

National Wastewater Surveillance Programme - COVID-19

Week 16 2022 (Week ending 24 April 2022)

Report prepared on 28 April 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 islands of New Zealand. In addition, in Auckland there are a small number of sample sites that are pump stations and manholes. 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-hour 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 or per mL) is converted to a viral load of **genome copies per day per person**. This calculation takes into account the flow rate of wastewater entering the wastewater treatment plant and the population in the catchment. This is the population-normalised viral load.

Key Points and 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.
- Results from wastewater testing should not be used in isolation but as an additional tool used for early detection and monitoring trends.
- 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.

Please see notes at the end of the document for further details.

Results from Week 16 2022

In the week ending 24 April 2022 (week 16), 155 wastewater samples from 114 different sites have been collected. Analysis is still in progress for two samples.

Of the samples analysed, SARS-CoV-2 RNA was detected in all but two samples (Figure 1). Those samples were from Paeroa (Waikato) and Oamaru (Otago).

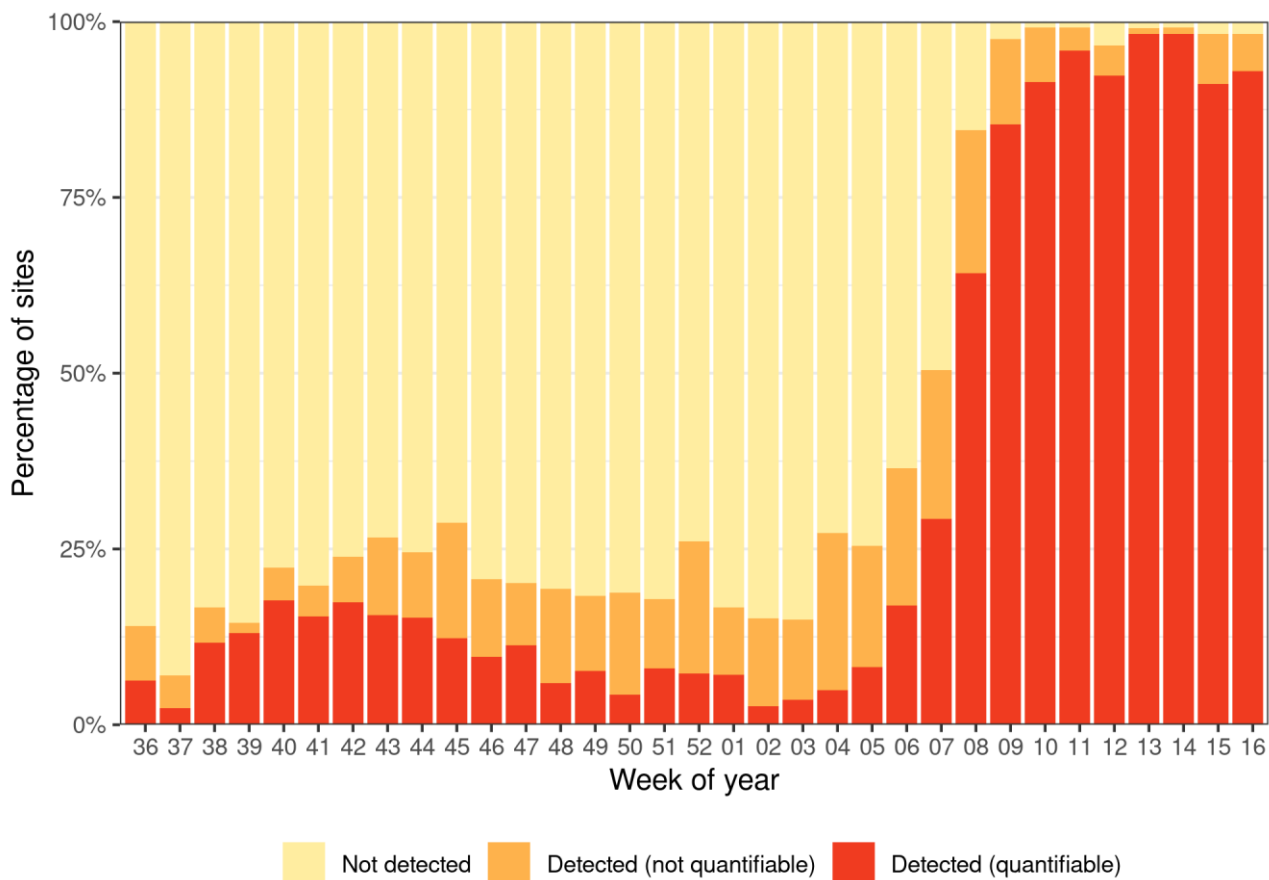


Figure 1. Results for SARS-CoV-2 RNA in wastewater collected across New Zealand by week (from week 36, 2021 to week 16, 2022).

This report also includes a visual representation of sampling locations (Figure 2), individual graphs from sampling locations, and a weekly summary of results from each site.

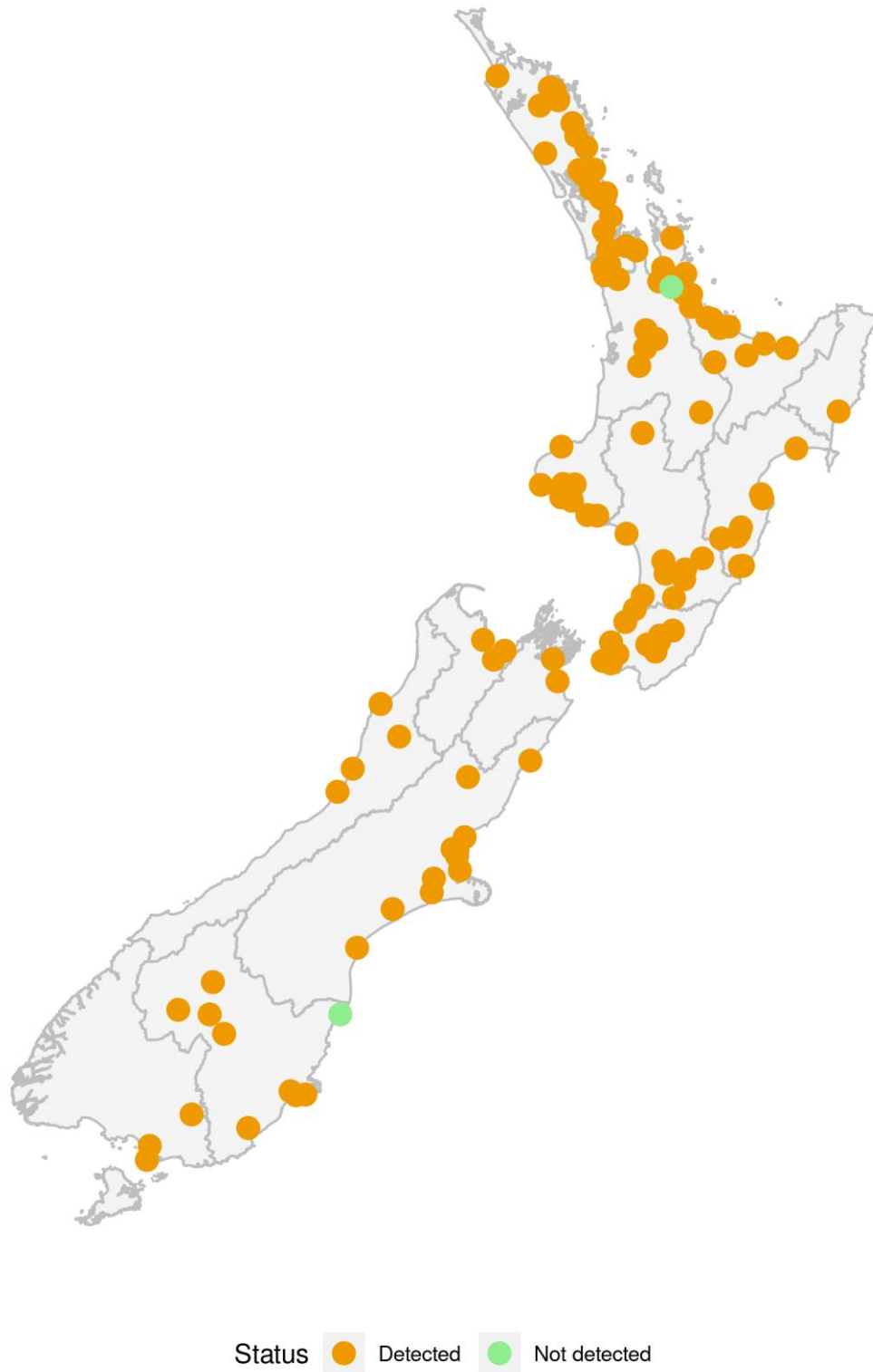


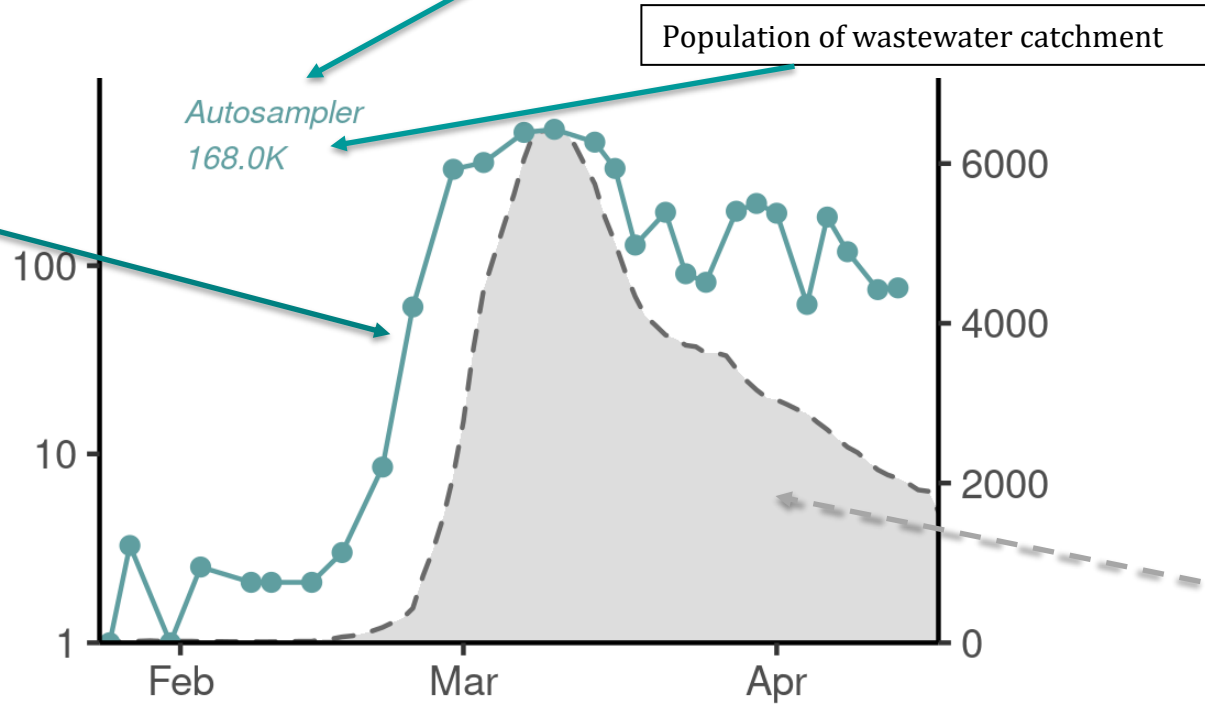
Figure 2 Location of sampling sites and latest results in the two weeks ending 24 April, 2022. Interactive map of weekly results available publicly at <https://www.esr.cri.nz/our-expertise/covid-19-response/wastewater-testing-results>

Interpreting site graphs

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

Genome copies/day/person
Green solid line
Log₁₀ scale

Genome copies/mL x daily wastewater influent (m³)
 = genome copies x 10⁴/day
 Genome copies/day ÷ population = genome copies x 10⁴/day/person

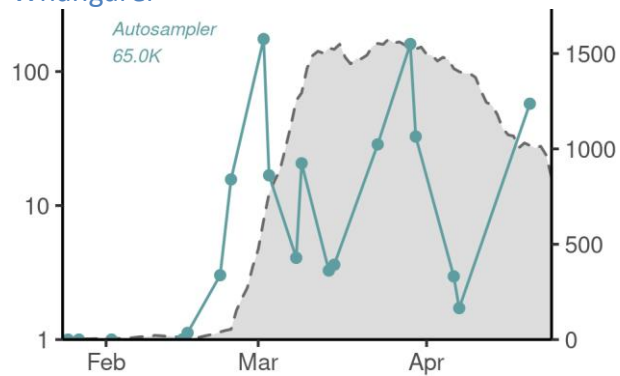


Rolling seven-day **TOTAL new cases** in the catchment
 Grey dotted line (shaded)
 Linear Scale
 This data is not available for all sites, and subject to change.

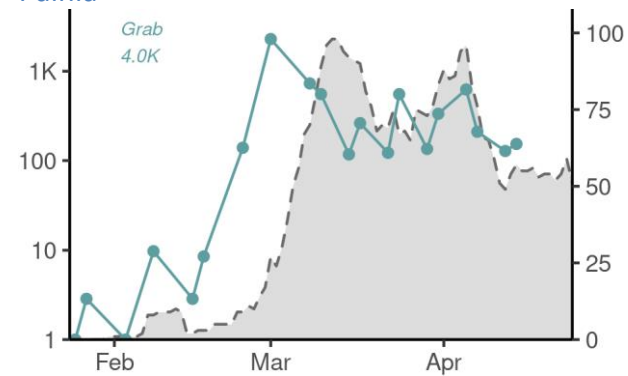
Note the scales may differ for each graph
 Wastewater results are on log₁₀ scale, while case data is on a linear scale.

Northland

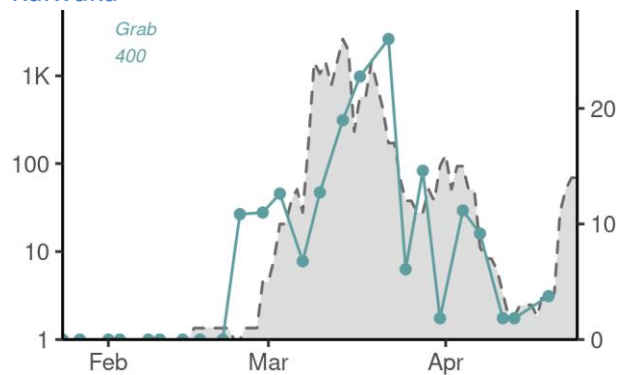
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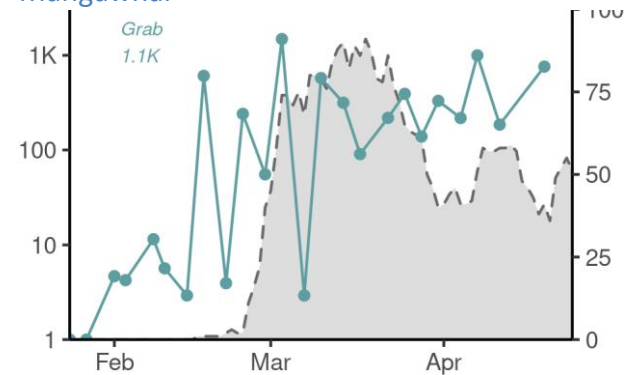
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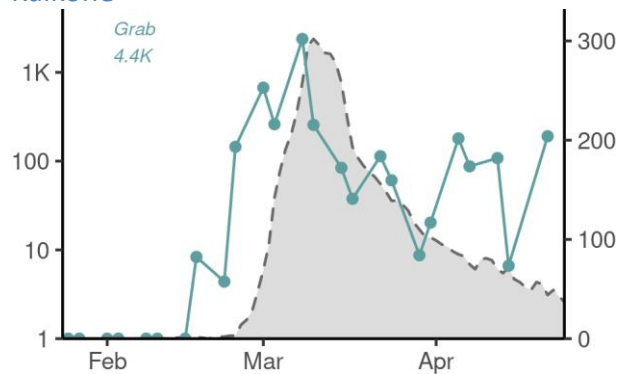
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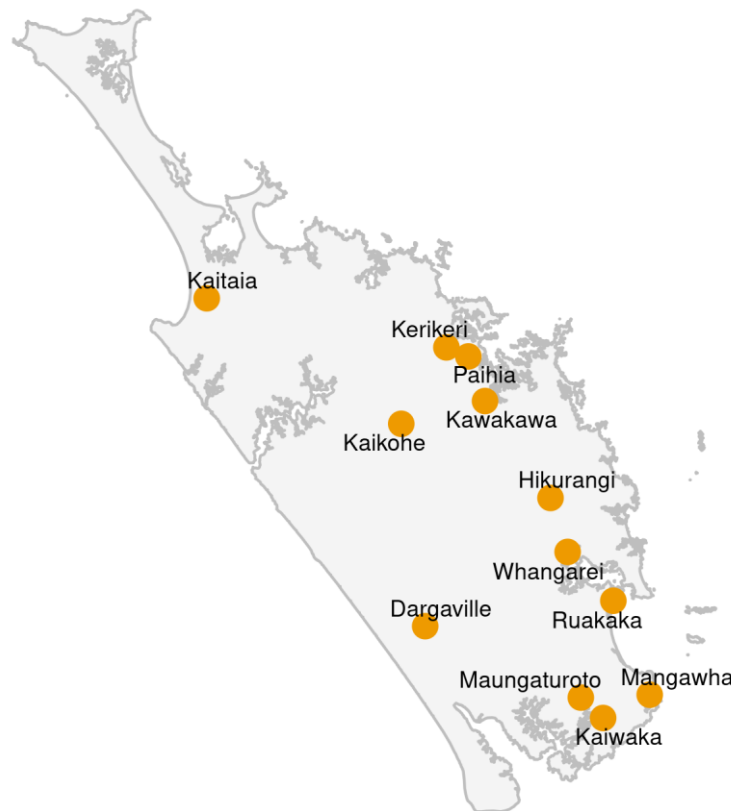
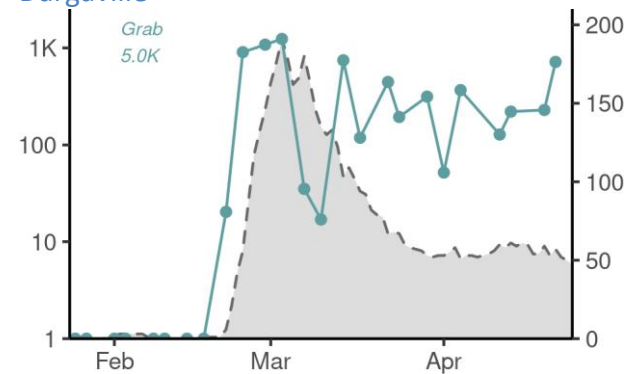
Mangawhai



Kaikohē

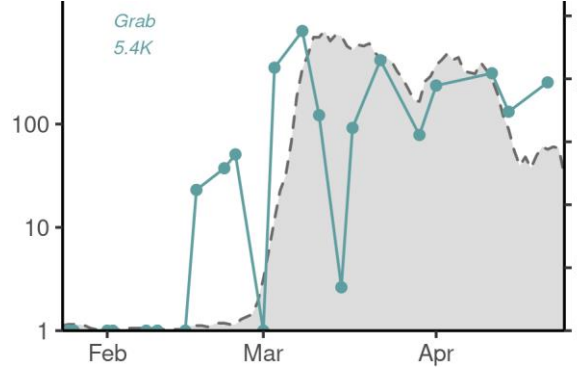


Dargaville

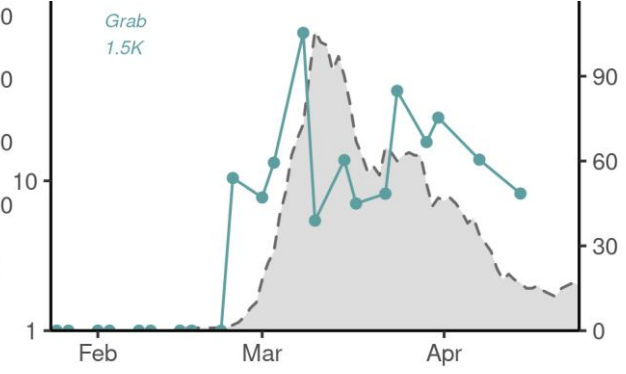


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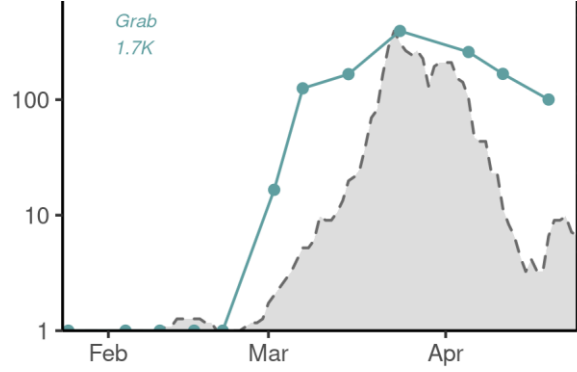
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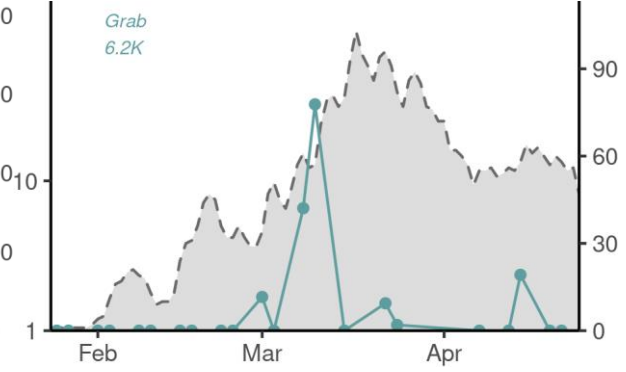
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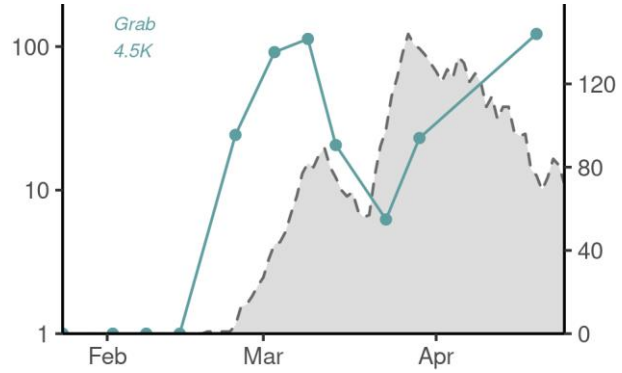
Hikurangi



Kerikeri

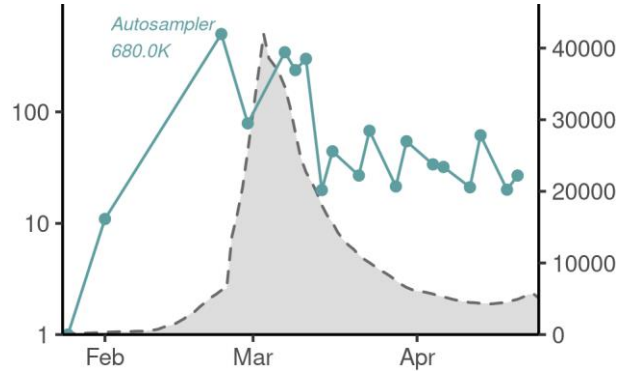


Ruakaka

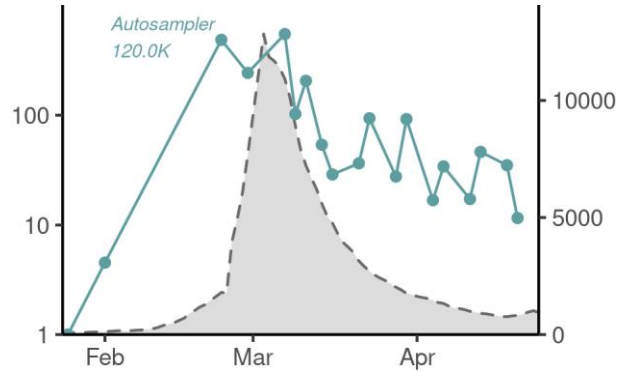


Auckland

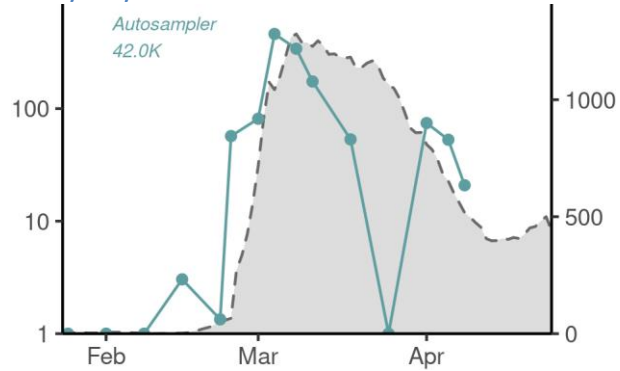
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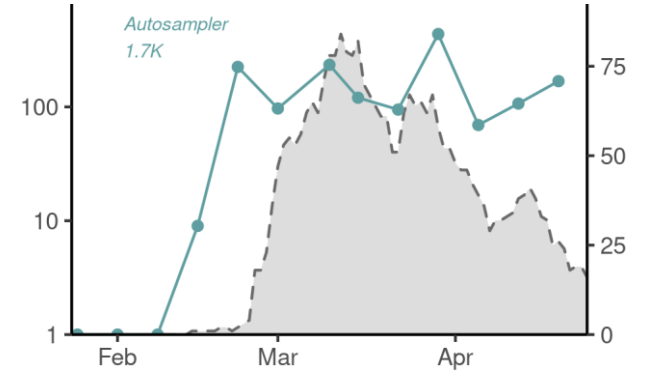
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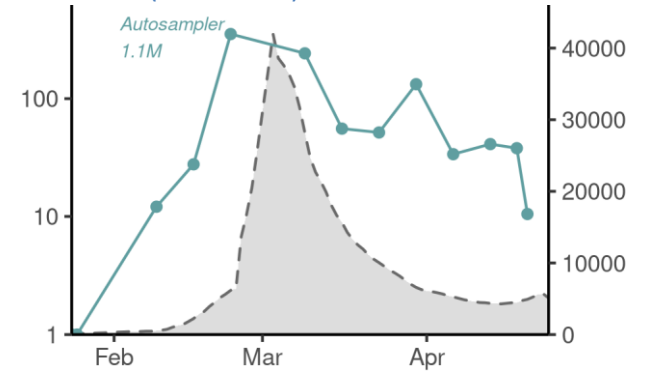
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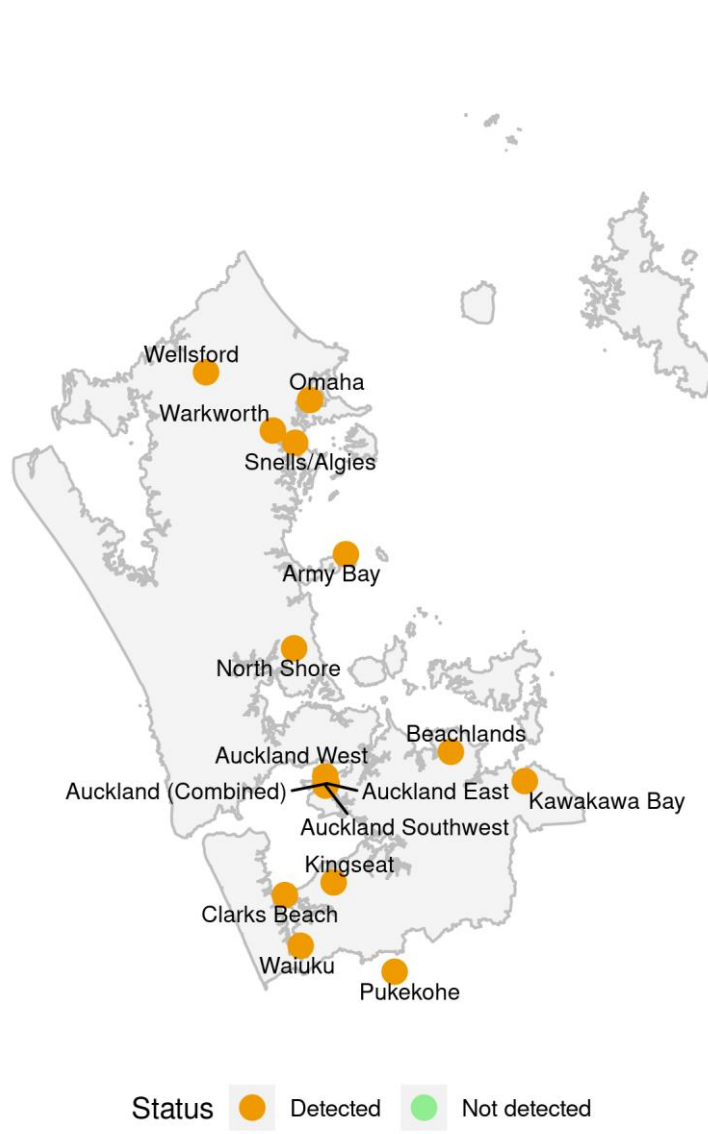
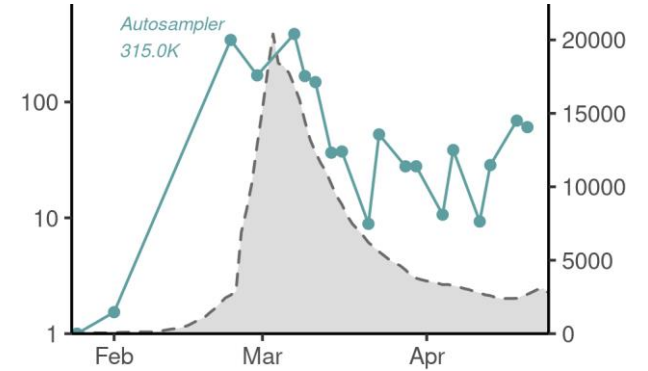
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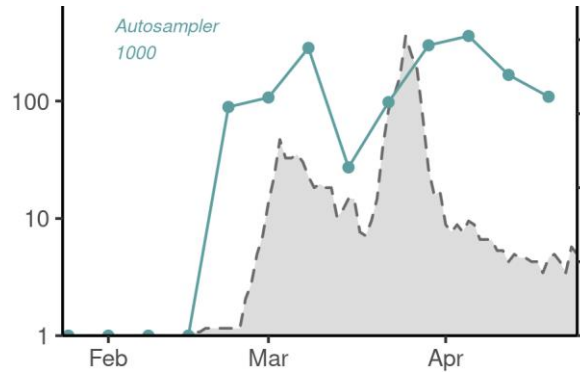
Auckland (Combined)



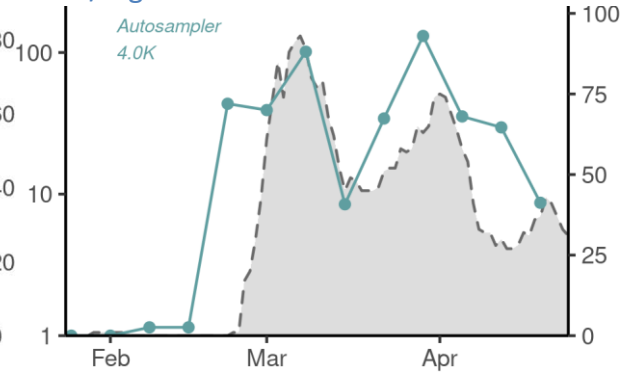
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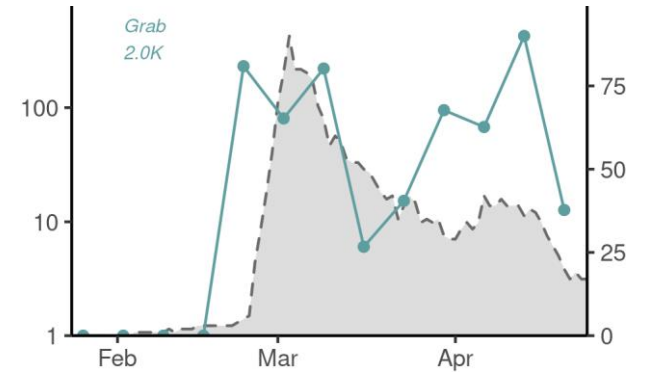
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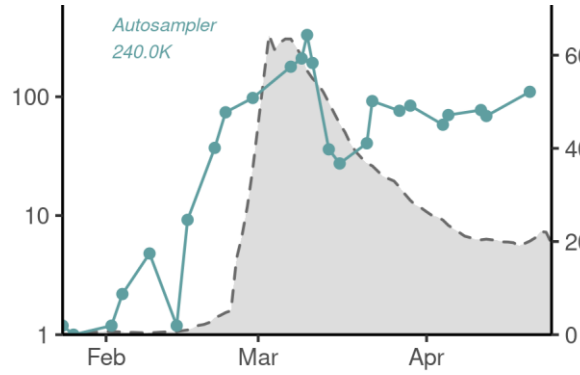
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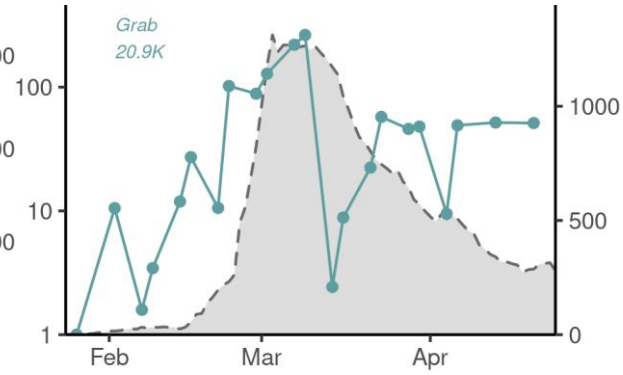
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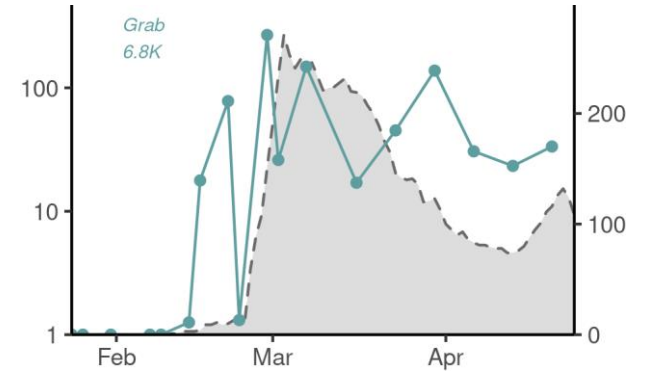
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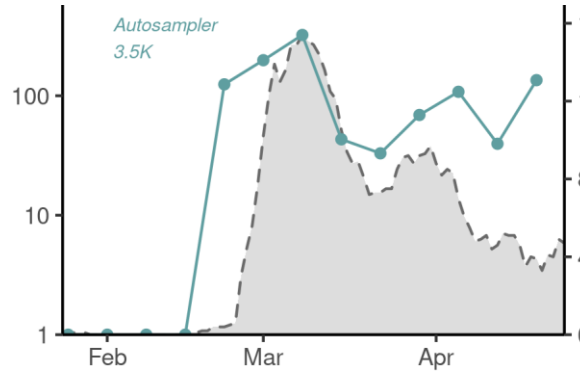
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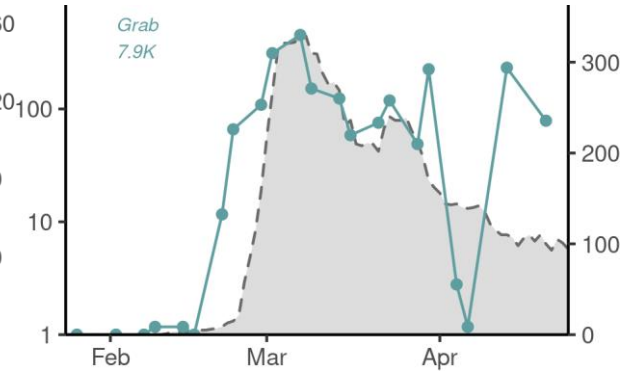
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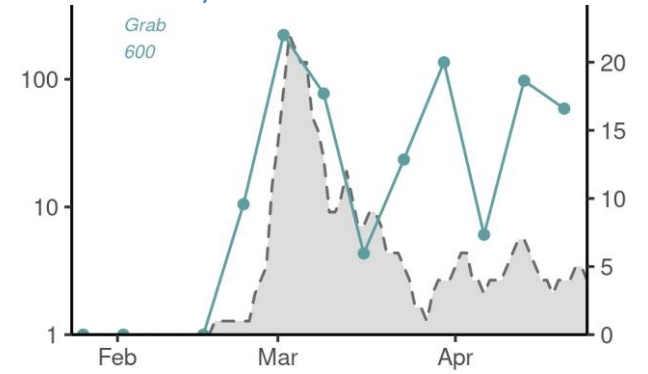
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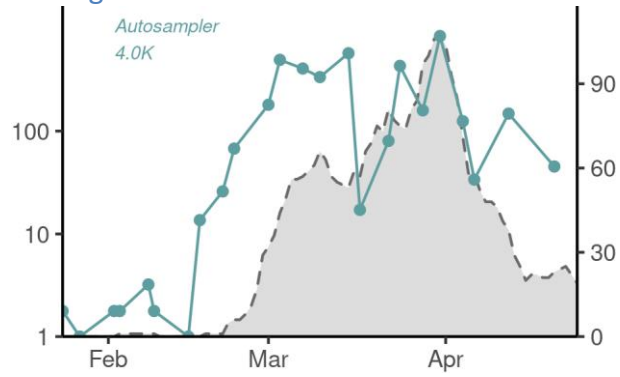


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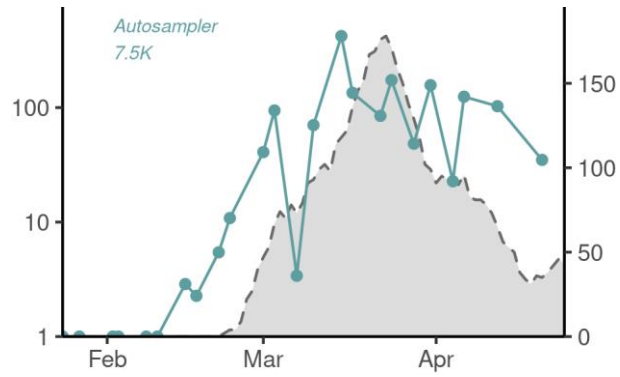


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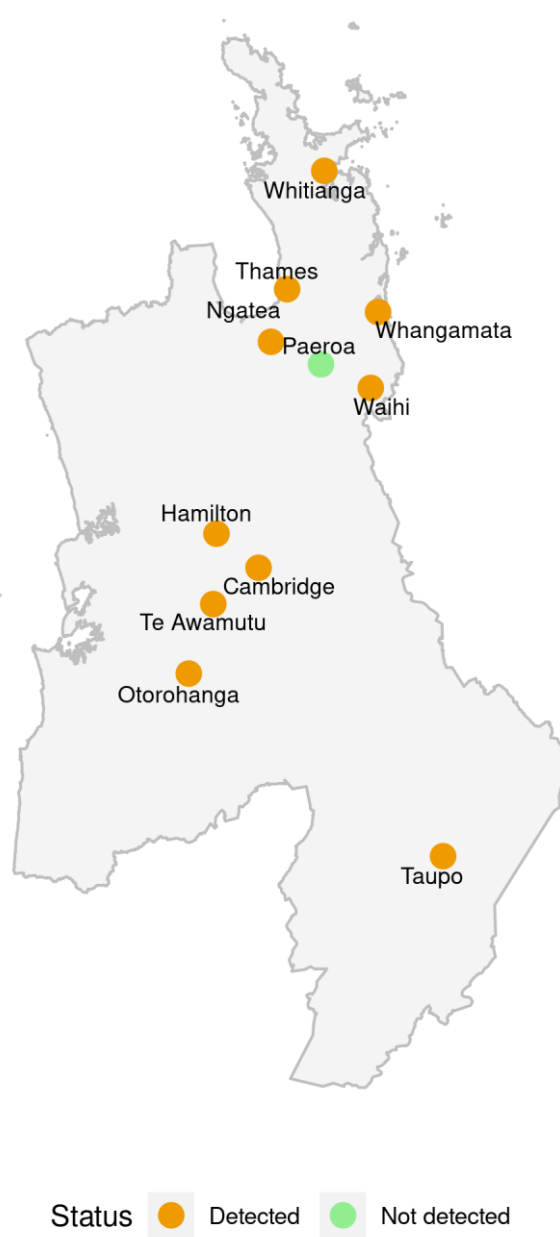
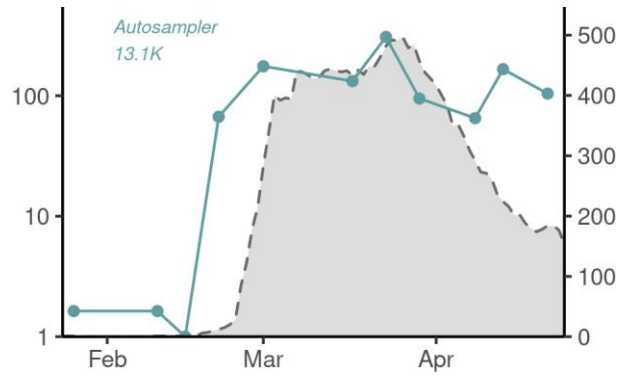
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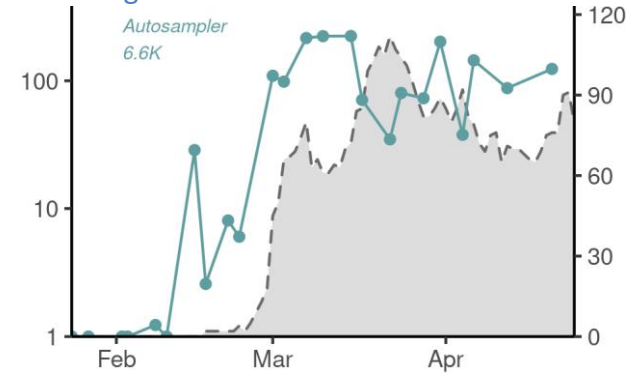
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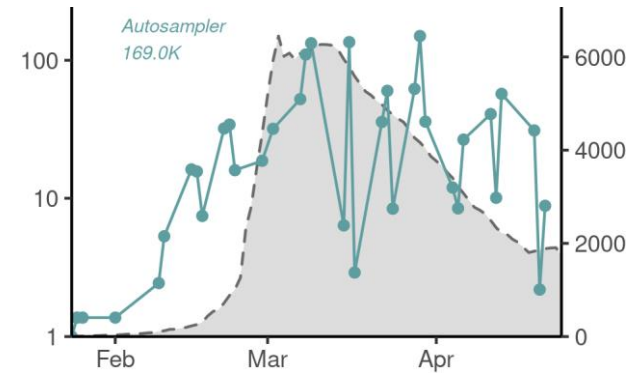
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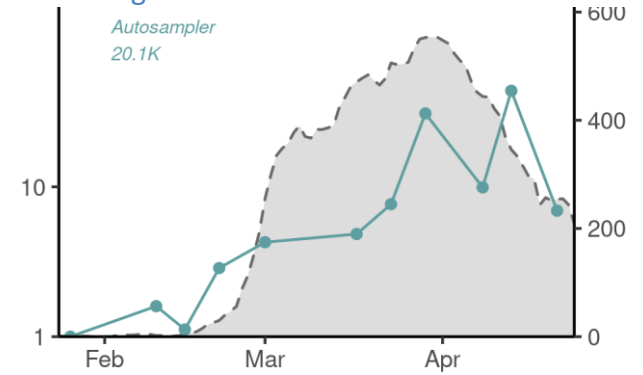
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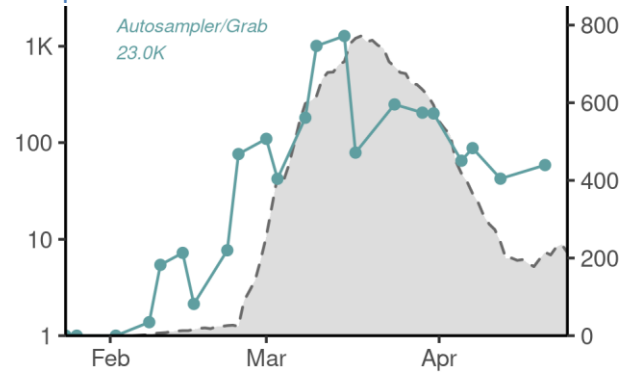
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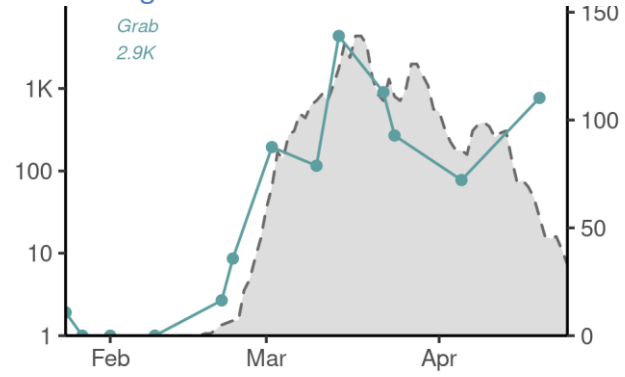
Cambridge



Taupo

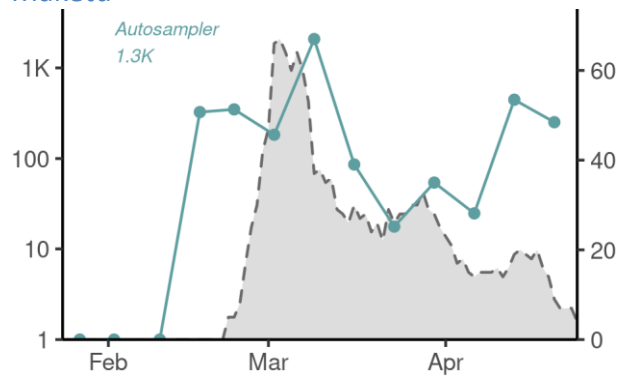


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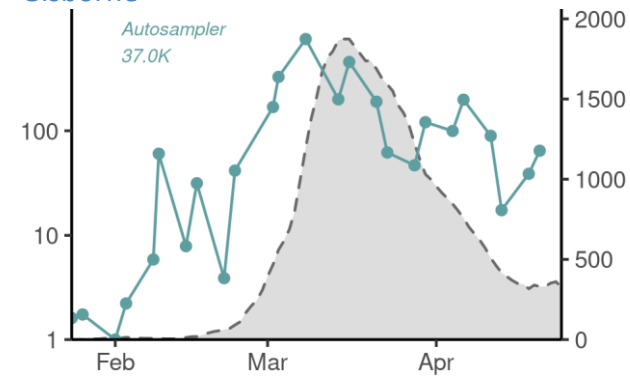


Bay of Plenty and Gisborne

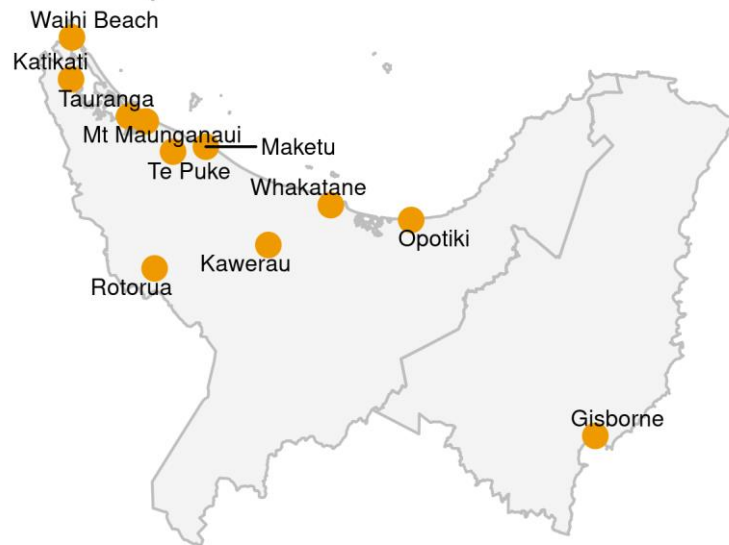
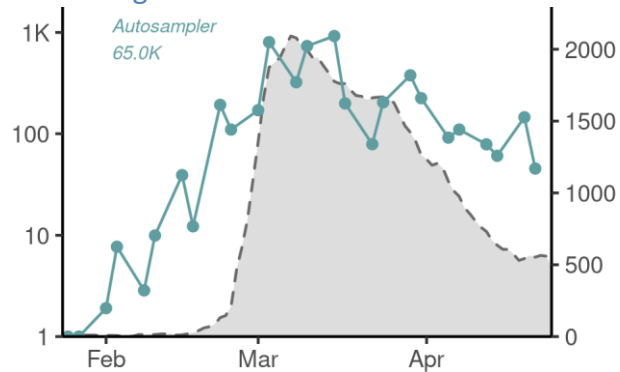
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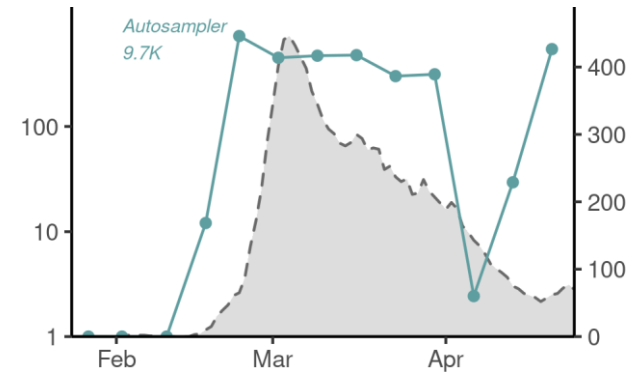
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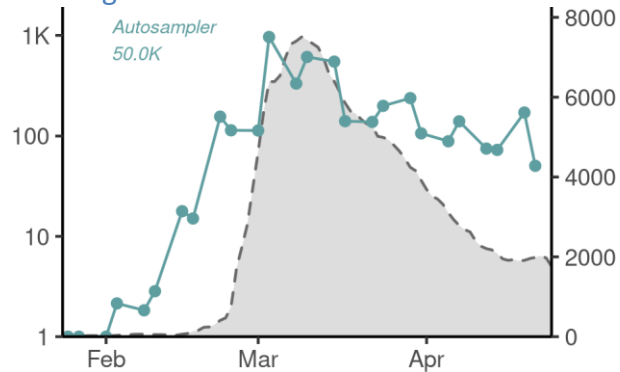
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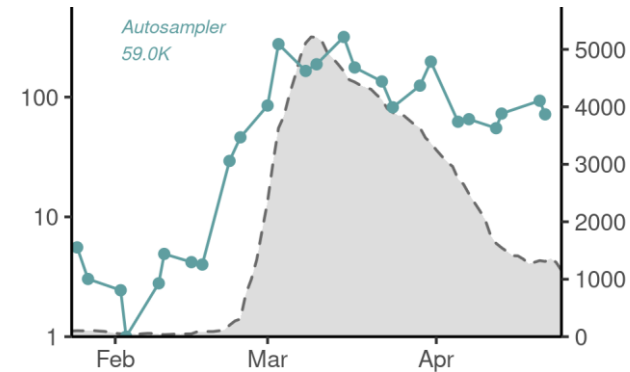
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Tauranga

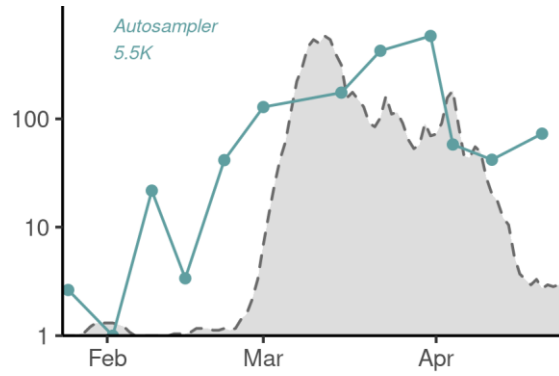


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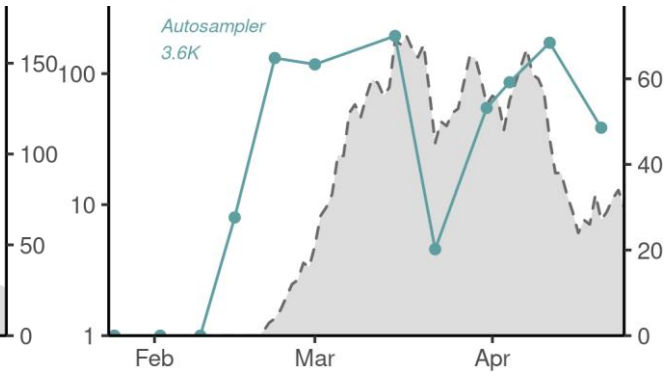


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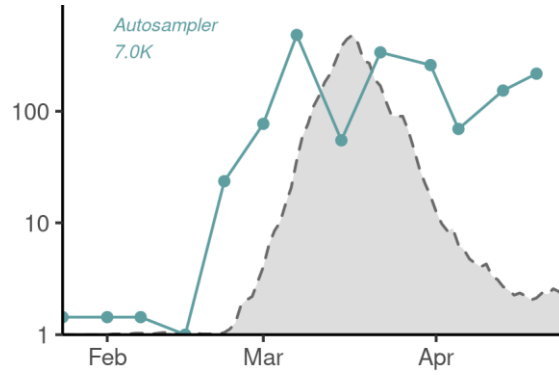
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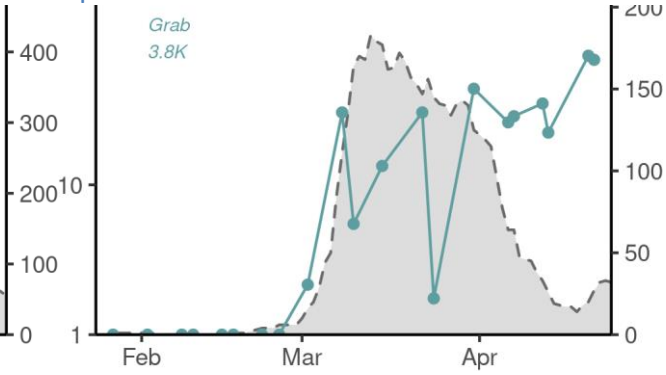
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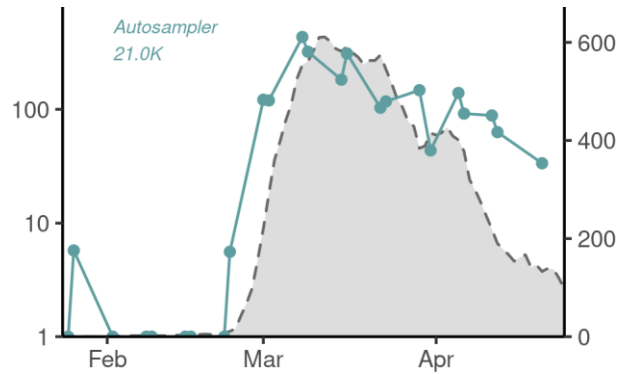
Kawerau



Opotiki

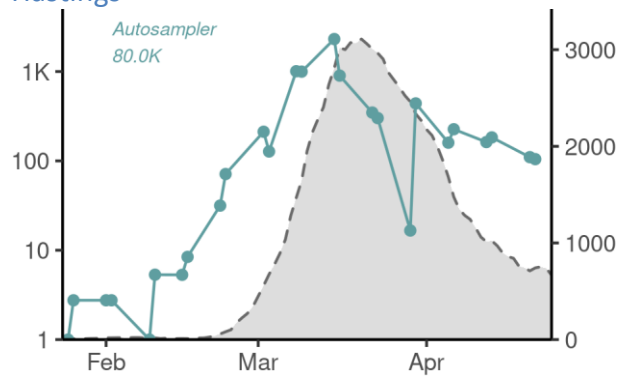


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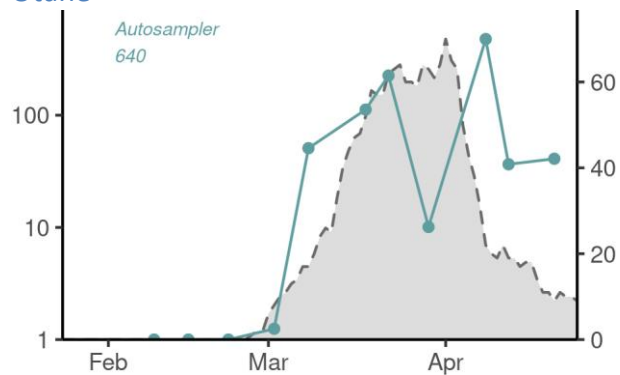


Hawke's Bay

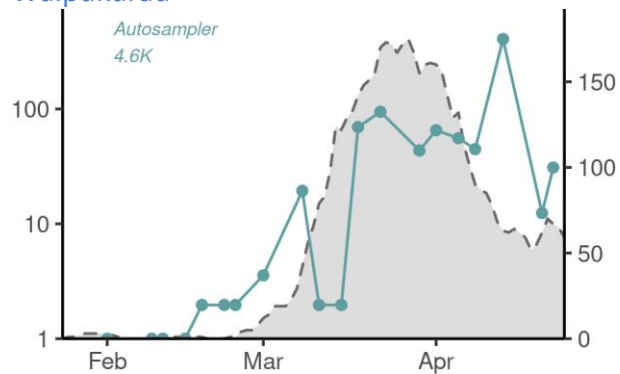
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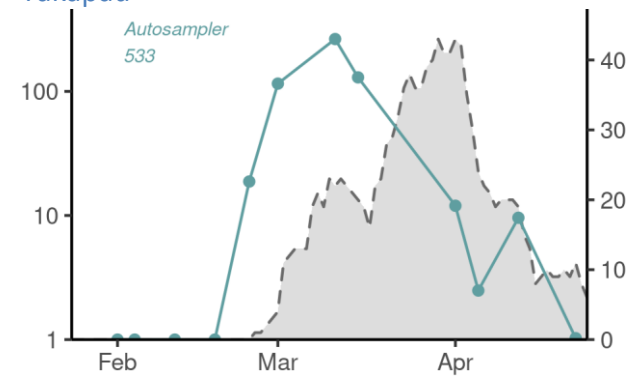
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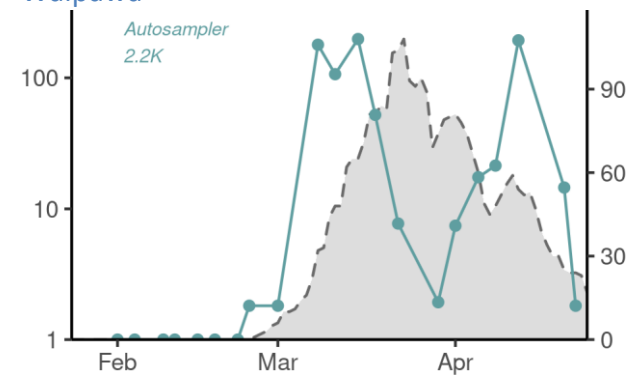
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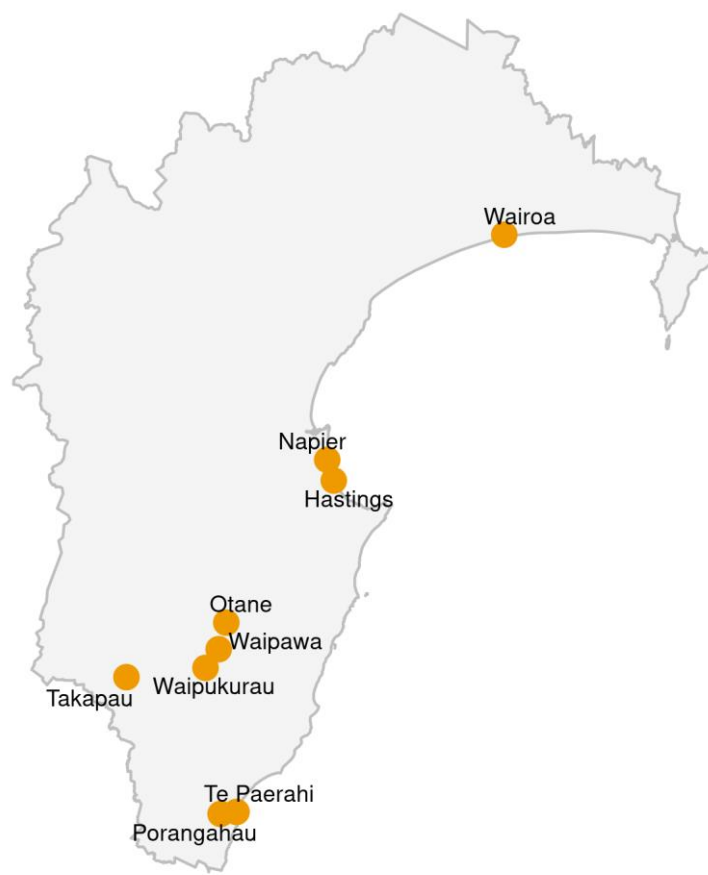
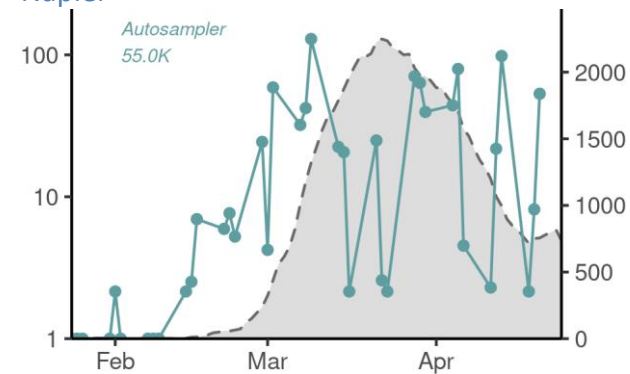
Takapau



Waipawa

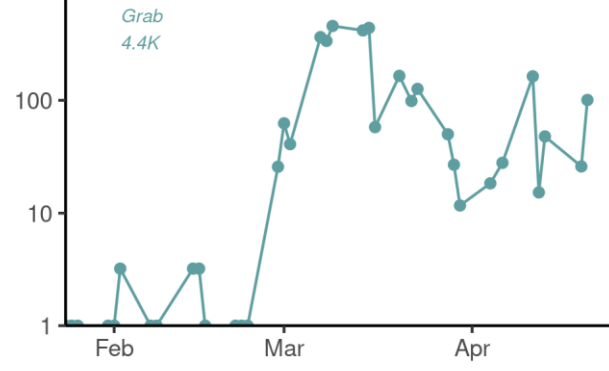


Napier



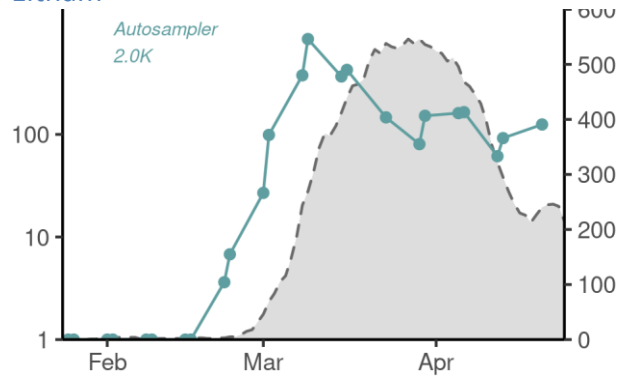
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Wairoa

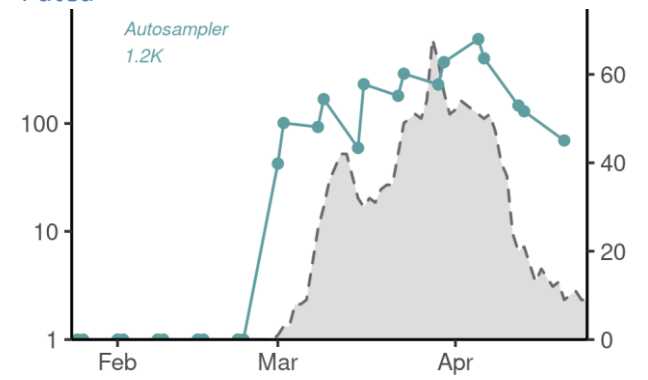


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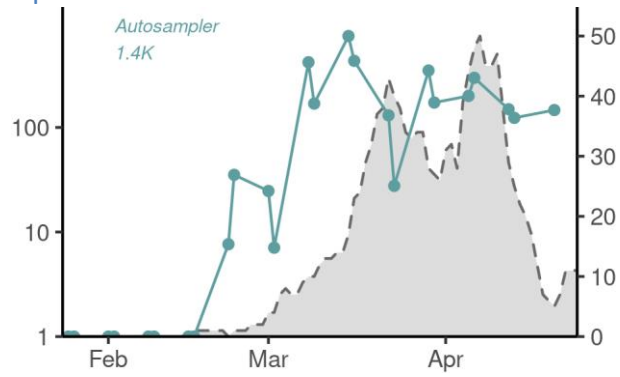
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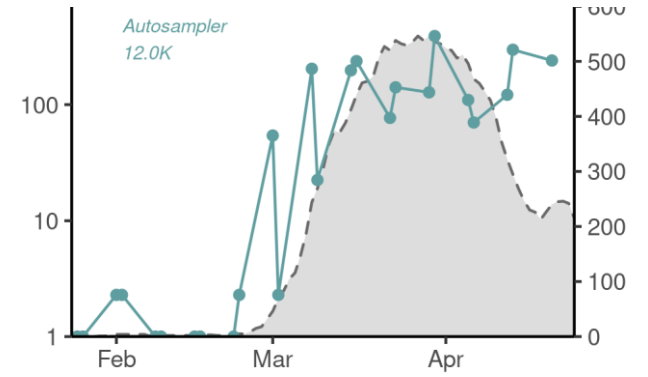
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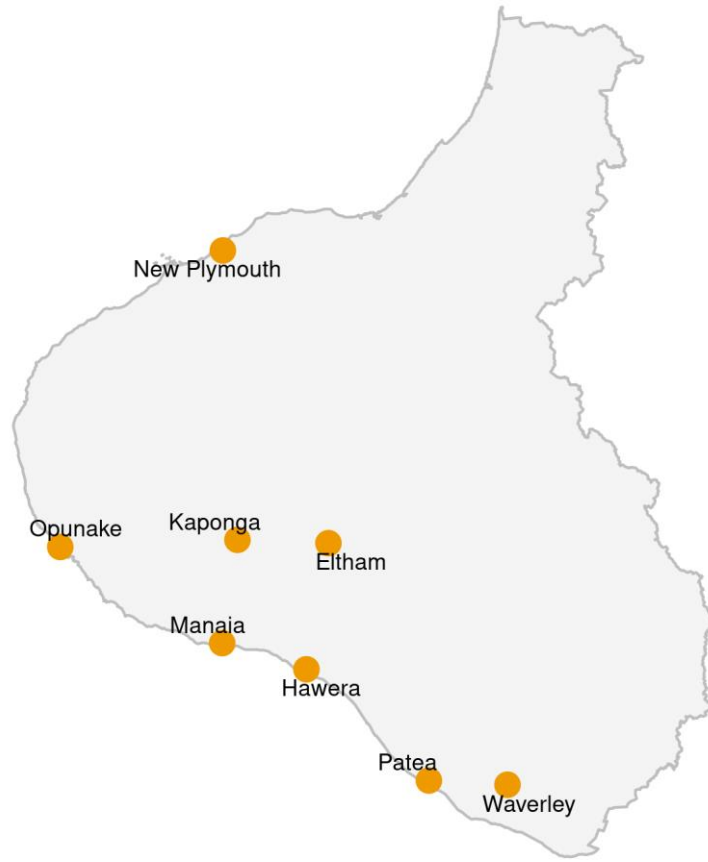
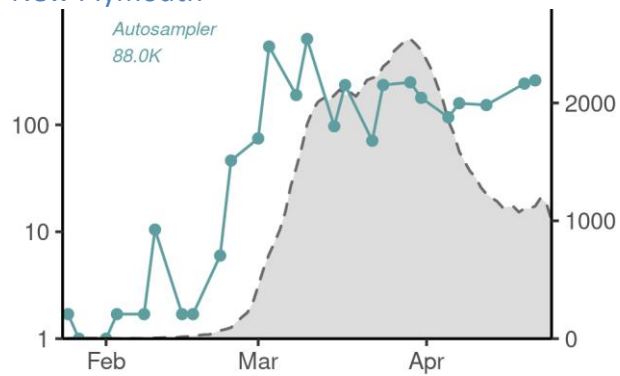
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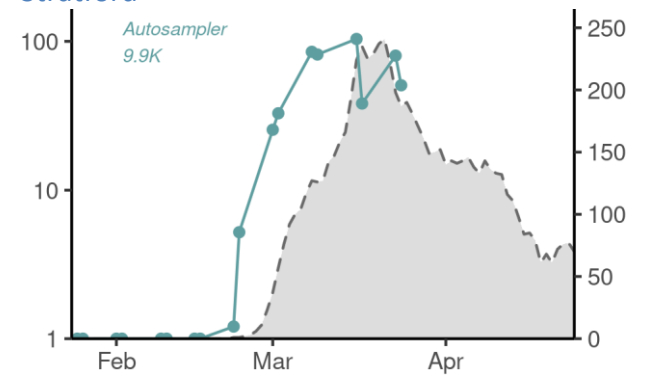


New Plymouth

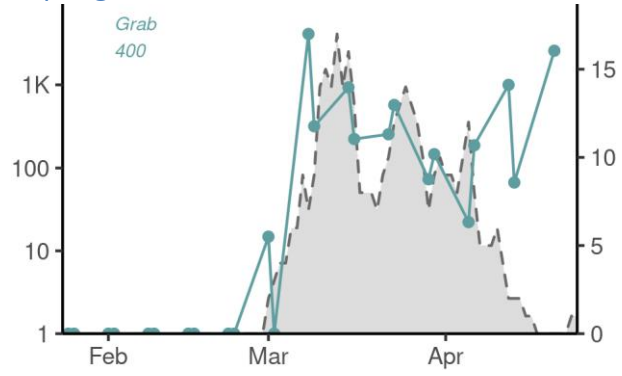


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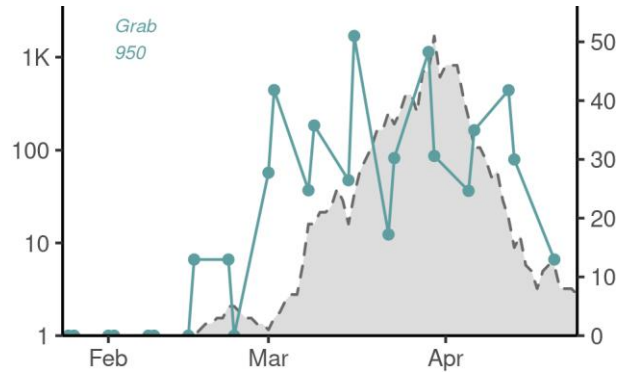
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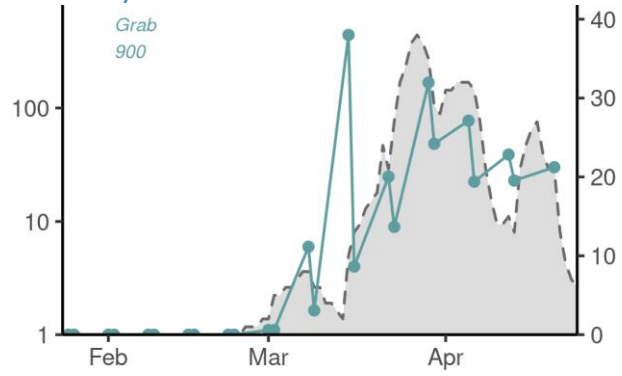
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Manaia

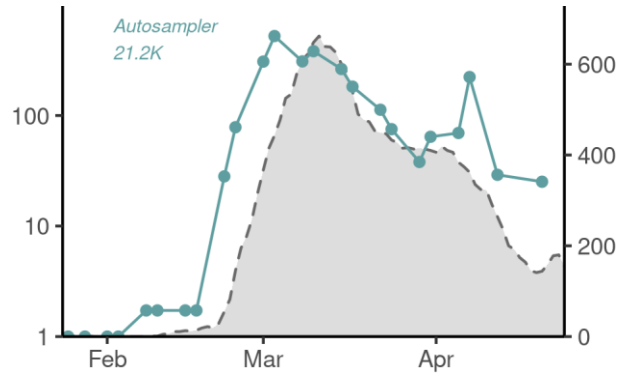


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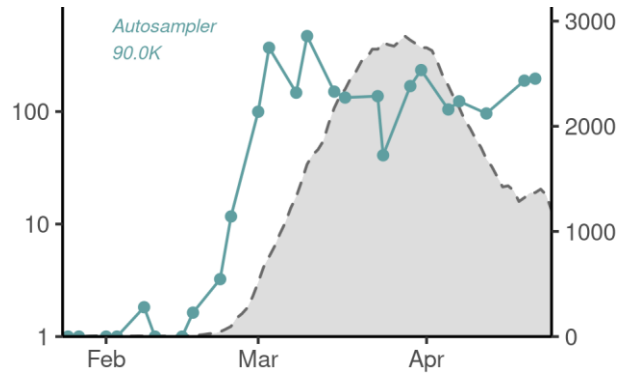


Manawatu-Wanganui

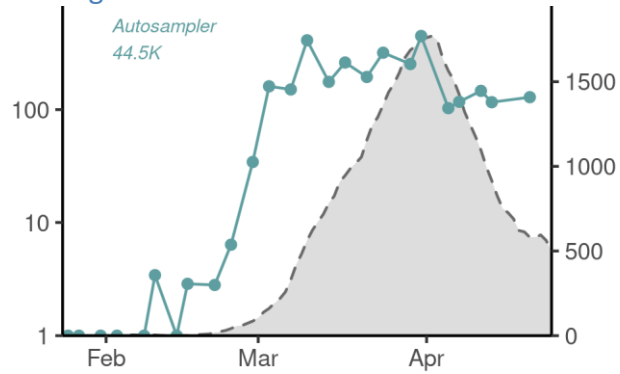
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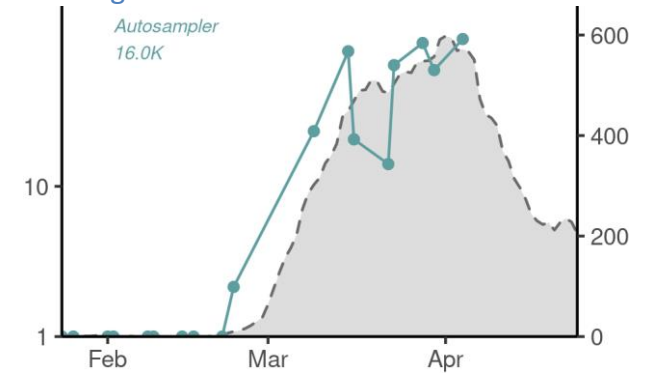
Palmerston North



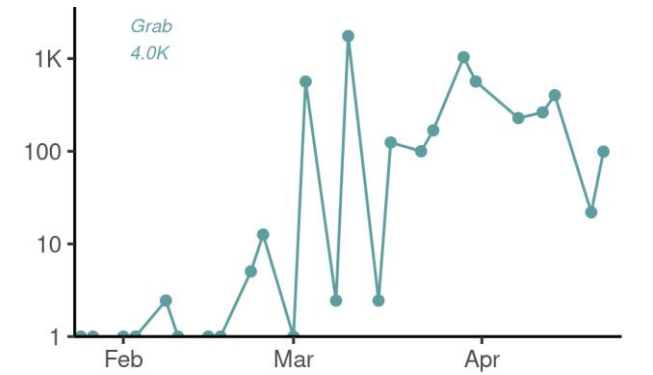
Whanganui Urban



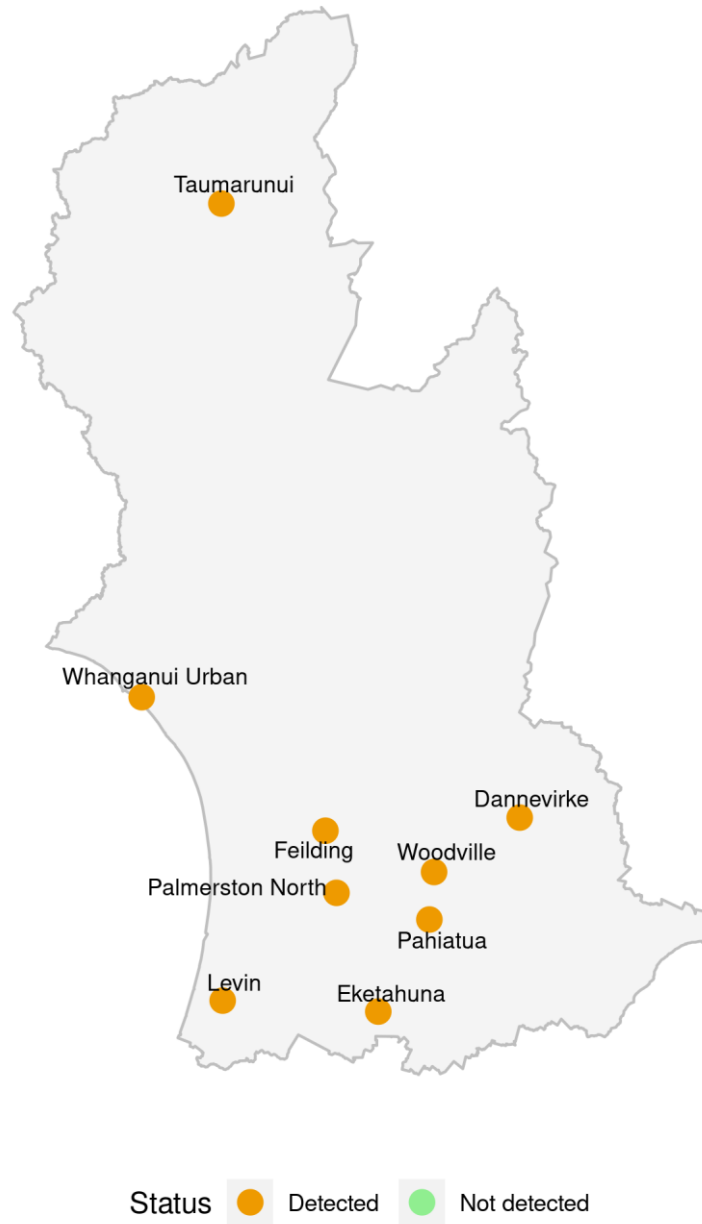
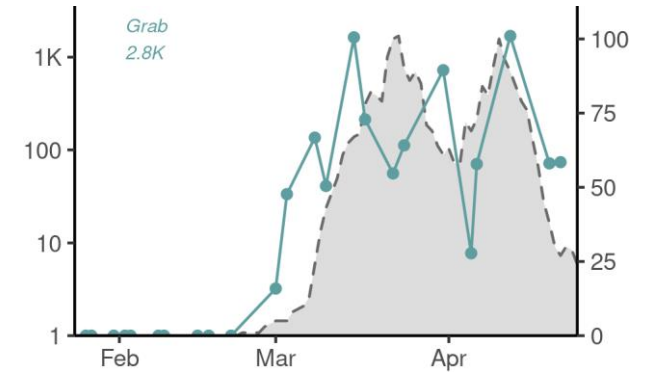
Feilding



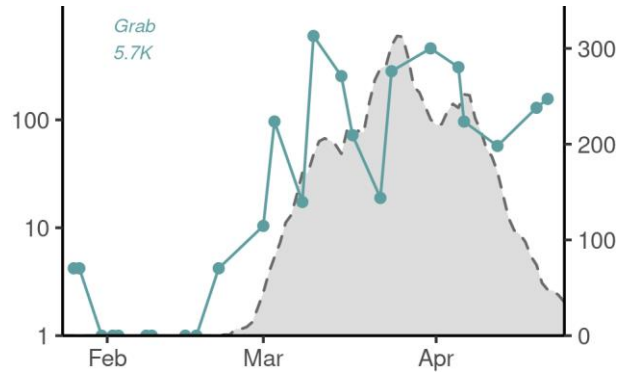
Taumarunui



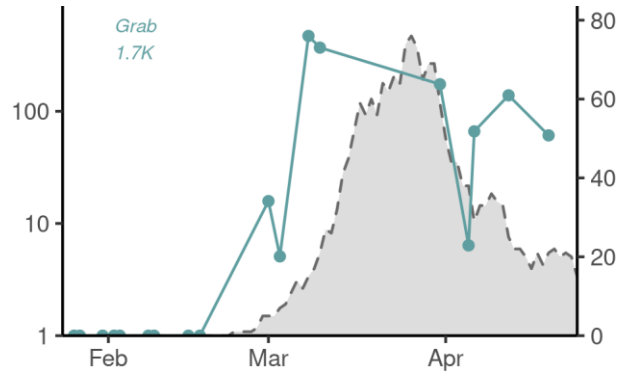
Pahiatua



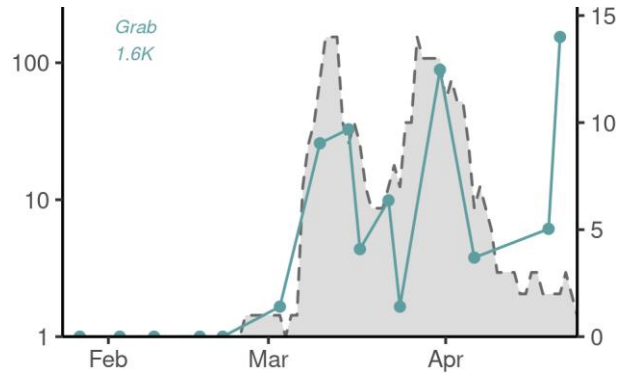
Dannevirke



Woodville

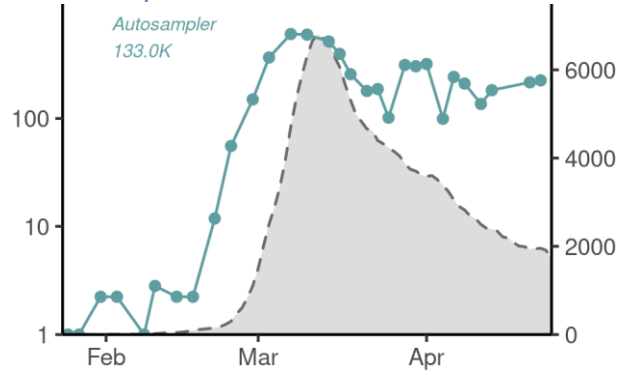


Eketahuna

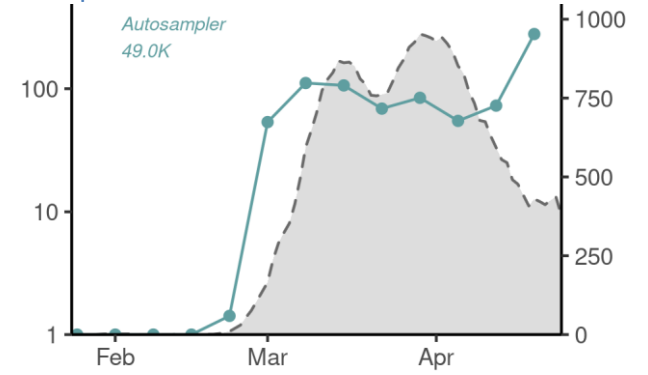


Wellington

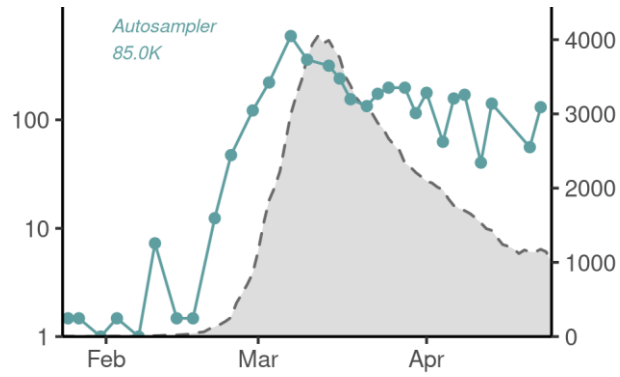
Hutt Valley



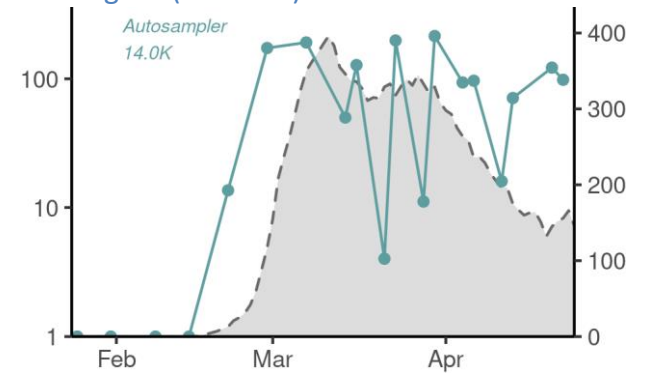
Paraparaumu



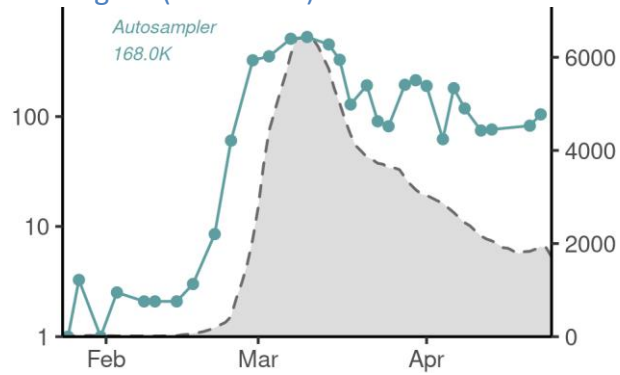
Porirua



Wellington (Western)

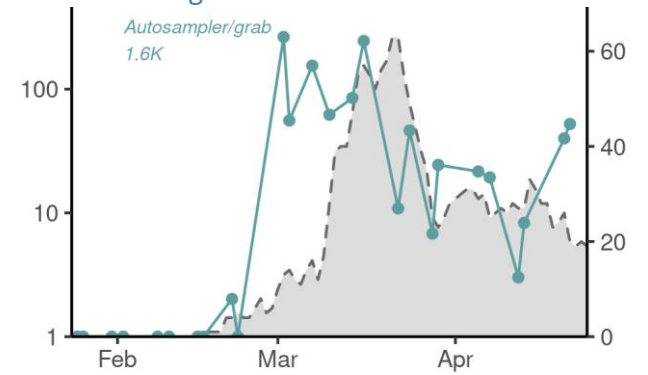


Wellington (Moa Point)

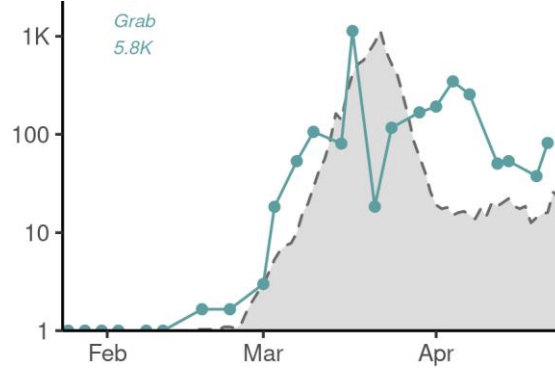


Status ● Detected ● Not detected

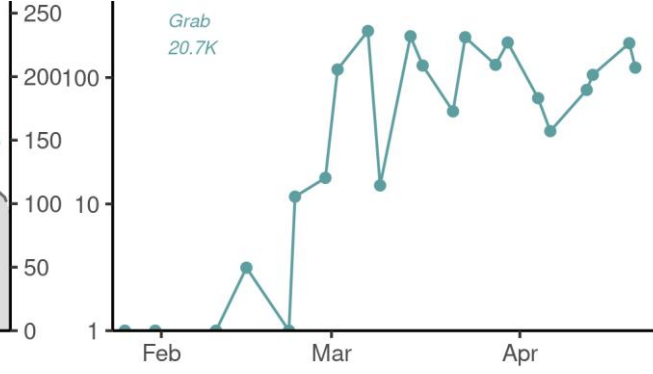
Martinborough



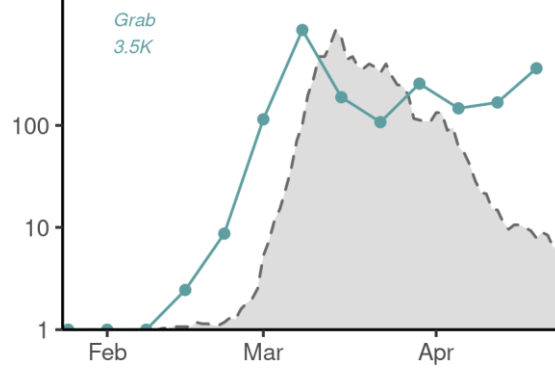
Carterton



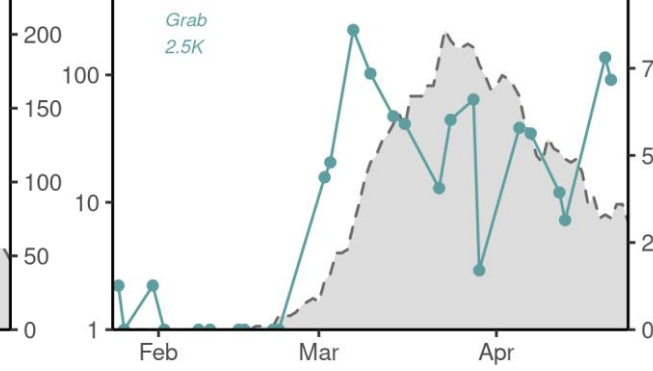
Masterton



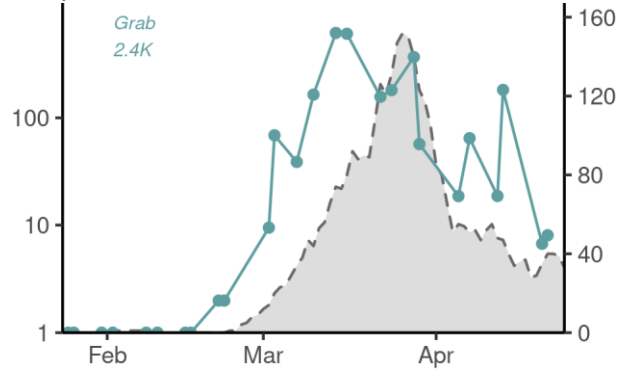
Otaki



Featherston

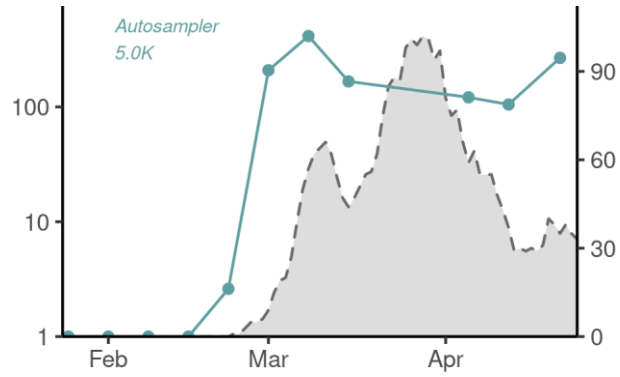


Greytown

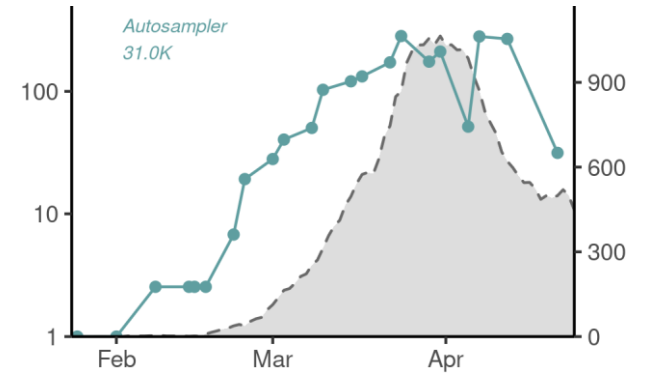


Tasman, Nelson, and Marlborough

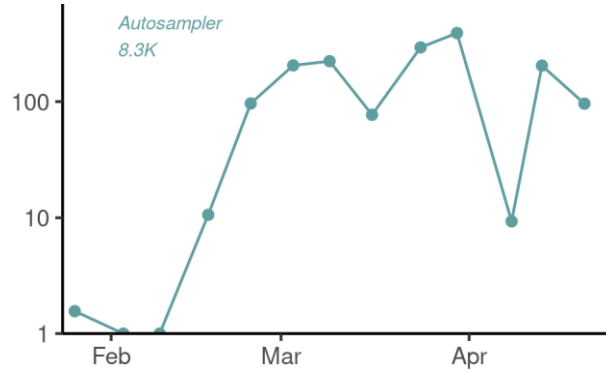
Picton



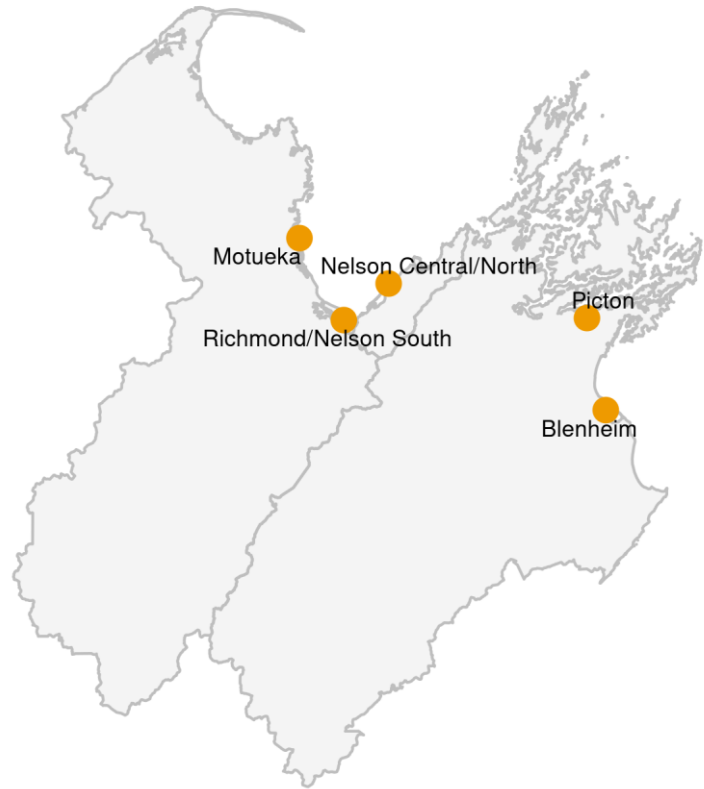
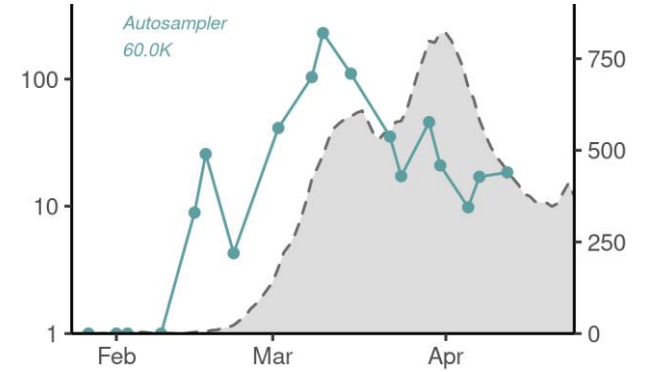
Blenheim



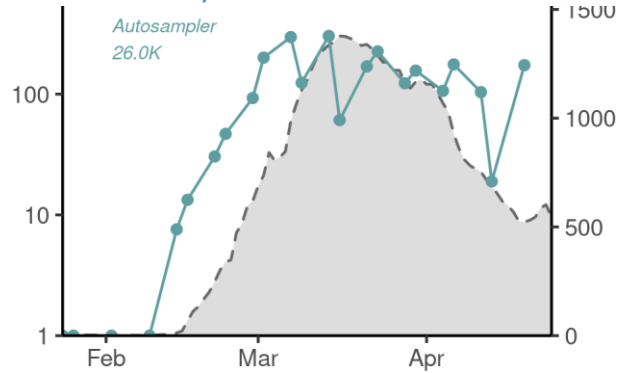
Motueka



Richmond/Nelson South



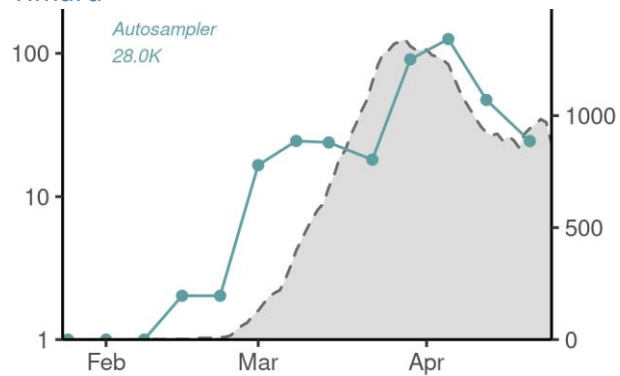
Nelson Central/North



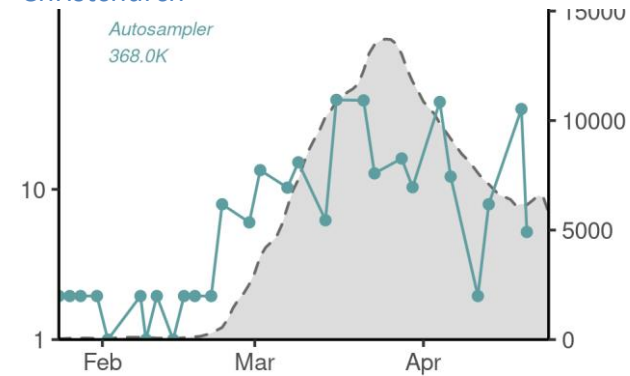
Status ● Detected ● Not detected

West Coast and Canterbury

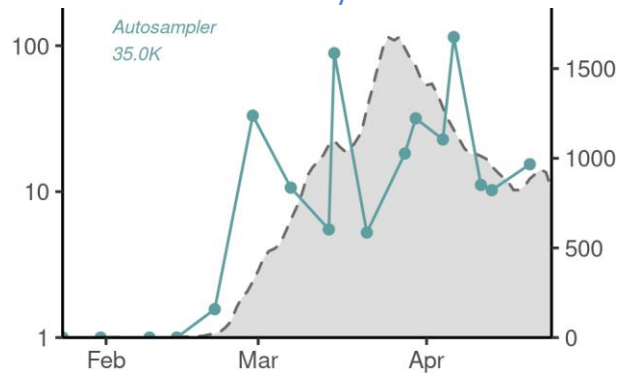
Timaru



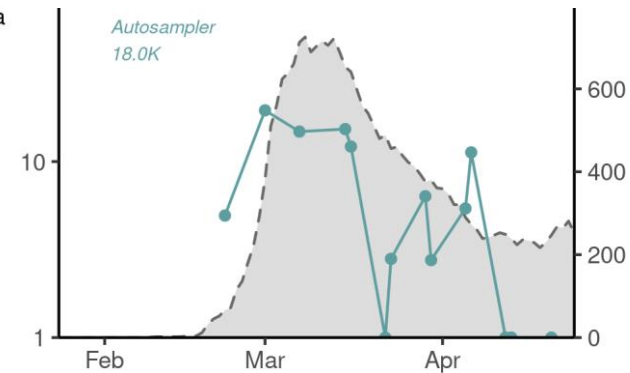
Christchurch



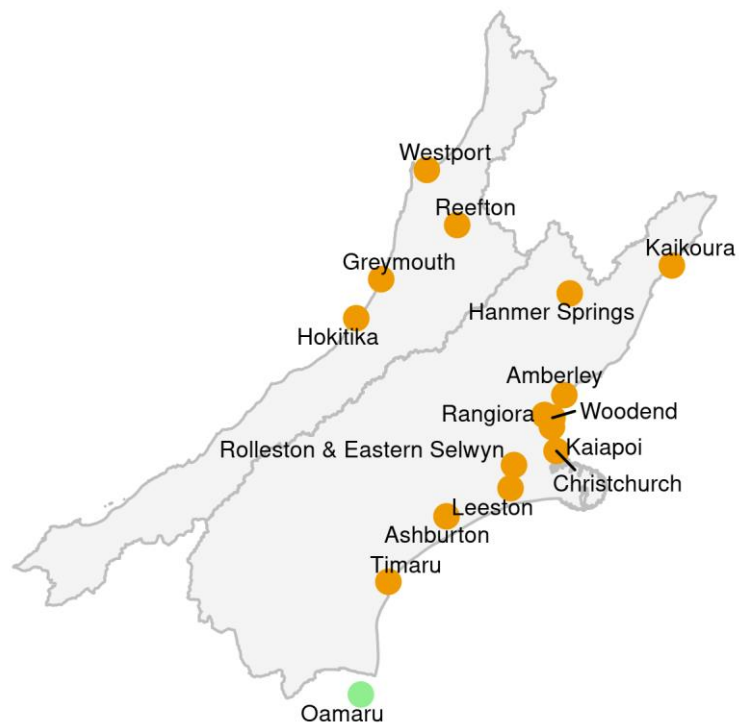
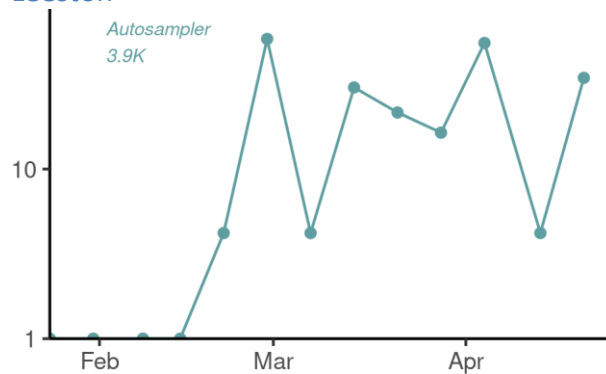
Rolleston & Eastern Selwyn



Ashburton

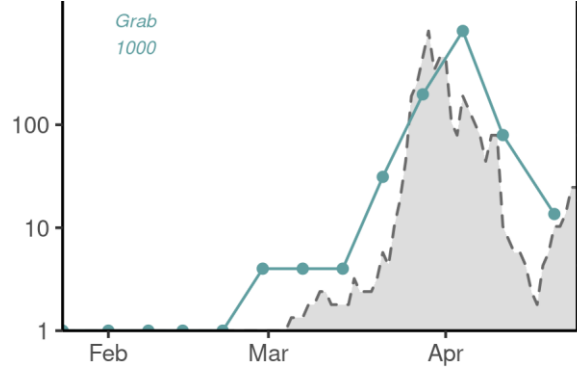


Leeston

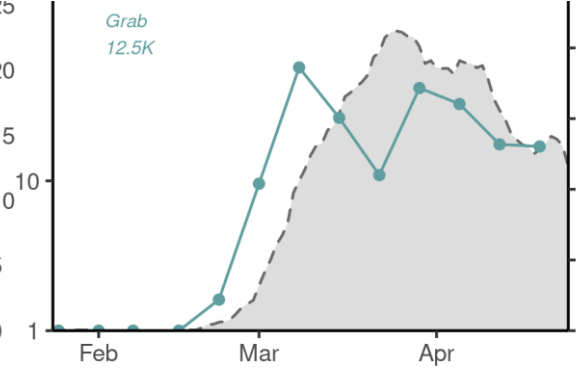


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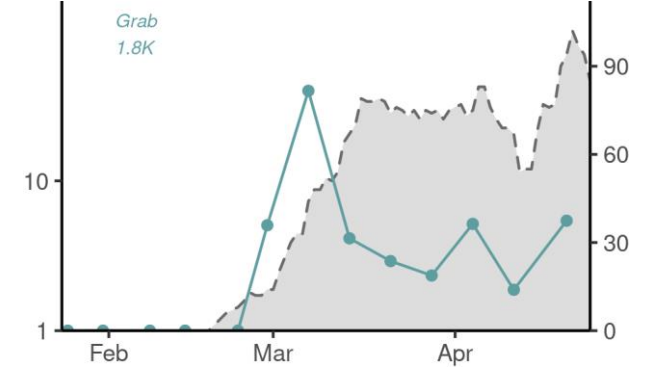
Reefton



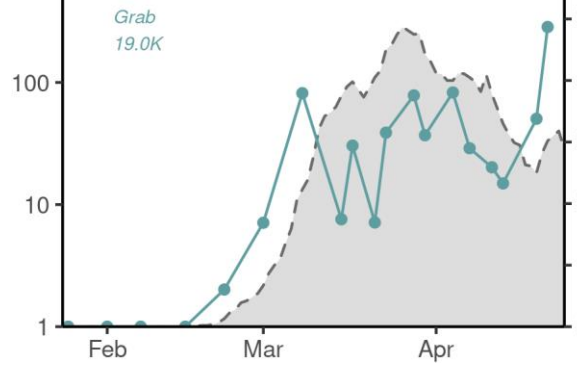
Kaipoi



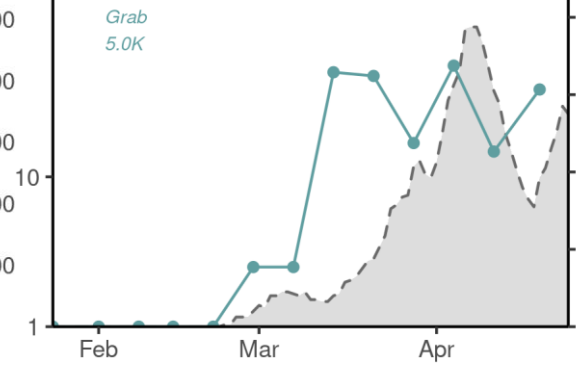
Amberley



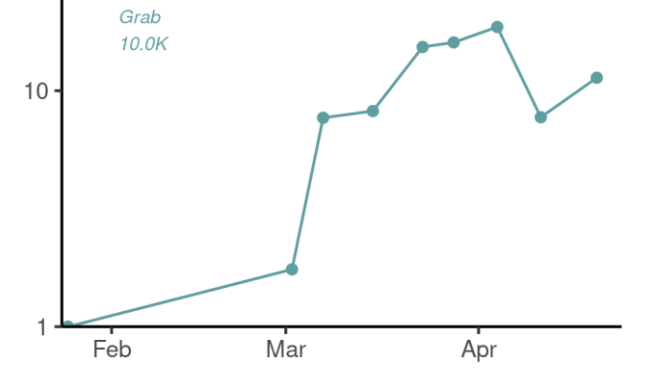
Rangiora



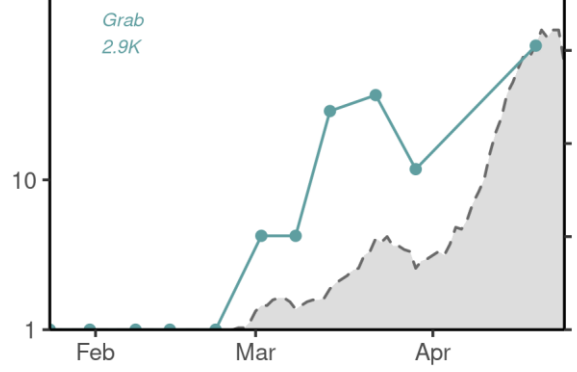
Westport



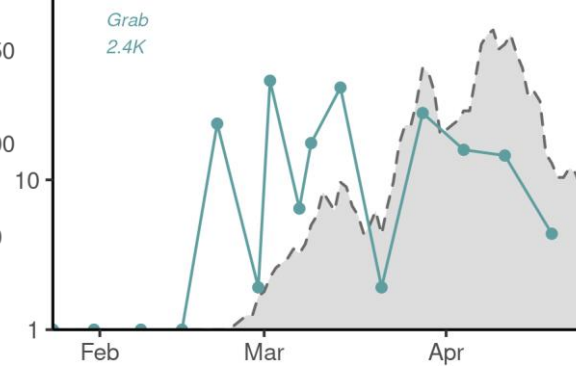
Greymouth



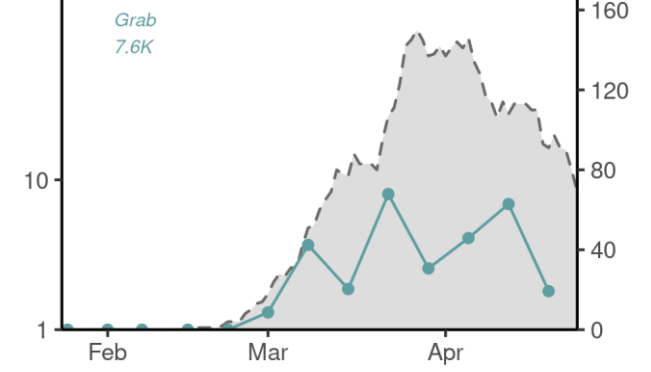
Hokitika



Kaikoura

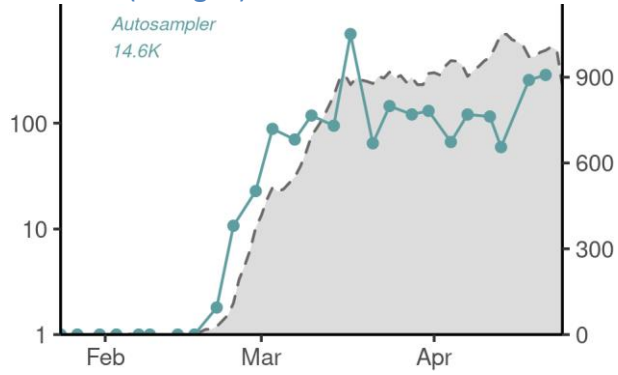


Woodend

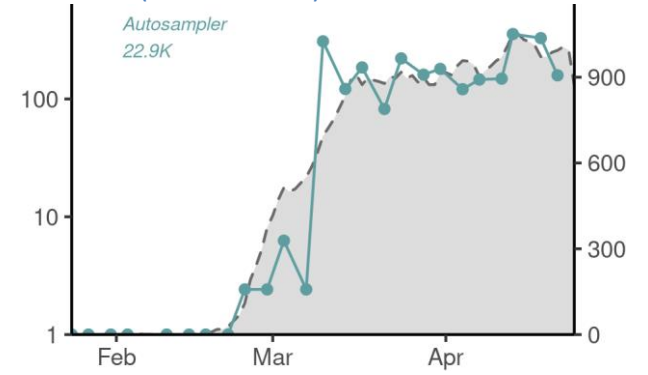


Otago and Southland

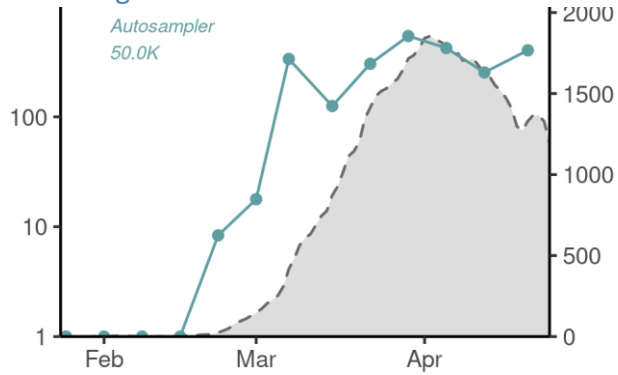
Dunedin (Mosgiel)



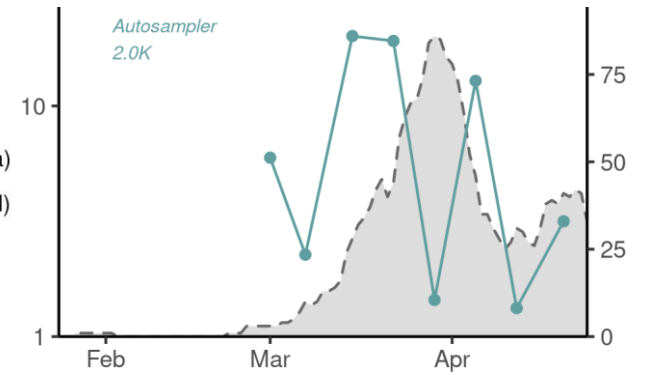
Dunedin (Green Island)



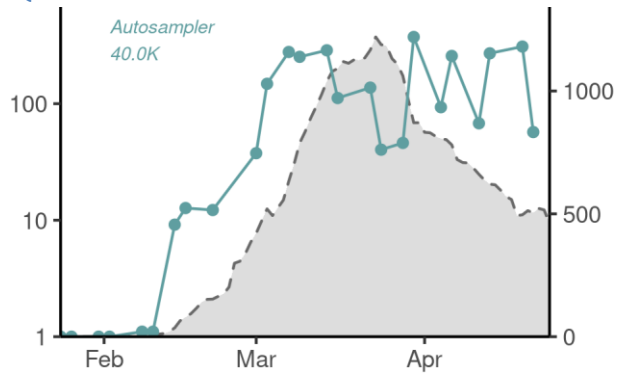
Invercargill



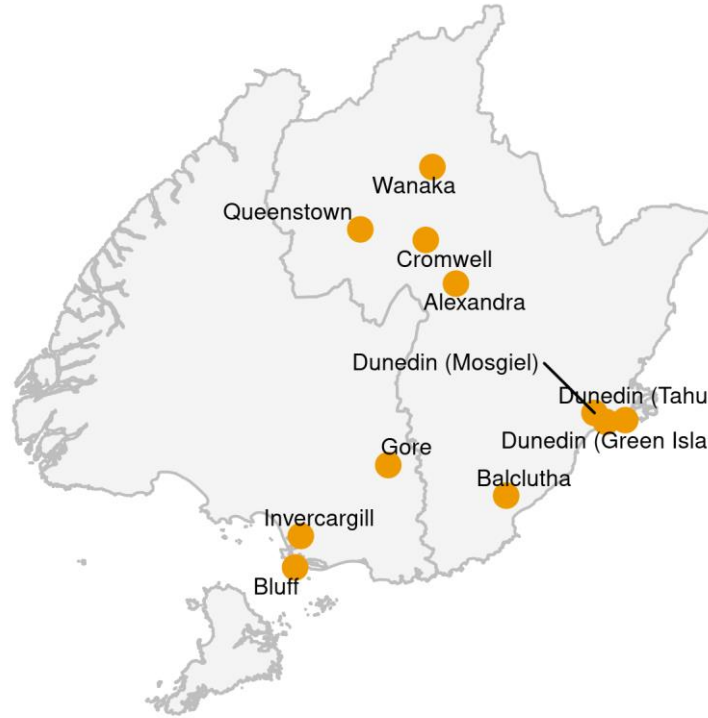
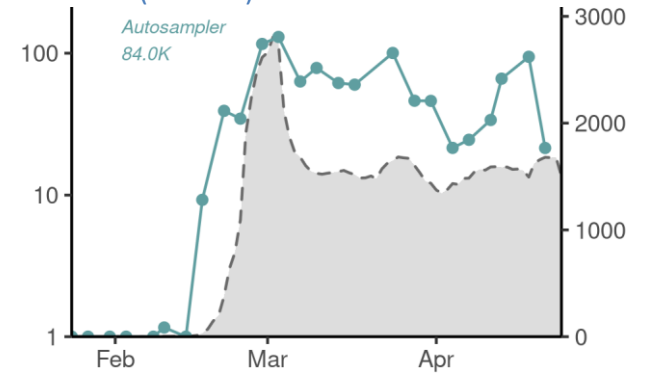
Bluff



Queenstown

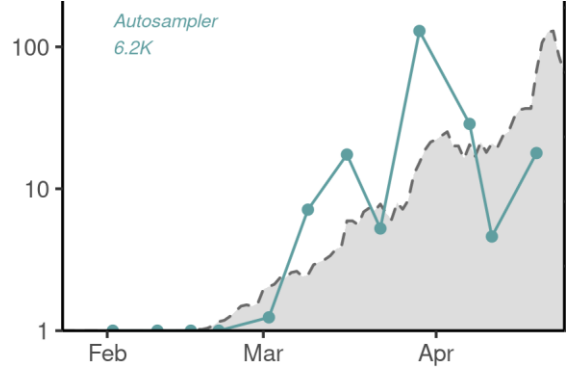


Dunedin (Tahuna)

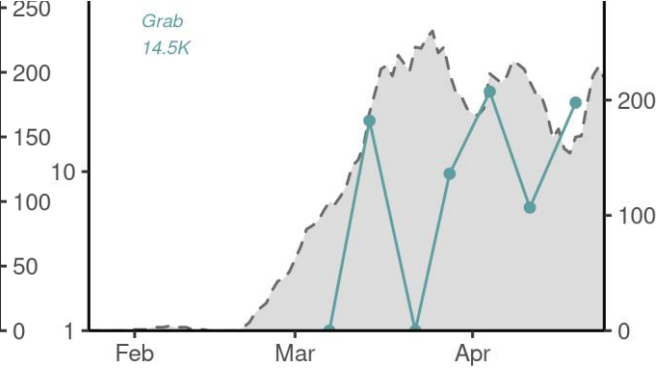


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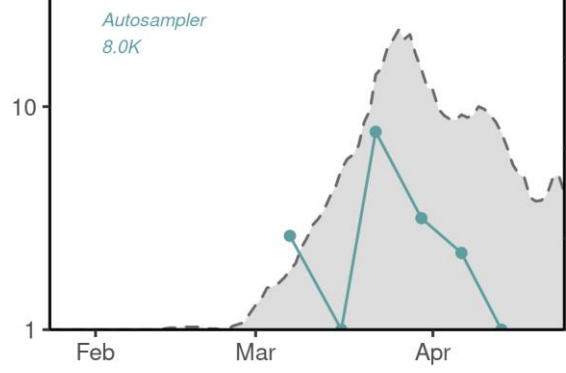
Alexandra



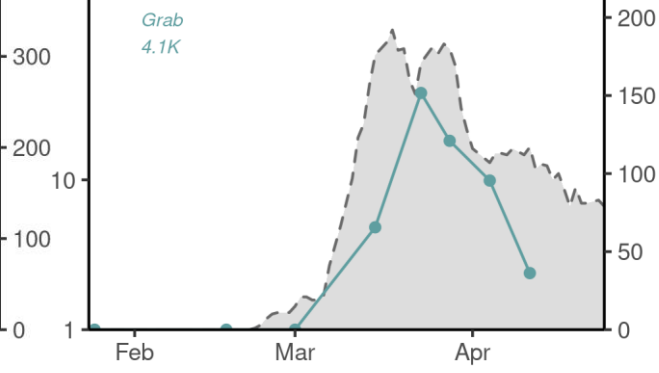
Wanaka



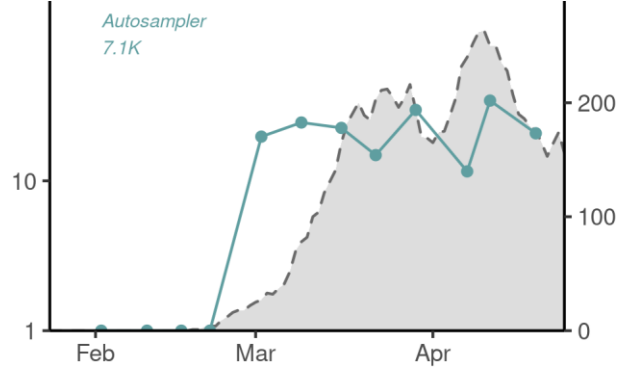
Gore



Balclutha



Cromwell



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				
Paeroa																																					
Pauanui																																					
Putaruru																																					
Raglan																																					
Taupo																																					
Tauwhare																																					
Te Awamutu																																					
Te Kauwhata																																					
Te Kowhai																																					
Te Kuiti																																					
Thames																																					
Tokoroa																																					
Turangi																																					
Waihi																																					
Waitakaruru																																					
Whangamata																																					
Whitianga																																					
Bay of Plenty																																					
Edgecumbe																																					
Katikati																																					
Kawerau																																					
Maketu																																					
Mt Maunganui																																					
Murupara																																					
Ohope																																					
Opotiki																																					
Rotorua																																					
Taneatua																																					
Tauranga																																					
Te Puke																																					
Waihi Beach																																					
Whakatane																																					
Gisborne																																					
Gisborne																																					

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	
Hawke's Bay																																		
Hastings	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	O	O	O	O	R	R	R	R	R	R	R	R	R	R	
Mahia																								Y	O	R	R	R	R	Y	Y	Y	Y	
Napier	Y	Y	Y	Y	Y	Y	Y	Y	O	Y	Y	Y	Y	Y	O	O	Y	Y	Y	O	Y	O	Y	R	R	R	R	R	R	R	R	R	R	
Otane										Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	O	R	R	R	R	R	R	R	
Porangahau																	Y							Y	O	Y	R	Y	R	R	R	R	R	
Takapau													Y	Y	Y	Y	Y							Y	R	R	R	R	R	R	R	Y	Y	
Te Paerahi																	Y							Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Waipawa		Y								Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	O	O	R	R	R	R	R	R	R	R	
Waipukurau		Y								Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	O	O	O	R	R	R	R	R	R	R	
Wairoa		Y		Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	O	Y	O	Y	R	R	R	R	R	R	R	R	
Taranaki																																		
Eltham															O	O	Y		Y	Y	Y	Y	Y	Y	O	R	R	R	R	R	R	R	R	
Hawera	Y	Y				Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						O	Y	Y	O	R	R	R	R	R	R	R	
Kaponga										Y	Y	Y	Y	Y	Y	Y	Y							Y	O	R	R	R	R	R	R	R	R	
Manaia																	Y							O	O	R	R	R	R	R	R	R	Y	Y
New Plymouth	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	O	O	O	Y	Y	Y	Y			O	O	R	O	R	R	R	R	R	R	R	R	
Opunake	Y	Y															Y							Y	Y	R	R	R	R	R	R	R	R	
Patea	Y	Y															Y							Y	R	R	R	R	R	R	R	R	R	
Stratford	Y	Y															Y							Y	R	R	R	R	R	R	R	R	R	
Waverley																	Y							Y	O	R	R	R	R	R	R	R	R	
Manawatu-Wanganui																																		
Dannevirke																	Y		Y	Y	O	Y	Y	Y	O	R	R	R	R	R	R	R	R	
Eketahuna																	Y							Y	O	R	R	R	R	R	R	R	R	
Feilding	Y	Y			Y												Y							Y	R	R	R	R	R	R	R	R	R	
Hunterville					Y												Y							Y	R	R	R	R	R	R	R	R	R	
Levin		Y															Y							O	O	R	R	R	R	R	R	R	R	
Pahiatua																	Y							Y	R	R	R	R	R	R	R	R	R	
Palmerston North	Y	Y	Y	Y	R	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y					O	O	R	R	R	R	R	R	R	R	
Taumarunui																	Y							Y	O	R	R	R	R	R	R	R	R	
Whanganui Urban	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y					O	O	R	R	R	R	R	R	R	R	
Woodville																	Y							Y	R	R	R	R	R	R	R	R	R	

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
Wellington																																
Carterton		Yellow																						Orange	Orange	Red	Red	Red	Red	Red	Red	Red
Featherston		Yellow																	Orange	Orange	Orange	Orange			Orange	Red	Red	Red	Red	Red	Red	Red
Greytown																									Orange	Red	Red	Red	Red	Red	Red	Red
Hutt Valley	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Orange		Orange				Orange	Orange	Orange	Red	Red	Red	Red	Red	Red	Red	
Martinborough																									Orange	Red	Red	Red	Red	Red	Red	Red
Masterton		Yellow									Yellow	Orange													Orange	Red	Red	Red	Red	Red	Red	Red
Otaki	Yellow	Yellow																							Orange	Red	Red	Red	Red	Red	Red	Red
Paraparaumu	Yellow	Yellow						Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow								Orange	Red	Red	Red	Red	Red	Red	Red	
Porirua	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow				Orange	Orange	Orange	Red	Orange	Red	Red	Red	Red	Red	Red	Red	
Wellington (Moa Point)	Orange	Yellow																	Orange	Orange	Orange	Orange	Orange	Orange	Red	Red	Red	Red	Red	Red	Red	Red
Wellington (Western)		Yellow																							Orange	Red	Red	Red	Red	Red	Red	Red
Tasman																																
Motueka												Yellow	Yellow	Yellow	Yellow	Yellow		Yellow	Orange	Orange	Orange	Orange	Orange	Red	Red	Red	Red	Red	Red	Red	Red	
Nelson																																
Nelson Central/North	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow									Red	Red	Red	Red	Red	Red	Red	Red
Richmond/Nelson South		Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow									Red	Red	Red	Red	Red	Red	Red	Red
Marlborough																																
Blenheim	Yellow	Yellow						Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow								Orange	Orange	Red	Red	Red	Red	Red	Red	Red
Picton		Yellow						Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow								Orange	Red	Red	Red	Red	Red	Red	Red	
West Coast																																
Greymouth		Yellow																								Red	Red	Red	Red	Red	Red	Red
Hokitika																									Orange	Orange	Red	Red	Red	Red	Red	Red
Reefton																									Orange	Red	Red	Red	Red	Red	Red	Red
Westport	Yellow																								Orange	Orange	Red	Red	Red	Red	Red	Red
Canterbury																																
Amberley	Yellow	Yellow																							Orange	Red	Red	Red	Red	Red	Red	Red
Ashburton	Yellow	Yellow						Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow									Red	Red	Red	Red	Red	Red	Red	Red
Christchurch	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Orange	Yellow	Yellow	Orange	Orange	Orange	Orange	Red	Red	Red	Red	Red	Red	Red	Red	
Hanmer Springs																							Red	Yellow	Orange	Red	Red	Red	Red	Red	Red	Red
Kaiapoi		Yellow																							Orange	Red	Red	Red	Red	Red	Red	Red
Kaikoura	Yellow	Yellow																							Orange	Red	Red	Red	Red	Red	Red	Red

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			
Leeston	Y	Y							Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			
Methven		Y																																		
Oamaru	Y																										Y							Y		
Oxford		Y																																		
Rangiora	Y	Y							Y	Y		Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			
Rolleston & Eastern Selwyn	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			
Timaru	Y	Y																		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			
Waimate	Y	Y																																		
Woodend		Y						Y	Y		Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			
Otago																																				
Alexandra		Y																				Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		
Balclutha		Y		Y					Y		Y		Y						Y		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		
Cromwell		Y																			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		
Dunedin (Green Island)	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		
Dunedin (Mosgiel)	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		
Dunedin (Tahuna)	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		
Milton		Y																																		
Queenstown	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		
Wanaka		Y																										Y	Y		Y	Y	Y	Y	Y	Y
Southland																																				
Bluff		Y																								Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Gore	Y	Y																																		
Invercargill	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		

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.

The wastewater analysis has been undertaken at the ESR Kenepuru (in Porirua) and Christchurch laboratories by a team which may on any given week include contributions from: Kirsten Carter, Joanne Chapman, Dawn Croucher, Joanne Hewitt, Joycelyn Ho, Anower Javed, Susan Lin, Olivia Macrae, Ashley McDonald, Andrew Ng, Ashley Orton, Paula Scholes and Fatiha Sulthana. Data science analysis, visualisation and reporting is the result of team effort from: Franco Andrews, Bridget Armstrong, Raewyn Campbell, Gerhard de Beer, Richard Dean, Brent Gilpin, Joanne Hewitt, Dawen Li, Helen Morris and Bindu Priya. Ongoing support for this work from the Ministry of Health and ESR management is appreciated.

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 mL or per L 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, such as chilli sauce, 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).