What needs to be planted to supply native birds in Christchurch with food all year around?

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Executive Summary

Context of research

The goal of our project was to determine what needs to be grown to supply native birds with food throughout the year. While the preliminary challenge lay in narrowing down our research question, we arrived at a question that should be both feasible and aligned with our objectives.

Research question

After having met with our community partner Di Lucas we were able to refine our research question to 'What needs to be planted to provide native birds in Christchurch with food all year round and how this can be presented in an interactive way for the public?'. This had an emphasis on creating an interactive and intuitive way to present these findings.

Summary of methods

Quantitative methods were used to collect secondary data of plants fruiting and seeding seasons. The plant lists provided by Lucas Associates were condensed by using principles which included food sources, tolerances, and suitability to gardens. This condensed list was made into a table and used in ArcGIS StoryMaps.

Key findings

Di Lucas associates provided plant lists from all the different ecosystem zones within Christchurch. These plant lists included various important sources especially what plants provided what types of food. The plant lists would prove essential in the deduction of our project as it would greatly help answering what would need to be grown.

The Lyttelton Harbour Basin Food Calendar crafted by Di Lucas associates exemplified a guideline for the project. Developed through unpublished and published scientific secondary data, the Lyttelton Harbour Basin Food Calendar promoted what needs to be grown to supply birds within the Lyttelton Harbour and assisted in setting the tone for the project.

Limitations

The timeframe put on this project was a main limitation for us. As we were given a large amount of quantitative secondary data from our community partner this meant that we spent most of our time sorting and collating the necessary data. This meant that instead of collecting our own primary research we were narrowing down the data to what we need. Initially we were aiming for a highly interactive map which after having done research, we settled for a more engaging approach through ArcGIS StoryMaps.

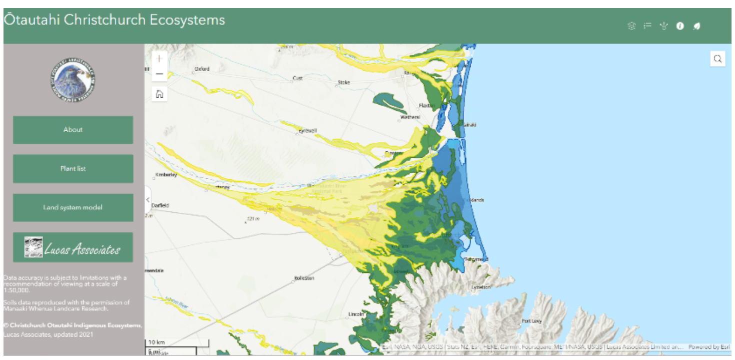
Future research

There is a possibility for future research to expand and build on the foundation we have built through ArcGIS StoryMaps. This can be done by adding other relevant data or exploring more specific locations in terms of the ecosystem and soil types. As well there is a possibility to work with organizations as well as residents to expand the population of native birds.

Introduction

This report provides a description of our group's completion of a Christchurch bird food guide for Di Lucas and Lucas Associates. We were originally proposed with the question "what needs to be grown to supply native birds with food all year round?". After some discussion among group members, our community partner, and our supervisor we finalized our research question to "What needs to be grown to supply native Birds with food all year around in the Christchurch area and how can this be presented in an interactive way for the public?". This report is structured in a way that makes it easy to follow our research design/process and how we completed our final project through precise reviews of previous literature, methods, results, discussion, limitations, and future research suggestions. This project is important because it will provide insight to who are interested in planting various native trees and bushes through a clear guide of what native plants should be grown, based on where they live to supply our native bird species with enough food all year round. This project could benefit the biodiversity of the Christchurch ecosystems with the possible increase of native plants, resulting in an increase in the abundance of native birdlife in and around the Christchurch area.

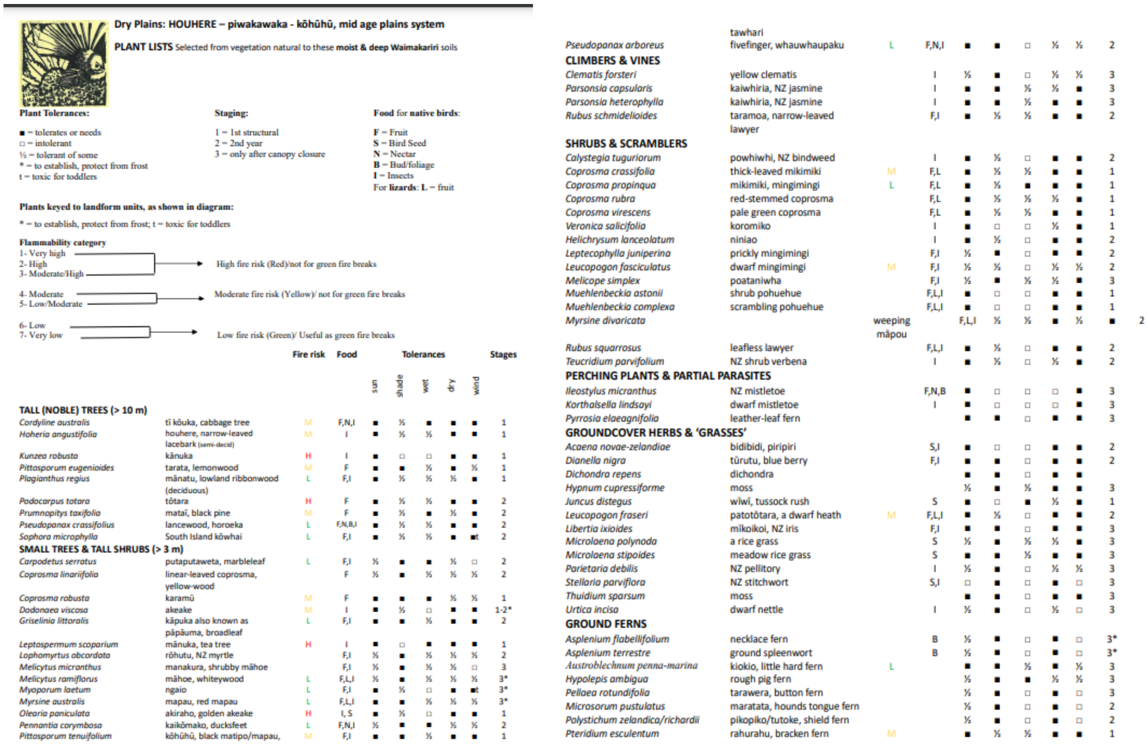
Literature review



Map 1: Interactive Christchurch ecosystem map (Lucas associates, 2021).

Our community partner Di Lucas showed us an existing Christchurch ecosystems map on the Christchurch City Council website created by Lucas Associates. Map 1, seen above is an interactive online map that identifies and displays three different environmental ecosystems within Christchurch. Each coloured area seen on the interactive map represents a different ecosystem. The yellow area represents a dry plains ecosystem, the sprawling green area represents a wet plains ecosystem, and the blue area represents the coastal plains ecosystem.

Within this interactive map, clicking on one of the ecosystems zones opens that displays a list with a huge amount of valuable information seen below in figure 1.



Dry Plains: HOUHERE – piwakawaka - kōhūhū, mid age plains system

PLANT LISTS Selected from vegetation natural to these **moist & deep Waimakariri** soils

Plant Tolerances:

■ = tolerates or needs
□ = intolerant
½ = tolerant of some
* = to establish, protect from frost
t = toxic for toddlers

Staging:

1 = 1st structural
2 = 2nd year
3 = only after canopy closure

Food for native birds:

F = Fruit
S = Bird Seed
N = Nectar
B = Bud/foliage
I = Insects
For **lizards**: **L** = fruit

Plants keyed to landform units, as shown in diagram:

* = to establish, protect from frost; t = toxic for toddlers

Flammability category

1- Very high
2- High
3- Moderate/High → High fire risk (Red)/not for green fire breaks

4- Moderate
5- Low/Moderate → Moderate fire risk (Yellow)/ not for green fire breaks

6- Low
7- Very low → Low fire risk (Green)/ Useful as green fire breaks

		Fire risk	Food	Tolerances: sun	shade	wet	dry	wind	Stages
TALL (NOBLE) TREES (> 10 m)									
Cordyline australis	tī kōuka, cabbage tree	M	F,N,I	■	½	■	■	■	1
Hoheria angustifolia	houhere, narrow-leaved lacebark (semi-decid)	M	I	■	½	½	■	■	1
Kunzea robusta	kānuka	H	I	■	□	□	■	■	1
Pittosporum eugenioides	tarata, lemonwood	M	F	■	■	½	■	½	1
Plagianthus regius	mānatu, lowland ribbonwood (deciduous)	L	F,I	■	½	½	½	■	1
Podocarpus totara	tōtara	H	F	■	½	½	■	■	2
Prumnopitys taxifolia	mataī, black pine	M	F	■	½	■	½	■	2
Pseudopanax crassifolius	lancewood, horoeka	L	F,N,B,I	■	½	½	■	■	2
Sophora microphylla	South Island kōwhai	L	F,I	■	½	½	■	■t	2
SMALL TREES & TALL SHRUBS (> 3 m)									
Carpodetus serratus	putaputaweta, marbleleaf	L	F,I	½	■	■	½	□	2
Coprosma linariifolia	linear-leaved coprosma, yellow-wood		F	½	■	½	½	½	2
Coprosma robusta	karamū	M	F	■	■	■	½	½	1
Dodonaea viscosa	akeake	M	I	■	½	□	■	■	1-2*
Griselinia littoralis	kāpuka also known as pāpāuma, broadleaf	L	F,I	■	■	½	■	■	2
Leptospermum scoparium	mānuka, tea tree	H	I	■	□	■	■	■	1
Lophomyrtus obcordata	rōhutu, NZ myrtle		F,I	½	■	½	½	½	2
Melicytus micranthus	manakura, shrubby māhoe		F,I	½	■	½	½	□	3
Melicytus ramiflorus	māhoe, whiteywood	L	F,L,I	½	■	½	½	½	3*
Myoporum laetum	ngaio	L	F,I	■	½	□	■	■t	3*
Myrsine australis	mapau, red mapau	L	F,L,I	■	■	½	½	½	3*
Olearia paniculata	akiraho, golden akeake	H	I, S	■	½	□	■	■	1
Pennantia corymbosa	kaikōmako, ducksfeet	L	F,N,I	½	■	■	½	½	2
Pittosporum tenuifolium	kōhūhū, black matipo/mapau, tawhari	M	F,I	■	■	½	■	■	1
Pseudopanax arboreus	fivefinger, whauwhaupaku	L	F,N,I	■	■	□	½	½	2
CLIMBERS & VINES									
Clematis forsteri	yellow clematis		I	½	■	□	½	½	3
Parsonsia capsularis	kaiwhiria, NZ jasmine		I	■	■	½	½	■	3
Parsonsia heterophylla	kaiwhiria, NZ jasmine		I	■	■	½	■	■	3
Rubus schmidelioides	taramoa, narrow-leaved lawyer		F,I	■	½	½	■	■	2
SHRUBS & SCRAMBLERS									
Calystegia tuguriorum	powhiwhi, NZ bindweed		I	■	½	□	■	■	2
Coprosma crassifolia	thick-leaved mikimiki	M	F,L	■	½	½	■	■	1
Coprosma propinqua	mikimiki, mingimingi	L	F,L	■	½	■	■	■	1
Coprosma rubra	red-stemmed coprosma		F,L	■	½	½	½	■	1
Coprosma virescens	pale green coprosma		F,L	■	½	½	■	■	1
Veronica salicifolia	koromiko		I	■	□	□	½	■	1
Helichrysum lanceolatum	niniao		I	■	½	□	■	■	2
Leptecophylla juniperina	prickly mingimingi		F,I	½	■	□	■	■	2
Leucopogon fasciculatus	dwarf mingimingi	M	F,I	½	½	□	½	½	2
Melicope simplex	poataniwha		F,I	½	■	½	½	■	3
Muehlenbeckia astonii	shrub pohuehue		F,L,I	■	□	□	■	■	1
Muehlenbeckia complexa	scrambling pohuehue		F,L,I	■	□	□	■	■	1
Myrsine divaricata		weeping māpou		F,L,I	½	½	■	½	■ 2
Rubus squarrosus	leafless lawyer		F,L,I	■	½	□	■	■	2
Teucridium parvifolium	NZ shrub verbena		I	■	½	□	½	■	2
PERCHING PLANTS & PARTIAL PARASITES									
Ileostylus micranthus	NZ mistletoe		F,N,B	■	□	□	□	■	3
Korthalsella lindsayi	dwarf mistletoe		I	■	□	□	□	■	3
Pyrrosia elaeagnifolia	leather-leaf fern			■	■	□	■	■	3
GROUNDCOVER HERBS & 'GRASSES'									
Acaena novae-zelandiae	bidibidi, piripiri		S,I	■	□	□	■	■	2
Dianella nigra	tūrutu, blue berry		F,I	■	■	□	■	■	2
Dichondra repens	dichondra			■	■	□	■	■	
Hypnum cupressiforme	moss			½	■	½	■	■	3
Juncus distegus	wīwī, tussock rush		S	■	□	■	½	■	1
Leucopogon fraseri	patotōtara, a dwarf heath	M	F,L,I	■	½	□	■	■	2
Libertia ixioides	mīkoikoi, NZ iris		F,I	■	■	□	■	■	3
Microlaena polynoda	a rice grass		S	½	■	½	½	■	3
Microlaena stipoides	meadow rice grass		S	■	■	½	■	■	3
Parietaria debilis	NZ pellitory		I	½	■	□	½	½	3
Stellaria parviflora	NZ stitchwort		S,I	□	■	□	■	□	3
Thuidium sparsum	moss			■	■	□	■	■	3
Urtica incisa	dwarf nettle		I	½	■	□	½	□	3
GROUND FERNS									
Asplenium flabellifolium	necklace fern		B	½	■	□	■	□	3*
Asplenium terrestre	ground spleenwort		B	½	■	□	■	□	3*
Austroblechnum penna-marina	kiokio, little hard fern	L		■	■	½	■	½	3
Hypolepis ambigua	rough pig fern			½	■	■	½	½	3
Pellaea rotundifolia	tarawera, button fern			½	■	□	■	□	3
Microsorum pustulatus	maratata, hounds tongue fern			½	■	□	■	□	2
Polystichum zelandica/richardii	pikopiko/tutoke, shield fern			½	■	□	■	□	2
Pteridium esculentum	rahurahu, bracken fern	M		■	½	½	■	■	1

Figure 1: A Dry Plains plant list document found within ecosystem map (Lucas associates, 2021).

Each plant list document provides information on

- What ecosystem zone these plants thrive in, a native plant/tree common to that area along with a native bird species that is commonly found in that ecosystem.
- What soil type the native plants naturally grow in.
- How tolerant the plant is to sun, shade, dry weather, wet weather, and wind.
- Different plant stages.
- What food each plant produces for native birds whether it is fruit, bird seed, nectar, buds/ foliage, and the attraction of insects, which native birds also feed on.
- How flammable each plant is.
- Native plants are divided into categories based on the size of the plant.

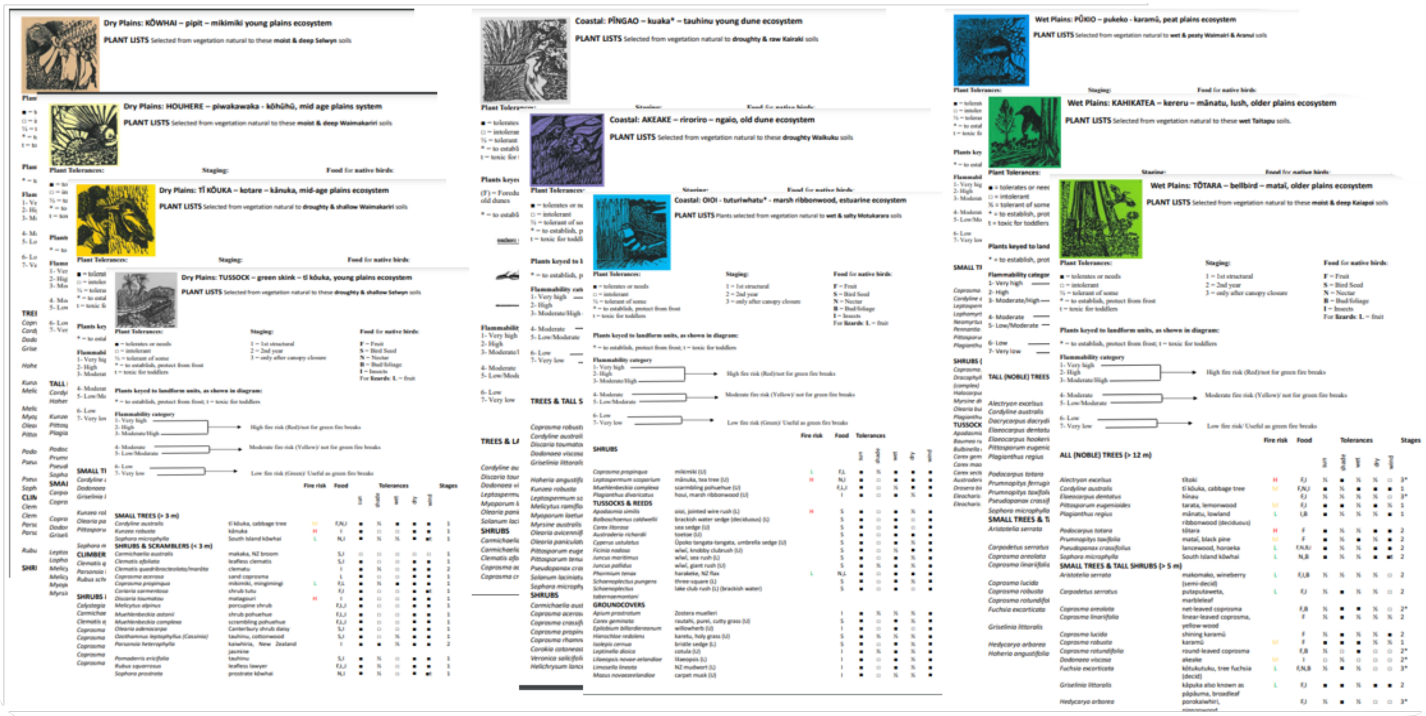


Figure 2: All plant list documents from the Ecosystem map (Lucas associates, 2021).

Within the interactive ecosystems map there were 10 different plant lists similar to Figure 1, this can be seen in Figure 2. Within the dry plains ecosystem zone there are four different plant list documents, this includes Figure 1, within the wet plains ecosystem zone there are three different plant list documents and within the coastal plains ecosystem zone there are three different plant list documents. All the plant lists have slightly different information based on what ecosystem zone the lists are from. However, there is some crossover between plant lists with many of the lists containing some of the same native trees and plants.

This ecosystem map and the plant lists provided to us by our community partner greatly contributed to the design of our final project because it allowed us to answer the first part of our research question, “What needs to be grown to supply native Birds with food all year around in the Christchurch area?”. It also gave us another variable to think about in terms of different ecosystems. This contributed to our research design by making us investigate the interactions between native birds and plants within each ecosystem.

Lyttelton Harbour Basin Food Calendar

The Lyttelton Harbour Basin Food Calendar (LHBFC) is an existing bird food calendar produced by Lucas Associates, Colin Meurk, and Ian Lynn. The LHBFC, made in 1998, allows for adaptable components as a result of climate degradation, temporal, and spatial challenges given its dated publish. The LHBFC focuses on the following contents: identification of native flora and food calendar, ecosystem and dynamic processes and planting guidelines. The LHBFC additionally provides some situational beneficiaries in bridging different articles.

The background and vision of the LHBFC was simply to increase the presence of native birds to complement the scenery in Lyttelton harbour. The project was essentially a small-scale trial to test the efficacy of attracting native birds. The importance of food calendars has changed since due to the issues it now combats. Anthropogenic influences have impacted migratory patterns of birds creating wider implications that are not considered within the LHBFC. Therefore, the reliability of a food calendar has shifted from visual appeal to maintaining the balance of ecosystems. The need to attract more native birds is just as important in understanding why they are not as present as they used to be. The by-product of urbanization and environmental degradation is an example. The mission behind this project typically surrounds the idea of "what needs to be grown to supply native birds with food". But delves deeper into increased conservation and community effort towards maintaining abundance of food for an abundance of birds.

Lucas Association used data sources that included indigenous ecosystems from published and unpublished scientific papers. These scientific papers acknowledged all areas necessary to distinguish constituents of local ecology. The data collection research method used is effective in determining specific attributes but provides limited context in a wider understanding of food calendars. Comparing and contrasting secondary data was the main method of data collection for the LHBFC, in which this project would find the most effective process in addressing the ideal food calendars. These other scientific papers, or secondary data, that culminates a large magnitude of food basin would represent an essential guideline towards how a successful project could be emulated or replicated on a larger scale.

Williams et al., (2015) uses native wildflower plantings to increase the abundance of wild bees within three different regions within the United States. Introducing wildflower plantings to increase abundance of plant food bolstered attraction and ultimately concluded two important takeaways.

1. Evidence of increasing availability of plants attracts and nourishes the target species.
2. Relates to other sub-themes that the target species interact with different regions – similar to the interaction between the other sub themes; interaction between native birds and ecosystem zones (coastal, dry, wet).

This similar methodology is relevant to our project as we can incorporate the fundamentals of simply increasing crop availability with the LHBFC's knowledge of what crops grow and where to improve areas that might lack. As mentioned, comparing and contrasting promotes validity of the project, whilst also acknowledging that of the LHBFC's project already. Culminating the best of secondary data in combination with the LHBFC ultimately fills areas of uncertainty between ecological and knowledge groups to grant a greater understanding of why our project is important and how it can be properly employed.

Researched secondary data

Interaction between native plants and birds

After collecting existing secondary data on the interactions between native birds and plants key information, we found was that using native plant life in agricultural landscapes can increase animal wellbeing and repair/restore native biodiversity. We found that the total number of native bird species increases when there are native plants within 1km of existing native bird populations. As well when there are non-native plants/forests nearby there is a decrease in the number of native bird species and an increase in the number of non-native bird species (Eggers, 2022). This study also highlights that the spread-out nature of many New Zealand agroecosystems provides opportunities for non-native birds to flourish because non-native birds are better suited to deal with areas on the edge of habitat borders and will out compete the native species for food and shelter (Eggers, 2022). This information relates to the interests of our community partner and reinforces the purpose of the project. Highlighting the need for an online guide that provides accessible and presentable information on what native trees keep the native birds fed all year-round. This also reiterates the importance of the relationship between native plants and birds and the impact it can have on the surrounding ecosystem.

Interactive mapping

To answer the second part of our research question "how can this be presented in an interactive way for the public?", we researched different ways of using and presenting interactive maps. We found that interactive maps are powerful tools for visual representation providing users with multi-layered data and customizable viewing experiences. However, one of their drawbacks is that they can sometimes overwhelm users, especially those unfamiliar with navigating such tools (Harrower, 2020; Baur, 2017). This research greatly contributed to the overall research design by leading us down a less interactive path by using ArcGIS StoryMaps to present our findings as it simplifies the presentation of complex information, making it more accessible to a broader audience.

Methods

The research project employed a combination of quantitative and qualitative research methods to gather the information for the study. Quantitative methods were primarily used for collecting secondary data through online searches, with a specific focus on plant fruiting and seeding seasons. Websites such as iNaturalist were important in accessing this data. iNaturalist serves as a valuable resource, offering a database for citizen scientists to identify various plant and animal species. The iNaturalist community, consisting of both experts and enthusiasts, played a crucial role in identifying native plant species fruiting and seeding seasons.

The decision not to collect primary data was strategic, especially considering the vast research area encompassing the entire Christchurch region. Undertaking a detailed and accurate primary data collection for such an expansive area would have been impractical within the project's time constraints.

Qualitative secondary data was essential when seeking to understand the interactions between native birds and native plants in the region. The initial step in the research project was selecting the native plant species to study. A substantial portion of the required data was generously provided by Lucas Associates in the form of detailed plant lists. This data proved valuable in the process of narrowing down the ideal native plant species for each type of soil found in the Christchurch area.

The volume of data within these plant lists presented a significant challenge. The primary objective was to determine which plant species were most suitable for each soil type. After discussions within the group and our community partner, the plant list was refined for each soil type, ultimately containing between 15 and 20 different plant species.

When it came time to make the selection of plants for the project, specific criteria were used to guide the decision-making process. Key considerations included identifying which plant species provided the most abundant and diverse food sources for native wildlife, the plant's ability to thrive in different weather conditions, tolerability towards sunlight requirement, and its suitability for use in garden settings. These principles made the plant selection process straight forward, making it easier to identify the most appropriate native plants for each soil type. iNaturalist was used to identify what season the selected native plants fruit or seed to provide food for the native birds. The data collected was then split into different sections using the seasons as headers as this helped answer our research question more effectively.

The data was then transferred to ArcGIS StoryMaps in the form of tables created in excel, these tables included the plant name and food name. The tables were placed next to a description of each soil type, along with what native birds are known to feed on the plants. Pictures of the native plant types and native birds that are commonly found in each soil type were added. This was repeated for each soil type, under the heading of seasonality.

Results

Plant Name	Food Name
Lancewood, Horoeka	Fruit, Nectar, Bud/Foliage, Insects
Hīnau	Fruit
Mānatu, Lowland ribbonwood	Bud/Foliage
Tōtara	Fruit
Miro	Fruit
New Zealand Mistletoe	Fruit, Nectar, and Bud/Foliage
Climbing Fuchsia	Fruit and Nectar
Horopito	Fruit and Nectar
Kaikōmako	Fruit and Nectar
Mānatu	Fruit
Crinkly Shrub Daisy	Bird Seed
Harakeke	Nectar
Weeping Māpou	Fruit
Mānuka	Nectar

Figure 3: Showing the plant names and the food they provide for the birds in the Wet Plains during the Autumn month in Christchurch (Cotter et al. 2023)

Plant Name	Food Name
Tī Kōuka, Cabbage Tree	Fruit and Nectar
Kāpuka also known as Pāpāuma, Broadleaf	Fruit
Kōhūhū, Black Matipo/Mapau, Tawhari	Fruit
Mānatu, Lowland Ribbonwood (deciduous)	Fruit
Rōhutu, NZ Myrtle	Fruit
Māhoe, Whiteywood	Fruit
Kaikōmako, Ducksfeet	Fruit and Nectar

Figure 4: Showing the plant names and the food they provide for the birds in the Wet Plains during the Summer month in Christchurch (Cotter et al. 2023)

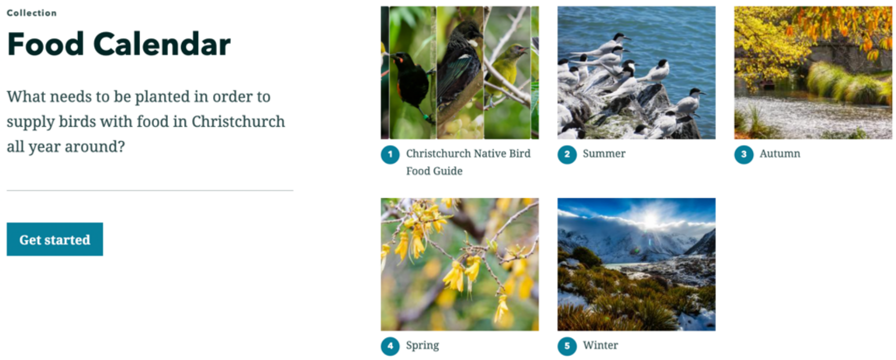


Figure 5: Showing the finished food calendar through ArcGIS StoryMaps **(Cotter et al. 2023)*.***

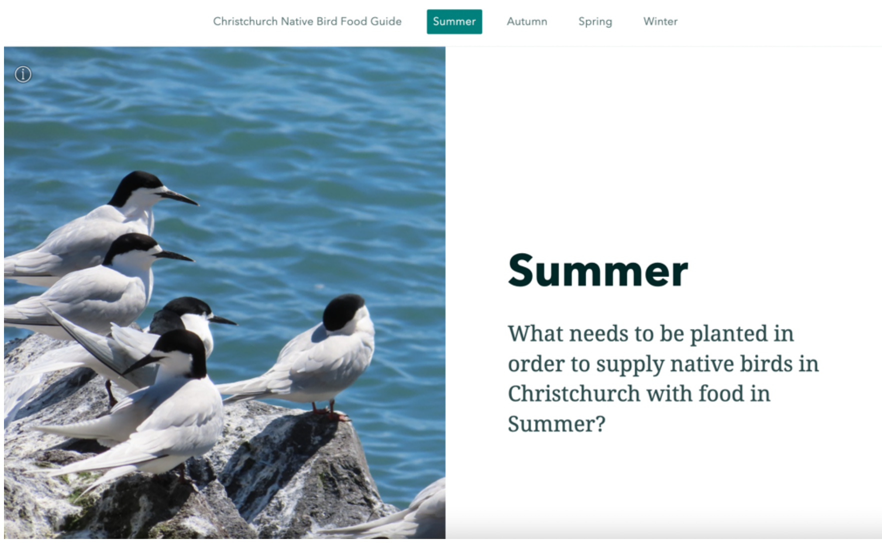


Figure 6: Showing the Summer season for our food calendar **(Cotter et al. 2023)*.***

Our final result led us to creating a native plant calendar through ArcGIS StoryMaps which shows the most common native plants and trees that work best within each ecosystem. Portraying our data this way we were able to show a yearly analysis through seasonality of when the native plants are fruiting. This is divided into the four seasons and then the three ecosystems for each season as per Figures 5 and 6. Figures 3 and 4 are just two examples of our final data project calendar. Figure 3 shows what trees are fruiting in the wet plain ecosystems/soil types during the Autumn month and Figure 4 shows what trees fruit in the wet plains during summer. These figures are both visible on our ArcGIS StoryMap where they demonstrate when trees are fruiting as well as where they can be planted depending on their ecosystem (Cotter et al. 2023). Figure 5 shows how the food calendar is split into the seasons as well as an extra option to determine the ecosystem locations as this works best to answer our research question. This is then broken up into the seasons where each season holds the information for that time of month. This information includes the food calendar, images of the common birds which would be seen, as well as images of the common plants that are grown here. This project is both interactive and intuitive, which was our goal for the final project.

Discussion

Have we answered our research question?

We believe that our final project has answered our research question as well, as it also lines up with what our community partner was seeking to be produced. Our research question was "What needs to be planted to supply native birds in Christchurch with food all year around and how we can show this in an interactive and intuitive way?". What we produced was a seasonal calendar that shows what season the native plants fruit or provide food for the birds. Creating this through ArcGIS StoryMaps made it interactive and intuitive whilst also incorporating the research done through our literature reviews. We adapted our project to fit all our information as well as fitting this into our community partners requirements. Using the idea of scrolling makes this both engaging and printable. This project would answer our research question as we showed what plants need to be planted through all the seasons in each of the ecosystems identified.

Significance of results

The result of our final project is significant because it will give the public who are interested in planting various native trees and bushes on their property a clear guide of what native plants should be grown. This can be based on where they live to supply our native bird species with enough food all year round. This project could benefit the biodiversity of the different Christchurch ecosystems with the possible increase of native plants, resulting in an increase in the abundance of native birdlife in and around the Christchurch area. Our results also show the importance of working within an ecosystem when discussing the interaction between the birds and the trees. As explained previously this interaction is very valuable as what works within one ecosystem, we found usually doesn't work in another. By looking at the individual ecosystems and soil types we found that because these ecosystems have been thriving and working well together for years it is best to continue these existing trends. Our results mean that when people grow these plants in their backyards within their given ecosystem location, they are more likely to see the native birds who commonly eat the food provided by the plant.

Limitations

We found that one of the main limitations for this project was due to the large amount of quantitative secondary data provided to us by our community partner. This data shaped our project in a large way meaning that a lot of our time was spent narrowing down and sorting out what is appropriate and necessary for our project rather than collecting our own data. The timeframe we had to complete this project was also a limitation we came across as with more time we would've been able to gather our own primary data. This would mean that for example we could have had more specific locations for our ecosystem zones within Christchurch because the interactive map we were provided is 25 years old. However, we are not sure that gathering our own primary research and data would provide much different results to the ecosystem map. Lastly, we initially wanted a heavily interactive map yet, after our critical reflections assignment we were drawn away and decided to go with something else as we found it to be more engaging and less time consuming. The limitation we found here was that our final project was not as interactive as we first thought it would be but still displayed the necessary information we hoped it would.

Future Research

For future research there is a possibility to expand and build on the foundation we have built through ArcGIS StoryMaps. The data we collected and analyzed isn't going to have much fluctuation over the years and will be very consistent for the most part. However, future research could be done in other areas of our topic, for example focusing on planting trees and plants native to Christchurch in public green spaces. This would be beneficial and would expand our topic to businesses and organizations by not only relying on residents to be planting native species in their own private gardens and spaces. Future research could also be refining the ecosystem zones in Christchurch by updating the data. This would allow for more specific results on the exact locations of trees and would give an appropriate set of plants that would be seen thriving in these environments. Also, more research could be done around the native birds as our topic had a focus on the plants which feed the birds instead of the birds themselves. Future research could include the impact our project had on targeted bird species and further uphold the importance of our project to a mainstream audience.

Conclusions

Figuring out what needs to be grown to supply native birds all year long has been appropriately answered acknowledging temporal, spatial, seasonal and accessibility elements. We reviewed various amounts of literature to uphold validity of our project and drew upon a local project, Lyttelton Harbour Basin Food Calendar, to not only show a variety of benefits associated with a similar project, but to also set guidelines. Further information such as the analysis of our ecosystem zones and plant lists allowed easy deduction of plants to include within the project in combination of what the best method of presenting it was (ArcGIS StoryMaps). Acknowledging limitations and potential further research is expected in such a dynamic project. Future developments on this project could be further monitoring of the efficacy of this project as well as including or expanding within the collective through gathering specific data within our ecosystems.

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