National Wastewater Surveillance Programme - COVID-19

Week 44 & 45 (Weeks Ending 06 November & 13 November 2022)

Report prepared on 18 November 2022

99%	76%	Omicron BA.4/5 (66%)
sites tested in the last 2 weeks had SARS-CoV-2 detected (85/86 sites)	NZ population covered by wastewater testing	Most prevalent variant detected

Nationally, SARS-CoV-2 levels in wastewater have been plateauing for the last fortnight. This is reflected by a levelling off in reported cases in recent weeks.

- In the week 45 compared to week 44, 31% of sites showed an increase in SARS-CoV-2 levels while 44% of sites showed a decrease.
- Compared to a month ago (week 41, week ending 23 October 2022), 40% of sites show an increase in SARS-CoV-2 levels while 36% sites showed a decrease in SARS-CoV-2.

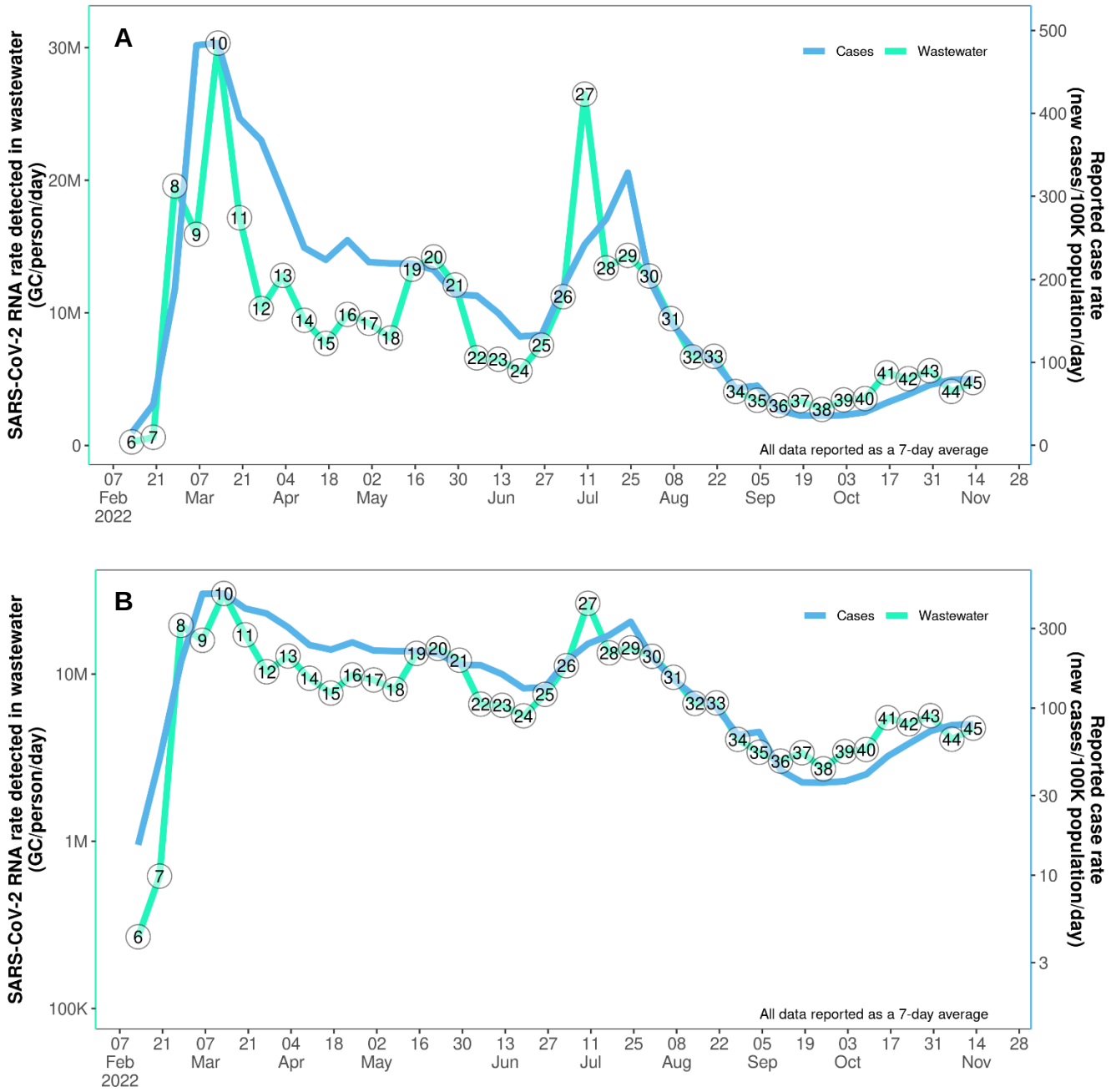


Figure 1. National timeseries of estimated SARS-CoV-2 genome copies (GC) in wastewater rate (GC/person/day, green line) and reported case rate (new cases/100,000 population/day, blue line). Numbers in the points are the week of the year. A. Linear scale. B. Log_{10} scale. Data reported as 7-day average.

Results for Weeks 44 & 45 2022 (Weeks ending 06 November & 13 November 2022)

In the two weeks ending 13 November 2022, 248 samples were collected from 86 locations across New Zealand.

SARS CoV-2 RNA was **detected** in 246/248 samples from 85 (99%) sites tested during this period (Figure 2 and Table 1).

SARS-CoV-2 RNA was **not detected** in samples collected from Helensville (week 44, no sample received in week 45) and Balclutha (week 45).

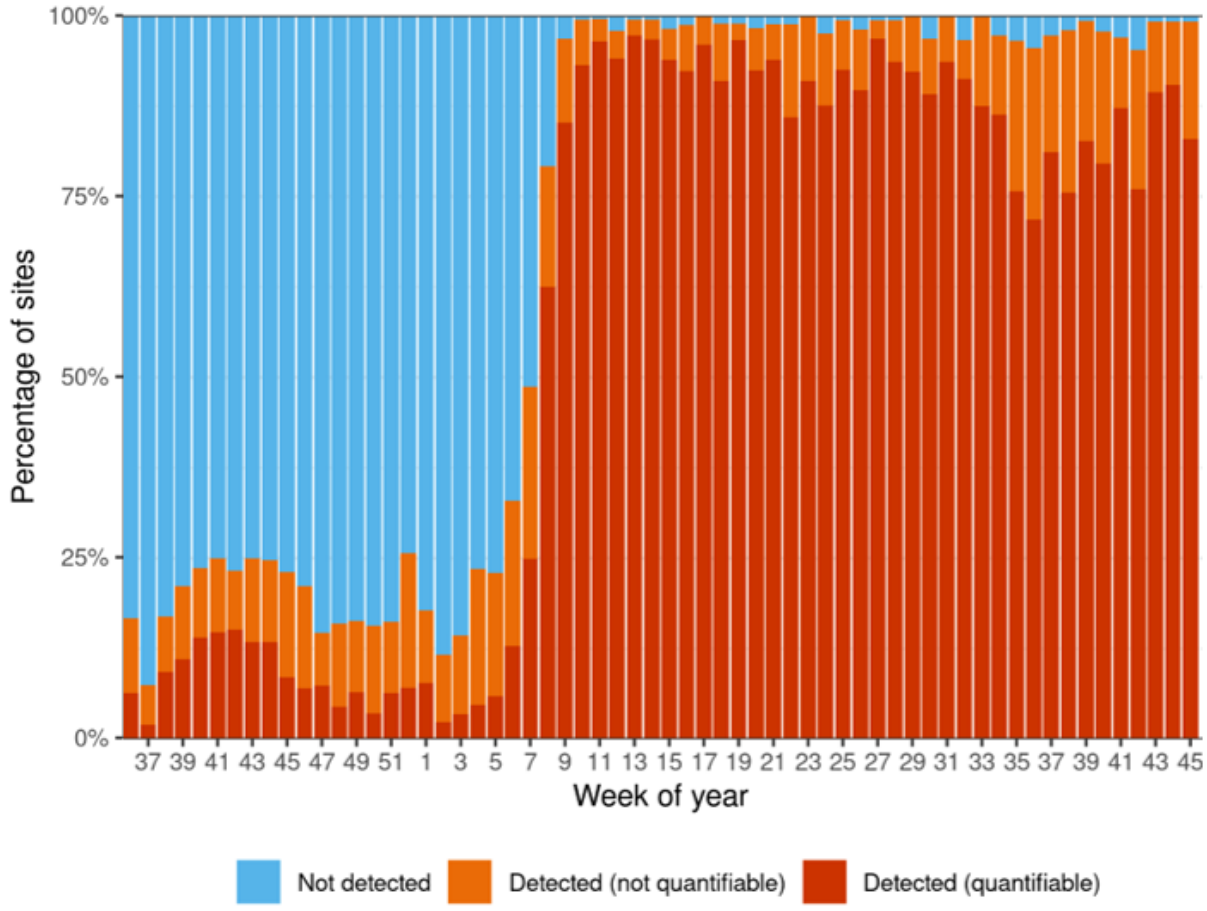


Figure 2. Results for SARS-CoV-2 RNA in wastewater collected across New Zealand.

Regional Trends

Regional summaries (Figure 3) of the wastewater data indicates generally steady viral levels across all regions except Northern, which shows an ongoing reduction.

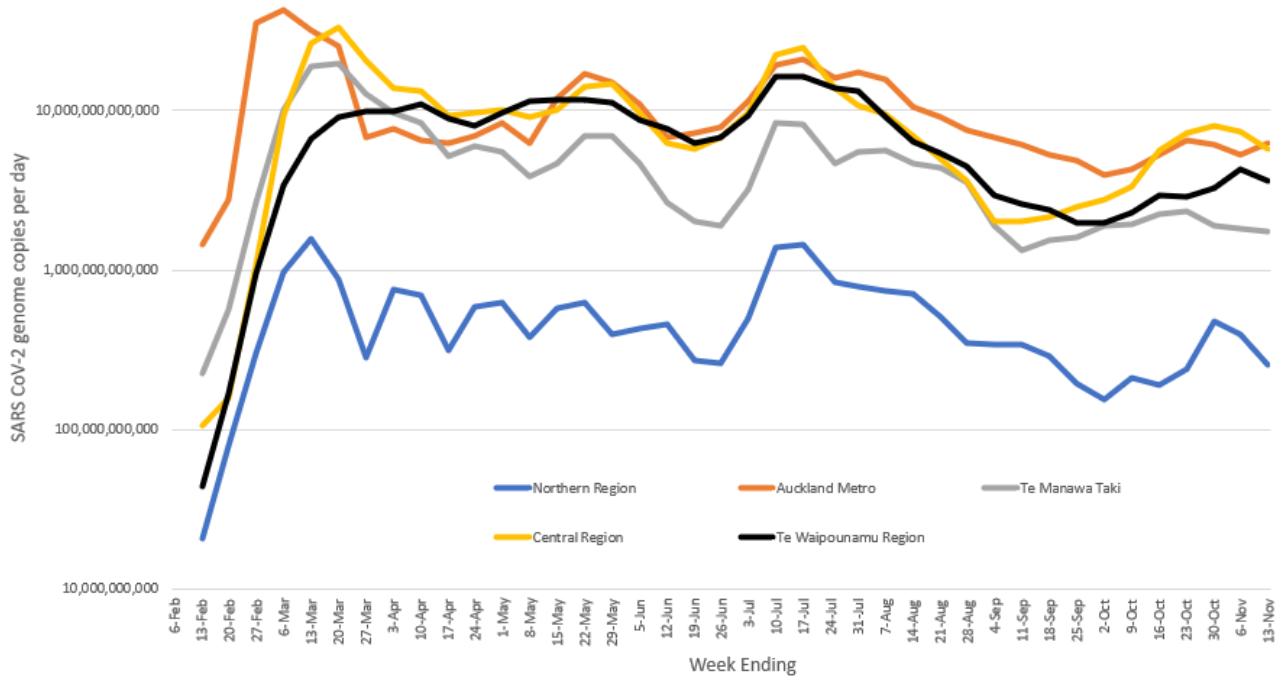


Figure 3. Total SARS-CoV-2 genome copies detected per day in the five Ministry of Health regions (Rolling two-week average).

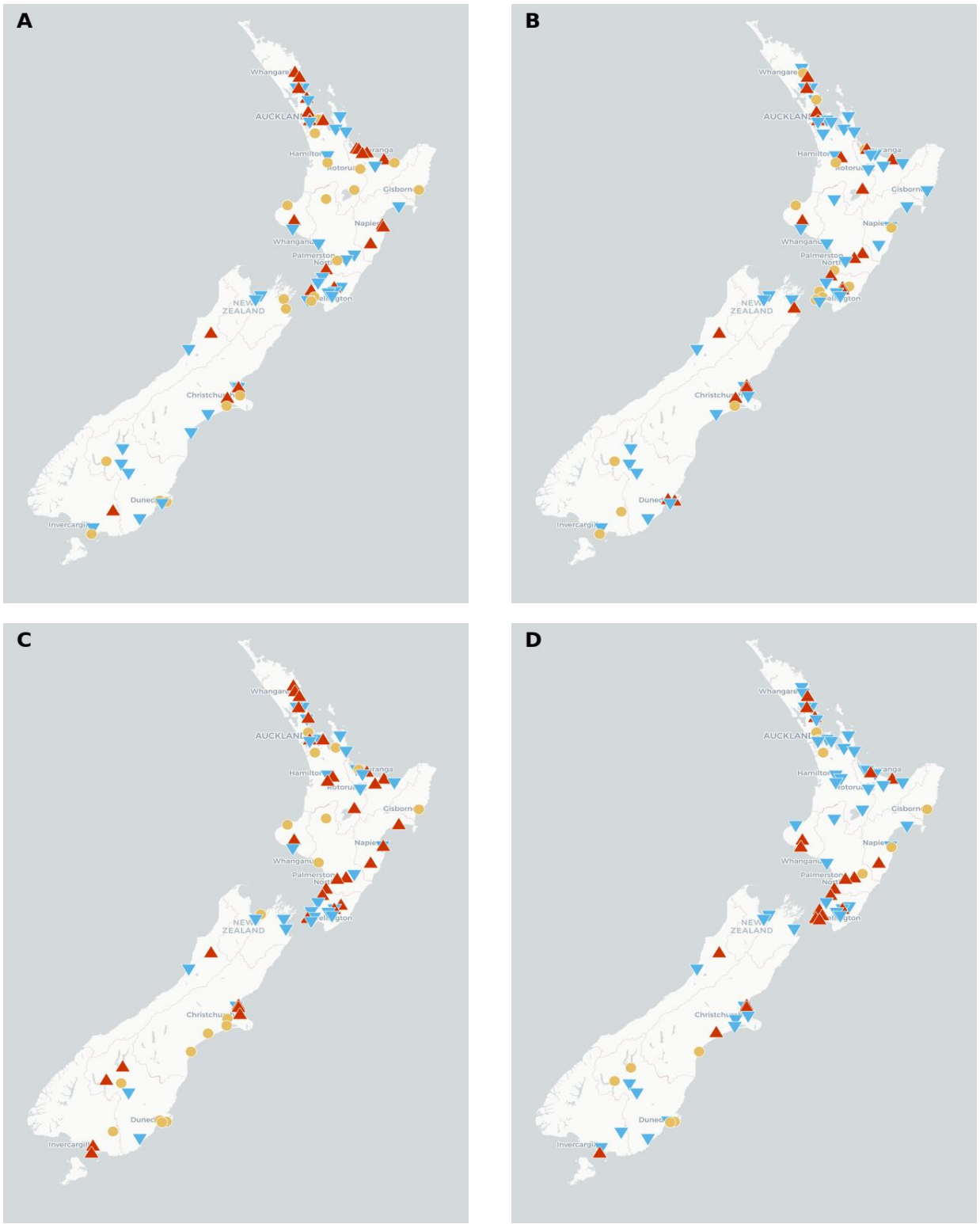


Figure 4. Comparison of SARS-CoV-2 levels for the week ending 13 November 2022, compared to levels measured: A) 1 week ago; B) 2 weeks ago; C) 4 weeks ago; D) 12 weeks ago. Only sites with results for both time points are included. When the viral quantity is 30% or more higher this is labelled as increased (red up arrow on map). When the viral quantity is 30% or more lower, this is labelled as decreased (blue down arrow on map). If viral levels have changed less than this in the compared weeks, this is labelled as no change (yellow circle on map). Interactive map of weekly results available publicly at https://www.esr.cri.nz/our-expertise/covid-19-response/wastewater-testing-results.

Wastewater Variant Analysis

In collaboration with Wilderlab, ESR generated the variant analysis results (Figure 5) from a set of nationwide sentinel sites in: Week 44 (ending 6 November) and Week 45 (ending 13 November).

Consistent with the WGS of clinical cases, BA.4/5 continue to be the dominant SARS-CoV-2 detected across Aotearoa (national average of 66%). However, in recent weeks, other (sub)variants are being detected. There have been increased detections of BA.2.75 and BQ.1.1 in wastewater - consistent with WGS results from clinical samples. Following the first detection of the XBB variant in wastewater in week 42, this variant was again detected at three sites.

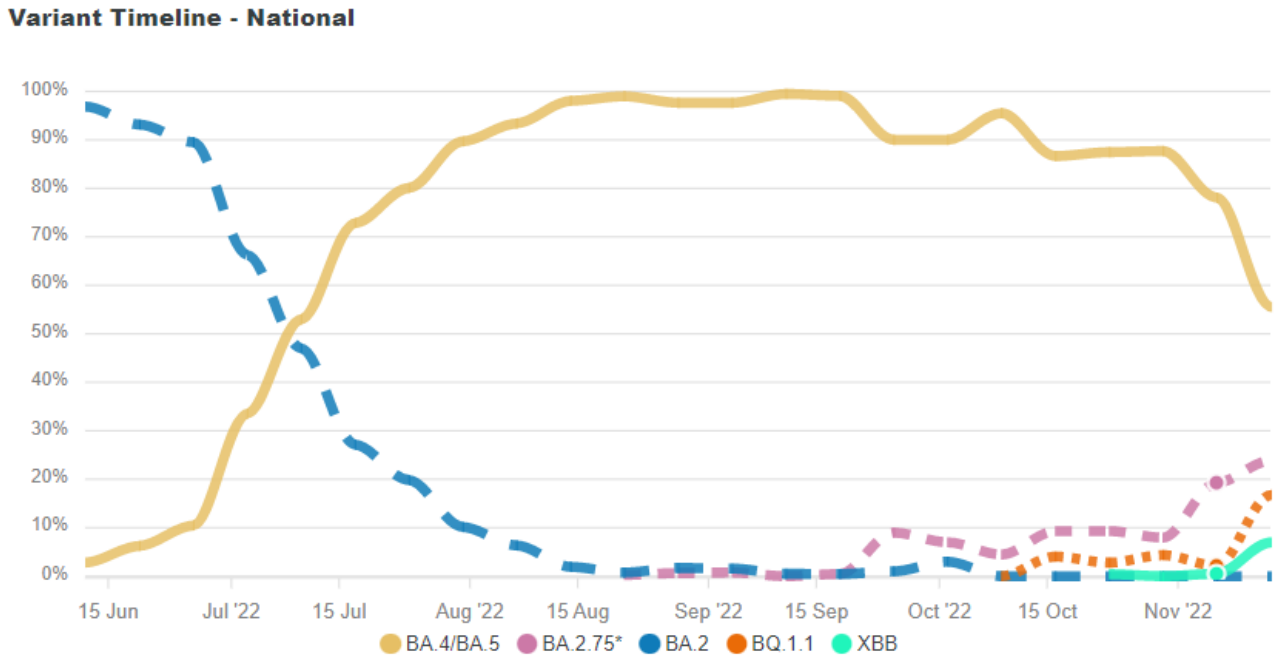
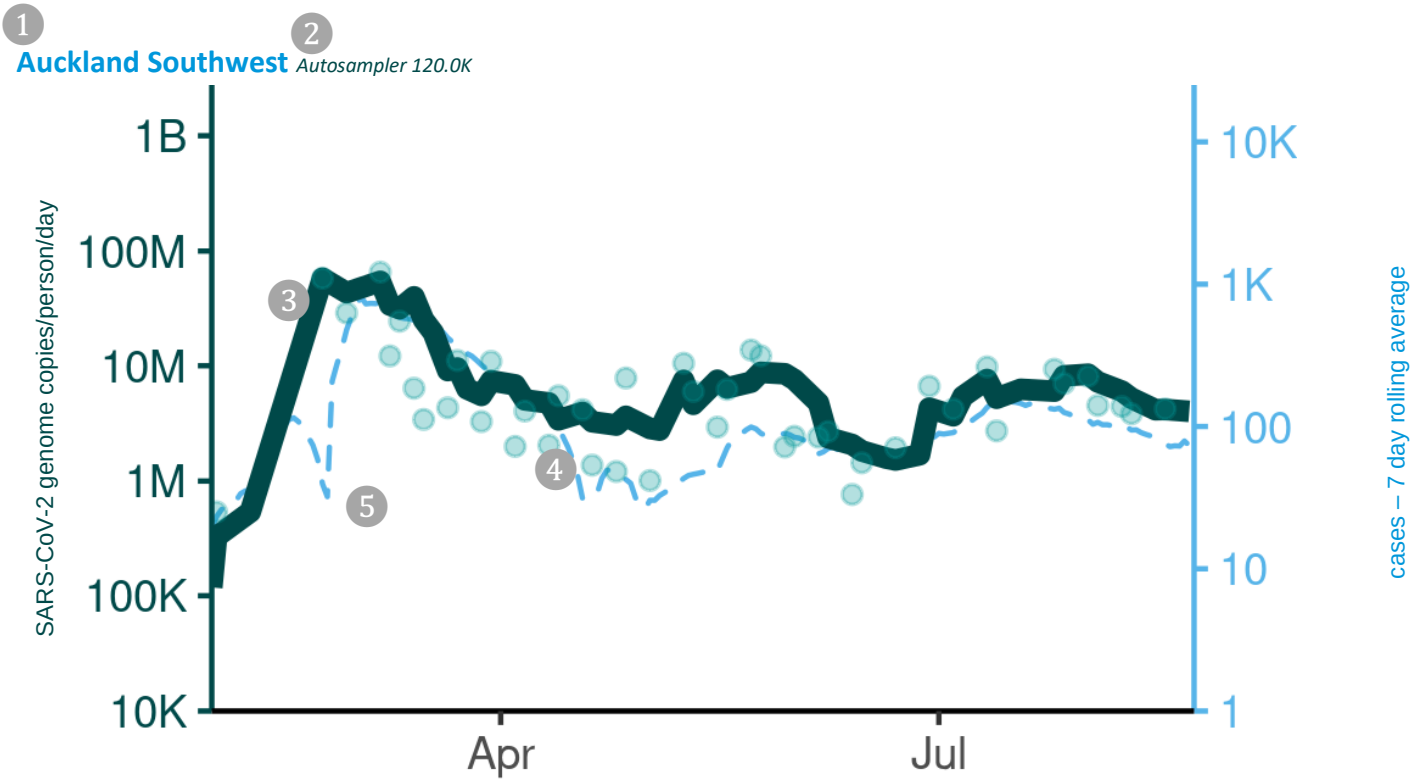


Figure 5. Variant prevalence over time at a national scale. Data are collected from up to 20 sentinel sites each week

Interpreting Sites Graphs



1 Site Name

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

3 Wastewater results shown as solid line | 14-day average of genome copies/person/day on a $\log_{10}$ scale.

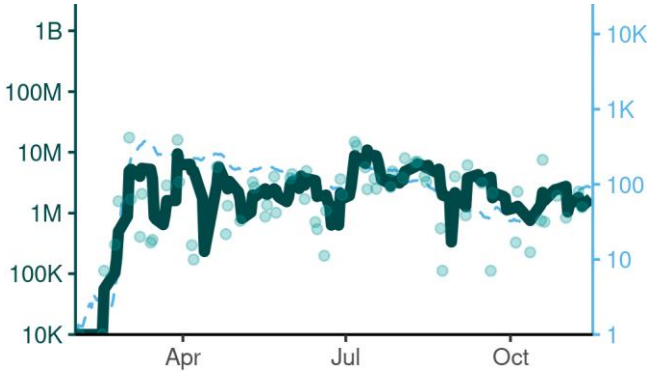
4 Individual results samples shown as circles | Rolling 14-day average of genome copies/person/day on a $\log_{10}$ scale.

5 Rolling 7-day average of new cases shown as dashed line | New cases reported in a catchment based on reported date of illness on a $\log_{10}$ scale. This data is not available for all sites and subject to change.

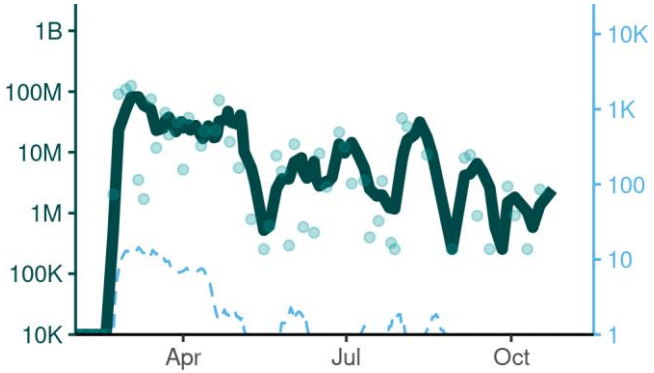
Note: Wastewater and cases data are on a $\log_{10}$ scale. Scales on all graphs have been normalized to cover the same scale on every graph. Care should be taken when interpreting the data.

Northland

Whangarei *Autosampler 65.0K*

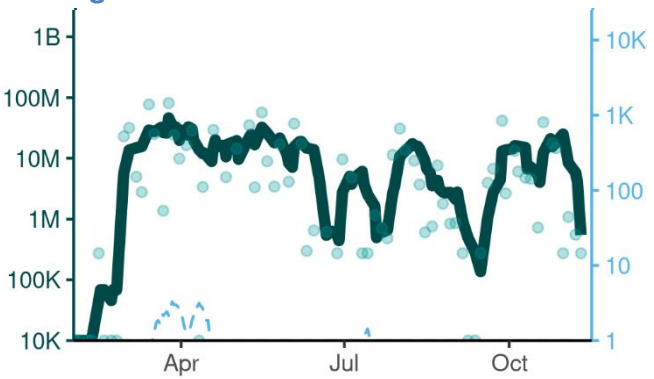


Dargaville *Grab 5.0K*

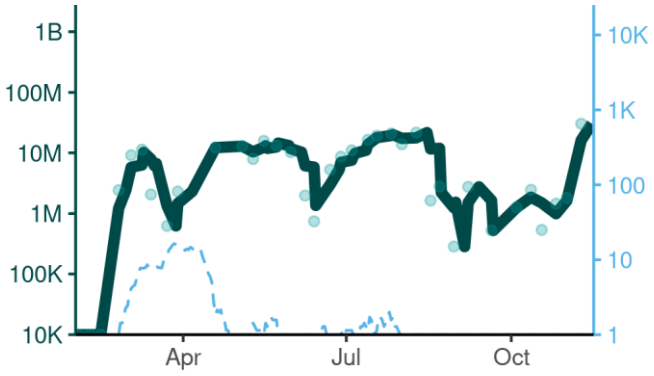


SARS-CoV-2 genome copies / day / person

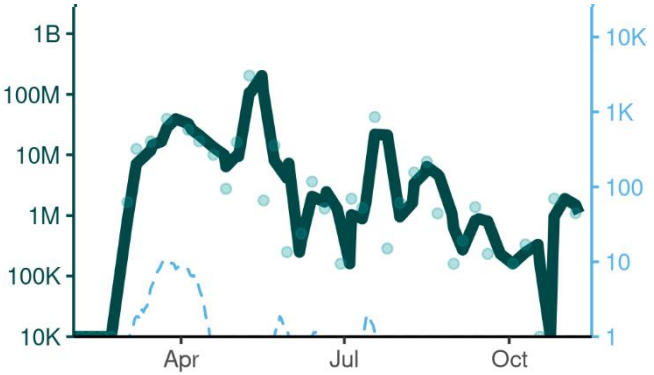
Maungaturoto *Grab 1.3K*



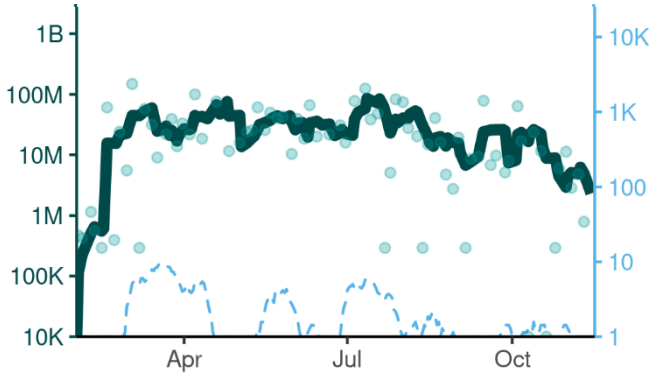
Ruakaka *Grab 4.5K*



Hikurangi *Grab 1.7K*

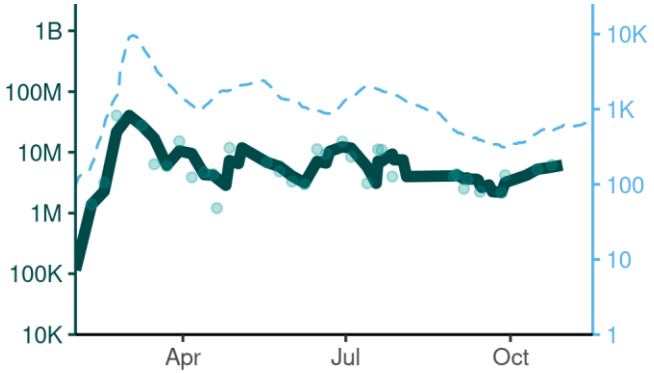


Mangawhai *Grab 1.1K*

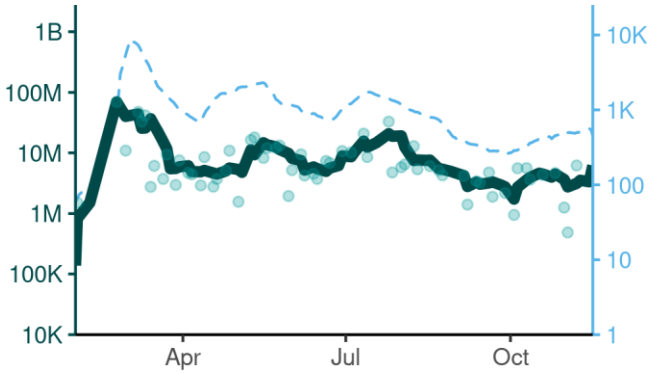


Auckland

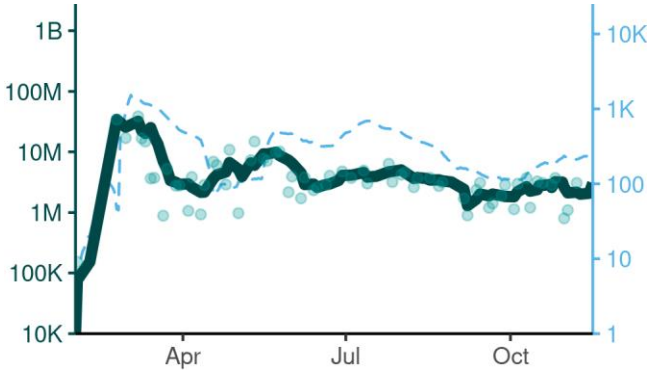
Auckland (Combined) *Autosampler 1.1M*



Auckland East *Autosampler 680.0K*

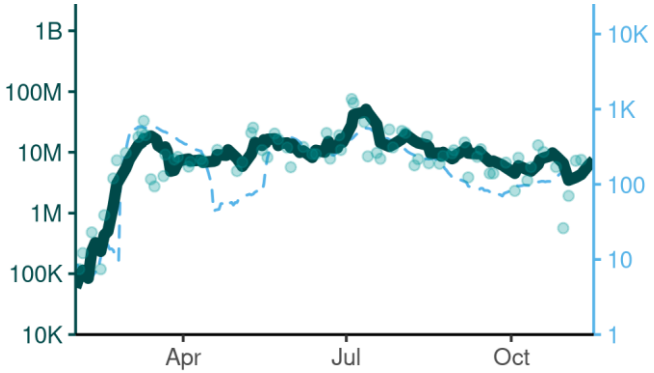


Auckland West *Autosampler 315.0K*

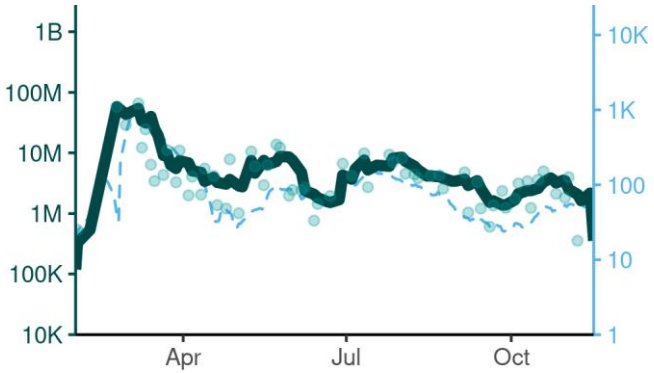


SARS-CoV-2 genome copies / day / person

North Shore *Autosampler 240.0K*

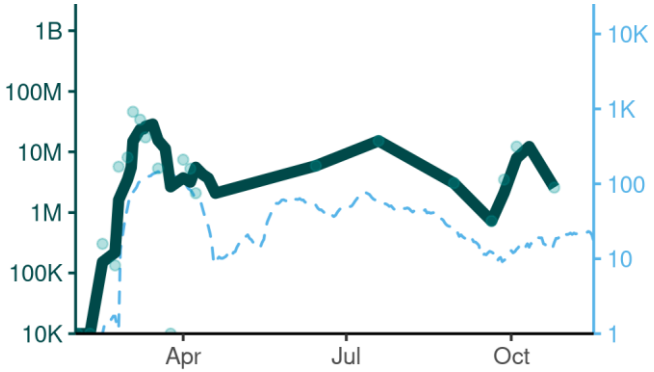


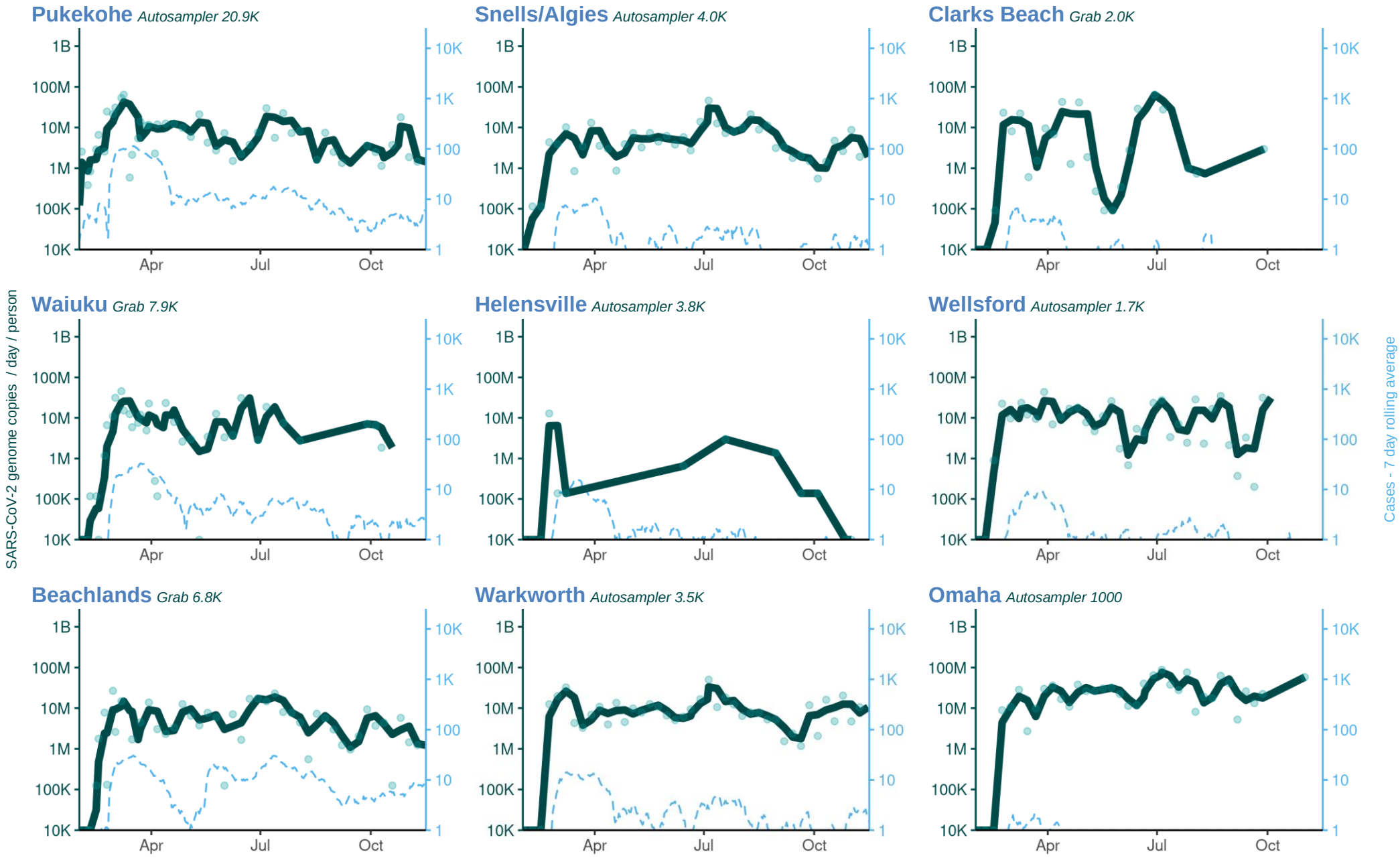
Auckland Southwest *Autosampler 120.0K*



Cases - 7 day rolling average

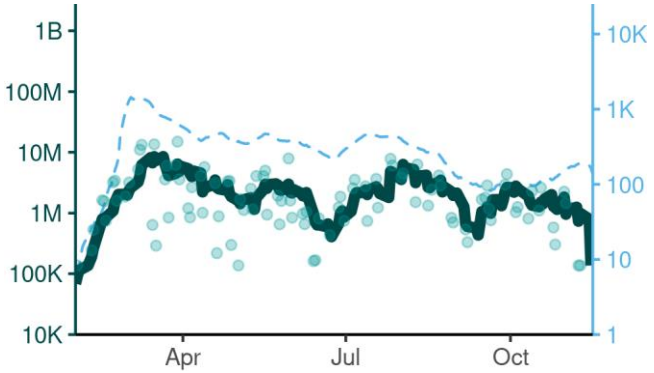
Army Bay *Autosampler 42.0K*



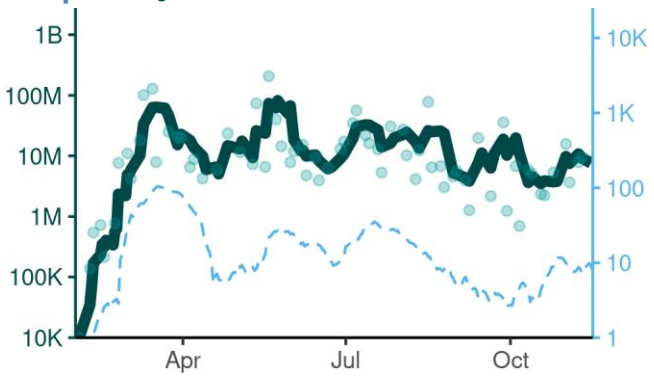

Pukekohe Autosampler 20.9K
Snells/Algies Autosampler 4.0K
Clarks Beach Grab 2.0K
Waiuku Grab 7.9K
Helensville Autosampler 3.8K
Wellsford Autosampler 1.7K
Beachlands Grab 6.8K
Warkworth Autosampler 3.5K
Omaha Autosampler 1000
SARS-CoV-2 genome copies / day / person
Cases - 7 day rolling average
1B
100M
10M
1M
100K
10K
1K
100
10
1
Apr
Jul
Oct

Waikato

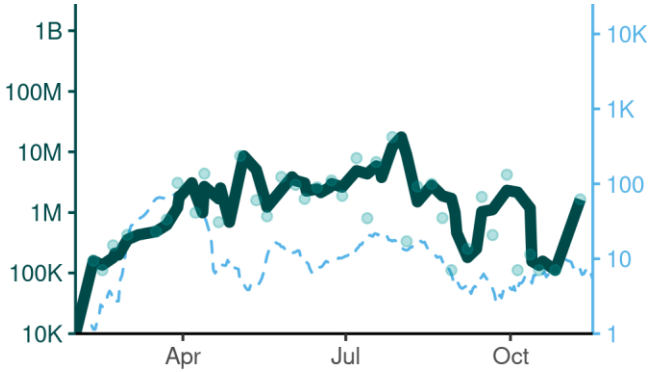
Hamilton *Autosampler 169.0K*



Taupo *Auto/grab 23.0K*

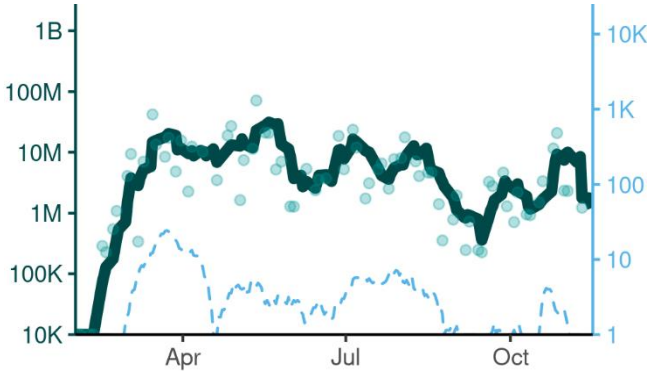


Cambridge *Autosampler 20.1K*

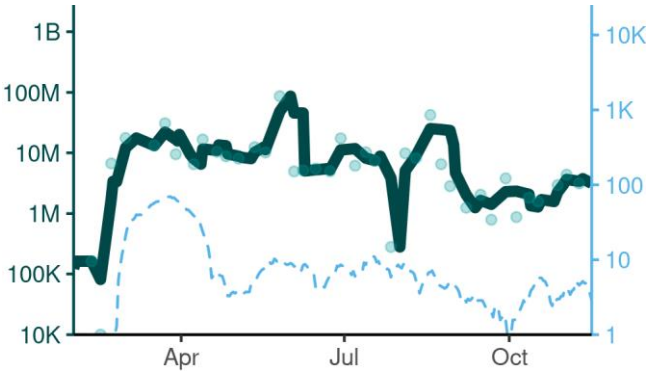


SARS-CoV-2 genome copies / day / person

Thames *Autosampler 7.5K*

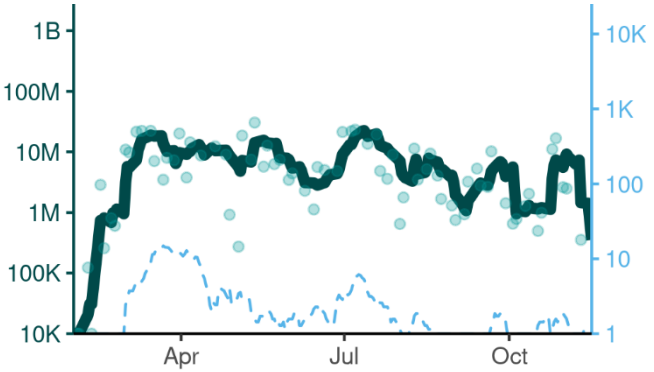


Te Awamutu *Autosampler 13.1K*

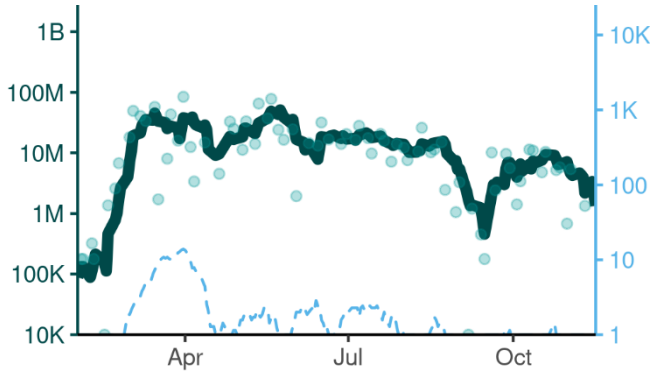


Cases - 7 day rolling average

Whitianga *Autosampler 6.6K*



Whangamata *Autosampler 4.0K*

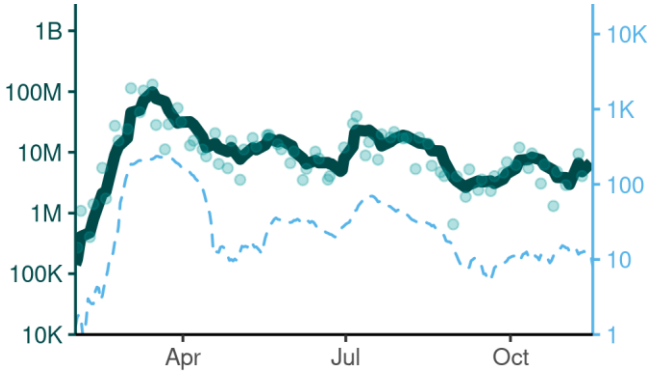


SARS-CoV-2 genome copies / day / person

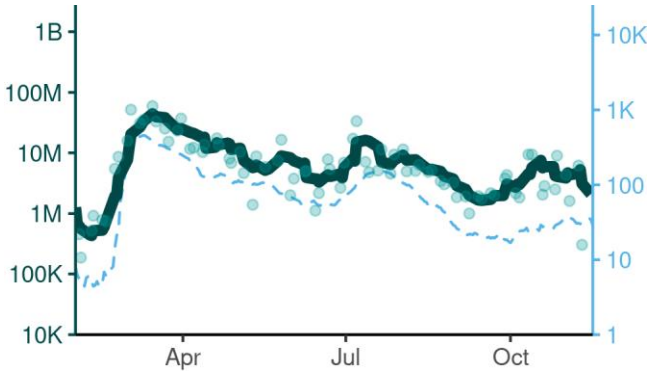
Cases - 7 day rolling average

Bay of Plenty and Gisborne

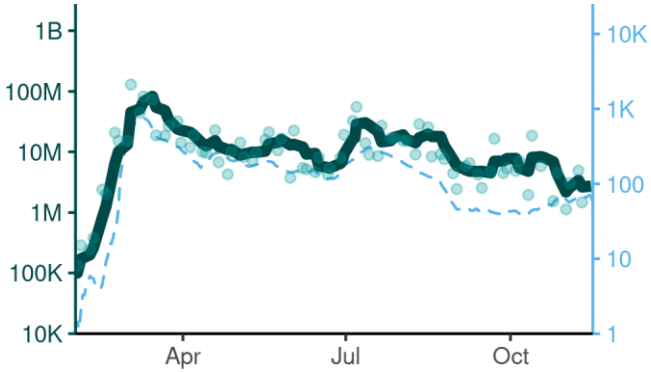
Mt Maunganui/Papamoa *Autosampler 65.0K*



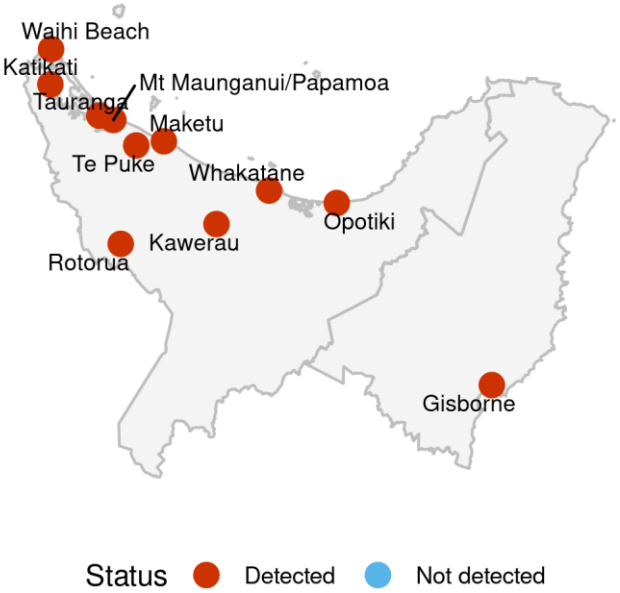
Rotorua *Autosampler 59.0K*



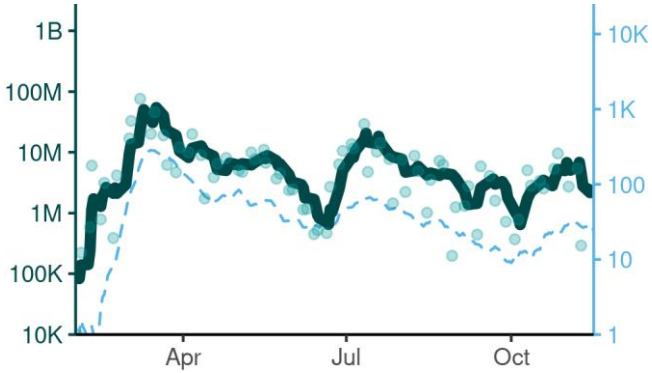
Tauranga *Autosampler 50.0K*



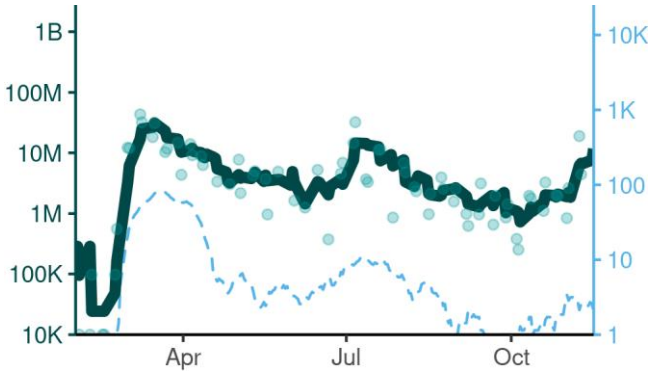
SARS-CoV-2 genome copies / day / person



Gisborne *Autosampler 37.0K*

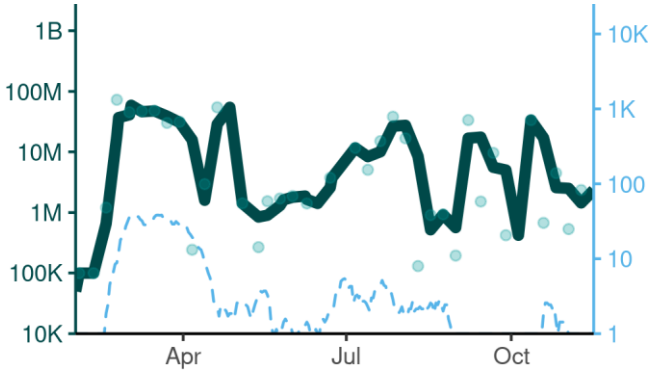


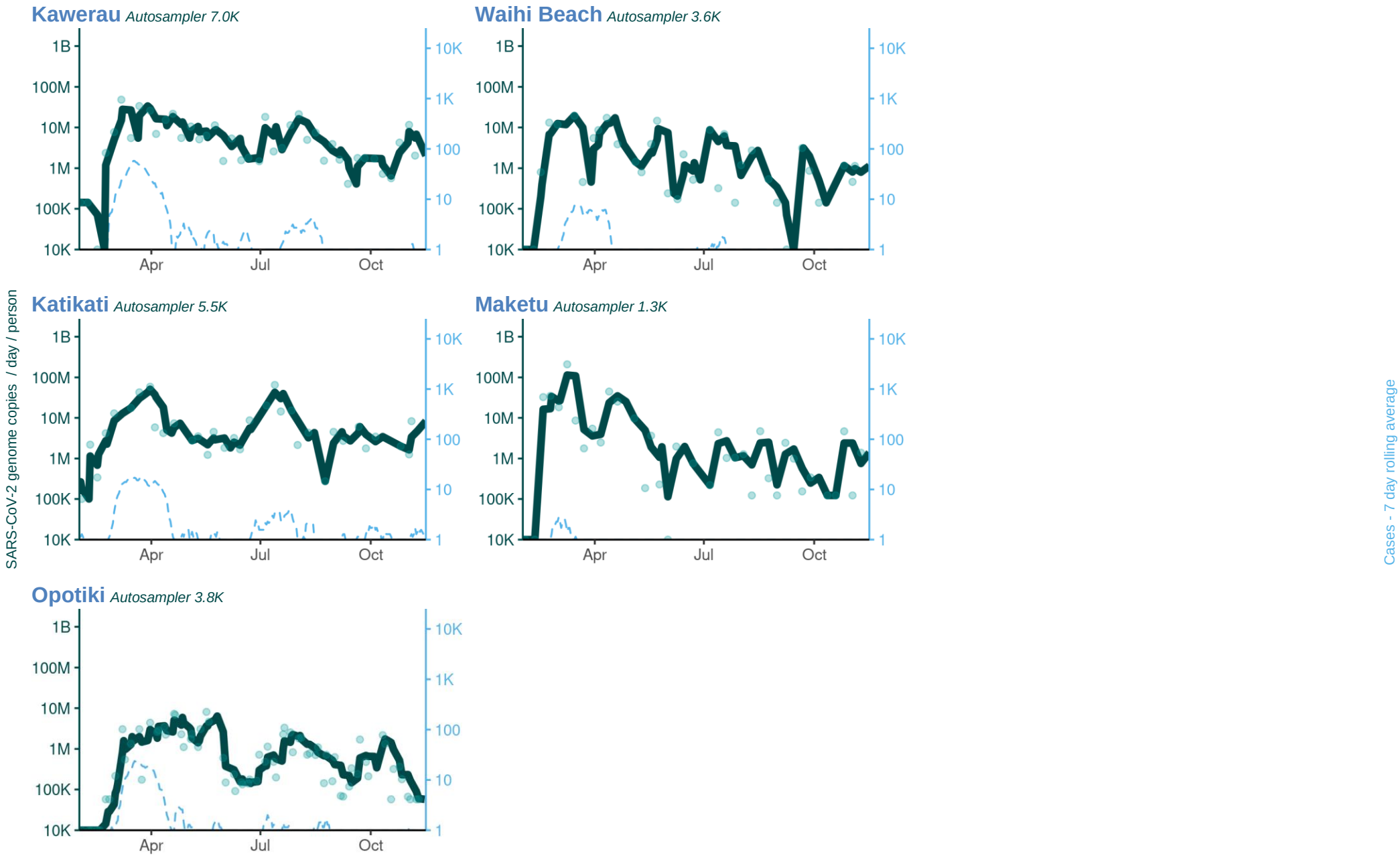
Whakatane *Autosampler 21.0K*



Cases - 7 day rolling average

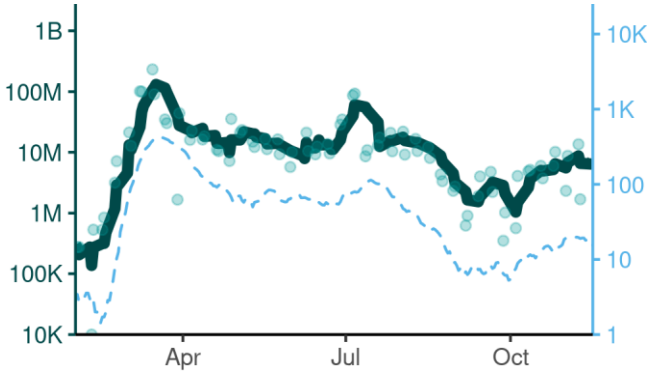
Te Puke *Autosampler 9.7K*



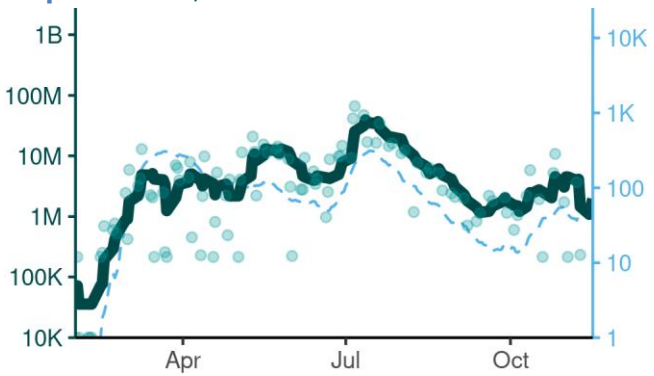

Kawerau Autosampler 7.0K
Waihi Beach Autosampler 3.6K
Katikati Autosampler 5.5K
Maketu Autosampler 1.3K
Opotiki Autosampler 3.8K
SARS-CoV-2 genome copies / day / person
Cases - 7 day rolling average
1B
100M
10M
1M
100K
10K
10K
1K
100
10
1
Apr
Jul
Oct

Hawke's Bay

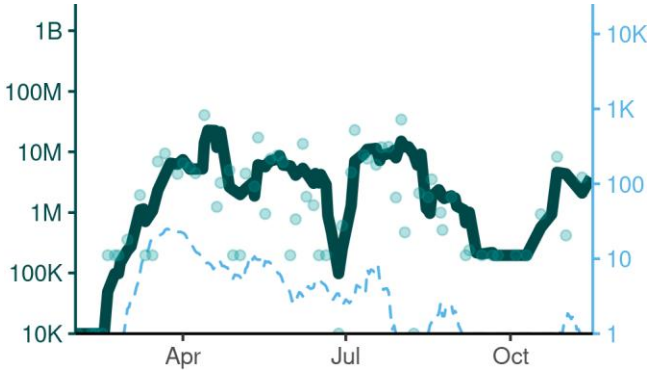
Hastings *Autosampler 80.0K*



Napier *Autosampler 55.0K*

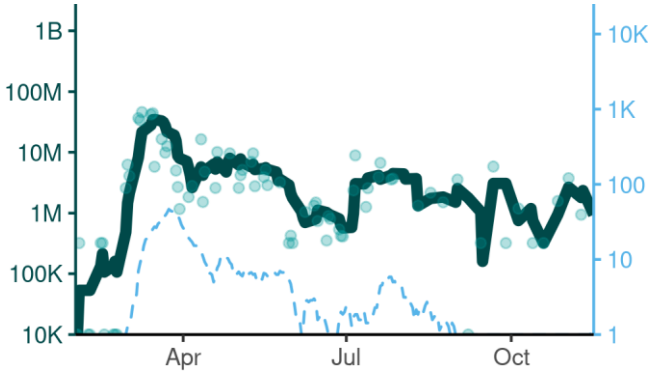


Waipukurau *Autosampler 4.6K*

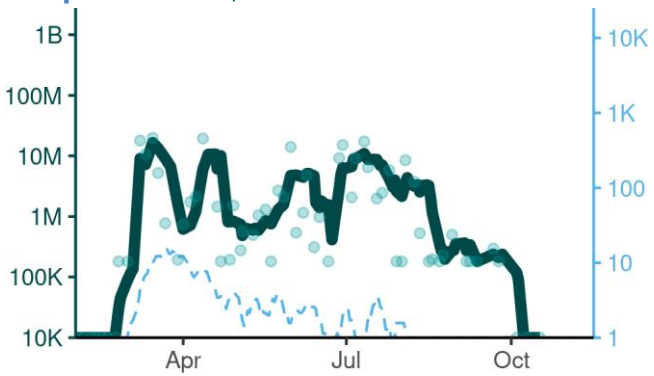


SARS-CoV-2 genome copies / day / person

Wairoa *Grab 4.4K*



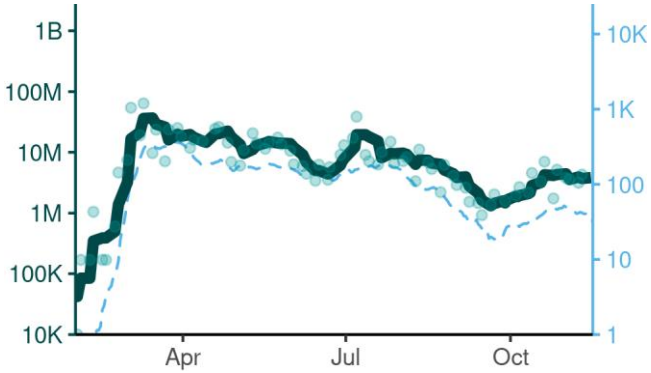
Waipawa *Autosampler 2.2K*



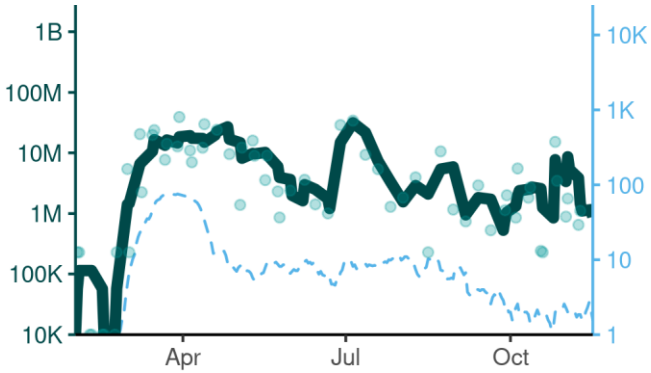
Cases - 7 day rolling average

Taranaki

New Plymouth *Autosampler 88.0K*

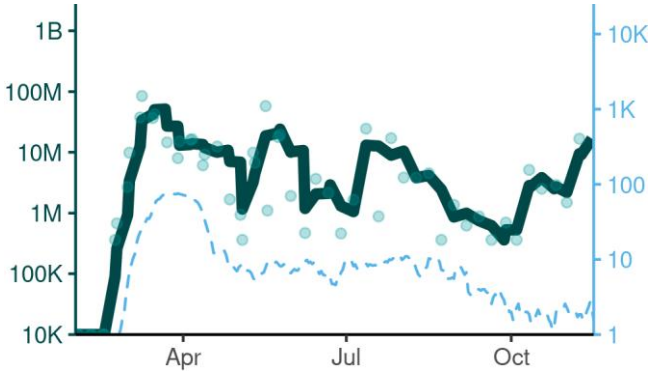


Hawera *Autosampler 12.0K*

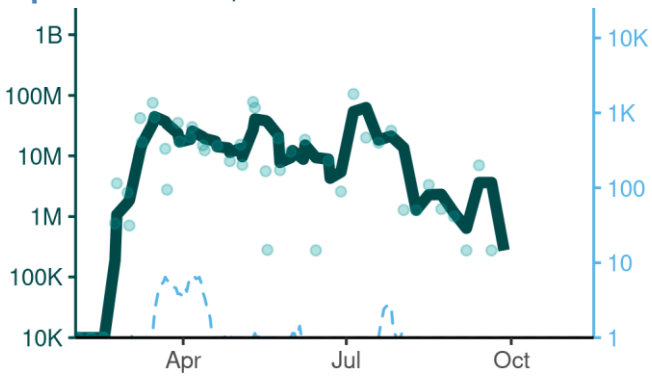


SARS-CoV-2 genome copies / day / person

Eltham *Autosampler 2.0K*

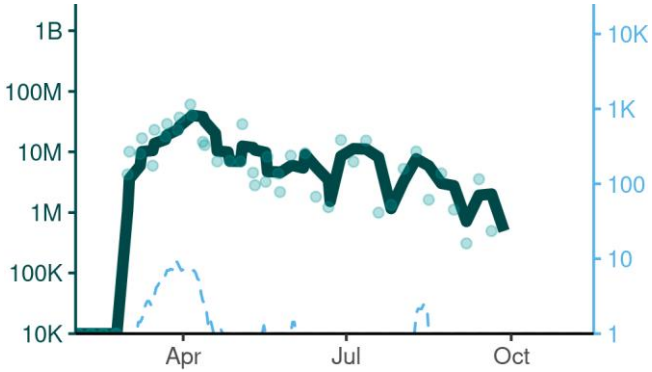


Opunake *Autosampler 1.4K*



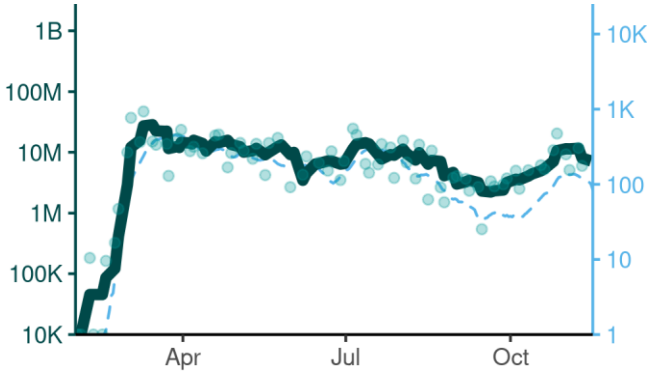
Cases - 7 day rolling average

Patea *Autosampler 1.2K*

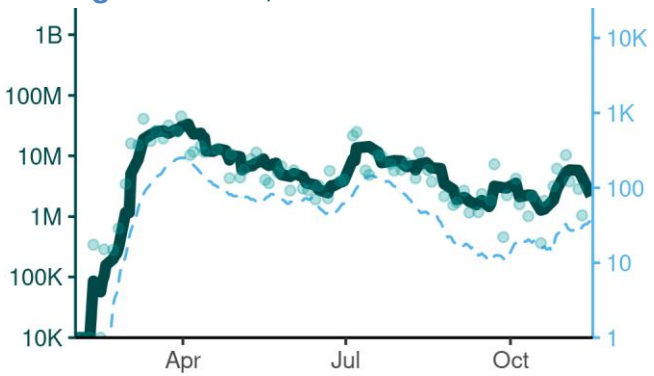


Manawatu-Whanganui

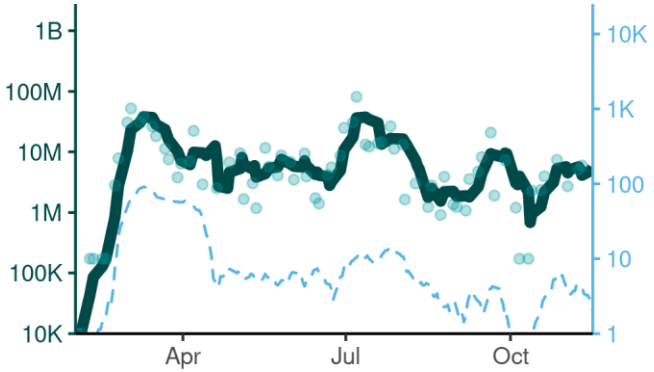
Palmerston North *Autosampler 90.0K*



Whanganui *Autosampler 44.5K*

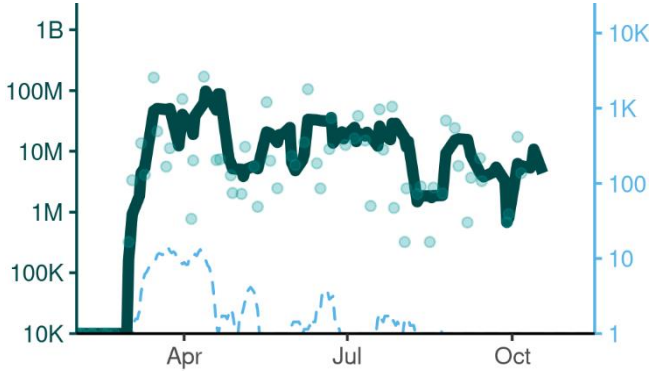


Levin *Autosampler 21.2K*

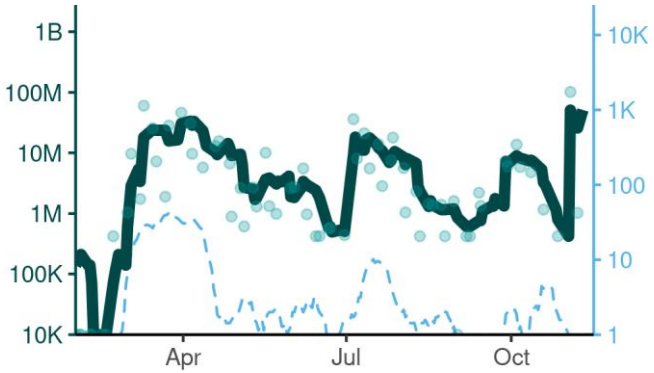


SARS-CoV-2 genome copies / day / person

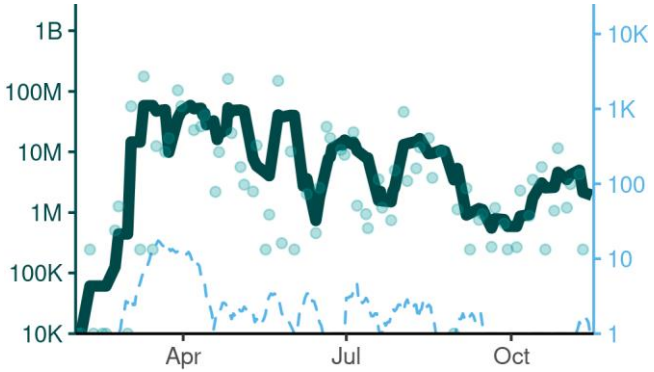
Pahiatua *Grab 2.8K*



Dannevirke *Grab 5.7K*

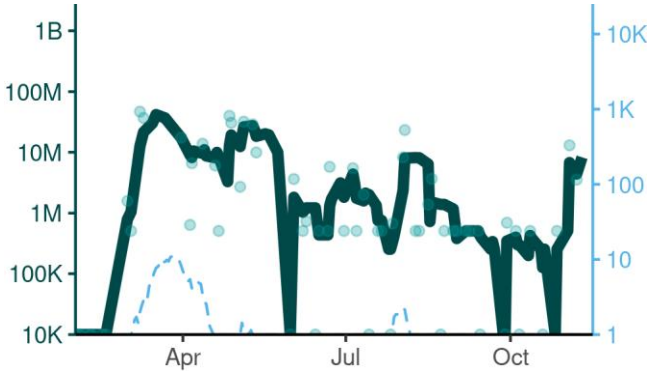


Taumarunui *Grab 4.0K*

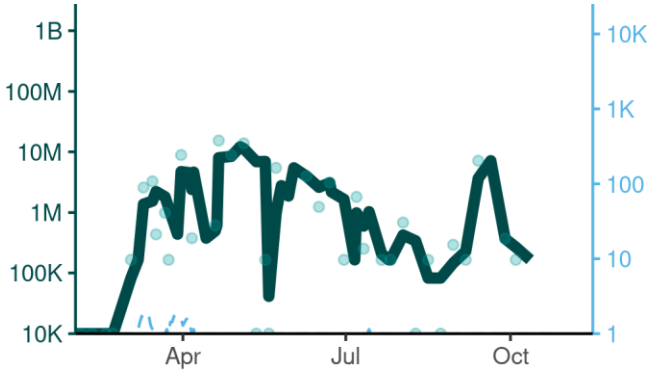


Cases - 7 day rolling average

Woodville *Grab 1.7K*



Eketahuna *Grab 1.6K*

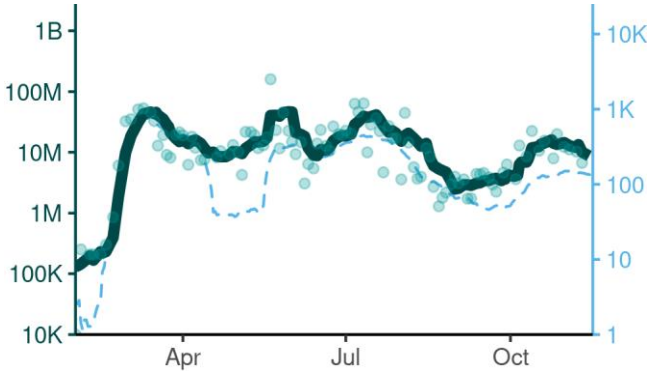


SARS-CoV-2 genome copies / day / person

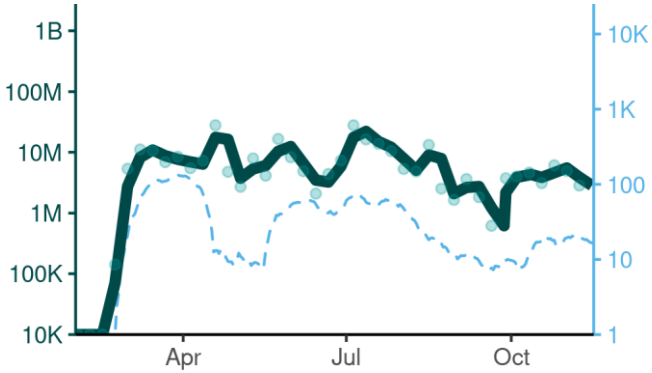
Cases - 7 day rolling average

Wellington

Wellington (Moa Point) *Autosampler 168.0K*

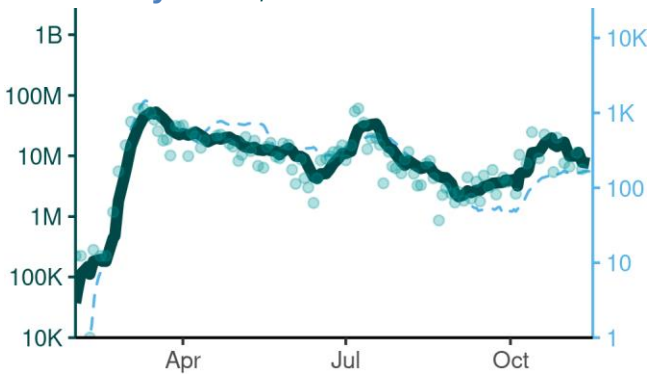


Paraparaumu *Autosampler 49.0K*

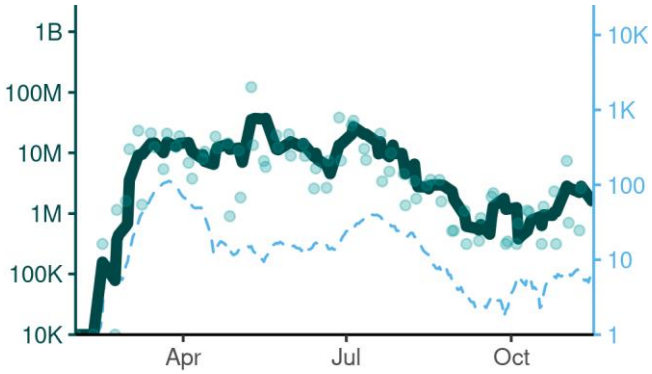


SARS-CoV-2 genome copies / day / person

Hutt Valley *Autosampler 133.0K*

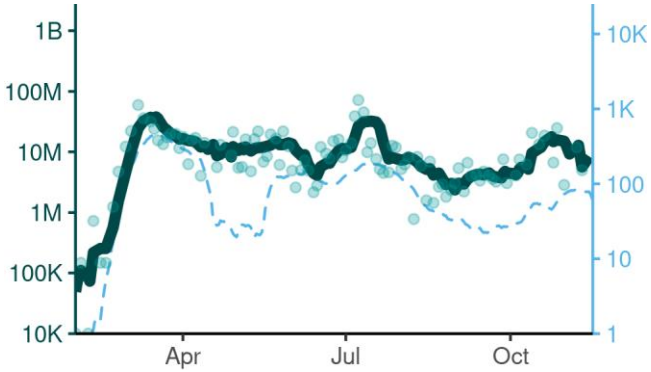


Masterton *Auto/grab 20.7K*

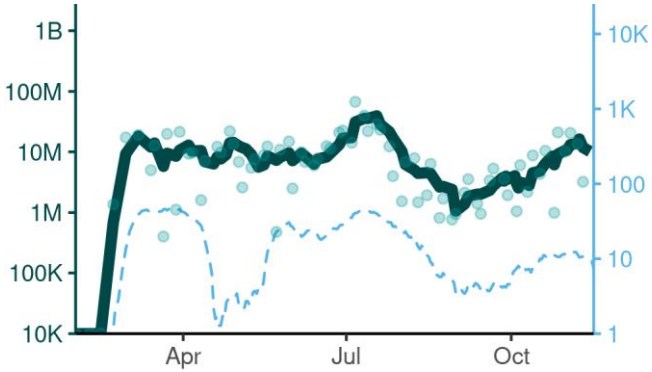


Cases - 7 day rolling average

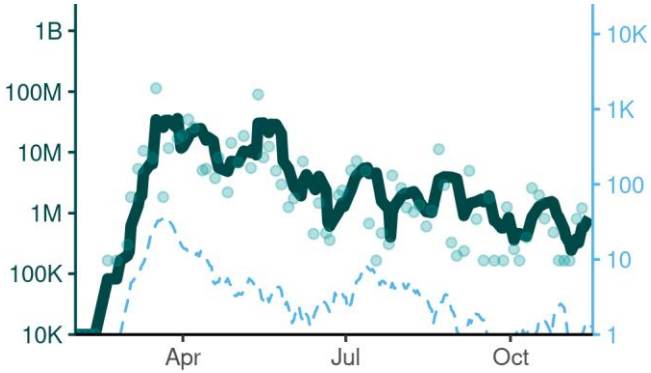
Porirua *Autosampler 85.0K*



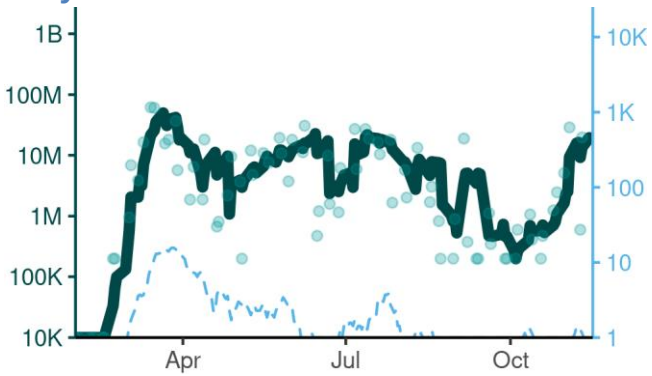
Wellington (Western) *Autosampler 14.0K*



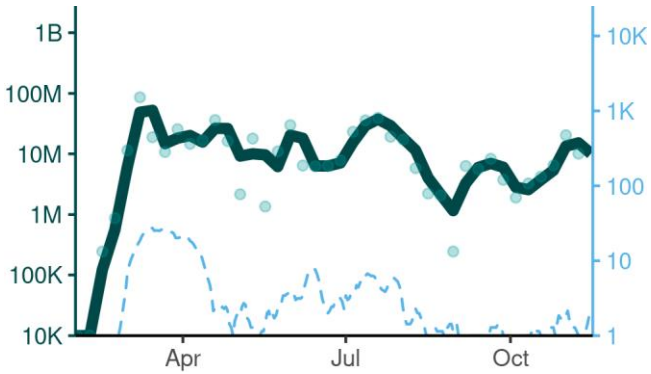
Carterton *Grab 5.8K*



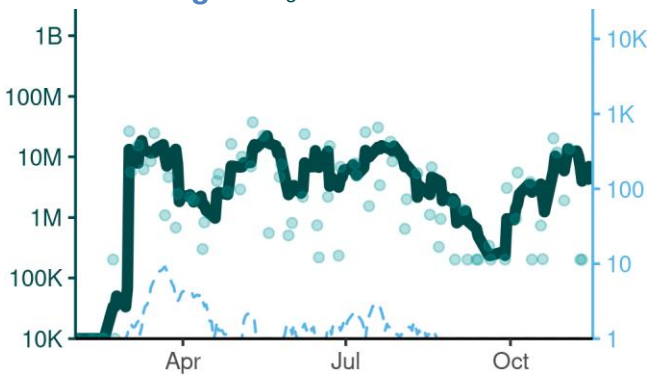
Greytown *Grab 2.4K*



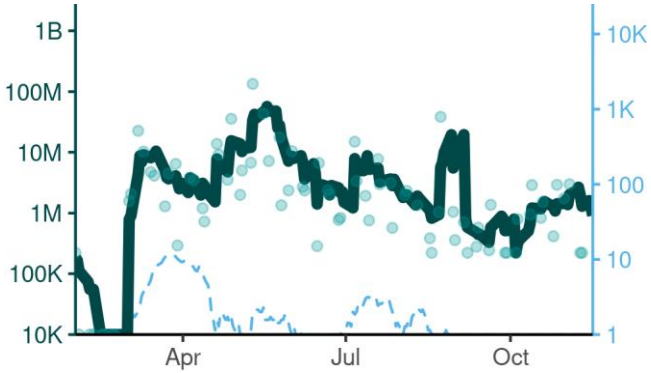
Otaki *Autosampler 3.5K*



Martinborough *Auto/grab 1.6K*



Featherston *Grab 2.5K*

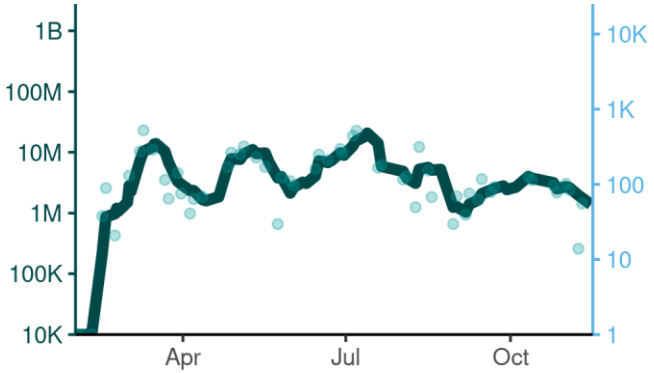


SARS-CoV-2 genome copies / day / person

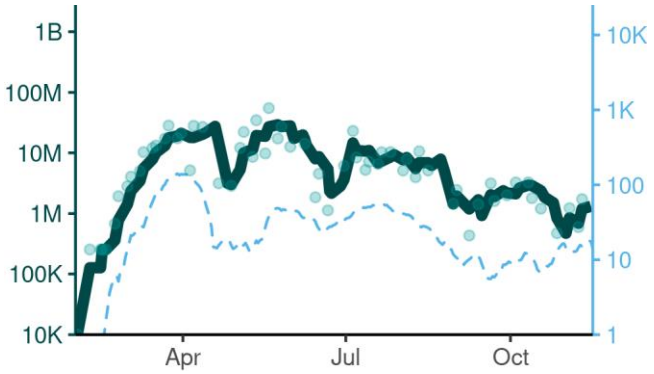
Cases - 7 day rolling average

Tasman, Nelson, and Marlborough

Richmond/Nelson South *Autosampler 60.0K*

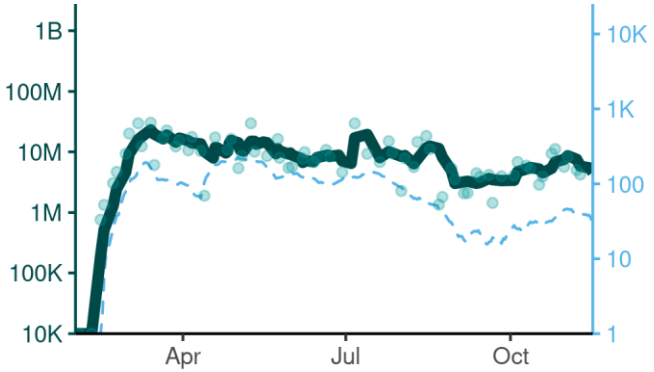


Blenheim *Autosampler 31.0K*

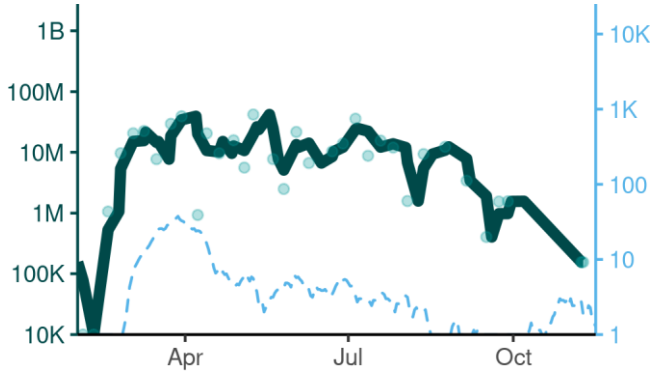


SARS-CoV-2 genome copies / day / person

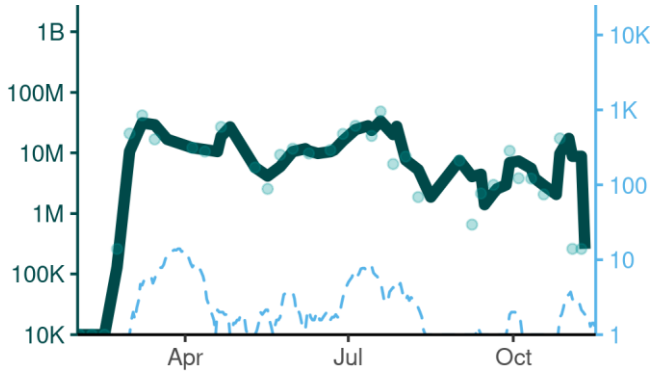
Nelson Central/North *Autosampler 26.0K*



Motueka *Autosampler 8.3K*



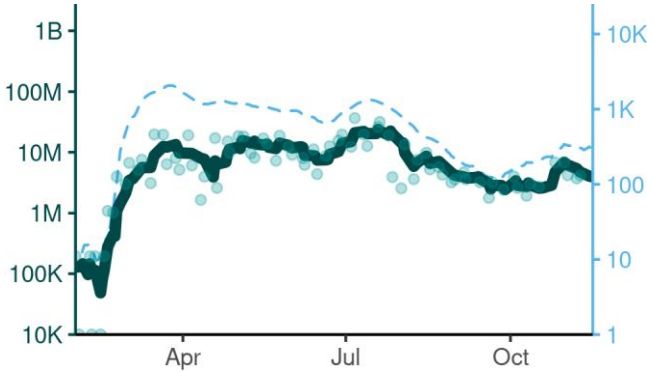
Picton *Autosampler 5.0K*



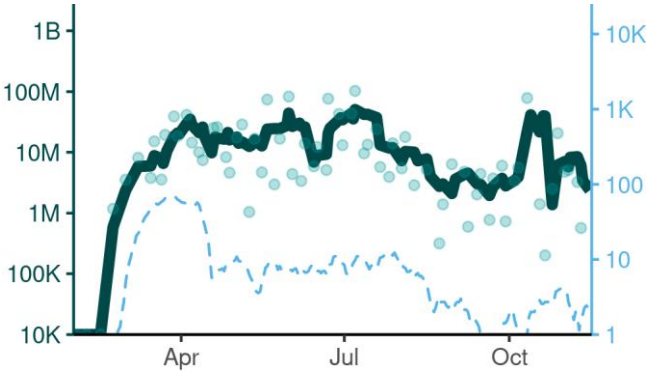
Cases - 7 day rolling average

West Coast and Canterbury

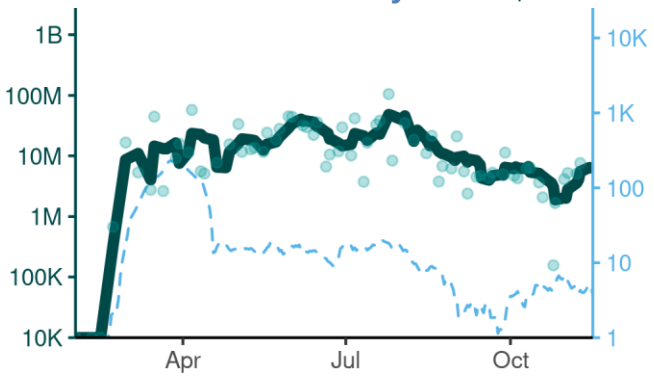
Christchurch *Autosampler 368.0K*



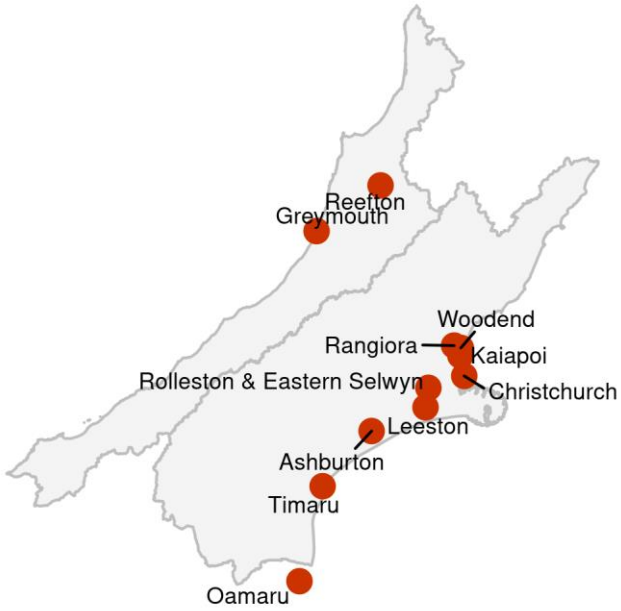
Rangiora *Grab 19.0K*



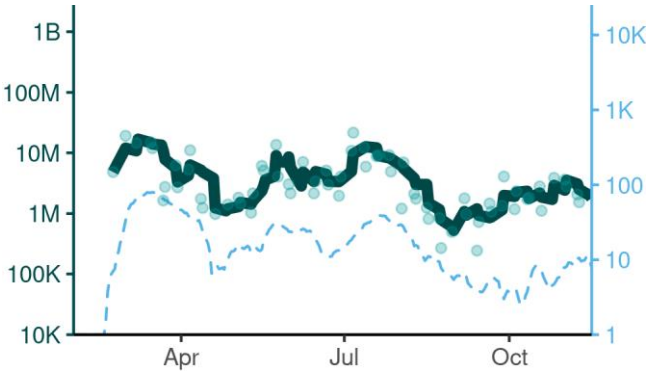
Rolleston & Eastern Selwyn *Autosampler 35.0K*



SARS-CoV-2 genome copies / day / person

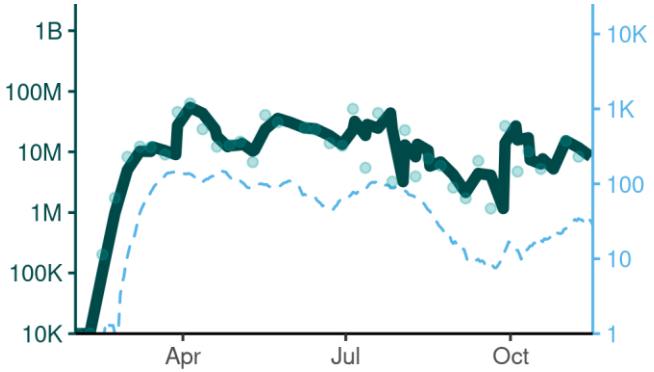


Ashburton *Autosampler 18.0K*

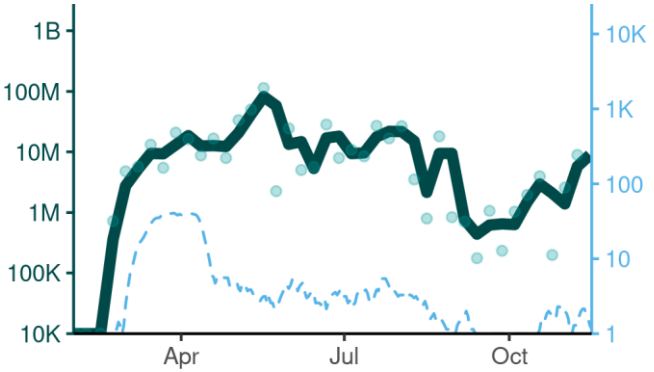


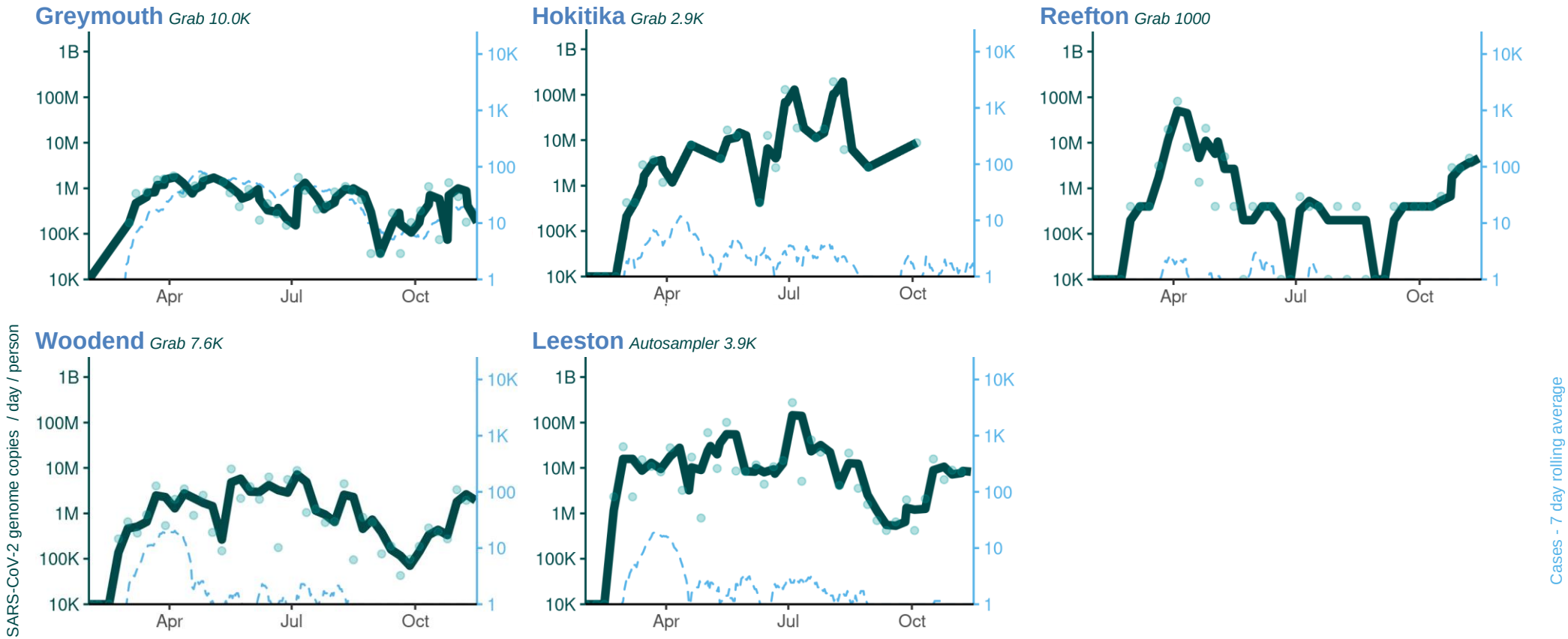
Cases - 7 day rolling average

Timaru *Autosampler 28.0K*



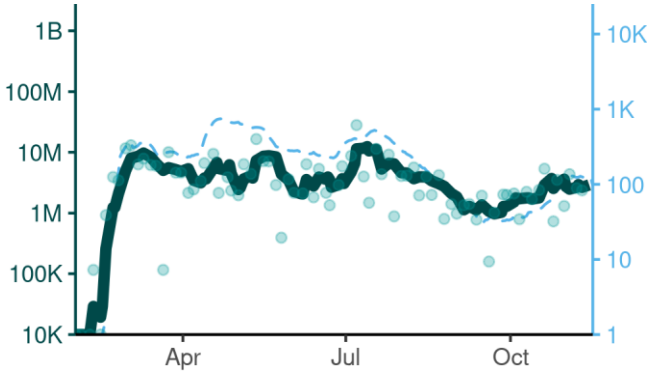
Kaiapoi *Grab 12.5K*



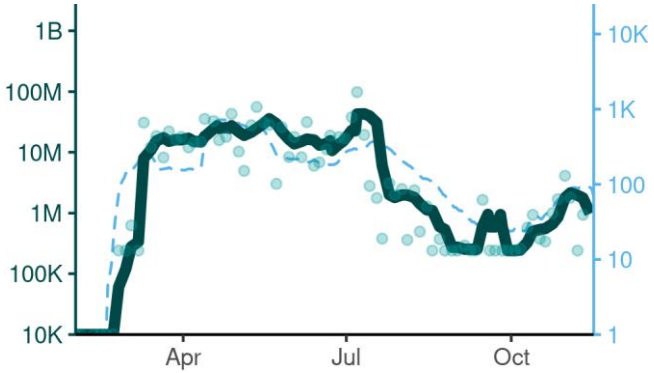

Greymouth Grab 10.0K
Hokitika Grab 2.9K
Reefton Grab 1000
Woodend Grab 7.6K
Leeston Autosampler 3.9K
SARS-CoV-2 genome copies / day / person
Cases - 7 day rolling average
1B
100M
10M
1M
100K
10K
1K
100
10
1
Apr
Jul
Oct

Otago and Southland

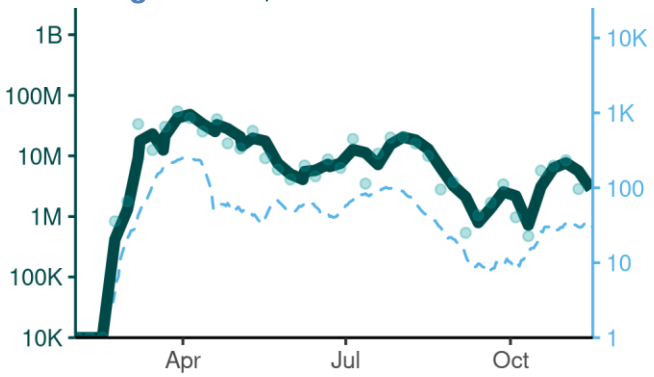
Dunedin (Tahuna) *Autosampler 84.0K*



Dunedin (Green Island) *Autosampler 22.9K*

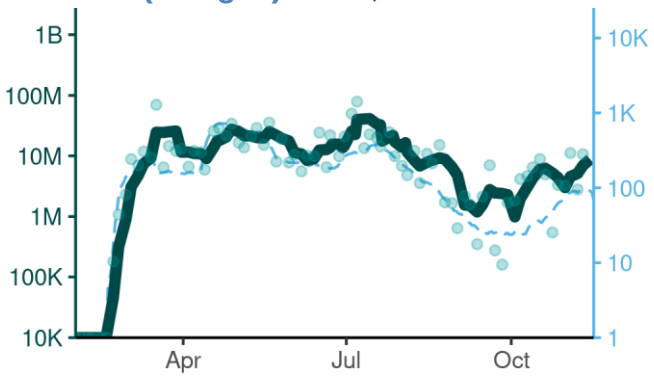


Invercargill *Autosampler 50.0K*



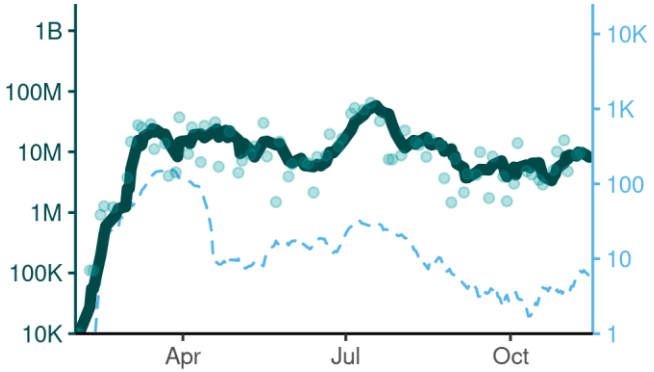
SARS-CoV-2 genome copies / day / person

Dunedin (Mosgiel) *Autosampler 14.6K*

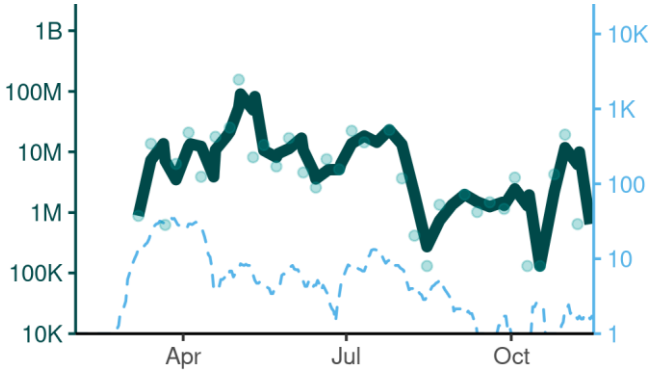


Cases - 7 day rolling average

Queenstown *Autosampler 40.0K*



Wanaka *Grab 14.5K*



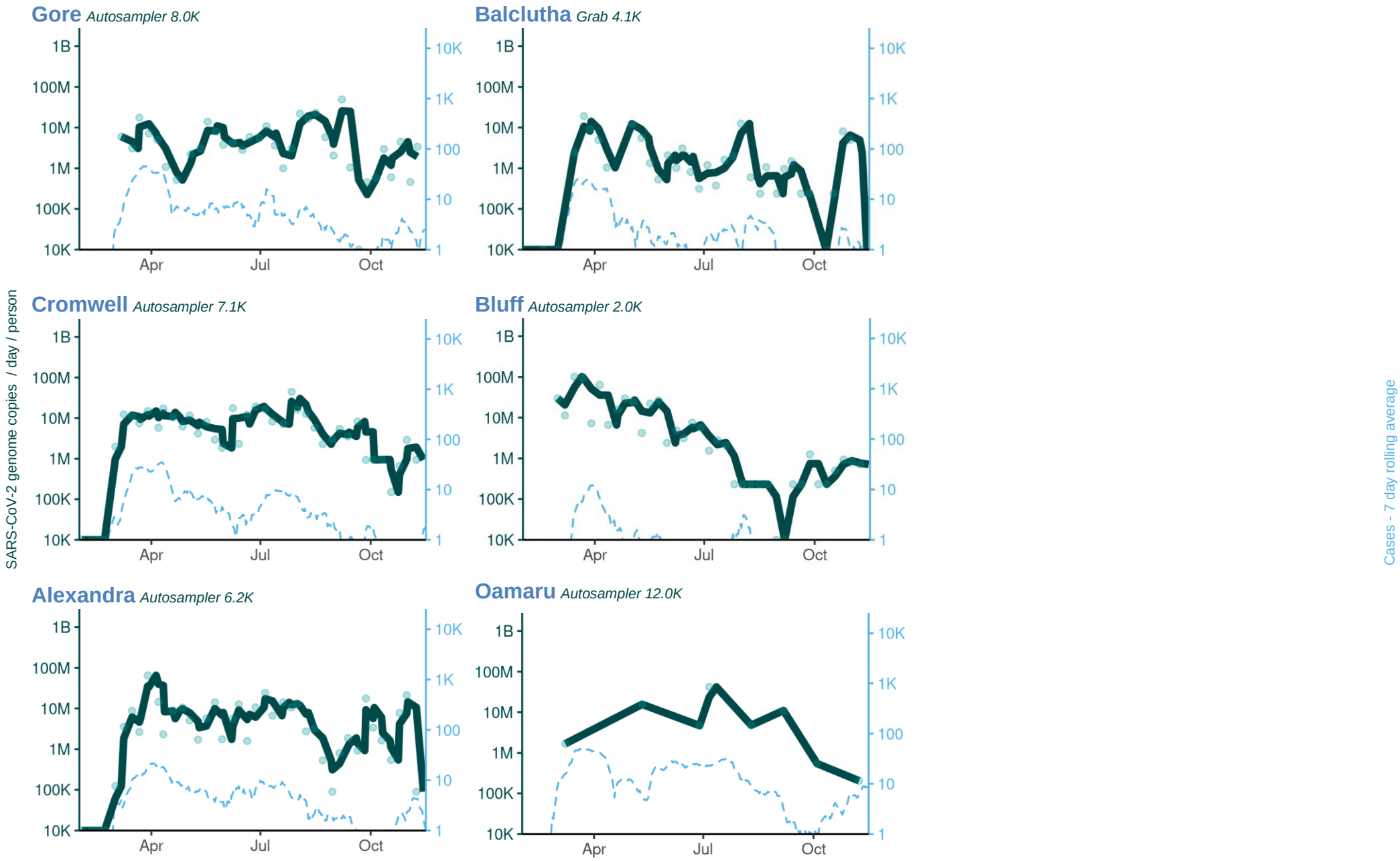
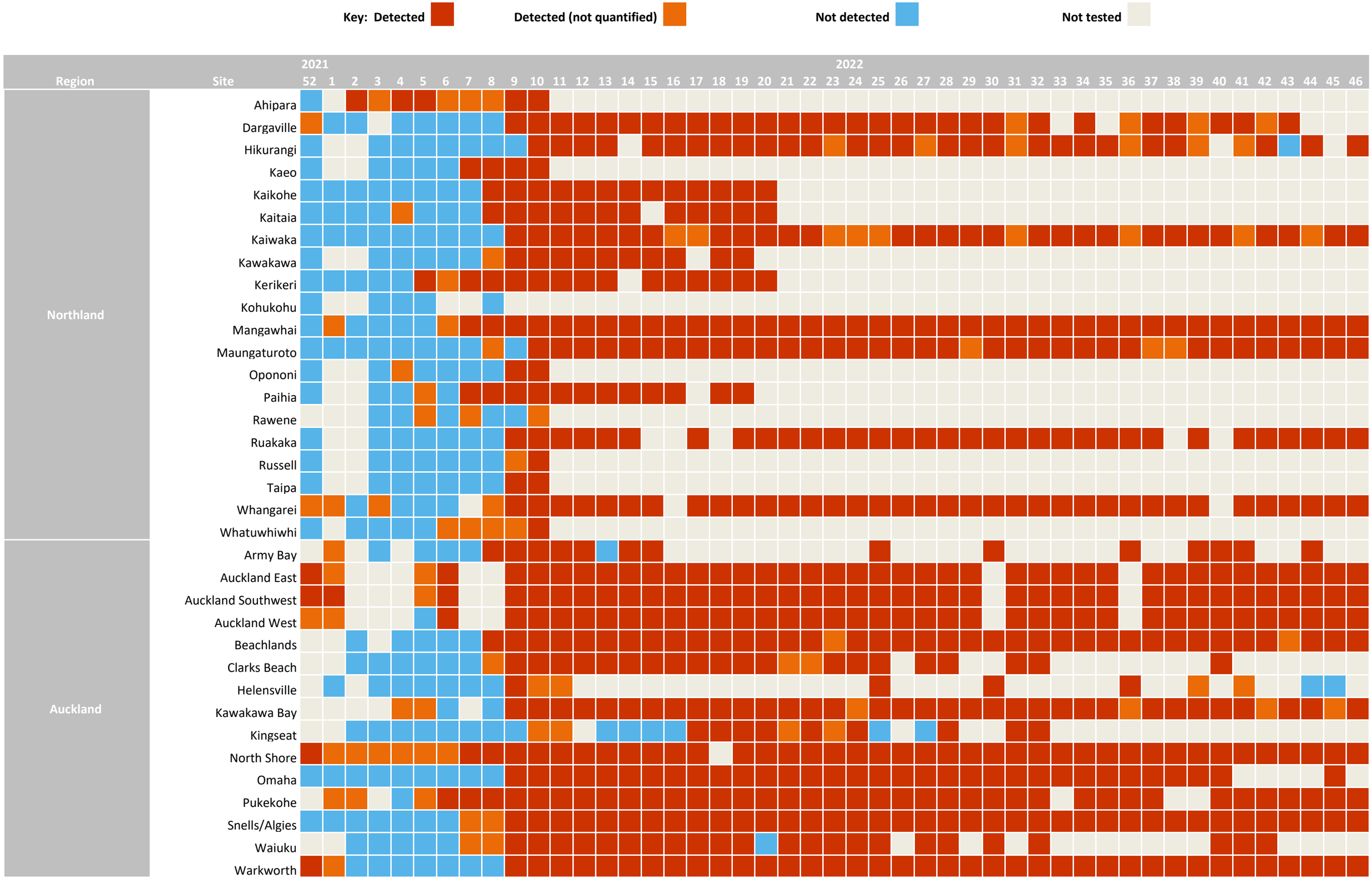
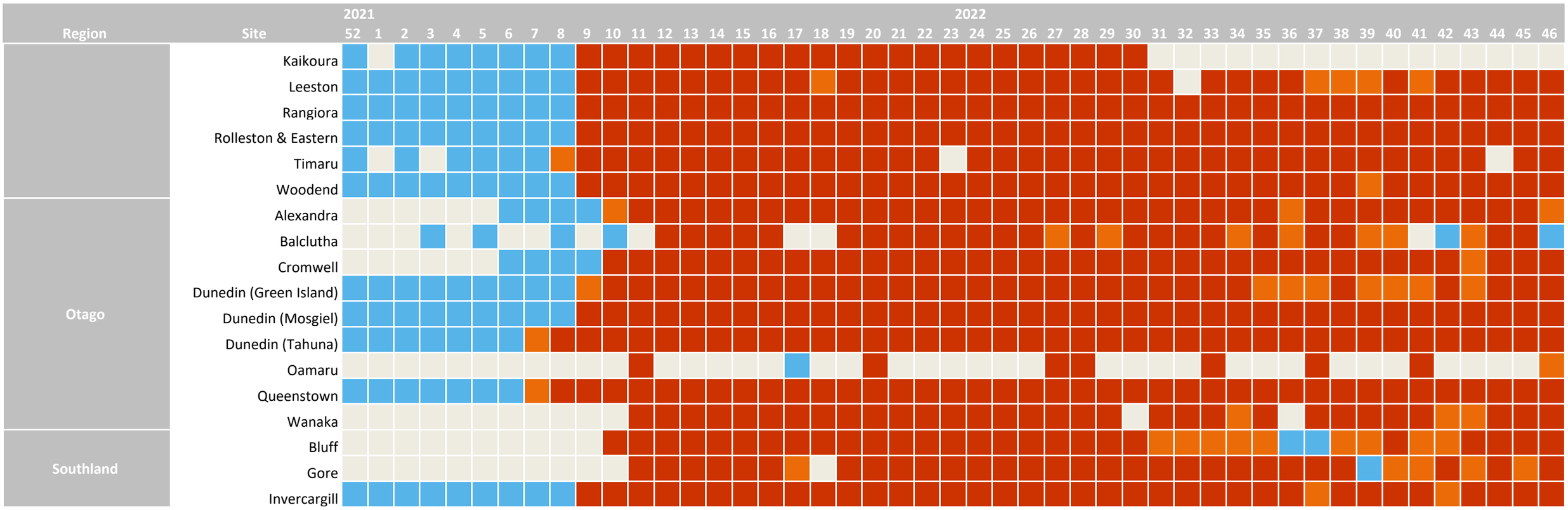

Gore Autosampler 8.0K
Balclutha Grab 4.1K
Cromwell Autosampler 7.1K
Bluff Autosampler 2.0K
Alexandra Autosampler 6.2K
Oamaru Autosampler 12.0K
1B
100M
10M
1M
100K
10K
10K
1K
100
10
1
Apr
Jul
Oct
SARS-CoV-2 genome copies / day / person
Cases - 7 day rolling average

Table 1: Weekly Summary of Wastewater Sampling Results for SARS-CoV-2



Region	Site	2021 52	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
	Wellsford																																																
Waikato	Cambridge																																															
	Hamilton																																															
	Matamata																																															
	Morrinsville																																															
	Ngatea																																															
	Otorohanga																																															
	Paeroa																																															
	Putaruru																																															
	Taupo																																															
	Te Awamutu																																															
	Te Kuiti																																															
	Thames																																															
	Tokoroa																																															
	Turangi																																															
	Whangamata																																															
	Whitianga																																															
Bay of Plenty	Katikati																																															
	Kawerau																																															
	Maketu																																															
	Mt Maunganui/Papamoa																																															
	Opotiki																																															
	Rotorua																																															
	Tauranga																																															
	Te Puke																																															
	Waihi Beach																																															
	Whakatane																																															
Gisborne	Gisborne																																															
Hawke's Bay	Hastings																																															
	Napier																																															
	Otane																																															
	Porangahau																																															
	Takapau																																															
	Te Paerahi																																															
	Waipawa																																															
	Waipukurau																																															
	Wairoa																																															
Taranaki	Eltham																																															
	Hawera																																															
	Kaponga																																															

Region	Site	2021 52	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
	Manaia																																																
	New Plymouth																																																
	Opunake																																															
	Patea																																															
	Stratford																																															
	Waverley																																															
Manawatu-Whanganui	Dannevirke																																															
	Eketahuna																																															
	Feilding																																															
	Levin																																															
	Pahiatua																																															
	Palmerston North																																															
	Taumarunui																																															
	Whanganui																																															
	Woodville																																															
Wellington	Carterton																																															
	Featherston																																															
	Greytown																																															
	Hutt Valley																																															
	Martinborough																																															
	Masterton																																															
	Otaki																																															
	Paraparaumu																																															
	Porirua																																															
	Wellington (Moa Point)																																															
	Wellington (Western)																																															
Tasman	Motueka																																															
Nelson	Nelson Central/North																																															
	Richmond/Nelson South																																															
Marlborough	Blenheim																																															
	Picton																																															
West Coast	Greymouth																																															
	Hokitika																																															
	Reefton																																															
	Westport																																															
Canterbury	Amberley																																															
	Ashburton																																															
	Christchurch																																															
	Hanmer Springs																																															
	Kaiapoi																																															


Region
Site
2021
2022
52 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46
Kaikoura
Leeston
Rangiora
Rolleston & Eastern
Timaru
Woodend
Otago
Alexandra
Balclutha
Cromwell
Dunedin (Green Island)
Dunedin (Mosgiel)
Dunedin (Tahuna)
Oamaru
Queenstown
Wanaka
Southland
Bluff
Gore
Invercargill

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. Grab or 24 hr composite sample s are collected. 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. Greater variability is expected with grab samples.

Approach

Samples are sent from each wastewater treatment plant to ESR. 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/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.

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.

Acknowledgements

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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: 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, 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).

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