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Establishing a comprehensive invertebrate and vegetation inventory of Auckland Zoo, Aotearoa / New Zealand

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Abstract

Invertebrates are major contributors to biodiversity, with important roles in ecosystem function, but are often overlooked in conservation work in favour of larger, more charismatic species. Invertebrates living outside of captive conditions may have the potential to affect zoo activities, and it has been suggested that zoos might contribute to invertebrate conservation programmes by providing suitable habitat for these organisms. In this study, a survey of invertebrates living in non-fenced areas of Auckland Zoo was carried out to explore the relationship between the vegetation and invertebrate communities throughout the zoo grounds. A total of 6,133 invertebrate specimens were collected in pitfall traps over a ten-day period in January of 2018. Using morphospecies as surrogates for species, differences in invertebrate community structure in different non-fenced areas were assessed. No significant relationship between native vegetation and native invertebrates was detected.

Keywords
Invertebrates, gardens, morphospecies, zoo

Introduction

The invertebrates are the most diverse animal phylum on the planet (Losey & Vaughan 2006), and are major contributors to biodiversity in terrestrial ecosystems across all continents (Kremen et al. 1993; Crisp et al. 1998). They also provide a number of ecosystem services, such as pollination (Klein et al. 2007), and interact with other organisms at all different trophic levels, as grazers, predators and parasites (Traill et al. 2010). These services and often-complex interactions make invertebrates a vital component of the ecosystems they occupy, with some being keystone species (Kellert 1993). In order to better protect invertebrate diversity, management efforts need to know what species are present. However, obtaining species-level identifications for all invertebrates within a given area is rarely feasible due to the combined cost of labour (Oliver & Beatie 1996a) or genetic sequencing, and the typically limited availability of taxonomic expertise (Hebert et al. 2003). This latter issue can be a significant barrier in countries such as Aotearoa / New Zealand, where there is a high rate of endemism, and with new invertebrate species still being identified (Crisp et al., 1998). One method to address this issue is the use of morphospecies as surrogate for species, wherein non-experts group specimens based on morphological similarity. Oliver and Beattie (1996b) found that while non-experts tend to clump multi species into one group, or split a single species into multi groups, the rate at which these two sources of error occur is approximately equal, allowing for morphospecies to be used to estimate species diversity.

While urban gardens are small in area, and independently maintained by private owners with varying knowledge or interest in biodiversity, their high number combines to make them a significant proportion of the green space in cities (Davies et al. 2009; Vergnes et al. 2012). Urban gardens and green paces have the potential to contribute to local biodiversity and conservation by providing habitat to local wildlife (Vergnes et al. 2012; Davies et al. 2009; Thompson et al. 2003) and creating corridors through otherwise developed areas (Smith et al. 2006a). However, urbanisation generally increases the proportion of introduced species in an area (Roy et al. 1999; Smith et al. 2006b). Introduced plant species have the potential to become invasive and alter the existing ecosystem functions, such as the hydrological cycle and biogeochemical cycling (Blossey 1999). They can also affect habitat suitability for specialist herbivore insects, which may not be able to adapt to using the introduced plants as a food source (Tallamy 2004), creating a habitat more suited to generalist herbivores and non-native invertebrate species (Zuefle et al. 2008). It is also possible for an introduced plant species to provide a new resource to a native invertebrate species, increasing the success of the native species but making it vulnerable to local extinction should the introduced plant be removed (Rodríguez et al. 2019; Singer & Parmesan 2018).

With their often-large garden areas, zoos may have the potential to encourage free-living native invertebrate fauna, in addition to their captive colonies. The Auckland Zoo is the largest zoo in Aotearoa / New Zealand, covering 16.36 hectares, and houses over 2,800 animals, representing 130 animal species (Auckland Zoo n.d.). The zoo's grounds, which neighbour the Western Springs wildlife sanctuary, include unfenced garden areas that provide habitat to wild fauna. The aim of this project was to establish a list of the invertebrates and vegetation within the Auckland Zoo's garden areas, to gain a better understanding of the spatial occurrence of invertebrates within these gardens and to test for any correlation between this and the diversity of vegetation in those gardens.

Materials and Methods

Sampling was carried out in January 2018, when invertebrate populations were expected to be active and abundant. The Auckland Zoo grounds were divided into 20 quadrants. Staff areas were not sampled, with the exception of a staff area behind the baboon enclosure, which was easily accessible and has been a walkway with public access in the past. Quadrants lacking accessible plantings were also excluded, leaving ten quadrants for sampling. The location of pitfall traps and leaf litter collections were selected based on accessibility and staff approval, leading to some samples being closely grouped. Due to the shape and size of the gardens and the necessity of safe access, many traps were positioned close to walkways. Three pitfall traps were laid in each of the ten sampling quadrants. Each trap was 8 cm in diameter and approximately 10 cm deep. The traps were ¼ filled with water with three drops of biodegradable detergent, and covered to prevent rain and plant material from falling into the trap. Traps were checked and emptied every one to two days throughout the following ten-day sampling period. A leaf litter collection, consisting of ten samples, one per quadrant, was carried out on the final day of sampling. Leaf litter samples were placed in Tullgren funnels for four days, after which the isolated invertebrates were sorted for identification.

The zoo's gardens are themed to reflect the origins of the animals on display. Five polygons with these regionally themed planting types were identified. An additional two polygons, Mixed Ornamental A and Mixed Ornamental B, which are the oldest gardens in the zoo, did not have regional themes, and were instead made of species of varying origin, typical of ornamental gardens of the 20th century. The quadrants used to divide the zoo grounds were comprised of between one and four different planting types. Consequently, in addition to analysing the data by quadrant, both the vegetation and invertebrate data were also re-grouped into these seven polygons (Table 1). These polygons contained between four and seven pitfall traps and one to two leaf litter collection sites. Unfortunately, garden areas in which sampling took place were removed as part of an enclosure development project within a month of sampling being completed, preventing any future sampling of the precise locations that were sampled in this study.

identified. Specimens that were morphologically similar were placed into the same morphospecies.

Of those that could not be easily identified, 269 specimens, representing 84 morphospecies, were photographed and uploaded to iNaturalist (https://www.inaturalist.org) (Table A1), allowing community members with wider taxonomic expertise to identify the specimens. Identifications suggested on iNaturalist were accepted for use in this study when made by a community member whose expertise could be verified. Specimens that could not be identified to species level were placed into morphospecies and identified to the lowest possible taxonomic level. The native / non-native status was recorded for specimens that could be identified to species. The Aotearoa / New Zealand status of morphospecies which could not be identified to species level were recorded as Unknown.

The vegetation growing within a 2 m radius of the trap / leaf litter collection was photographed for later identification. Identifications were carried out by Dr Peter de Lange, Unitec (Table B1). Species of vegetation were recorded as present / absent at each location; abundance information was not recorded.

For the purposes of analysis, each individual pitfall trap or leaf litter collection was treated as a single sample. Multidimensional scaling (MDS), carried out using Primer 7, was used to examine similarities between the samples using Bray-Curtis resemblance. The invertebrate abundance data were log-transformed before being analysed via MDS. Rare values were not removed from the vegetation data prior to analysis. Invertebrate species' richness and evenness was determined by first grouping samples by polygon, then applying Margalef's diversity index and Pielou's evenness

Table 1. Polygons and coordinates for the approximate centre of each.

Polygon	Latitude	Longitude
Africa	36°51′50.0″S	174°43′16.4″E
Australia	36°51′42.9″S	174°43′09.2″E
Mixed Ornamental A	36°51′45.0″S	174°43′12.7″E
Mixed Ornamental B	36°51′47.7″S	174°43′20.2″E
New Zealand A	36°51′49.2″S	174°43′11.5″E
New Zealand B	36°51′43.8″S	174°43′19.1″E
South America	36°51′41.9″S	174°43′13.4″E

When collected, the contents of each pitfall trap were rinsed with 90% ethanol to remove the water and any soil or plant material, before being stored in 90% ethanol. Invertebrate specimens were identified using morphological characteristics easily observed under binocular microscope. Specimens that could not be confidently identified to species level using this approach were attributed a morphospecies ID, named for the lowest taxonomic level to which they had been in Primer 7. Testing for correlations between vegetation diversity and invertebrate diversity and abundance was performed in R vR4.2.1 using the package Hmisc (Harrel 2023).

Results

A total of 6,133 invertebrate specimens was collected over a ten-day period. Individual pitfall traps collected between ten and 2,360 specimens, with a mean of 173.23 (SD 437.5) specimens per trap. The pitfall traps in quadrant D4 collected the highest number of specimens, with a mean of 1,188 (SD 864.3) specimens per trap, totalling 3,656 specimens across all three traps. Specimens from leaf litter collections made up 1,430 (23.32%) of the total, with a mean of 93.6 9 (SD 87.8) specimens per sample.

The invertebrate specimens were divided into 142 morphospecies, representing seven orders (Table 2). Fifty-four of these morphospecies were singletons. Twenty-three morphospecies were identified to species level, with an additional 20 being identified to genus. Twenty-seven morphospecies could be identified to family, 26 to order, 45 to class, and one to phylum. Nine of the morphospecies were determined to be native and a further 28 were introduced. The remaining 105 morphospecies could not be confirmed as being either native or introduced due to lack of taxonomic resolution. All identified invertebrate species are common in gardens and forested areas throughout Aotearoa / New Zealand or the Tāmaki Makaurau / Auckland region.

The most abundant morphospecies found was a group of Collembola, which were unidentifiable and difficult to differentiate. This polyphyletic group was found throughout the zoo grounds, with 2,955 specimens being found in the New Zealand B polygon. Conversely, this morphospecies was the least abundant in the New Zealand A polygon, with a single specimen being found. The New Zealand B polygon also had 474 Malacostraca specimens, the greatest number of this taxa found in any polygon, and was the only polygon in which nematodes where found.

When the four samples from each quadrant were combined, there were between 81 and 3,681 specimens collected per quadrant, with a mean of 613.3 (SD 1,084.47). These specimens represented between 24 and 49 morphospecies per quadrant, with a mean of 36.7 (SD 8.68). The Margalef index for richness was between 4.50 and 8.09 for each quadrant, with evenness between 0.32 and 0.88 (Table 3). When these samples were grouped by polygon, the seven polygons had between 234 and 3,681 specimens, with a mean of 45.57 (SD 13.14), belonging to between 25 and 63 morphospecies (Table 4). The Margalef index for richness was between 4.40 and 9.52 for each polygon, with evenness between 0.32 and 0.71.

A total of 124 vegetative species were found within the sampled areas. Of these, 119 were vascular plants, with 102 being identified to the species level, 25 of which could be identified to subspecies, variety, or cultivar. A further 14 were identified to genus level, and three to family level. In addition to the vascular plants, one moss, one lichen and three fungi were found. Vegetation native to Aotearoa / New Zealand was present in all polygons. The New Zealand A polygon had the greatest proportion of native vegetative species, with 29 of the 30 species (96.67%) being native. This polygon also had the greatest

Table 2. Specimen abundance and morphospecies grouped by taxonomic order.

Order	Morphospecies	Abundance
Arachnida	34	1017
Collembola	18	3214
Gastropoda	5	8
Geophilomorpha	1	1
Insecta	80	1088
Malacostraca	3	780
Nematoda	1	25
Total	142	6133

Table 3. Morphospecies abundance, diversity, richness (Margalef's index) and evenness (Pielous's index) in each quadrant.

Quadrant	Morphospecies	Specimens	Species richness	Evenness
B2	34	177	6.38	0.76
B3	24	165	4.50	0.77
B4	26	203	4.71	0.67
C1	47	411	7.64	0.72
C2	42	295	7.21	0.71
C3	38	283	6.55	0.69
D1	49	376	8.09	0.69
D4	44	3681	5.24	0.32
E2	31	461	4.89	0.66
E3	32	81	7.05	0.88

Table 4. Morphospecies abundance, diversity, richness (Margalef's index) and evenness (Pielous's index) in each polygon.

Polygon	Morphospecies	Specimens	Species richness	Evenness
Africa	44	454	7.03	0.65
Australia	25	235	4.40	0.71
Mixed Ornamental A	59	561	9.16	0.71
Mixed Ornamental B	63	675	9.52	0.65
New Zealand A	49	293	8.45	0.70
New Zealand B	44	3681	5.24	0.32
South America	35	234	6.23	0.73

proportion of native invertebrates, with seven (14.68%) of the 48 morphospecies identified as native (Figure 1).

The MDS analysis of the invertebrate abundance data showed strong grouping of the invertebrate communities found throughout the zoo, with a single leaf litter sample from the Africa polygon, E3.4 ($n = 1$), being plotted separately from the remaining samples (Figure 2A). This outlier was removed, and a second analysis carried out using the remaining samples (Figure 2B). This second MDS showed overlapping of the samples from different polygons. The four samples collected from within the staff-only area in quadrant D1 (Mixed Ornamental B) were loosely clustered with those collected from publicly accessible areas of the zoo. The MDS analysis of the vegetation data did not show distinct clustering of the samples (Figure 3).

When samples were treated independently, a moderate negative correlation was found between the number of vegetative species and the diversity of invertebrate morphospecies found (Pearson = -0.67, $p = 0.05$). However, when the sample data were pooled by polygon, this correlation was not significant. The polygon-pooled data showed a strong positive correlation between the number of native vegetative species and both the native invertebrate abundance (Pearson = 0.76, $p = 0.017$) and native invertebrate diversity (Pearson = 0.8, $p = 0.01$). No correlation was found between total vegetation diversity and either total invertebrate diversity or total abundance.

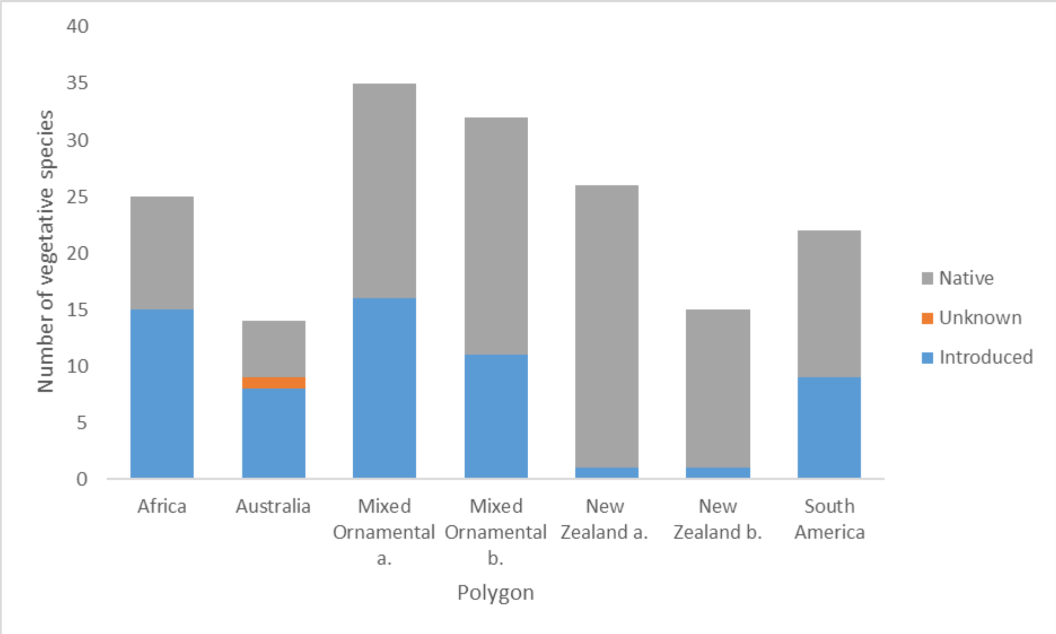

Figure 1. Diversity and New Zealand native status of vegetation in each polygon.

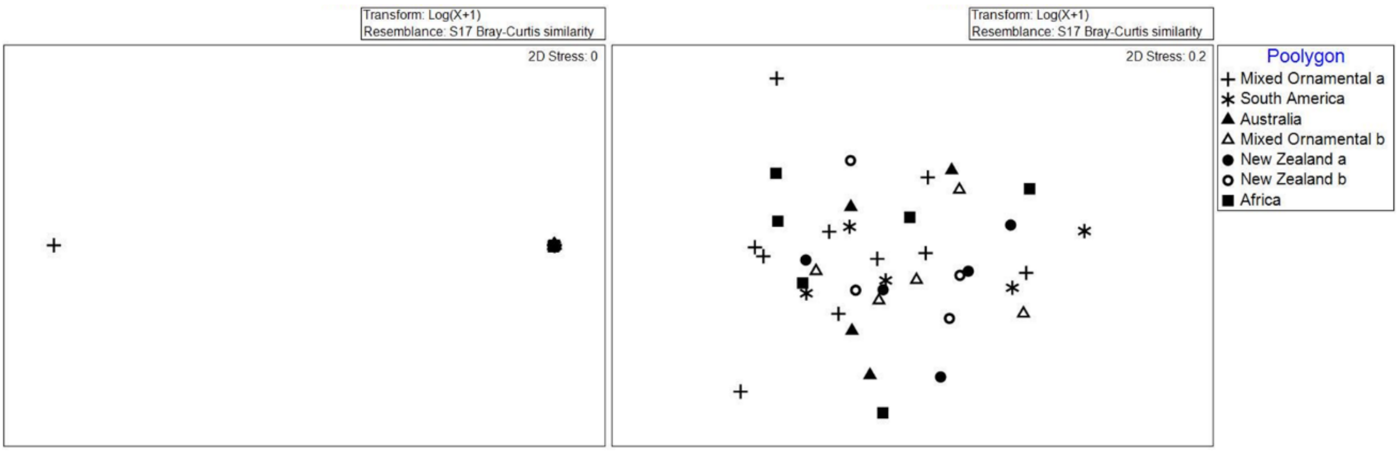

Figure 2. (A) MDS of invertebrate abundance, log transformed, showing the samples clustered into one point, with leaf litter sample E3.4 as an outlier. (B) MDS of invertebrate abundance data, log transformed, with the E3.4 outlier removed to show dissimilarity of remaining samples.

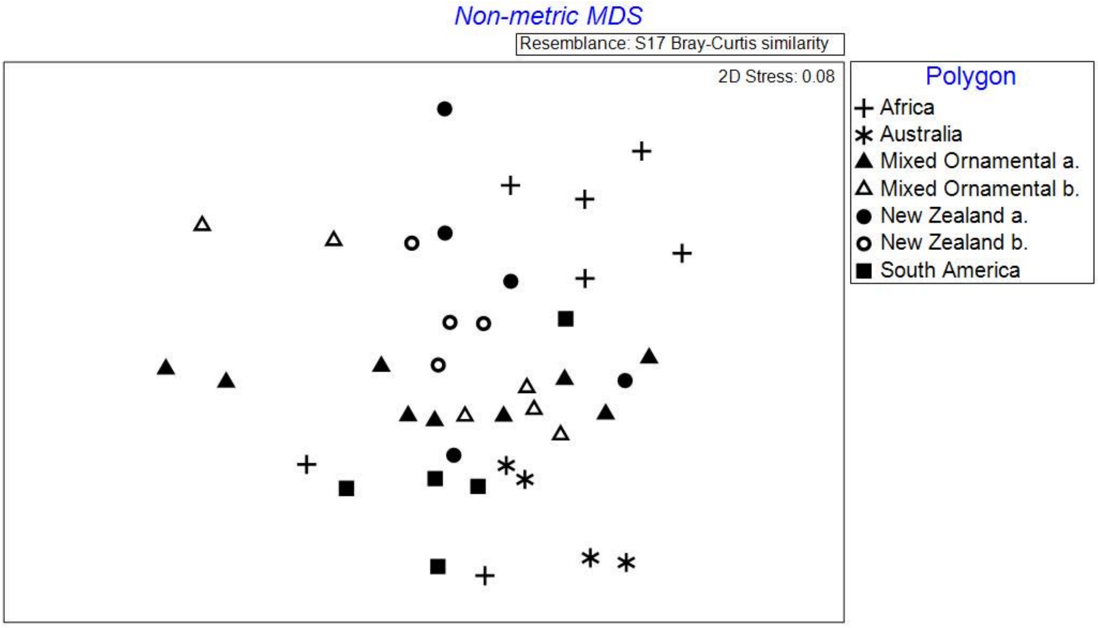

Figure 3. Multidimensional scaling analysis of binary vegetation species presence.

Discussion

Vegetation diversity is generally expected to have a positive correlation with insect diversity (Wenninger & Inouye 2008), by providing a greater range of potential host plants (Liebhold et al. 2018). However, our results did not show a correlation between the total vegetation richness and either invertebrate diversity or abundance. Relationships between vegetation and invertebrate diversity can be strongly influenced by structural variation, water availability, and other environmental factors (Kemp & Ellis 2017), which give rise to microhabitats and varied resource availability (Smith et al. 2006b; Wenninger & Inouye 2008). The presence of small mammalian predators can also pose a threat to native invertebrate species, with some native species potentially being more vulnerable than introduced ones (Stringer & Hitchmough 2012; Lester et al. 2014). Such untested factors may be having a greater effect on the composition of the invertebrate community within Auckland Zoo than the diversity of the vegetative community. The small size of some of the gardens, particularly those which are narrow strips next to walkways, will also be subject to edge effects, which may affect both the invertebrate diversity and abundance, favouring generalist species (Foggo et al. 2001).

The New Zealand B polygon was dominated by low-growing shrubs, such as *Hebe sp.*, and had a layer of bark chips as ground cover, with large sections exposed to direct sunlight. Conversely, the significantly larger New Zealand B polygon had dense, canopy-forming vegetation that prevented direct sunlight from reaching the ground, which was blanketed in leaf litter. These structural differences are expected to result in significant differences between the invertebrate communities (Kemp & Ellis 2017). The New Zealand A polygon had higher species richness and evenness than the New Zealand B polygon; however, these differences were not sufficient to separate these polygons in the MDS analysis.

Our analysis showed a positive correlation between the diversity of native vegetation and the abundance and diversity of native invertebrates; however, this was likely the result of the low number of invertebrate specimens that could be determined to be native skewing the analysis. Consequently, this correlation should not be considered significant. Given that the New Zealand native status could not be determined for 106 morphospecies, due to a lack of taxonomic resolution, the number of native species within the zoo grounds may be higher than this study indicates. This lack of taxonomic resolution also makes it difficult to compare the data obtained with that of other studies.

Variations in morphospecies abundance between some polygons may be due to differences in resource availability rather than limitations on dispersal, as many of the zoo's garden areas are connected, allowing for the uninhibited movement of invertebrates between areas with different planting types. And, while some garden areas are separated by walkways, these are likely not sufficient to fully prevent the dispersal of many species between gardens (Vergnes et al. 2012; Chapman et al. 2005). The movement of zoo staff between areas may also facilitate the dispersal of some species. Any future efforts to either promote native species or to control pest species need to take the connectivity of the gardens into account and be applied throughout the zoo rather than in small areas.

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Data Accessibility

Data collected for this study are available upon reasonable request to the author.

Author Contributions

Erin Doyle: Validation; formal analysis; investigation; resources; data curation; writing – original draft preparation; writing – review and editing; visualisation; supervision
Marie-Caroline Lefort: Conceptualisation; methodology; writing – original draft preparation; writing – review and editing; project administration; funding acquisition
Both authors have read and agreed to the published version of the manuscript.

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References

Auckland Zoo (n.d.). https://www.aucklandzoo.co.nz [Accessed 2023]

Blossey, B. (1999). Before, during and after: The need for long-term monitoring in invasive plant species management. *Biological Invasions*, 1: 301–311. https://doi.org/10.1023/A:1010084724526

Chapman, J. W., Reynolds, D. R., Smith, A. D., Riley, J. R., Telfer, M. G., Woiwod, I. P. (2005). Mass aerial migration in the carabid beetle *Notiophilus biguttatus*. *Ecological Entomology*, 30(3): 264–272. https://doi.org/10.1111/j.0307-6946.2005.00702.x

Crisp, P. N., Dickson, K. J. K., Gibbs, G. W. (1998). Does native invertebrate diversity reflect native plant diversity? A case study from New Zealand and implications for conservation. *Biological Conservation*, 83(2): 209–220. https://doi.org/10.1016/S0006-3207(97)00053-0

Davies, Z. G., Fuller, R. A., Loram, A., Irvine, K. N., Sims, V., Gaston, K. J. (2009). A national scale inventory of resource provision for biodiversity within domestic gardens. *Biological Conservation*, 142: 761–771. https://doi.org/10.1016/j.biocon.2008.12.016

Foggo, A., Ozanne, C. M. P., Speight, M. R., Hambler, C. (2001). Edge effects and tropical forest canopy invertebrates. *Plant Ecology*, 153: 347–359. https://doi.org/10.1023/A:1017594108769

Harrel, F. (2023). *Hmisc: Harrel Miscellaneous. R package version 5.1-0*. Available online: https://CRAN.R-project.org [Accessed 2023]

Hebert, P. D. N., Cywinska, A., Ball, S. L., deWaard, J. R. (2003). Biological identification through DNA barcodes. *Proceedings of the Royal Society B. Biological Sciences*, 270(1512): 313–321. https://doi.org/10.1098/rspb.2002.2218

Kellert, S. (1993). Values and perspectives of invertebrates. *Conservation Biology*, 7(4): 845–855.

Kemp, J. K., Ellis, A. G. (2017). Significant local-scale plant-insect species richness independent of abiotic effects in the temperate cape floristic region biodiversity hotspot. *PLoS ONE*, 12(1). https://doi.org/10.1371/journal.pone.0168033

Klein, A-M., Vaissiere, B. E., Cane, J. H., Steffan-Dewenter, I., Cunningham, S. A., Kremen, C., Tscharntke, T. (2007). Importance of pollinators in changing landscapes for world crops. *Proceedings of the Royal Society*, 274: 303–313. https://doi.org/10.1098/rspb.2006.3721

Kremen, C., Colwell, R. K., Erwin, T. L., Murphy, D. D., Noss, R. F., Sanjayan, A. (1993). Terrestrial arthropod assemblages: Their use in conservation planning. *Conservation Biology*, 7(4): 796–808. https://doi.org/10.1046/j.1523-1739.1993.740796.x

Lester, P. J., Brown, S. D. J., Edwards, E. D., Holwell, G. I., Pawson, S. M., Ward, D. F., Watts, C. H. (2014). Critical issues facing New Zealand entomology. *New Zealand Entomologist*, 37(1): 1–13. https://doi.org/10.1080/00779962.2014.861789

Liebhold, A. M., Yamanaka, T., Roques, A., Augustin, S., Chown, S. L., Brockerhoff, E. G., Pyšek, P. (2018). Plant diversity drives global patterns of insect invasion. *Scientific Reports*, 8: 12095. https://doi.org/10.1038/s41598-018-30605-4

Losey, J. E., Vaughan, M. (2006). The economic value of ecological services provided by insects. *Bioscience*, 56(4): 311–323. https://doi.org/10.1641/0006-3568(2006)56[311:TEVOES]2.0.CO;2

Oliver, I., Beattie, A. (1996a). Designing a cost-effective invertebrate survey: A test of methods for rapid assessment of biodiversity. *Ecological Applications*, 6(2): 594–607. https://doi.org/10.2307/2269394

Oliver, I., Beattie, A. (1996b). Invertebrate morphospecies as surrogates for species: A case study. *Conservation Biology*, 10(1): 99–109. https://doi.org/10.1046/j.1523-1739.1996.10010099.x

Rodríguez, J., Thompson, V., Rubido-Bará, M., Cordero-Rivera, A., González, L. (2019). Herbivore accumulation on invasive alien plants increases the distribution range of generalist herbivorous insects and supports proliferation of non-native insect pests. *Biological Invasions*, 21: 1511–1527. https://doi.org/10.1007/s10530-019-01913-1

Roy, D. B., Hill, M. O., Rothery, P. (1999). Effects of urban land cover on the local species pool in Britain. *Ecography*, 22: 507–515. https://www.jstor.org/stable/3683142

Singer, M. C., Parmesan, C. (2018). Lethal trap created by adaptive evolutionary response to an exotic resource. *Nature*, 557: 238–241. https://doi.org/10.1038/s41586-018-0074-6

Smith, R. M., Warren, P. H., Thompson, K., Gaston, K. J. (2006a). Urban domestic gardens (VI): Environmental correlates of invertebrate species richness. *Biodiversity and Conservation*, 15: 2415–2438. https://doi.org/10.1007/s10531-004-5014-0

Smith, R. M., Warren, P. H., Thompson, K., Gaston, K. J. (2006b). Urban domestic gardens (VIII): Environmental correlates of invertebrate species richness. *Biodiversity and Conservation*, 15: 2515–2545. https://doi.org/10.1007/s10531-005-2784-y

Stringer, A. N., Hitchmough, R. A. (2012). Assessing the conservation status of New Zealand's native terrestrial invertebrates. *New Zealand Entomologist*, 35(2): 7–84. https://doi.org/10.1080/00779962.2012.686309

Tallamy, D. W. (2004). Do alien plants reduce insect biomass? *Conservation Biology*, 18(6): 1689–1692. https://doi.org/10.1111/j.1523-1739.2004.00512.x

Thompson, K., Austin, K. C., Smith, R. M., Warren, P. H., Angold, P. G., Gaston, K. J. (2003). Urban domestic gardens (I): Putting small-scale plant diversity in context. *Journal of Vegetation Science*, 14: 71–78. https://doi.org/10.1111/j.1654-1103.2003.tb02129.x

Traill, L. W., Lim, M. L. M., Sodhi, N. S., Bradshaw, C. J. A. (2010). Mechanisms driving change: Altered species interactions and ecosystem function through global warming. *Journal of Animal Ecology*, 79(5): 937–947. https://doi.org/10.1111/j.1365-2656.2010.01695.x

Vergnes, A., Le Viol, I., Clergeau, P. (2012). Green corridors in urban landscapes affect the arthropod communities of domestic gardens. *Biological Conservation*, 145: 171–178. https://doi.org/10.1016/j.biocon.2011.11.002

Wenninger, E. J., Inouye, R. S. (2008). Insect community response to plant diversity and productivity in sagebrush-steppe ecosystem. *Journal of Arid Environments*, 72(1): 24–33. https://doi.org/10.1016/j.jaridenv.2007.04.005

Zuefle, M. E., Brown, W. P., Tallamy, D. W. (2008). Effects of non-native plants on the native insect community of Delaware. *Biological Invasions*, 10: 1159–1169. https://doi.org/10.1007/s10530-007-9193-y

Appendix A

Table A1. URL links of specimens uploaded to inaturalist.com.

Taxa	URL
Arachnida: Acari	https://www.inaturalist.org/observations/10093770
Arachnida: Acari	https://www.inaturalist.org/observations/10102852
Arachnida: Acari	https://www.inaturalist.org/observations/10102853
Arachnida: Acari	https://www.inaturalist.org/observations/10102951
Arachnida: Acari	https://www.inaturalist.org/observations/10103363
Arachnida: Acari	https://www.inaturalist.org/observations/10103368
Arachnida: Acari	https://www.inaturalist.org/observations/10131146
Arachnida: Acari	https://www.inaturalist.org/observations/10133742
Arachnida: Acari	https://www.inaturalist.org/observations/10133743
Arachnida: Acari	https://www.inaturalist.org/observations/10133751
Arachnida: Acari	https://www.inaturalist.org/observations/10142416
Arachnida: Acari	https://www.inaturalist.org/observations/10142417
Arachnida: Acari	https://www.inaturalist.org/observations/10142422
Arachnida: Acari	https://www.inaturalist.org/observations/10142429
Arachnida: Acari	https://www.inaturalist.org/observations/10192319
Arachnida: Acari	https://www.inaturalist.org/observations/10335530
Arachnida: Acari	https://www.inaturalist.org/observations/10437304
Arachnida: Acari	https://www.inaturalist.org/observations/10454455
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Arachnida: Acari	https://www.inaturalist.org/observations/10651631
Arachnida: Acari	https://www.inaturalist.org/observations/10837583
Arachnida: Acari	https://www.inaturalist.org/observations/10837584
Arachnida: Acari	https://www.inaturalist.org/observations/10837585
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Arachnida: Acari	https://www.inaturalist.org/observations/12219716
Arachnida: Acari	https://www.inaturalist.org/observations/12336080
Arachnida: Acari	https://www.inaturalist.org/observations/12336081
Arachnida: Acari	https://www.inaturalist.org/observations/12436555
Arachnida: Acari	https://www.inaturalist.org/observations/12436557
Arachnida: Acari	https://www.inaturalist.org/observations/12436560
Arachnida: Araneae	https://www.inaturalist.org/observations/10103358
Arachnida: Araneae	https://www.inaturalist.org/observations/10103367
Arachnida: Araneae	https://www.inaturalist.org/observations/10103370

Arachnida: Araneae	https://www.inaturalist.org/observations/10103371
Arachnida: Araneae	https://www.inaturalist.org/observations/10117047
Arachnida: Araneae	https://www.inaturalist.org/observations/10133749
Arachnida: Araneae	https://www.inaturalist.org/observations/10142414
Arachnida: Araneae	https://www.inaturalist.org/observations/10142427
Arachnida: Araneae	https://www.inaturalist.org/observations/10192325
Arachnida: Araneae	https://www.inaturalist.org/observations/10192331
Arachnida: Araneae	https://www.inaturalist.org/observations/10211710
Arachnida: Araneae	https://www.inaturalist.org/observations/10211712
Arachnida: Araneae	https://www.inaturalist.org/observations/10236030
Arachnida: Araneae	https://www.inaturalist.org/observations/10335519
Arachnida: Araneae	https://www.inaturalist.org/observations/10335525
Arachnida: Araneae	https://www.inaturalist.org/observations/10437305
Arachnida: Araneae	https://www.inaturalist.org/observations/10454459
Arachnida: Araneae	https://www.inaturalist.org/observations/10465544
Arachnida: Araneae	https://www.inaturalist.org/observations/10465554
Arachnida: Araneae	https://www.inaturalist.org/observations/10762302
Arachnida: Araneae	https://www.inaturalist.org/observations/10837578
Arachnida: Araneae	https://www.inaturalist.org/observations/10837580
Arachnida: Araneae	https://www.inaturalist.org/observations/12111303
Arachnida: Araneae	https://www.inaturalist.org/observations/12276262
Collembola	https://www.inaturalist.org/observations/10191897
Collembola	https://www.inaturalist.org/observations/12336083
Collembola: Entomobryomorpha	https://www.inaturalist.org/observations/10131145
Collembola: Entomobryomorpha	https://www.inaturalist.org/observations/10142413
Collembola: Entomobryomorpha	https://www.inaturalist.org/observations/10191564
Collembola: Entomobryomorpha	https://www.inaturalist.org/observations/10191658
Collembola: Entomobryomorpha	https://www.inaturalist.org/observations/10191896
Collembola: Entomobryomorpha	https://www.inaturalist.org/observations/10191898
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Collembola: Isotomidae	https://www.inaturalist.org/observations/10191894
Collembola: Isotomidae	https://www.inaturalist.org/observations/10191895
Collembola: Isotomidae	https://www.inaturalist.org/observations/10335517
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Collembola: Poduromorpha	https://www.inaturalist.org/observations/10142420
Collembola: Poduromorpha	https://www.inaturalist.org/observations/10142421
Collembola: Poduromorpha	https://www.inaturalist.org/observations/10191893
Collembola: Poduromorpha	https://www.inaturalist.org/observations/10192323

Collembola: Poduromorpha	https://www.inaturalist.org/observations/10454454
Collembola: Poduromorpha	https://www.inaturalist.org/observations/10465551
Collembola: Symphypleona	https://www.inaturalist.org/observations/10131144
Collembola: Symphypleona	https://www.inaturalist.org/observations/10192326
Collembola: Symphypleona	https://www.inaturalist.org/observations/10335515
Collembola: Symphypleona	https://www.inaturalist.org/observations/11468968
Collembola: Symphypleona	https://www.inaturalist.org/observations/11468971
Gastropoda	https://www.inaturalist.org/observations/12111271
Gastropoda	https://www.inaturalist.org/observations/12336082
Gastropoda: Stylommatophora	https://www.inaturalist.org/observations/10105628
Gastropoda: Stylommatophora	https://www.inaturalist.org/observations/10105629
Gastropoda: Stylommatophora	https://www.inaturalist.org/observations/12107725
Gastropoda: Stylommatophora	https://www.inaturalist.org/observations/12436558
Geophilomorpha	https://www.inaturalist.org/observations/10335528
Insecta	https://www.inaturalist.org/observations/12496109
Insecta: Blattodea	https://www.inaturalist.org/observations/10102851
Insecta: Blattodea	https://www.inaturalist.org/observations/10117108
Insecta: Blattodea	https://www.inaturalist.org/observations/10133748
Insecta: Blattodea	https://www.inaturalist.org/observations/10236032
Insecta: Blattodea	https://www.inaturalist.org/observations/10465543
Insecta: Blattodea	https://www.inaturalist.org/observations/11086950
Insecta: Coleoptera	https://www.inaturalist.org/observations/10093769
Insecta: Coleoptera	https://www.inaturalist.org/observations/10102848
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Insecta: Coleoptera	https://www.inaturalist.org/observations/10103360
Insecta: Coleoptera	https://www.inaturalist.org/observations/10103364
Insecta: Coleoptera	https://www.inaturalist.org/observations/10103372
Insecta: Coleoptera	https://www.inaturalist.org/observations/10106979
Insecta: Coleoptera	https://www.inaturalist.org/observations/10142418
Insecta: Coleoptera	https://www.inaturalist.org/observations/10207274
Insecta: Coleoptera	https://www.inaturalist.org/observations/10211725
Insecta: Coleoptera	https://www.inaturalist.org/observations/10437296
Insecta: Coleoptera	https://www.inaturalist.org/observations/10437300
Insecta: Coleoptera	https://www.inaturalist.org/observations/10465545
Insecta: Coleoptera	https://www.inaturalist.org/observations/10465553
Insecta: Coleoptera	https://www.inaturalist.org/observations/12107727
Insecta: Coleoptera	https://www.inaturalist.org/observations/12219714
Insecta: Coleoptera	https://www.inaturalist.org/observations/12219721
Insecta: Coleoptera	https://www.inaturalist.org/observations/12496113

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Insecta: Coleoptera	https://www.inaturalist.org/observations/12496130
Insecta: Dermaptera	https://www.inaturalist.org/observations/10093895
Insecta: Dermaptera	https://www.inaturalist.org/observations/10142424
Insecta: Dermaptera	https://www.inaturalist.org/observations/10207267
Insecta: Dermaptera	https://www.inaturalist.org/observations/12496111
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Insecta: Diptera	https://www.inaturalist.org/observations/10102847
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Insecta: Diptera	https://www.inaturalist.org/observations/10131143
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Insecta: Diptera	https://www.inaturalist.org/observations/10191900
Insecta: Diptera	https://www.inaturalist.org/observations/10192322
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Insecta: Diptera	https://www.inaturalist.org/observations/10454452
Insecta: Diptera	https://www.inaturalist.org/observations/10454458
Insecta: Diptera	https://www.inaturalist.org/observations/10651627
Insecta: Diptera	https://www.inaturalist.org/observations/10762304
Insecta: Diptera	https://www.inaturalist.org/observations/10837582
Insecta: Diptera	https://www.inaturalist.org/observations/11374546
Insecta: Diptera	https://www.inaturalist.org/observations/11380036
Insecta: Diptera	https://www.inaturalist.org/observations/12222774
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Insecta: Hemiptera	https://www.inaturalist.org/observations/10093899
Insecta: Hemiptera	https://www.inaturalist.org/observations/10093902

Insecta: Hemiptera	https://www.inaturalist.org/observations/10192321
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Insecta: Hemiptera	https://www.inaturalist.org/observations/10236029
Insecta: Hemiptera	https://www.inaturalist.org/observations/12276264
Insecta: Hemiptera	https://www.inaturalist.org/observations/12436553
Insecta: Hymenoptera	https://www.inaturalist.org/observations/10093772
Insecta: Hymenoptera	https://www.inaturalist.org/observations/10191507
Insecta: Hymenoptera	https://www.inaturalist.org/observations/10207269
Insecta: Hymenoptera	https://www.inaturalist.org/observations/10335522
Insecta: Hymenoptera	https://www.inaturalist.org/observations/10335526
Insecta: Hymenoptera	https://www.inaturalist.org/observations/10465547
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Insecta: Hymenoptera	https://www.inaturalist.org/observations/10837577
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Insecta: Hymenoptera: Formicidae	https://www.inaturalist.org/observations/10093768
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Insecta: Hymenoptera: Formicidae	https://www.inaturalist.org/observations/12219706
Insecta: Hymenoptera: Formicidae	https://www.inaturalist.org/observations/12219710
Insecta: Hymenoptera: Formicidae	https://www.inaturalist.org/observations/12219711
Insecta: Hymenoptera: Formicidae	https://www.inaturalist.org/observations/12219712
Insecta: Hymenoptera: Formicidae	https://www.inaturalist.org/observations/12219713
Insecta: Hymenoptera: Formicidae	https://www.inaturalist.org/observations/12219719
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Insecta: Hymenoptera: Formicidae	https://www.inaturalist.org/observations/12276259
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Insecta: Hymenoptera: Formicidae	https://www.inaturalist.org/observations/12496117
Insecta: Hymenoptera: Formicidae	https://www.inaturalist.org/observations/12496118
Insecta: Hymenoptera: Formicidae	https://www.inaturalist.org/observations/12496119
Insecta: Hymenoptera: Formicidae	https://www.inaturalist.org/observations/12496126
Insecta: Hymenoptera: Formicidae	https://www.inaturalist.org/observations/15182071
Insecta: Lepidoptera	https://www.inaturalist.org/observations/10117044
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Insecta: Lepidoptera	https://www.inaturalist.org/observations/10133747

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Insecta: Orthoptera	https://www.inaturalist.org/observations/12336079
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Insecta: Psocodea	https://www.inaturalist.org/observations/10335521
Insecta: Psocodea	https://www.inaturalist.org/observations/11468967
Insecta: Psocodea	https://www.inaturalist.org/observations/12107724
Insecta: Psocodea	https://www.inaturalist.org/observations/12111263
Insecta: Psocodea	https://www.inaturalist.org/observations/12111272
Insecta: Psocodea	https://www.inaturalist.org/observations/12219709
Insecta: Psocodea	https://www.inaturalist.org/observations/12222771
Insecta: Psocodea	https://www.inaturalist.org/observations/12436554
Insecta: Thysanoptera	https://www.inaturalist.org/observations/10335527
Insecta: Thysanoptera	https://www.inaturalist.org/observations/12108026
Insecta: Thysanoptera	https://www.inaturalist.org/observations/12111261
Malacostraca: Isopoda	https://www.inaturalist.org/observations/10093901
Malacostraca: Isopoda	https://www.inaturalist.org/observations/10117052
Malacostraca: Isopoda	https://www.inaturalist.org/observations/10117053
Malacostraca: Isopoda	https://www.inaturalist.org/observations/10117107
Malacostraca: Isopoda	https://www.inaturalist.org/observations/10131142
Malacostraca: Isopoda	https://www.inaturalist.org/observations/10142423
Malacostraca: Isopoda	https://www.inaturalist.org/observations/10142428
Malacostraca: Isopoda	https://www.inaturalist.org/observations/10192320
Malacostraca: Isopoda	https://www.inaturalist.org/observations/10211721
Malacostraca: Isopoda	https://www.inaturalist.org/observations/10236031
Malacostraca: Isopoda	https://www.inaturalist.org/observations/10236033
Malacostraca: Isopoda	https://www.inaturalist.org/observations/10335520
Malacostraca: Isopoda	https://www.inaturalist.org/observations/10335529
Malacostraca: Isopoda	https://www.inaturalist.org/observations/10437298
Malacostraca: Isopoda	https://www.inaturalist.org/observations/10454453
Malacostraca: Isopoda	https://www.inaturalist.org/observations/10454457

Appendix B

Table B1. Vegetation diversity (presence / absence) within each polygon.

Taxa	Australia	Africa	Mixed A	Mixed B	NZ A	NZ B	South America
Acacia baileyana F.Muell.	0	1	0	0	0	0	0
Acca sellowiana (O.Berg.) Burret	0	0	0	0	0	0	1
Acer negundo L.	1	0	0	0	0	0	0
Adiantum hispidulum Sw.	0	0	0	0	1	0	0
Fungi: Agaricomycetes Doweld	0	0	0	1	0	0	0
Fungi: *Agaricus* L.	1	0	0	0	0	0	0
Agathis australis (D.Don) Lindl. ex Loudon	0	0	0	0	1	0	0
Agonis flexuosa ((Willd.) Sweet)	1	0	0	0	0	0	0
Aloe L.	0	1	0	0	0	0	0
Angophora Cav.	0	1	0	0	0	0	0
Arecaceae Bercht. & J.Presl.	0	1	0	0	0	0	0
Arthropodium bifurcatum Heenan, A.D.Mitch. & de Lange	0	0	0	1	0	1	0
Alsophila tricolor (Colenso) R.M.Tryon	0	0	1	0	1	1	0
Arthropodium cirratum (Forst.f.) R.Br.	0	0	1	0	0	0	1
Asplenium oblongifolium Colenso	0	0	1	0	0	0	0
Asplenium polyodon G.Forst.	0	1	0	0	0	0	0
Asplenium ×lucrosum Perrie & Brownsey	0	0	1	0	1	0	0
Astelia banksii A.Cunn.	0	0	0	0	1	1	0
Astelia grandis Hook.f. ex Kirk	0	0	0	0	0	0	1
Astelia hastata Colenso	0	0	0	0	0	1	0
Auricularia cornea Ehrenb.	0	0	0	1	0	0	0
Austrostipa stipoides (Hook.f.) S.W.L.Jacobs et J.Everett	0	0	0	1	0	0	0
Backhousia citriodora F.Muell.	0	0	0	0	0	0	1
Bambusa oldhamii (Munro)	0	0	1	0	0	0	0
Bischofia Blume	0	1	0	0	0	0	0
Brachychiton rupestris (T.Mitch. ex Lindl.) K.Schum	0	1	0	0	0	0	0
Calliandra Benth.	0	1	0	0	0	0	0
Carex L.	0	1	1	0	0	1	1
Carex divulsa Stokes	0	1	0	0	0	0	0
Carex flagellifera Colenso	0	1	0	0	0	0	0
Carex testacea Sol. ex Boott	0	1	0	0	0	0	0
Carex virgata Sol. ex Boott	0	0	0	1	0	0	0
Chamaecyparis lawsoniana (A.Murray bis) Parl.	0	0	1	0	0	0	0

Coprosma acerosa A.Cunn. cv.	0	0	0	1	0	0	0
Coprosma lucida J.R.Forst. & G.Forst	0	0	0	0	0	1	0
Coprosma macrocarpa Cheeseman subsp. *macrocarpa*	0	0	0	0	0	0	0
Coprosma macrocarpa subsp. *minor* A.P.Druce ex R.O.Gardner & Heads	0	1	1	1	1	0	1
Coprosma macrocarpa subsp. *minor* A.P.Druce ex R.O.Gardner & Heads × *C. robusta* Raoul	0	0	0	1	0	0	0
Coprosma repens A.Rich.	0	0	1	0	0	0	0
Coprosma repens A.Rich. cv.	1	0	0	0	0	0	0
Coprosma rhamnoides A.Cunn	0	0	0	0	1	0	0
Coprosma robusta Raoul	0	0	1	1	0	1	0
Coprosma virescens Petrie	0	1	0	0	0	1	0
Cordyline australis (G.Forst.) Endl.	0	1	1	0	0	0	1
Corokia cotoneaster Raoul	0	1	0	0	0	0	0
Corokia ×virgata Turrill	0	0	1	1	0	0	0
Crassula sarmentosa Harv.	0	0	1	0	0	0	0
Cryptomeria japonica (L.f.) D.Don	0	0	1	0	0	0	0
Cryptomeria japonica (L.f.) D.Don 'Elegans'	0	0	1	0	0	0	0
Cunonia capensis L.	0	1	0	0	0	0	0
Cupressaceae Gray	0	0	1	0	0	0	0
Cupressus sempervirens L.	0	0	1	0	0	0	0
Cymbalaria muralis P.Gaertn., B.Mey. & Scherb.	0	1	0	1	0	0	0
Cymbidium Sw. cv.	0	0	0	0	0	0	1
Cyperus papyrus L.	0	1	0	1	0	0	0
Cyperus ustulatus A.Rich.	0	0	0	1	0	0	1
Dicksonia squarrosa (G.Forst.) Sw.	0	0	0	1	0	0	1
Doodia australis (Parris) Parris	0	0	1	0	0	0	0
Dracaena Vand.	0	1	0	0	0	0	0
Didymocheton spectabile (G.Forst.) Mabb. et Holzmeyer	0	0	0	0	0	1	1
Elegia capensis (Burm.f.) Schelpe	0	1	0	0	0	0	0
Ensete ventricosum (Welw.) Cheeseman	0	0	0	1	0	0	0
Euphorbia peplus L.	1	0	0	0	0	0	0
Ficus benjamina L.	0	0	0	0	0	0	1
Ficus L.	0	0	1	0	0	0	0
Gahina pauciflora Kirk	0	0	0	0	1	0	0
Geniostoma ligustrifolium A.Cunn. var. *ligustrifolium*	0	0	0	0	1	0	0
Grewia L.	0	1	0	0	0	0	0
Griselinia lucida G.Forst.	0	0	0	1	0	0	1

Veronica diosmifolia A.Cunn. × *V. speciosa* R.Cunn. ex A.Cunn.	0	0	0	0	0	1	0
Hemerocallis L.	0	0	0	0	0	0	1
Hesperocyparis arizonica (Greene) Bartel	0	0	1	0	0	0	0
Hibiscus aff. *trionum* ("New Zealand Diploid Race")	0	0	1	0	0	0	0
Hoheria sexstylosa Colenso	0	0	0	0	1	0	0
Hymenosporum flavum (Hook.) F.Muell.	1	0	0	0	0	0	0
Hypopterygium didictyon Müll.Hal.	0	0	1	0	0	0	0
Juniperus L. sp. 1	0	0	1	0	0	0	0
Juniperus L. sp. 2	0	0	1	0	0	0	0
Knightia excelsa R.Br.	0	0	0	1	0	0	0
Lapsana communis L.	0	0	0	1	0	0	0
Loropetalum chinense (R.Br.) Oliv.	0	1	0	1	0	0	0
Macadamia tetraphylla L.A.S.Johnson	0	0	0	1	0	0	0
Melaleuca L.	0	1	0	0	0	0	0
Melaleuca linearis Schrad. & J.C.Wendl.	1	0	0	0	0	0	0
Melaleuca viminalis (Sol. ex Gaertn.) Byrnes	1	0	0	0	0	0	0
Melicytus ramiflorus J.R.Forst & G.Forst. subsp. *ramiflorus*	0	0	1	0	0	0	1
Meryta sinclairii (Hook.f.) Seem.	0	0	0	0	1	0	0
Metrosideros excelsa Sol. ex Gaertn.	0	0	1	0	1	1	0
Lecanopteris pustulata (G.Forst.) Perrie & Brownsey subsp. *pustulata*	0	0	1	0	0	0	0
Monstera deliciosa Liebm.	0	0	0	0	0	0	1
Muehlenbeckia astonii Petrie	0	0	0	0	1	1	0
Muehlenbeckia australis (G.Forst.) Meisn. × *M. complexa* (A.Cunn.) Meisn. var. *complexa*	0	0	0	1	0	0	0
Muehlenbeckia complexa (A.Cunn.) Meisn. var. *complexa*	0	0	0	0	1	0	0
Musa L.	0	0	0	0	0	0	1
Myrsine australis (A.Rich.) Allan	0	0	1	0	1	0	0
Myrtaceae Juss.	1	0	0	0	0	0	0
Nestegis lanceolata (Hook.f.) L.A.S.Johnson	0	0	0	0	1	0	0
Oplismenus hirtellus subsp. *imbecillis* (R.Br.) U.Scholz.	0	0	1	0	0	0	0
Parmotrema reticulatum (Taylor) M.Choisy	0	0	1	0	0	0	1
Parthenocissus tricuspidata (Siebold & Zucc.) Planch.	0	0	1	0	0	0	0
Phormium cookianum subsp. *hookeri* (Hook.f.) Wardle	0	1	0	0	1	1	0
Phyllocladus trichomanoides G.Benn ex D.Don	0	0	0	0	0	0	1
Piper excelsum G.Forst. subsp. *excelsum*	1	0	1	1	1	1	1
Piper excelsum subsp. *peltatum* (R.O.Gardner) de Lange	0	0	0	0	1	0	0

Pittosporum crassifolium Banks et Sol. ex A.Cunn.	0	1	0	0	0	0	0
Pittosporum eugenioides A.Cunn.	0	0	0	1	1	0	0
Pittosporum ralphii Kirk	0	1	0	0	0	0	0
Pittosporum tenuifolium Sol. ex Gaertn.	0	0	0	0	1	0	0
Plagianthus regius (Poit.) Hochr. subsp. *regius*	0	0	0	0	1	0	0
Platanus L.	0	0	0	1	0	0	0
Platanus x hispanica Mill. ex Münchh. 'Acerifolia'	0	0	0	1	0	0	0
Podocarpus totara D.Don. var. *totara*	0	0	1	1	1	0	0
Polyspora axillaris (Roxb. ex Ker Gawl.) Sweet ex G.Don	0	0	1	0	0	0	0
Protea L.	0	0	0	1	0	0	0
Pseudopanax discolor (Kirk) Harms	0	1	0	0	0	0	1
Pseudopanax lessonii (DC.) K.Koch	0	0	0	1	0	0	0
Ptisana salicina (Sm.) Murdock	0	0	0	0	0	1	0
Ranunculus repens L.	0	0	0	1	0	0	0
Rhopalostylis sapida H.Wendl. & Drude	0	0	0	0	1	0	0
Saccharum officinarum L.	0	0	0	1	0	0	0
Sphaeropteris cooperi (Hook. ex F.Muell.) R.M.Tryon	0	0	1	0	0	0	0
Streblus banksii (Cheeseman) C.Webb	0	0	0	0	1	0	0
Strelitzia Banks	0	0	0	0	0	0	1
Thuja L.	0	0	1	0	0	0	0
Toronia toru (A.Cunn.) L.A.S.Johnson et B.G.Briggs	0	0	0	1	0	0	0
Veronica stricta Banks & Sol. ex Benth. var. *stricta*	0	0	0	0	0	0	1
Westringia fruticosa (Willd.) Druce	1	0	0	0	0	0	0

Authors

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