National Wastewater Surveillance Programme - COVID-19

Week 22, 2022 (Week Ending 05 June 2022)

Report prepared on 09 June 2022

Overview

SARS-CoV-2, the virus that causes COVID-19 disease, is shed in the faeces of people that are infected and so the viral RNA can be detected in wastewater. As such, testing wastewater for SARS-CoV-2 RNA is an efficient population-based COVID-19 surveillance tool. Based on national and international data, this method has been shown to be an indicator of increasing and decreasing cases (i.e., early warning system) and complements other surveillance tools. A national wastewater COVID-19 surveillance programme was established in 2021 by the Institute of Environmental Science and Research (ESR). This work is funded by the New Zealand Ministry of Health and is part of New Zealand's COVID-19 response.

Wastewater samples are collected from wastewater treatment plants across both the North and South Island of New Zealand. Most sites are sampled at least weekly between Monday and Thursday of any given week. The number of sites and frequency of collection varies over time. Grab or 24 hr composite samples are collected.

Approach

Samples are sent from each wastewater treatment plant to one of the ESR laboratories (Porirua or Christchurch). Processing involves the concentration of virus and extraction of viral RNA. The presence of SARS-CoV-2 RNA in the sample is then determined using RT-qPCR.

A result of not detected means that SARS-CoV-2 RNA is either absent from the sample, or at a level too low to be detected. When SARS-CoV-2 RNA is detected, the concentration in the sample can be calculated. Low amounts of SARS-CoV-2 RNA in a sample may not be able to be accurately quantified and are recorded as less than the limit of quantitation. For quantitation, the raw concentration data (i.e., genome copies per L) is converted to a viral load of genome copies per day per person. This calculation considers the flow rate of wastewater entering the wastewater treatment plant and the population in the catchment. This is the population-normalised viral load.

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Key Points & Limitations

- SARS-CoV-2 RNA concentrations should not be compared between wastewater catchments.
- Day to day variability in SARS-CoV-2 RNA concentrations, especially in smaller catchments, is to be expected. Greater variability is expected with grab samples.
- Generally, increasing viral loads are associated with increasing numbers of people with SARS-CoV-2 infection and vice versa (decreasing concentrations indicating decreasing cases). However, there are a number of factors that affect the amount of viral RNA detected and so data from wastewater surveillance cannot indicate the exact number of COVID-19 cases in the catchment area.
- The number of COVID-19 cases reported via individual testing are reported for each region to provide a comparison to the wastewater results. The cases in each catchment area are an estimate of the number of people in that wastewater catchment area that have reported a positive test. However, because the wastewater catchments do not exactly align with regional boundaries, the number of cases estimated by region and by water catchment area may be different.
- Data are provisional and may be subject to change by location.
- As septic tank systems are not connected to wastewater treatment plants, the wastewater from these households will not be represented in the data.

Results For Week 22, 2022

In the week ending 5 June 2022, 163 samples were collected from 108 locations in New Zealand. Analysis of samples from two sites is still in progress (Cambridge & Te Awamutu, received 8 June).

SARS CoV-2 RNA was detected in all samples except for two – Maketu (Bay of Plenty), and the first, but not the second sample collected from Woodville (Manawatu-Wanganui).

Figure 1 below gives the proportion of sites with positive results for this and previous weeks.

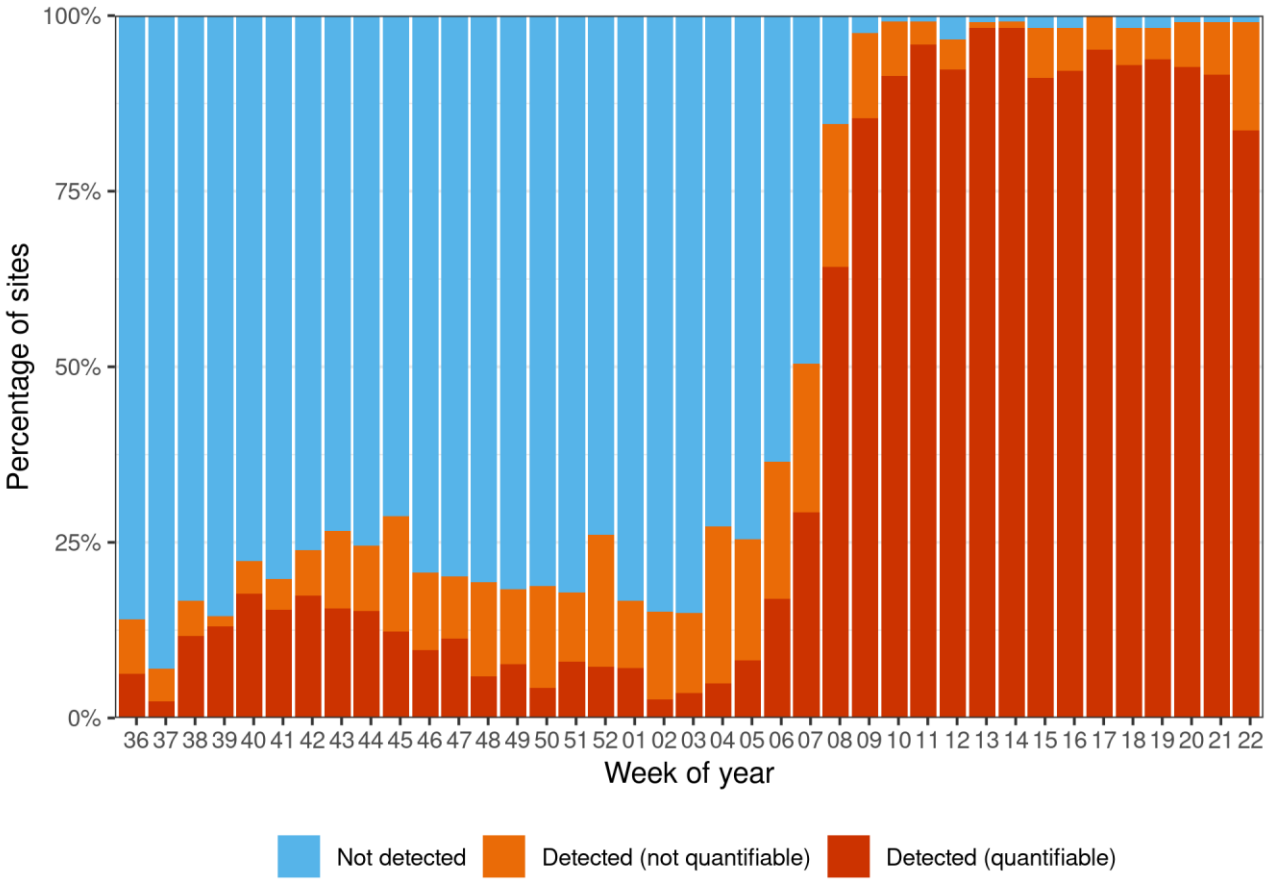


Figure 1. Results for SARS-CoV-2 RNA in wastewater collected across New Zealand.

Figure 2. Location of sampling sites and latest results in the two weeks ending 05 June 2022. Interactive map of weekly results available publicly at https://www.esr.cri.nz/our-expertise/covid-19-response/wastewater-testing-results

Interpreting site graphs

Wastewater Results

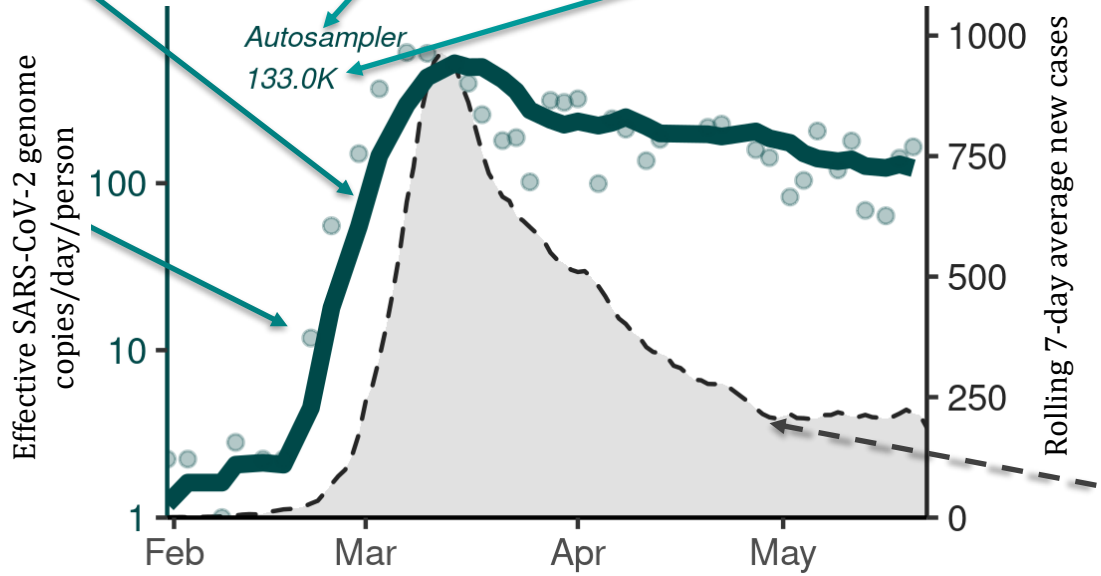
Rolling 14-day average of genome copies/day/person **shown as solid line**

Individual wastewater sample results are shown as **circles**

Log_{10} scale

Sample collection method. Results based on autosampler may be more representative than grab sample-based results.

Population of wastewater catchment



Cases

Rolling seven-day average **new cases** in the catchment based on onset date of illness, or if not available the laboratory sample date

Dotted line (shaded)

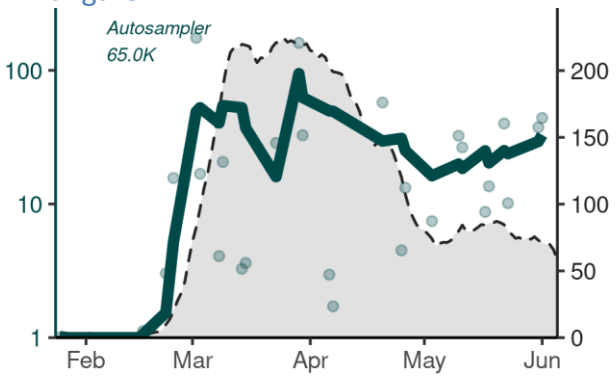
Linear scale

Note the scales differ for each graph and care should be taken when interpreting the data.

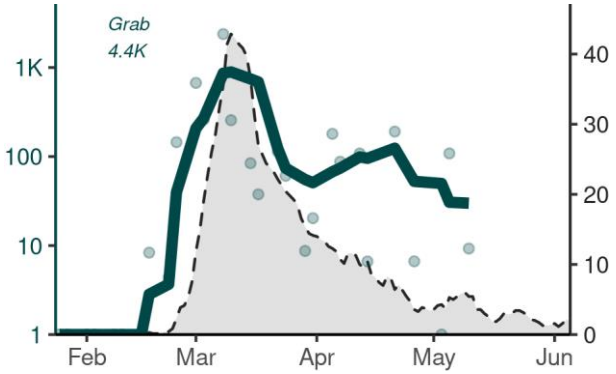
Wastewater results are on log_{10} scale, while case data is on a linear scale.

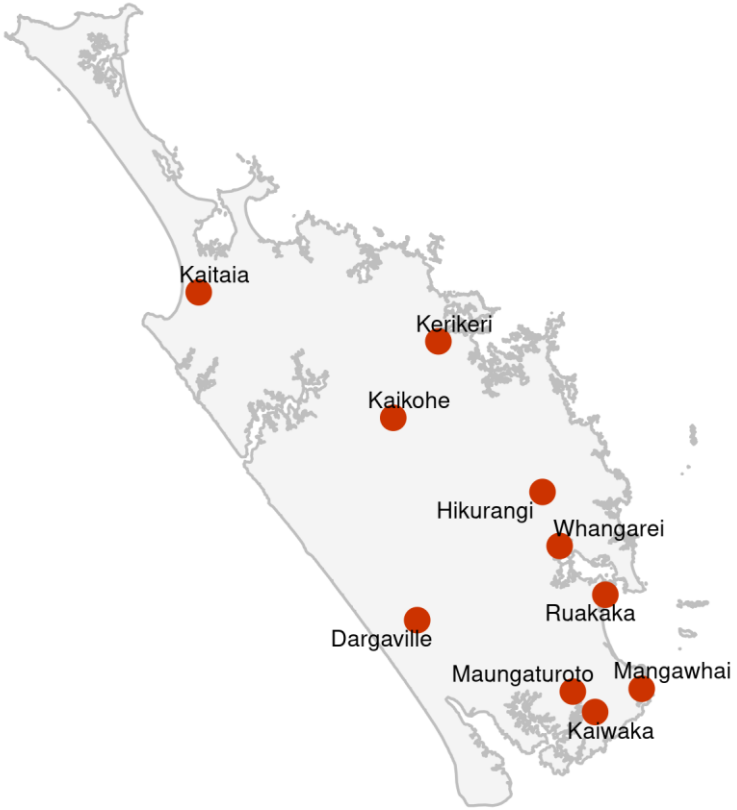
Northland

Whangarei

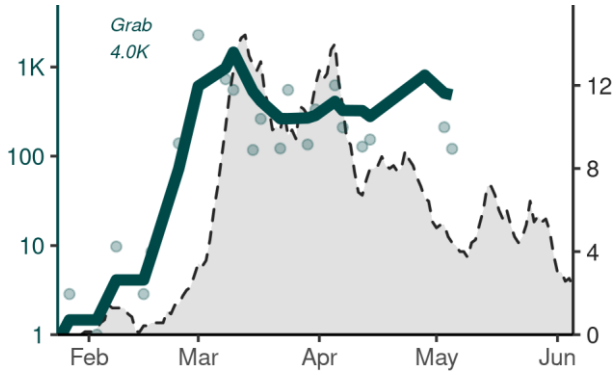


Kaikohe

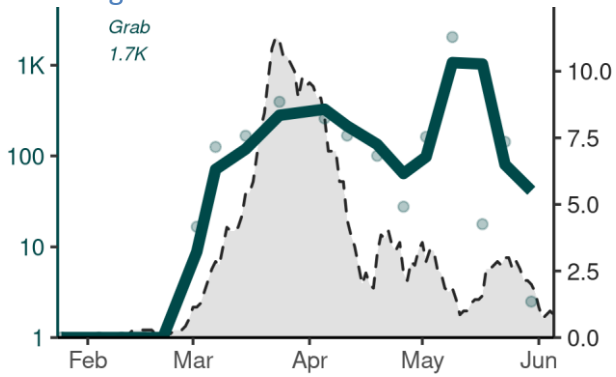




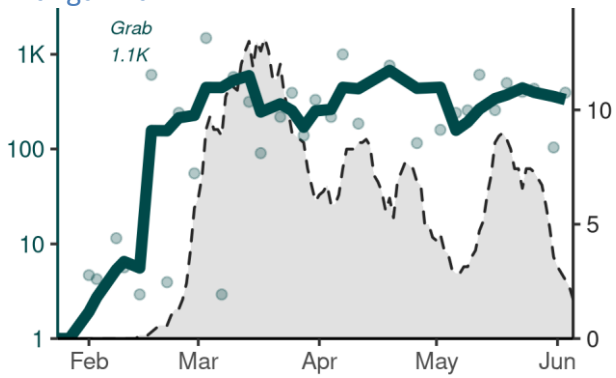
Paihia



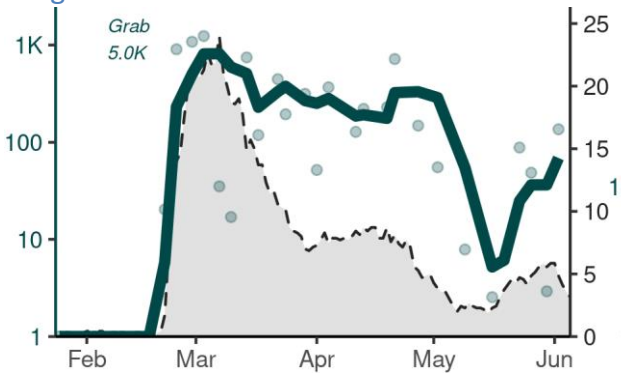
Hikurangi



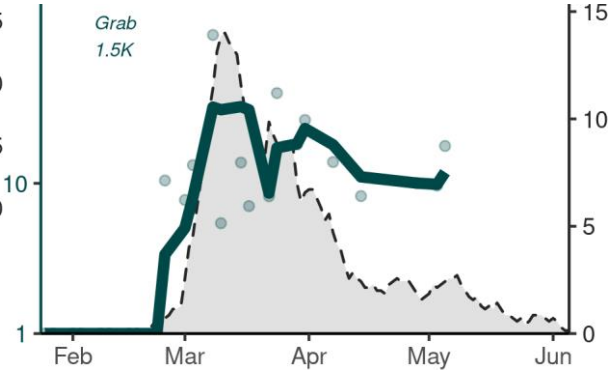
Mangawhai



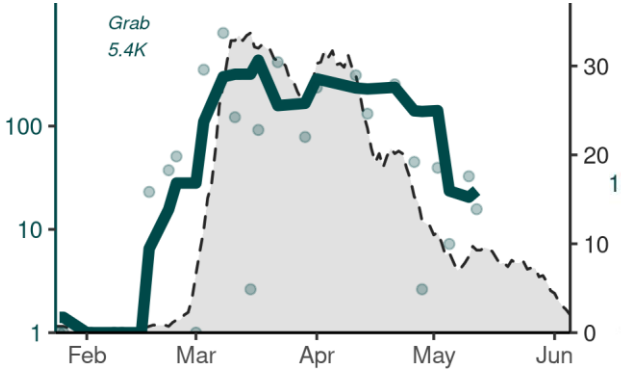
Dargaville



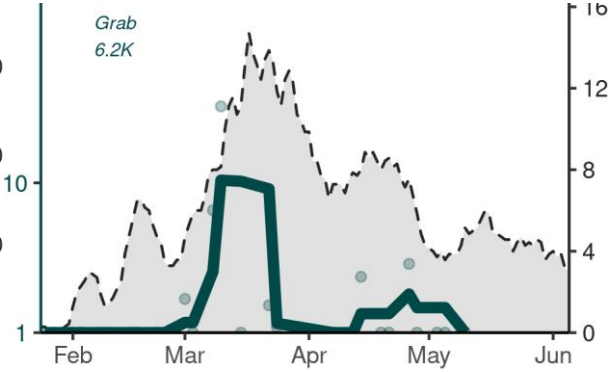
Kawakawa



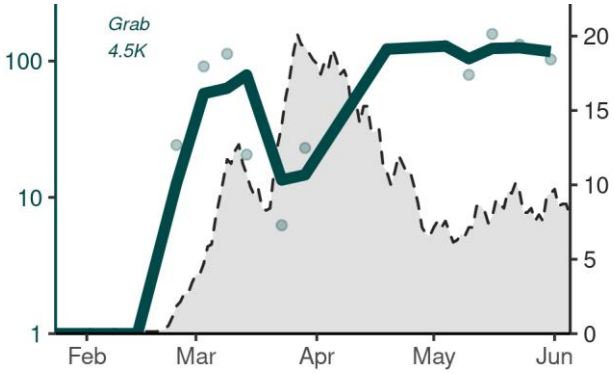
Kaitaia



Kerikeri

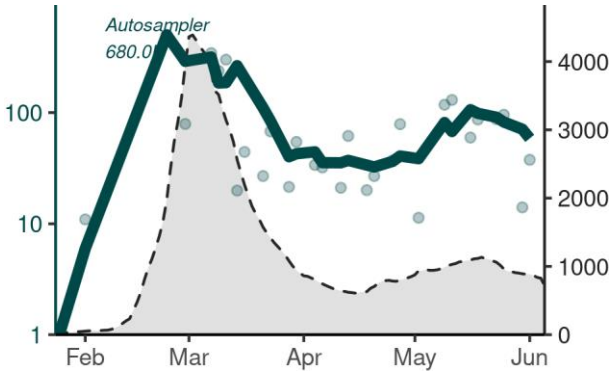


Ruakaka

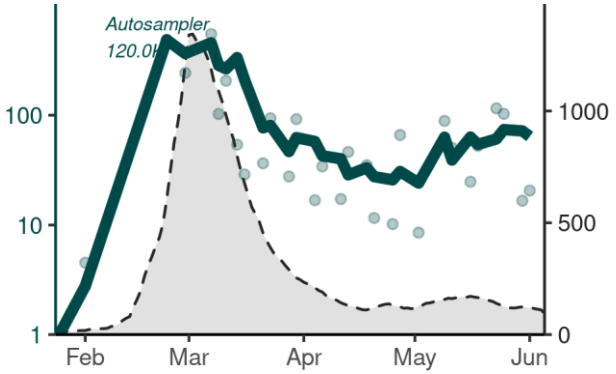


Auckland

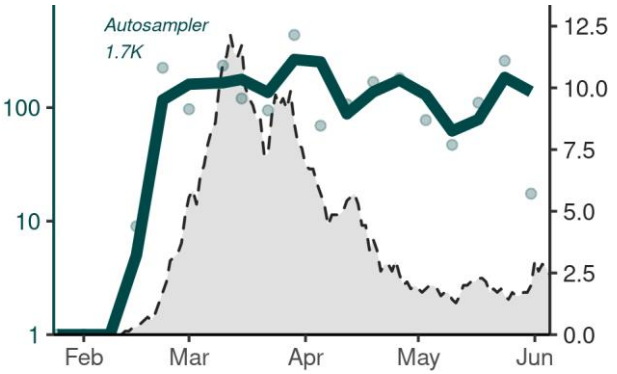
Auckland East



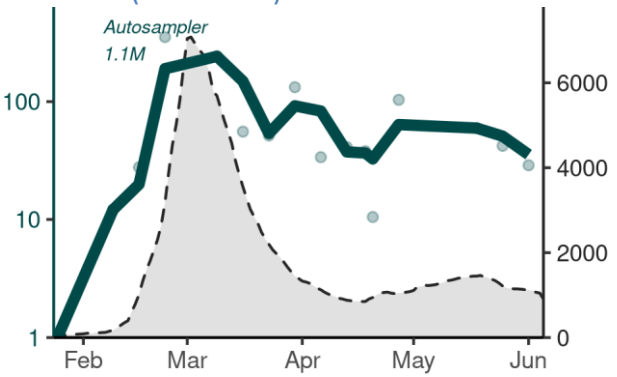
Auckland Southwest



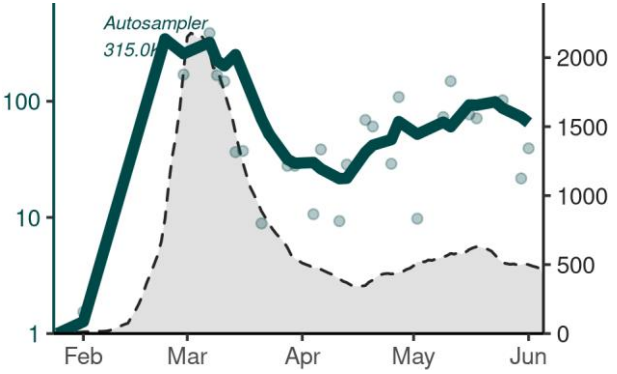
Wellsford



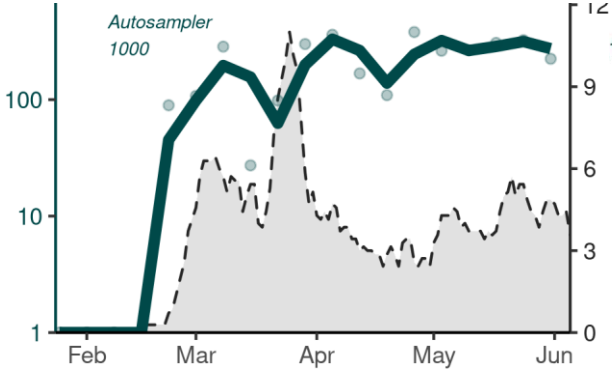
Auckland (Combined)



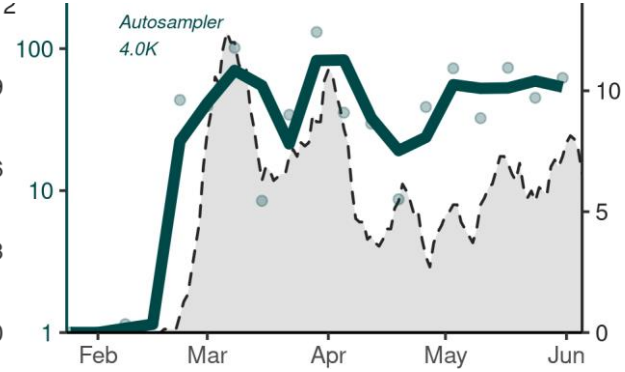
Auckland West



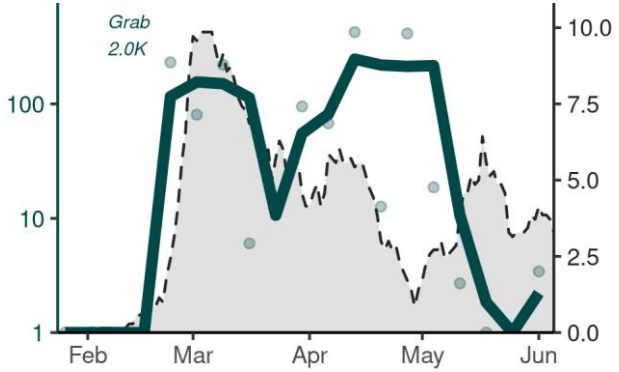
Omaha



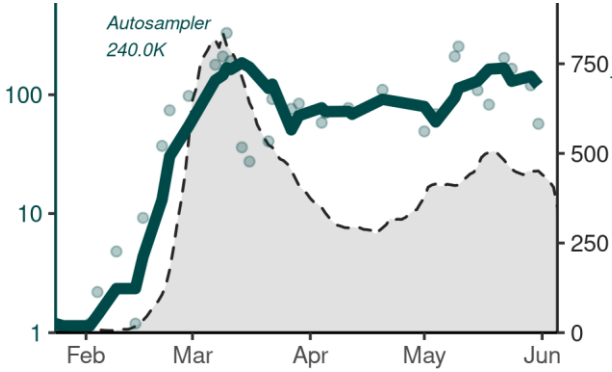
Snells/Algies



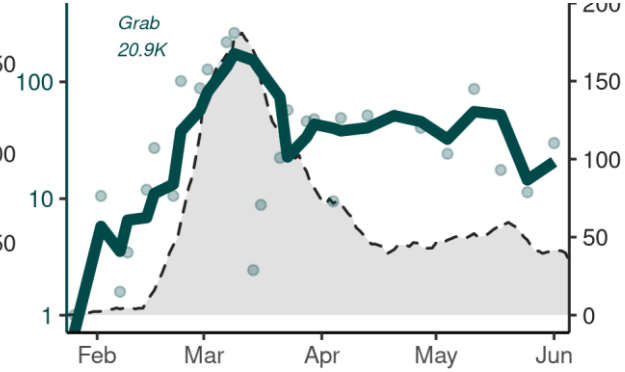
Clarks Beach



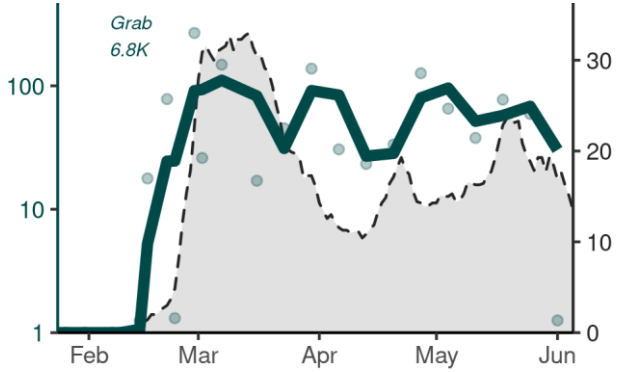
North Shore



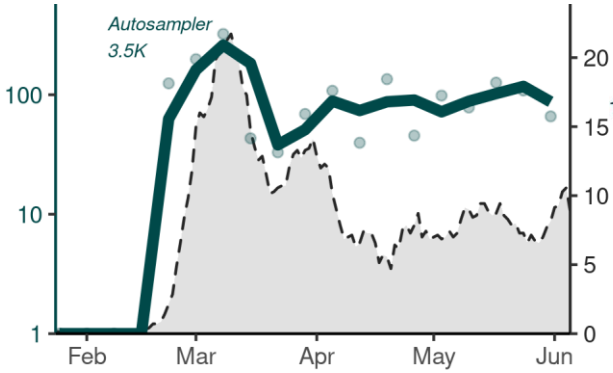
Pukekohe



Beachlands



Warkworth



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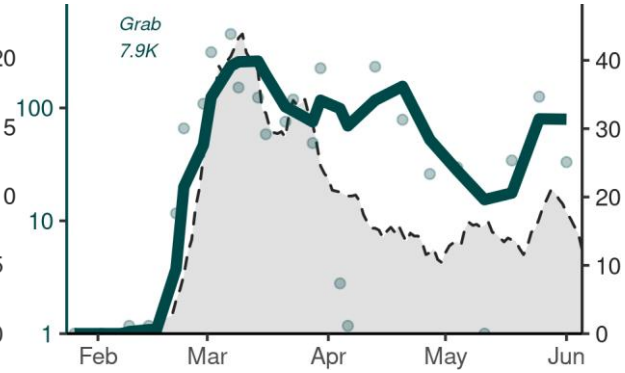
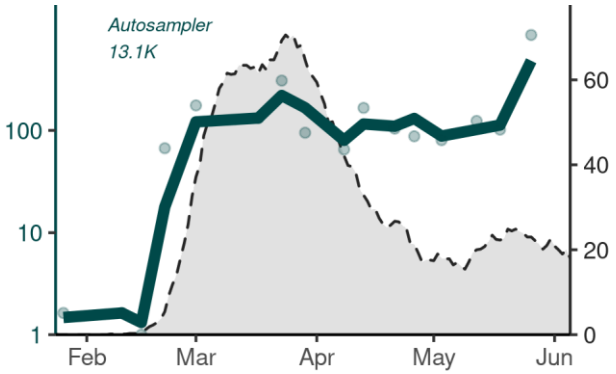
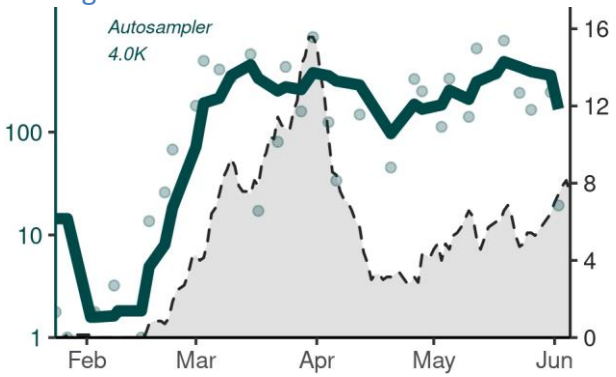


Waikato

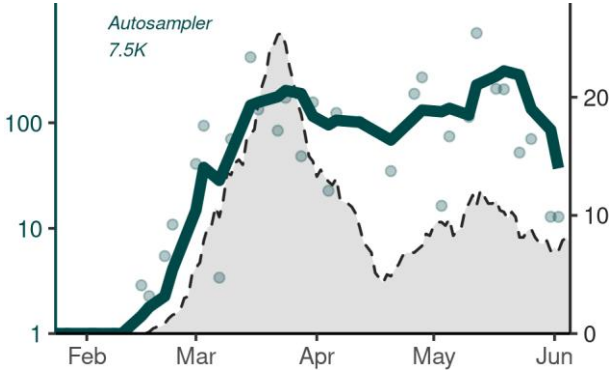
Te Awamutu

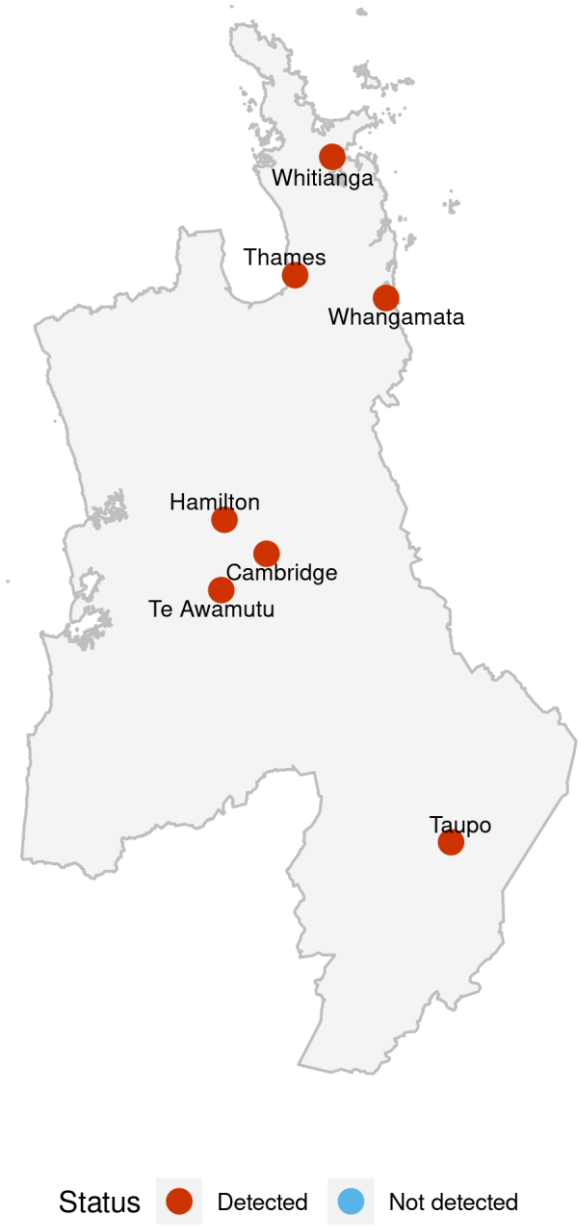


Whangamata



Thames





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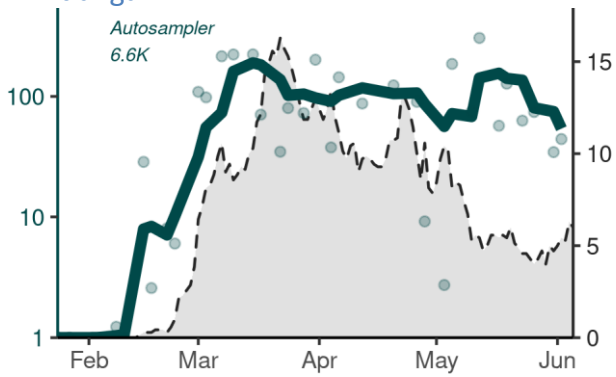

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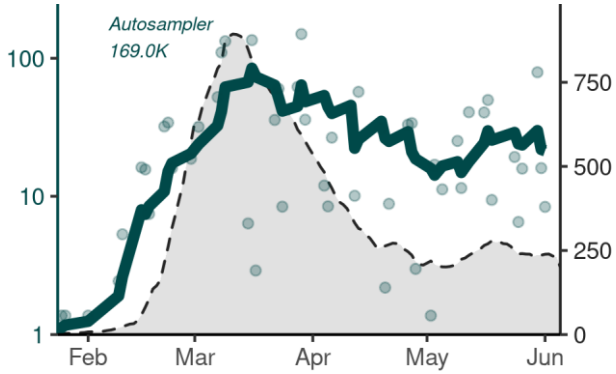

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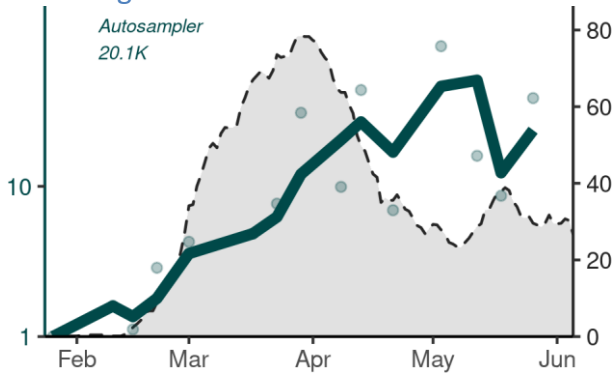
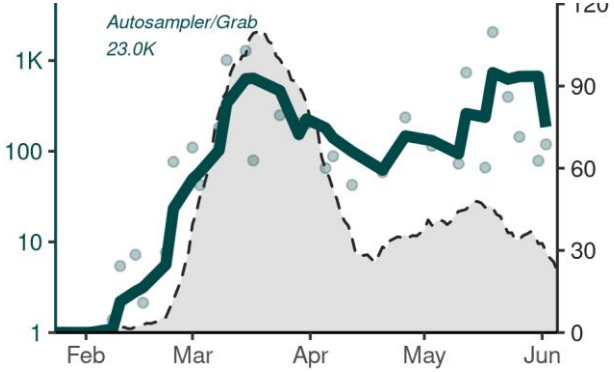


Taupo


Autosampler/Grab
23.0K
1K
100
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1
120
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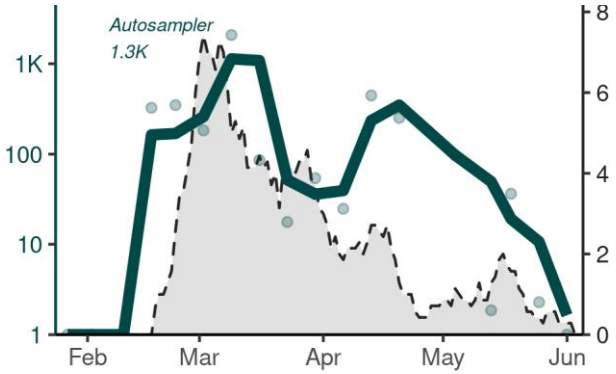
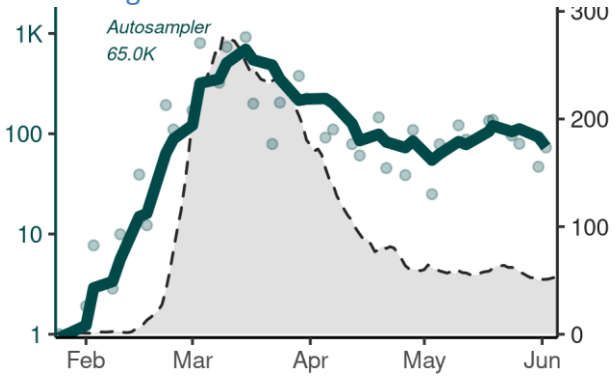
Feb
Mar
Apr
May
Jun

Bay of Plenty and Gisborne

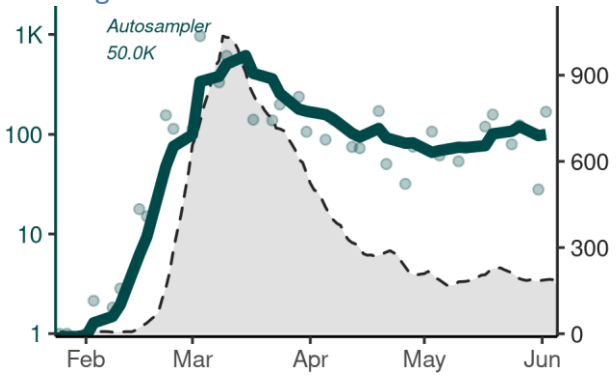
Maketu

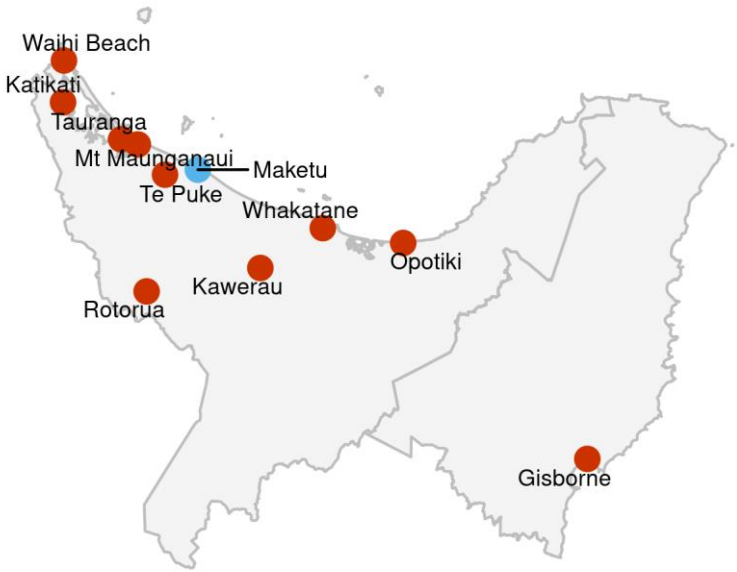


Mt Maunganaui

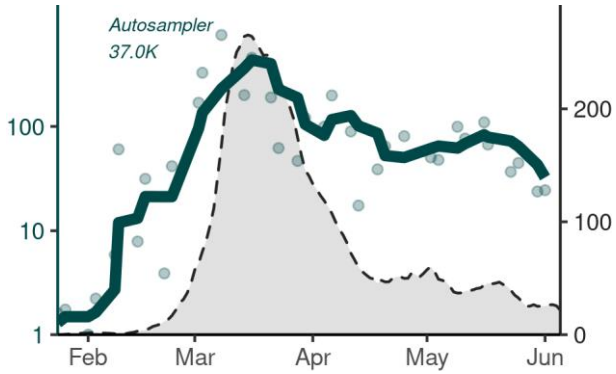


Tauranga

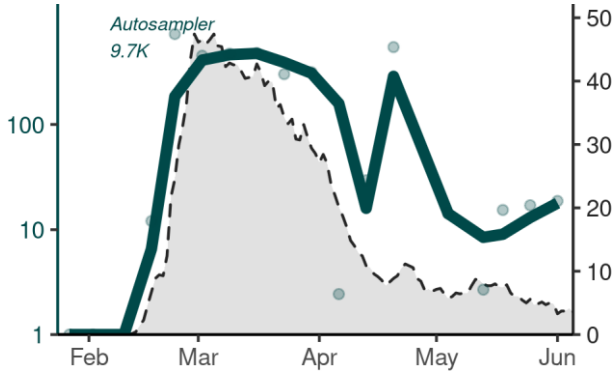




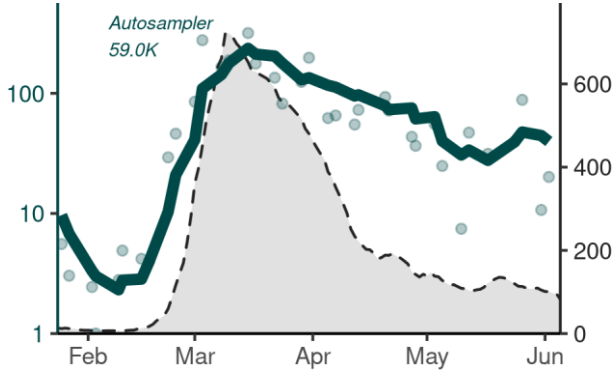
Gisborne



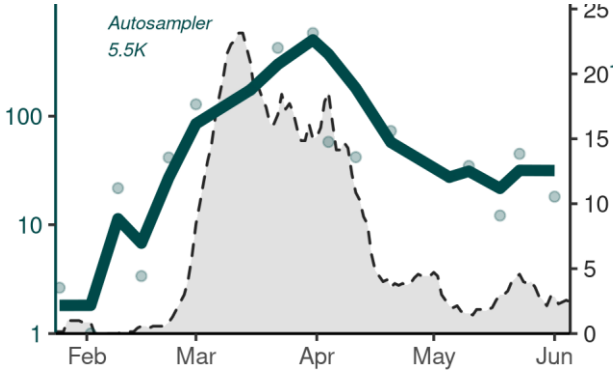
Te Puke



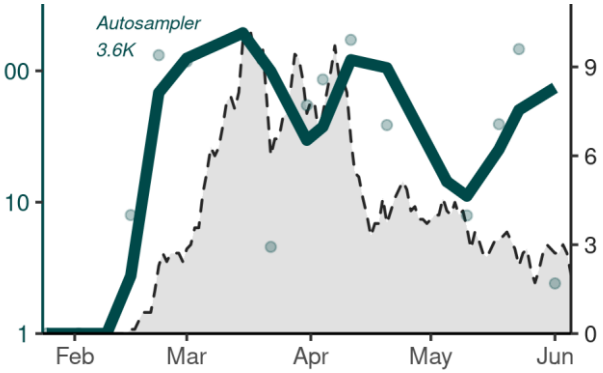
Rotorua



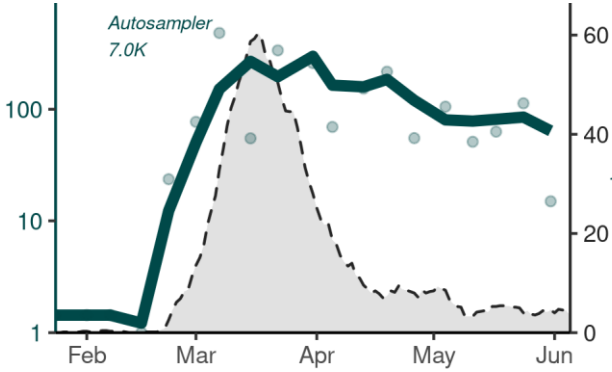
Katikati



Waihi Beach



Kawerau



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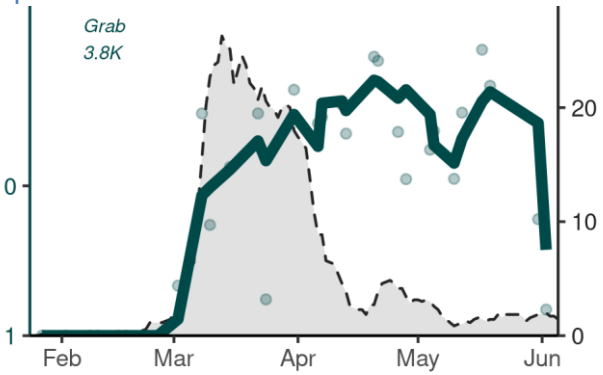

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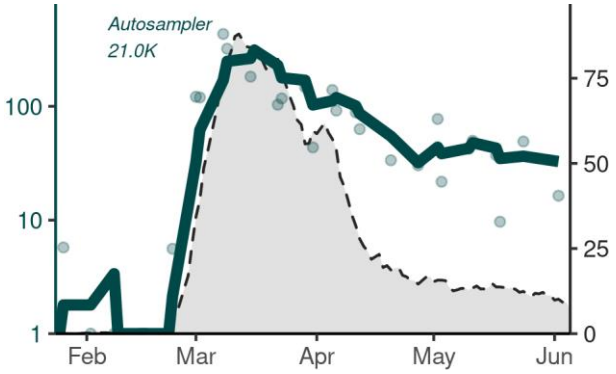
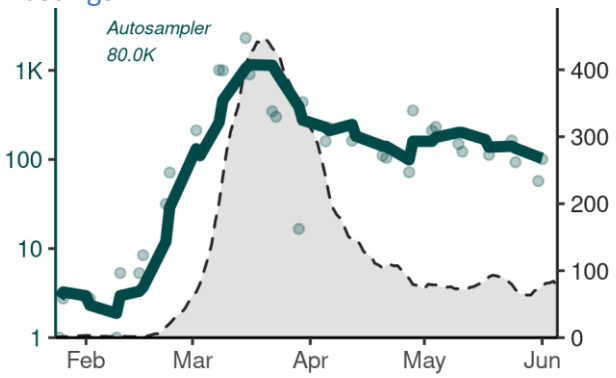
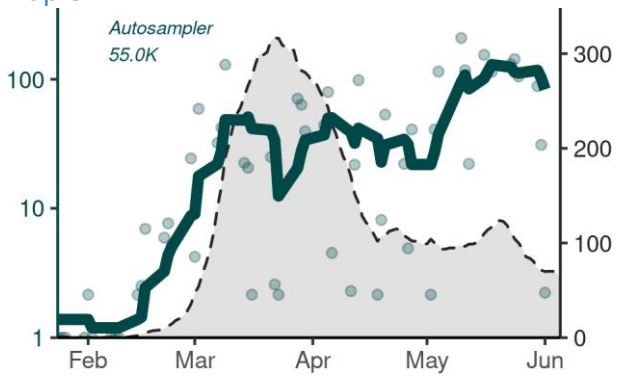


Hawke's Bay

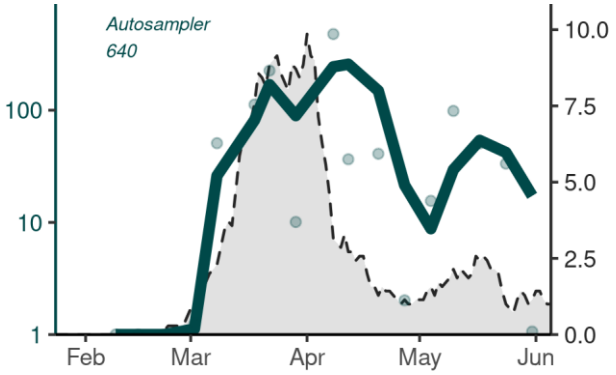
Hastings



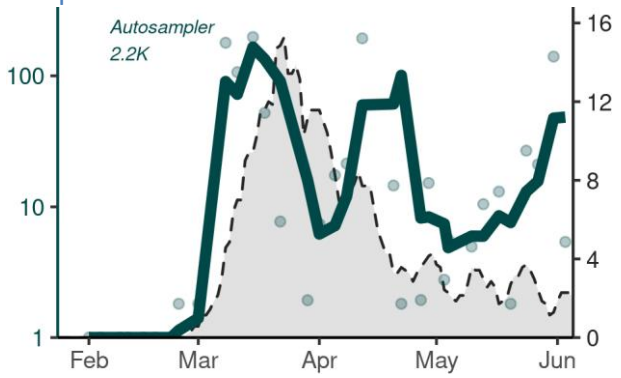
Napier



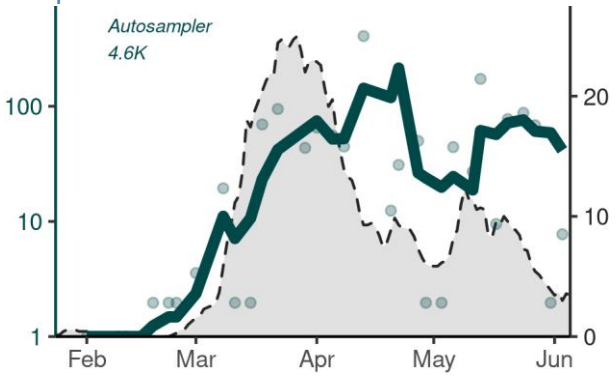
Otane



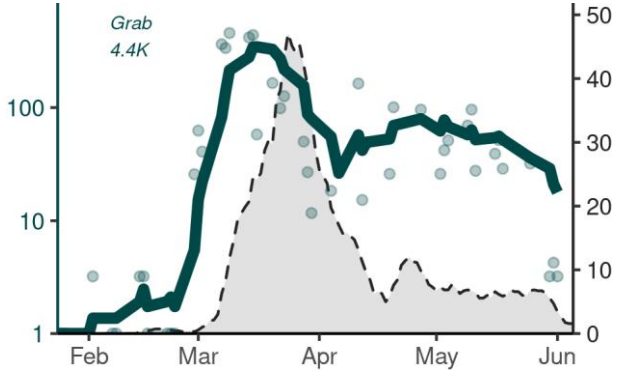
Waipawa



Waipukurau

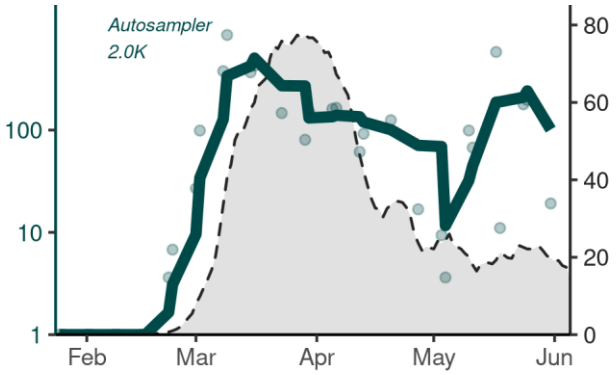


Wairoa

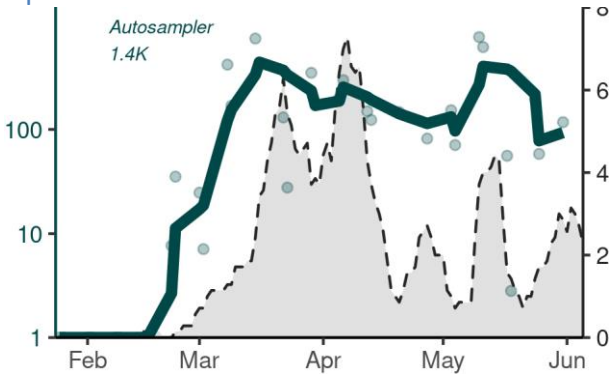


Taranaki

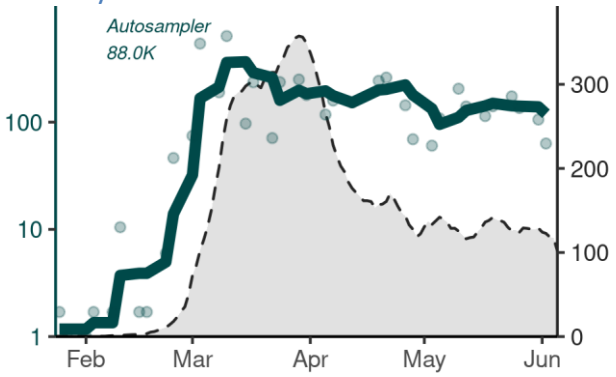
Eltham

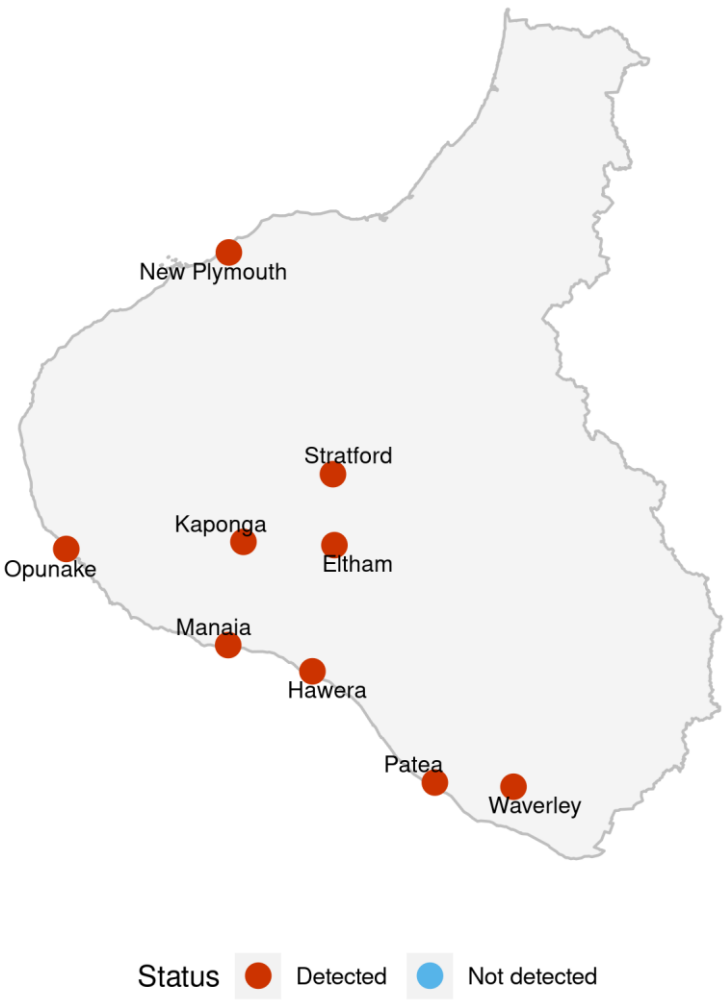


Opunake

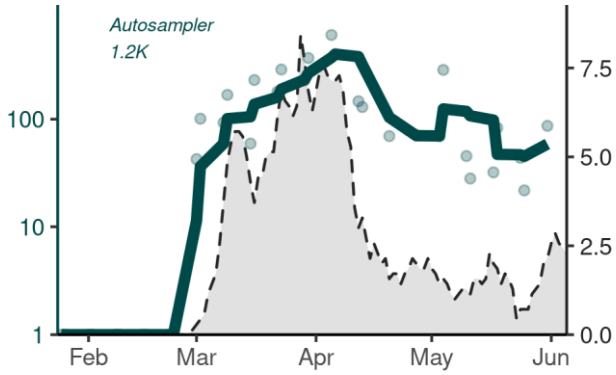


New Plymouth

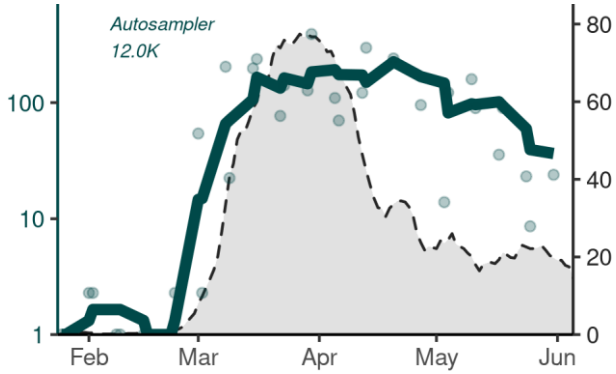




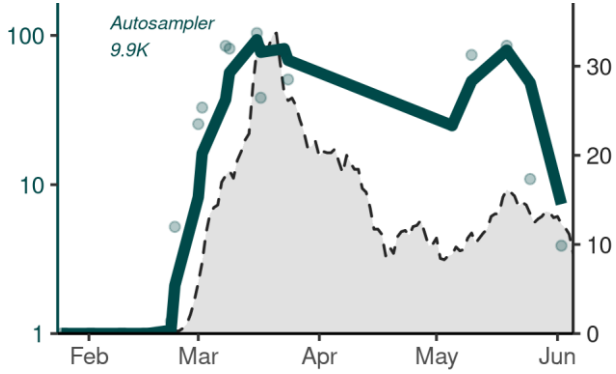
Patea



Hawera

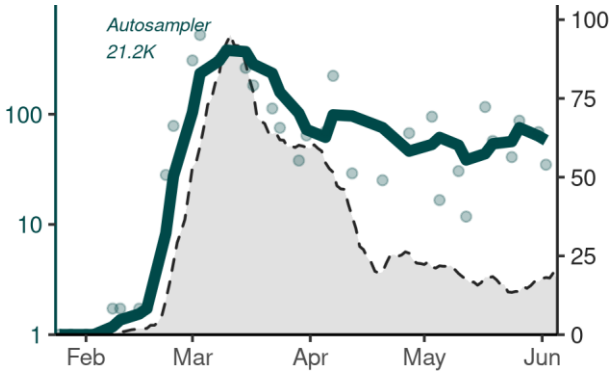


Stratford

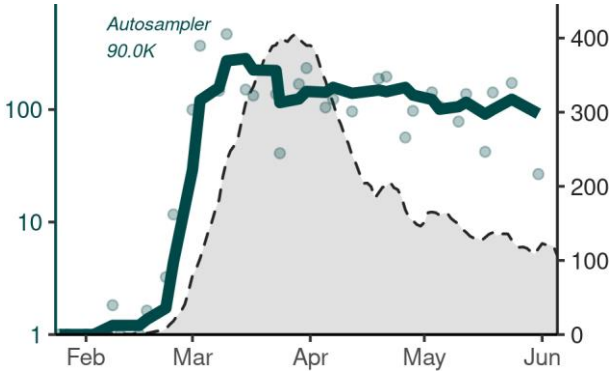


Manawatu-Whanganui

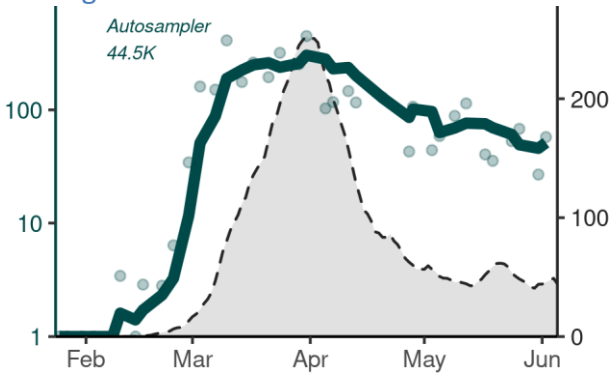
Levin



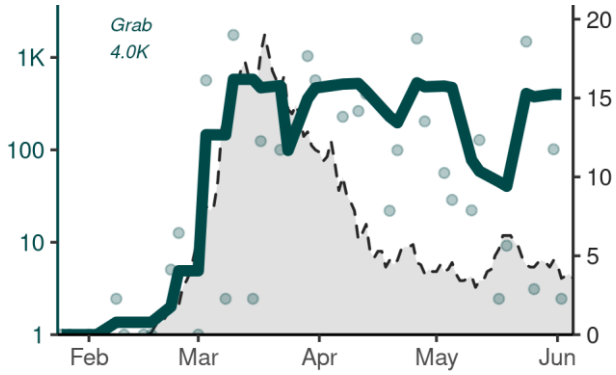
Palmerston North



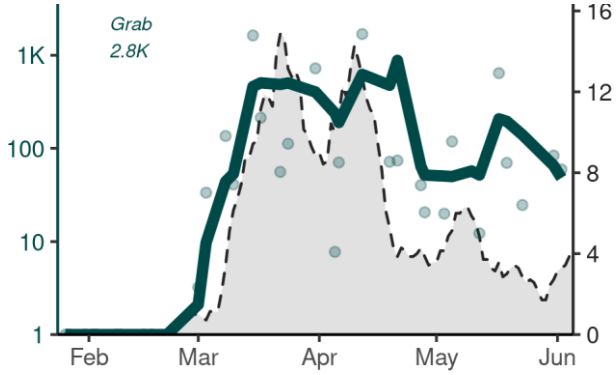
Whanganui Urban



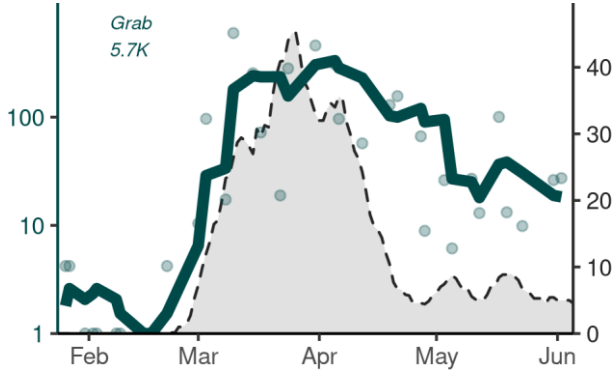
Taumarunui



Pahiatua

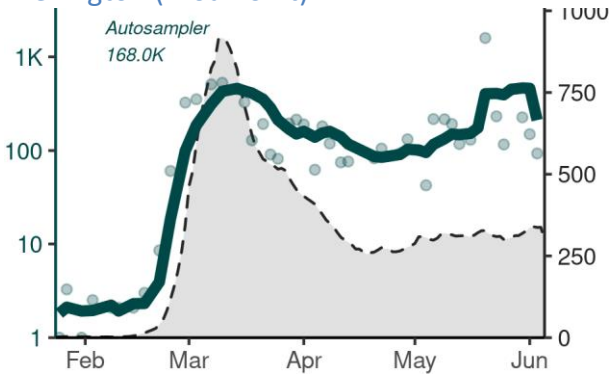


Dannevirke

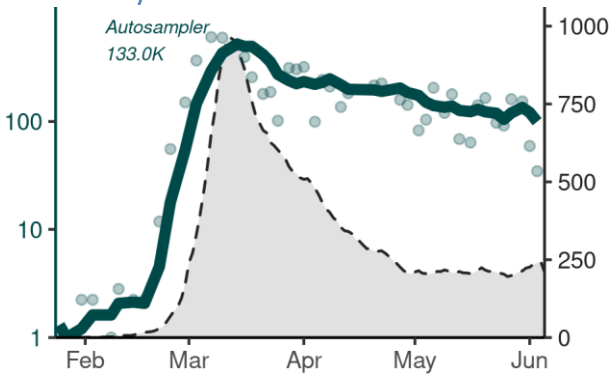


Wellington

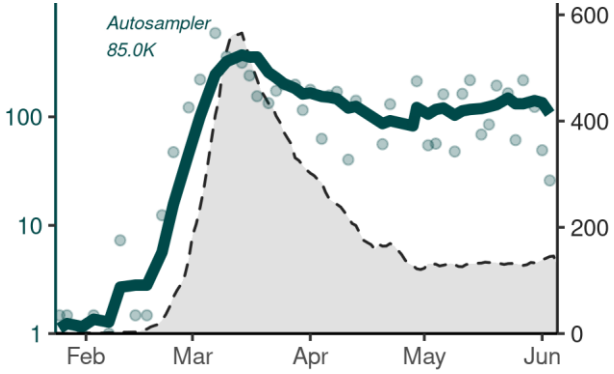
Wellington (Moa Point)

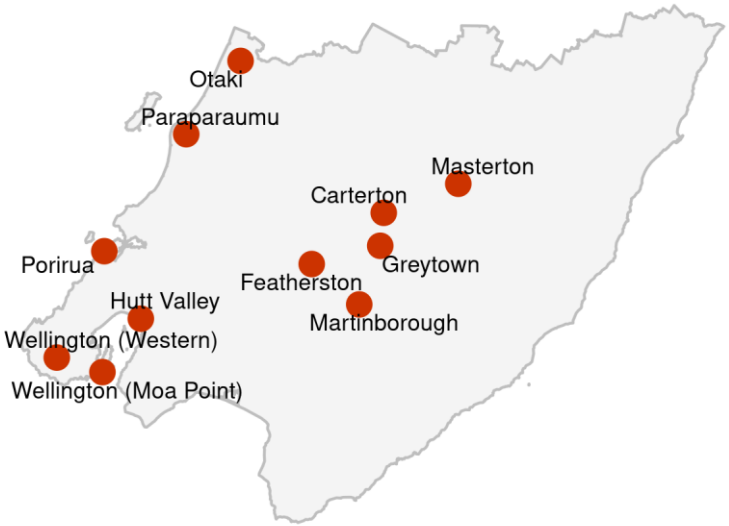


Hutt Valley

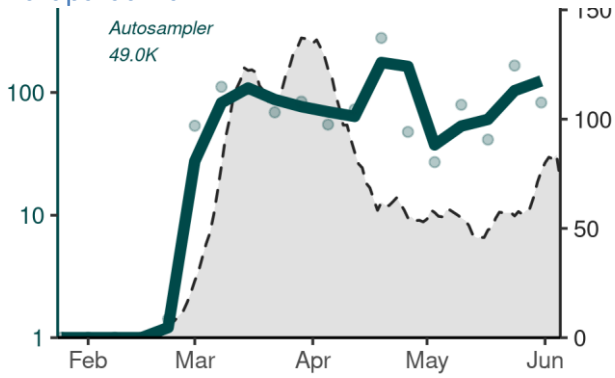


Porirua

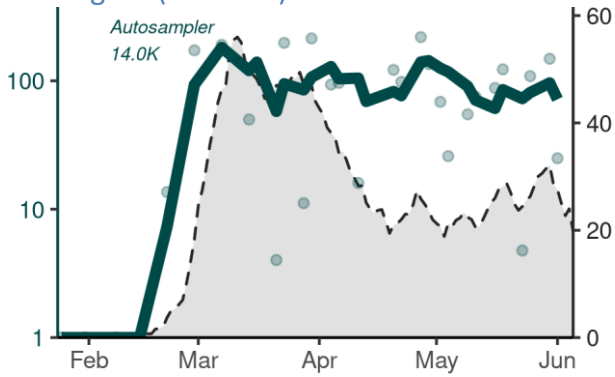




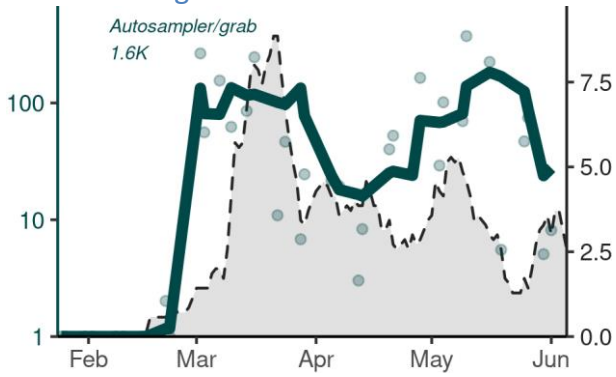
Paraparaumu



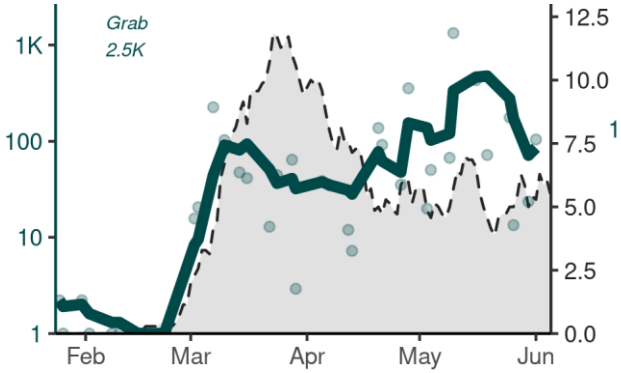
Wellington (Western)



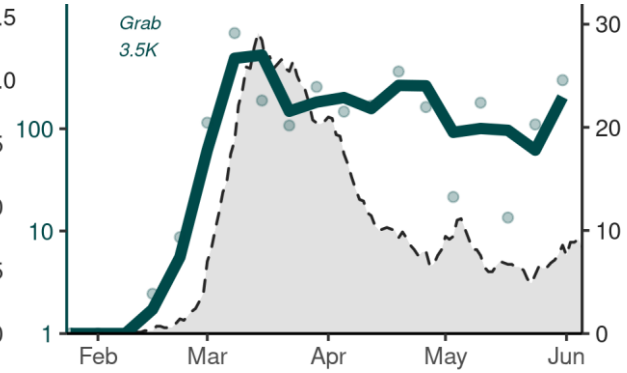
Martinborough



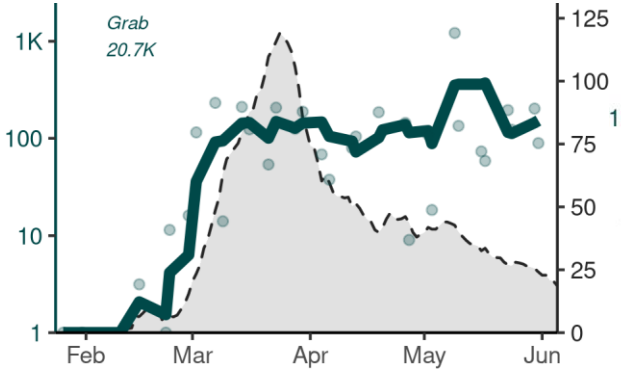
Featherston



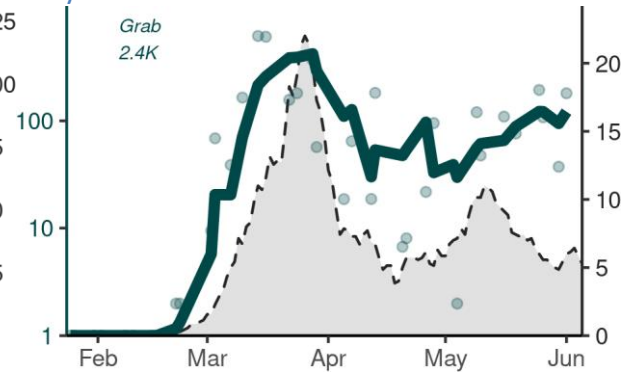
Otaki



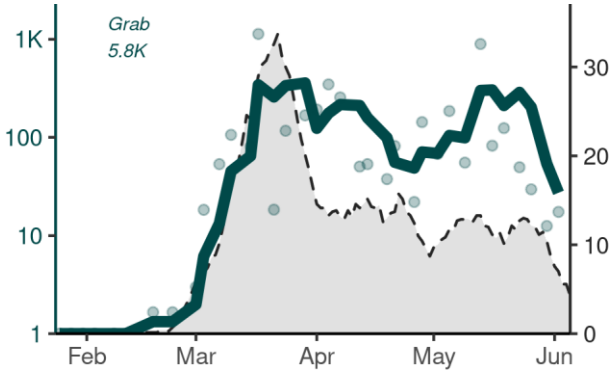
Masterton



Greytown

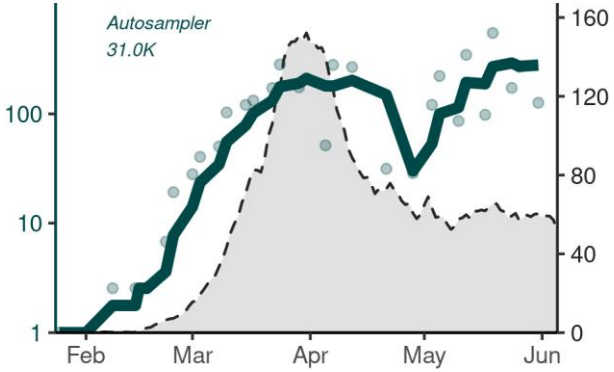


Carterton

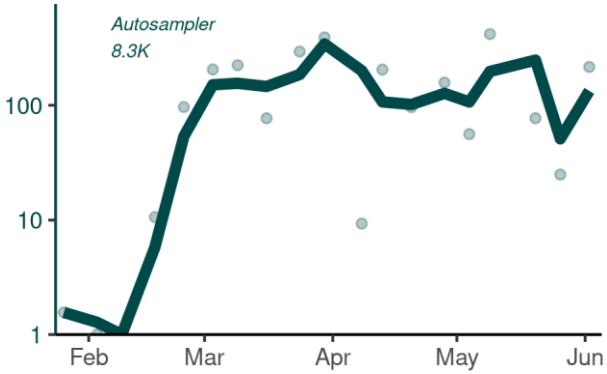


Tasman, Nelson, and Marlborough

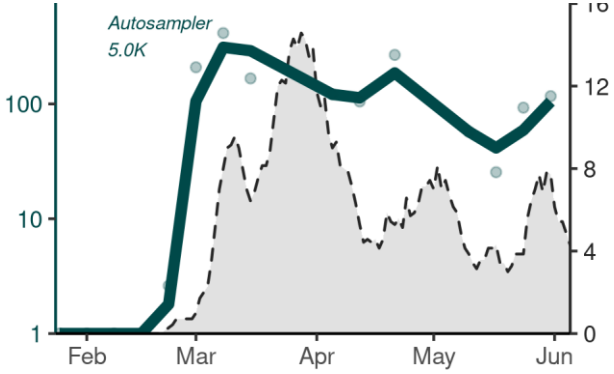
Blenheim



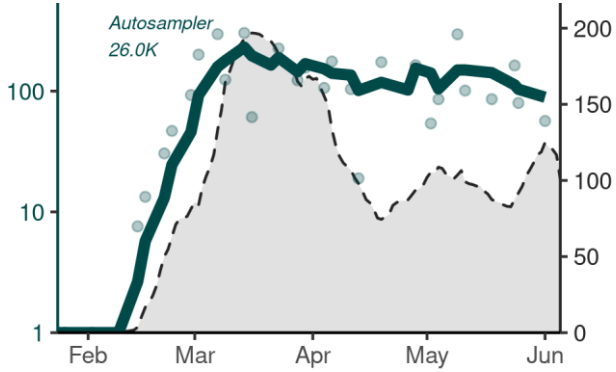
Motueka



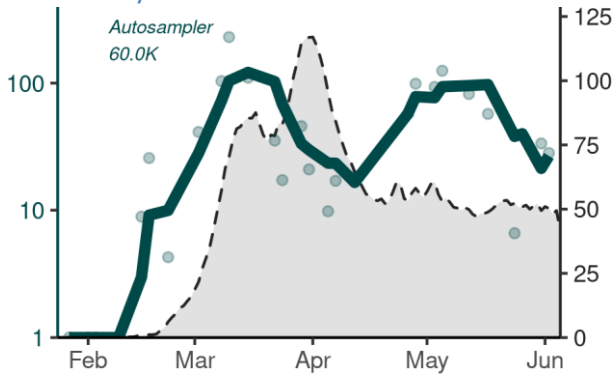
Picton



Nelson Central/North

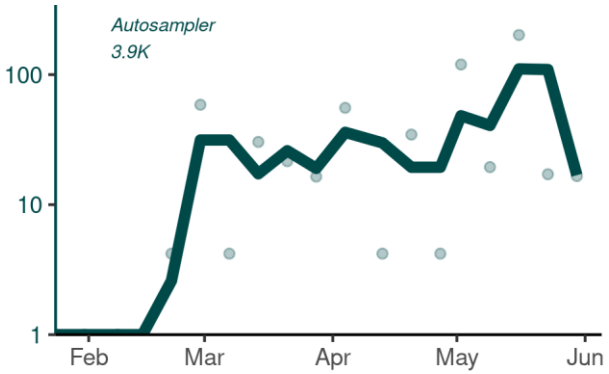


Richmond/Nelson South

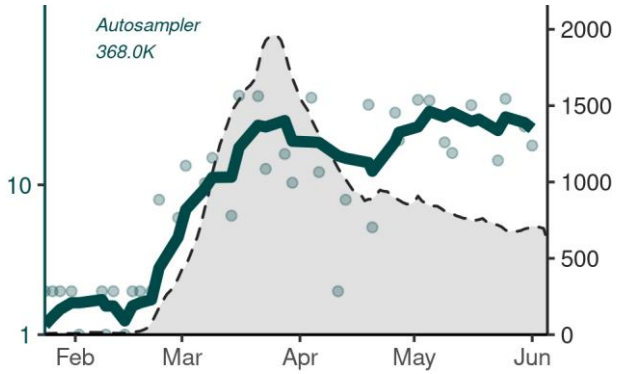


West Coast and Canterbury

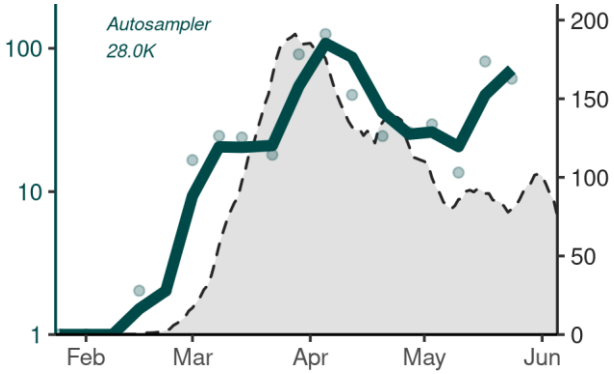
Leeston



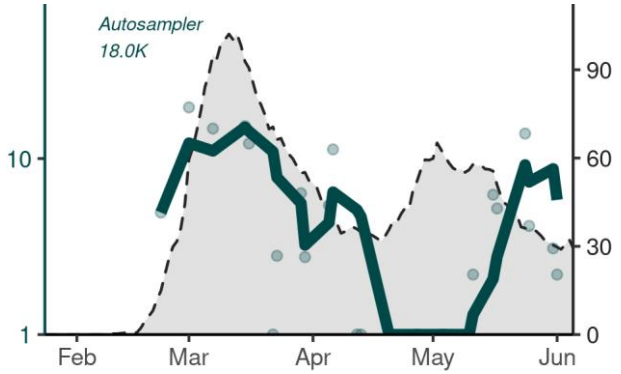
Christchurch



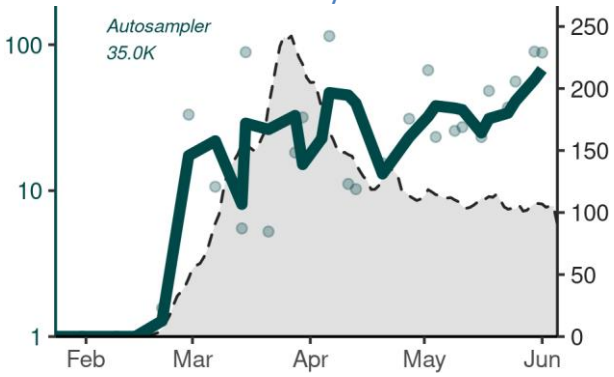
Timaru



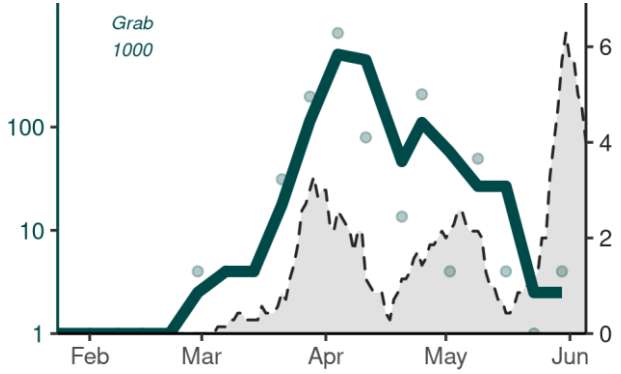
Ashburton



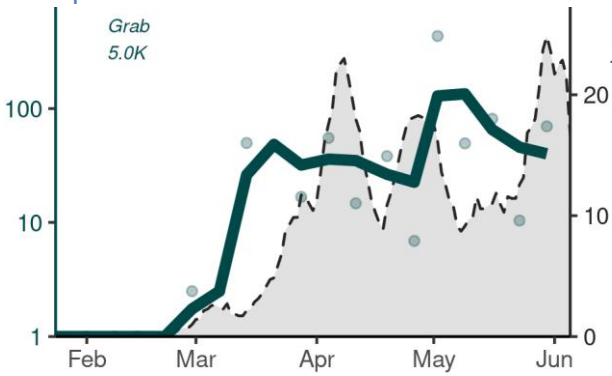
Rolleston & Eastern Selwyn



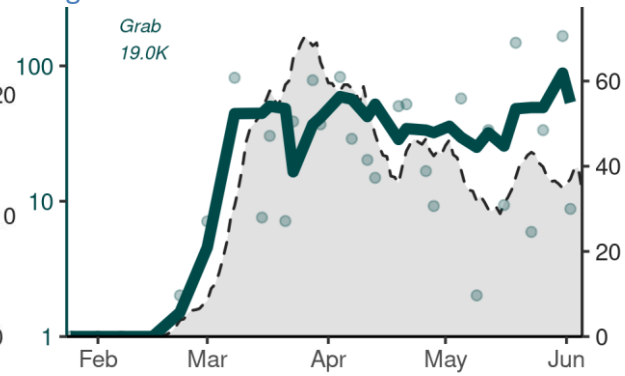
Reefton



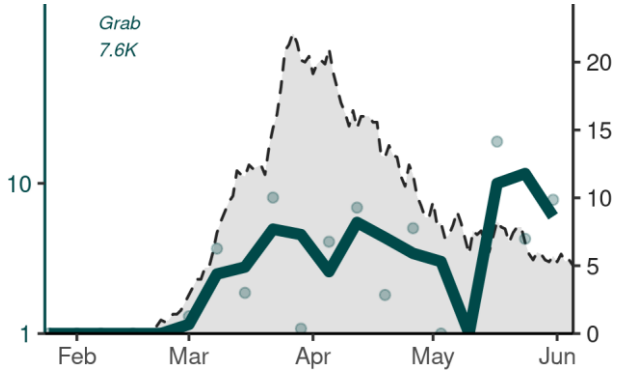
Westport



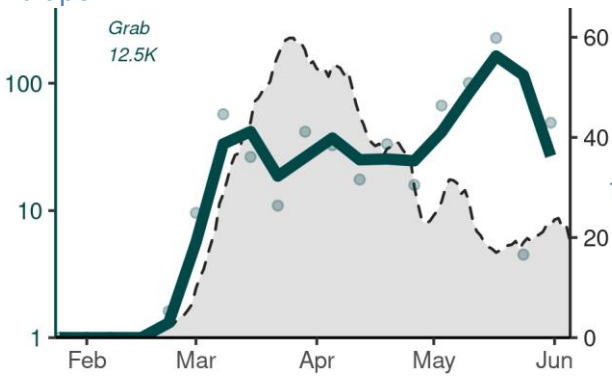
Rangiora



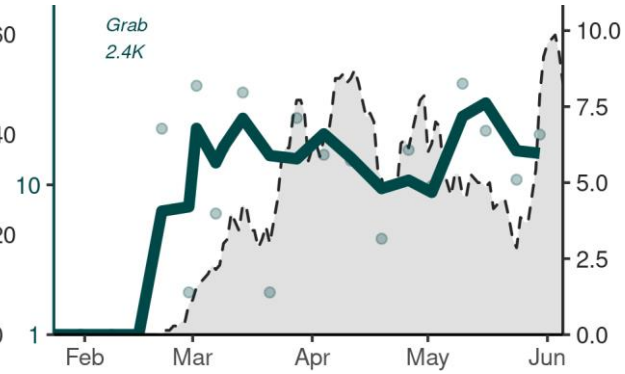
Woodend



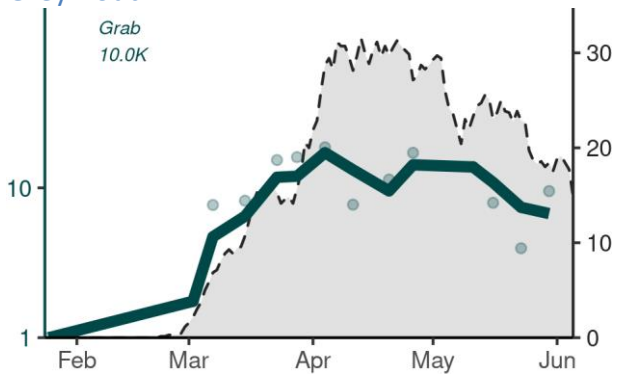
Kaiapoi



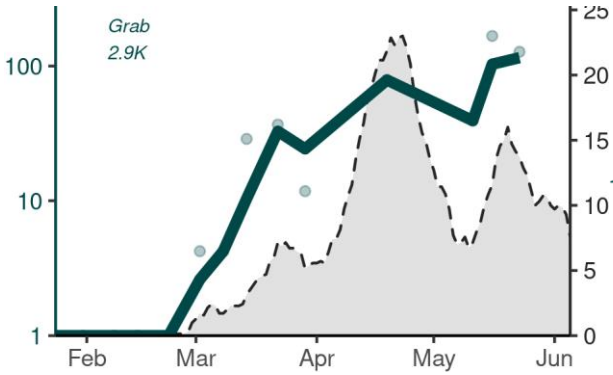
Kaikoura



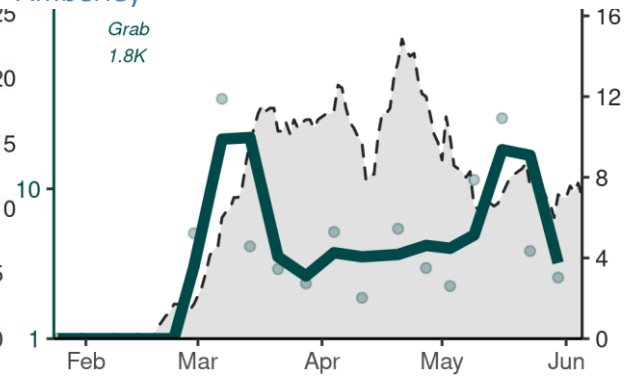
Greymouth



Hokitika

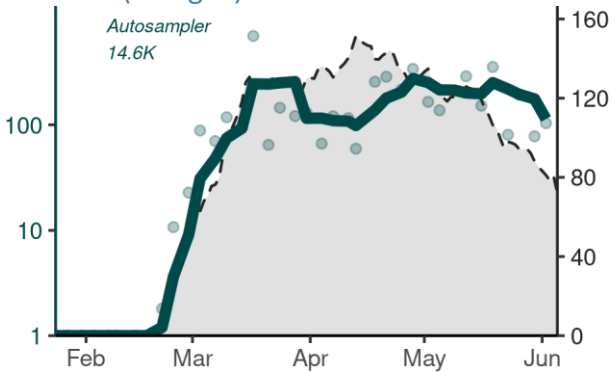


Amberley

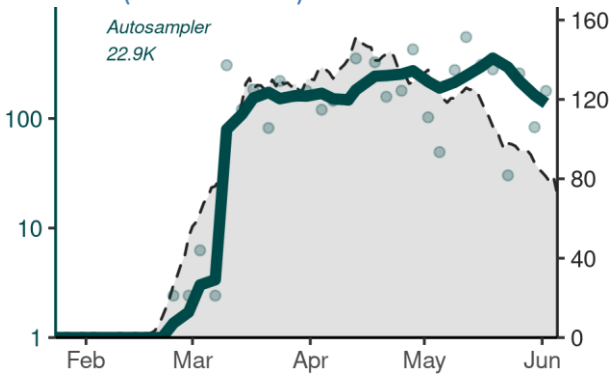


Otago and Southland

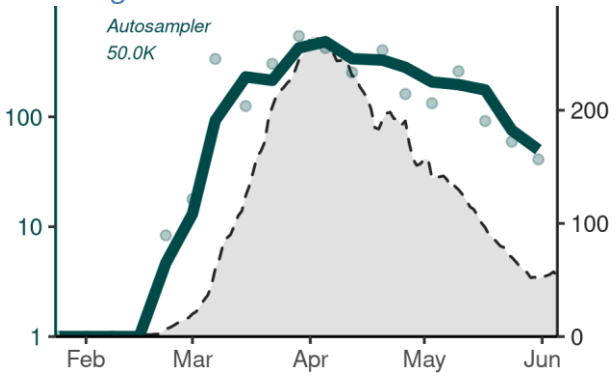
Dunedin (Mosgiel)

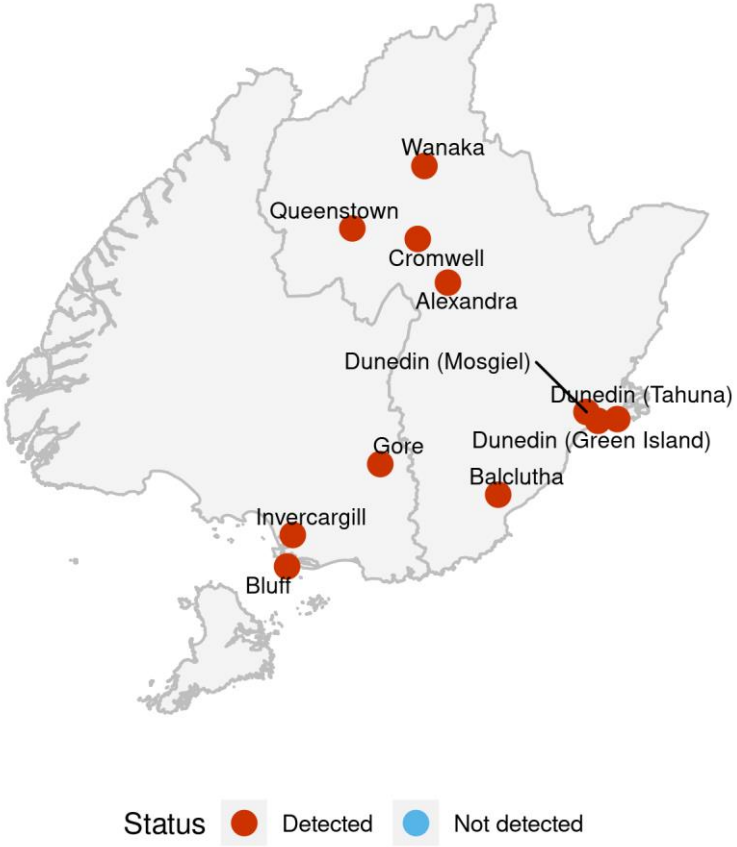


Dunedin (Green Island)

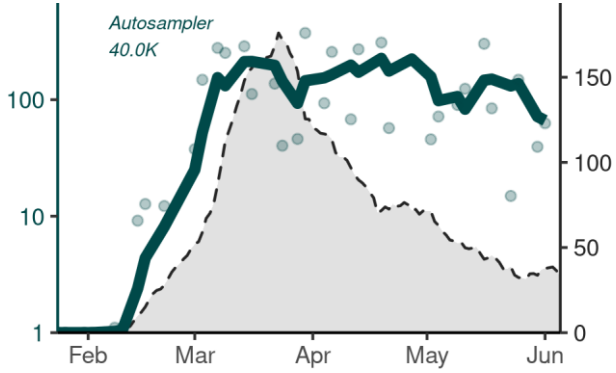


Invercargill

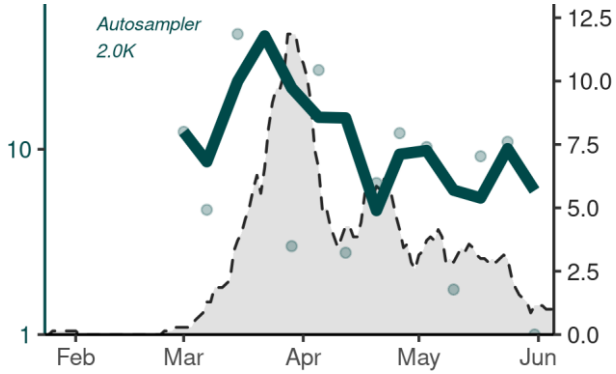




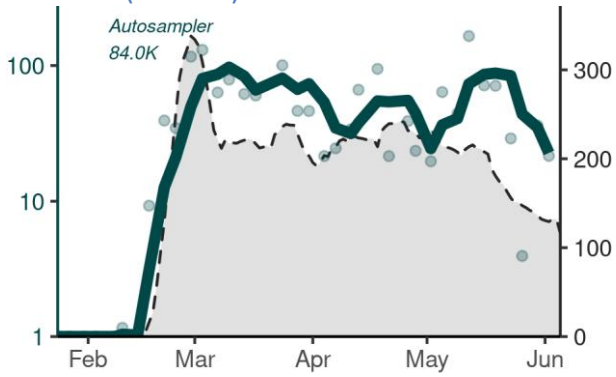
Queenstown



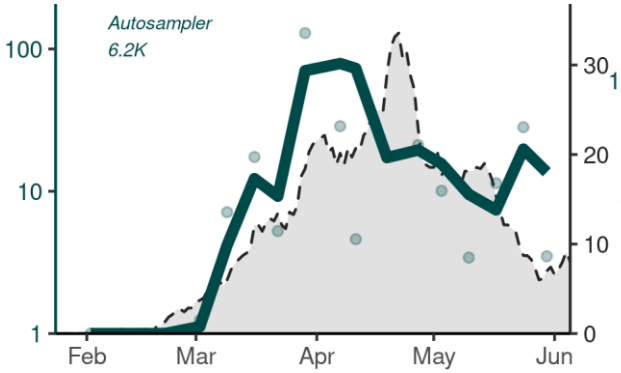
Bluff



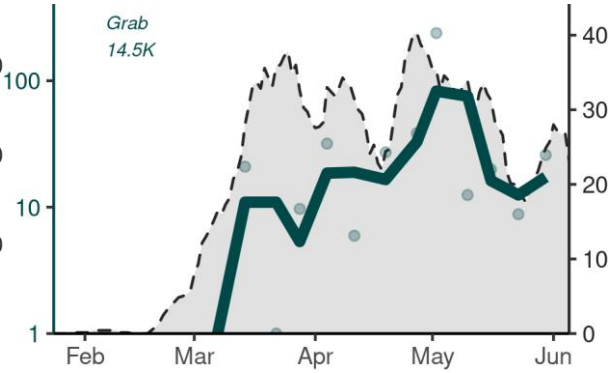
Dunedin (Tahuna)



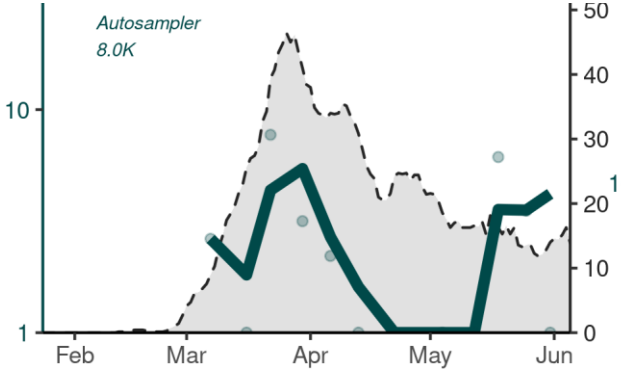
Alexandra



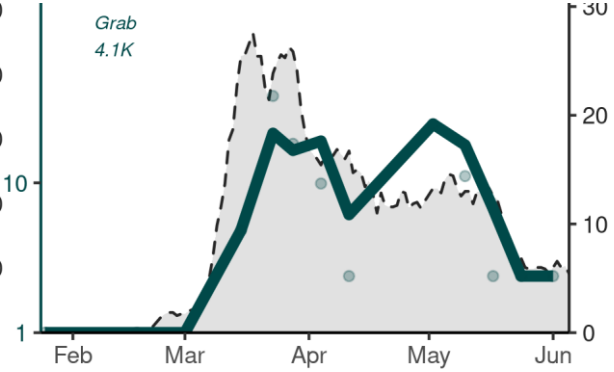
Wanaka



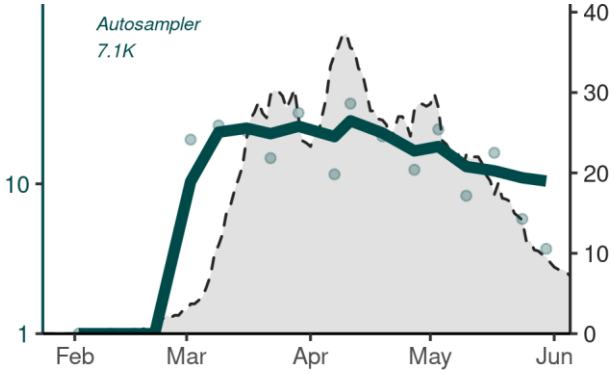
Gore



Balclutha



Cromwell



Weekly summary

Key: Not Detected | Detected (below limit of quantification) | Detected (quantifiable) | Not sampled

Site	2021																2022																	
	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22
Northland																																							
Ahipara																																							
Awanui																																							
Dargaville																																							
Haruru																																							
Hihi																																							
Hikurangi																																							
Kaeo																																							
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Site	2021																2022																	
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Woodend																																							
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Alexandra																																							
Balclutha																																							
Cromwell																																							
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Milton																																							
Queenstown																																							
Wanaka																																							
Southland																																							
Bluff																																							
Gore																																							
Invercargill																																							

Acknowledgements

This work represents the combined efforts of a large number of individuals and organisations.

We continue to be indebted to the teams across the country who are collecting the wastewater that underpins this work.

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Notes

Sites and frequency of sample collection: The catchment population sites selected for the surveillance range from approximately 100 to over 1,000,000 individuals. The sites cover all regions of the country. Most major towns and all cities, as well as many smaller communities, are included. In early 2022, the wastewater catchment areas cover over 80% of the population connected to wastewater treatment plants. The sites from which samples have been collected have varied over the last 12 months. New sites may be added over time, and/or sampling may reduce in frequency or cease for other sites. The selection and frequency of sampling vary depending on the local population, access to wastewater collection points, staff availability to collect samples and risk factors. When included, samples are collected at least weekly, with twice weekly sampling being common. A number of samples have also been collected from non-WWTP sites (manholes and pump stations- mostly in Auckland).

Sampling method: The preferred option is to automatically collect a 24 hour ‘composite’ sample. This is where a pump automatically collects a small volume of wastewater every 15 minutes over 24 hours using a composite sampler. These samplers are available in some wastewater treatment plants. When composite samplers are not available, ‘grab’ samples are collected. These range from a sample being taken at a single point in time, to 3 samples taken over 30 minutes, to samples collected over a day. Grab samples represent only the composition of the source at that time of collection and may not be as representative as a 24-hour composite sampler. More variation may be expected with grab samples.

Laboratory analysis of wastewater samples: Samples are sent from each wastewater treatment plant to one of the ESR laboratories (Porirua or Christchurch). Processing of each sample commences within an hour or two of receipt. Processing involves the concentration of virus from 250 mL sample to approx. 1 mL using centrifugation and polyethylene glycol. Viral RNA is then extracted from a small volume of 0.2 mL concentrate to give a final volume of 0.05 mL The presence of SARS-CoV-2 RNA is determined using RT-qPCR. SARS-CoV-2 is considered detected when any of the RT-qPCR replicates are positive.

RT-qPCR: Reverse transcription (RT) to convert RNA to complementary DNA (cDNA), followed by quantitative PCR (qPCR). RT-qPCR is used for detection and quantification of viral RNA.

Method sensitivity: The protocol used to concentrate SARS-CoV-2 from wastewater allows for the sensitive detection of SARS-CoV-2 by RT-qPCR. ESR has shown that when 10 individuals are actively shedding SARS-CoV-2 RNA in a catchment of 100,000 individuals, there was a high likelihood of detecting viral RNA in wastewater (https://doi.org/10.1016/j.watres.2021.118032). Shedding by one individual may be detected in wastewater, but it does depend on many factors including the amount and duration of shedding. Very low levels in wastewater may be not able to be quantified (i.e., less than the limit of quantification- see below).

SARS-CoV-2 RNA detected (positive result): A positive detection in the wastewater indicates that at least one person has been shedding SARS-CoV-2 into the wastewater at some point during the time period that the sample was being collected. In some cases, detections could also be due to the shedding of low levels of SARS-CoV-2 RNA by a recently recovered case. The detection of SARS-CoV-2 RNA does not indicate that infectious virus is present.

SARS-CoV-2 RNA not detected (negative result): A negative result can occur because there are no active 'shedding' cases in the catchment or because the SARS-CoV-2 RNA concentration is too low to be detected, most likely because there are a very low number of cases in the wastewater catchment. Therefore, negative finding does not necessarily guarantee the absence of COVID-19 in the community.

Viral loads and normalisation: When detected, the SARS-CoV-2 RNA concentration is calculated as genome copies per L of wastewater. This is then converted to a viral load of **genome copies/day/person**. This conversion takes into account the flow rate of wastewater entering the treatment plant (the influent) and the population in the catchment. The **flow rate** is the total volume (m3 per day) recorded at the inlet of the wastewater treatment plant over 24 hours. This is a **population-normalised viral load**. Currently, the flow rate is the average annual flow rate, but will be replaced with daily flow rate when available (note that rainfall may significantly increase the flow rate at the inlet, diluting the sample, and may result in lower concentrations and a false negative result).

In future, SARS-CoV-2 RNA concentrations will also be normalised by testing for the presence of pepper mild mottled virus (PMMoV). PMMoV is a virus that infects peppers but not humans. Consumption of peppers or pepper products means that PMMoV is detected in wastewater –

normally at very high concentrations. Therefore, PMMoV has been found to be a useful proxy for the amount of faecal material in a wastewater sample. For normalisation, the concentration of SARS-CoV-2 RNA is divided by that of PMMoV in each sample. Different normalisation methods may result in changes to some data points, but trends are unlikely to change significantly.

Limit of quantification: The lowest concentration of the target that can be reliably quantified is referred to as the limit of quantification. For those samples where SARS-CoV-2 is detected but cannot be quantified, a value of 5 genome copies/mL wastewater is used. While a standard method is being used, virus recovery can vary from sample to sample, and this may affect the quantitation.

Data subject to change: Data generated for the New Zealand Wastewater COVID-19 Surveillance Programme should be considered provisional and may be subject to change. Data may be incomplete for the most recent 2-week period due to processing, testing and reporting delays.

Data not shown:

- Data from 'ad hoc' sampling locations including from individual facilities/building (e.g., workplaces, prisons, MIQs) are not included.
- Results from certain samples may not be shown, as the result was either deemed invalid, or the sample could not be tested (e.g., leaked in transit, not labelled).

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END OF REPORT