National Wastewater Surveillance Programme - COVID-19

Week 21 2022 (Week Ending 29 May 2022)

Report prepared on 02 June 2022

Overview

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

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

Approach

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

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

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

Results For Week 21, 2022

In the week ending 29 May 2022 (week 21), 163 samples were collected from 109 locations in New Zealand. Analysis of one sample is still in progress (Eastern Catchment, Auckland, collected on 29 May).

SARS CoV-2 RNA was detected in all samples except for two – Manaia, Taranaki, collected 24 May, and Reefton, West Coast, collected 23 May) (Figure 1, Figure 3, Table 1).

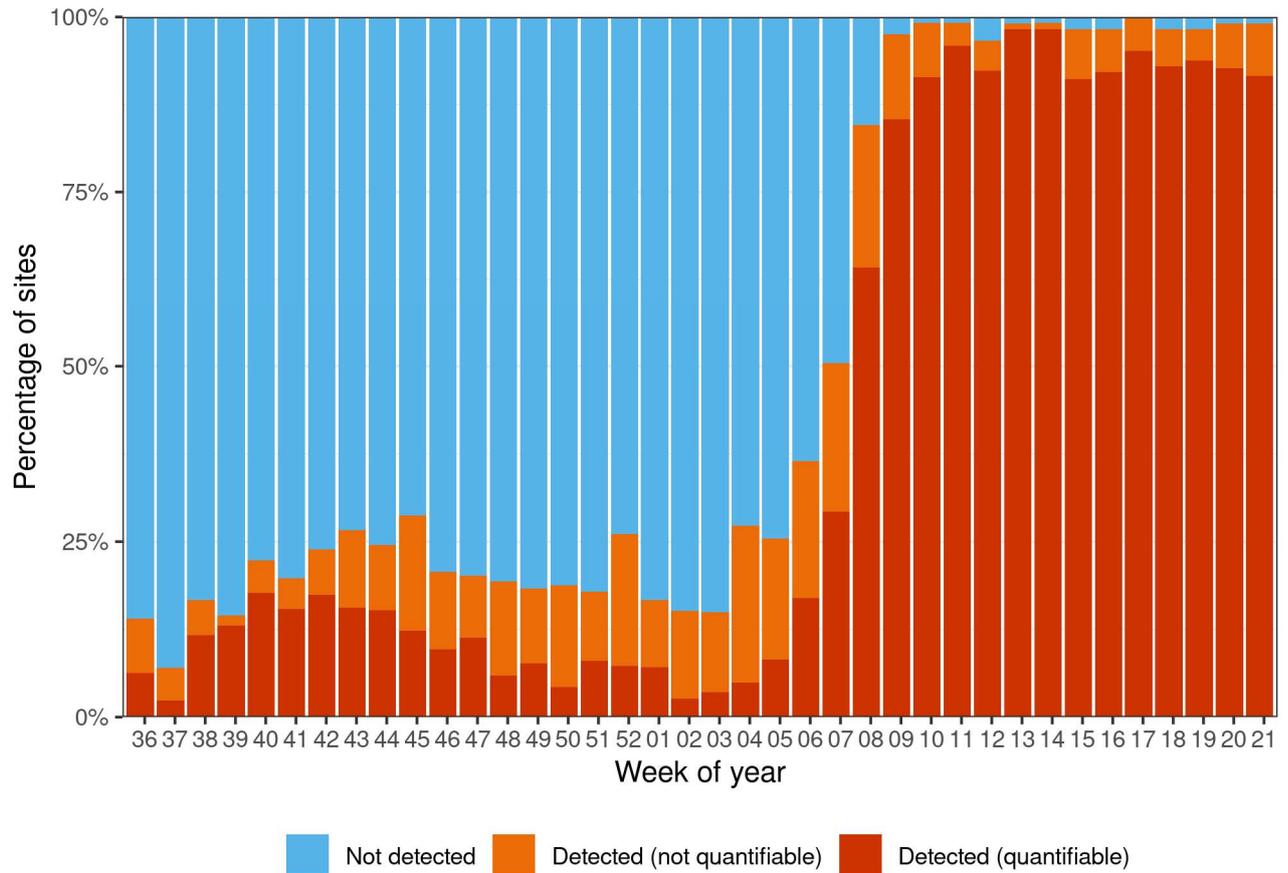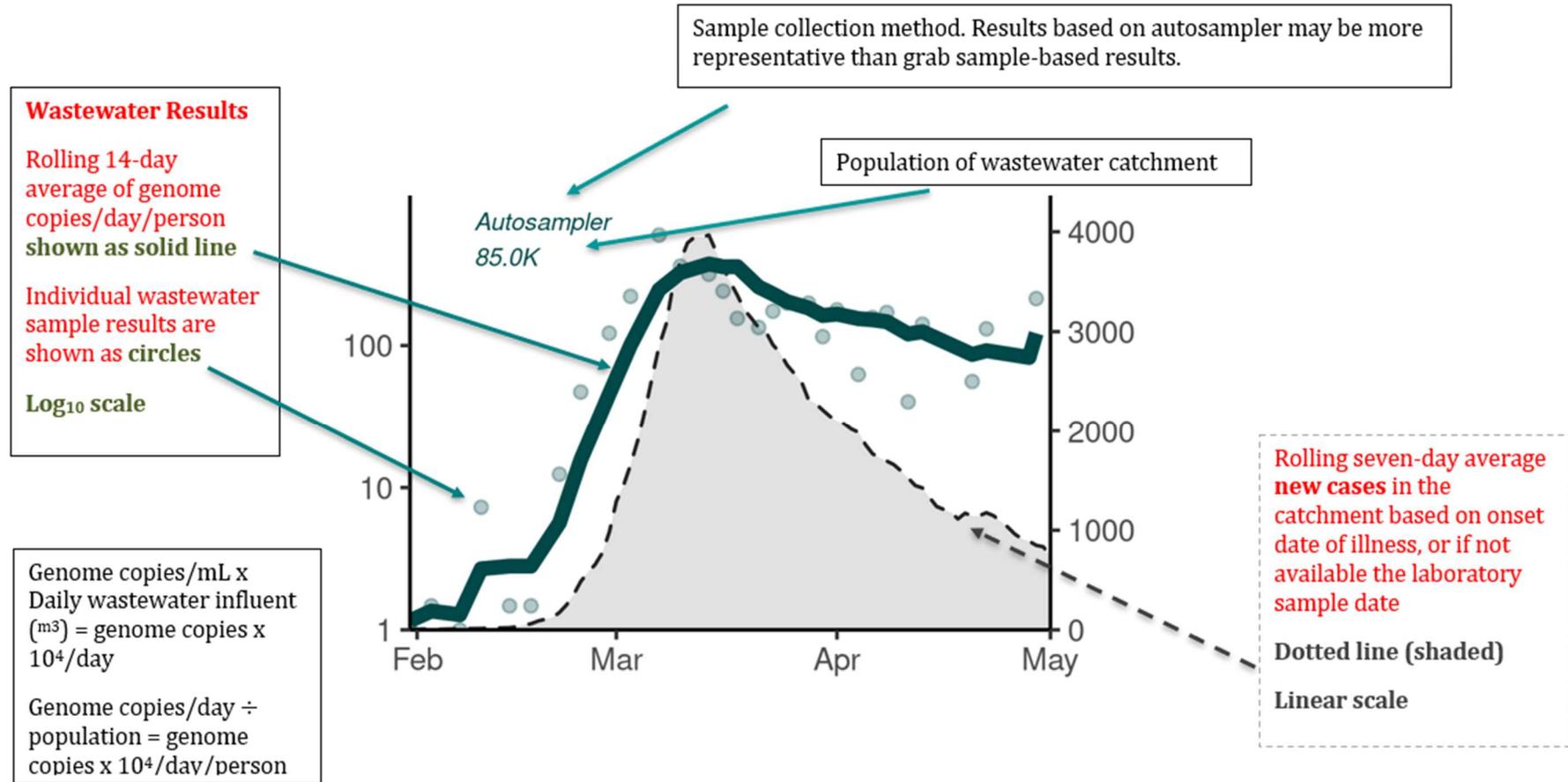Figure 1 below gives the proportion of sites with positive results for this and previous weeks.

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

Status ● Detected ● Not detected

Figure 2. Location of sampling sites and latest results in the two weeks ending 29 May 2022.
Interactive map of weekly results available publicly at https://www.esr.cri.nz/our-expertise/covid-19-
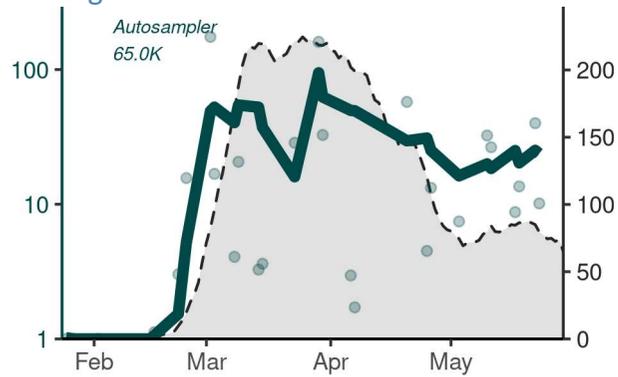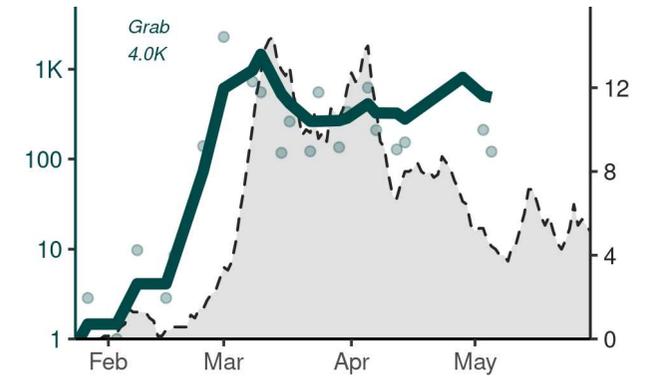response/wastewater-testing-results

Interpreting site graphs

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

Wastewater Results

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

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

Log$_{10}$ scale

Population of wastewater catchment

Autosampler
85.0K

Genome copies/mL x Daily wastewater influent (^{m3}) = genome copies x 10^4/day

Genome copies/day ÷ population = genome copies x 10^4/day/person

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

Dotted line (shaded)

Linear scale

Note the scales may differ for each graph

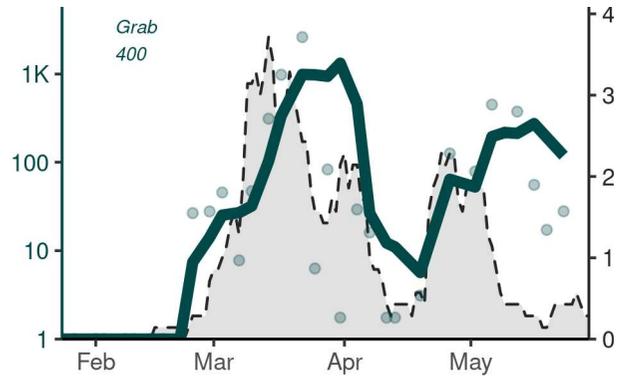Wastewater results are on log$_{10}$ scale, while case data is on a linear scale.
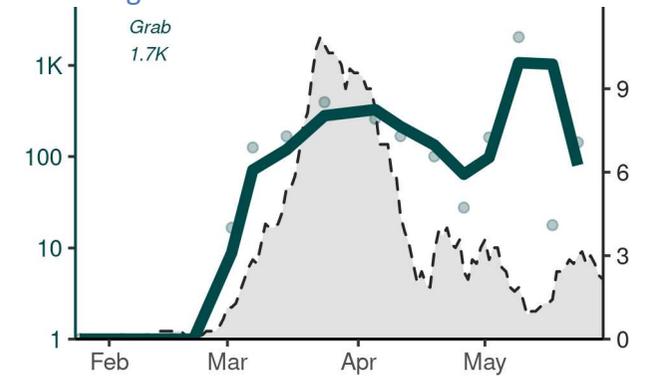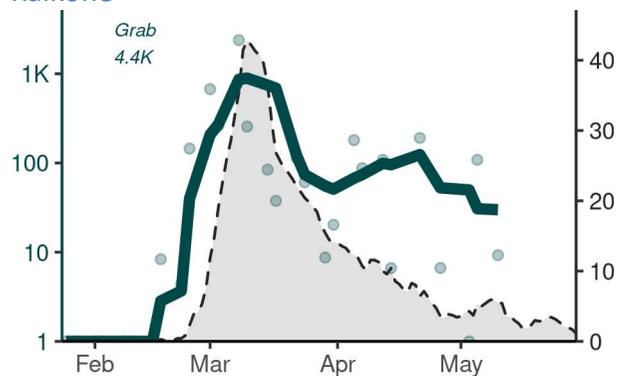
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Northland

Whangarei

Autosampler 65.0K

Paihia

Grab 4.0K

Kaiwaka

Grab 400

Hikurangi

Grab 1.7K

Kaikohe

Grab 4.4K

Mangawhai

Grab 1.1K

Kaitaia

Kerikeri

Paihia

Kawakawa

Kaikohe

Hikurangi

Whangarei

Ruakaka

Dargaville

Maungaturoto   Mangawhai

Kaiwaka
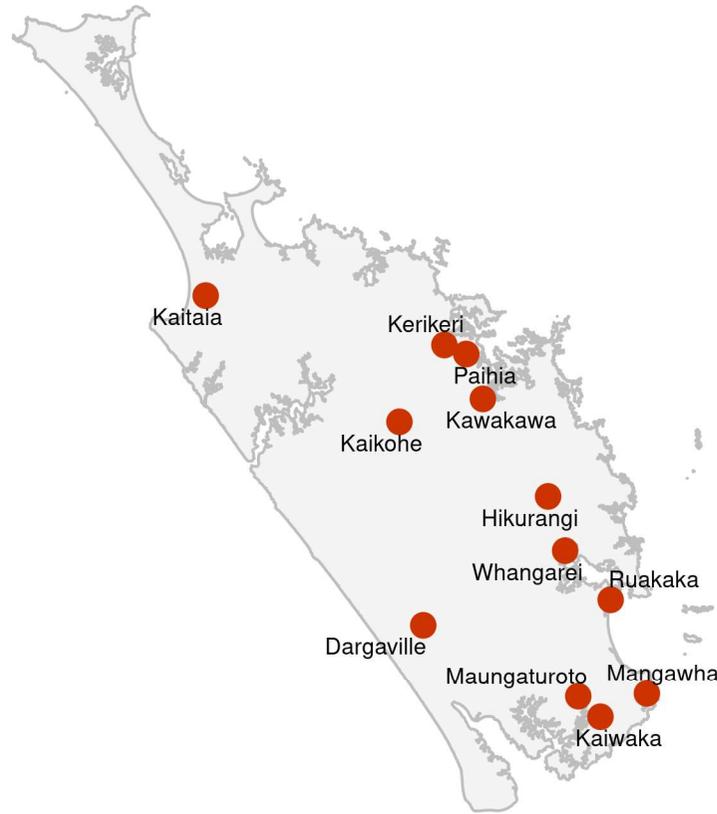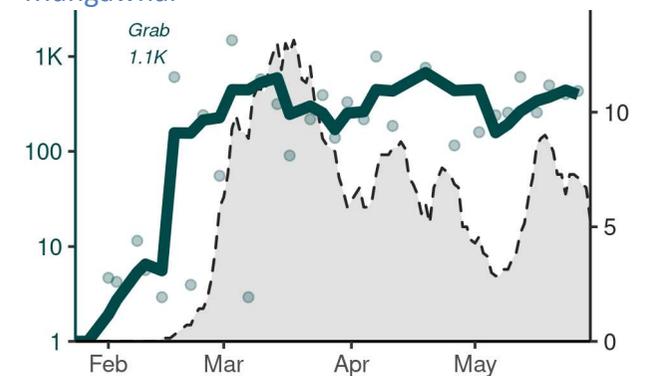
Status   ● Detected   ● Not detected

Dargaville

Grab
5.0K

Ruakaka

Grab
4.5K

Kaitaia

Grab
5.4K

Kawakawa

Grab
1.5K

Kerikeri

Grab
6.2K
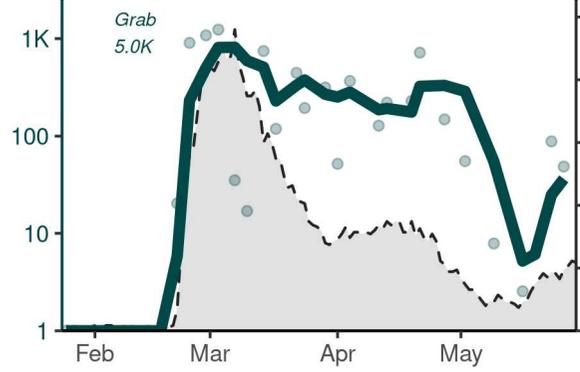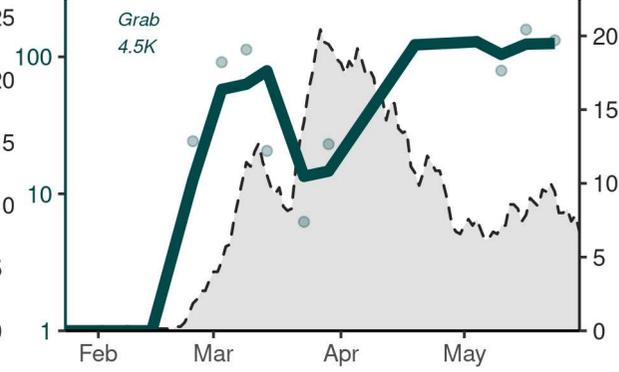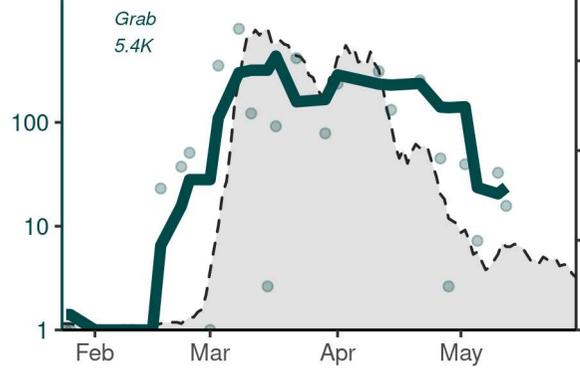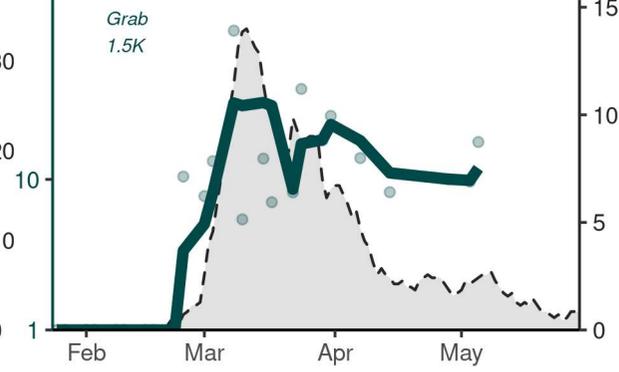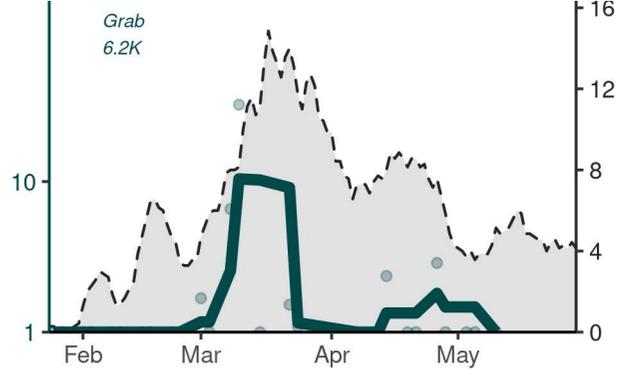
Auckland

Auckland East

Autosampler 680.0K
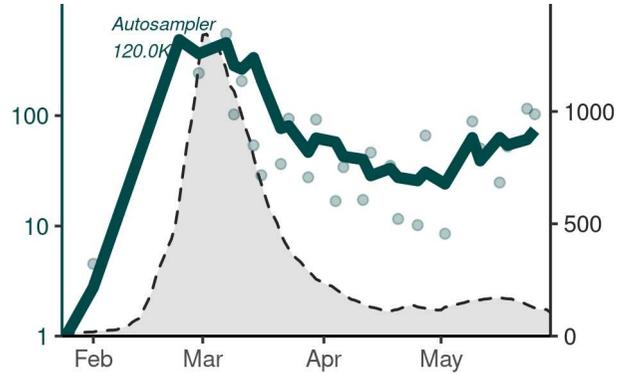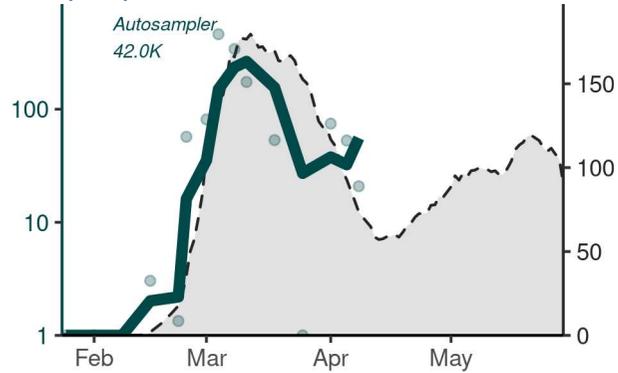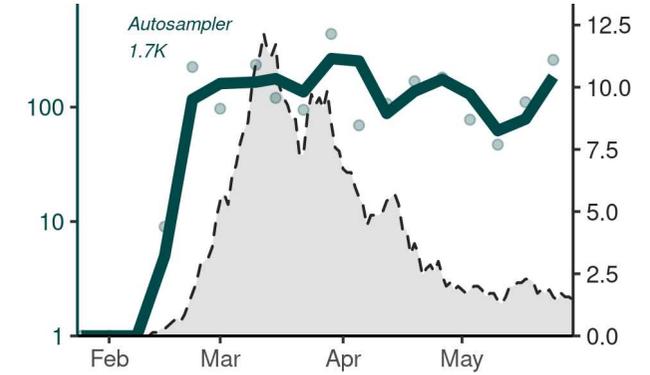
Wellsford

Autosampler 1.7K

Auckland Southwest

Autosampler 120.0K

Auckland (Combined)

Autosampler 1.1M

Army Bay

Autosampler 42.0K

Auckland West

Autosampler 315.0K

Wellsford
Omaha
Warkworth
Snells/Algies
North Shore
Beachlands
Auckland West
Auckland (Combined)
Auckland East
Auckland Southwest
Kawakawa Bay
Kingseat
Clarks Beach
Waiuku
Pukekohe

Status   ● Detected   ● Not detected

Waikato

Te Awamutu

Autosampler 13.1K

Whitianga

Autosampler 6.6K

Whangamata

Autosampler 4.0K

Hamilton

Autosampler 169.0K

Thames

Autosampler 7.5K

Cambridge

Autosampler 20.1K

Whitianga

Thames

Whangamata

Ngatea

Paeroa

Waihi

Hamilton

Cambridge

Te Awamutu

Taupo

Status ● Detected ● Not detected

Taupo

Autosampler/Grab
23.0K
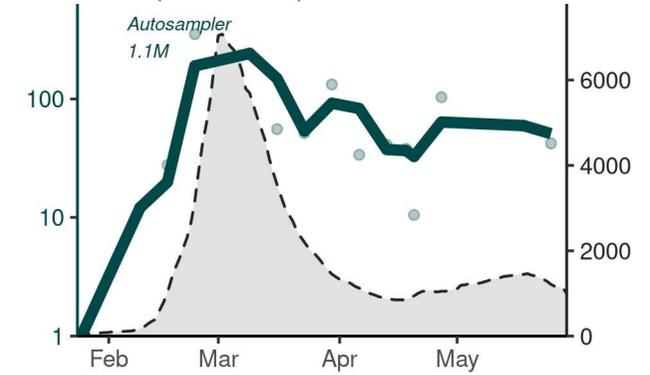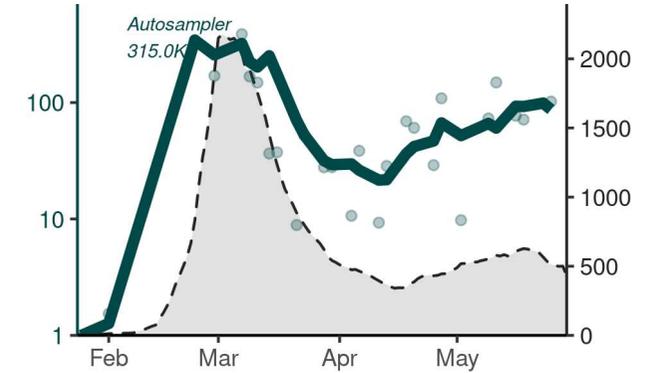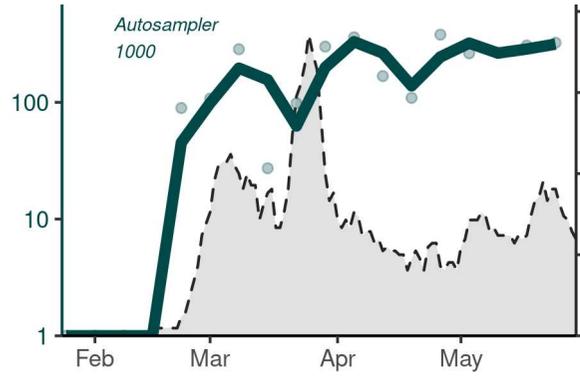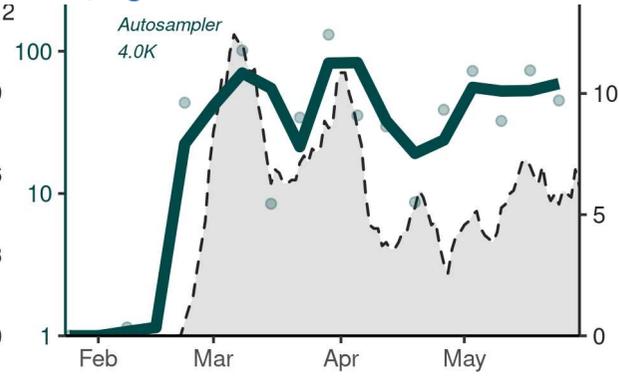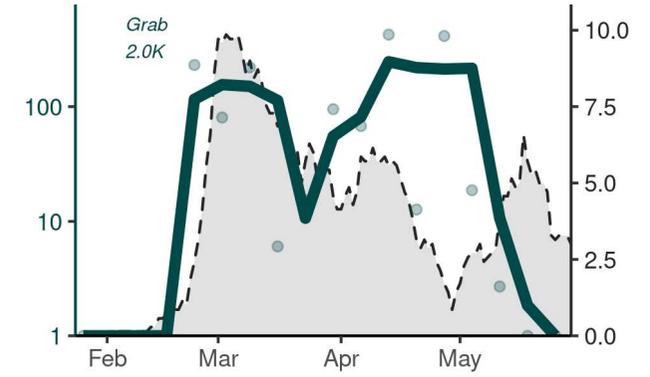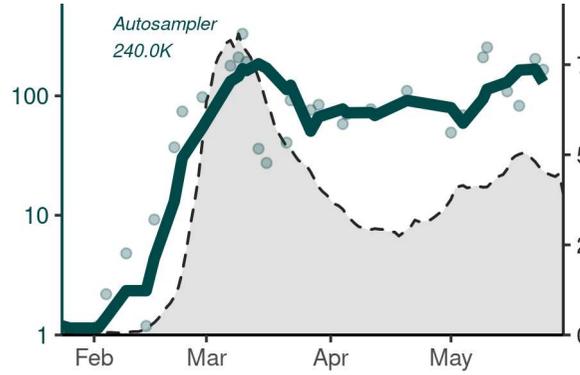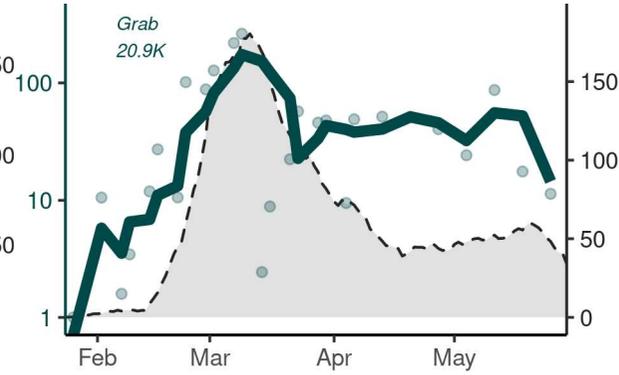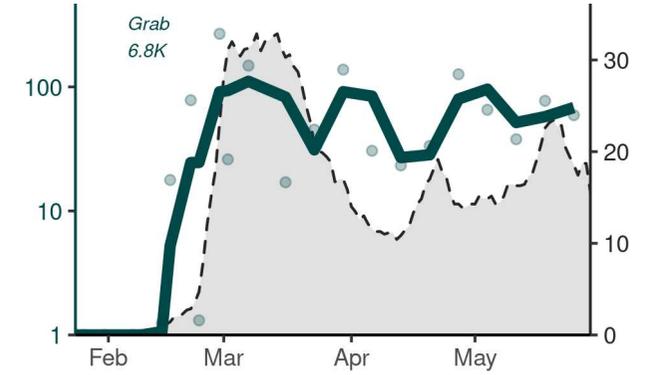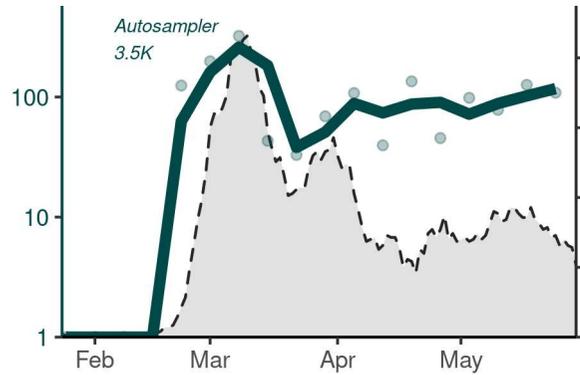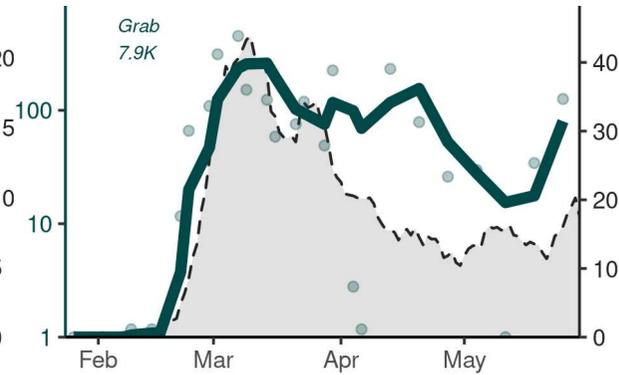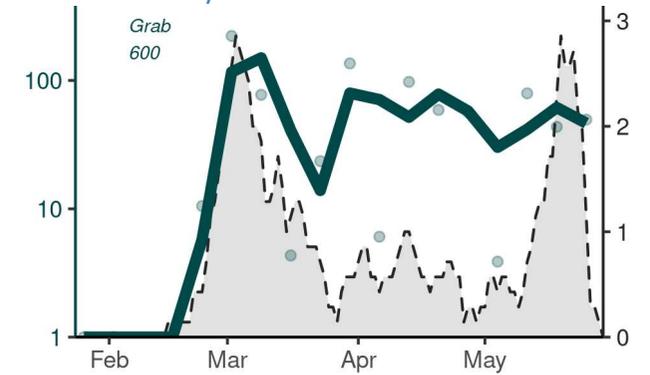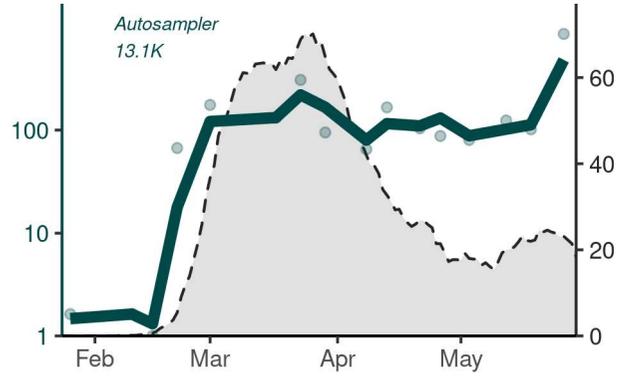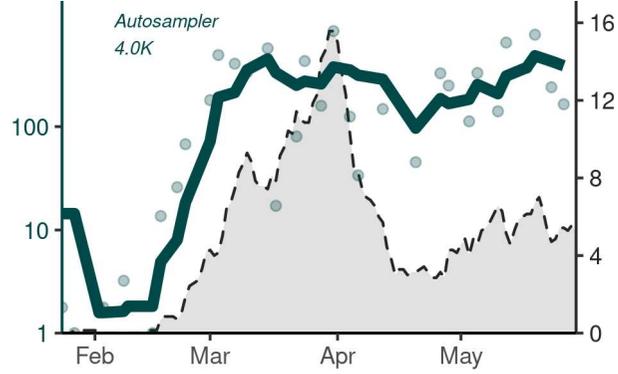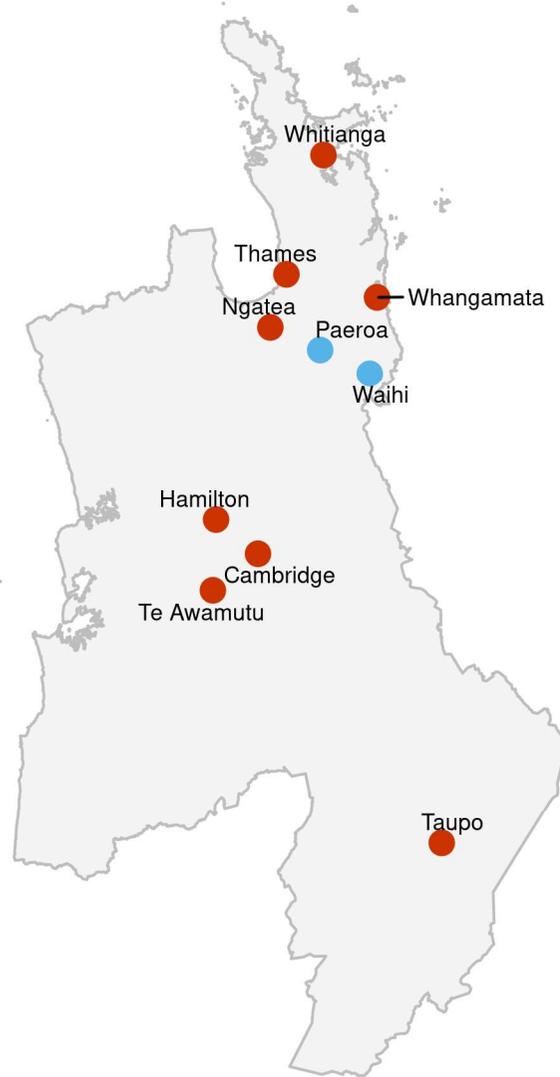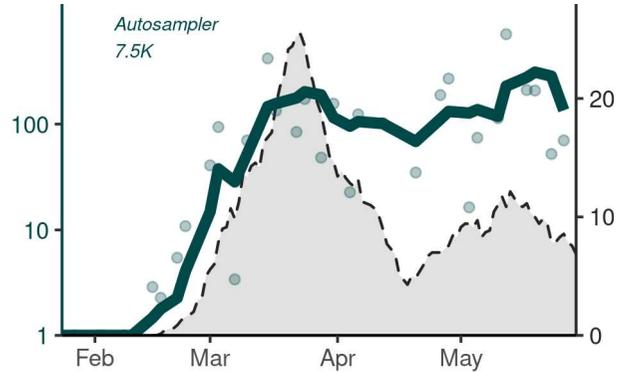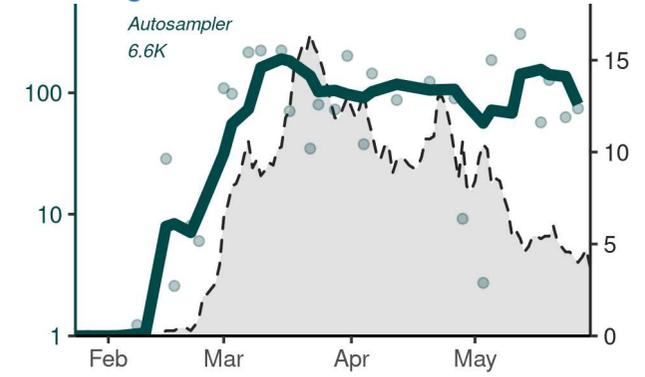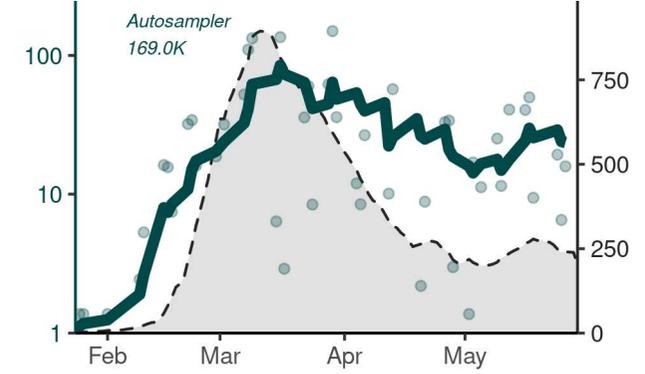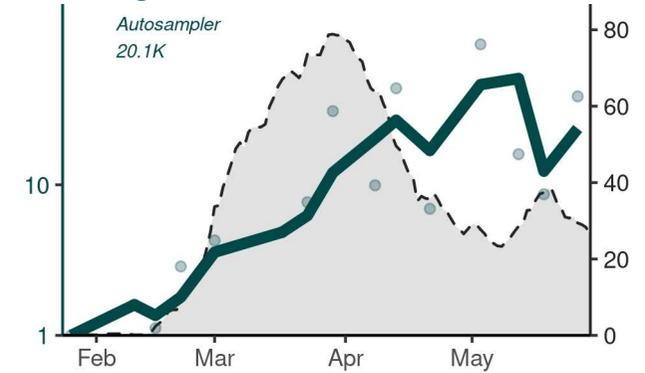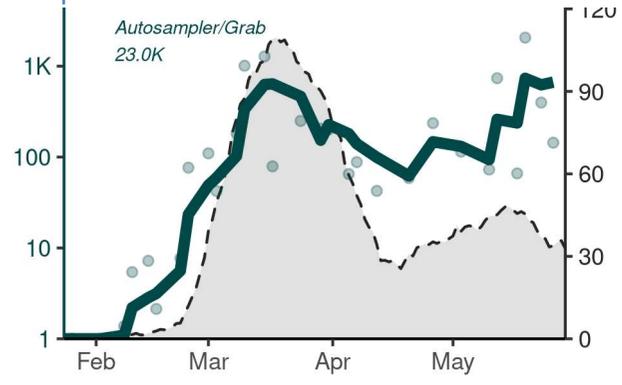
Bay of Plenty and Gisborne

Maketu

Autosampler 1.3K

Gisborne

Autosampler 37.0K

Mt Maunganaui

Autosampler 65.0K

Te Puke

Autosampler 9.7K

Tauranga

Autosampler 50.0K

Rotorua

Autosampler 59.0K

Waihi Beach
Katikati
Tauranga
Mt Maunganaui — Maketu
Te Puke
Whakatane
Rotorua
Kawerau
Opotiki
Gisborne
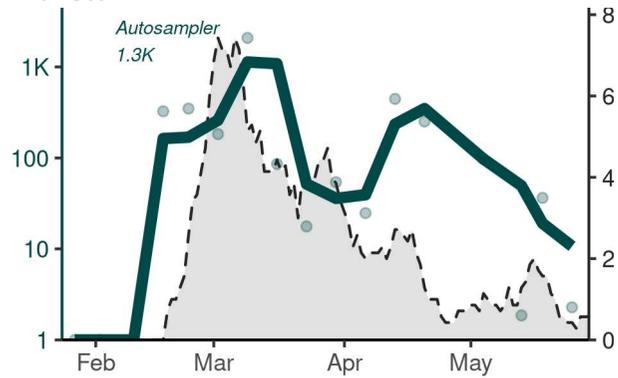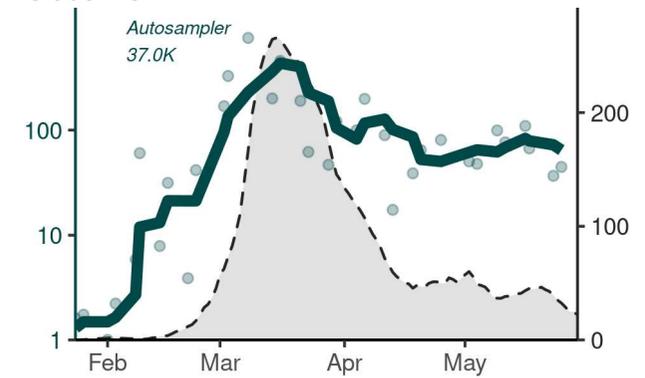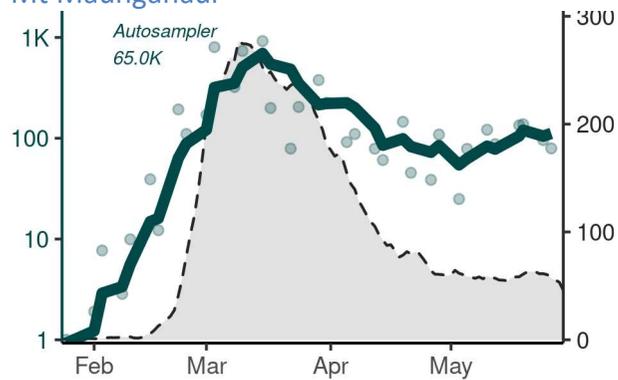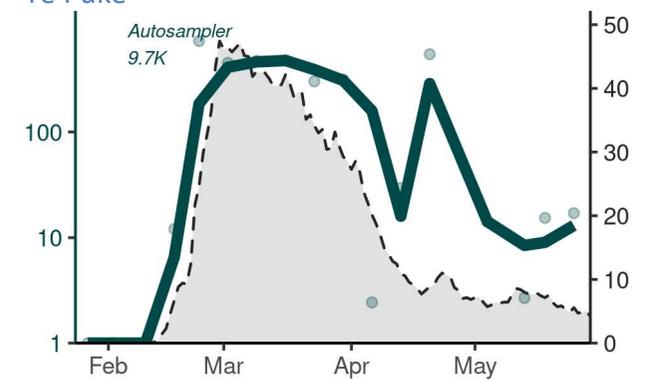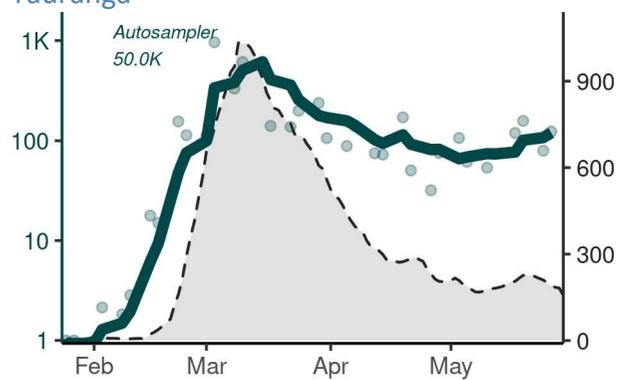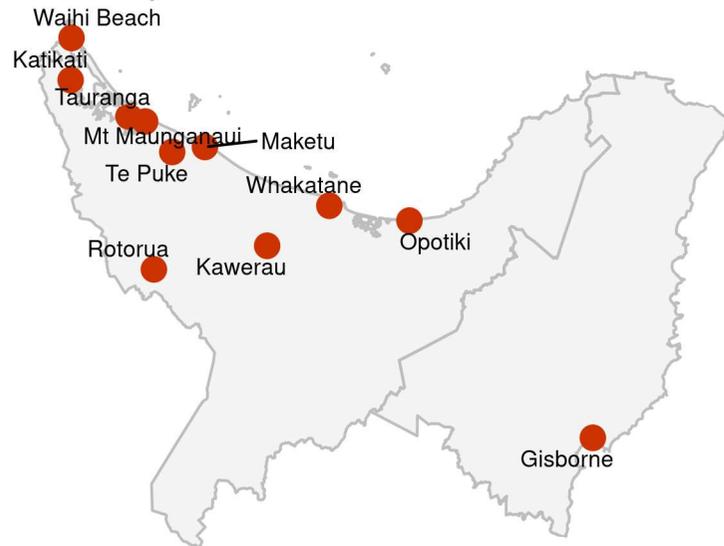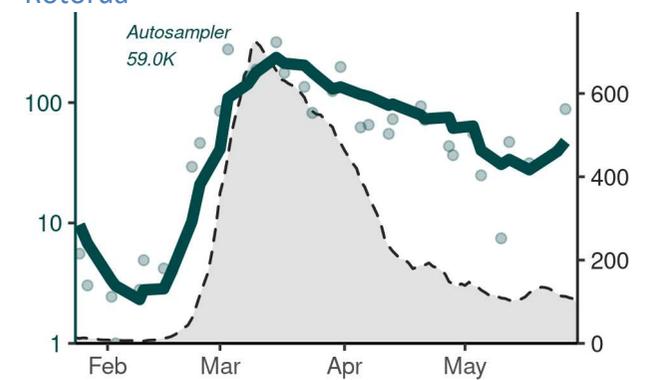
Status ● Detected ● Not detected

Katikati
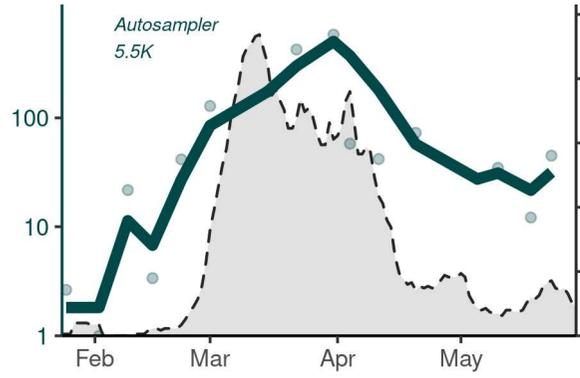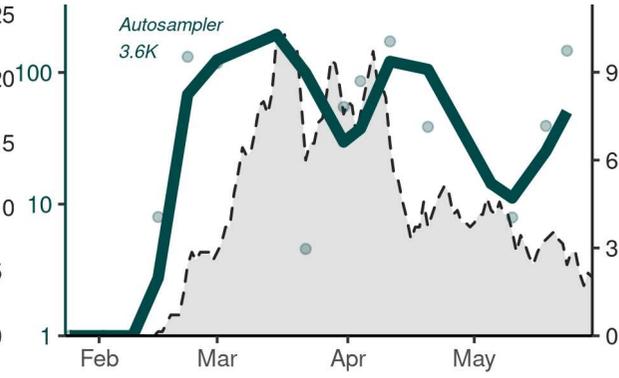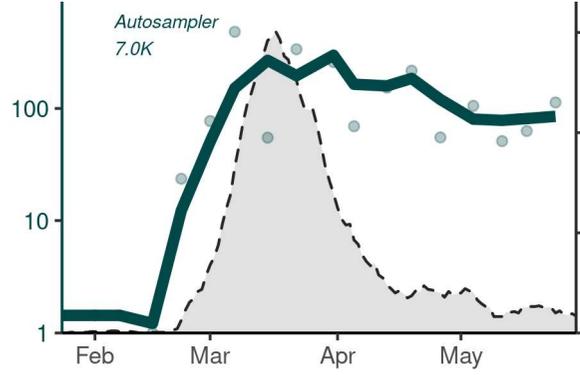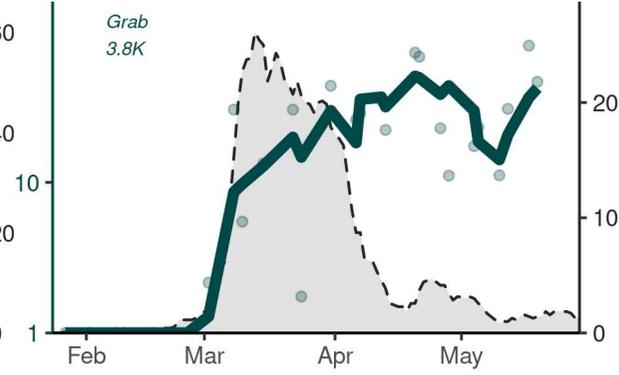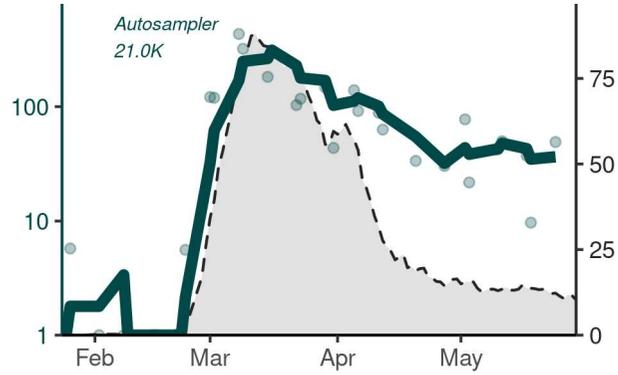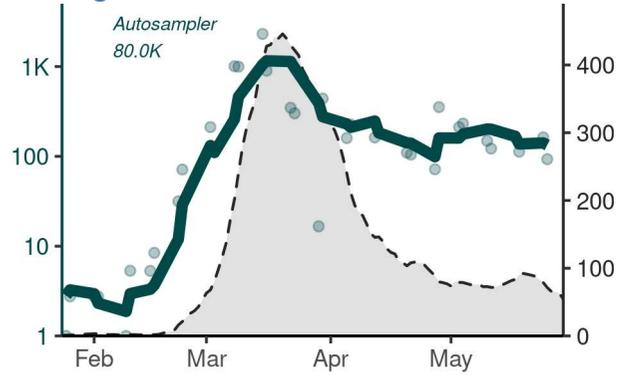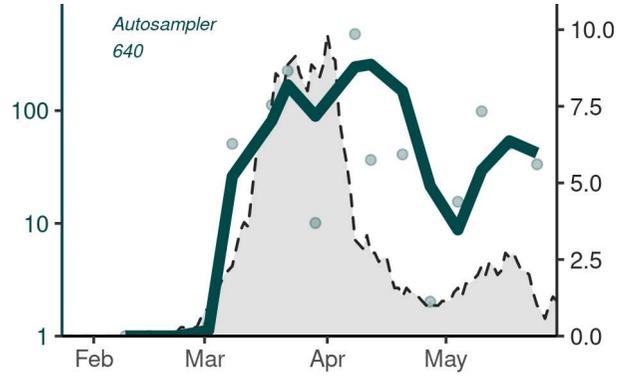
Autosampler
5.5K

Waihi Beach

Autosampler
3.6K

Kawerau

Autosampler
7.0K

Opotiki

Grab
3.8K

Whakatane

Autosampler
21.0K

13

Hawke's Bay

Hastings

Autosampler 80.0K

Takapau

Autosampler 533

Otane

Autosampler 640

Napier

Autosampler 55.0K

Waipukurau

Autosampler 4.6K

Waipawa

Autosampler 2.2K

Wairoa

Napier

Hastings

Otane

Waipawa

Takapau

Waipukurau

Te Paerahi

Porangahau

Status ● Detected ● Not detected

Wairoa

Grab
4.4K

Taranaki

Eltham

Autosampler 2.0K

Patea

Autosampler 1.2K

Opunake

Autosampler 1.4K

Hawera

Autosampler 12.0K

New Plymouth

Autosampler 88.0K

Stratford

Autosampler 9.9K

New Plymouth

Stratford

Kaponga

Eltham

Opunake

Manaia

Hawera

Patea

Waverley

Status   ● Detected   ● Not detected

Kaponga

Grab
400

Manaia

Grab
950

Waverley

Grab
900

Manawatu-Whanganui

Levin

Autosampler
21.2K

Palmerston North

Autosampler
90.0K

Whanganui Urban

Autosampler
44.5K

Taumarunui

Grab
4.0K

Pahiatua

Grab
2.8K

Dannevirke

Grab
5.7K

Taumarunui

Whanganui Urban

Dannevirke

Woodville

Palmerston North

Pahiatua

Levin

Eketahuna

Status   ● Detected   ● Not detected

18

Woodville

Grab
1.7K

Eketahuna

Grab
1.6K
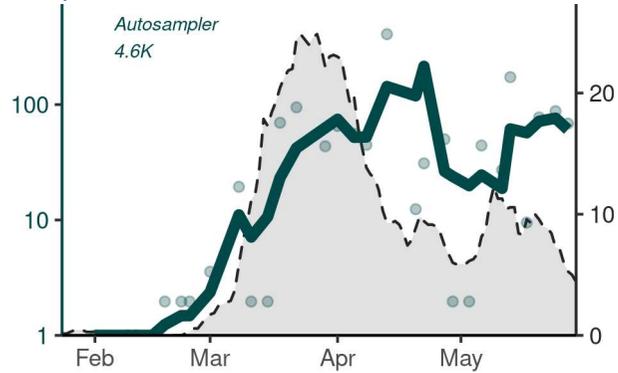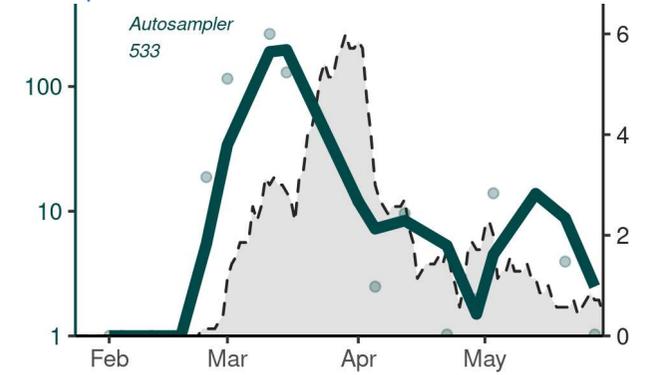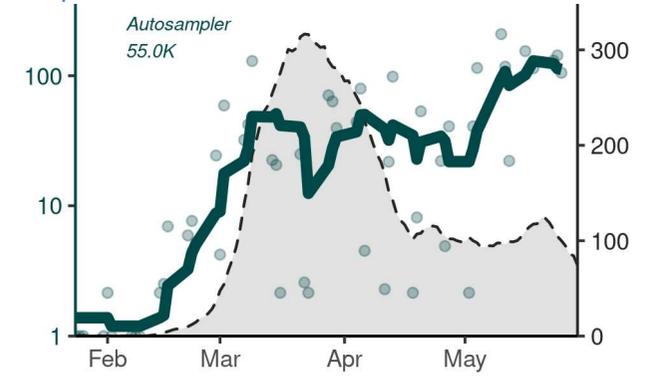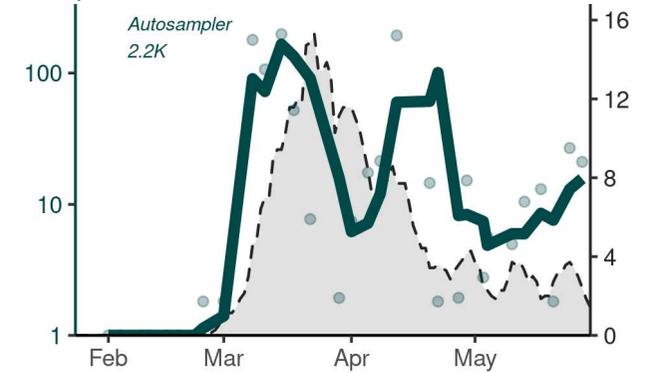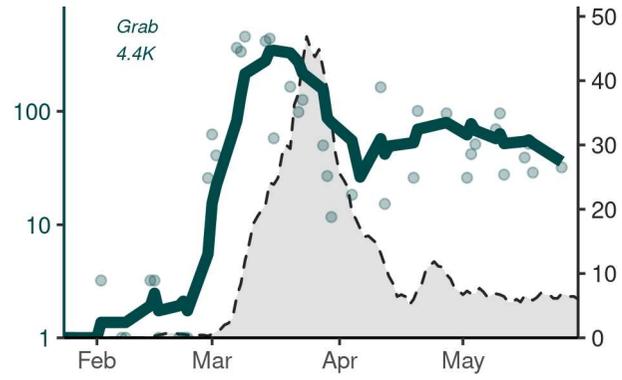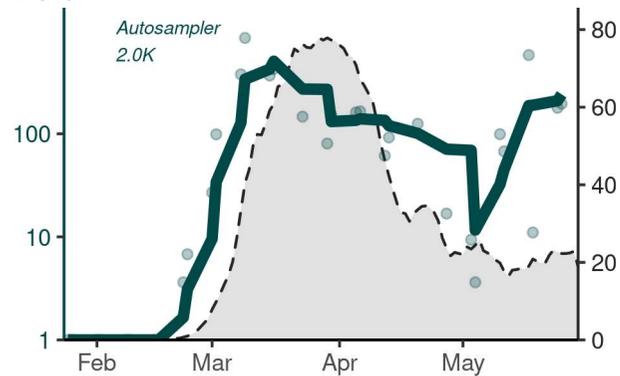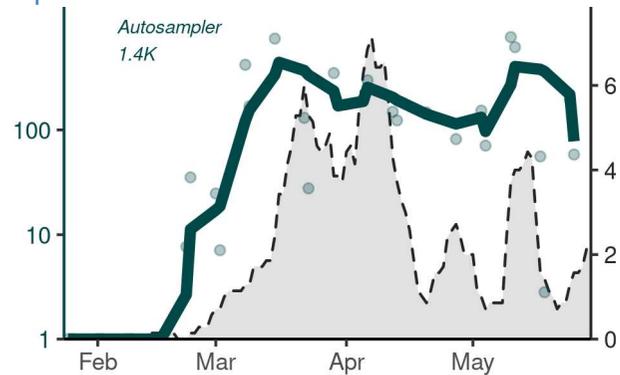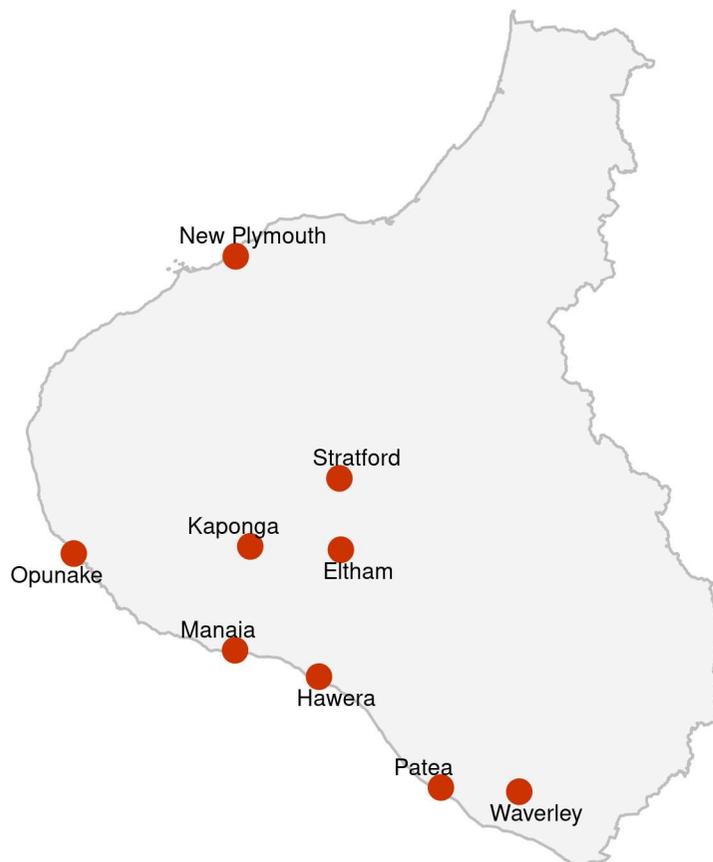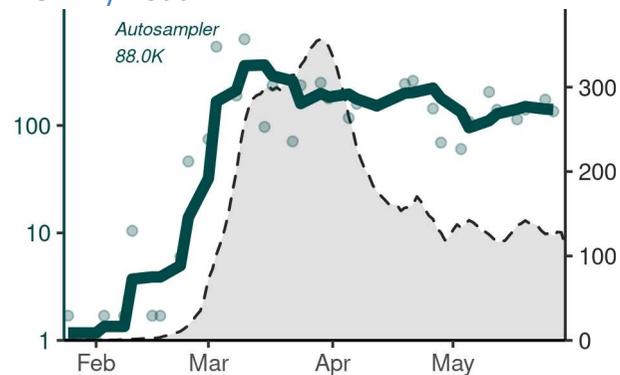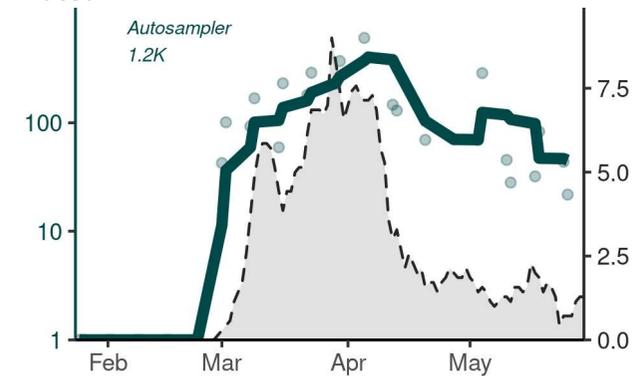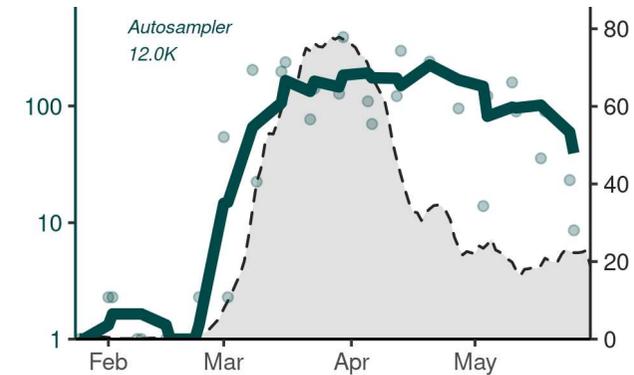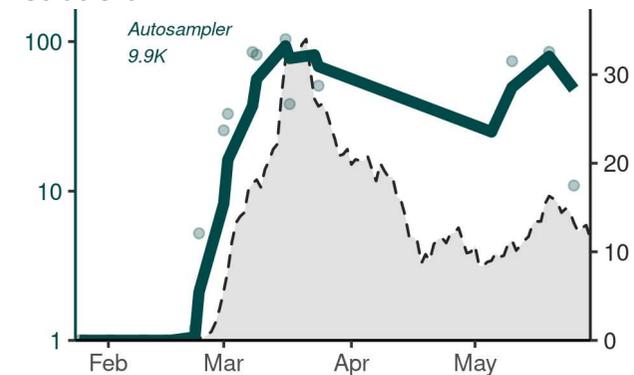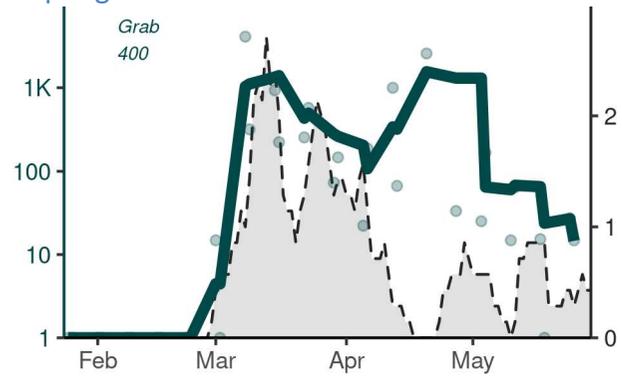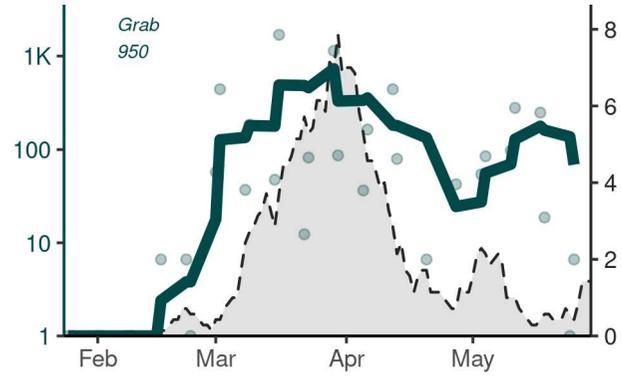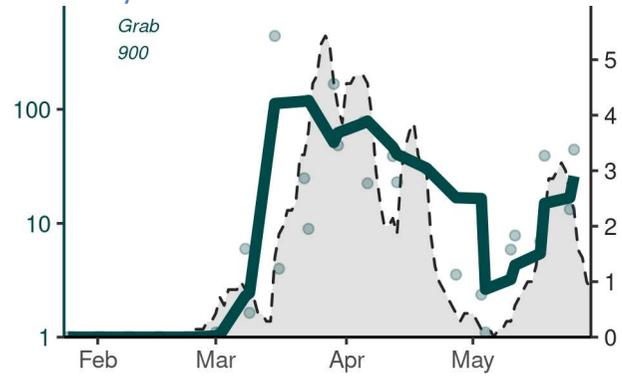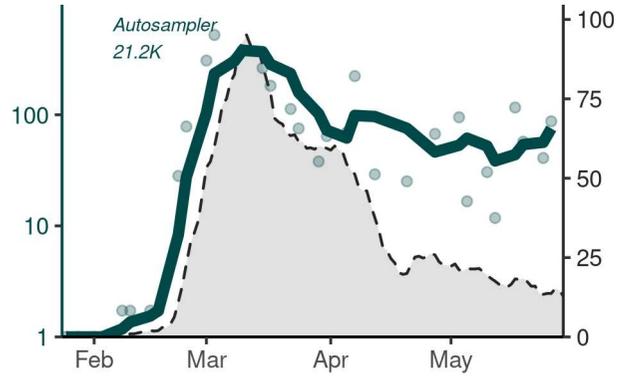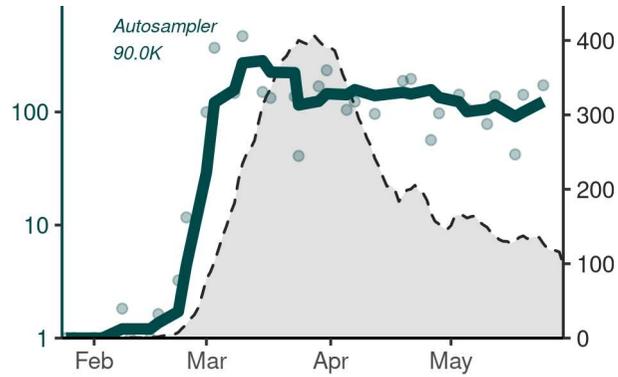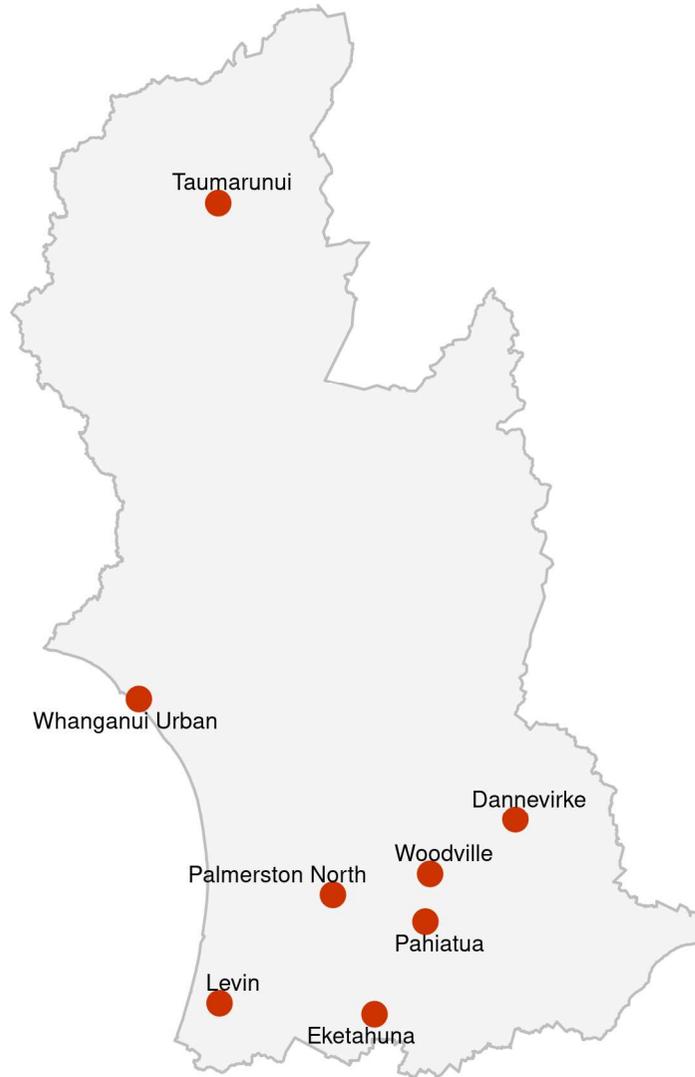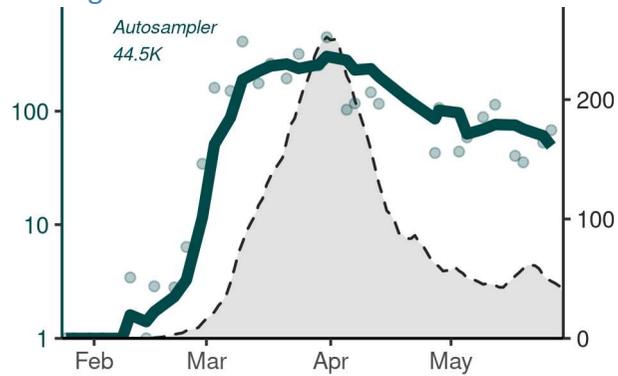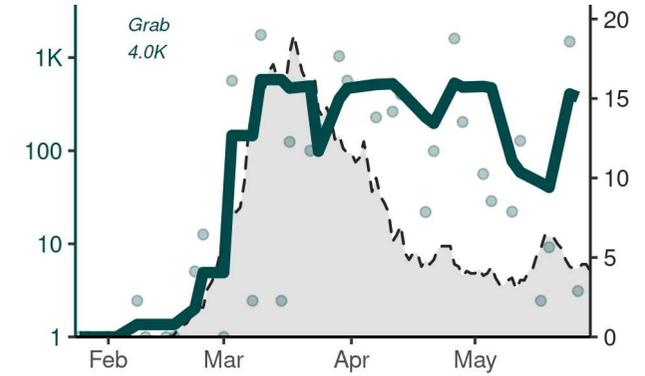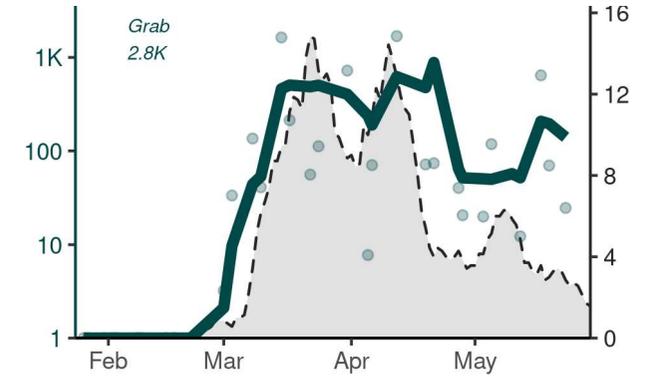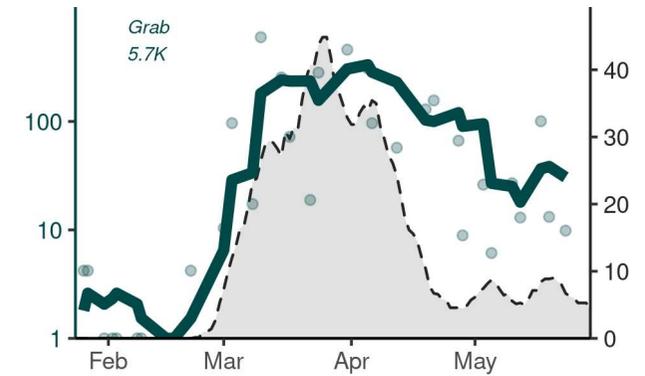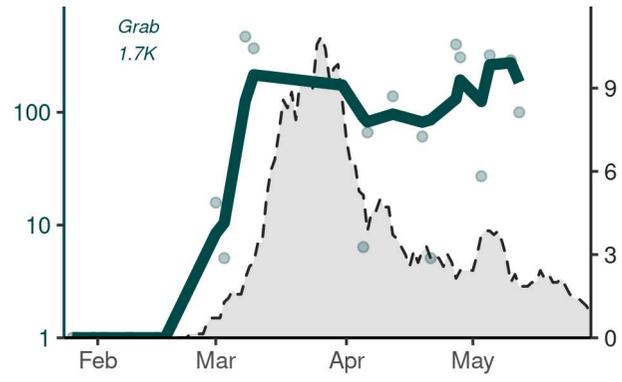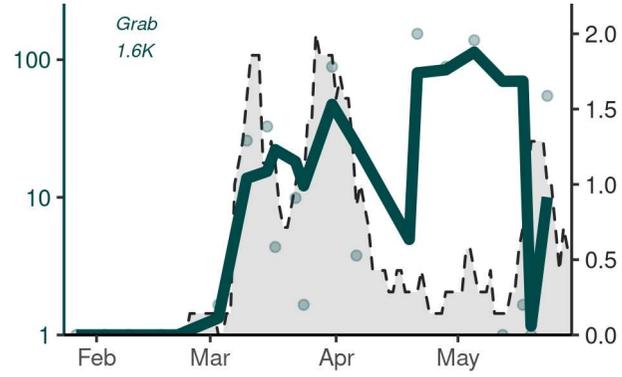
Wellington

Wellington (Moa Point)
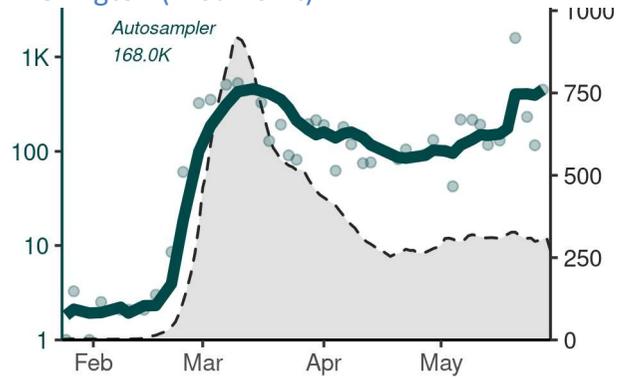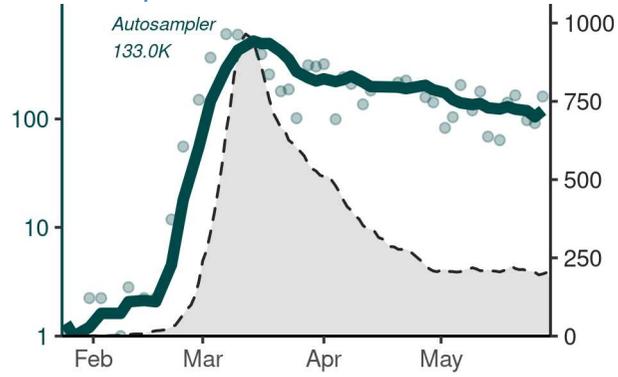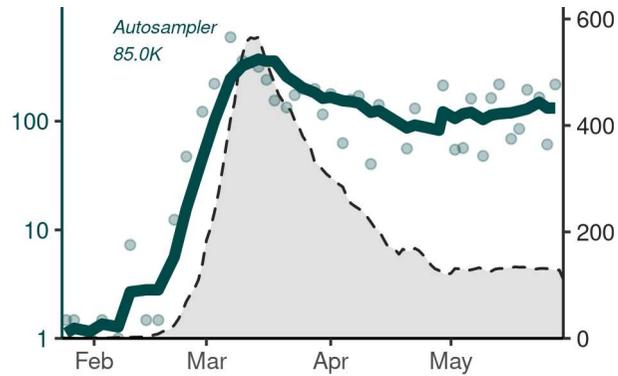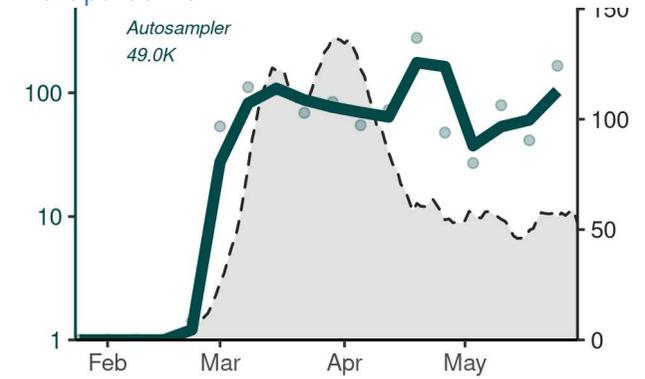
Autosampler
168.0K

Paraparaumu

Autosampler
49.0K

Hutt Valley

Autosampler
133.0K

Wellington (Western)

Autosampler
14.0K

Porirua

Autosampler
85.0K

Martinborough

Autosampler/grab
1.6K

Otaki
Paraparaumu
Masterton
Carterton
Porirua
Greytown
Featherston
Hutt Valley
Martinborough
Wellington (Western)
Wellington (Moa Point)

Status — Detected — Not detected

20

Featherston

Grab
2.5K

Otaki

Grab
3.5K

Masterton

Grab
20.7K

Greytown

Grab
2.4K

Carterton

Grab
5.8K
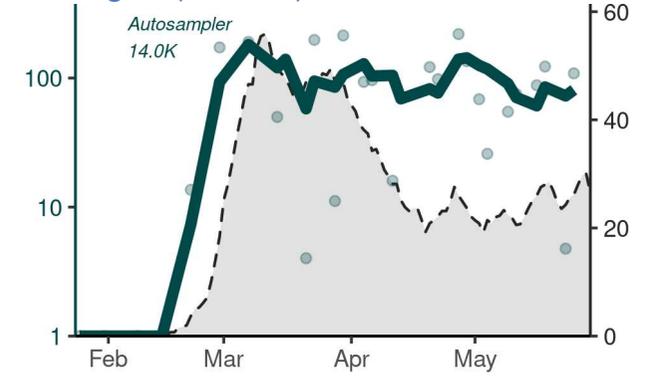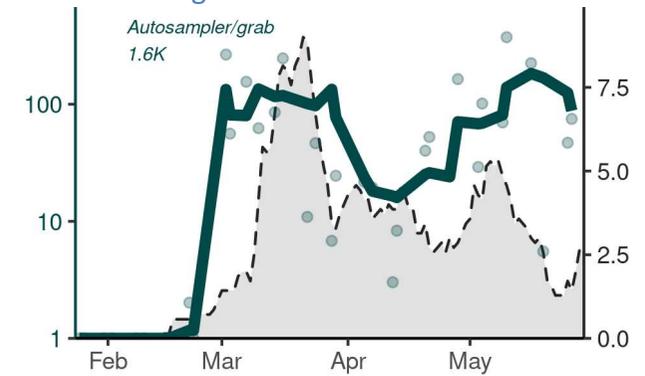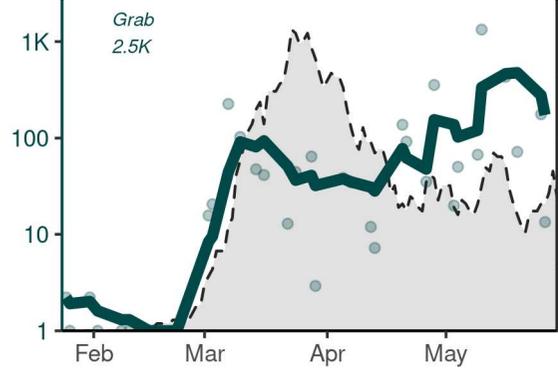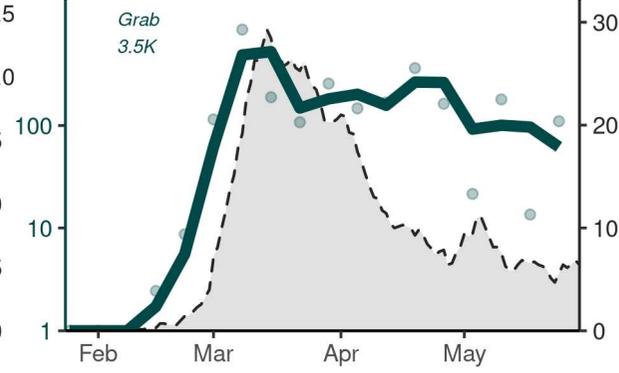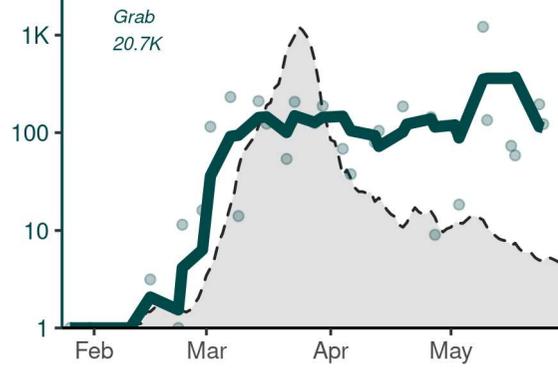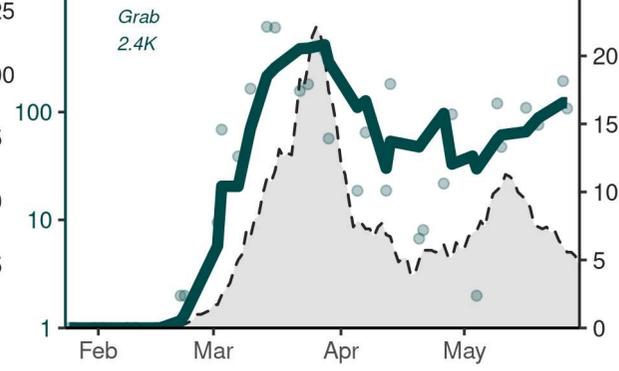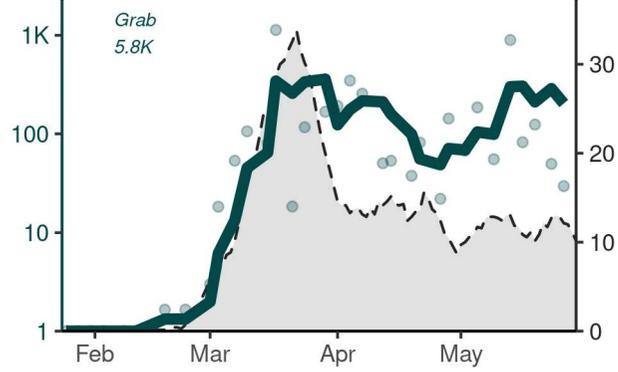
Tasman, Nelson, and Marlborough

Blenheim
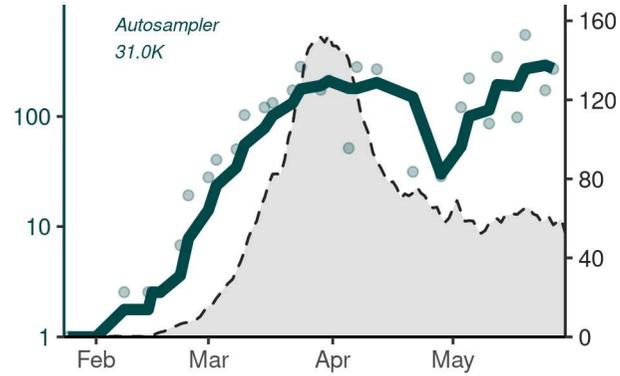
Autosampler 31.0K

Motueka

Autosampler 8.3K

Picton

Autosampler 5.0K

Nelson Central/North

Autosampler 26.0K

Richmond/Nelson South

Autosampler 60.0K

Motueka

Nelson Central/North

Richmond/Nelson South

Picton

Blenheim
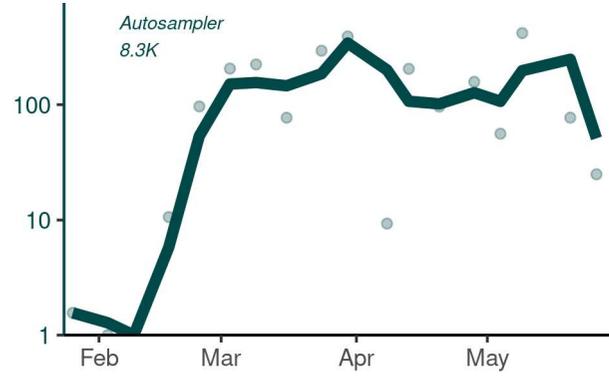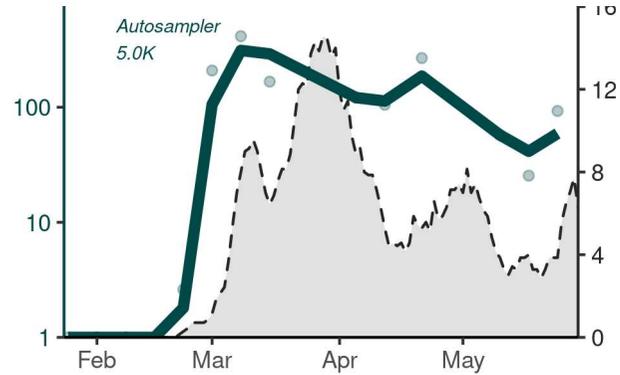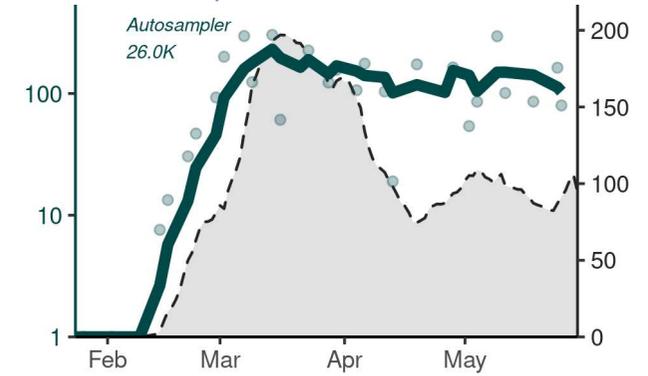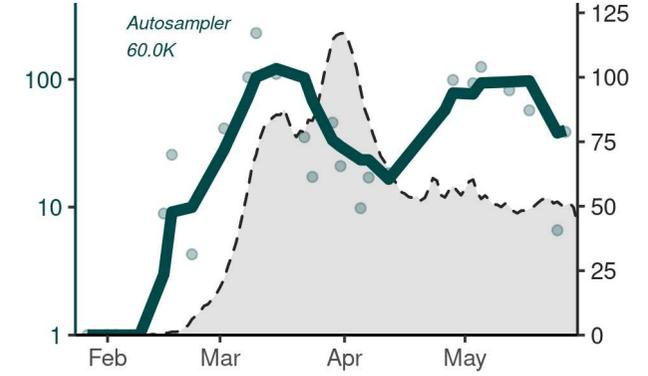
Status ● Detected ● Not detected

West Coast and Canterbury

Leeston
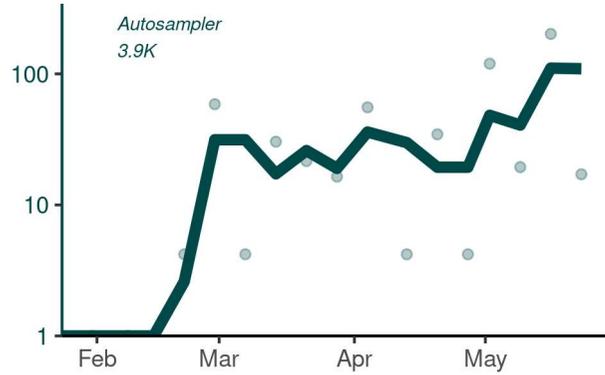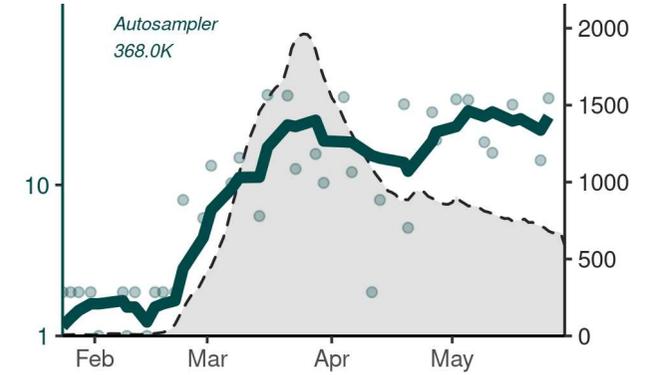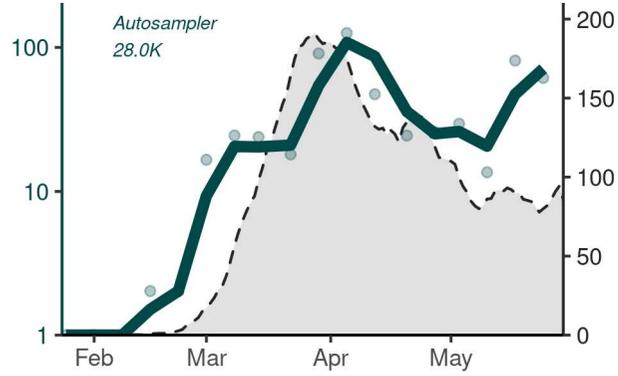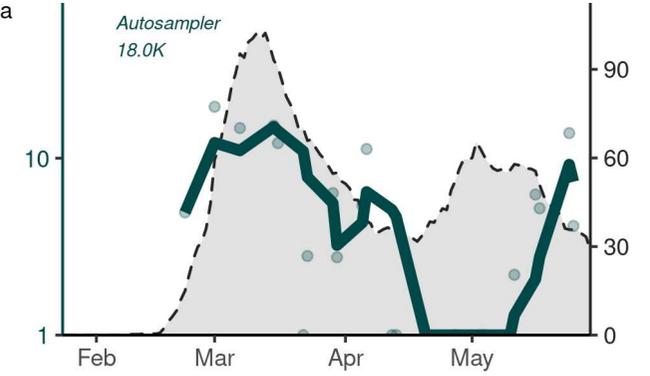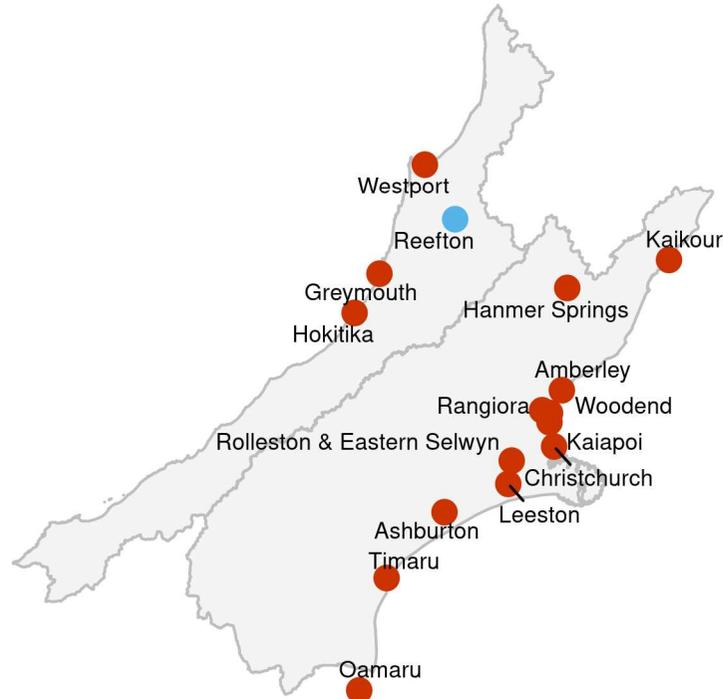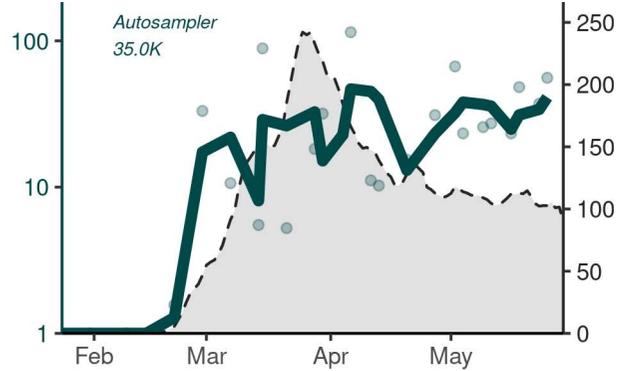
Autosampler
3.9K

Christchurch

Autosampler
368.0K

Timaru

Autosampler
28.0K

Ashburton

Autosampler
18.0K

Rolleston & Eastern Selwyn

Autosampler
35.0K

Reefton

Grab
1000

Westport
Reefton
Kaikoura
Greymouth
Hanmer Springs
Hokitika
Amberley
Rangiora
Woodend
Rolleston & Eastern Selwyn
Kaiapoi
Christchurch
Leeston
Ashburton
Timaru
Oamaru

Status   ● Detected   ● Not detected

23

Westport

Grab
5.0K

Rangiora

Grab
19.0K

Woodend

Grab
7.6K

Kaiapoi

Grab
12.5K

Kaikoura

Grab
2.4K

Greymouth

Grab
10.0K

Hokitika

Grab
2.9K

Amberley

Grab
1.8K
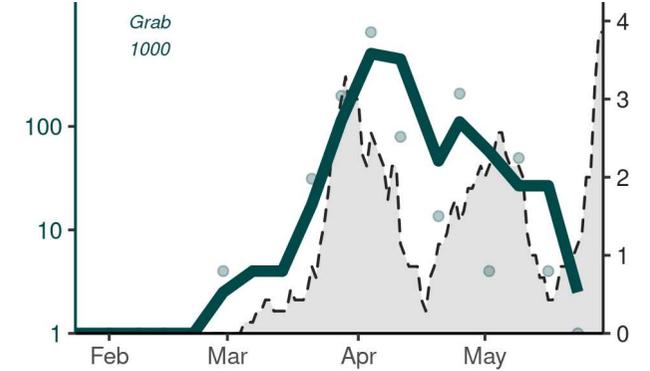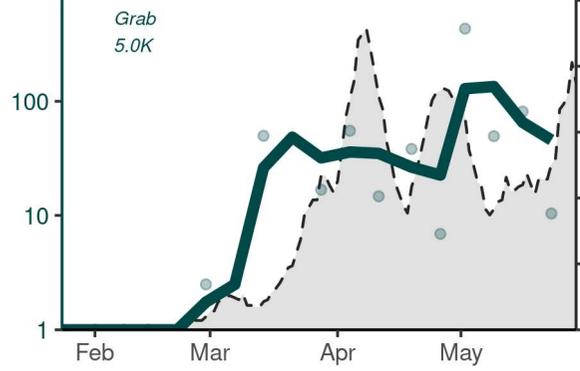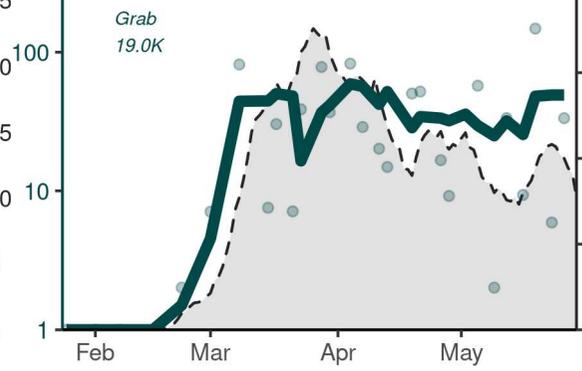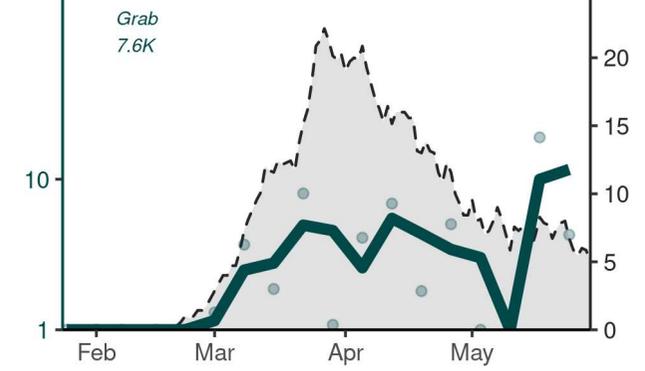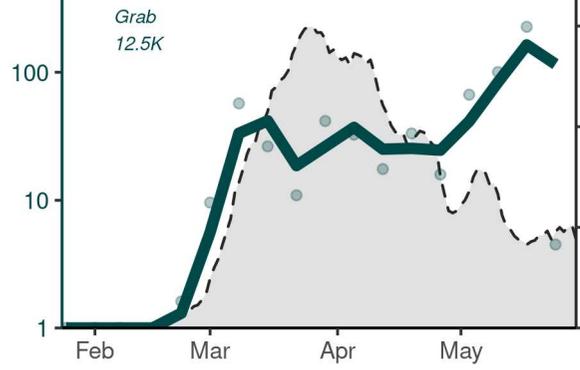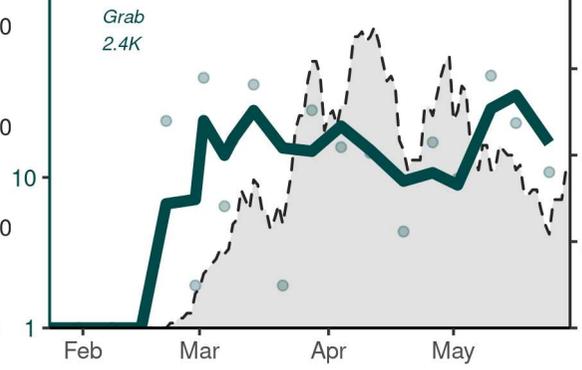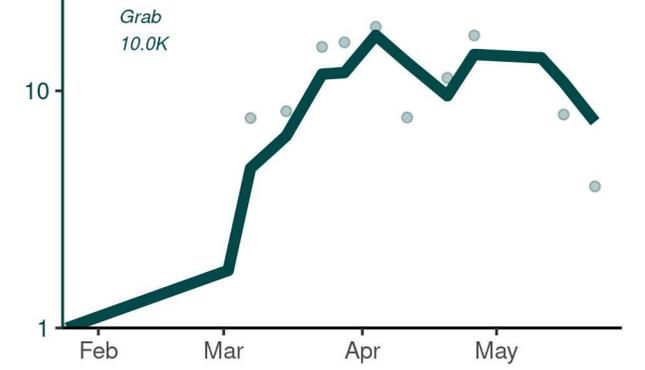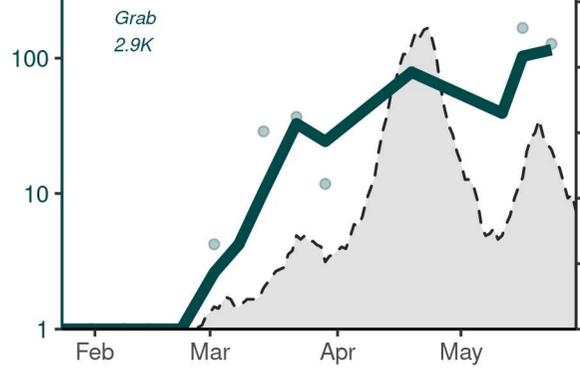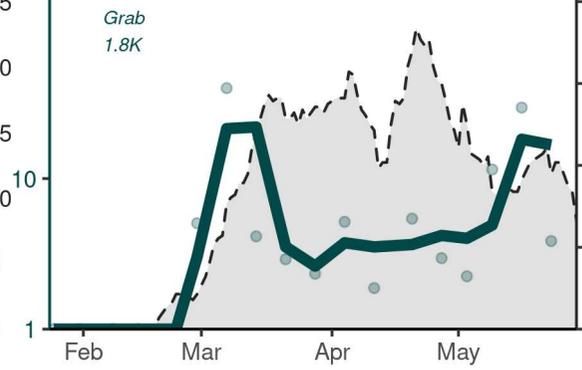
Otago and Southland

Dunedin (Mosgiel)
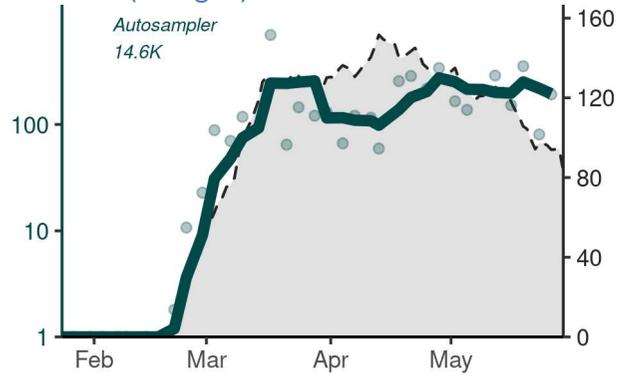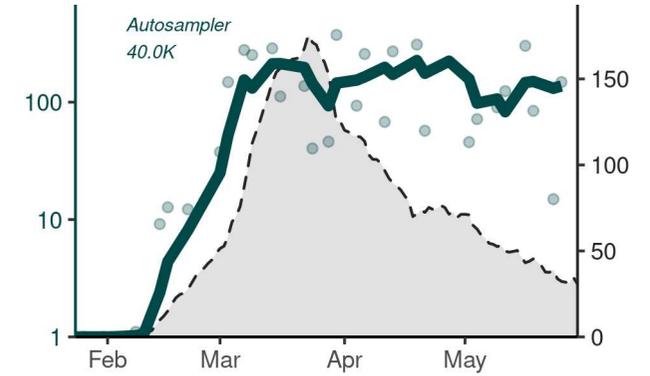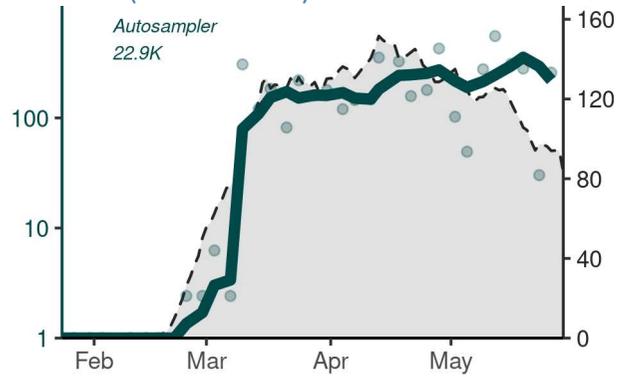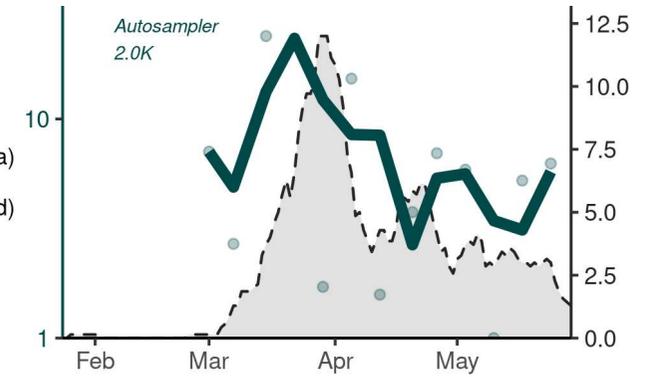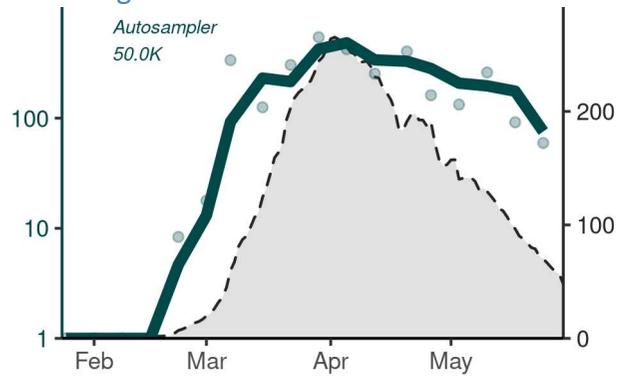
Autosampler 14.6K

Queenstown

Autosampler 40.0K

Dunedin (Green Island)

Autosampler 22.9K

Bluff

Autosampler 2.0K

Wanaka

Queenstown

Cromwell

Alexandra

Dunedin (Mosgiel) — Dunedin (Tahuna)

Dunedin (Green Island)

Gore

Balclutha

Invercargill

Bluff

Invercargill

Autosampler 50.0K

Status ● Detected ● Not detected

Dunedin (Tahuna)

Autosampler 84.0K

Alexandra

Autosampler
6.2K

Wanaka

Grab
14.5K

Gore

Autosampler
8.0K

Balclutha

Grab
4.1K

Cromwell

Autosampler
7.1K
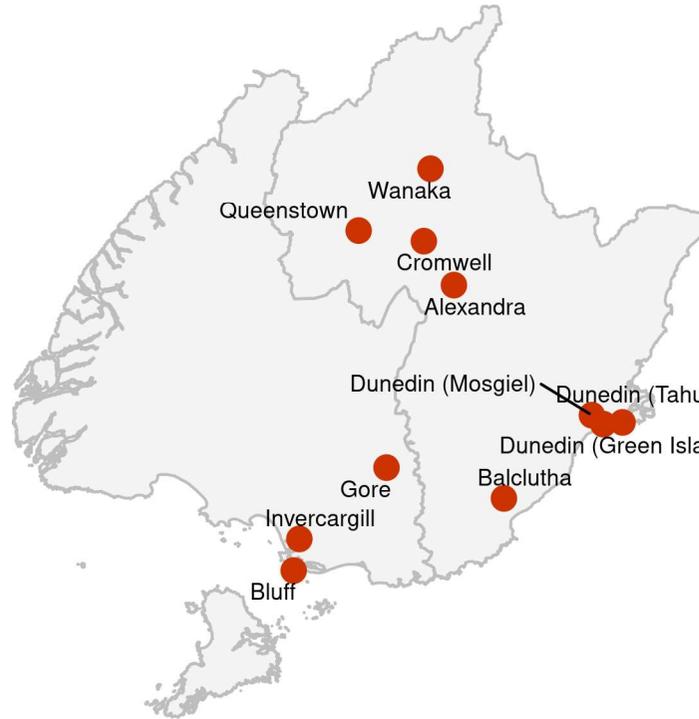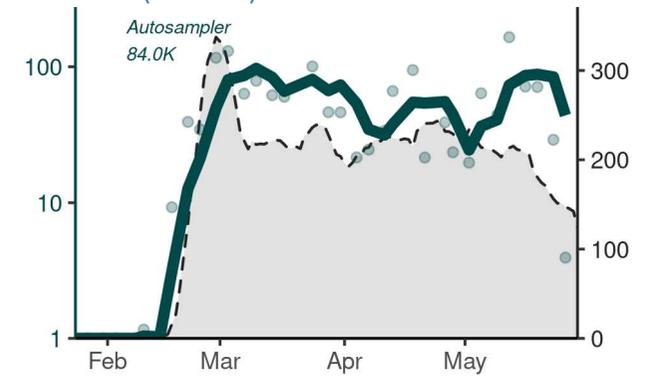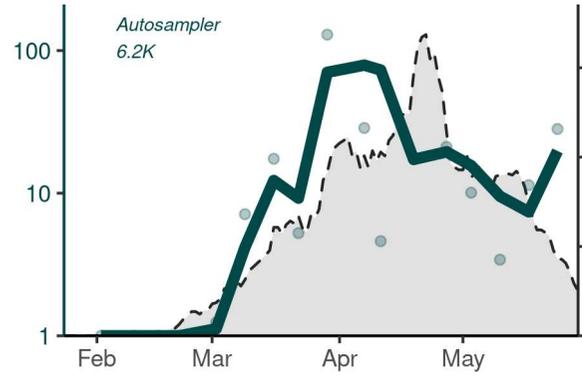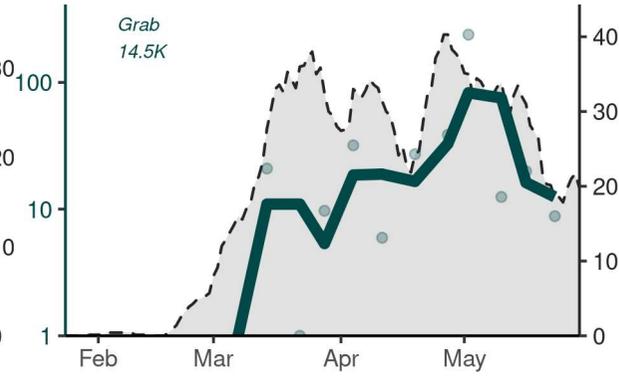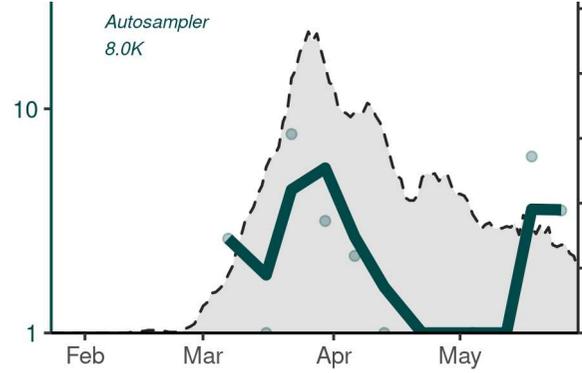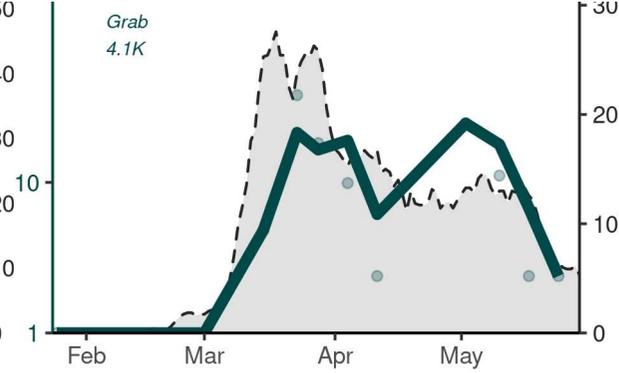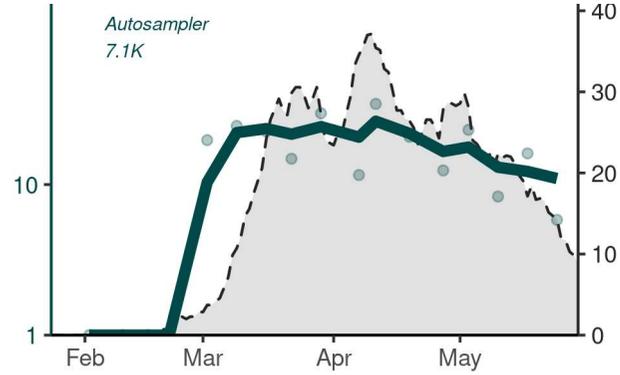
Weekly summary

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

Site	2021																	2022																				
	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21
Northland																																						
Ahipara																																						
Awanui																																						
Dargaville																																						
Haruru																																						
Hihi																																						
Hikurangi																																						
Kaeo																																						
Kaikohe																																						
Kaitaia																																						
Kaiwaka																																						
Kawakawa																																						
Kerikeri																																						
Kohukohu																																						
Mangawhai																																						
Maungaturoto																																						
Opononi																																						
Paihia																																						
Rangiputa																																						
Rawene																																						
Ruakaka																																						
Russell																																						
Taipa																																						
Waipu																																						
Whangarei																																						
Whatuwhiwhi																																						
Auckland																																						
Army Bay																																						
Auckland (Combined)																																						
Auckland East																																						
Auckland Southwest																																						
Auckland West																																						
Beachlands																																						
Clarks Beach																																						
Helensville																																						
Kawakawa Bay																																						
Kingseat																																						
North Shore																																						
Omaha																																						
Pukekohe																																						
Snells/Algies																																						
Waiheke Island																																						
Waiuku																																						
Warkworth																																						
Wellsford																																						
Waikato																																						
Cambridge																																						
Coromandel																																						
Hamilton																																						
Huntly																																						
Kihikihi																																						
Kinloch																																						
Mangakino																																						
Maramarua																																						
Matamata																																						
Matangi																																						
Meremere																																						
Morrinsville																																						
Motuoapa																																						
Ngaruawahia																																						
Ngatea																																						
Omori																																						
Otorohanga																																						
Paeroa																																						

Site	2021																	2022																	
	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21
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 Maunganaui																																						
Murupara																																						
Ohope																																						
Opotiki																																						
Rotorua																																						
Taneatua																																						
Tauranga																																						
Te Puke																																						
Waihi Beach																																						
Whakatane																																						
Gisborne																																						
Gisborne																																						
Hawke's Bay																																						
Hastings																																						
Mahia																																						
Napier																																						
Otane																																						
Porangahau																																						
Takapau																																						
Te Paerahi																																						
Waipawa																																						
Waipukurau																																						
Wairoa																																						
Taranaki																																						
Eltham																																						
Hawera																																						
Kaponga																																						
Manaia																																						
New Plymouth																																						
Opunake																																						
Patea																																						
Stratford																																						
Waverley																																						
Manawatu-Whanganui																																						
Dannevirke																																						
Eketahuna																																						
Feilding																																						
Hunterville																																						
Levin																																						
Pahiatua																																						
Palmerston North																																						
Taumarunui																																						
Whanganui Urban																																						
Woodville																																						
Wellington																																						
Carterton																																						
Featherston																																						

Site	2021																	2022																				
	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21
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																																						
Kaikoura																																						
Leeston																																						
Methven																																						
Oamaru																																						
Oxford																																						
Rangiora																																						
Rolleston & Eastern Selwyn																																						
Timaru																																						
Waimate																																						
Woodend																																						
Otago																																						
Alexandra																																						
Balclutha																																						
Cromwell																																						
Dunedin (Green Island)																																						
Dunedin (Mosgiel)																																						
Dunedin (Tahuna)																																						
Milton																																						
Queenstown																																						
Wanaka																																						
Southland																																						
Bluff																																						
Gore																																						
Invercargill																																						

Acknowledgements

Notes

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

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

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

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

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

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

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

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

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