study, time spent in nature while accompanied by family especially increased one's emotional connection to nature and the resulting desire to protect it (Kals et al., 1999).

Chapter 3: Methodology

Our project focused on the identification and analysis of trends in Wellington bird life knowledge. In order to achieve this goal, we completed the following objectives:

1. Assess previous studies
2. Identify missing information
3. Develop and execute a comprehensive survey

3.1 Assessing previous studies and surveys

Our first objective involved understanding all the existing relevant data such as the 2013 and 2017 IQP projects. We began with a simple review of the old surveys; we read over all the questions asked by the teams and created a list of repeated questions. We also reviewed the responses from the 2017 project. The 2013 data was lost over time so we could not analyze the responses. First, we cleaned up the data by removing blank responses and formatting the answers which respondents typed in to make analysis easier. Following this, we wrote a program in Python to quantify each respondents bird life knowledge into a singular score. For each correct answer a person gained points towards their score.

To further research the previous IQP projects, we conducted semi-structured interviews. Professor Ingrid Shockey, Associate Interdisciplinary Teaching Professor, was our first interviewee. Our questions for Prof. Shockey focused on gaining an understanding of the analysis the team had performed and opportunities to build upon it. Danielle Shanahan and Anastasia Turnbull, our sponsors, were our next interviewees. We directed these interviews to obtain as much of the previous data as we could from Zealandia. We acquired the contact lists used, the response data sheets, and sponsor feedback on the surveys.

Lastly, we performed archival research in order to assess relevant case studies. These included studies performed by the Victoria University of Wellington and other research conducted by Zealandia. We either found the studies ourselves through research or we obtained them through interviewing Danielle or Anastasia. Through this research, we compiled a list of bird life knowledge topics which were consistent throughout all studies.

3.2 Identifying critical information missing from previous studies

Through a site assessment of Zealandia and semi-structured interviews, we identified critical information missing from previous studies. We identified demographics with low participation in Zealandia and new indicators of bird life knowledge.

3.2.1 Identifying target demographics

To better understand the demographics that frequent Zealandia, we conducted a site assessment. During this time, we completed various observations, both participant and non-participant. As for participant observation, we took part in several on-site programs at Zealandia as well as tours throughout the sanctuary. We gained a better understanding of the types of people who come to the ecosanctuary and the types of people who volunteer. Similarly, we also performed non-participant observation by listening in on some of the educational programs at Zealandia. Furthermore, we conducted observations off-site. The locations included shuttle rides and local hubs around the city (i.e., cafes, food courts,

popular streets). In many of these locations we found high populations of the demographic groups that were outlined in our preliminary research.

We then conducted interviews with Zealandia workers based on the following research questions:

- What demographics are least involved in conservation activities?
- What demographics have the lowest level of bird life knowledge?
- What specific demographics are in low attendance to Zealandia?
- What groups are the volunteers primarily composed of?
- Which suburbs are seeing the greatest increase in bird life?

The interviewees included our sponsors Anastasia Turnbull and Danielle Shanahan, the Lead Community Educator, Steve Moorhouse and a member of the marketing team, Pippa Drakeford-Croad. In addition, we obtained Excel sheet lists of those reached in previous surveys and various contacts that Zealandia has from Anastasia; we gained a better understanding of who is being consistently reached through marketing and who is not (P. Drakeford-Croad, personal communication, January 16, 2020).

3.2.2 Identifying new knowledge indicators and valuable information

We identified information for our project that would be valuable to our stakeholders at Zealandia. We used semi-structured interviews to determine the type of information that we should collect for the marketing, education, and conservation teams. We conducted these interviews informally, did not record audio, and had one facilitator and one note taker. We interviewed our primary sponsor Danielle Shanahan, the Lead Community Educator Steve Moorhouse and the marketing team lead Pippa Drakeford-Croad. Each of these interviews had different primary objectives and discussion questions. From the interview with Danielle Shanahan, we gathered information primarily about the previous surveys. We asked which survey topics were still of interest to Zealandia and what new knowledge would be useful to survey. In the interview with Steve Moorhouse, we asked questions about differences in people's knowledge of bird biodiversity and what information would be valuable to the education department. Finally, we asked Pippa questions based on the different distribution methods currently used by Zealandia. We also inquired about the various ways in which Wellingtonians interact with forms of media and how these platforms differ for various demographics.

3.3 Developing and distributing a comprehensive survey

We created a survey utilizing elements we identified through our previous study research and new research. We then executed the survey by distributing it amongst various channels.

3.3.1 Creating the survey

Overall, the methods for this objective aimed to address the following research questions:

- How do we create an engaging survey across different platforms and respondents?
- How do we create a survey that will get a high respondent rate?
- What surveys have had high response rates in previous years?

We conducted semi-structured interviews with various Zealandia staff to inquire about their marketing and outreach efforts, the ways in which Wellingtonians interact with

their social media, and the best methods for creating a survey with a high response rate. We learned to make the survey brief (no more than 10-15 minutes) and attention grabbing (P. Drakeford-Croad, personal communication, January 16, 2020).

In order to collect data from Wellingtonians, we designed a survey using Qualtrics, this ensured that data could be analyzed for correlations with statistical significance and longitudinal trends. Drafting the survey required many iterations. We added logic pathways to save time for respondents. For example, if a respondent answered that they did not feed the kākā parrot, they would bypass the following questions about their kākā feeding habits. We made visual improvements to help hold respondents' attention. We only allowed 3 to 4 questions to be displayed on the screen at a time, we made sure that the questions and answer choices were easy to read, and we added an eye-catching background.

We pretested the survey on our advisors and fellow students. They provided feedback about the wording of questions and responses. We adjusted the survey based on their recommendations (Appendix A).

3.3.2 Executing the survey

After we identified our desired respondents, we outlined the best way to reach these groups using insight from several Zealandia workers. We held a semi-structured interview with Anastasia Turnbull to gain a better understanding of the various ways in which the two previous surveys were distributed. We learned that both the 2017 and 2013 groups used methods such as snowball sampling and samples of convenience. We also obtained from Anastasia a list of contacts which have previously been used for survey. These contacts provided the opportunity to snowball sample more respondents as well. Previous groups also distributed surveys to Zealandia members via email. We repeated this to maintain consistency over time. An interview with a member of Zealandia's marketing team, provided ideas for different distribution channels.

Through the use of bird sighting databases, we plotted which suburbs have the highest sightings of the more common native birds. Those areas then became a part of our desired survey respondents (D. Shanahan, personal communication, January 16, 2020).

Following the interviews, we expanded our ideas for distribution capabilities through participant observation. We observed several locations throughout the city where diverse groups of Wellingtonians converge. Our team selected these places to observe the younger age groups (18-39) and those living in the central business district to determine locations for samples of convenience.

Our main distribution channel was social media, especially through *Facebook* advertising. This advertising reaches specified age ranges, interests, and locations; thus, we easily marketed our survey to desired respondents. The ad displayed the survey link in an eye-catching yet minimal way to those aged above 18 within the Greater Wellington Region on both Zealandia's Facebook and the Wellington City Council's Facebook. Another effective method was mass emailing to contact lists we received from Zealandia, the Wellington City Council, and ones we composed, as they all led into snowball sampling. The last way we distributed the survey was flyers with a link to the survey (Appendix B). We posted the flyers at various locations throughout the central business district for passersby to see. All of the distribution methods were supported by the incentive to be entered into a raffle for a year-long Zealandia membership.

Chapter 4: Results

In this chapter we present our findings. Our survey remained active to Wellingtonians via a *Reddit* post along with *Facebook* and *Instagram* advertisements for 10 days. We collected 2,860 responses. However, after reviewing the data and removing responses from outside of the Greater Wellington Region and responses with no recorded answers, we had 2,403 responses to use for our results.

4.1 The survey reached a diverse population

We found that we reached a diverse sample of Wellingtonians with our distribution methods. We asked for the respondents' home suburb, gender identity, age, ethnicity, highest level of achieved education, and current employment status. All demographic questions were optional, respondents could skip any question they did not want to answer. Appendix E presents the demographic findings in full.

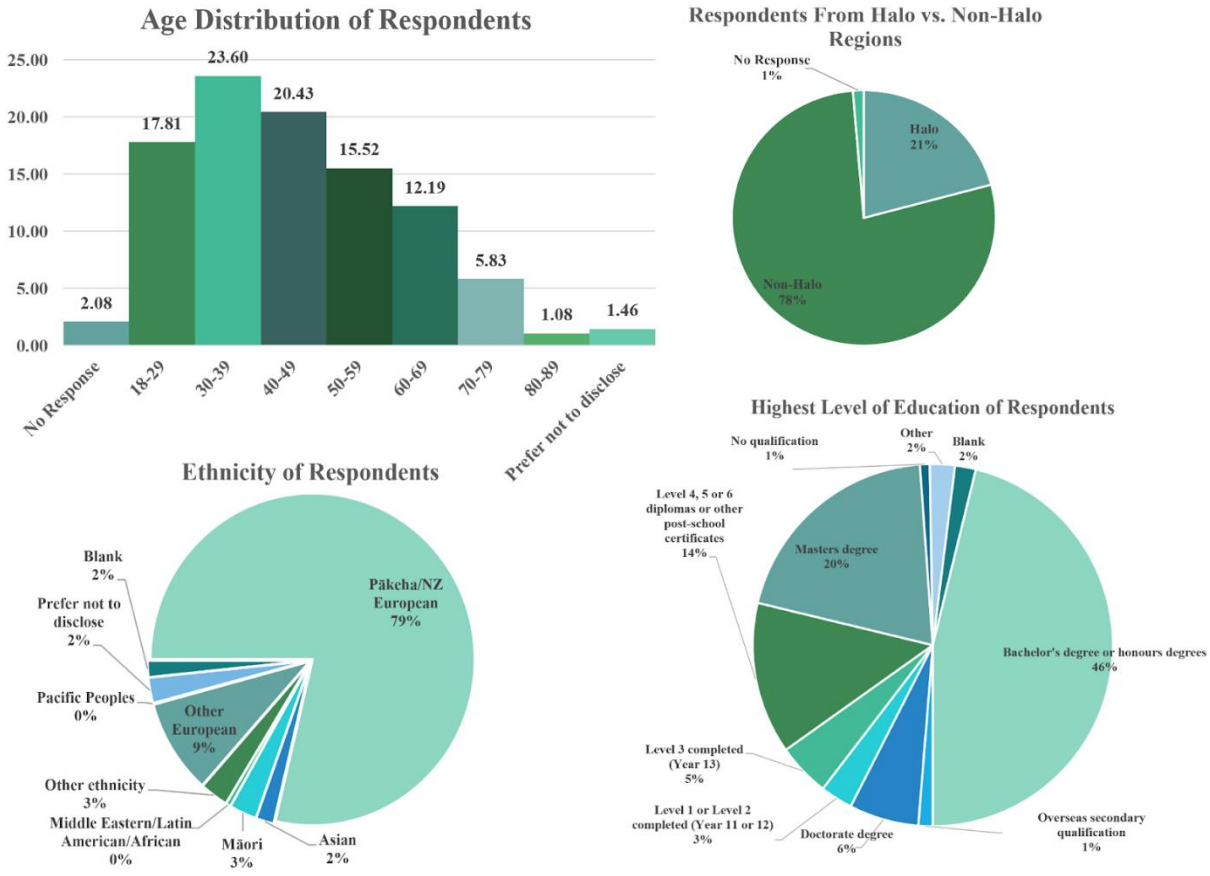


Figure 12. The ethnic distribution of our respondent pool

People from 154 different suburbs of the Greater Wellington Region responded to our survey. Most of our respondents (78%) were from the non-Halo Region, and the remaining respondents (21%) were from the Halo Region (Karori, Kelburn, Northland, Highbury, and Brooklyn) surrounding Zealandia (Figure 12).

We also found that the majority of our respondents (72.49%) received a bachelor's degree or higher. Very few of our respondents (0.87%) recorded having no qualifications at all (Figure 12).

We determined that most of our respondents fell within the age range of 30-39 (23.60 %). However, we were able to reach Wellington residents from each of the age groups, including 18-29 (17.81 %) and 80+ (1.08 %) (Figure 12).

When analyzing the ethnic distribution of survey participants, we found that most of our respondents (78.69%) identified as Pākehā, or New Zealand European and only 2.75% identified as Māori (Figure 12).

4.2 Low Māori collaboration

We found that there is consistent low Māori collaboration with Zealandia. We interviewed Zealandia staff members to gain insight on the current levels of participation with the organization. Through the interviews we identified the different demographic groups that have a lower Zealandia participation rate than others. These groups specifically include the 20-29 age group and the Māori population (A. Turnbull, personal communication, January 16, 2020; S. Moorhouse, personal communication, January 17, 2020). Only 2.75% of our respondents identified as Māori. From the 2018 census, we found that approximately 18.5% of the Greater Wellington Region identifies as Māori (Wellington City, 2018), which is significantly greater than the percent of our respondents that identify as Māori. We also examined the same findings from the 2017 IQP. They also struggled to reach Māori, as only 3.72% of their respondents identified as Māori. From this evidence, we found that there is a consistent lower collaboration rate between the Māori population and Zealandia.

4.3 Respondents properly interact with nature

We found that the majority of our respondents were ecologically conscious when interacting with the native bird life. We asked respondents to state how frequently they participate in various activities including kākā parrot feeding habits. Of our respondents, 93% said they do not feed kākā parrots, 2.21% recorded that they do feed them, and 2.79% said they do not anymore but they used to. For those who responded that they do feed kākā, most recorded feeding them fruit or sugar water (Figure 13).

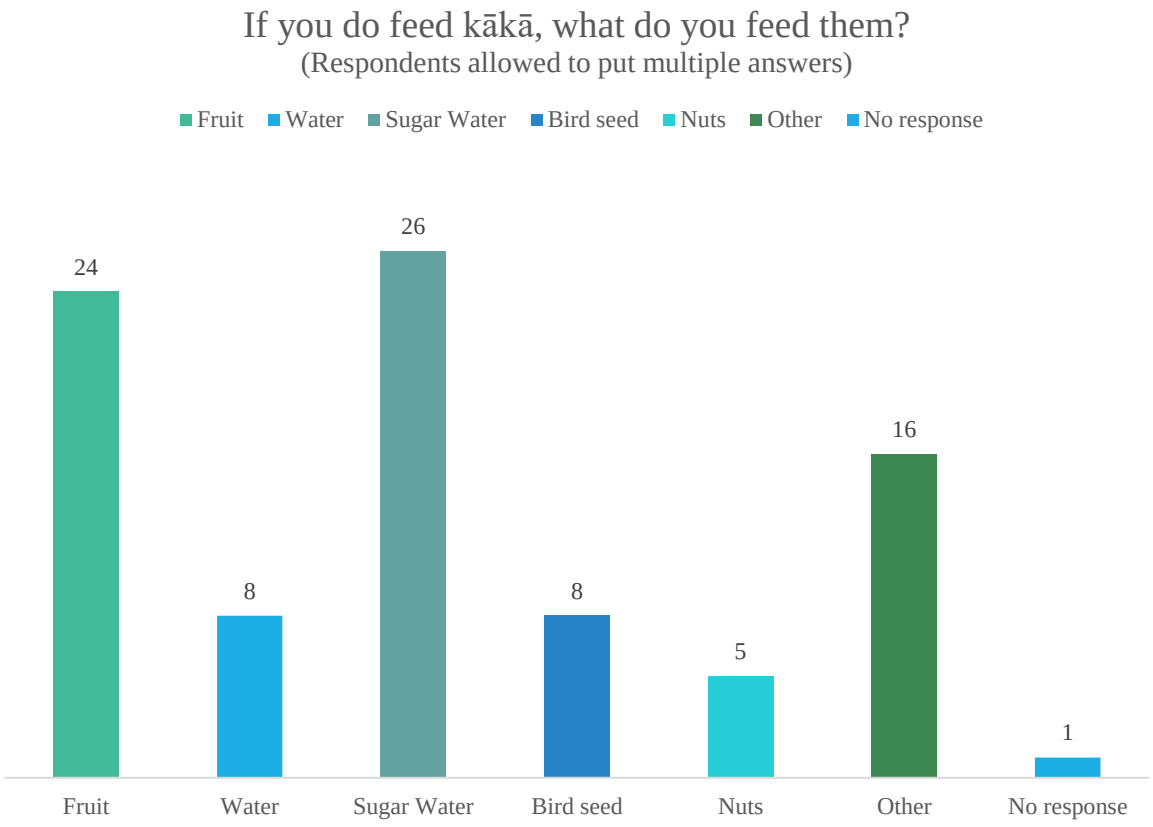


Figure 13. What respondents feed kākā parrots

For those who no longer feed kākā, most of the motivations to stop feeding included moving, learning about the negative effects (e.g. metabolic bone disease), and the annoyance of damage to trees or property caused by kākā. In total, 38.29% of respondents did see damage by kākā near their home; these respondents mostly cited tree damage (33.29 %) and roof/gutter damage (3.7%)(Figure 14).

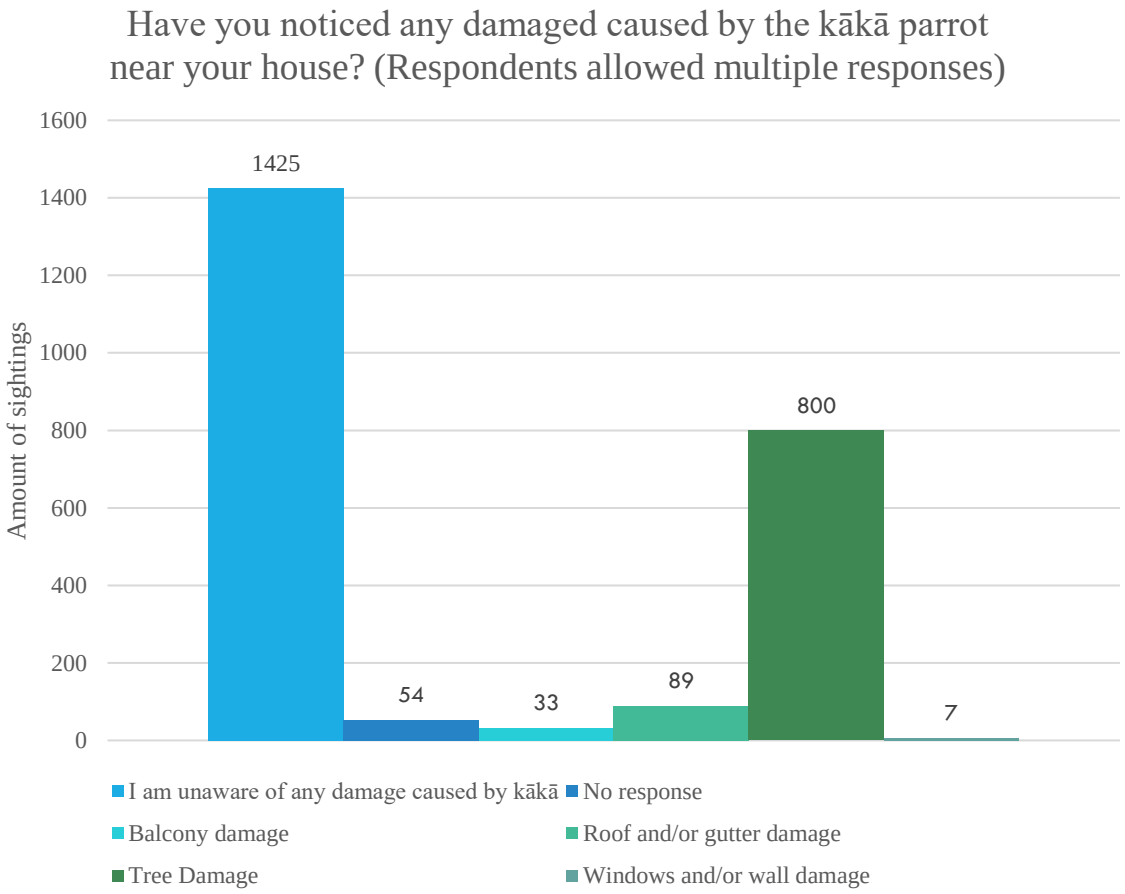


Figure 14. Damage caused by kākā

Respondents were also asked to answer how frequently they participate in various nature related activities. These activities included pest trapping, visiting Zealandia, maintaining a bird feeder, gardening, and bird watching. We determined that the activity our respondents performed most frequently was maintaining a bird feeder, with 28.92% saying they participated daily (Figure 15). The least frequented activity was visiting Zealandia, 63.92% of respondents recorded that they never visit Zealandia.

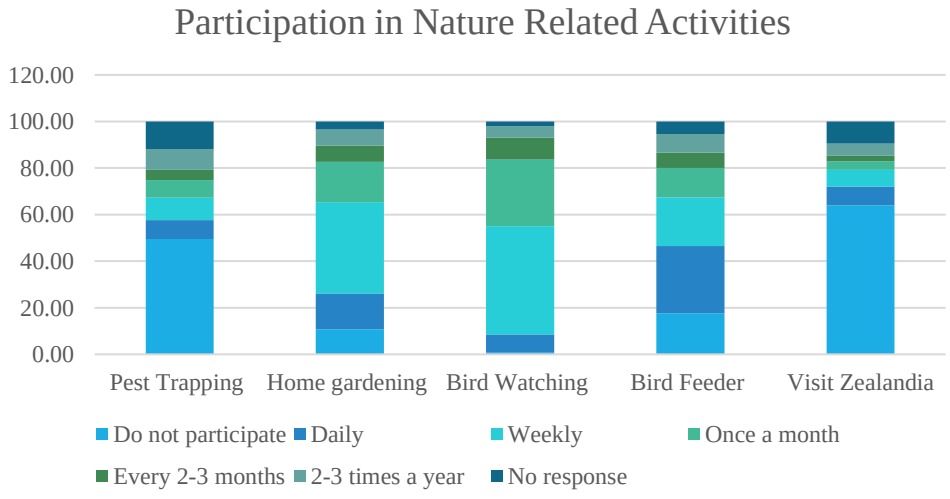


Figure 15. Respondent participation in nature activities

4.4 Variations in bird life knowledge

The survey tested the bird life knowledge levels of our respondents. This was accomplished by asking respondents to identify the names and status (native or non-native to New Zealand) of different bird species. **We found that the level of bird life knowledge varies across different demographics and about different bird species.**

4.4.1 Bird species identification

We first tested people's ability to identify four native New Zealand bird species (Figure 16), all of which can be found in Zealandia. Respondents provided a text entry of their answer for the bird species. We accepted misspellings of the correct species, the Māori or English spelling, and the binomial nomenclature.

Figure 16. Tūī, tīeke, kererū, and kākā (left to right)(Zealandia, 2018).

We found the highest accuracy in identifying the tūī, with 98.42% of respondents correctly naming the tūī. We found that the lowest percentage of correct answers came from identifying the tīeke, 79.98% of respondents correctly named the bird. 96.80% of respondents properly identified the kererū, and 85.31% properly identified the kākā (Figure 17).

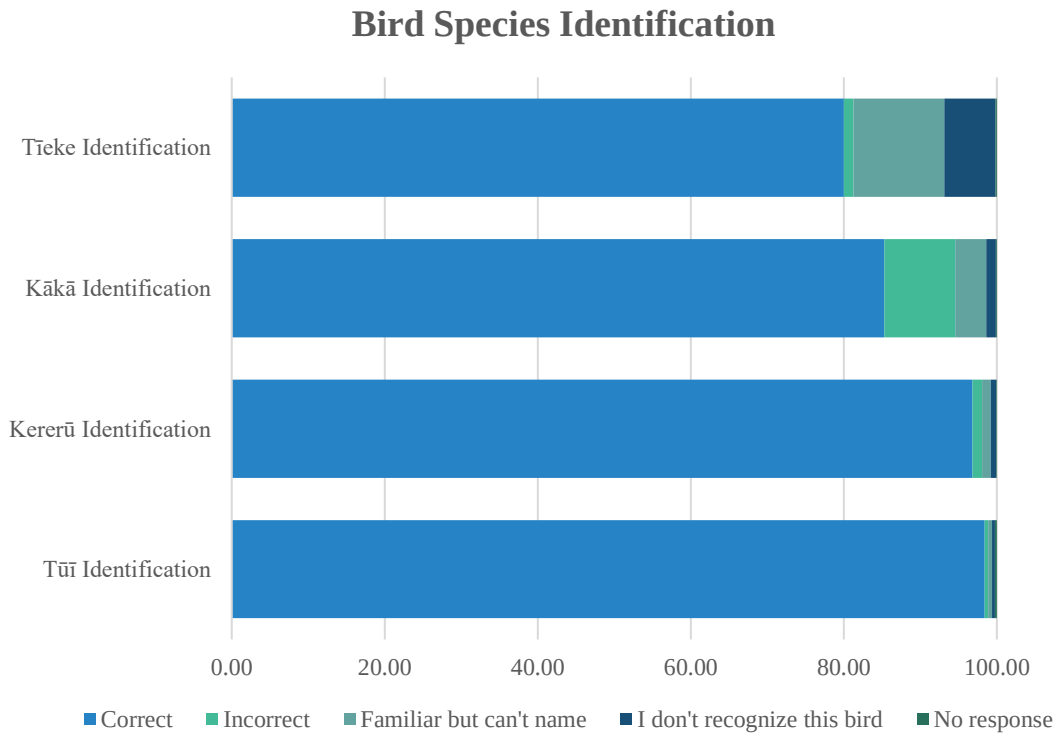


Figure 17. Bird species identification

We asked respondents to also provide text entries of features they use to identify each of the bird species. The different descriptive words used to identify the tūī can be seen in the word map; words which respondents used more frequently are larger than the others (Figure 18). The more common ways people identify the tūī is through its white tuft or its coloring. The remaining word maps can be found in Appendix F.

Figure 18. Different ways respondents identify the tūī

Respondents were also asked if each of the species were native to New Zealand or not. The highest level of accuracy was found from the tūī, 98.96% of respondents identified it as native and the lowest was found from the tīeke identification (86.97%)(Figure 19).

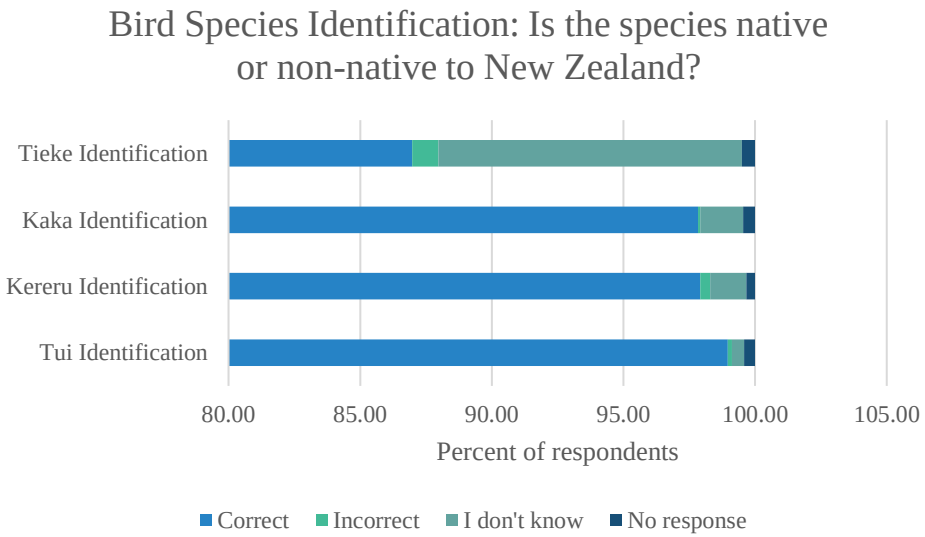


Figure 19. Identification of tūī, kererū, tīeke, and kākā as native

4.4.2 Native versus non-native species

We further tested people's bird life knowledge by asking them to identify whether or not a displayed species was native to New Zealand. We presented the respondents with a house sparrow, kākāriki, hihi, and California quail (Figure 20).

Figure 20. The kākāriki, California quail, the hihi, and the house sparrow (left to right)(Zealandia, 2018).

Most respondents correctly identified the hihi as native (92.88%). The kākāriki posed the most difficulty with only 72.03% of respondents identifying it as native (Figure 21).

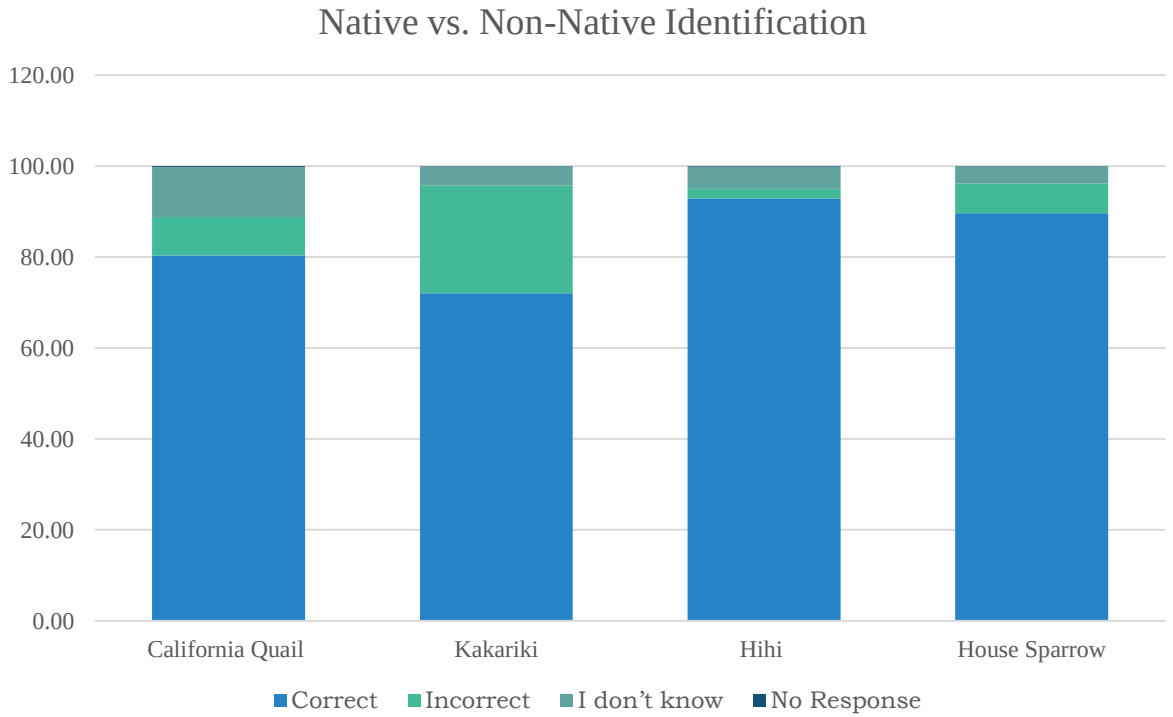


Figure 21. The results from the native and non-native identification questions.

4.4.3 Bird score calculation

In order to understand the overall bird life knowledge of Wellingtonians, we analyzed the responses to species identification and native or non-native questions. To quantify this knowledge into a single value, we generated a "bird score" for every respondent. We wrote code in Python to calculate each score (Appendix C). The bird score was computed based on the correctness of survey responses with a range from 0 to 100, zero being no correct answers and 100 being all correct answers. The amount of points awarded for naming each species depended on how easily survey respondents identified the species and how common the bird is throughout Wellington. In total, 98.42% of respondents were able to correctly name the tūī while people struggled the most to identify the tīeke. For this reason, a respondent who correctly identified the tūī received 13 points while a respondent who correctly identified a tīeke gained 17 points. Identification of the kākā and the kererū were both worth 16 points. Table 1 further explains the point distribution used to calculate bird score. The complete code used to generate bird scores can be found in Appendix C.

Table 1. Calculation of bird score

Native versus non-Native species		
House sparrow	Non-native	5 pts
	Native	0 pts
Hihi	Non-native	0 pts
	Native	5 pts
Kākāriki	Non-native	0 pts
	Native	5 pts
California quail	Non-native	5 pts
	Native	0 pts
Tūī	Non-native	0 pts
	Native	5 pts
Kākā	Non-native	0 pts
	Native	5 pts
Kererū	Non-native	0 pts
	Native	5 pts
Tīeke	Non-native	0 pts
	Native	5 pts
Bird species identification		
Tūī	Correct	13 pts
	Incorrect	0 pts
Kākā	Correct	16 pts
	Incorrect	0 pts
Kererū	Correct	16 pts
	Incorrect	0 pts
Tīeke	Correct	17 pts
	Incorrect	0 pts
Total Score		**Bird Score**

4.4.4 Positive relationships between demographics and bird life knowledge

Table 2. The average bird score for the Halo and non-Halo Region.

Halo vs. non-Halo	Average Bird Score	Standard Deviation	Sample Size
No Response	81.03	23.05	32
Non-Halo	86.20	16.98	1871
Halo	91.71	14.47	500

We found that the people living in the Halo Region have a higher level of bird life knowledge than those that live farther away. Those living in the Halo Region around Zealandia, on average, scored about 5.51 points higher than those in the non-Halo Region (Table 2). By computing the t-test, we determined the t-score to equal -7.2763 and the degrees of freedom to equal 901. We then determined the p-value to be less than 0.05. Because of this, we rejected the null hypothesis where the average bird scores of these two groups are equal; we then concluded that the average bird score for those in the Halo Region is significantly greater than those in the non-Halo Region with 95% confidence.

Table 3. The average bird score for varying levels of education.

Education	Average Bird Score	Standard Deviation	Sample Size
No Response	79.40	23.30	45
Bachelor's degree or honor's degrees	88.03	16.43	1109
Level 4, 5 or 6 diplomas or other post-school certificates	85.11	16.97	326
Other	86.59	13.93	54
Master's degree	89.91	14.79	483
Doctorate degree	89.62	16.23	150
Level 1 or Level 2 completed (Year 11 or 12)	83.43	15.52	70
Level 3 completed (Year 13)	83.07	17.77	114
Overseas secondary qualification	79.87	24.09	31
No qualification	69.38	23.92	21

We further found that a higher level of education is positively correlated with knowledge about bird life. In terms of education levels, we found that the highest average bird scores came from people with a master's degree or higher. The average bird score for people with a master's degree is 89.91 points while the average bird score for respondents with a doctorate degree is 89.62 points (Table 3). The lowest average bird scores came from those with no qualification, overseas secondary qualification, and a completion of year 11 and 12. We then performed a t-test for respondents with a master's degree and respondents with a completion of year 11 or 12. Our calculated t-score is 3.2835 and the degrees of freedom are 88. We computed a p-value less than .005, so we concluded with 95% confidence that the average bird score was significantly higher for those with a master's degree than those with a completion of year 11 or 12. This was further supported by a comparison of the average bird scores of those with a bachelor's degree and those who achieved a Level 4, 5, or 6 diploma. We found that those with a bachelor's degree scored 2.92 points higher than those with a Level 4, 5, or 6 diploma. We confirmed the significance of this through a t-test. We calculated a t-score of 2.7508 and degrees of freedom of 517. After computing a p-value of less than 0.05, we concluded with 95% confidence that the average bird score of those with a bachelor's degree was significantly higher.

We asked respondents to identify how they have seen bird life biodiversity change near their house. People ranked the change as either a large decrease, decrease, no change, increase or large increase (Table 4).

Table 4. The average bird scores for changes in bird life around respondents' homes.

Change in bird life around home	Average bird score	Standard Deviation	Sample Size
No Response	64.60	38.22	5
Large decrease	78.89	18.47	27
Decrease	79.64	24.50	112
No change	82.90	19.54	726
Increase	89.22	14.81	1192
Large increase	93.33	9.98	341

We found that those who saw a greater increase in bird life near their home had greater bird life knowledge. A two-sample, unpaired t-test, to compare the bird score means between people who saw a large increase in bird life and those who saw a decrease, resulted in a t-score of -5.7586 and degrees of freedom of 123. Using these values, we calculated a p-value of less than 0.05 allowing us to conclude with 95% confidence that the average bird score of those who saw a large increase was significantly greater than those who saw a decrease. The same correlation is found when comparing the mean of those who saw no change in bird life near their house to those who saw an increase in bird life around them. A two-sample unpaired t-test was completed to compare these respondent groups. This resulted in a t-score of -7.5006 and degrees of freedom of 1229. The p-value was less than 0.05, which allowed us to conclude with 95% confidence that those who saw an increase in bird life have a significantly higher level of bird life knowledge than those who saw no change.

Table 5. Average bird score for different respondent age groups.

Age	Average Score	Standard Deviation	Population Size
No Response	80.24	22.84	50
30-39	85.34	19.00	567
18-29	84.92	18.14	428
70-79	92.64	10.18	140
50-59	88.13	15.65	373
40-49	87.48	15.84	491
Prefer not to disclose	92.69	7.95	35
60-69	90.70	13.13	293
80+	91.12	15.03	26

Lastly, we determined that there is a positive correlation between age and bird life knowledge. When relating the age groupings and bird knowledge score, we noted the highest average bird score came from the 70-79 age group (Table 5). The lowest average bird score came from the 18-29-year-old age group. We compared the means of these two age groups and calculated a t-score of 6.285 and degrees of freedom of 427. Using this, we found a p-value of less than 0.05. We then concluded, with 95% confidence, that the difference between the average bird scores of 18-29 and 70-79 is statistically significant. Similarly, we found that those in the age range from 40-49 scored about 2.79 points higher than those in the age range from 30-39. Using a two-sample unpaired t-test, we calculated a t-score of -2.6043 and degrees of freedom of 1054. We then calculated a p-value less than 0.05 allowing us to conclude with 95% confidence that the difference in the means was significant.

4.5 Longitudinal trends

We identified changes in bird life knowledge overtime by comparing our findings with those of previously conducted IQPs. Specifically, we looked at findings for kākā feeding habits, species identification and bird sightings.

We found that there was not a significant improvement in bird species recognition from 2017 to 2020. In the 2017 IQP survey, respondents identified pictures of the tūī, tīeke, sparrow and kākā. We also asked respondents to identify the tūī, tīeke, and kākā. Instead of identifying the sparrow, we added the kererū. We compared the percent of respondents who could correctly identify each of these birds; percentages were used in place

of the number of respondents due to the large difference in sample size (Figure 22). In 2017, 418 people responded to the survey, whereas 2403 people responded to our survey.

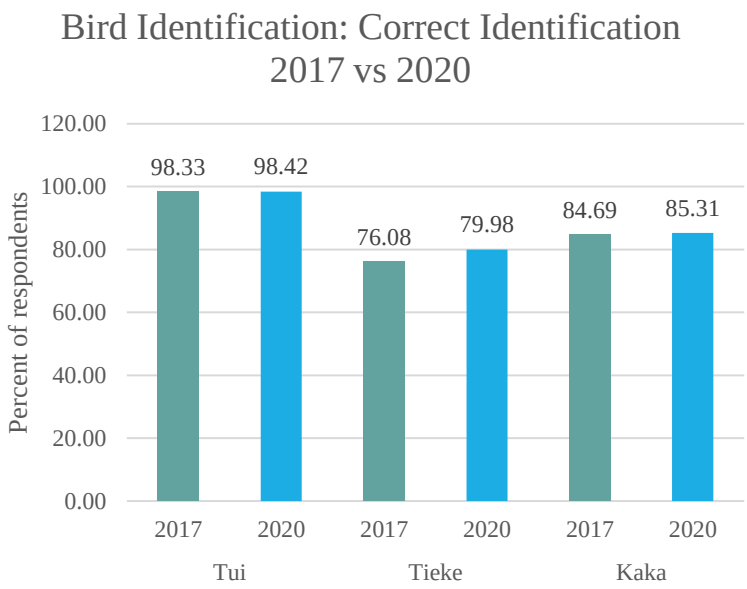


Figure 22. Comparison of bird identification results from 2017 to 2020.

For each of the bird species, (tūī, tīeke, and kākā) the percent of respondents who correctly named them increased from 2017 to 2020. An increase of 0.09% occurred in tūī identification, 3.90% more people correctly identified the tīeke and proper kākā identification increased by 0.62%.

We did not find a significant improvement in people's ability to correctly identify species as native or non-native between 2017 and 2020. Respondents were asked to identify four species as native or non-native to New Zealand in the 2017 survey. These species included the tūī, tīeke, kākā and the sparrow (Figure 23). When compared to our data for the same questions, the percentage of participants who correctly identified the tūī as native decreased by 0.32%. As for the tīeke, the percent of participants who correctly stated that it is native decreased by 2.26%. The percent of participants who correctly identified the kākā as native increased slightly (2.86%).

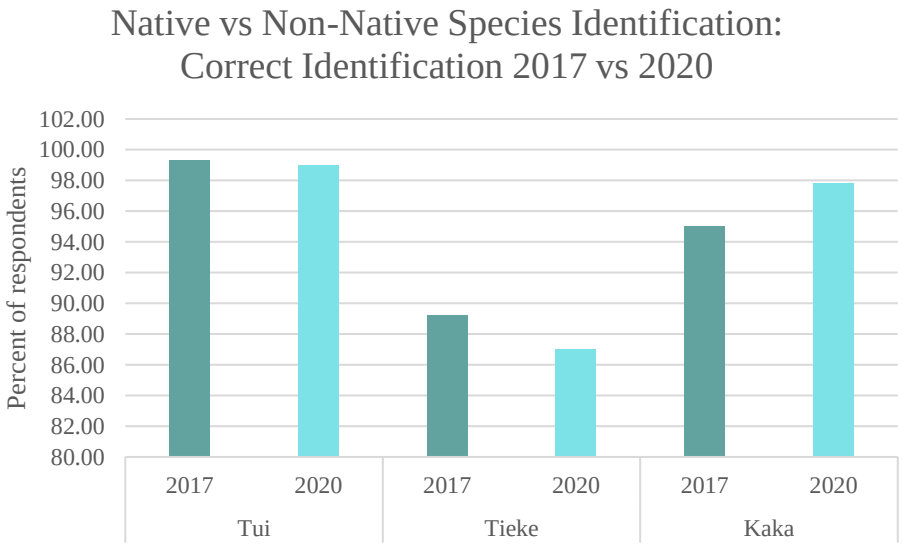


Figure 23. Comparison in native and non-native species identification: 2017 and 2020

Moreover, we compared the percent of respondents who stated seeing the tūī, tīeke and kākā near where they live. Again, we used percentages instead of the total number of sightings due to the variation in the sample sizes. **We found an increase in species sightings for both the tūī and the tīeke from 2017 to 2020; however, we noted that the percent of respondents who noticed kākā near their home decreased by 5.85%** (Figure 24)**.**

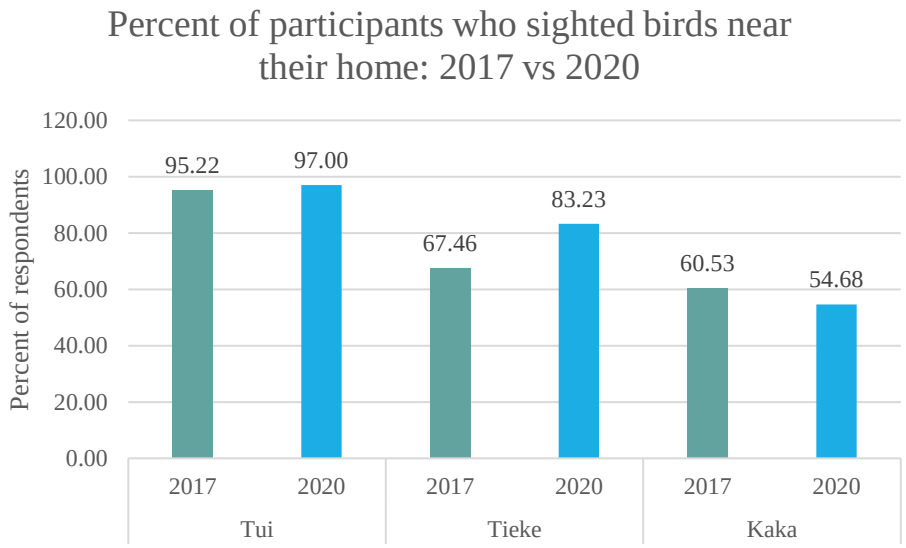


Figure 24. Comparison of bird sightings near respondents' home in 2017 vs 2020.

Finally, we analyzed the difference in kākā feeding habits between the respondents in 2013, 2017, and 2020 (Figure 25). **From 2013 to 2020, we found the amount of people who responded "yes" to feeding the kākā progressively decreased.**

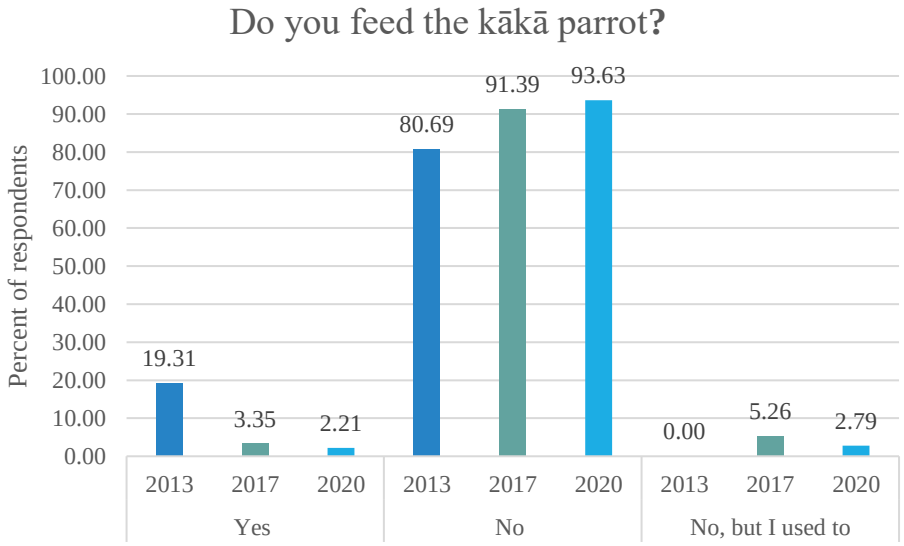


Figure 25. Comparison of the percent of respondents who feed kākā parrots between 2013, 2017 and 2020.

Similar to what we did with the data from our survey, we calculated a bird score for each respondent from 2017 (Appendix D). The total number of points a respondent could score was 50 due there being less questions factored into their score. However, we were still able to consolidate and compare the data amongst different factors including age, highest achieved level of education, and proximity to Zealandia.

We found that in 2017, those with more advanced degrees were more educated on bird life knowledge. In 2017, those with a master's degree or higher received the highest average bird score with an average of 44.99 points. We compared this to the average bird

score of the lowest level of education respondents could select, completing year 10 at high school (40.53 points). After performing a two-sample unpaired t-test, we determined that the mean for those with a master's degree or higher was significantly greater than those who completed year 10 at high school with 95% confidence. This corresponds to our finding where we identified that those with a higher education level have a significantly higher bird life knowledge level.

We also calculated the average bird score for respondents living in the Halo Region and those living in the non-Halo Region during 2017. The average bird score for people in the Halo Region was 44.20, while the average for people outside the Halo Region was 43.70. We performed two-sample, unpaired t-test and did not find a statistically significant difference between the averages. **We found no significant difference in bird life knowledge between the Halo Region and non-Halo Region in 2017.**

Chapter 5: Conclusions

After analyzing our findings, we were able to formulate various conclusions to gauge the level of bird life knowledge in the Greater Wellington Region. After drawing these conclusions, we formulated four recommendations for Zealandia.

5.1 Conclusions

Through further analysis of our findings we formulated conclusions about the bird life knowledge of Wellingtonians' and changes in the level of awareness over the years. After finding a higher average bird score for those living in the Halo Region than those living outside of the Halo Region, we concluded that those in closer proximity to nature have higher levels of bird life knowledge. This led us to the further conclusion of there being benefits that exist in frequently seeing and interacting with nature. Those in the region around the perimeter of Zealandia are likely to be the most frequent viewers of bird species that migrate to due to the spillover effect. This is supported by the data as most of the survey participants who responded "yes" to seeing various bird species near where they live, were from the Halo Region (Figure 26)(Appendix G).

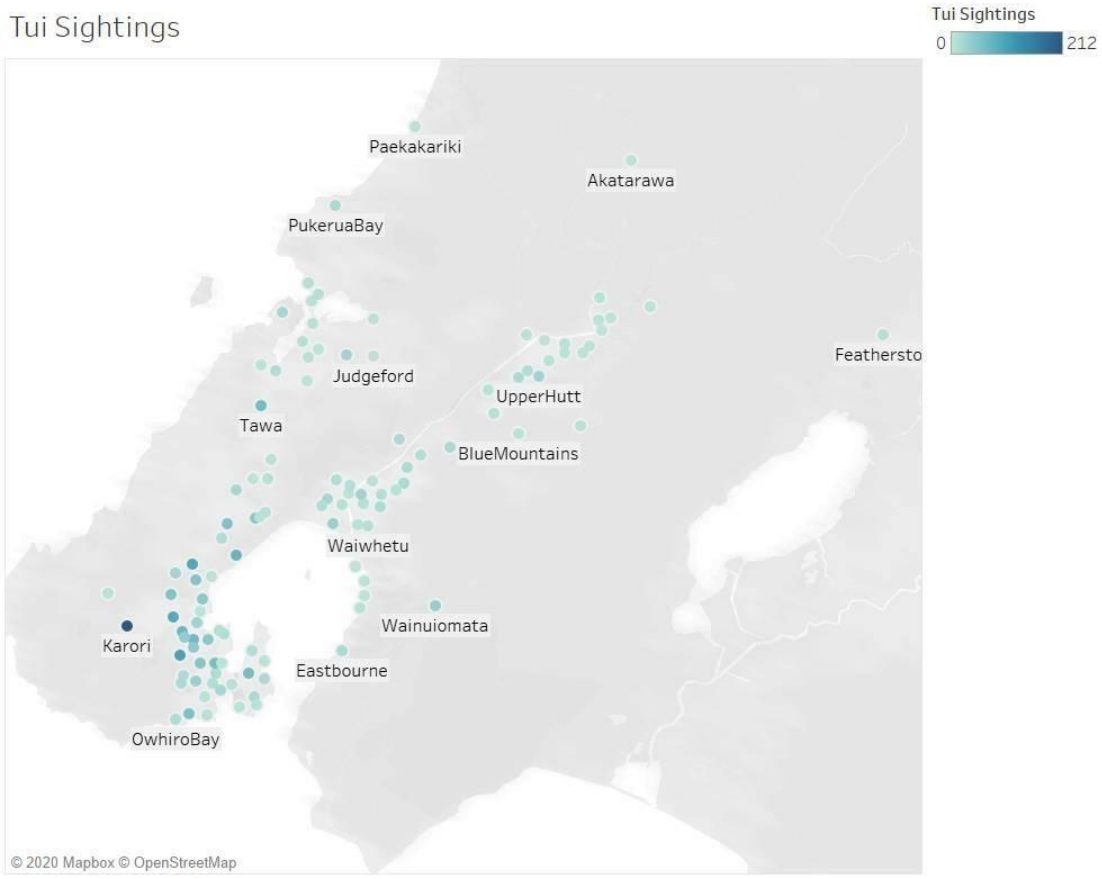


Figure 26. Locations of tūī sightings.

We also drew the conclusion that the higher quantities of birds in the region surrounding Zealandia leads to increased interactions between humans and birds. As these interactions occur more frequently, people become more aware of the birds around them and thus develop a higher level of bird life knowledge, as shown by the average bird scores.

We further support this conclusion with our data pertaining to respondents' perception of the change in bird life around where they live. The average bird score was higher for those who saw a “large increase” in bird life in comparison to those who saw a “decrease.” We attribute the higher bird score to the increased interactions with bird life. We also believe that people who see bird species more frequently are more alert and cognitive of birds. Thus, they are also more attentive and invested and more likely to become educated about the birds that they see.

Similarly, we concluded that those with higher levels of education are more likely to be educated about bird life as well. The average bird score for those who had a master’s degree was significantly greater than that of someone with a Level 1 or 2 qualification. We believe that this could be due to a variety of reasons. The first being that those with a higher level of education may have studied ecology and bird life through formal education. Additionally, they may have been surrounded by other students who were educated in bird life and were encouraged by peers to become more knowledgeable. Those with higher levels of education may also be more aware of informative, trustworthy news sources where they could learn about birds.

Through tests of significance, we found that respondents who fell in the 70-79 age group were more educated on bird life than those aged 18-29. During interviews with staff members, we learned that older age demographics participate in Zealandia the most and are also the primary volunteers. Conversely, the staff identified that the younger age groups were least participative in Zealandia’s activities. We believe that this is a contributing factor to the lower average bird score of the younger Wellingtonians. We also assume that older generations are more likely to be retired and have time to take up hobbies such as birding. Younger generations may have different time and financial constraints preventing them from dedicating time to bird life.

Although we created significant conclusions from our own findings, we are unable to find many concrete longitudinal trends in bird life knowledge between 2013, 2017, and 2020. Although we concluded that there has been an increase in bird life knowledge for those living within the Halo Region, the data was only statistically significant in 2020, not in 2017. We also noted that the percent of respondents who correctly identified various bird species increased. However, the increase was not substantial and may likely be attributed to the fact that the sample sizes in 2013 and 2017 are significantly smaller than ours. In the native species recognition, we even found that the percent of correct respondents decreased for some species.

We only saw consistent changes in kākā feeding habits. From 2013 to 2020, the percent of respondents that participated in kākā feeding decreased. We believe this is likely due to more publicity on the dangers of feeding kākā and the increasing kākā populations in the urban environments. Kākā are notorious for causing damage to trees and buildings, therefore, we assume that people might not feed or stop feeding the kākā to prevent them from returning and causing further damage.

5.2 Recommendations

As part of our conclusion, we have four recommendations for Zealandia to help improve their outreach efforts. These recommendations will also aid in promoting bird life awareness throughout the Greater Wellington Region.

5.2.1 Develop an automated data collection tool

We recommend that Zealandia create a formal and automated data collection tool. This data collection tool would include both a comprehensive way to test people's bird life knowledge and a repeatable method for distribution (e.g., a survey on an app or website). We hoped to establish longitudinal trends from past IQP project data, but we found this challenging due to the varying sample sizes and there only being two data sets to compare to. We collected responses from 2,403 respondents in total. This was five times the size of the sample collected in 2017 and 10 times the sample collected in 2013. Additionally, there was a variation between the questions found in each of the surveys. Although we were able to compare some categories like bird species identification and kākā feeding habits, it would be beneficial to compare the same survey over years. Zealandia could use a program similar to our code used to determine bird score to quantify people's bird life knowledge to allow for easier analysis of these trends. The creation of a data collection tool and a method for distribution, especially a routinely used one, would allow Zealandia to easily establish correlations and longitudinal trends for years to come.

5.2.2 Increase Māori collaboration

The demographic breakdown for our survey consisted of 2.75% Māori participants, while the Wellington census showed the population of Māori is around 18.5%. This large discrepancy between our sample population and the census population may be due to a failure in distribution or an overall lower Māori interaction within the birder population. Marketing to this group may lead to an increase in the number of participants to Zealandia and different conservation projects. Having increased collaboration with Māori may also provide a new perspective on conservation efforts. One way to connect with the Māori demographic may be to converse with different cultural organizations throughout Wellington.

5.2.3 Focus on rarer birds

We found knowledge on the more commonly known birds to be higher than that of the rarer ones. This lack of awareness about some bird species might be filled by focusing marketing material on the specific birds that are less common throughout Wellington. This could mean giving Zealandia visitors different facts and details about a bird of the day. In addition to providing information, Zealandia could have single-question trivia polls about the bird of the day for social media and Zealandia visitors. After the poll, fun facts could be given to increase interest in a bird. These micro educational opportunities have the potential to help form positive attachments between visitors and birds.

5.2.4 Publish a regional newsletter

In our research, we found a statistically significant difference between the bird life knowledge of residents in the Halo and non-Halo region. This difference may be attributed to the distance of the suburbs from Zealandia. This could be solved by the use of a regional newsletter. Residents who cannot visit Zealandia as often if they live farther away, can read about fun facts, birds that have been spotted in different areas, and popular bird watching spots. This newsletter will allow residents from various locations to have access to the same information regardless if they can make it to Zealandia or not.

5.3 Further work

Our project accomplished a significant amount towards gauging the quantitative side of Wellingtonians' bird life knowledge. However, there are still more approaches to explore bird life knowledge and awareness. To create stronger and more well-rounded analyses, we suggest collecting a higher level of qualitative data. Throughout our project we informally conversed with both Zealandia visitors and the staff about their experiences with the native bird life. These conversations gave us insight into all the interactions, both positive and negative, people have had with the bird life around them. Further and more structured research can be done to collect these various bird stories from Wellingtonians. These stories could be analyzed to identify motivations of a passion for bird life and could be used to support or contrast the quantitative data.

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Appendices

Appendix A: Qualtrics Survey

WPI

Intro

Kia ora! Thank you for taking the time to complete this survey. We are a team from WPI, a university in the United States, conducting a research project to gain a better understanding of Wellingtonians' knowledge of bird life. This survey includes questions relating to bird recognition, nature habits, and some demographic information. Survey responses will be kept anonymous and used for research purposes only. Please only respond to this survey if you live in the greater Wellington region and are at least 18 years of age. You may stop this survey at any point. At the end of this survey, you will have the option to enter your email into a draw to win a free year membership to Zealandia. For further inquiries, contact us at birdlifewpi@gmail.com or 021-214-2524.

Native or Non-native

Is this bird native to New Zealand? *(Photo Credit: @malangeo_birbs)*

- ◯ Yes
- ◯ No
- ◯ I don't know

Is this bird native to New Zealand? *(Photo credit: @bsd1)*

- ◯ Yes
- ◯ No
- ◯ I don't know

Is this bird native to New Zealand? *(Photo credit: @karlamaree.nz)*

- ◯ Yes
- ◯ No
- ◯ I don't know

Is this bird native to New Zealand? *(Photo Credit: Ormond Torr)*

- ◯ Yes
- ◯ No
- ◯ I don't know

Bird Life Knowledge 1

This section is about bird life knowledge.

Can you identify this bird? *(Photo credit: @jackdriver)*

- ◯ Yes, it is a _____
- ◯ No, but I am familiar with it
- ◯ No, I don't know this bird

How do you know it's this kind of bird?

- ◯ I can't identify this bird
- ◯ I identify this bird by: _____

Is this bird native to New Zealand?

- ◯ Yes
- ◯ No
- ◯ I don't know

Have you noticed this bird near where you live?

- ◯ Yes
- ◯ No

Bird Life Knowledge 2

Can you identify this bird? (*Photo credit: @melissa_boardman)*

- ◯ Yes, it is a _____
- ◯ No, but I am familiar with it
- ◯ No, I don't know this bird

How do you know it's this kind of bird?

- ◯ I can't identify this bird
- ◯ I identify this bird by: _____

Is this bird native to New Zealand?

- ◯ Yes
- ◯ No
- ◯ I don't know

Have you noticed this bird near where you live?

- ◯ Yes
- ◯ No

Bird Life Knowledge 3

Can you identify this bird? (*Photo credit: @judi.lapsley.miller)*

- ◯ Yes, it is a _____
- ◯ No, but I am familiar with it
- ◯ No, I don't know this bird

How do you know it's this kind of bird?

- ◯ I can't identify this bird
- ◯ I identify this bird by: [ ]

Is this bird native to New Zealand?

- ◯ Yes
- ◯ No
- ◯ I don't know

Have you noticed this bird near where you live?

- ◯ Yes
- ◯ No

Bird Life Knowledge 4

Can you identify this bird? *(Photo credit: @hollyneill)*

- ◯ Yes, it is a [ ]
- ◯ No, but I am familiar with it
- ◯ No, I don't know this bird

How do you know it's this kind of bird?

- ◯ I can't identify this bird
- ◯ I identify this bird by: [ ]

Is this bird native to New Zealand?

- ◯ Yes
- ◯ No
- ◯ I don't know

Have you noticed this bird near where you live?

- ◯ Yes
- ◯ No

Bird Life Knowledge 5

This sections is about the kākā. (*Photo credit: @hollyneill)*

Do you feed kākā?

- ◯ Yes
- ◯ No
- ◯ No, but I used to

- ◯ I don't know

How long ago did you start feeding kākā?

- ◯ In the past month
- ◯ In the past 6 months
- ◯ In the past year
- ◯ In the past 2 years
- ◯ Longer than 2 years

What do you usually feed kākā? (Select all that apply)

- ☐ Nuts (please specify if possible)
- ☐ Fruit
- ☐ Sugar Water
- ☐ Water
- ☐ Bird seed
- ☐ Other

Why did you stop feeding kākā?

Have you seen any damage caused by kākā? (Select all that apply)

- ☐ I am unaware of any damage caused by kākā
- ☐ Roof and/or gutter damage
- ☐ Windows and/or wall damage
- ☐ Balcony damage
- ☐ Tree damage

Bird Band

Have you ever noticed a bird around where you live with a identifying band around its feet? An example is displayed above. *(Photo credit: @leonberardnz)*

- ◯ Yes
- ◯ No

Nature Habits

This section is about nature habits.

How often do you take part in the following activities:

Pest trapping

Home gardening

Visiting parks or gardens

Bird watching

Maintaining a bird feeder

Visiting Zealandia

Have you noticed a change in bird life around your home?

- ◯ Large decrease
- ◯ Decrease
- ◯ No change
- ◯ Increase
- ◯ Large increase

Please select which activity you believe is most responsible for the increase in bird life within Wellington:

- ◯ Personal trapping efforts
- ◯ Zealandia's efforts
- ◯ Community trapping efforts
- ◯ Natural resurgence
- ◯ Department of Conservation's efforts
- ◯ Local and Regional efforts
- ◯ Other

Rate the level of threat to bird life of each of the following:

Pets (i.e., cats, dogs)

Pests (i.e., rats, stoats, possums)

Habitat destruction

Window strike

Car strike

Improper feeding by humans

Demographics

This section will ask optional questions about demographics. Your responses will be kept anonymous and not used for identification.

What suburb do you live in?

Post code of your current residence:

What gender do you identify as?

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

How old are you?

What ethnicity do you most identify with?

What is the highest level of education you have received?

What is your current employment status?

- ○ In paid employment
- ○ Not in paid employment
- ○ Retired
- ○ Student
- ○ Prefer not to disclose

Where do you get information on nature related topics? (Select all that apply)

- ☐ Social media (specify if possible)

☐ Websites (specify if possible)

☐ Print sources (i.e., newspaper, posters, pamphlets)

☐ Mainstream media (i.e., radio, television)

Closing Question

Thank you for taking the time to complete our survey! If you would like to enter for the chance to win a year long membership at Zealandia please enter your email:

Powered by Qualtrics

Appendix B: Distribution Flyer

Appendix C: Bird Score Code 2020

```
import unicodedata
import numpy as np
import re

def getstuff(filename):
    # opening a csv to read it and write it
    with open(filename, "r", encoding="utf8") as csvfile, open("IQPFINALDATA.csv", "w", newline='',
encoding='utf8') as writefile:
        data = csv.reader(csvfile)
```

```
        dataWriter = csv.writer(writefile)
        # yield next(data)  # yield the header row
        count = 0
        headers = next(data)
        #going through each row of the data
        for row in data:
            if count == 0:
                row.append('Bird Score')
            else:
                #uses arbitrary weights to measure bird life knowledge
                birdScore = calcBirdScore(row) #22 - Tūī, 28 - saddleback, 34 - Kererū, 40 - Kākā #Native: quail -
17, Kākāriki - 18, hihi - 19, sparrow - 20
                row.append(birdScore)

            dataWriter.writerow(row)
            # print(row)
            # print(row[44])
            # birdScore = calcBirdScore(row) #22 - Tūī, 28 - saddleback, 34 - Kererū, 40 - Kākā
            count += 1
            # if count > 5:
            #     return

def refineAnswer(ans):
    return re.sub('[^0-9a-zA-Z]+', ' ', unicodedata.normalize('NFKD', ans).encode('ASCII', 'ignore').decode("utf-
8").lower())
        # row.append()

def checkingCorrectWord(possibleWords, badWords, response):
            for bad in badWords:
                        if bad in response:
                                    return False

            for word in possibleWords:
                        if word in response:
                                    return True
            return False

def calcBirdScore(row):
    #number to return
    birdScore = 0
    #finds the answer from the row in the csv and then removes any macrons and makes it lowercase
    TūīAnswer = refineAnswer(row[22])
    saddlebackAnswer = refineAnswer(row[28])
    KererūAnswer = refineAnswer(row[34])
    KākāAnswer = refineAnswer(row[40])

    #adds arbitrary numbers based on the question
    if row[17] == 'No': birdScore += 5
    if row[18] == 'Yes': birdScore += 5
    if row[19] == 'Yes': birdScore += 5
    if row[20] == 'No': birdScore += 5

    if row[25] == 'Yes': birdScore += 5
    if row[31] == 'Yes': birdScore += 5
    if row[37] == 'Yes': birdScore += 5
    if row[44] == 'Yes': birdScore += 5
```

```
    #adds depending on whether they identify it right (includes spelling errors and alternate spellings (levenshtein distance was not implemented))
    if checkingCorrectWord(['Tūī', 'parson', 'tiu'], [], TūīAnswer): birdScore += 13
    if checkingCorrectWord(['saddl', 'tiek'], [], saddlebackAnswer): birdScore += 17
    if checkingCorrectWord(['ker', 'wood', 'nz pigeon'], [], KererūAnswer): birdScore += 16
    if checkingCorrectWord(['Kākā', 'parrot'], ['Kākāriki', 'Kākāpo',''], KākāAnswer): birdScore += 16

    # if 'Tūī' in TūīAnswer or 'parson' in TūīAnswer or 'tiu' in TūīAnswer: birdScore += 13
    # if 'saddl' in saddlebackAnswer or 'tiek' in saddlebackAnswer: birdScore += 17
    # if 'ker' in KererūAnswer or 'wood pigeon' in KererūAnswer or 'nz pigeon' in KererūAnswer or 'wood pigeon' in KererūAnswer: birdScore += 16
    # if ('Kākā' in KākāAnswer or 'parrot' in KākāAnswer) and not 'Kākāriki' in KākāAnswer and not 'Kākāpo': birdScore += 14

    #ghost code
    print(row[17], row[18], row[19], row[20] + ', ' + TūīAnswer + ', ' + saddlebackAnswer + ', ' + KererūAnswer + ', ' + KākāAnswer + ', ' + str(birdScore))
    return birdScore


getstuff("ValentineData.csv")
```

Appendix D: Bird Score Code 2017

```
import csv
import unicodedata
import numpy as np
import re

def getstuff(filename):
    # opening a csv to read it and write it
    with open(filename, "r", encoding="utf8") as csvfile, open("Scored Filtered 2017 Data.csv", "w", newline='', encoding='utf8') as writefile:
        data = csv.reader(csvfile)
        dataWriter = csv.writer(writefile)
        # yield next(data)  # yield the header row
        count = 0
        headers = next(data)
        #going through each row of the data
        for row in data:
            if count == 0:
                row.append('Bird Score')
            else:
                #uses arbitrary weights to measure bird life knowledge
                birdScore = calcBirdScore(row) #22 - Tūī, 28 - saddleback, 34 - Kererū, 40 - Kākā #Native: quail - 17, Kākāriki - 18, hihi - 19, sparrow - 20
                row.append(birdScore)
                print(birdScore)

            dataWriter.writerow(row)
            # print(row)
            # birdScore = calcBirdScore(row) #22 - Tūī, 28 - saddleback, 34 - Kererū, 40 - Kākā
            # print(birdScore)
```

```
            count += 1
            # if count > 5:
                # return

def refineAnswer(ans):
    return re.sub('[^0-9a-zA-Z]+', ' ', unicodedata.normalize('NFKD', ans).encode('ASCII', 'ignore').decode("utf-8").lower())
        # row.append()

def calcBirdScore(row):
    #number to return
    birdScore = 0
    #finds the answer from the row in the csv and then removes any macrons and makes it lowercase
    TūīAnswer = refineAnswer(row[5])
    saddlebackAnswer = refineAnswer(row[10])
    sparrowAnswer = refineAnswer(row[15])
    KākāAnswer = refineAnswer(row[20])

    #adds arbitrary numbers based on the question

    #Identified birds nativity
    if row[6] == 'Yes': birdScore += 4
    if row[11] == 'Yes': birdScore += 4
    if row[16] == 'No': birdScore += 4
    if row[21] == 'Yes': birdScore += 4

    #adds depending on whether they identify it right (includes spelling errors and alternate spellings (levenshtein distance was not implemented))
    if 'Tūī' in TūīAnswer or 'parson' in TūīAnswer or 'tiu' in TūīAnswer: birdScore += 7
    if 'saddl' in saddlebackAnswer or 'tiek' in saddlebackAnswer: birdScore += 10
    if 'spar' in sparrowAnswer or 'sparrow' in sparrowAnswer: birdScore += 8
    if 'Kākā' in KākāAnswer or 'parrot' in KākāAnswer: birdScore += 9

    #ghost code
    print(row[6], row[11], row[16], row[21] + ', ' + TūīAnswer + ', ' + saddlebackAnswer + ', ' + sparrowAnswer + ', ' + KākāAnswer + ', ' + str(birdScore))
    return birdScore


getstuff("Copy of Filtered 2017 Data.csv")
```

Appendix E: Tables of data

Table 6. Threats to bird life

	Pests (%)	Habitat destruction (%)	Pets (%)	Improper feeding (%)	Window strike (%)	Car strike (%)
No response	**1.37**	**2.25**	**1.37**	**8.49**	**5.78**	**4.83**
None	**0.42**	**0.54**	**0.29**	**0.75**	**1.41**	**1.62**

Low	**1.46**	**5.16**	**6.91**	**29.13**	**56.76**	**55.18**
Moderate	**5.24**	**21.97**	**27.13**	**42.66**	**30.05**	**31.00**
High	**24.26**	**35.71**	**39.24**	**15.06**	**5.24**	**6.20**
Very High	**67.25**	**34.37**	**25.05**	**3.91**	**0.75**	**1.17**
Total	**100**	**100**	**100**	**100**	**100**	**100**

Table 7. Bird species identification: 2017 and 2020

	Tūī		Tīeke		Kākā	
Bird Identification	**2017**	**2020**	**2017**	**2020**	**2017**	**2020**
Percent Correctly Identified	**98.33**	**98.42**	**76.08**	**79.98**	**84.69**	**85.31**

Table 8. Native and non-Native species identification: 2017 and 2020

	Tūī		Tīeke		Kākā	
Native vs. non-Native identification	**2017**	**2020**	**2017**	**2020**	**2017**	**2020**
Percent Correctly Identified	**99.28**	**98.96**	**89.23**	**86.97**	**94.98**	**97.84**

Table 9. Bird sightings near home: 2017 and 2020

	Tūī		Tīeke		Kākā	
Sightings near home	**2017**	**2020**	**2017**	**2020**	**2017**	**2020**
Percent Correctly Identified	**95.22**	**97.00**	**67.46**	**83.23**	**60.53**	**54.68**

Table 10. Kākā parrot feeding habits: 2013, 2017, and 2020

	Yes			No			No, but I used to		
Do you feed the Kākā parrot?	**2013**	**2017**	**2020**	**2013**	**2017**	**2020**	**2013**	**2017**	**2020**
Percent	**19.31**	**3.35**	**2.21**	**80.69**	**91.39**	**93.63**	**0.00**	**5.26**	**2.79**

Table 11. Participation in nature activities

Frequency	**Pest Trapping (%)**	**Home gardening (%)**	**Bird Watching (%)**	**Bird Feeder (%)**	**Visit Zealandia (%)**
Do not participate	**49.52**	**10.82**	**0.67**	**17.60**	**63.92**
Daily	**8.16**	**15.40**	**7.95**	**28.92**	**8.16**

Weekly	**9.53**	**39.16**	**46.40**	**20.93**	**7.16**
Once a month	**7.57**	**17.31**	**28.63**	**12.57**	**3.66**
Every 2-3 months	**4.49**	**7.03**	**9.45**	**6.62**	**2.58**
2-3 times a year	**8.86**	**6.87**	**4.87**	**8.03**	**5.08**
No response	**11.86**	**3.41**	**2.04**	**5.33**	**9.45**

Table 12. Tūī identification and naming

Answer	Quantity	Percent
Correct	**2365**	**98.42**
Incorrect	**11**	**0.46**
Familiar but can't name	**12**	**0.50**
I don't recognize this bird	**9**	**0.37**
No response	**6**	**0.25**
Total	**2403**	**100**

Table 13. Tūī native recognition

Native Recognition		
Answer	**Quantity**	**Percent**
Correct	**2378**	**98.96**
Incorrect	**4**	**0.17**
I don't know	**11**	**0.46**
No response	**10**	**0.42**
Total	**2403**	**100.00**

Table 14. Tūī sightings near home

Have you noticed this bird near where you live?		
Answer	**Quantity**	**Percent**
Yes	**2331**	**97.00**
No	**60**	**2.50**
No Response	**12**	**0.50**
Total	**2403**	**100**

Table 15. Tīeke identification and naming

Identification		
Answer	**Quantity**	**Percent**
Correct	**1922**	**79.98**
Incorrect	**31**	**1.29**
Don't know this bird	**285**	**11.86**

Familiar but can't name	**161**	**6.70**
No response	**4**	**0.17**
Total	**2403**	**100.00**

Table 16. Tīeke native identification

Native Recognition		
Answer	**Quantity**	**Percent**
Yes	**2090**	**86.97**
No	**24**	**1.00**
I don't know	**277**	**11.53**
No response	**12**	**0.50**
Total	**2403**	**100**

Table 17. Tīeke sightings near home

Have you seen this bird near your house?		
Answer	**Quantity**	**Percent**
Yes	**2000**	**83.23**
No	**377**	**15.69**
No response	**26**	**1.08**
Total	**2403**	**100**

Table 18. Kererū identification and naming

Identification		
Answer	**Quantity**	**Percent**
Correct	**2326**	**96.80**
Incorrect	**31**	**1.29**
Familiar but can't name	**27**	**1.12**
I don't recognize this bird	**17**	**0.71**
No response	**2**	**0.08**
Total	**2403**	**100**

Table 19. Kererū native identification

Native Recognition		
Answer	**Quantity**	**Percent**
Correct	**2353**	**97.92**
Incorrect	**9**	**0.37**
I don't know	**33**	**1.37**
No response	**8**	**0.33**
Total	**2403**	**100.00**

Table 20. Kererū sightings near home

Have you noticed this bird near where you live?		
Answer	**Quantity**	**Percent**
Yes	**1956**	**97.00**
No	**428**	**2.50**
No Response	**19**	**0.50**
Total	**2403**	**100**

Table 21. Kākā identification and naming

Identification		
Answer	**Quantity**	**Percent**
Correct	**2050**	**85.31**
Incorrect	**222**	**9.24**
Familiar but can't name	**98**	**4.08**
I don't recognize this bird	**30**	**1.25**
No response	**3**	**0.12**
Total	**2403**	**100**

Table 22. Kākā parrot native recognition

Native Recognition		
Answer	**Quantity**	**Percent**
Correct	**2351**	**97.84**
Incorrect	**2**	**0.08**
I don't know	**39**	**1.62**
No response	**11**	**0.46**
Total	**2403**	**100.00**

Table 23. Kākā parrot sightings near home

Have you seen this bird near your house?		
Answer	**Quantity**	**Percent**
Yes	**1314**	**54.68**
No	**1071**	**44.57**
No response	**18**	**0.75**
Total	**2403**	**100**

Table 24. Summary of bird species identification and naming

Possible Answers	**Tūī Identification (%)**	**Kererū Identification (%)**	**Kākā Identification (%)**	**Tīeke Identification (%)**

Correct	**98.42**	**96.80**	**85.31**	**79.98**
Incorrect	**0.46**	**1.29**	**9.24**	**1.29**
Familiar but can't name	**0.50**	**1.12**	**4.08**	**11.86**
I don't recognize this bird	**0.37**	**0.71**	**1.25**	**6.70**
No response	**0.25**	**0.08**	**0.12**	**0.17**

Table 25. Summary of native recognition for tūī, tīeke, kererū, and kākā

Possible Answers	Tūī Identification (%)	Kererū Identification (%)	Kākā Identification (%)	Tīeke Identification (%)
Correct	**98.96**	**97.92**	**97.84**	**86.97**
Incorrect	**0.17**	**0.37**	**0.08**	**1.00**
I don't know	**0.46**	**1.37**	**1.62**	**11.53**
No response	**0.42**	**0.33**	**0.46**	**0.50**

Table 26. Native or non-Native species identification

	California Quail (%)	Kākāriki (%)	Hihi (%)	House Sparrow (%)
Correct	**80.32**	**72.03**	**92.88**	**89.64**
Incorrect	**8.45**	**23.64**	**2.12**	**6.53**
I don’t know	**11.03**	**4.24**	**4.87**	**3.79**
No Response	**0.21**	**0.08**	**0.12**	**0.04**

Table 27. Sightings of bird with Zealandia bands

Have you ever noticed a bird with an identifying band near where you live?		
Response	**Quantity**	**Percentage**
No Response	**3**	**0.12**
Yes	**642**	**26.72**
No	**1758**	**73.16**
Total	**2403**	**100**

Table 28. Sighting of birds with Zealandia band: Halo and non-Halo Region

If you have noticed a bird with an identifying band, are you from the halo region?		
Response	**Quantity**	**Percentage**
Yes	**243**	**37.85046729**
No	**394**	**61.37071651**
No Response	**5**	**0.778816199**
Total	**642**	**100**

Table 29. Kākā parrot feeding

Kākā Feeding Habit	Quantity	Percentage
Yes	**53**	**2.205576363**
No, but used to	**67**	**2.78818144**
No	**2250**	**93.6329588**
No response	**33**	**1.373283396**
Total	**2403**	**100**

Table 30. Length of time respondents have been feeding kākā parrots

If you feed Kākā, how long ago did you start?		
Time	**Quantity**	**Percentage**
Longer than 2 years	**23**	**43.39622642**
In the past 2 years	**5**	**9.433962264**
In the past year	**10**	**18.86792453**
In the past 6 months	**11**	**20.75471698**
In the past month	**3**	**5.660377358**
No Response	**1**	**1.886792453**
Total	**53**	**100**

Table 31. Type of food fed to kākā parrots

If you do feed Kākā, what do you feed them?	
Food type	**Quantity**
Fruit	**24**
Water	**8**
Sugar Water	**26**
Bird seed	**8**
Nuts	**5**
Other	**16**
No response	**1**

Table 32. Damage caused by kākā parrots

Damage caused by kākā parrots (multiple response)

I am unaware of any damage caused by kākā	**1425**
No response	**54**
Balcony damage	**33**
Roof and/or gutter damage	**89**
Tree Damage	**800**
Windows and/or wall damage	**7**

Table 33. Motivations to stop feeding kākā parrots

If you used to feed Kākā parrots and stopped, why did you stop?
Wrong diet and can cause damage
Worried they'd get sick
We were unsure if raw sunflower seeds were safe for them
Told by Zealandia
time constraints
They stopped landing at my house
They stopped coming by my house
They scared off other birds
Their health
Read it was bad for them and their chicks
Publicity about that and below stealing food fromm tables outside mount bruce cafe
Not recommended that they eat human food
Not in breeding season
Not good for them
None near my new home
No food for it
My friends feed them at their place and I took part. They fed them almonds and apples, and sugar water, but then I read that the almonds are bad for them, so I suggested they stop. They did, but still feed them apple and sugarwater.
Moved and don't see them as much and no where to put sugarwater
Mainly because someone cut the tree down that they used to congregate in near my house. Also because it's not good for them - they should get their food from the wild.
made aware of metabolic bone disease
Learnt that it was bad

Learned about the negative impact
Knowledge of health risks
It's best if they forage for themselves. I do not want to encourage them to rely on humans, or to eat an inappropriate and non-nutririous diet. If they visit in winter, I may provide sugar water and mealworms.
It’s bad for them to be fed by humans
Information campaigns from zealandia
If feed improperly they can pass on their malnutrition to their young
I wasn’t sure if it would make them sick
I was told that it could harm their health
I was told apple was no good.
I want them to rely on the resources in the natural planet and not be reliant on me as a human
I used to feed Kākā at Zealandia to help a friend who was rostered as a volunteer until she stopped volunteering.
I saw your request.
I saw too many cases of metabolic bone disease in the chicks
I realised it wasn’t creating a healthy environment. I used to have a sugar water feeder and leave apples out for the kākā.
I read it was not a good idea to feed them.
I read in Zealandia newsletter that it wasn’t good for them
I read about not feeding them
I moved away from the place that I would feed them. Fed them fruits and put out sugar water (nectar)
I moved away from the area where the council recommended feeding
I moved away from the area they would come every day
I live in a different area
I heard it’s bad for them
I heard it wasn't good for them
I heard I might make them sick!
I feed Kākā sugar water only in the winter
I fed them on Stewart Island. There are no wild Kākā in Palmerston North
I don’t live near them anymore

I am unsure of what is their best diet
Heard not good for them
Heard it was bad for them
found out its not good for them
Fed it on Kapiti Island nature reserve once - when that was the practice. This no longer takes place.
Due to information from Zealandia and the council on social media. Information on site at Zealandia.
Concerns as to whether it is correct food
cant be bothered
bird feeder broke
Because there is plenty of food for the and even though we were only occasionally feeding them fruit it still felt wrong
because I read that nuts damage their bones
Because I read that it can cause them harm
Because I moved to an area where there aren't any.
Because I learnt that they were fed by Zealandia and had a specific diet that probably didn't include grapes
Because feeding adults during breeding season can give their chick's bone deficiency
Became too friendly and destructive, they would even come inside if they had the opportunity
After discovering it wasn't recommended.

Table 34. Employment status of respondents

Employment Status	Quantity	Percentage
In paid employment	1676	69.74615065
Not in paid employment	201	8.36454432
Prefer not to disclose	94	3.911776945
Retired	278	11.56887224
Student	124	5.160216396
No Response	30	1.248439451
Total	2403	100

Table 35. Highest achieved level of education

Highest Level of Education	Quantity	Percentage
Overseas secondary qualification	31	1.29
Doctorate degree	150	6.24
Level 1 or Level 2 completed (Year 11 or 12)	70	2.91
Level 3 completed (Year 13)	114	4.74
Level 4, 5 or 6 diplomas or other post-school certificates	326	13.57
Master's degree	483	20.10
No qualification	21	0.87
Other	54	2.25
Blank	45	1.87
Bachelor's degree or honours degrees	1109	46.15
Total	2403	100

Table 36. Ethnic distribution of respondents

Ethnicity	Quantity	Percentage
Pākehā/NZ European	1891	78.69
Asian	43	1.79
Māori	66	2.75
Middle Eastern/Latin American/African	12	0.50
Other ethnicity	68	2.83
Other European	222	9.24
Pacific Peoples	2	0.08
Prefer not to disclose	60	2.50
Blank	39	1.62
Total	2403	100

Table 37. Gender distribution of respondents

Gender	Quantity	Percentage
Female	1708	71.07781939
Male	618	25.71785268
No Response	9	0.374531835
Prefer Not to Disclose	52	2.163961715
Other	16	0.665834374
Total	2403	100

Table 38. Residence of respondents

Suburb	Quantity	Percentage of Responses
Karori	215	8.947149397

Brooklyn	**107**	**4.452767374**
Ngaio	**102**	**4.244694132**
Northland	**92**	**3.828547649**
Khandallah	**79**	**3.28755722**
TeAro	**79**	**3.28755722**
Kelburn	**71**	**2.954640033**
Tawa	**69**	**2.871410737**
Miramar	**67**	**2.78818144**
Hataitai	**63**	**2.621722846**
IslandBay	**57**	**2.372034956**
Johnsonville	**56**	**2.330420308**
Newtown	**52**	**2.163961715**
Wadestown	**51**	**2.122347066**
Wilton	**51**	**2.122347066**
Thorndon	**47**	**1.955888473**
MountVictoria	**46**	**1.914273824**
Newlands	**46**	**1.914273824**
MountCook	**41**	**1.706200583**
AroValley	**37**	**1.539741989**
Wainuiomata	**35**	**1.456512692**
[Blank]	**32**	**1.331668747**
Berhampore	**31**	**1.290054099**
Petone	**31**	**1.290054099**
CBD	**27**	**1.123595506**
UpperHutt	**26**	**1.081980857**
LowerHutt	**25**	**1.040366209**
whitby	**25**	**1.040366209**
CroftonDowns	**23**	**0.957136912**
Paraparaumu	**21**	**0.873907615**
ChurtonPark	**20**	**0.832292967**
LyallBay	**19**	**0.790678319**
Maungaraki	**19**	**0.790678319**
Waikanae	**19**	**0.790678319**
TitahiBay	**18**	**0.74906367**
Eastbourne	**16**	**0.665834374**
Kelson	**16**	**0.665834374**
Kingston	**16**	**0.665834374**
Naenae	**16**	**0.665834374**
PukeruaBay	**16**	**0.665834374**
StokesValley	**16**	**0.665834374**
Highbury	**15**	**0.624219725**
seatoun	**15**	**0.624219725**
Strathmore	**15**	**0.624219725**
Avalon	**14**	**0.582605077**
Roseneath	**14**	**0.582605077**

Kilbirnie	**13**	**0.540990429**
Silverstream	**13**	**0.540990429**
OwhiroBay	**12**	**0.49937578**
Vogeltown	**12**	**0.49937578**
Waterloo	**12**	**0.49937578**
Belmont	**11**	**0.457761132**
KapitiCoast	**11**	**0.457761132**
Melrose	**11**	**0.457761132**
Mornington	**11**	**0.457761132**
Paparangi	**11**	**0.457761132**
Porirua	**11**	**0.457761132**
Broadmeadows	**10**	**0.416146484**
Maupuia	**10**	**0.416146484**
Raumati	**10**	**0.416146484**
Korokoro	**9**	**0.374531835**
Epuni	**8**	**0.332917187**
HarbourView	**8**	**0.332917187**
Normandale	**8**	**0.332917187**
Otaki	**8**	**0.332917187**
Taita	**8**	**0.332917187**
Trentham	**8**	**0.332917187**
Camborne	**7**	**0.291302538**
Masterton	**7**	**0.291302538**
Plimmerton	**7**	**0.291302538**
TotaraPark	**7**	**0.291302538**
Waiwhetu	**7**	**0.291302538**
Woburn	**7**	**0.291302538**
Featherston	**6**	**0.24968789**
HoughtonBay	**6**	**0.24968789**
OrientalBay	**6**	**0.24968789**
GrenadaVillage	**5**	**0.208073242**
Papakowhai	**5**	**0.208073242**
Pinehaven	**5**	**0.208073242**
Tirohanga	**5**	**0.208073242**
Alicetown	**4**	**0.166458593**
Aotea	**4**	**0.166458593**
BreakerBay	**4**	**0.166458593**
Fairfield	**4**	**0.166458593**
Paremata	**4**	**0.166458593**
TeHoro	**4**	**0.166458593**
Woodridge	**4**	**0.166458593**
CentralHutt	**3**	**0.124843945**
Daysbay	**3**	**0.124843945**
Heretaunga	**3**	**0.124843945**
Hokowhitu	**3**	**0.124843945**

KarakaBays	**3**	**0.124843945**
Makara	**3**	**0.124843945**
Mana	**3**	**0.124843945**
Martinborough	**3**	**0.124843945**
PaeKākāriki	**3**	**0.124843945**
Pauatahanui	**3**	**0.124843945**
Ranui	**3**	**0.124843945**
RiverstoneTerraces	**3**	**0.124843945**
Rongotai	**3**	**0.124843945**
Southgate	**3**	**0.124843945**
Wairarapa	**3**	**0.124843945**
WhitemansValley	**3**	**0.124843945**
Birchville	**2**	**0.083229297**
Boulcott	**2**	**0.083229297**
BrownOwl	**2**	**0.083229297**
Carterton	**2**	**0.083229297**
Ebdentown	**2**	**0.083229297**
GrenadaNorth	**2**	**0.083229297**
Greytown	**2**	**0.083229297**
Horokiwi	**2**	**0.083229297**
Levin	**2**	**0.083229297**
Moera	**2**	**0.083229297**
Otaihanga	**2**	**0.083229297**
Papamoa	**2**	**0.083229297**
Pipitea	**2**	**0.083229297**
Whanganui	**2**	**0.083229297**
Akatarawa	**1**	**0.041614648**
AscotPark	**1**	**0.041614648**
BlueMountains	**1**	**0.041614648**
CannonsCreek	**1**	**0.041614648**
CloustonPark	**1**	**0.041614648**
Elderslea	**1**	**0.041614648**
Elsdon	**1**	**0.041614648**
EvansBay	**1**	**0.041614648**
Glenside	**1**	**0.041614648**
Horowhenua	**1**	**0.041614648**
Judgeford	**1**	**0.041614648**
Kaitoke	**1**	**0.041614648**
Kaiwharawhara	**1**	**0.041614648**
Kingsleyheights	**1**	**0.041614648**
Lyttelton	**1**	**0.041614648**
MahinaBay	**1**	**0.041614648**
Manawatu	**1**	**0.041614648**
Māoribank	**1**	**0.041614648**
Melling	**1**	**0.041614648**

MoaPoint	**1**	**0.041614648**
Pahiatua	**1**	**0.041614648**
PalmerstonNorth	**1**	**0.041614648**
Pointhoward	**1**	**0.041614648**
Putiki	**1**	**0.041614648**
Raimatibeach	**1**	**0.041614648**
Reikorangi	**1**	**0.041614648**
Roslyn	**1**	**0.041614648**
Sanson	**1**	**0.041614648**
Seaview	**1**	**0.041614648**
TeMarua	**1**	**0.041614648**
Timberlea	**1**	**0.041614648**
Tora	**1**	**0.041614648**
Waimuiomata	**1**	**0.041614648**
Wallaceville	**1**	**0.041614648**
WestSide	**1**	**0.041614648**
YorkBay	**1**	**0.041614648**

Table 39. Percent of respondents in the Halo and non-Halo Region

Halo vs. non-Halo	Quantity	Percentage
Halo	**500**	**20.80732418**
Non-Halo	**1871**	**77.86100707**
No Response	**32**	**1.331668747**
Total	**2403**	**100**

Table 40. Age breakdown of respondents

Age Group	Quantity	Percentage
No Response	**50**	**2.080732418**
18-29	**428**	**17.8110695**
30-39	**567**	**23.59550562**
40-49	**491**	**20.43279234**
50-59	**373**	**15.52226384**
60-69	**293**	**12.19309197**
70-79	**140**	**5.82605077**
80-89	**26**	**1.081980857**
Prefer not to disclose	**35**	**1.456512692**
Total	**2403**	**100**

Appendix F: Word clouds

Figure 27. Kererū word map

Figure 28. Tīeke word map

Figure 29. Kākā word map.

Appendix G: Heat maps of bird sightings

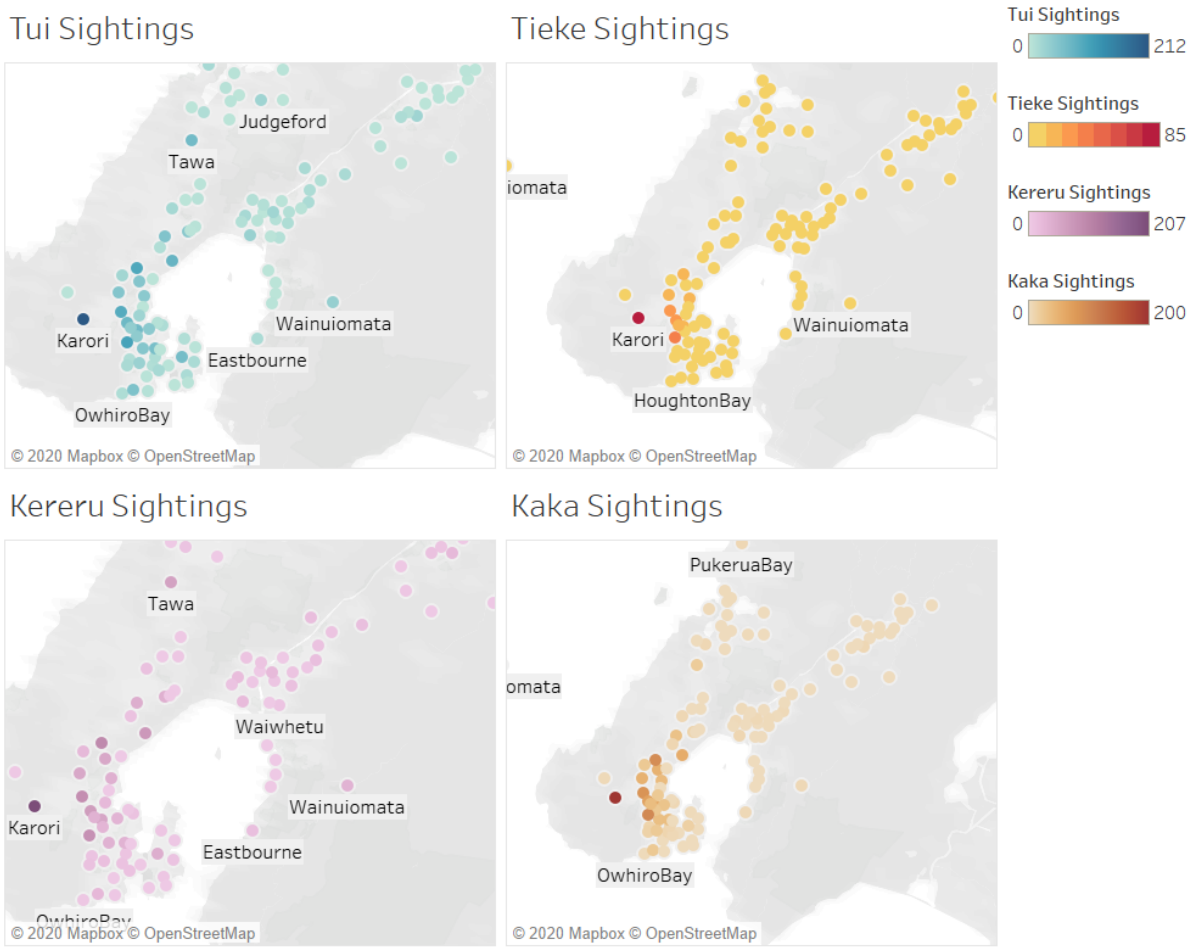

Figure 30. Heat map of bird sightings.