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Landcare Research

NZ Garden Bird Survey 2018: spatial coverage and trends in garden surveys

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NZ Garden Bird Survey 2018: spatial coverage and trends in garden records

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Summary

Purpose of this report

- This report summarises spatial coverage and trends in participation in the NZ Garden Bird Survey (NZGBS) 2007 to 2018 based on garden-survey records only. It then explores the implications of the findings for achieving a better understanding of the drivers of participation in citizen science, improvements in the garden bird trend analyses, and future NZGBS campaigns.

Source data

- The edited NZGBS 2007–18 data set, consisting of 36,075 garden-survey records collected by volunteers nationwide, was used as the basis for this report (i.e. school and park survey records are not considered). Unique garden identities were assigned to records using a set of standardised rules as part of the NZGBS data editing protocol.
- NZGBS records for all years were classified according to six geographical boundaries (as defined by Statistics NZ 2018):¹ region, territorial authority, urban rural, statistical area 2, statistical area 1, and meshblock.²

Coverage and retention of spatial units at multiple scales

- Cumulative coverage of spatial units over the lifetime of the NZGBS was estimated. At least 74% coverage was achieved at coarse to medium scales (region, territorial authority, urban rural, and statistical area 2). At finer scales, coverage was much lower: 40% for statistical area 1, 27% for meshblocks, and 1.4% for gardens. The highest rates of accumulation of new spatial units at each scale occurred in the initial 5 years of the NZGBS.
- Annual retention in spatial coverage was measured as the percentage of surveyed units in any given year that were resurveyed in the subsequent year. Average retention rates were 100% at coarse scales (region and territorial authority), c. 78% at medium scales (urban rural and statistical area 2), <50% at finer scales (statistical area 1 and meshblock), but just 30% at the garden scale.
- Across all scales the retention rate of spatial units (from year to year) stabilised about 5 years after the NZGBS was initiated but then dropped slightly over the last 3 years.

Number of garden records

- The number of garden records per year ranged from 1,387 to 4,378, equivalent to 0.09% to 0.28% of all gardens per year. Overall, regions with large cities (Auckland, Canterbury, Wellington and Otago) contributed the most records.

¹ <https://datafinder.stats.govt.nz/layer/92201-meshblock-higher-geographies-2018-high-definition/>

² For definitions, see: <http://archive.stats.govt.nz/methods/classifications-and-standards/classification-related-stats-standards/geographic-areas/pg4.aspx>

- The highest proportion of gardens surveyed was for Otago (c. 0.5% on average), a status it has maintained since 2010. Only six regions (Tasman, Marlborough, Wellington, Nelson, Canterbury and Hawke's Bay) achieved an average survey rate of >0.2%. In 2018, increases in survey rates were most apparent for Taranaki and Southland.
- Within territorial authorities, the highest proportions of gardens surveyed, on average, were for Dunedin City, Kāpiti Coast, Waimate, Waitaki, Clutha and Central Otago. Only Dunedin City, Kāpiti Coast and Waimate achieved an average survey rate of ≥0.5%.

Discussion and conclusions

- We recommend that future analyses explore the drivers of the retention rates in spatial coverage and surveyed gardens. Of particular interest are the socio-economic factors driving these patterns. We predict that gardens in more affluent neighbourhoods are more likely to be surveyed and resurveyed.
- Our bird trend analysis techniques, applied previously to the NZGBS 2007–17 bird count data set, have the advantage of cost-effectively calculating consistent and robust metrics at multiple spatial scales. However, the computational requirements are very high as the NZGBS data set is very large and the analyses account for four spatially nested variables. Previously some stakeholders raised concerns about whether the results at local scales were meaningful when the number of garden surveys was very low. These concerns are justified as the bird trend estimates for locations with small sample sizes will be more strongly influenced by those at coarser spatial resolutions. For this reason we recommend that the 2018 bird trend analysis focus on assessing variation in trends at coarse to medium spatial scales (region, territory authority and urban rural), while also controlling for garden identity. This approach balances the need to provide bird trend information at spatial scales that are meaningful to participants while addressing concerns about sample sizes and reducing the computational needs of the analysis.

Recommended next steps

- The 2018 trend analysis should consider variation in trends at the three coarser spatial scales only (region, territory authority and urban rural), while controlling for garden identity.
- We predict that garden survey and resurvey rates are likely to be higher in neighbourhoods that are more affluent, in closer proximity to nature, and/or have higher home ownership levels (leading to lower turnover of residents and hence more gardens being repeatedly surveyed), but this hypothesis needs to be tested.
- Information on garden survey rates should be readily available for finer scales to encourage participation. Future NZGBS campaigns should also aim to identify and apply mechanisms to encourage participants to resurvey their gardens. Participant feedback surveys could be used to determine the drivers of the high turnover in garden survey rates.

1 Introduction

1.1 Purpose of this report

This report summarises trends in participation in the NZ Garden Bird Survey for the period 2007 to 2018. It then explores the implications of the findings for achieving a better understanding of the drivers of participation in citizen science, improvements in the garden bird trend analyses, and future NZGBS campaigns.

1.2 Source data

The edited NZGBS 2007–18 data set, consisting of 36,075 garden-survey records collected by volunteers nationwide, was used as the basis for this report. The manual and automated processes for editing the raw NZGBS data (Spurr 2018; Spurr et al. 2018a,b, 2019) are documented elsewhere (Howard et al. 2017; MacLeod et al. 2017, 2019; MacLeod, Brandt et al. 2018). Unique garden identities were assigned to records using a set of standardised rules as part of the NZGBS data editing protocols.

NZGBS records for all years were classified according to six geographical boundaries (as defined by Statistics NZ 2018): region, territorial authority, urban rural, statistical area 2, statistical area 1, and meshblock.³

2 Coverage turnover of spatial units

2.1 Cumulative spatial coverage

Cumulative coverage of spatial units at multiple scales over the lifetime of the NZGBS was estimated (Table 1). At least 74% coverage was achieved at coarse to medium scales (region, territorial authority, urban rural, and statistical area 2). At finer scales, coverage was much lower: 40% for statistical area 1, 27% for meshblocks, and 1.4% for gardens. Overall, the accumulation rate for new spatial units at each scale was highest in the initial 5 years of the NZGBS (Figure 1).

³ For definitions, see: <http://archive.stats.govt.nz/methods/classifications-and-standards/classification-related-stats-standards/geographic-areas/pg4.aspx>

Table 1. Coverage of Statistics NZ 2018 geographical units by the NZGBS 2007–18 (n = 36,075 records) and 2013–18 (n = 20,274 records) data sets, respectively

<i>Statistics NZ 2018</i>		<i>Number of variable levels</i>			<i>Percentage coverage</i>	
<i>Geographical boundary layer</i>	<i>Variable name</i>	<i>Statistics NZ 2018</i>	<i>NZGBS 2007–18</i>	<i>NZGBS 2013–18</i>	<i>NZGBS 2007–18</i>	<i>NZGBS 2013–18</i>
Region	REGC2018_1	16	16	16	100%	100%
Territorial authority	TA2018_V_1	68	66	66 ^a	97%	97%
Urban rural ^b	UR2018_V_1	722	540	495 ^c	74%	69%
Statistical area 2	SA22018__1	2,253	2,004	1,908	88%	85%
Statistical area 1	SA12018_V1	29,889	12,036	8,929	40%	30%
Meshblock	MB2018_V1_	53,589	14,237	10,022	27%	19%
Gardens ^{d,e}	-	1,570,386	22,361	13,879	1.4%	0.9%

^a Note that if region and territorial authority names are concatenated, then the number of levels increases to 69 here.

^b Urban areas are built from the statistical area 2 geography, while rural areas are built from the statistical area 1 geography. See Statistics NZ's urban rural definition for more information: http://archive.stats.govt.nz/browse_for_stats/Maps_and_geography/Geographic-areas/urban-rural-profile/defining-urban-rural-nz.aspx

^c Note that if region, territorial authority and urban rural names are concatenated, then the number of levels increases to 498 here.

^d Garden identity for individual NZGBS records was derived using a set of standardised rules as part of the NZGBS data editing protocols, with overlapping gardens given the same identity.

^e The total number of available gardens was derived from the number of occupied dwellings, as defined in the data source: Statistics NZ 2013 Census counts by 2018 statistical area 1. <https://datafinder.stats.govt.nz/layer/92224-2013-census-counts-by-statistical-area-1-2018/>

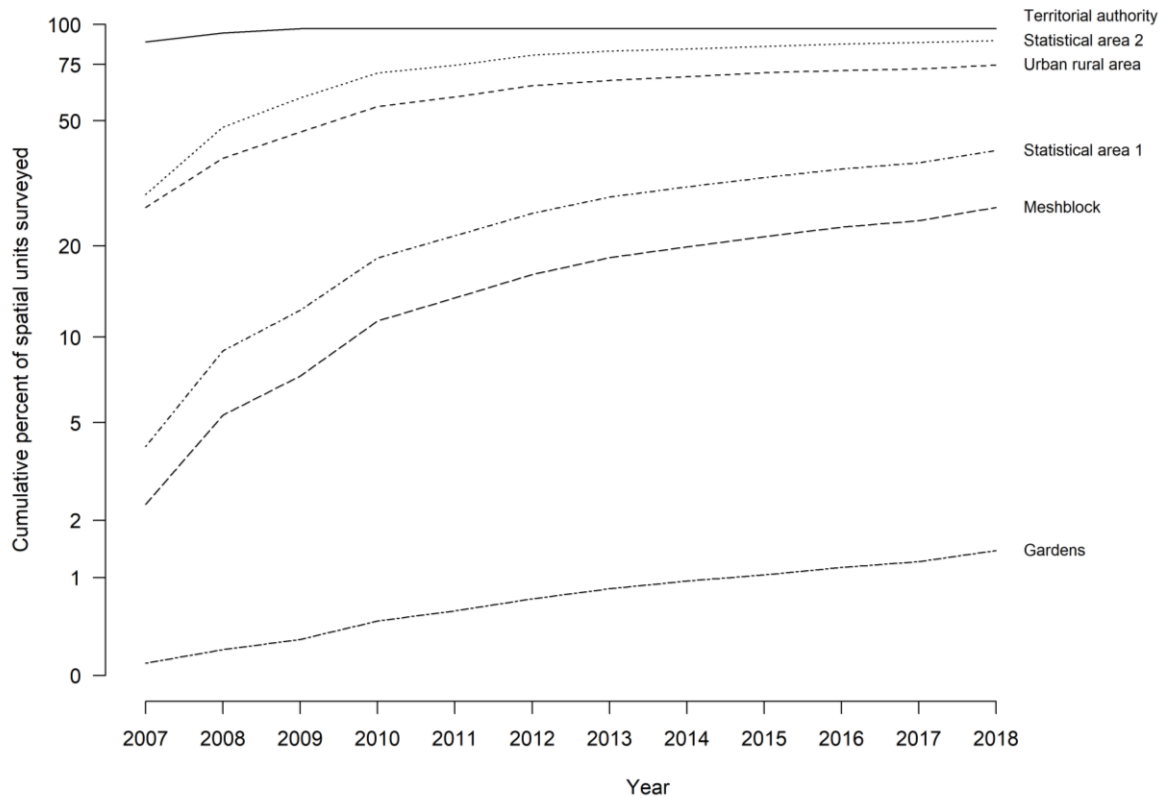


Figure 1. Cumulative percentage of units surveyed over the lifetime of the NZGBS for six spatial scales: region, territorial authority, urban rural areas, statistical area 2, statistical area 1, meshblock and gardens (see Table 1 for definition).

2.2 Annual turnover in spatial coverage

Annual turnover in the spatial area units surveyed is highest at finer spatial resolutions (Table 2; Figure 2). Coverage at the regional and territorial authority scales was stable, with all regions surveyed each year and very few territorial authorities dropping out in 3 years (one in 2008, three in 2009 and one in 2017). At medium spatial scales (urban rural and statistical area 2), around 20% of spatial units were new and a similar proportion were not resurveyed (compared to the previous year); at finer scales (statistical area 1, meshblock, and garden), the rate of turnover almost triples, with <50% of units being retained. At the garden scale, in particular, the turnover is very high (>70%); around 85% of gardens have only been surveyed once over the lifetime of the NZGBS (Figure 3).

Across all scales, the retention rate of spatial units (from year to year) stabilised about 5 years after the NZGBS was initiated (Figure 2). However, over the last 3 years the retention rate has dropped slightly, with proportionally more new gardens being added each year over the same period.

Table 2. Summary of annual turnover rates for spatial units across multiple scales

<i>Statistics NZ 2018</i>		<i>New survey units (%)^a</i>			<i>Units not resurveyed (%)^b</i>		
<i>Geographic boundary layer</i>	<i>Variable name</i>	Median	Min	Max	Median	Min	Max
Region	REGC2018_1	0	0	0	0	0	0
Territorial authority	TA2018_V_1	0	0	6	0	0	5
Urban rural ^c	UR2018_V_1	22	15	44	20	13	37
Statistical area 2	SA22018__1	22	18	53	22	13	44
Statistical area 1	SA12018_V1	58	54	85	61	50	78
Meshblock	MB2018_V1_	62	57	88	64	53	83
GardensError! Bookmark not defined. Error! Bookmark not defined.		73	68	92	74	63	88

^a As a percentage of total surveyed in any given year.

^b As a percentage of the total surveyed in the previous year.

^c Note that urban areas are built from the statistical area 2 geography, while rural areas are built from the statistical area 1 geography. See Statistics NZ's urban rural definition for more information: http://archive.stats.govt.nz/browse_for_stats/Maps_and_geography/Geographic-areas/urban-rural-profile/defining-urban-rural-nz.aspx

^d Garden identity for individual NZGBS records was derived using a set of standardised rules as part of the NZGBS data editing protocols, with overlapping gardens given the same identity.

^e The total number of available gardens was derived from the number of occupied dwellings as defined in the data source: Statistics NZ 2013 Census counts by 2018 statistical area 1.

<https://datafinder.stats.govt.nz/layer/92224-2013-census-counts-by-statistical-area-1-2018/>

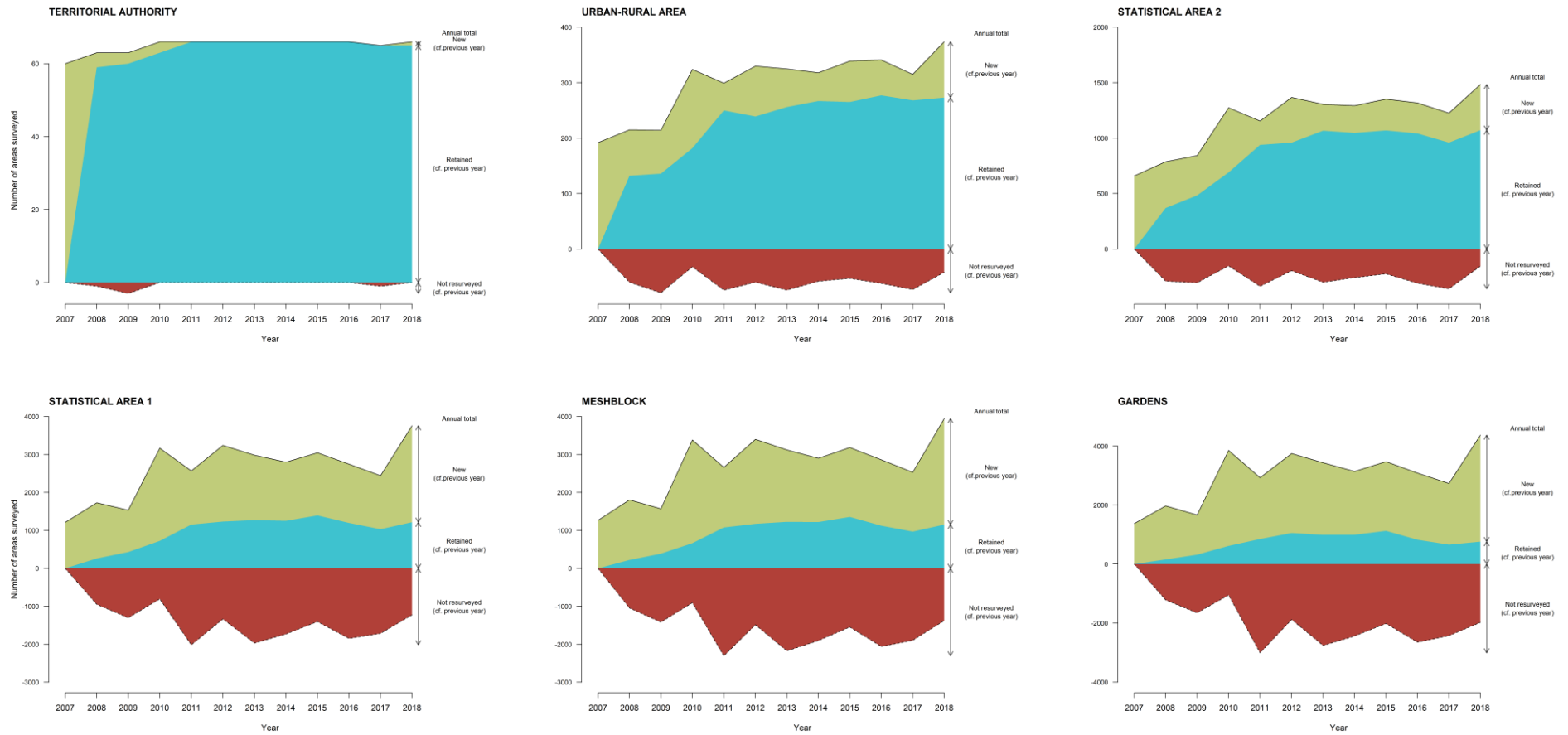


Figure 2. Annual turnover in spatial coverage over the lifetime of the NZGBS.

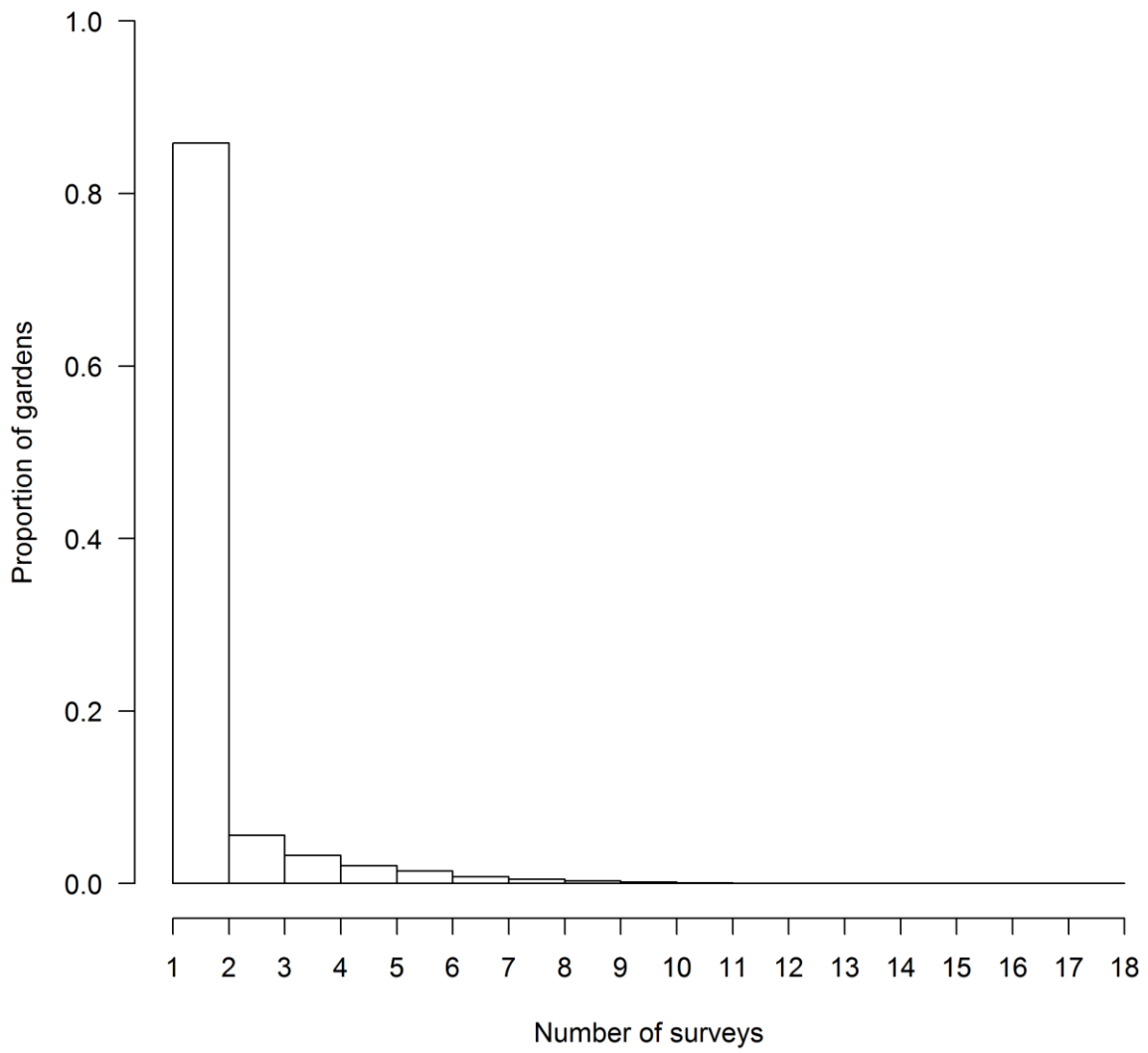


Figure 3. Number of surveys per unique garden identity.
 Note: Only four garden identities (out of 22,361) have more than 12 records, which may be an artefact of the NZGBS rules for defining garden identity.

3 Number of garden records

The number of records per year ranges from 1,387 to 4,378, equivalent to a survey rate of 0.09% to 0.28% of all New Zealand gardens⁴ per year (Table 3).

3.1 Garden records by region

The highest proportion of gardens surveyed was for Otago (around 0.5% on average; Figure 4)), a record it has maintained since 2010 (Figure 5). Only six regions (Tasman, Marlborough, Wellington, Nelson, Canterbury and Hawke's Bay) have achieved an average survey rate greater than 0.2% (Figure 4).

Regions with large cities (Auckland, Canterbury, Wellington and Otago) contributed more records than other areas (Figure 4). A visual inspection of regional trends shows the most apparent increases in survey rates in 2018 (compared to previous years) were for Taranaki and Southland (Figure 5).

Table 3. Number of records and survey rate per year in the edited NZGBS data set (2007–18), where the total number of gardens was 1,570,386 (as determined by the number of occupied dwellings derived from the Statistics NZ 2013 Census counts)

<i>Year</i>	<i>Number of records</i>	<i>Percentage of gardens</i>
2007	1,387	0.09
2008	1,982	0.13
2009	1,688	0.11
2010	3,998	0.25
2011	2,953	0.19
2012	3,791	0.24
2013	3,444	0.22
2014	3,147	0.20
2015	3,482	0.22
2016	3,088	0.20
2017	2,737	0.17
2018	4,378	0.28

Note: Garden identity for individual NZGBS records was derived using a set of standardised rules as part of the NZGBS data editing protocols, with overlapping gardens given the same identity.

⁴ The total number of available gardens was derived from the number of occupied dwellings as defined in the data source: Statistics NZ 2013 Census counts by 2018 statistical area 1. <https://datafinder.stats.govt.nz/layer/92224-2013-census-counts-by-statistical-area-1-2018/>

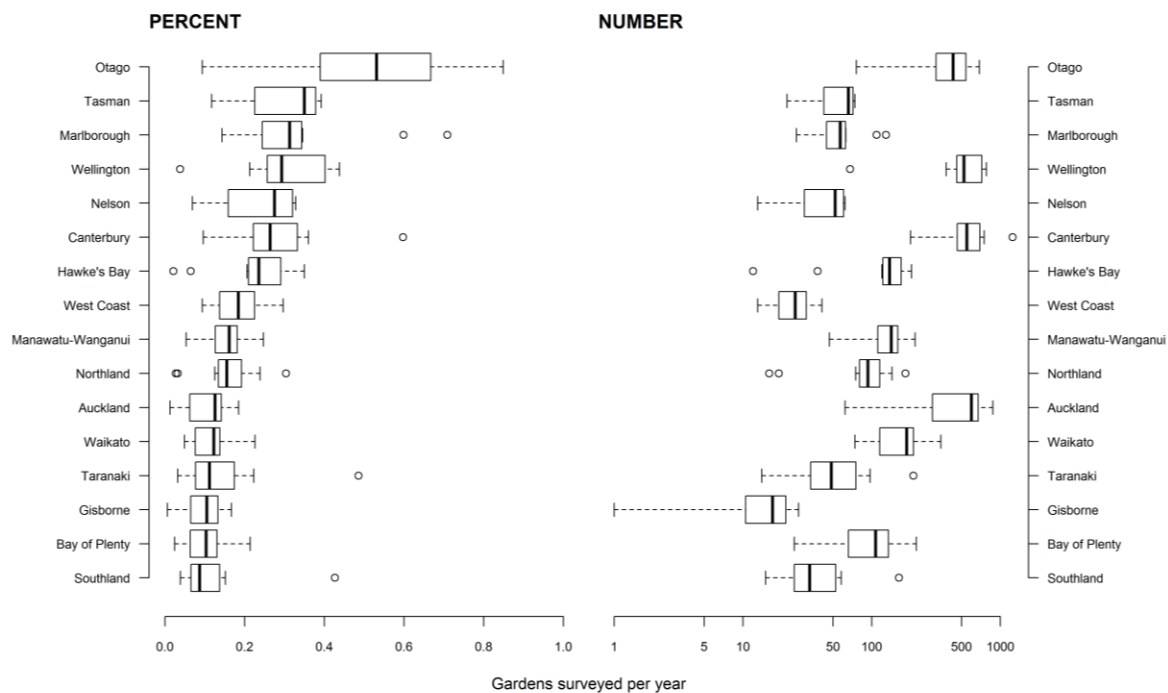


Figure 4. Variation among years ($n = 12$) in the percentage and total number of gardens sampled within each region. Boxes contain the 25th and 75th percentiles and the line within the box is the median. The whiskers extend to the most extreme data points that are no more than 1.5 times the interquartile range from the box, and outlier points show the minimum and maximum values.

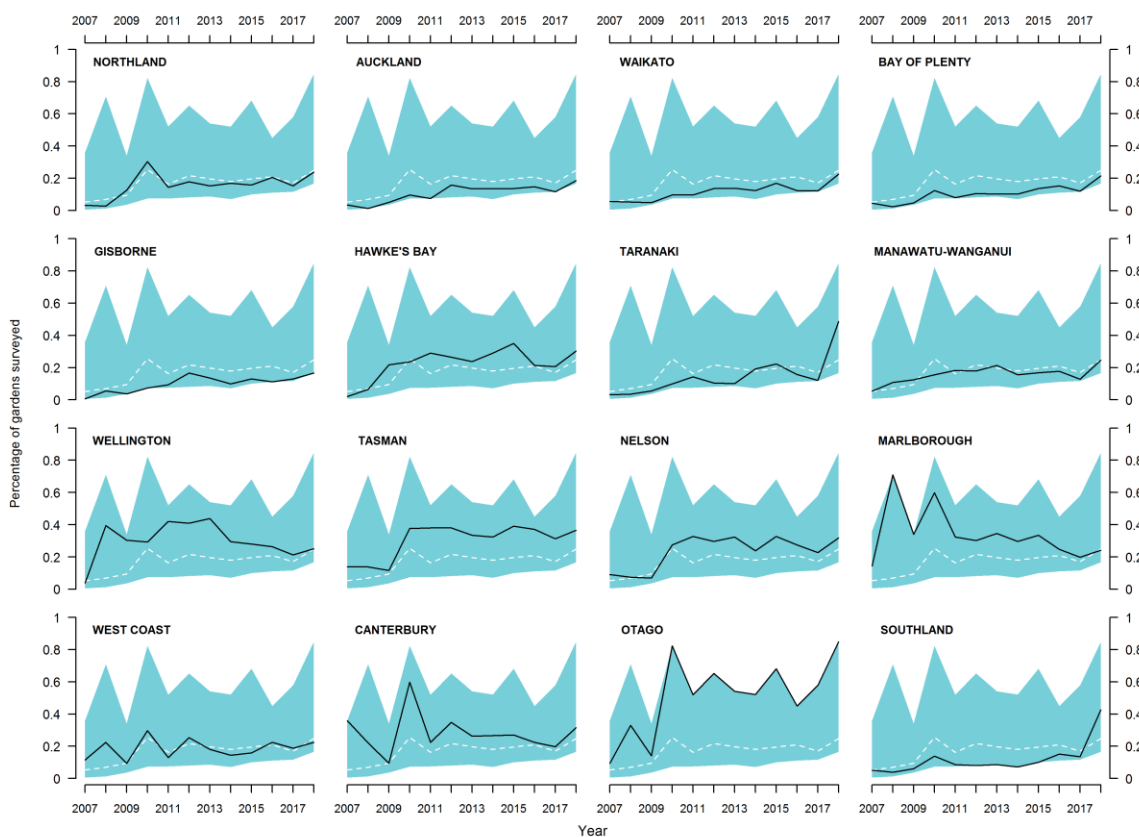


Figure 5. Trends in the percentage of gardens surveyed within a specified region (black line) in relation to the median (dashed white line) and range (blue shading) across all regions.

3.2 Garden records by territorial authority

The highest proportions of gardens surveyed, on average, by territorial authority were for Dunedin City, Kāpiti Coast, Waimate, Waitaki, Clutha and Central Otago (Figure 6). Only Dunedin City, Kāpiti Coast and Waimate achieved an average survey rate of $\geq 0.5\%$. In line with the regional patterns, the highest numbers of surveyed gardens were in districts encompassing large cities.

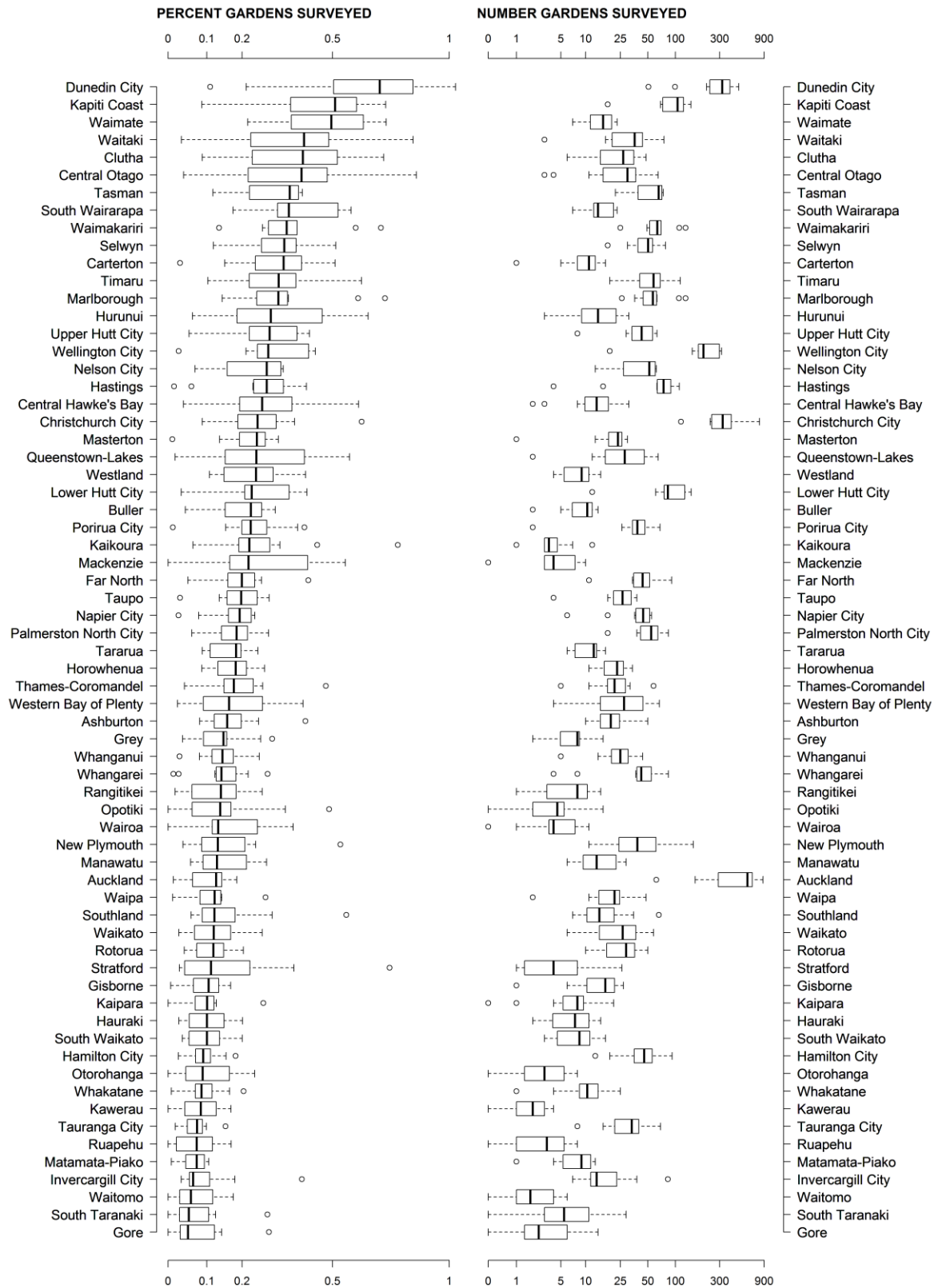


Figure 6. Variation among territorial areas ($n = 66$) in the number of gardens surveyed within territorial areas over 12 years. Boxes contain the 25th and 75th percentiles and the line within the box is the median. The whiskers extend to the most extreme data points that are no more than 1.5 times the interquartile range from the box, and outlier points show the minimum and maximum values.

4 Discussion and conclusions

4.1 Socio-economic drivers of participation

We recommend that future analyses explore the drivers of the spatial coverage of participation and high turnover rates in surveyed gardens. Of particular interest are the socio-economic factors that may drive these patterns. We predict that gardens in more affluent neighbourhoods are more likely to be surveyed and resurveyed. Drivers behind this pattern could include residents living in such neighbourhoods being more likely to own their homes and being closer in proximity to nature, and hence more likely to invest in enhancing and observing nature in their gardens. Another potential driver of high turnover rates is that the demographic of NZGBS participants is skewed towards older generations. The NZGBS organiser, for example, has received multiple emails over the years from older individuals not able to continue participating due to ill health or loss of mobility.

4.2 Considerations for future NZGBS bird trend analyses

Our earlier analysis of the NZGBS 2007–17 data set ($n = 31,679$ garden-survey records) accounted for the spatial variation in the presence or the number of birds by including random intercepts for four spatially nested variables in all models (MacLeod et al. 2019): region ('R', 16 factor levels), urban area ('U', 174 factor levels), area unit ('A', 1,690 factor levels) and garden identity ('G': 19,491 levels). The large data set and high number of spatial levels considered meant the computational requirements for this analysis were very high. However, these modelling techniques have the advantage of cost-effectively calculating consistent and robust bird trend metrics at multiple spatial scales at the same time.

On release of the *State of NZ Garden Birds 2017* report (MacLeod, Spurr et al. 2018), some stakeholders raised concerns about whether the results at local scales are meaningful when the number of garden surveys was very low (MacLeod et al. 2019). These concerns are justified because, where sample sizes are low, the trend estimates will be more strongly influenced by those at coarser spatial resolutions. While these local trend estimates are meaningful in as much as they reflect regional patterns and make best use of the available data, they would be more sensitive to local conditions with greater sample sizes.

Since its launch in 2007 (Spurr 2012), the NZGBS has achieved and sustained high coverage at coarse to medium spatial scales, with >70% of units sampled and a retention rate of >78%. At finer spatial scales, however, coverage and unit retention is relatively low ($\leq 40\%$ and $< 50\%$ respectively). We recommend that the 2018 trend analysis focus on assessing variation in trends at coarse to medium spatial scales only (region, territory authority and urban rural), while also controlling for garden identity. This balances the need to provide information at spatial scales that are meaningful to participants, while addressing concerns about sample sizes and reducing the computational needs of the analysis.

5 Recommended next steps

- The 2018 trend analysis should consider variation in trends at the three coarser spatial scales only (region, territory authority and urban rural), while controlling for garden identity.
- We predict that garden survey and resurvey rates are likely to be higher in neighbourhoods that are more affluent, in closer proximity to nature, and/or have higher home ownership levels (leading to lower turnover of residents and hence more gardens being repeatedly surveyed), but this hypothesis needs to be tested.
- Information on garden survey rates should be made readily available for finer scales to encourage participation, as on release of *State of NZ Garden Birds 2017* some parties were surprised at the low rates of participation at local scales, which spurred them on to take part in the 2018 campaign (MacLeod et al. 2019).
- Information on garden survey rates should be readily available for finer scales to encourage participation. Future NZGBS campaigns should also aim to identify and apply mechanisms to encourage participants to resurvey their gardens. Participant feedback surveys could be used to determine the drivers of the high turnover in garden survey rates.

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