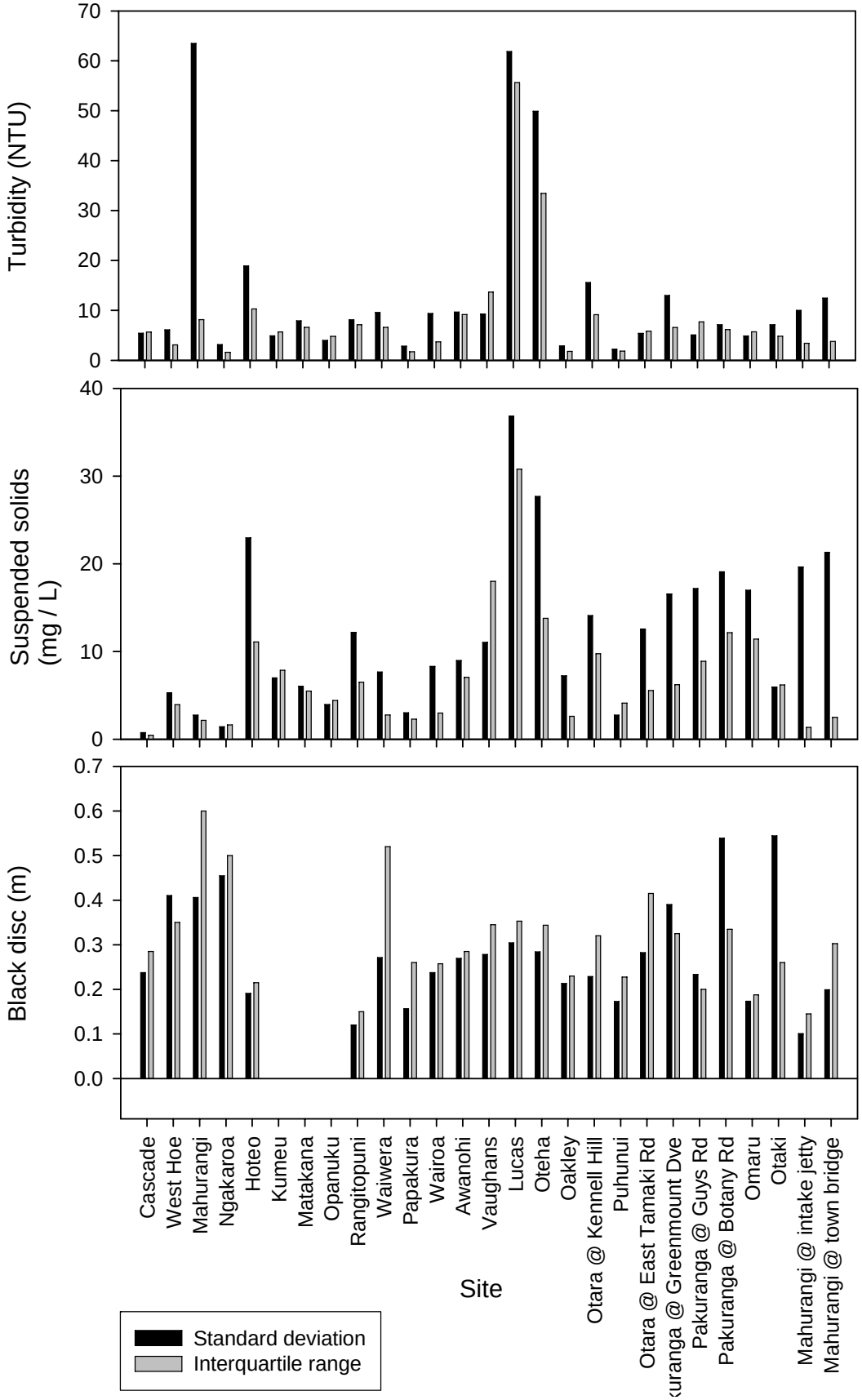
Figure 4.1h : Stream water quality results. Bar graphs (showing standard deviation and interquartile ranges) of water quality parameters obtained from monthly samples at each monitoring site in 2004.



4.2 Lakes

Results presented here are for the 2004-year only, except time series comparisons and summary statistical data in the appendices, which include data beginning 1988. Little interpretation of inter-annual results is provided. For a comprehensive analysis of water quality of the lakes (state and trend) covering the period from spring 1992 to summer 2005 see ARC Technical Publication No. 268 (ARC, 2005).

For 2004 summary tables of chemical and bacteriological data, see Appendix 2.

Lake Kereta data is in Table 8.1, Lake Kuwakatai (Table 8.2), Lake Ototoa (Table 8.3), Lake Pupuke (Table 8.4), Lake Spectacle (Table 8.5), Lake Tomerata (Table 8.6), and Lake Wainamu data is presented in Table 8.7.

Time-series plots of each parameter, presenting data back to 1988, follow the above tables in Appendix 2, Tables 8.8a and 8.8b.

Lake Kereta

Concentrations of the plant nutrients nitrogen and phosphorus and levels of the photosynthetic pigment chlorophyll *a* indicate Lake Kereta is eutrophic (nutrient enriched). High pH, which peaked in summer, also indicates primary productivity typical of enriched waterbodies.

Lake Kuwakatai

Lake Kuwakatai was supertrophic (nutrient saturated) throughout 2004. Indicators of primary productivity were high, although interestingly chlorophyll *a* levels were highest in the winter sample. A high concentration of ammoniacal nitrogen from the bottom waters in May indicates suppression of nitrification due to anoxia-mediated processes. Total suspended solid concentration was high throughout the year. Water clarity fluctuated between 1 and 2 metres (mean 1.5 m).

Lake Ototoa

Lake Ototoa consistently had the best water quality of the seven lakes monitored. The Lake was mesotrophic (moderately enriched), relatively clear (mean Secchi depth 4.8 m), and had low chlorophyll *a* concentrations. Chlorophyll *a* was highest in November, lowest in May. Total suspended solid concentration was low throughout the year.

Lake Pupuke

Water quality was generally good in Lake Pupuke during 2004; with a peak Secchi depth of 6.8 m in May indicating water clarity can be quite high. Despite this the lake is eutrophic with high levels of the plant nutrients nitrogen and phosphorus. Concentrations of these nutrients in the bottom waters, particularly ammonia, indicate that thermal stratification influences water quality. A seasonal pattern in chlorophyll *a* was observed with concentrations highest in April.

Lake Spectacle.

Lake Spectacle consistently had the lowest water quality of the seven monitored. The Lake was hypertrophic (nutrient overloaded), with low water clarity (mean Secchi depth 0.2 m), high total suspended solids, high total phosphorus and very high chlorophyll *a* concentrations. Chlorophyll *a* was highest in February, with a secondary peak in August. Faecal coliforms were abundant in May potentially indicating faecal contamination.

Lake Tomarata

Lake Tomarata was eutrophic with high levels of the plant nutrients nitrogen and phosphorus. Water clarity was reasonable and ranged between 1 to 3 m (mean Secchi depth 1.9 m). Chlorophyll *a* concentrations showed a moderate degree of seasonality with highest concentration recorded in February. A high level of faecal bacteria was observed during May, which if correct suggests inputs of catchment derived faecal matter during periods of high flows.

Lake Wainamu

Lake Wainamu had similar concentrations of nitrogen and phosphorus as Lake Tomarata and is classified as eutrophic. Water clarity however was not as good (Secchi depth 0.3 – 1.2 m) and appeared limited by high total suspended solid concentrations. Peak chlorophyll *a* was recorded in August.

4.3 Coastal

Patterns in seawater quality during 2004 were consistent with those observed in previous years. Salinity levels were lowest and most variable in the estuarine sites of the upper Waitemata Harbour, Mahurangi Harbour, and Weymouth (Figs. 4.3a and 4.3d), reflecting the confined nature of these sites and relatively large freshwater inputs. Salinity levels at Mangere, Puketütü Island, and Panmure Bridge also tended to be slightly lower and more variable than at the remaining sites. Salinity outliers at Dawsons Creek and Warkworth Town Basin recorded on 21 July were coincident with a high intensity storm event in the Mahurangi catchment (Fig. 4.3h). This event also caused elevated suspended solids, turbidity, and total phosphate levels, and a decline in pH at the two sites. Overall, Warkworth Town Basin had the lowest, median levels of pH, salinity and dissolved oxygen (Fig. 4.3a), and highest levels of faecal contaminants (Fig. 4.3b), due to it's location at the very top of the harbour, low volumes of sea water relative to freshwater inputs, bird effluent (predominantly ducks), stormwater runoff (urban and rural), and the Warkworth sewage treatment plant.

Suspended solids and turbidity levels were lowest and least variable at the east coast sites: Goat Island, Ti Point, Mahurangi Heads, Orewa and Browns Bay (Figs. 4.3a, 4.3b and 4.3d). Apart from the 21 July sample (see above), suspended solids and turbidity levels at the inner Mahurangi Harbour sites were comparable with those from the

Waitemata Harbour (upper and lower) and outer Tamaki. Suspended solids and turbidity levels tended to be highest and most variable at Panmure, in the Manukau Harbour and at the Kaipara Harbour site (Shelly Beach). Patterns of the faecal contaminants (faecal coliforms and Enterococci) were similar to those of suspended solids and turbidity, except that very high faecal contaminant levels were regularly recorded in Warkworth town basin (Figs. 4.3d, 4.3f (also see above)).

Despite significant reductions in nutrient inputs into the Manukau Harbour since the upgrade to the Mangere Sewage Treatment Plant, nutrient levels in the harbour are still higher and more variable than those recorded from other areas (Figs. 4.3c, 4.3e, and 4.3g). Highest levels of nitrite, nitrate, ammonia, total phosphate and dissolved reactive phosphate were recorded from the sites closest to the treatment plant: Mangere and Puketütü Island. The influence of the treatment plant also appears to be noticeable at Shag Point and Weymouth.

Nitrate levels were also elevated and more variable in the upper Waitemata Harbour, Tamaki Estuary, and in the two upper sites of Mahurangi Harbour, however, nutrient levels were generally low and stable at all of the remaining sites. Marked variations in primary production (chlorophyll a) were not observed, despite variations in nutrient levels across the region.

Figure 4.3a: Coastal water quality results. Box and whisker plots (showing medians, interquartile ranges, 90th percentiles and outliers) of water quality parameters obtained from monthly samples at each monitoring site in 2004. Sites are grouped by colour: red = exposed east coast, green = Mahurangi, blue = lower Waitemata Harbour, purple = upper Waitemata Harbour, yellow = Tamaki Estuary, grey = Manukau Harbour, and orange = Kaipara Harbour.

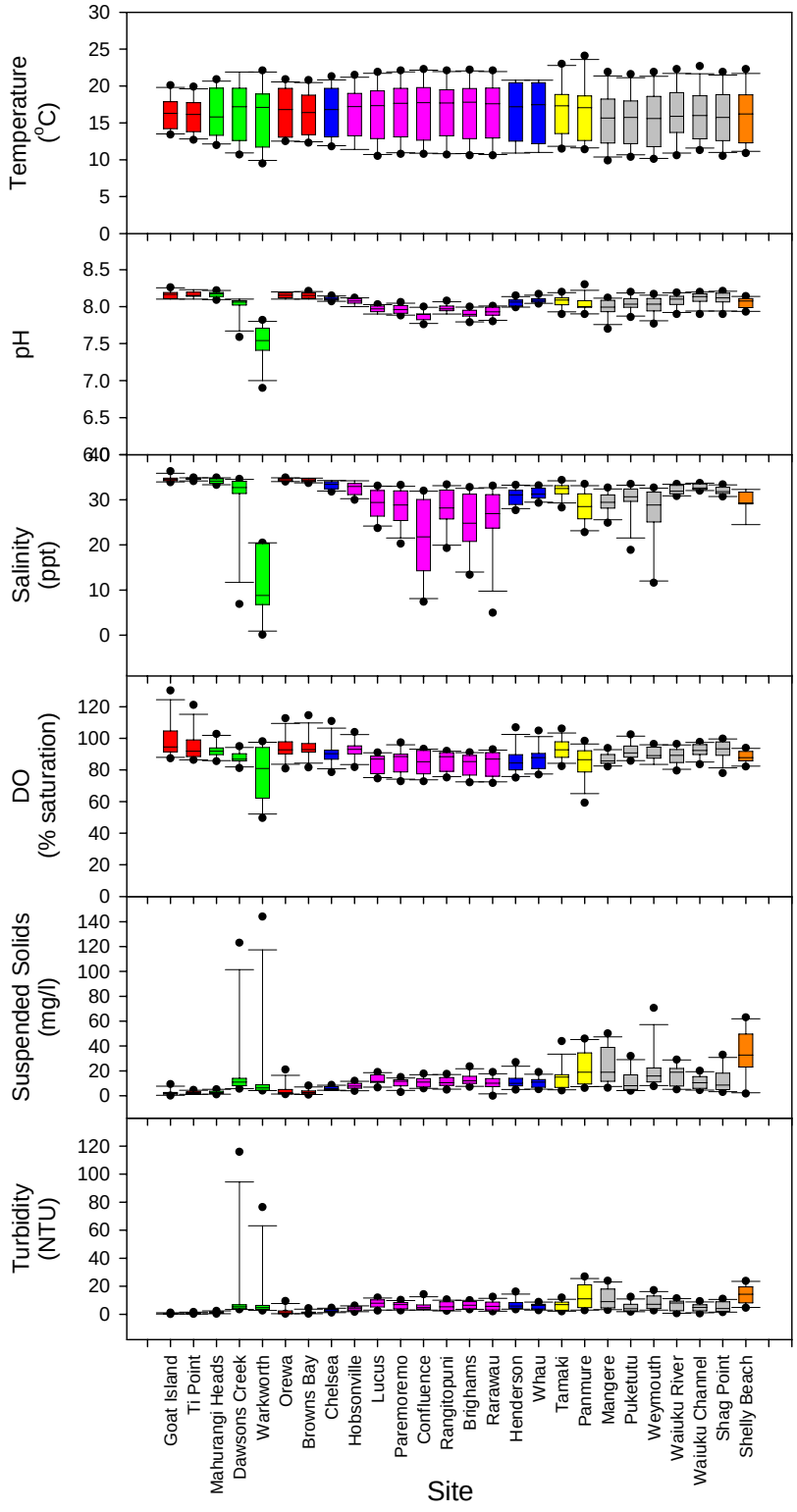


Figure 4.3b: Coastal water quality results. Box and whisker plots (showing medians, interquartile ranges, 90th percentiles and outliers) of water quality parameters obtained from monthly samples at each monitoring site in 2004. Sites are grouped by colour: red = exposed east coast, green = Mahurangi, blue = lower Waitemata Harbour, purple = upper Waitemata Harbour, yellow = Tamaki Estuary, grey = Manukau Harbour, and orange = Kaipara Harbour. The scales of both the turbidity and suspended solids axes have been reduced to highlight differences between sites. Full scale plots of these 2 parameters are provided in Fig. 4.3a above.

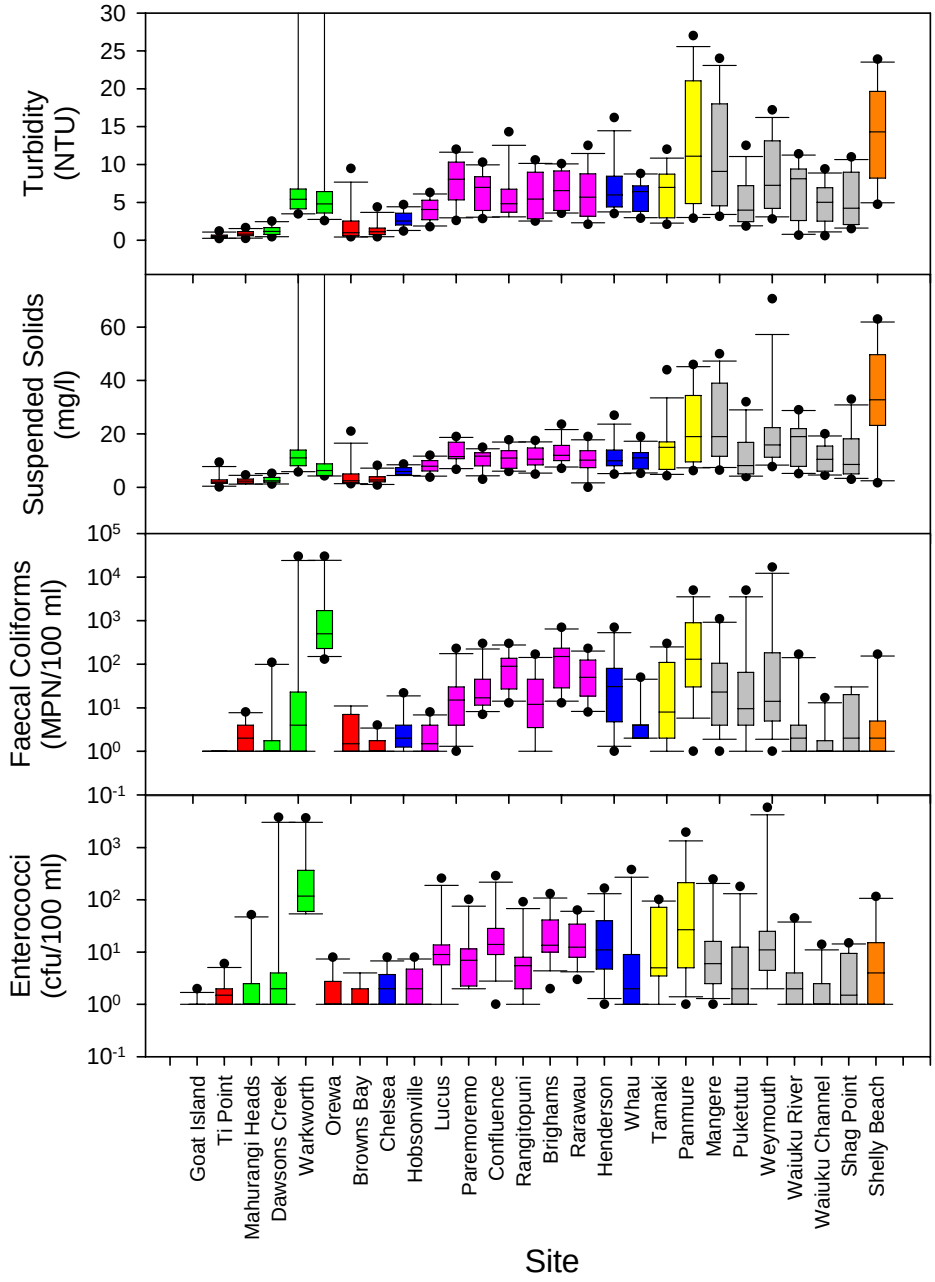


Figure 4.3c: Coastal water quality results. Box and whisker plots (showing medians, interquartile ranges, 90th percentiles and outliers) of water quality parameters obtained from monthly samples at each monitoring site in 2004. Sites are grouped by colour: red = exposed east coast, green = Mahurangi, blue = lower Waitemata Harbour, purple = upper Waitemata Harbour, yellow = Tamaki Estuary, grey = Manukau Harbour, and orange = Kaipara Harbour.

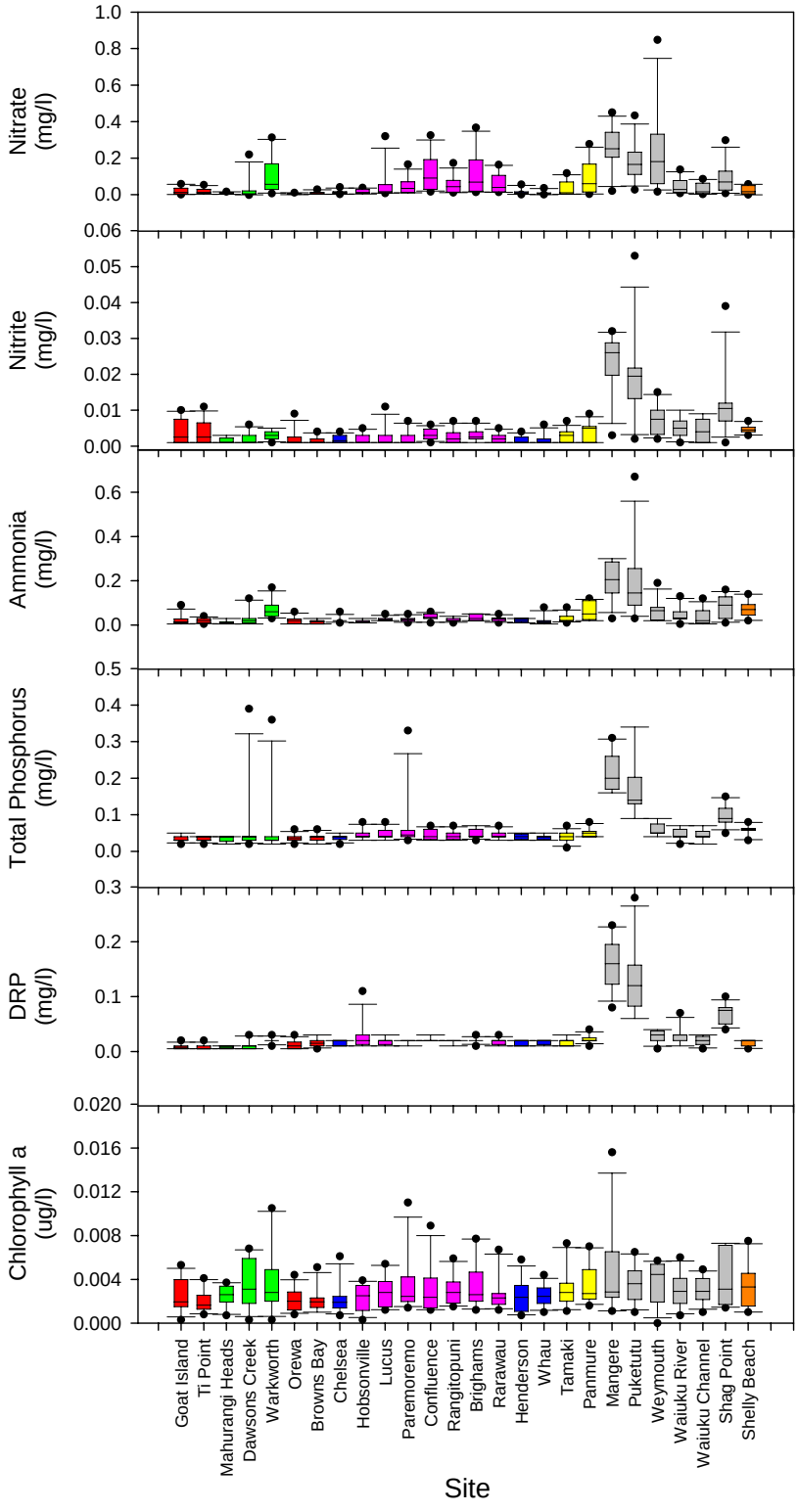


Figure 4.3d: Coastal water quality results. Interquartile ranges and standard deviations of water quality parameters obtained from monthly samples at each monitoring site in 2004.

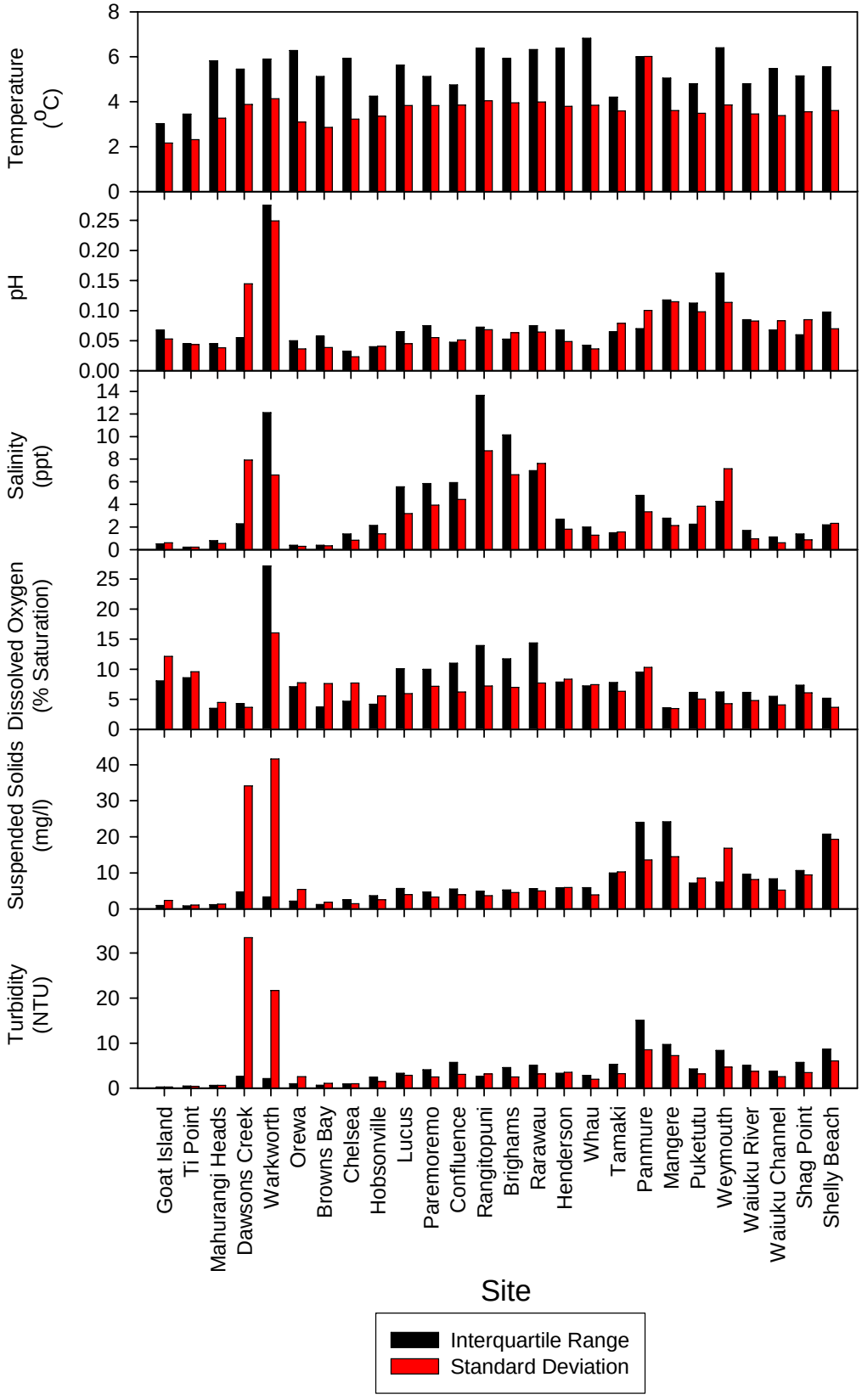


Figure 4.3e: Coastal water quality results. Interquartile ranges and standard deviations of water quality parameters obtained from monthly samples at each monitoring site in 2004.

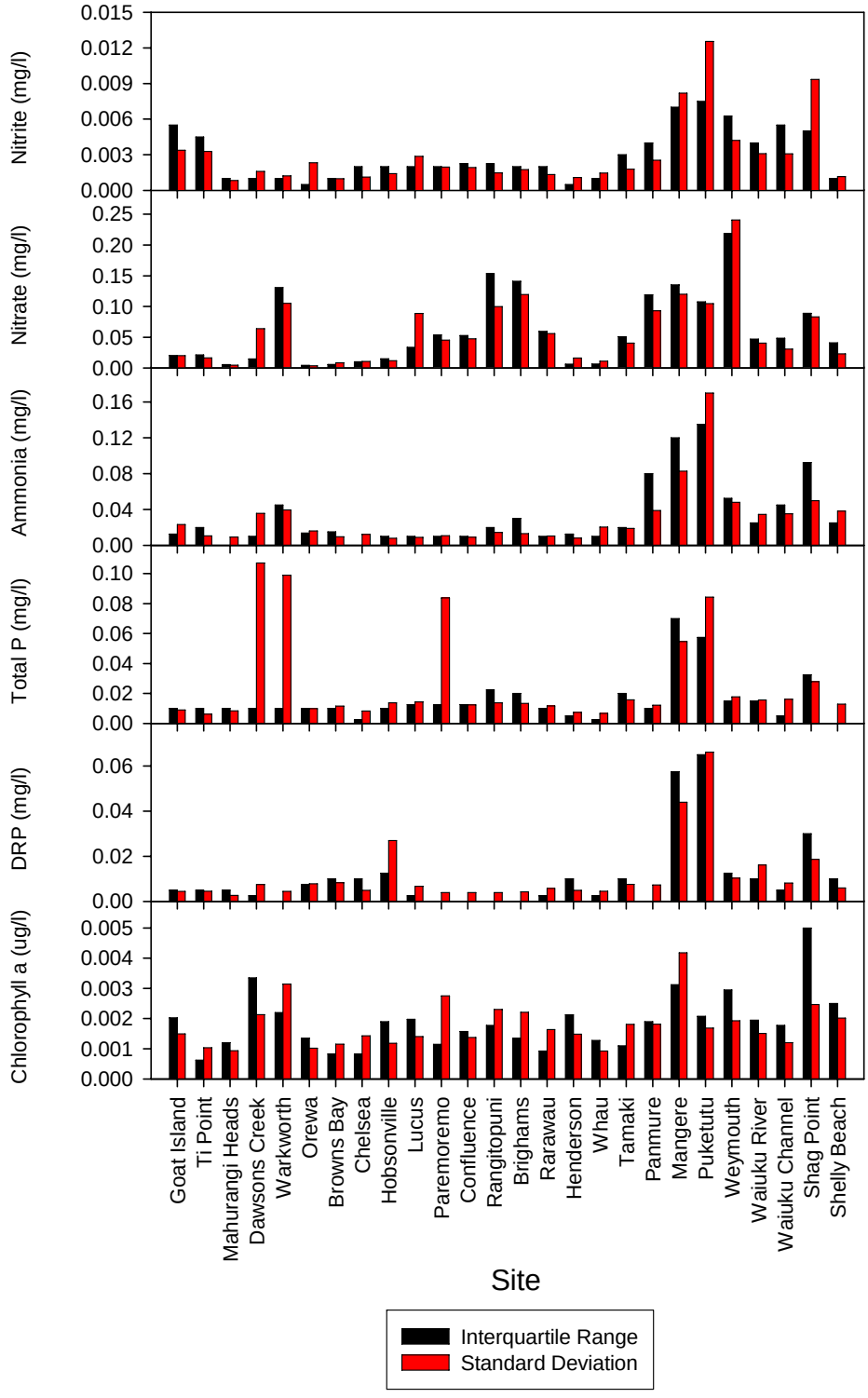


Figure 4.3f: Coastal water quality results. Relative median concentrations of suspended solids, Enterococci, and faecal coliforms, and levels of turbidity at coastal water quality sites during 2004.

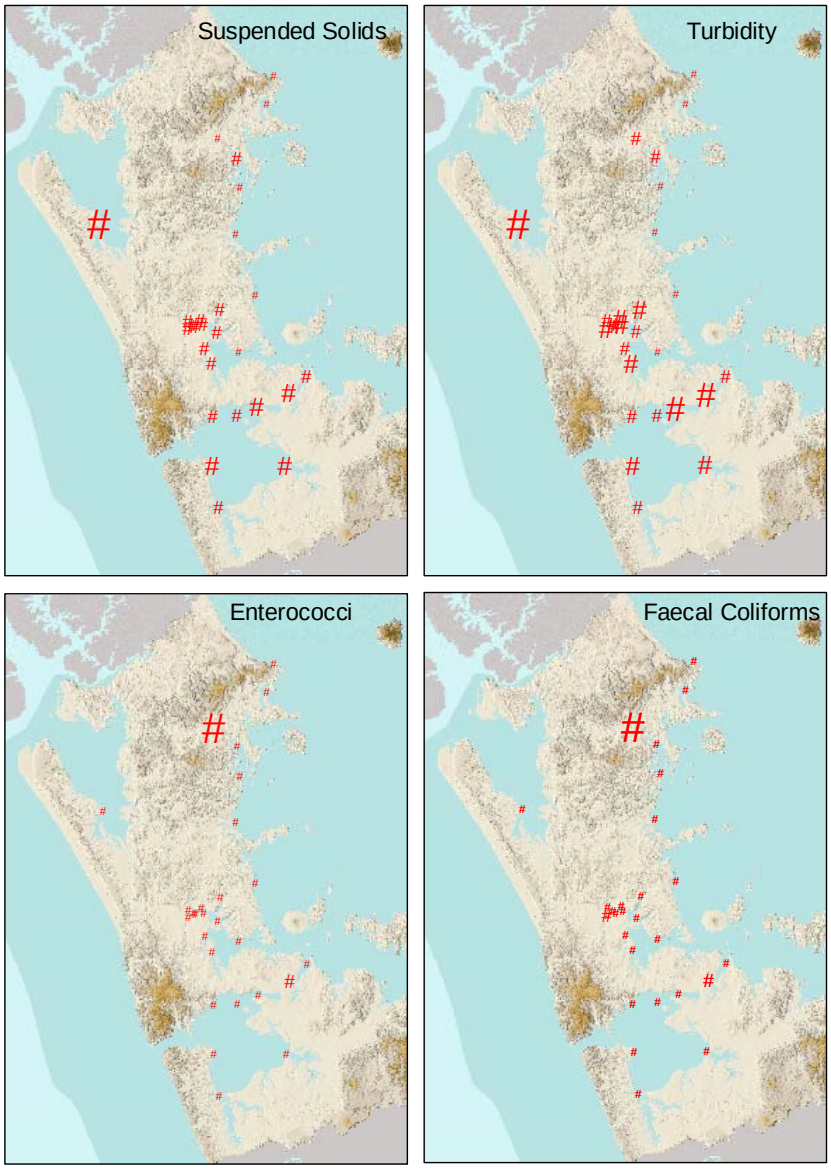


Figure 4.3g: Coastal water quality results. Relative median concentrations of ammonia, nitrate, total phosphorus and chlorophyll *a* at coastal water quality sites during 2004.

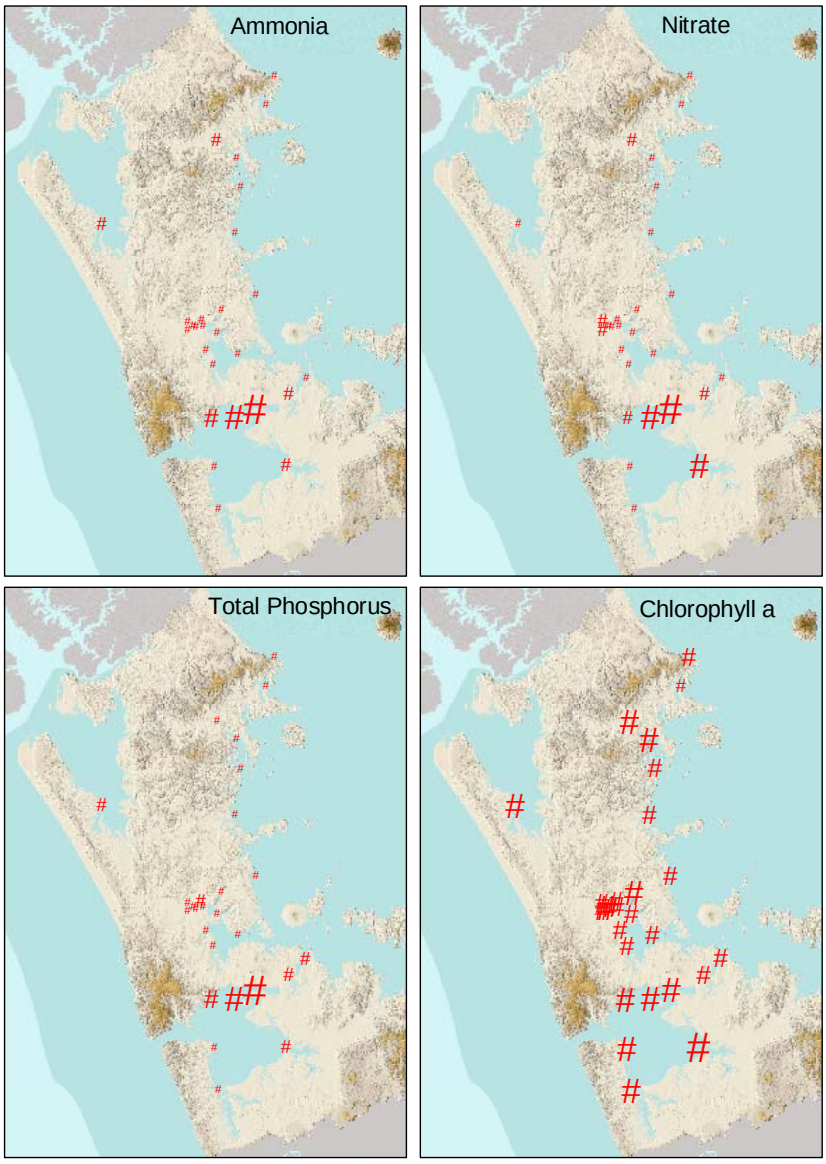
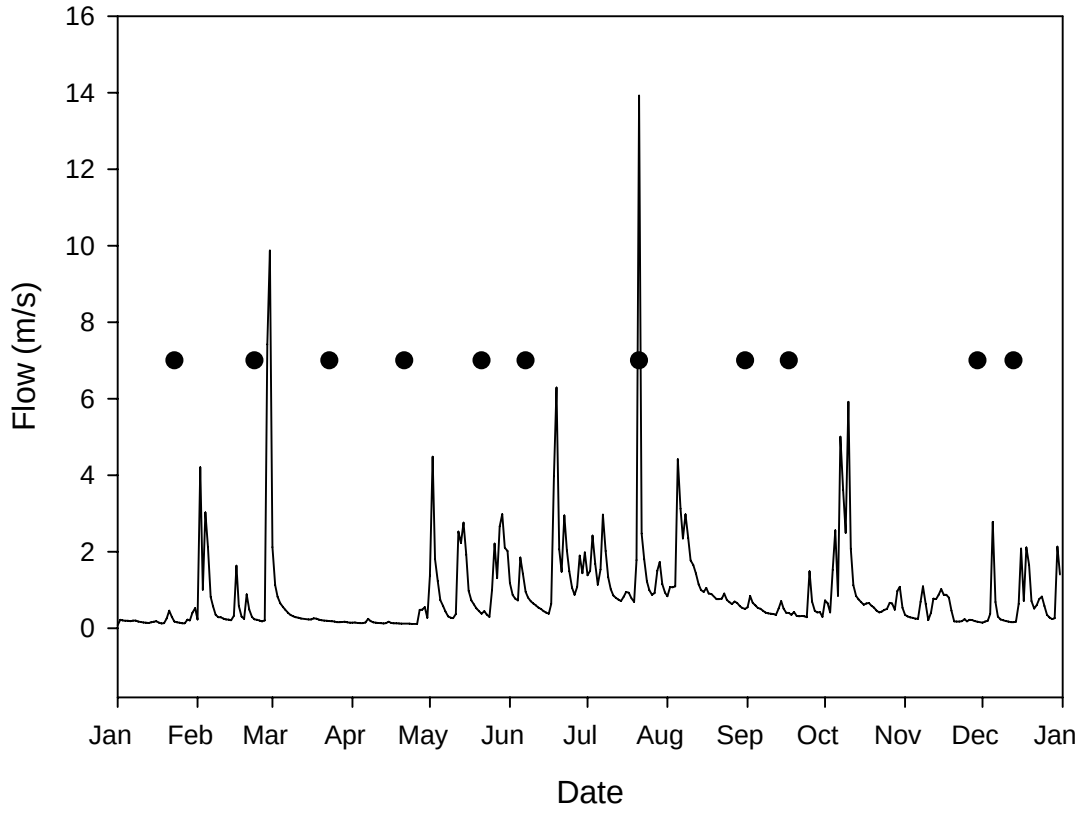


Figure 4.3h: Daily mean flow (m/s) of Mahurangi River recorded from the ARC's flow monitoring station located at Mahurangi College in 2004. Flow rate was recorded every 15 minutes. Filled circles indicate the days when Mahurangi coastal water quality samples were collected.



5 Conclusions

Water quality data were collected from 27 stream, 7 lake, and 27 coastal sites throughout 2004. The water quality data presents similar characteristics to data collected for these sites in previous years.

The recent upgrades to the Mangere Sewage Treatment Plant have significantly reduced Manukau Harbour nutrient inputs. However, nutrient levels in the harbour are still higher and more variable than those recorded from other areas.

6 References

ARC (2000). Year 2000 summary report : baseline water quality stream, lake, and saline waters. Prepared by: Wilcock, R.J.; and Stroud, M.J., Auckland Regional Council Technical Publication 132, 219 p.

ARC (2003). Water quality surveys of Mahurangi Harbour, Upper Waitemata Harbour and Tamaki Estuary 1992-2001. Prepared by Wilcock, R.J. and Kemp, C.L.S., Auckland Regional Council Technical Publication 191, 211 p.

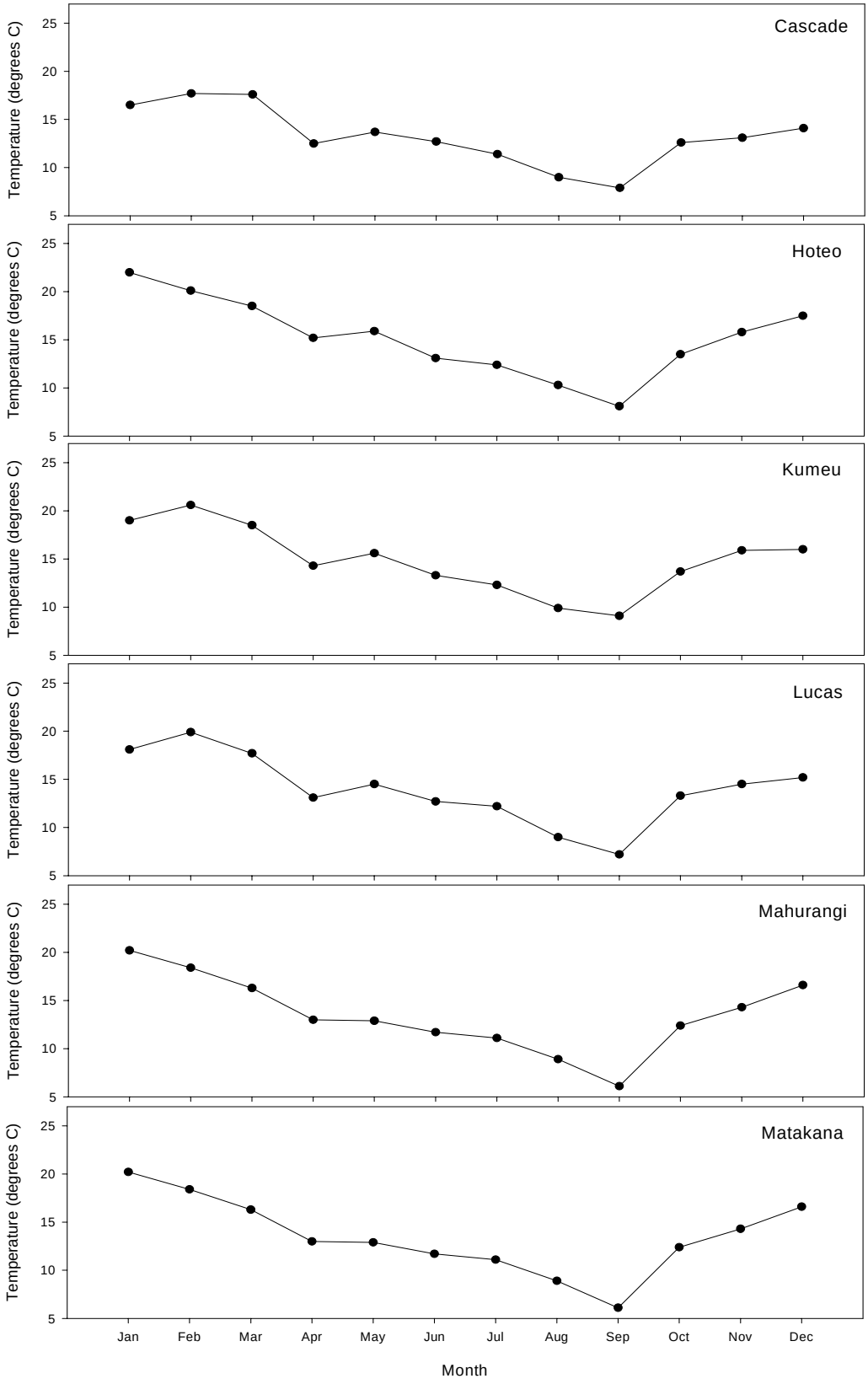
ARC (2005). Water quality trends in selected lakes of the Auckland Region (1992 – 2005). Auckland Regional Council Technical Publications No. 268, June 2005.

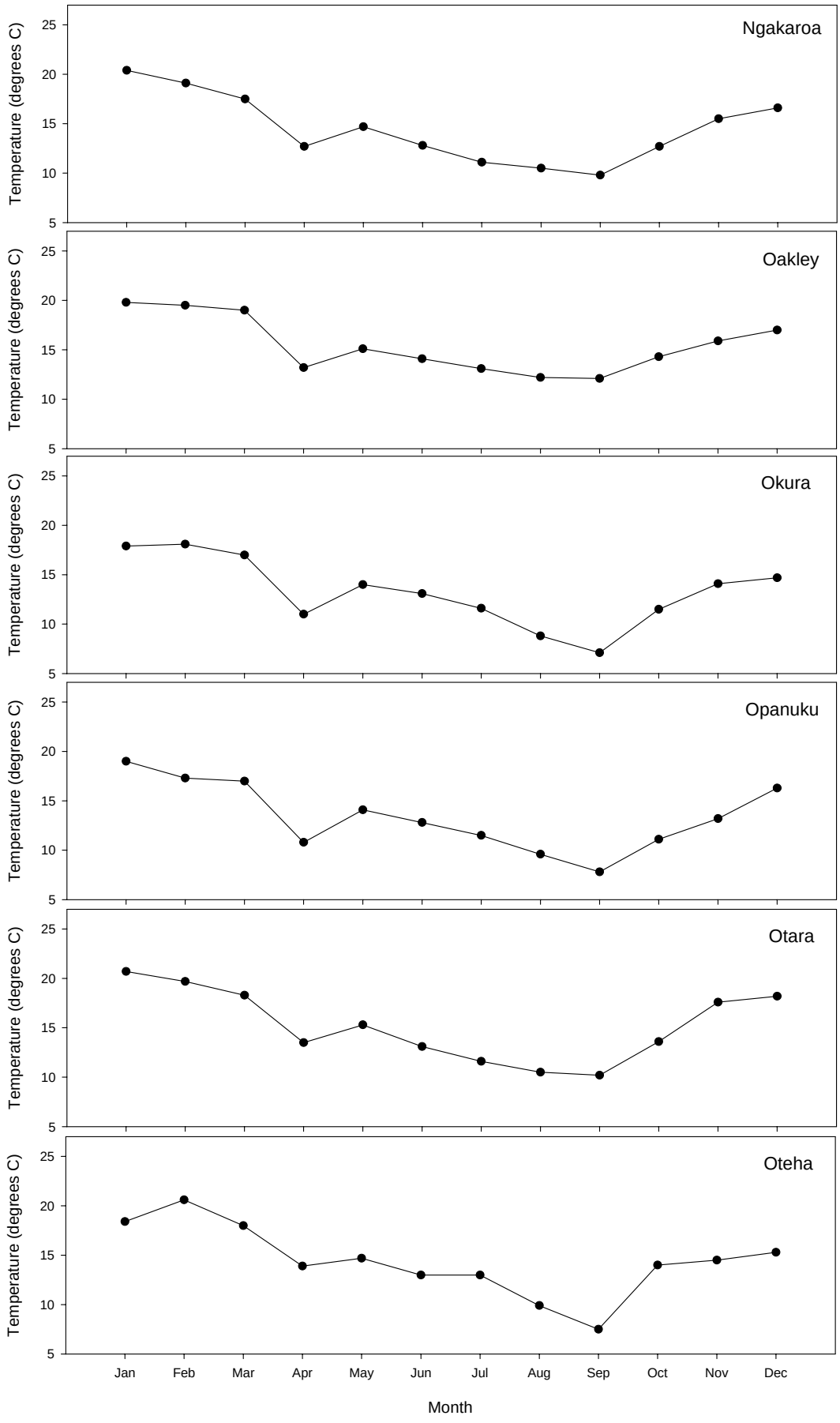
Mahurangi Estuary 2nd Edition (May 1999). ARC unpublished document.

Tämaki Estuary 3rd Edition (May 2002). ARC unpublished document.

Rivers 4th Edition (July 2002). ARC unpublished document.

7 Appendix 1: streams water quality parameters - 2004 time series plots.

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Okura
Opanuku
Otara
Oteha
Temperature (degrees C)
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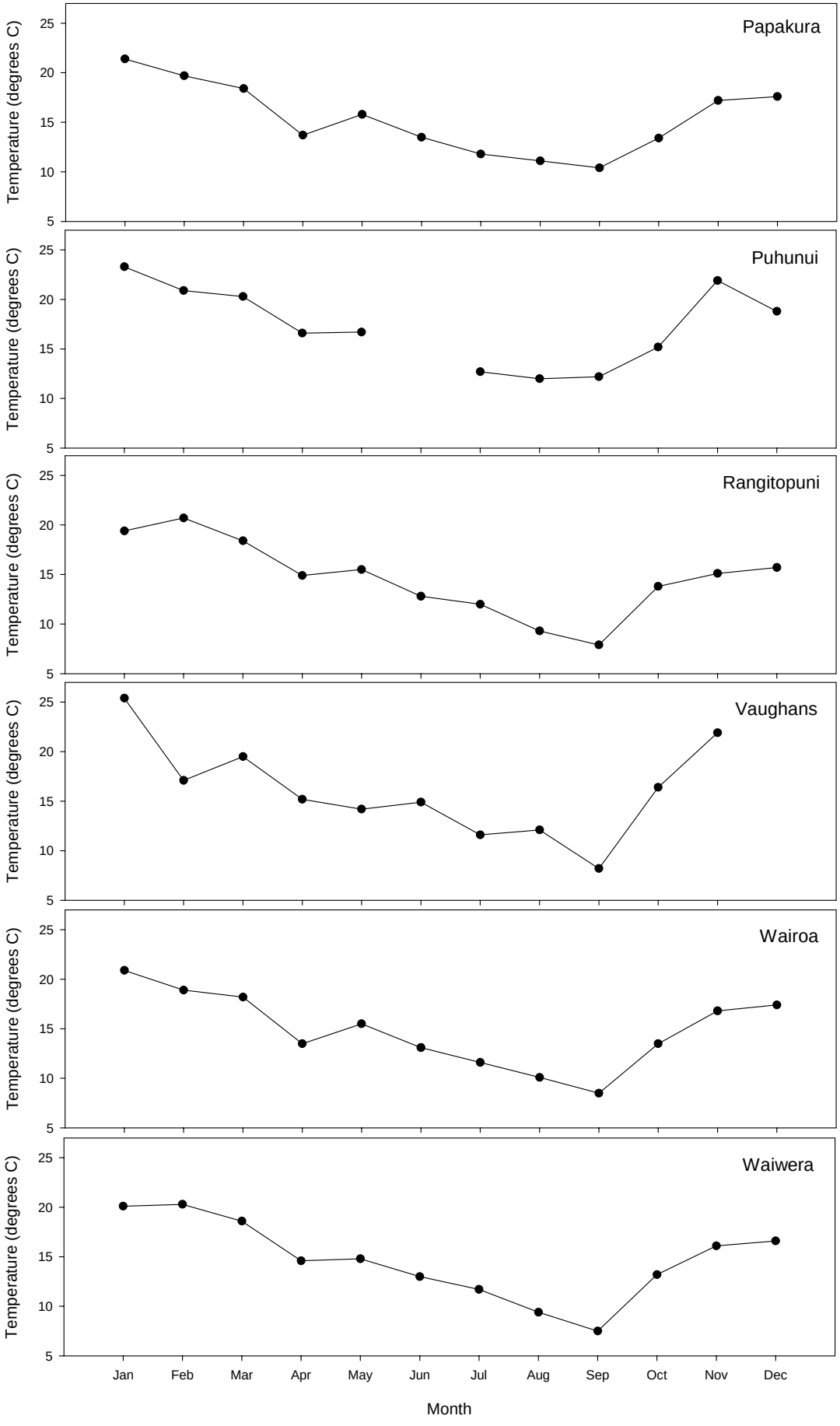
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Vaughans
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Temperature (degrees C)
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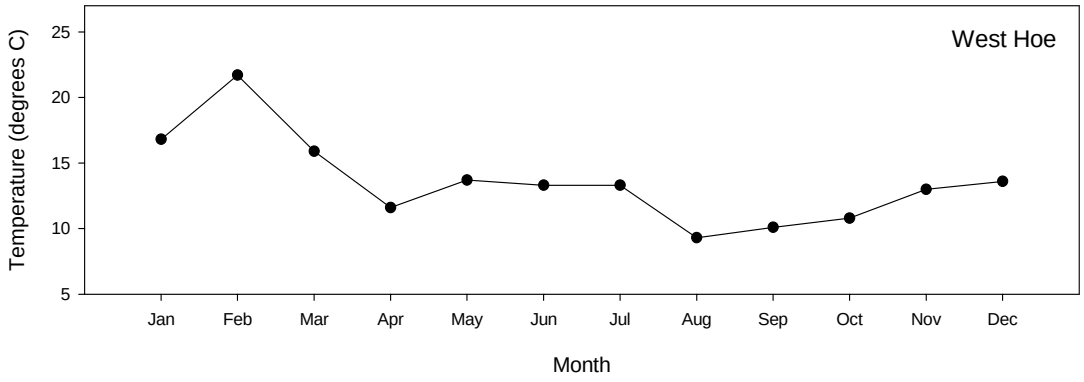
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Temperature (degrees C)
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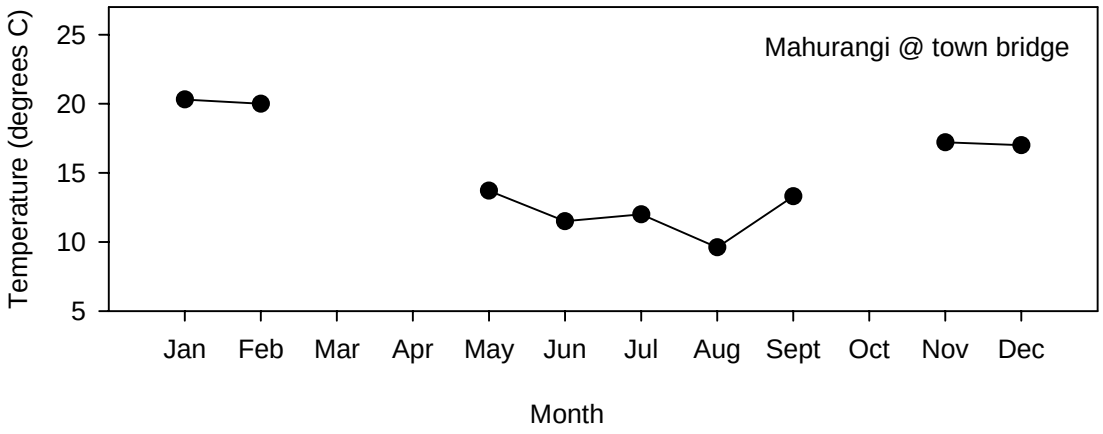
Mahurangi @ town bridge
Temperature (degrees C)
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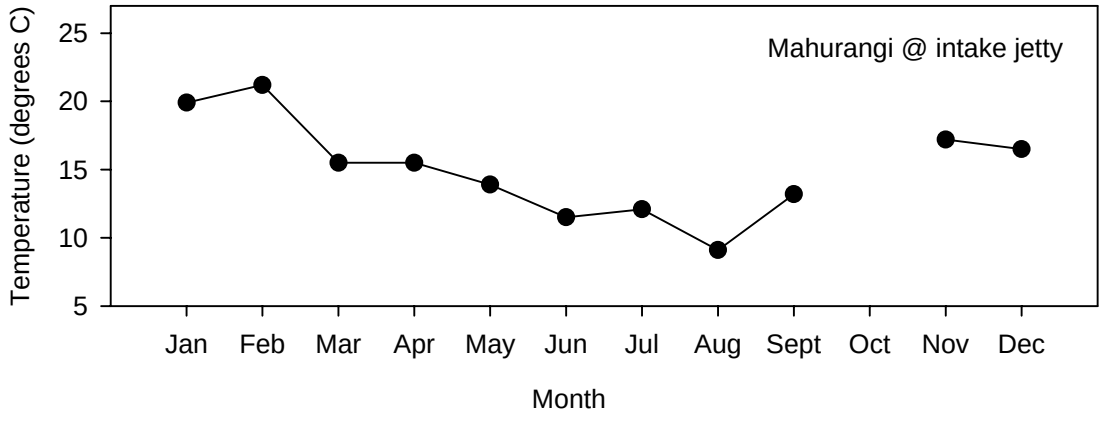
Mahurangi @ intake jetty
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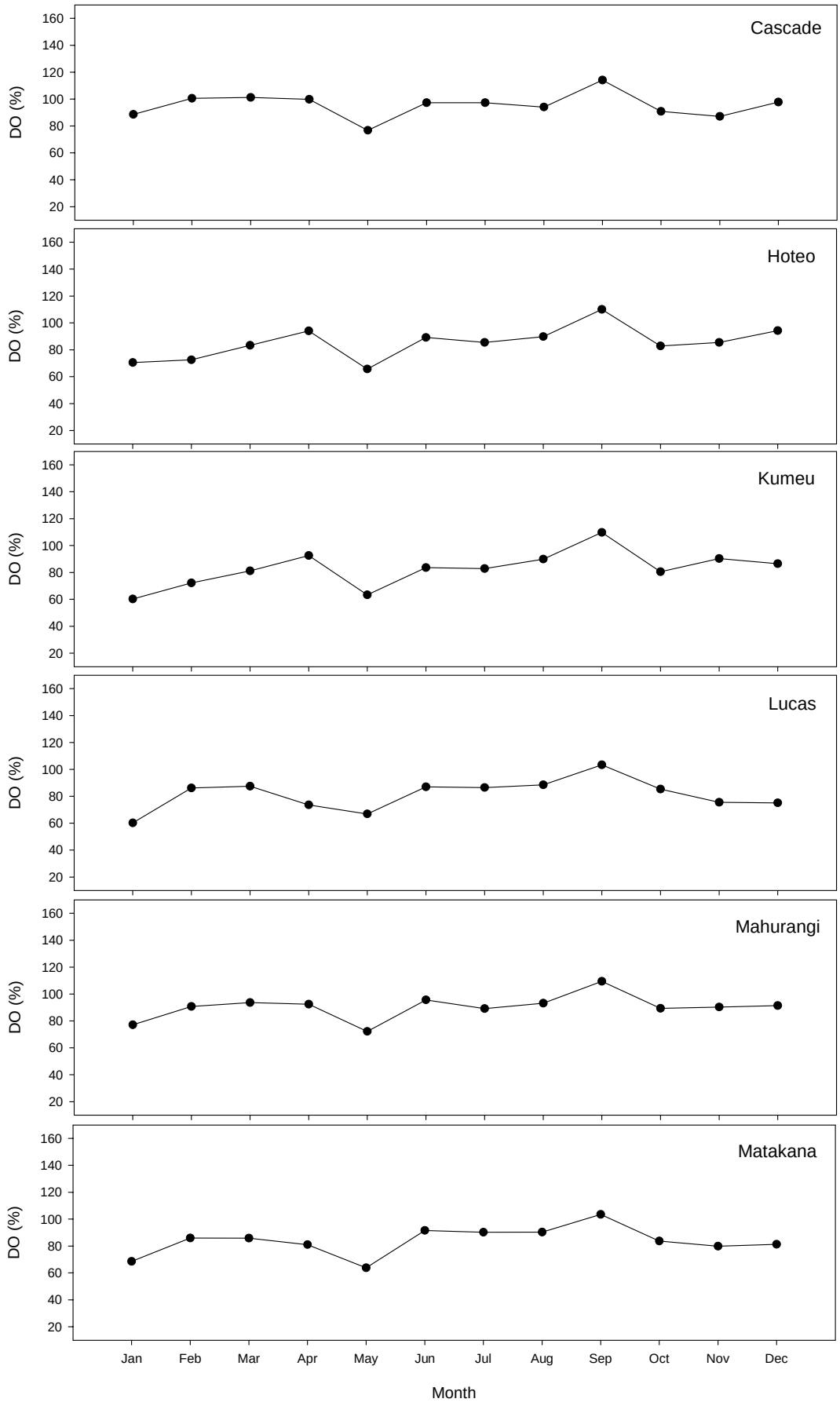
Cascade
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Mahurangi
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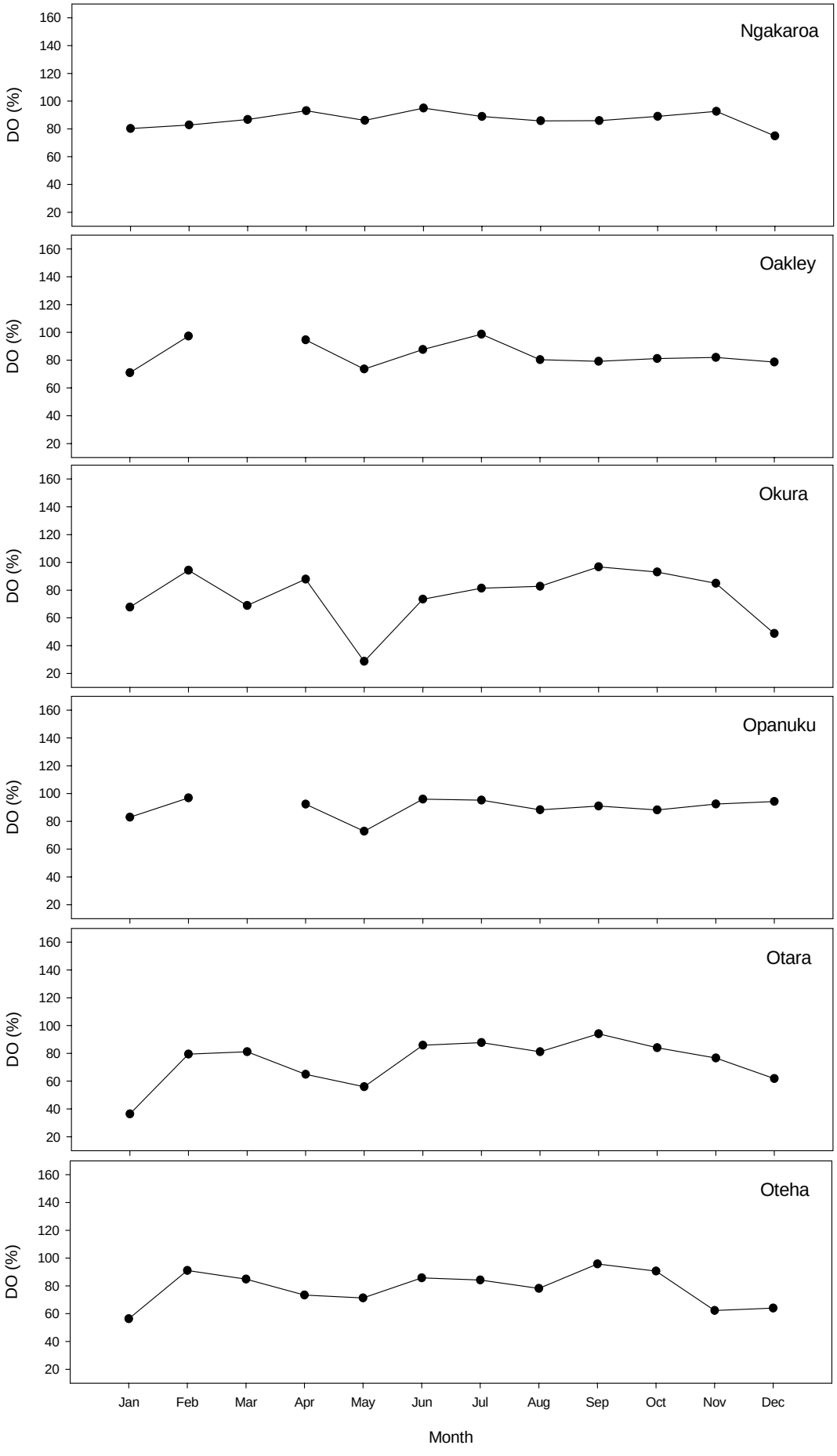
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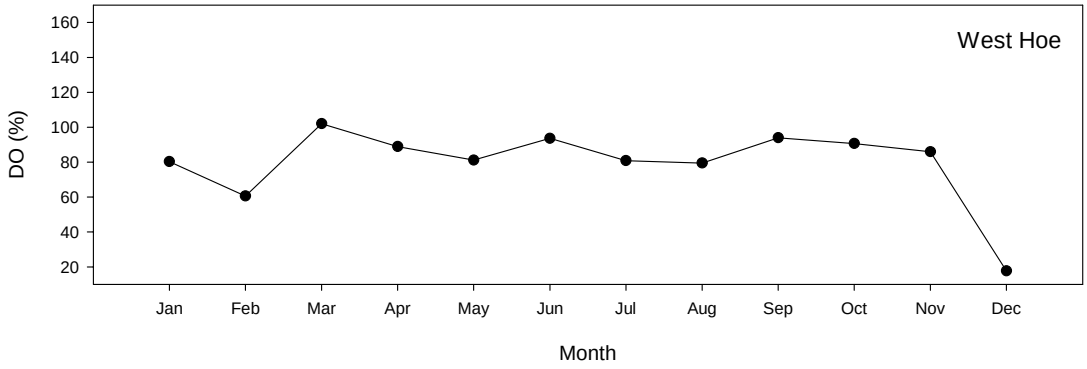
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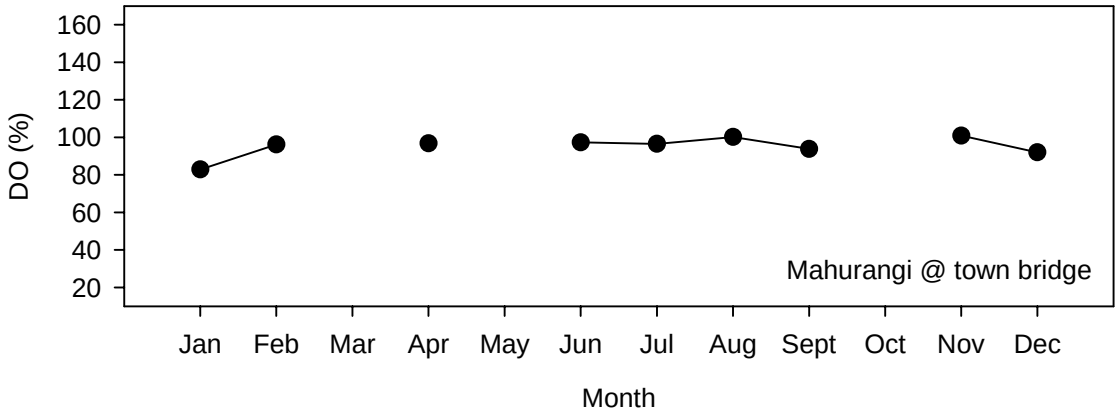
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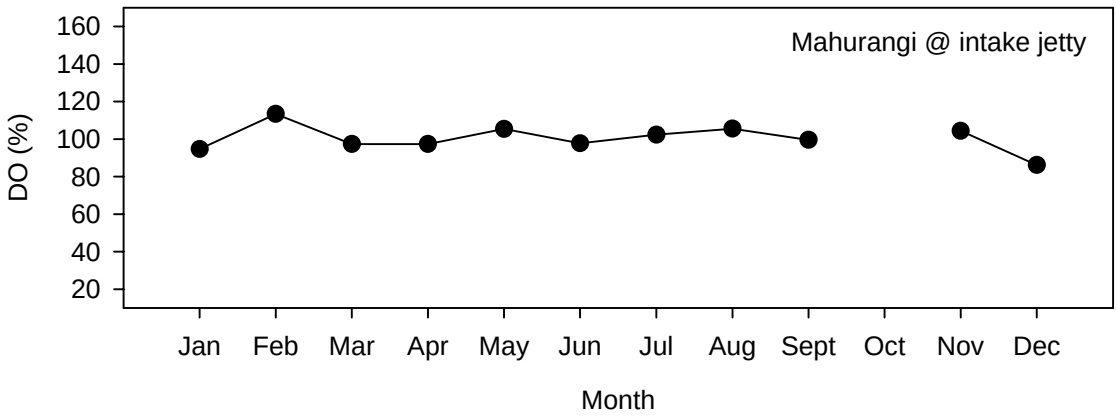
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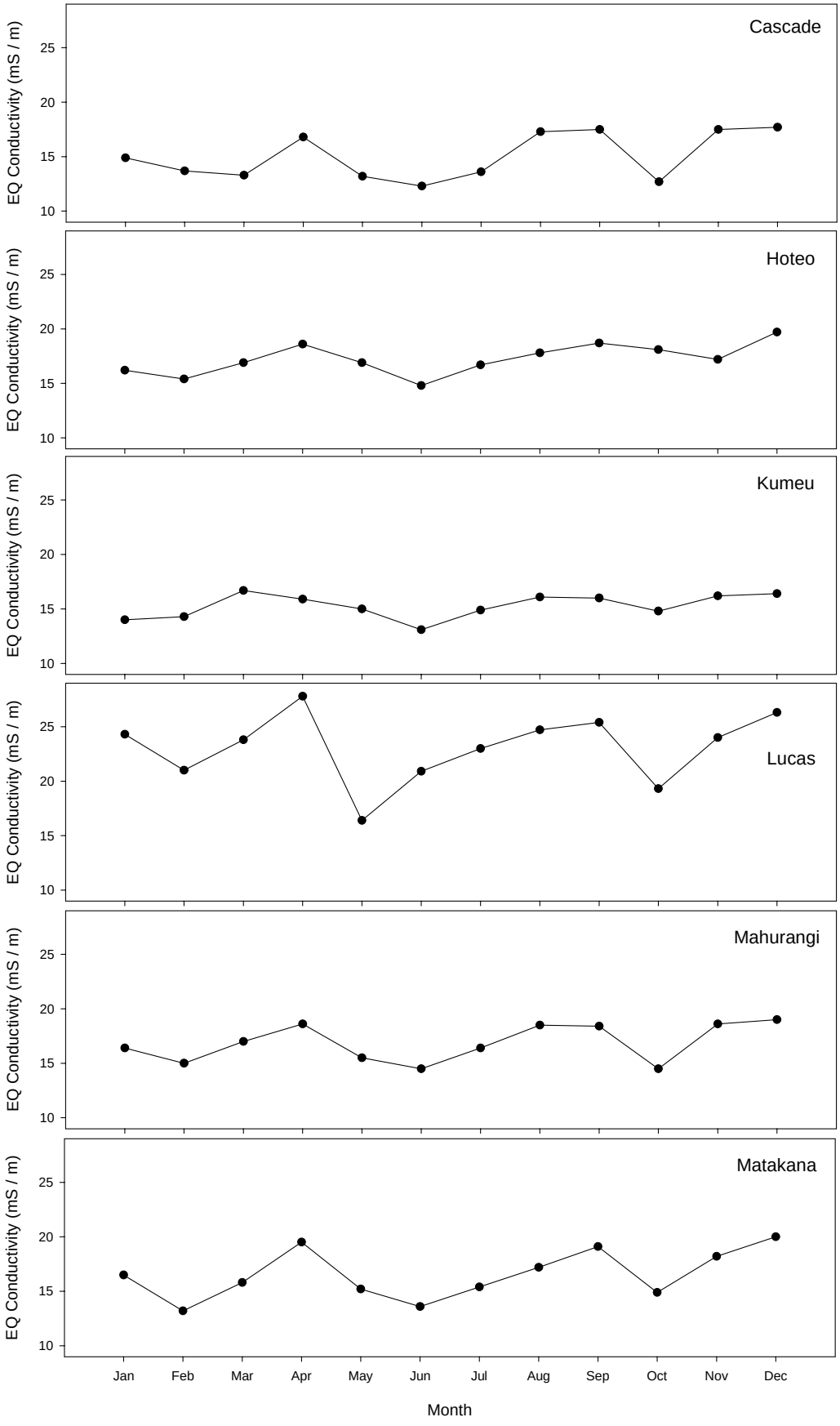
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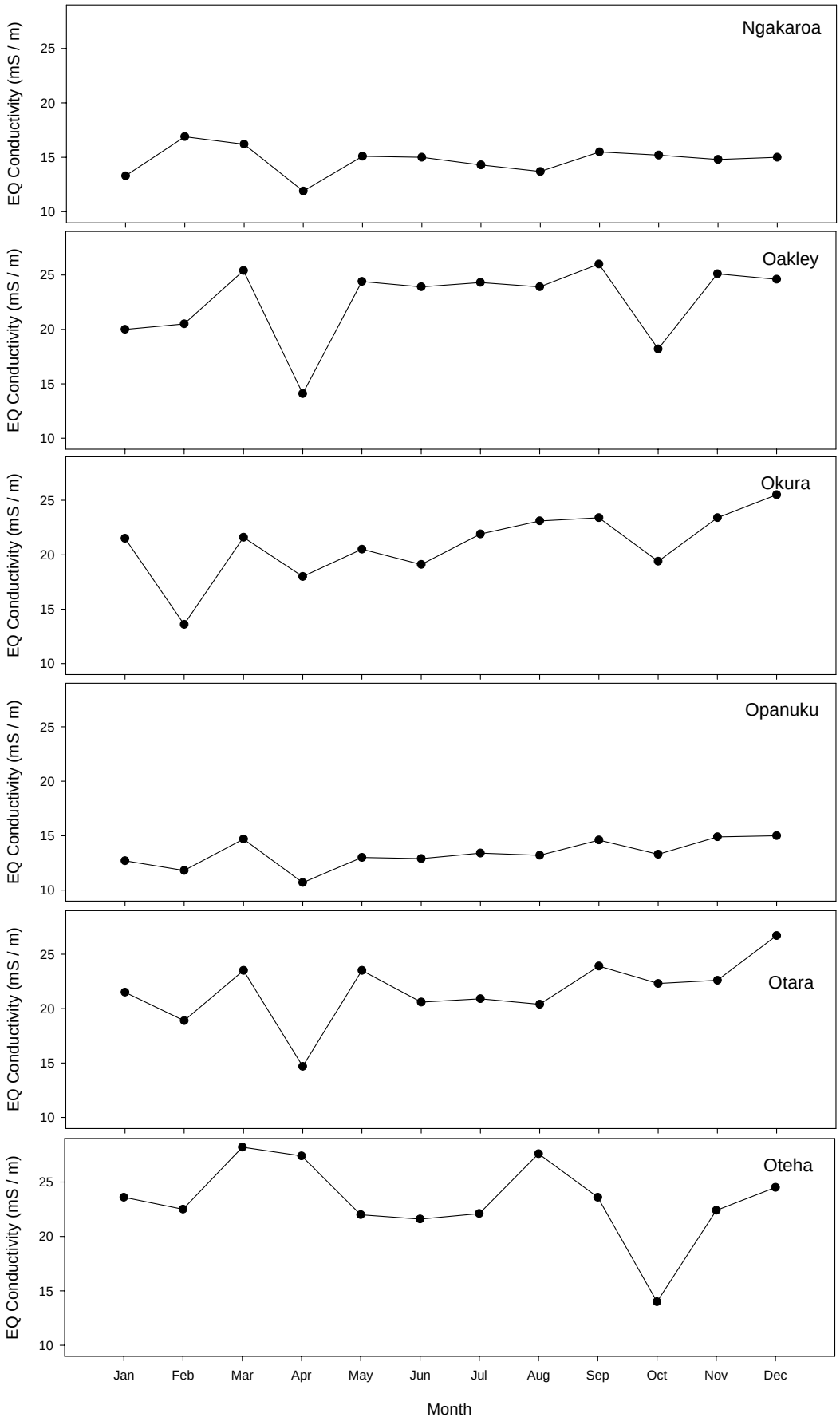
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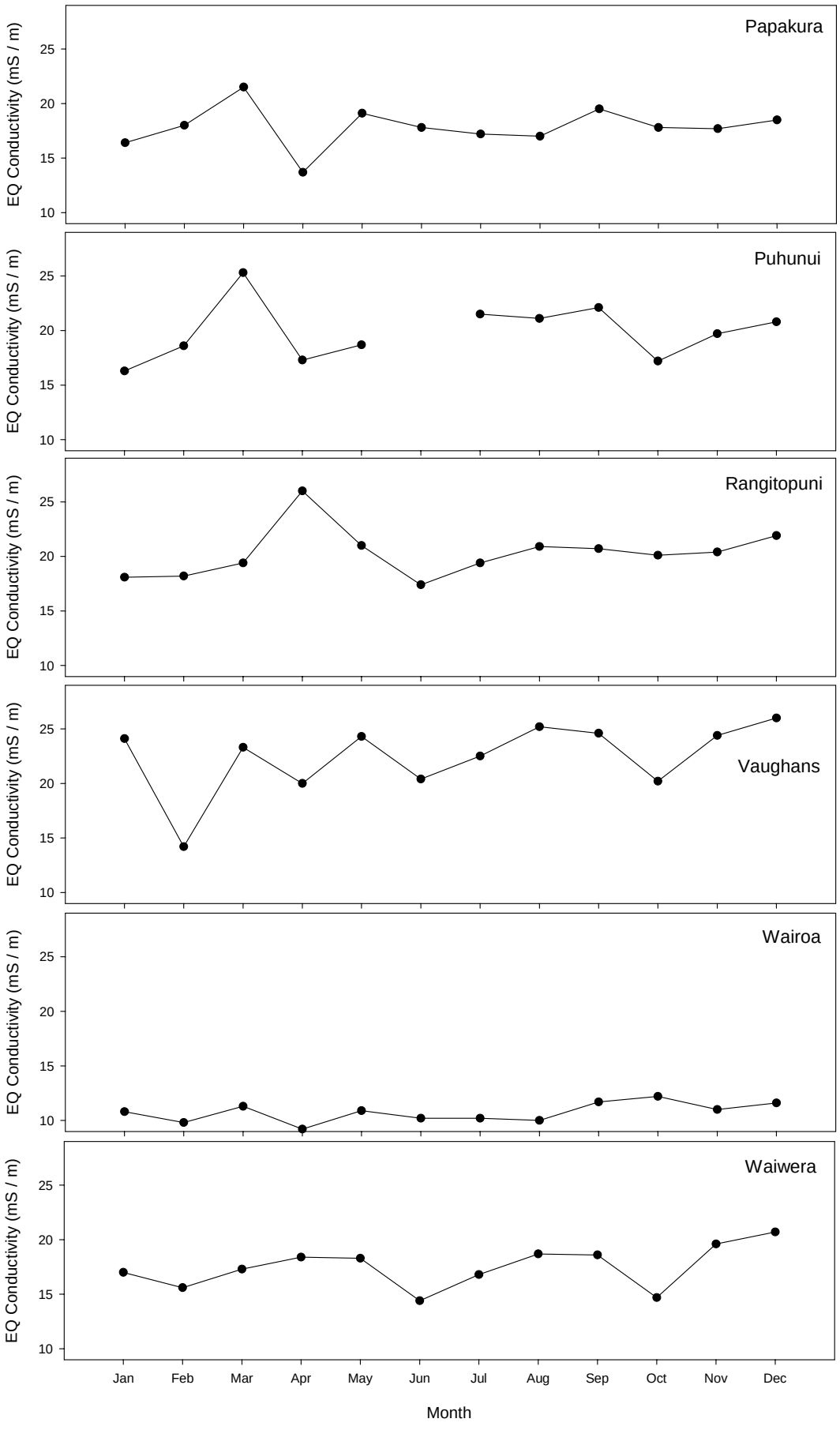
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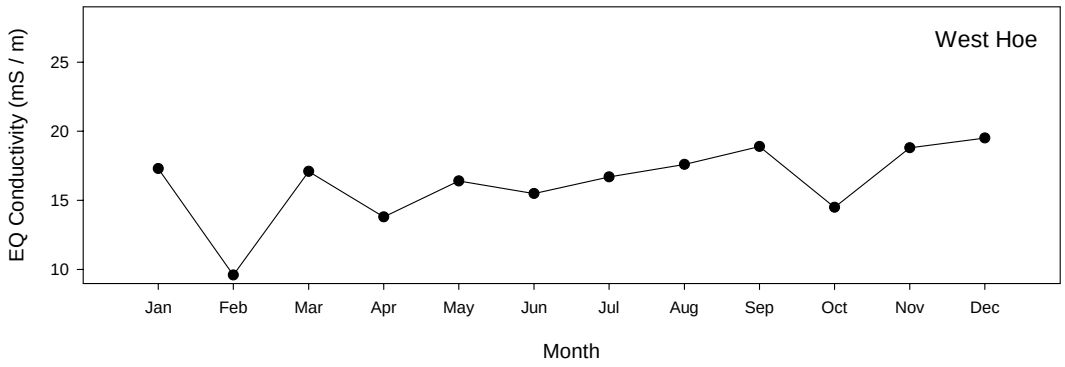
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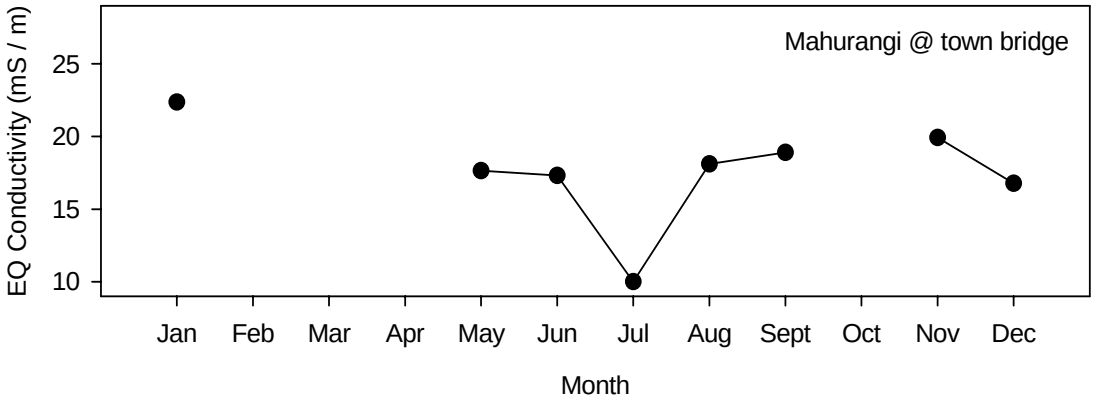
Mahurangi @ town bridge
EQ Conductivity (mS / m)
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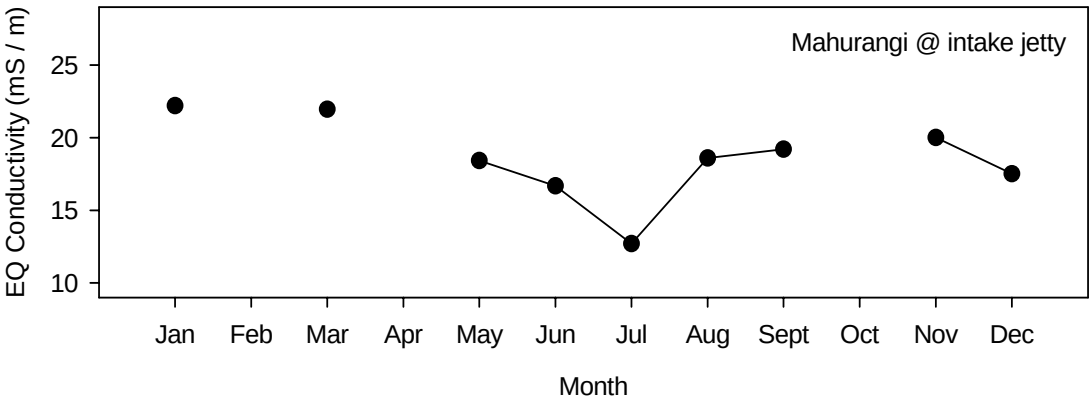
Mahurangi @ intake jetty
EQ Conductivity (mS / m)
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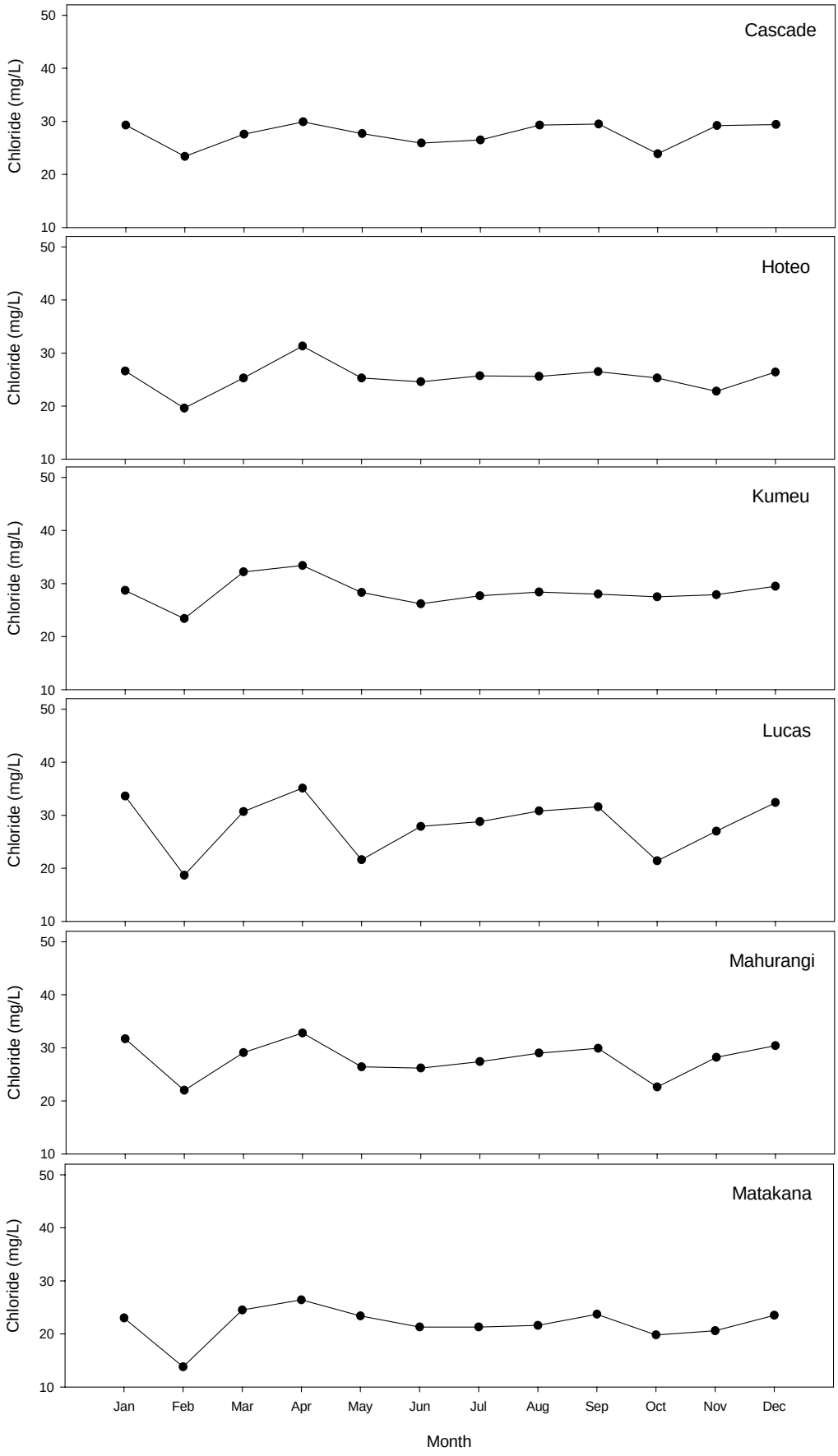
Cascade
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Chloride (mg/L)
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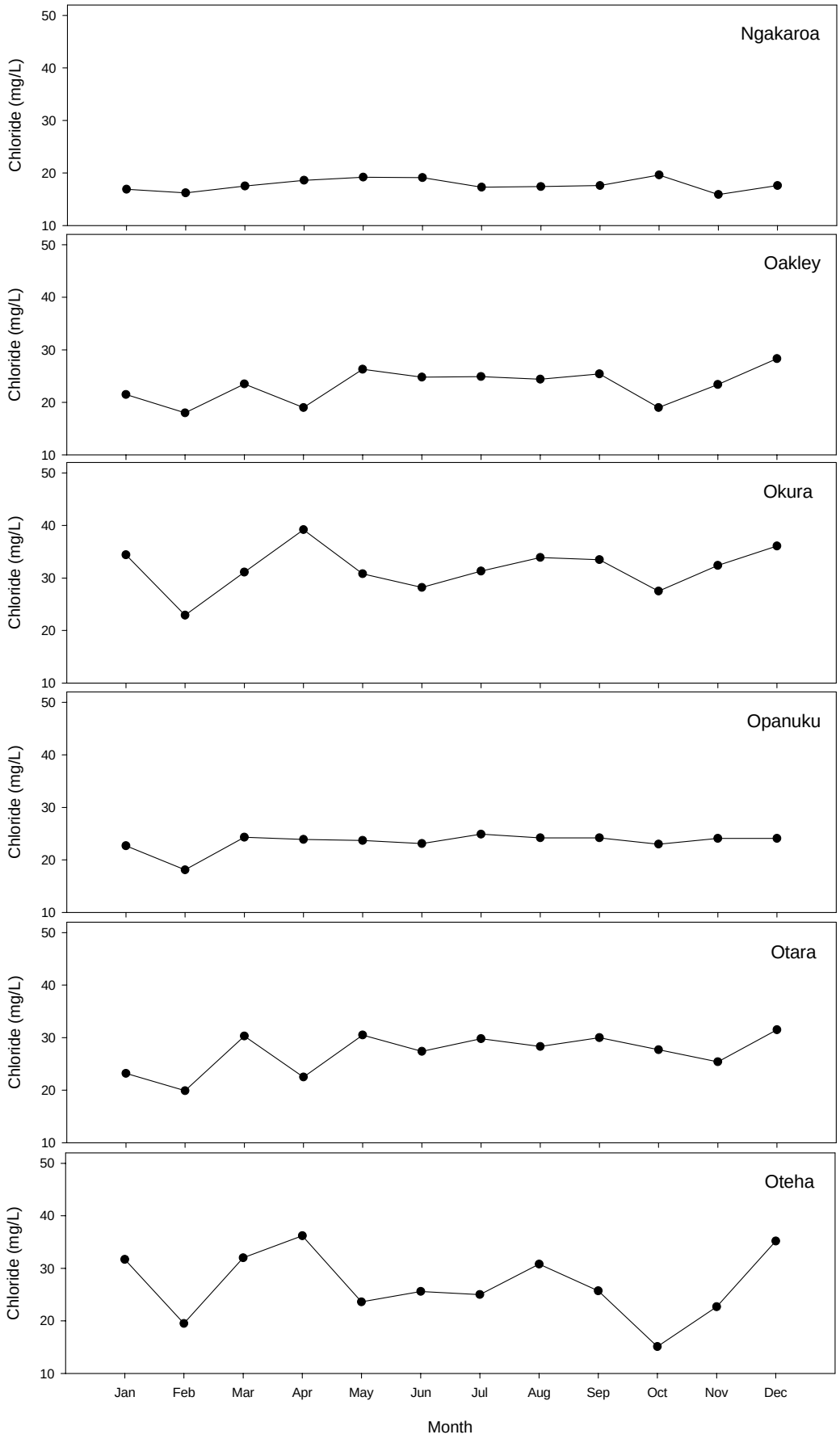
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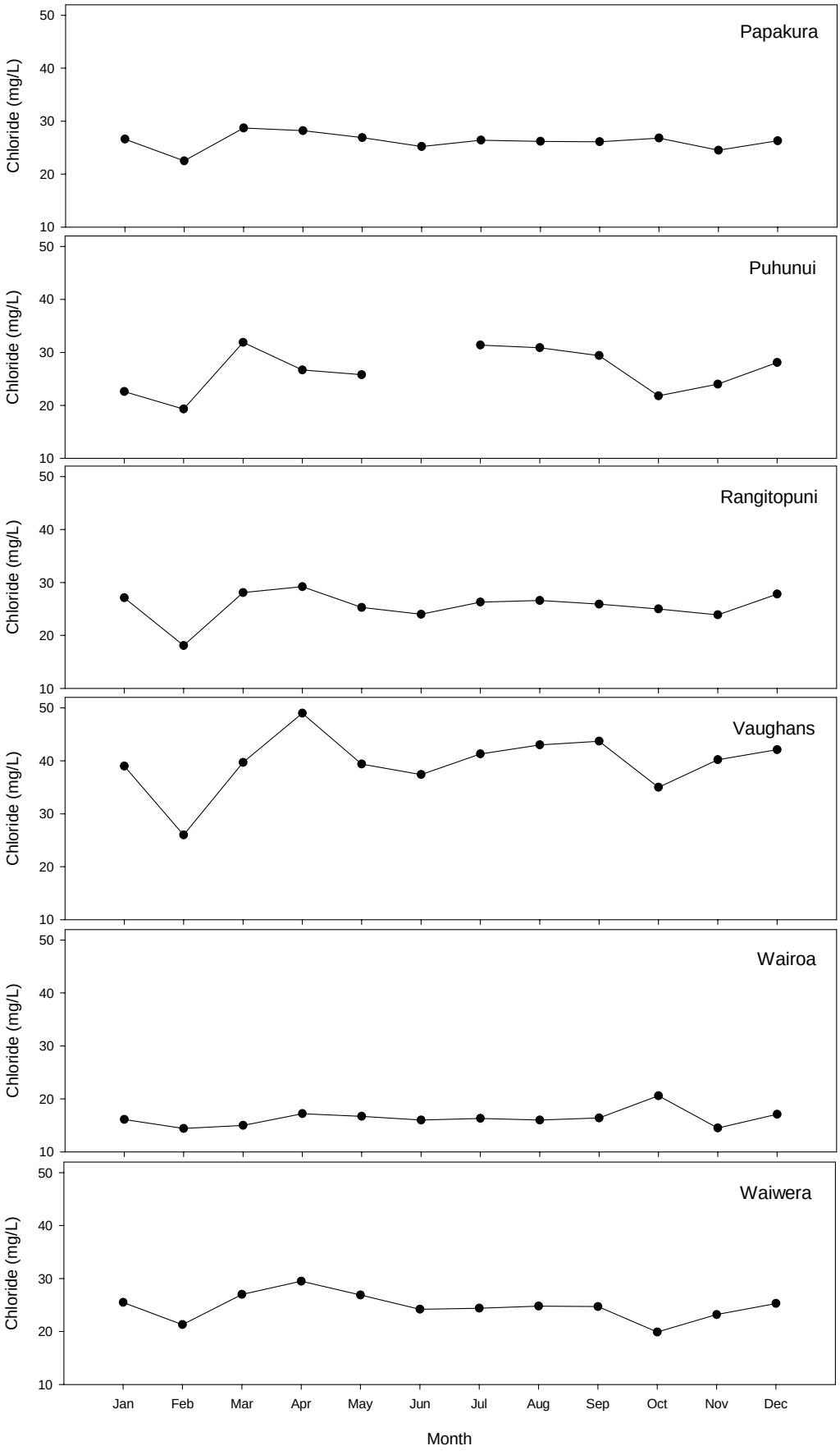
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Vaughans
Wairoa
Waiwera
Chloride (mg/L)
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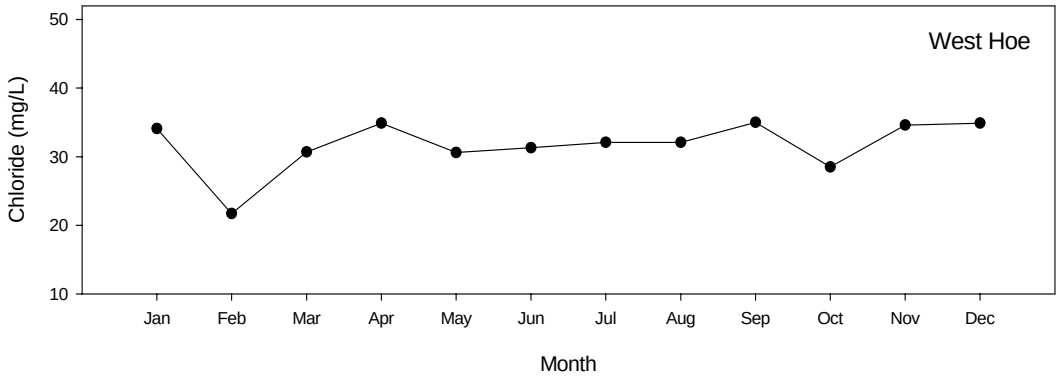
West Hoe
Chloride (mg/L)
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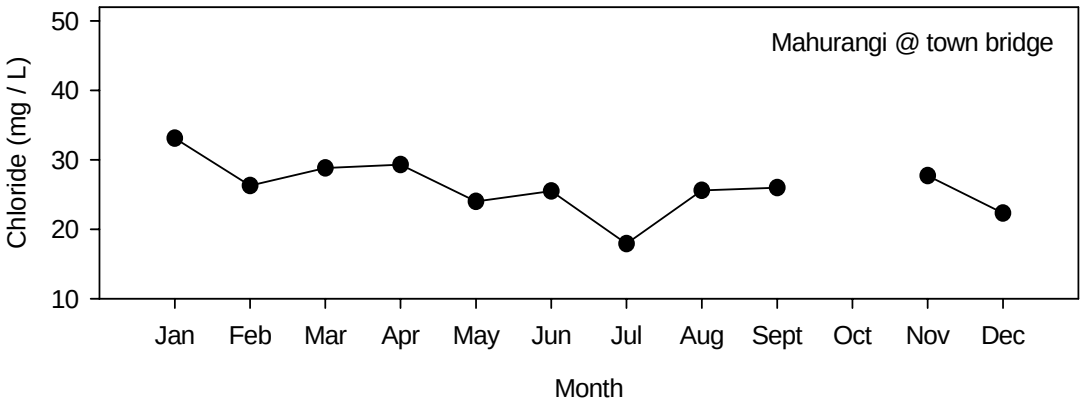
Mahurangi @ town bridge
Chloride (mg / L)
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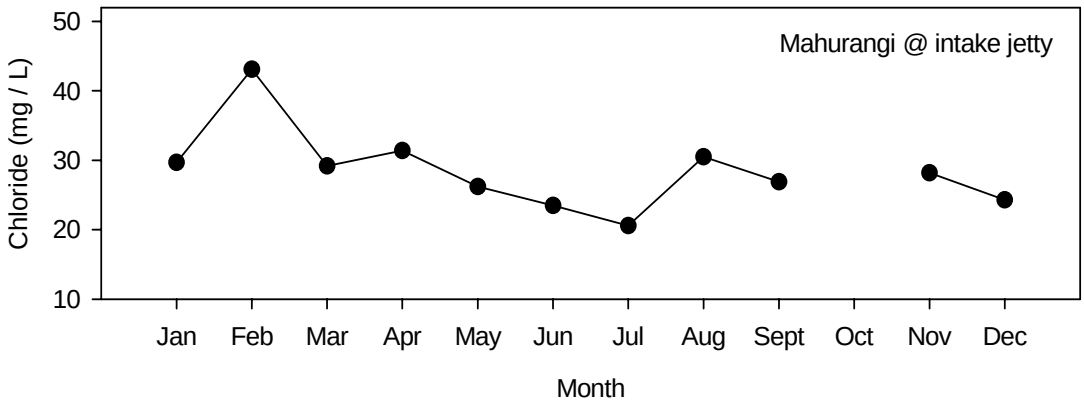
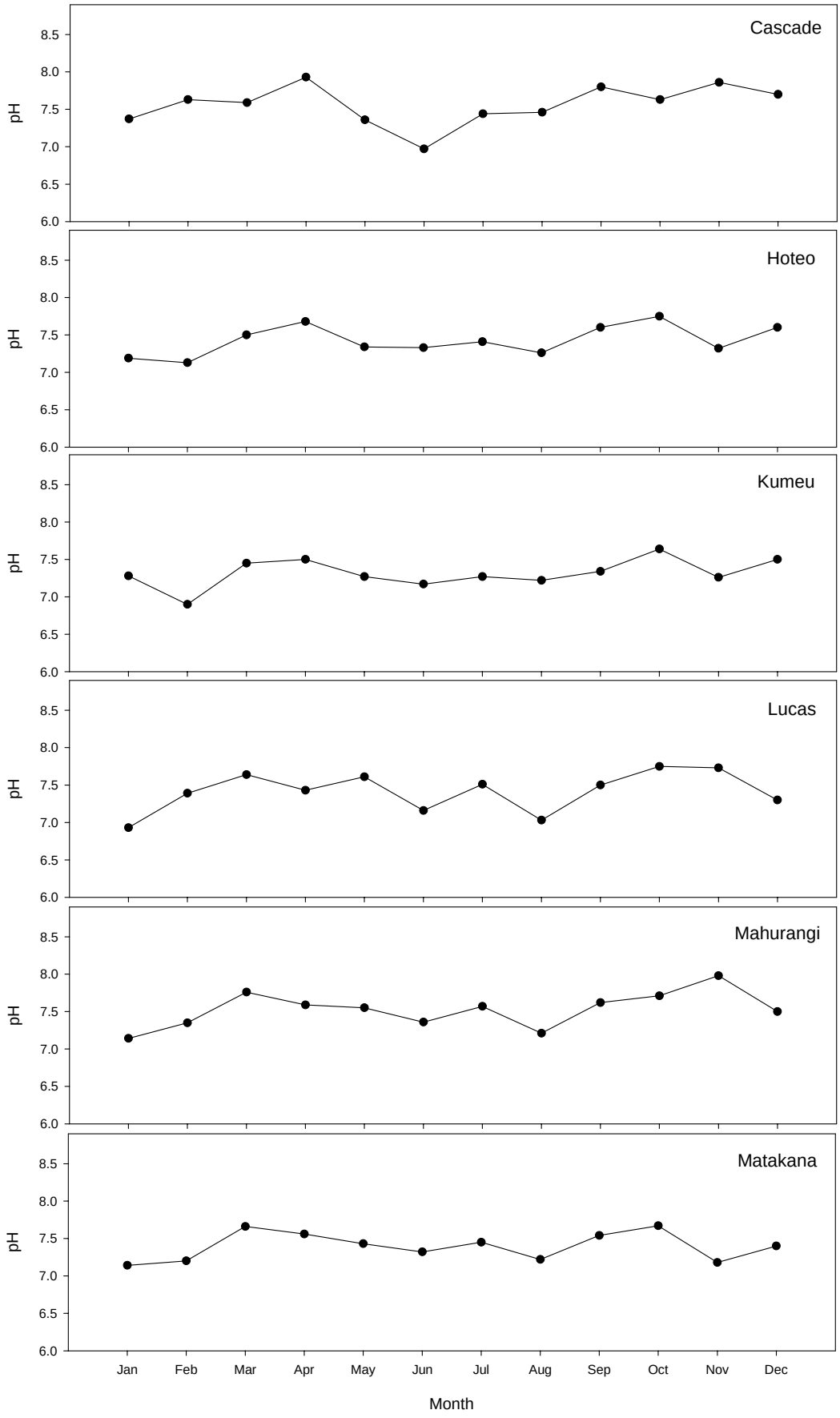
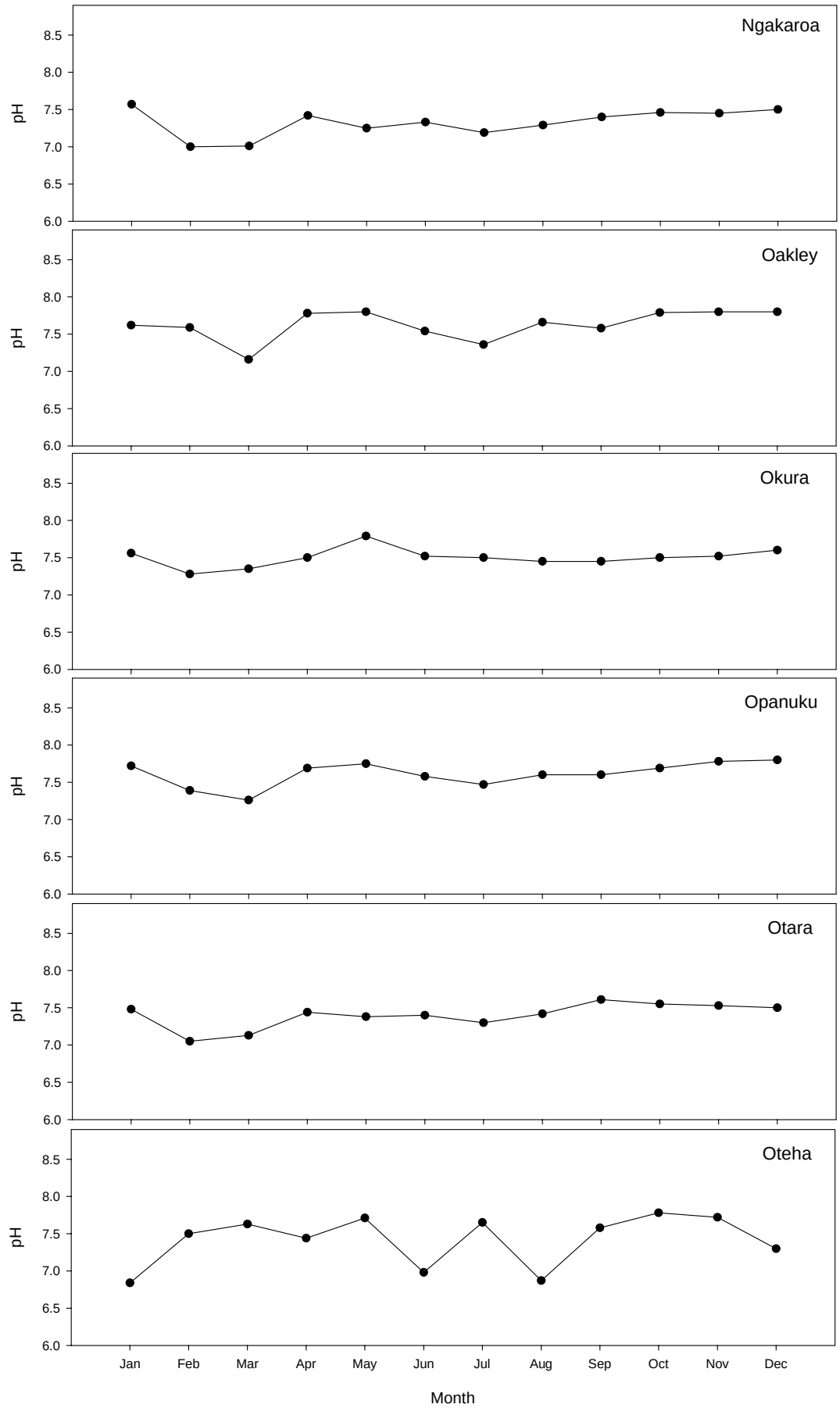
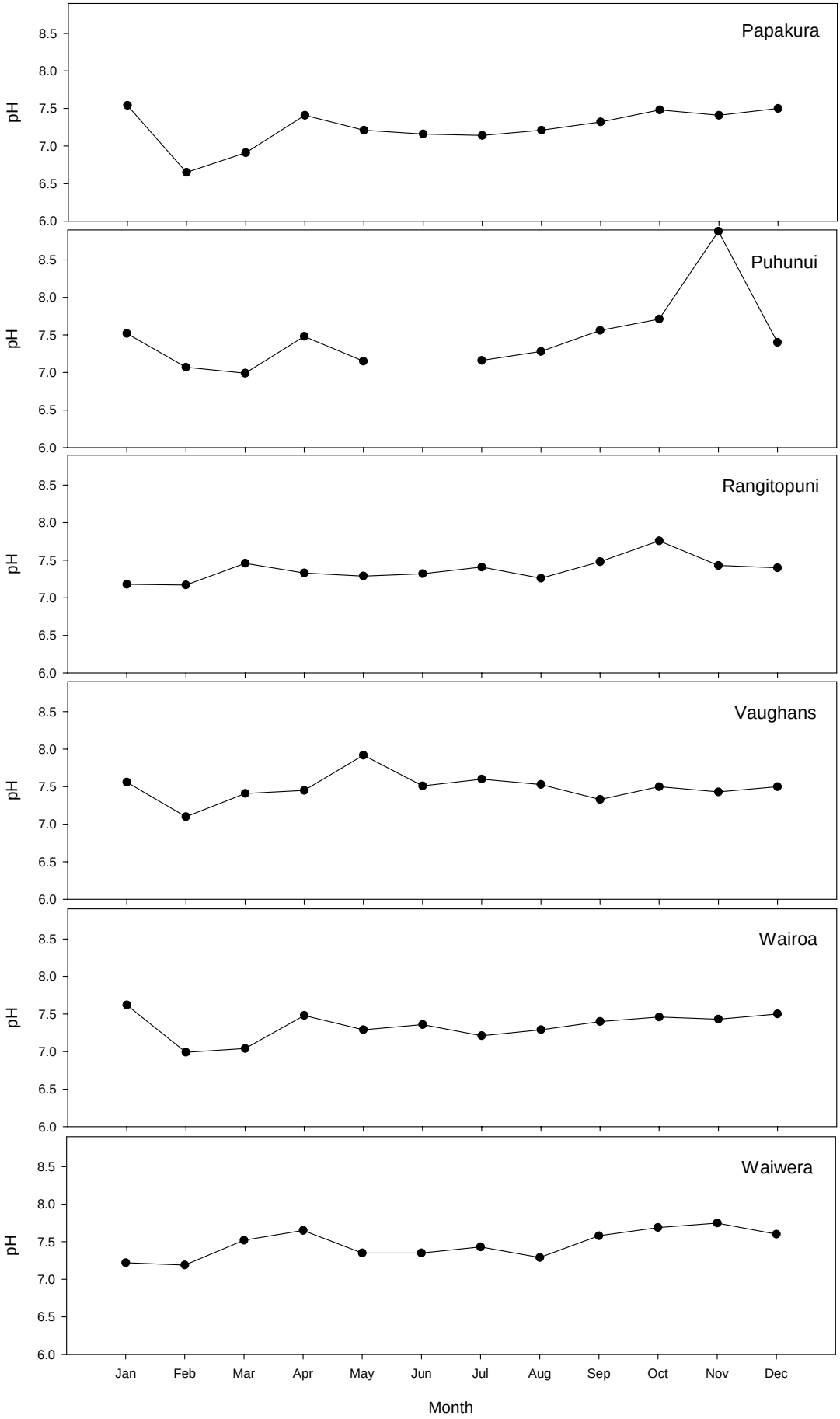
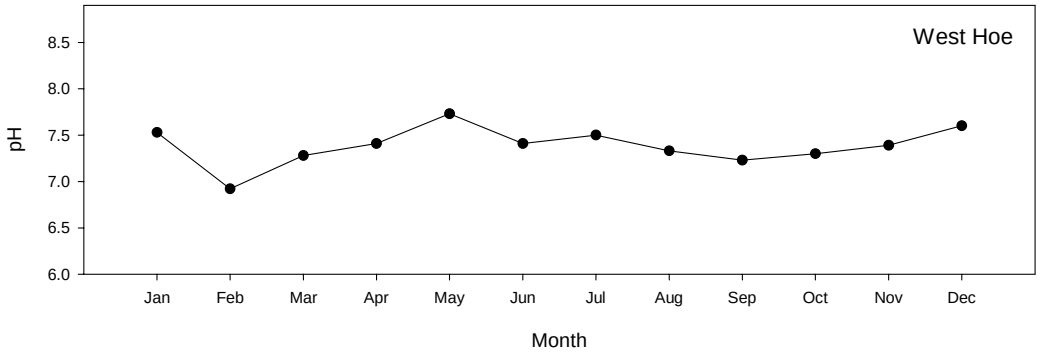
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Month

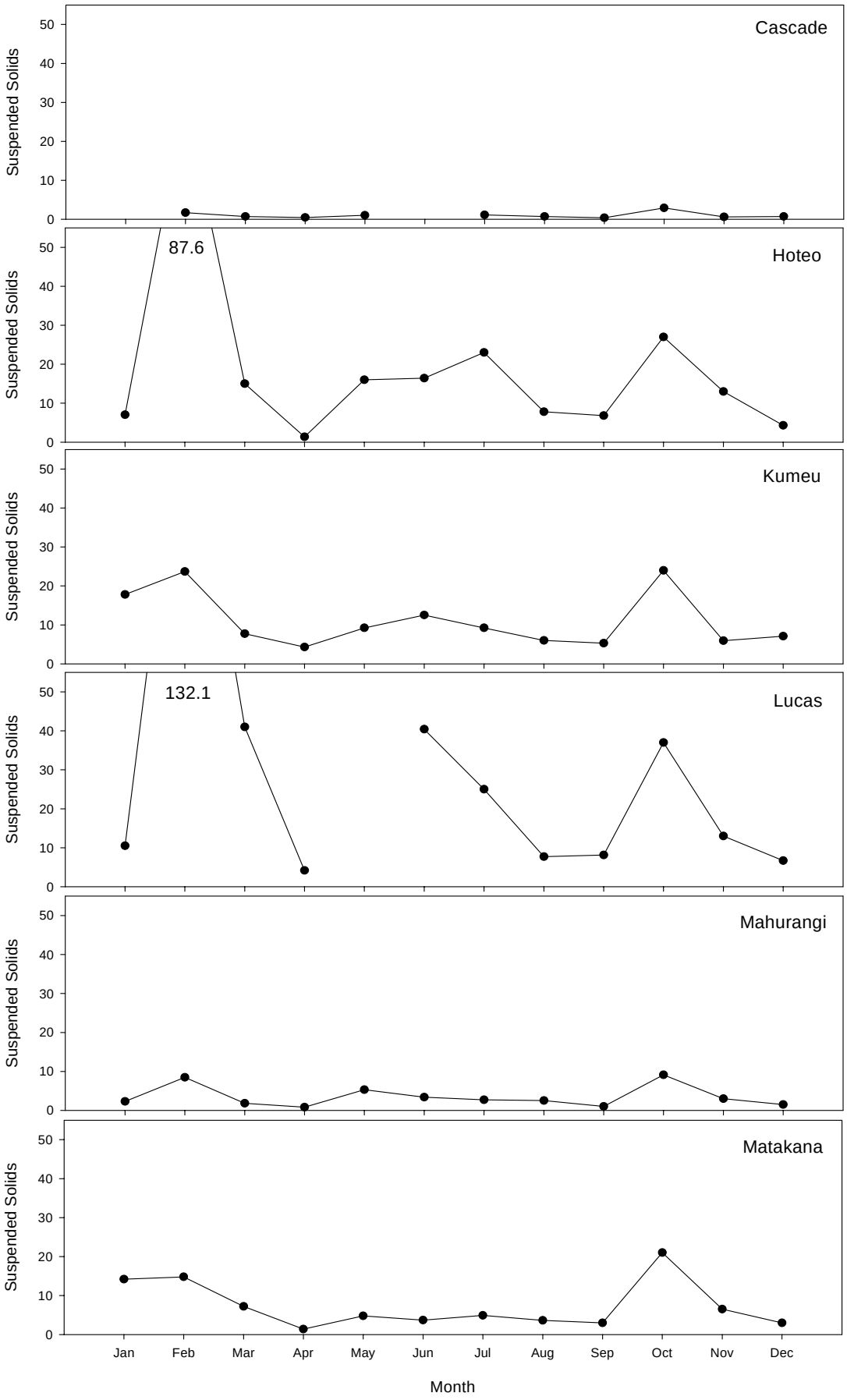

Mahurangi @ intake jetty
Chloride (mg / L)
50
40
30
20
10
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Month

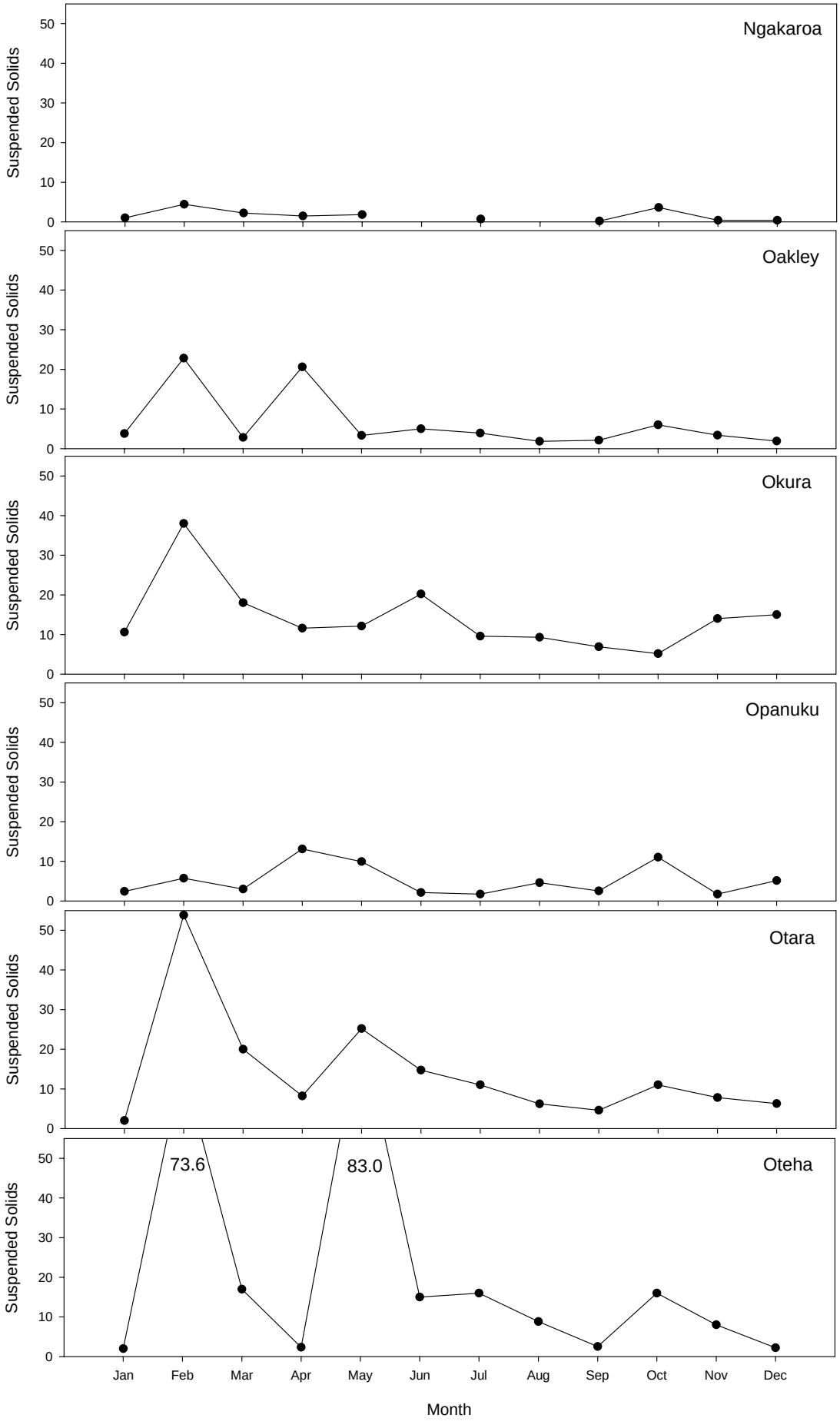

Cascade
Hoteo
Kumeu
Lucas
Mahurangi
Matakana
pH
8.5
8.0
7.5
7.0
6.5
6.0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

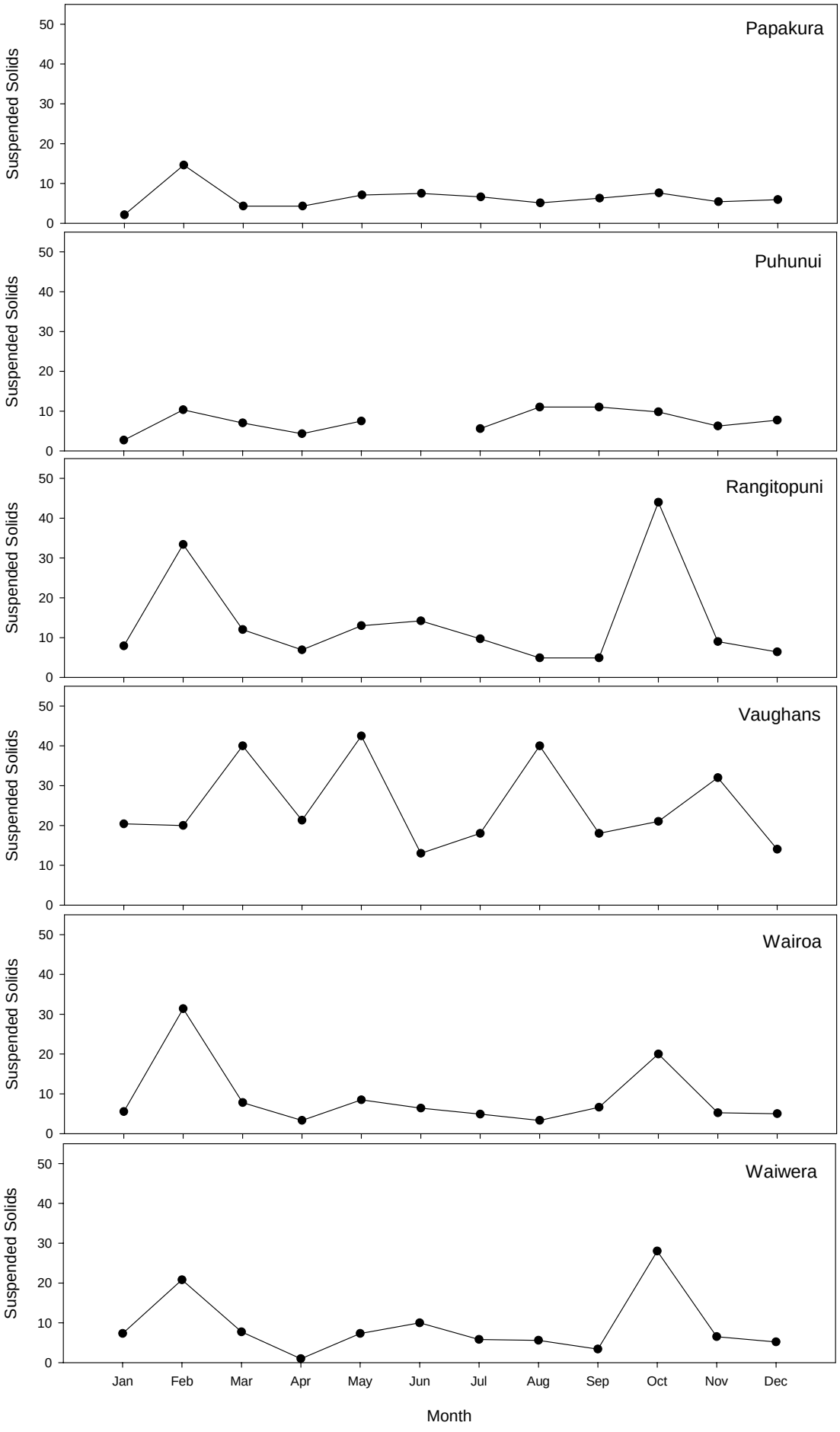

Ngakaroa
Oakley
Okura
Opanuku
Otara
Oteha
pH
8.5
8.0
7.5
7.0
6.5
6.0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

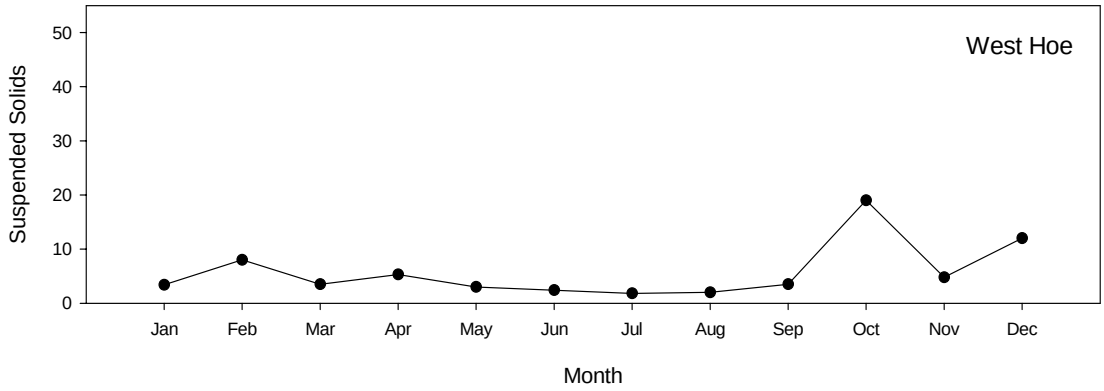

Papakura
Puhunui
Rangitopuni
Vaughans
Wairoa
Waiwera
pH
8.5
8.0
7.5
7.0
6.5
6.0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

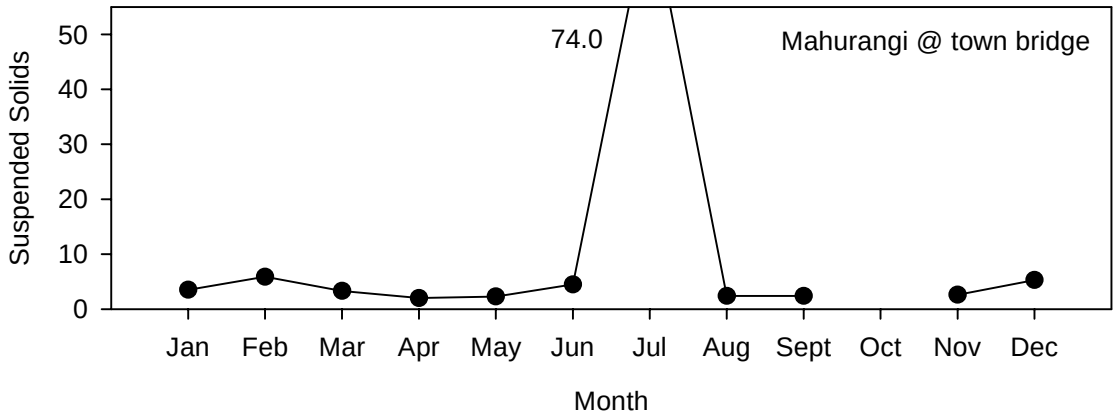

West Hoe
pH
8.5
8.0
7.5
7.0
6.5
6.0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

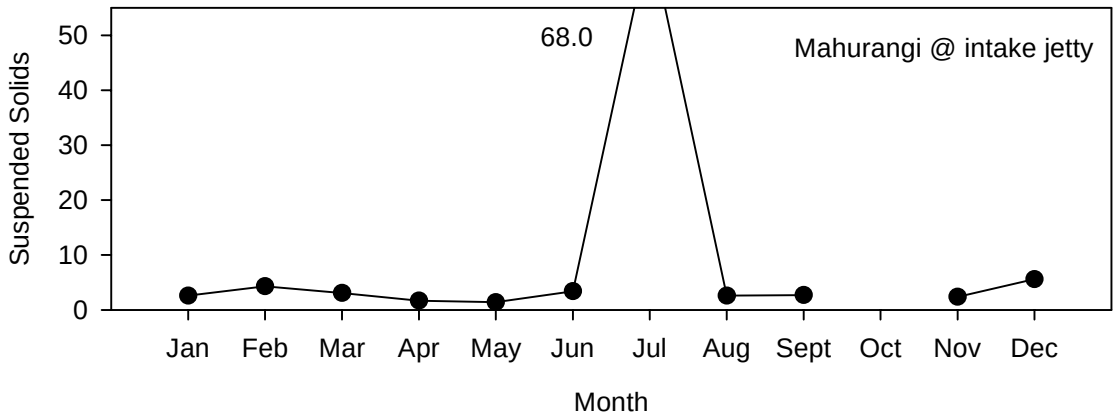

Cascade
Hoteo
87.6
Kumeu
Lucas
132.1
Mahurangi
Matakana
Suspended Solids
0
10
20
30
40
50
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

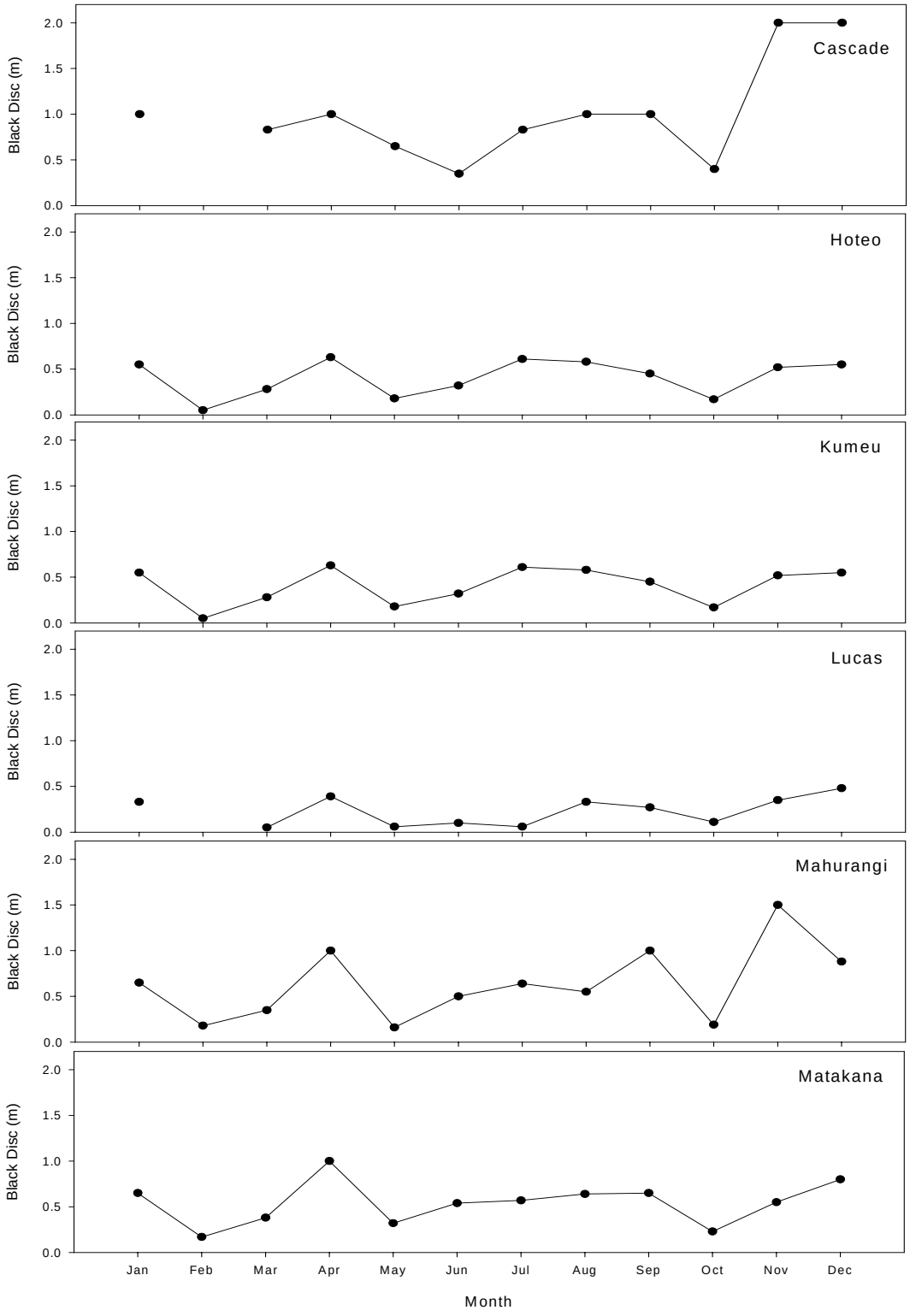

Ngakaroa
Oakley
Okura
Opanuku
Otara
Oteha
Suspended Solids
0
10
20
30
40
50
73.6
83.0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

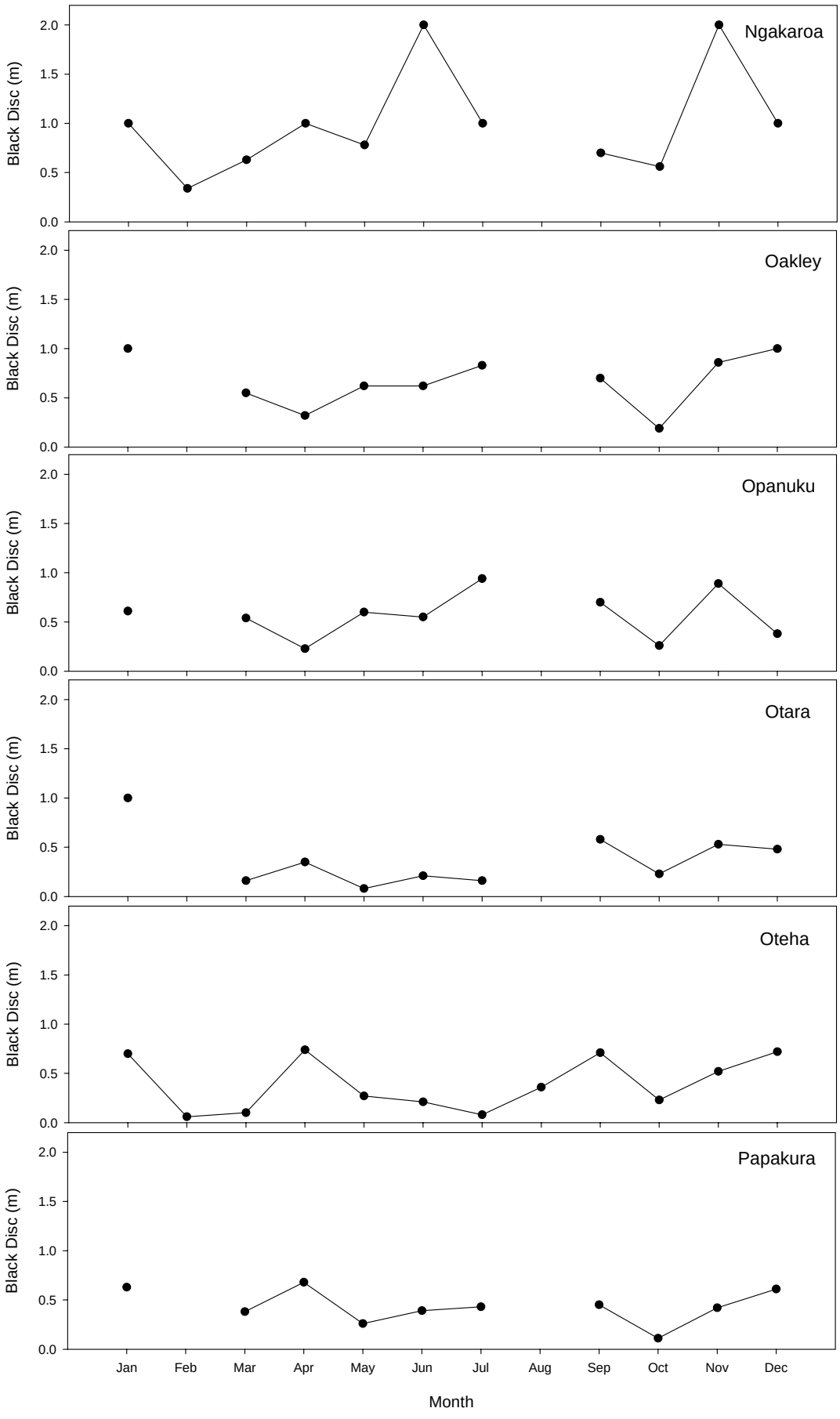

Papakura
Puhunui
Rangitopuni
Vaughans
Wairoa
Waiwera
Suspended Solids
0
10
20
30
40
50
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month


West Hoe
Suspended Solids
0
10
20
30
40
50
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

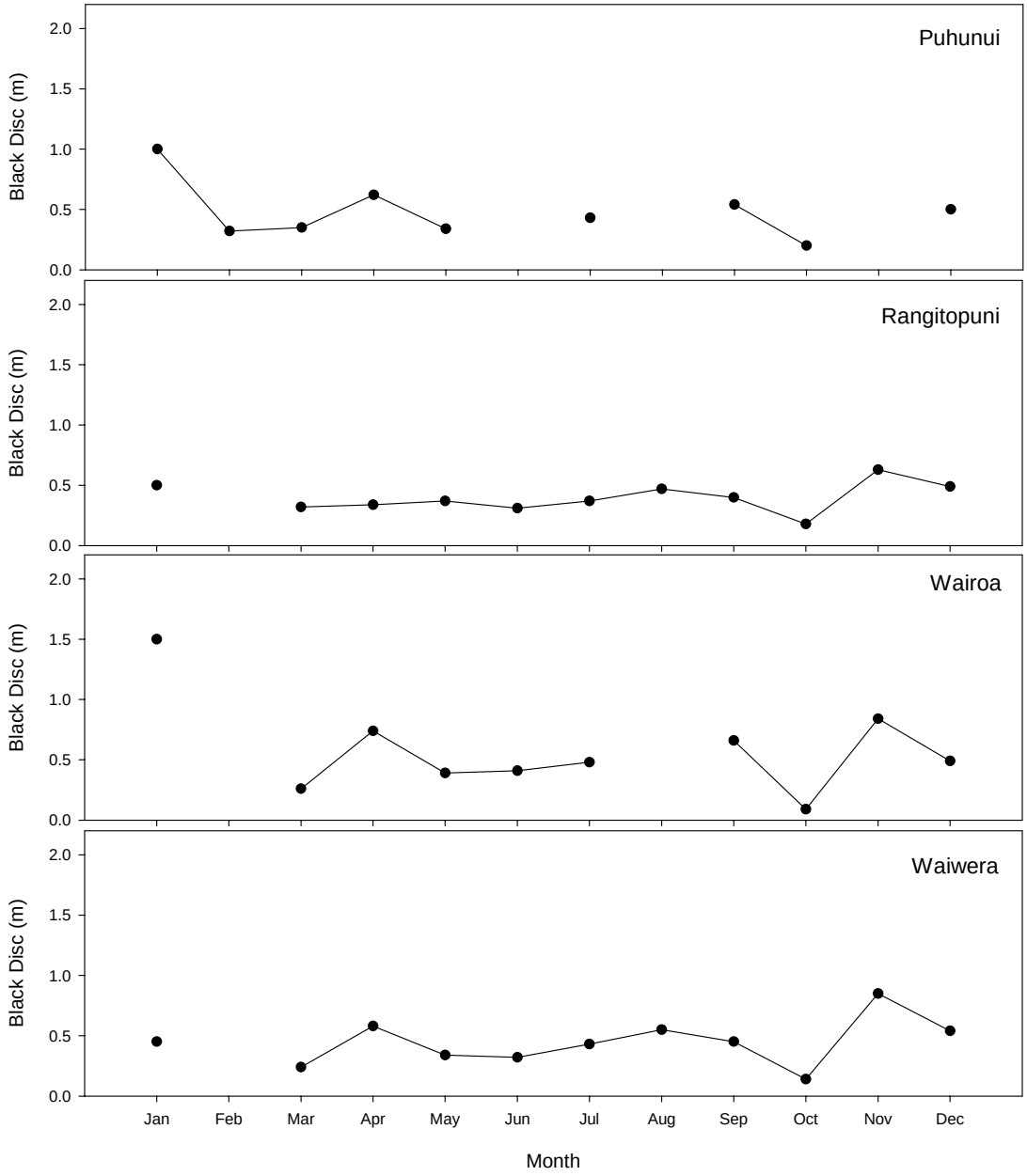

74.0
Mahurangi @ town bridge
Suspended Solids
0
10
20
30
40
50
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Month

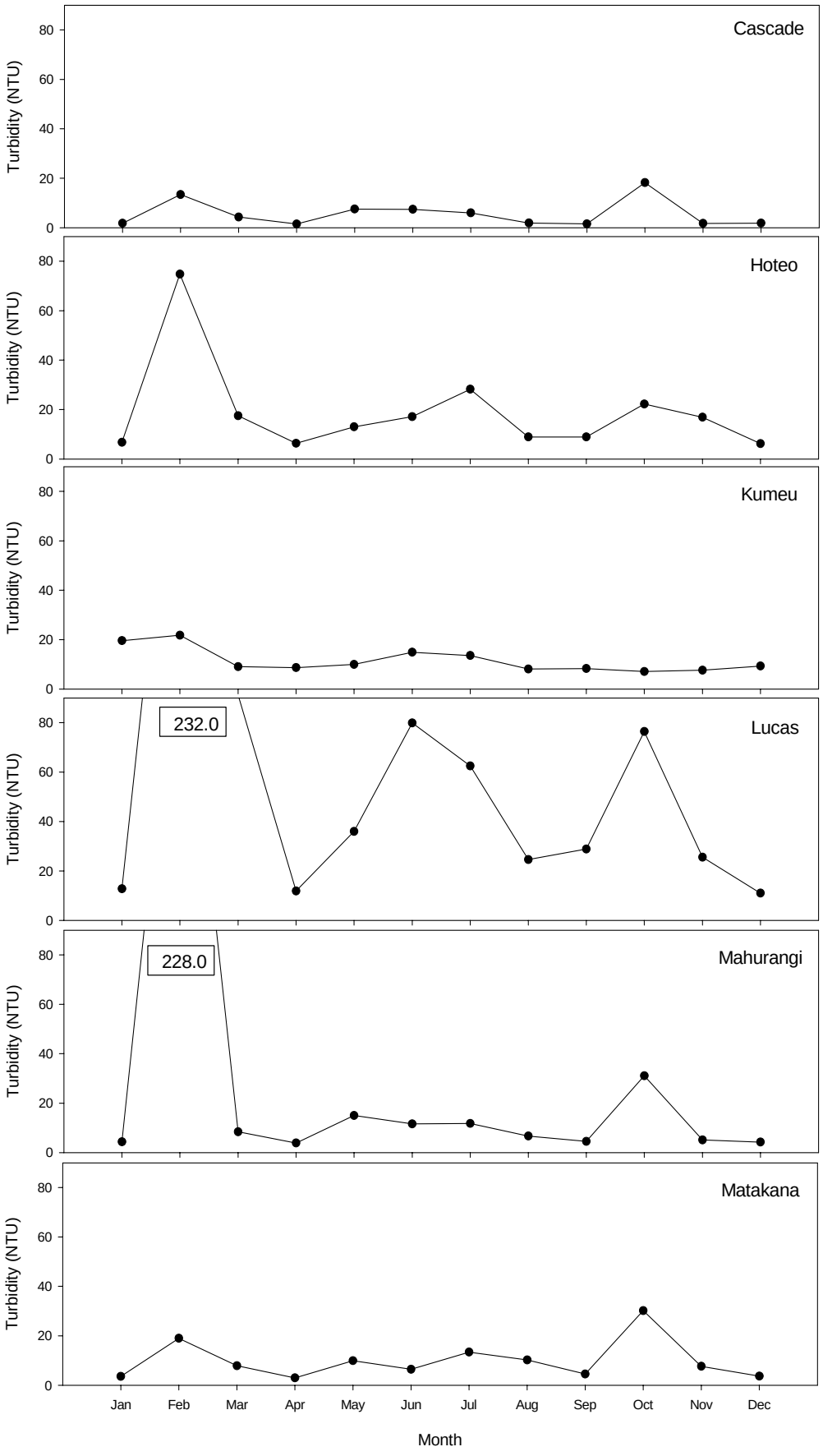

68.0
Mahurangi @ intake jetty
Suspended Solids
0
10
20
30
40
50
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Month

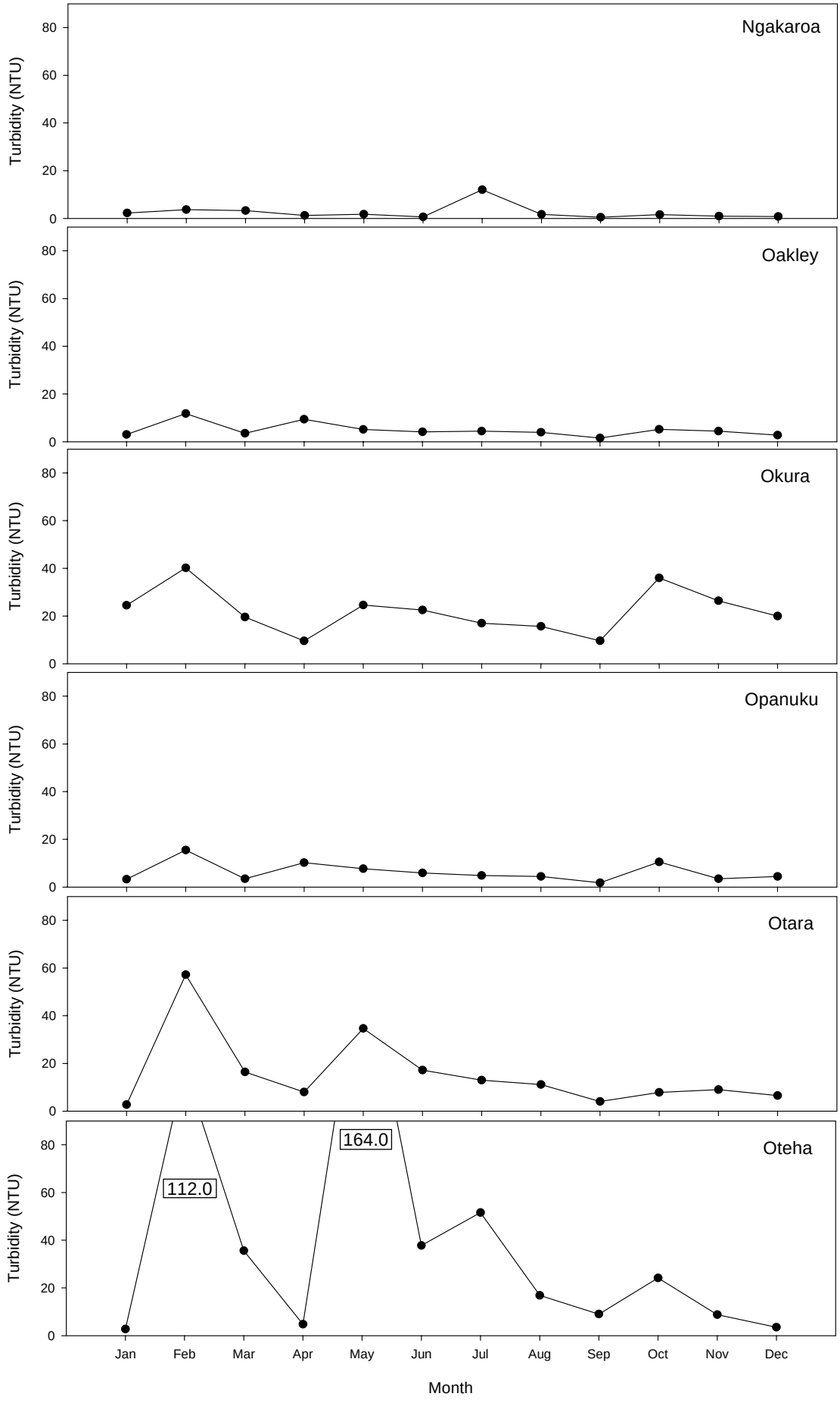

Cascade
Hoteo
Kumeu
Lucas
Mahurangi
Matakana
Black Disc (m)
0.0
0.5
1.0
1.5
2.0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

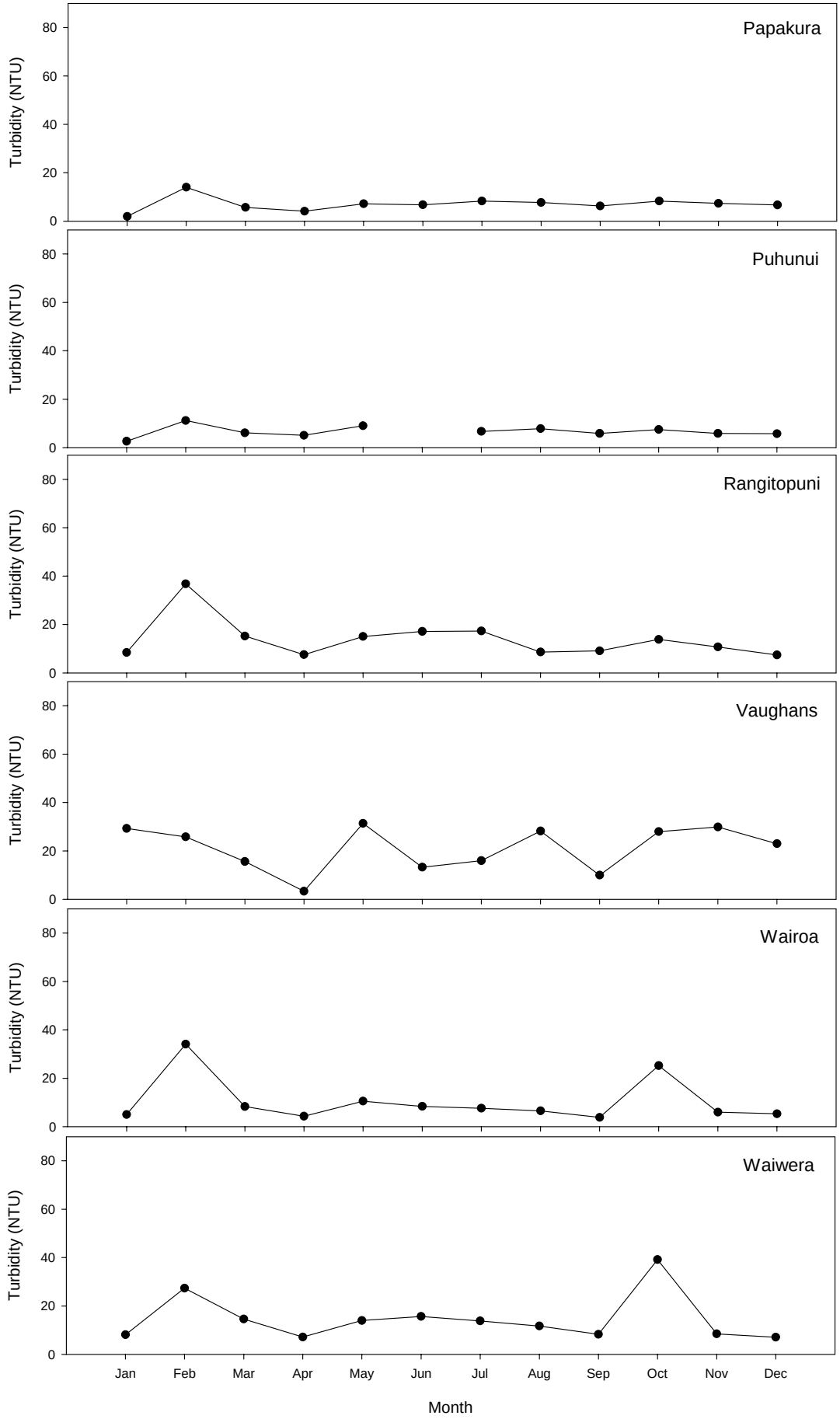


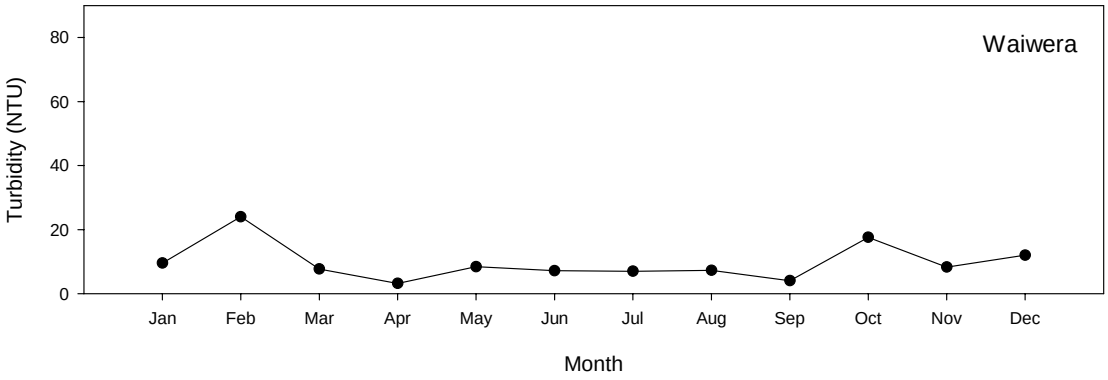
NB: only one reading each for Okura (Nov = 0.3m), Vaughans (Nov= 0.2m), and West Hoe(Nov = 0.8m).

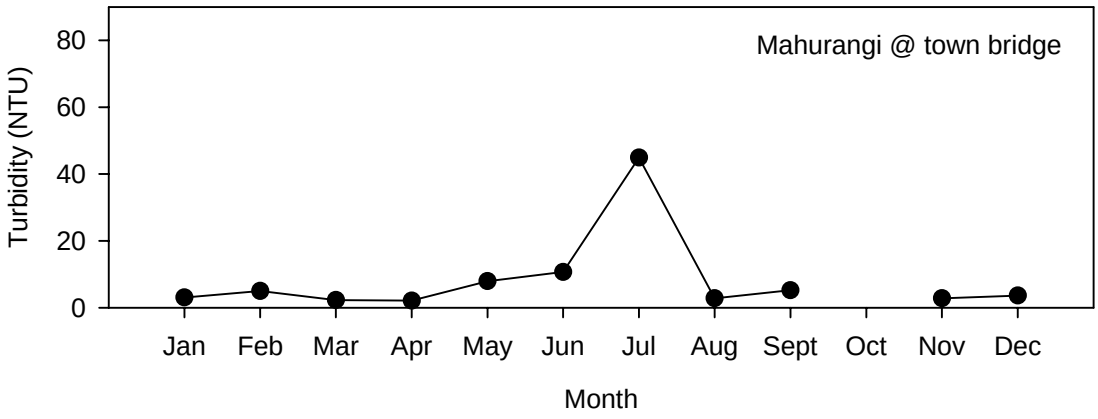

Puhunui
Rangitopuni
Wairoa
Waiwera
Black Disc (m)
0.0
0.5
1.0
1.5
2.0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

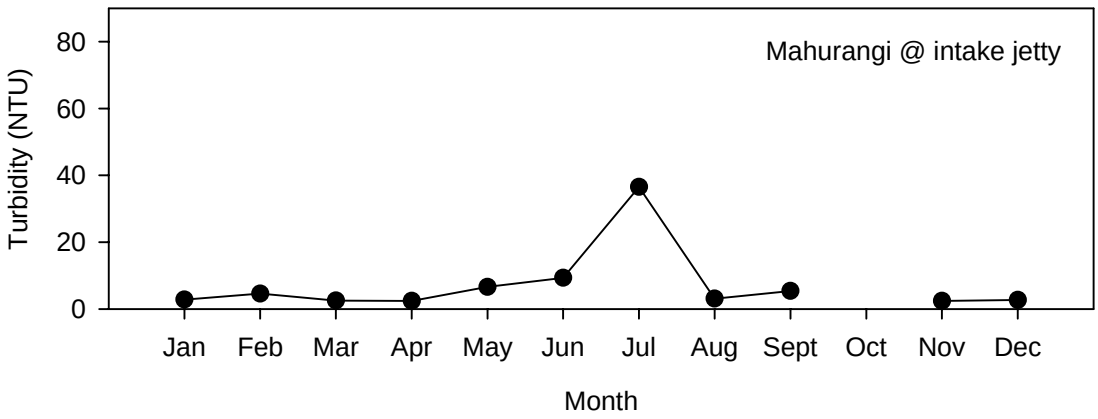

Cascade
Hoteo
Kumeu
Lucas
232.0
Mahurangi
228.0
Matakana
Turbidity (NTU)
0
20
40
60
80
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

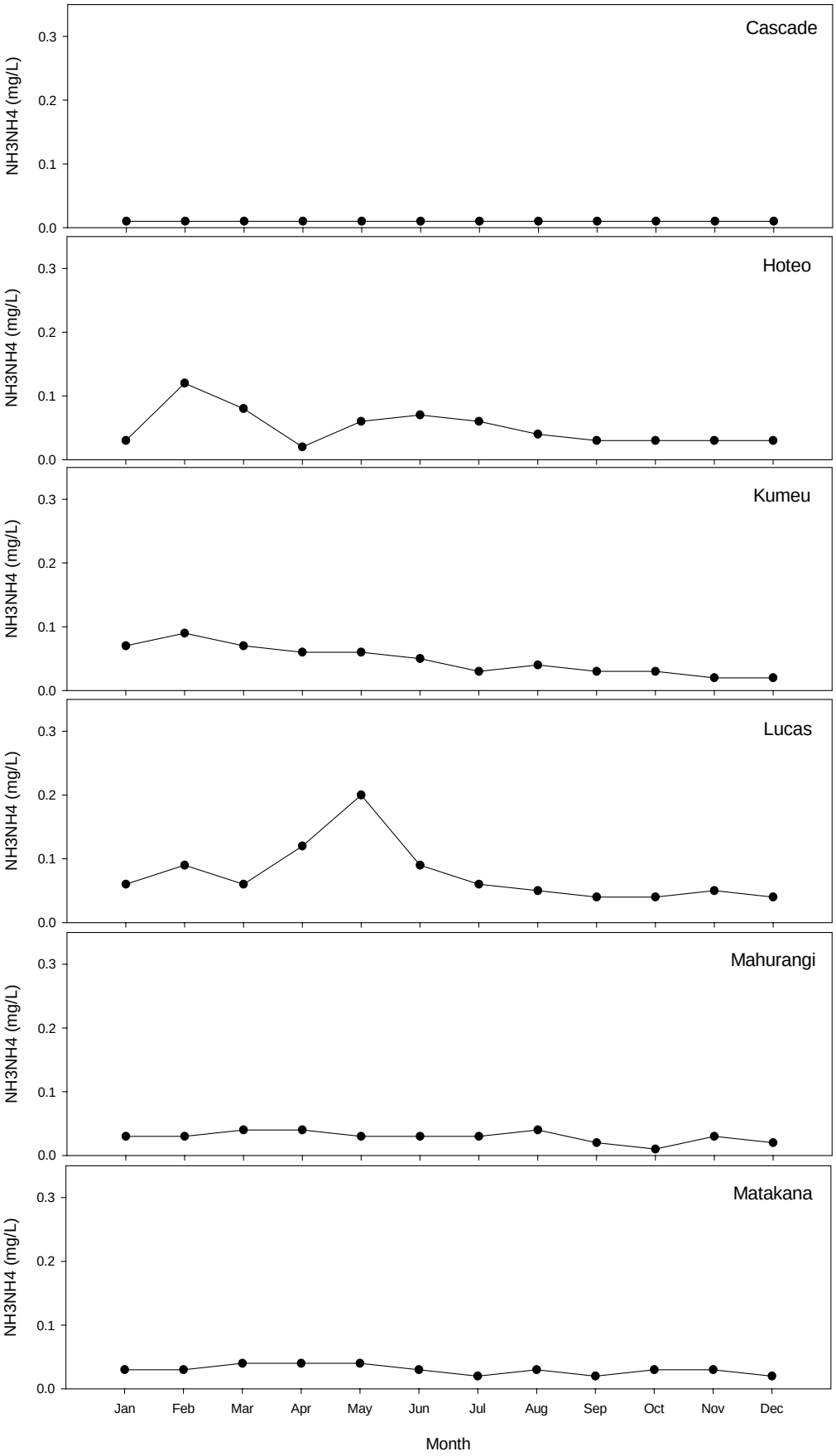

Ngakaroa
Oakley
Okura
Opanuku
Otara
Oteha
Turbidity (NTU)
0
20
40
60
80
112.0
164.0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

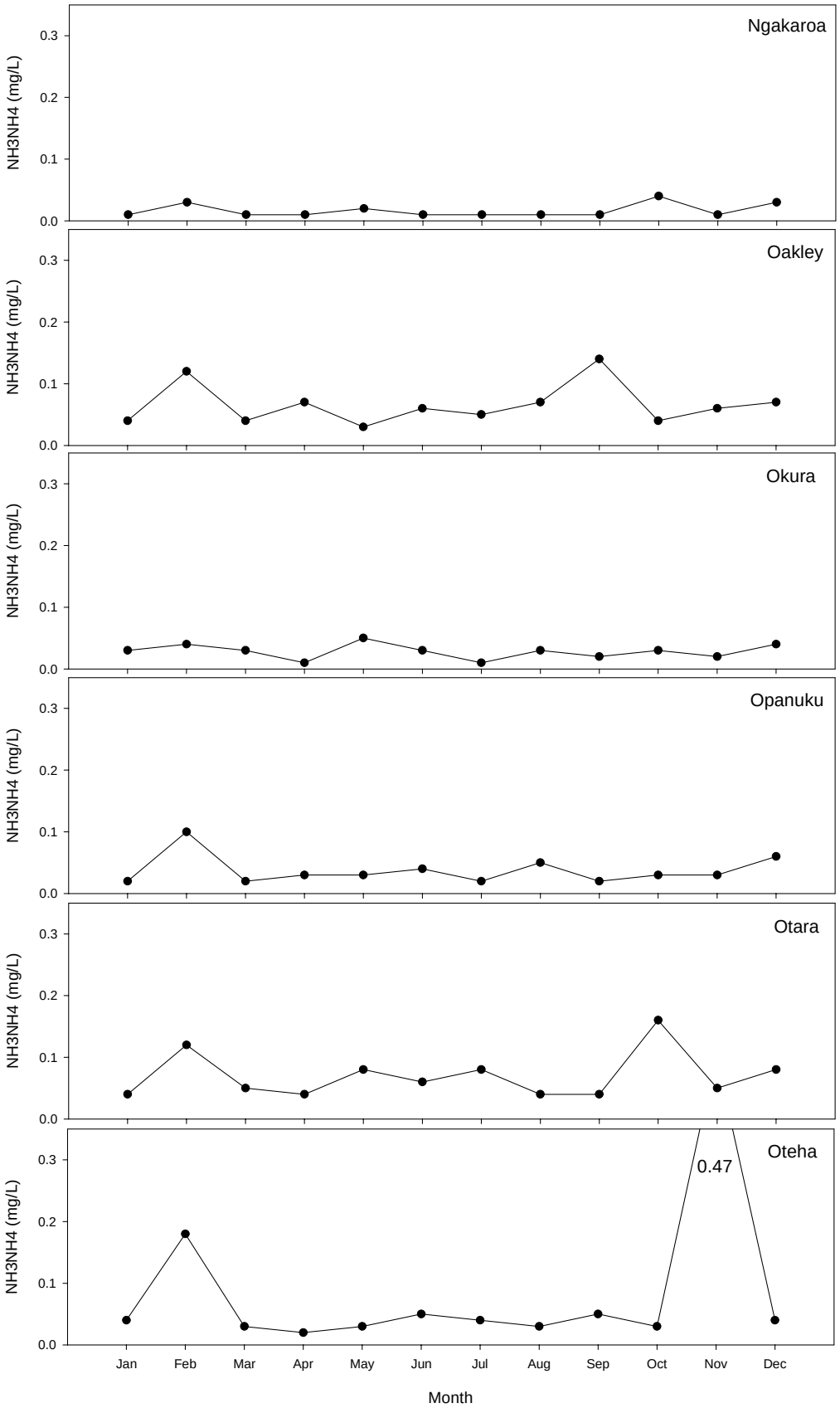

Papakura
Puhunui
Rangitopuni
Vaughans
Wairoa
Waiwera
Turbidity (NTU)
0
20
40
60
80
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

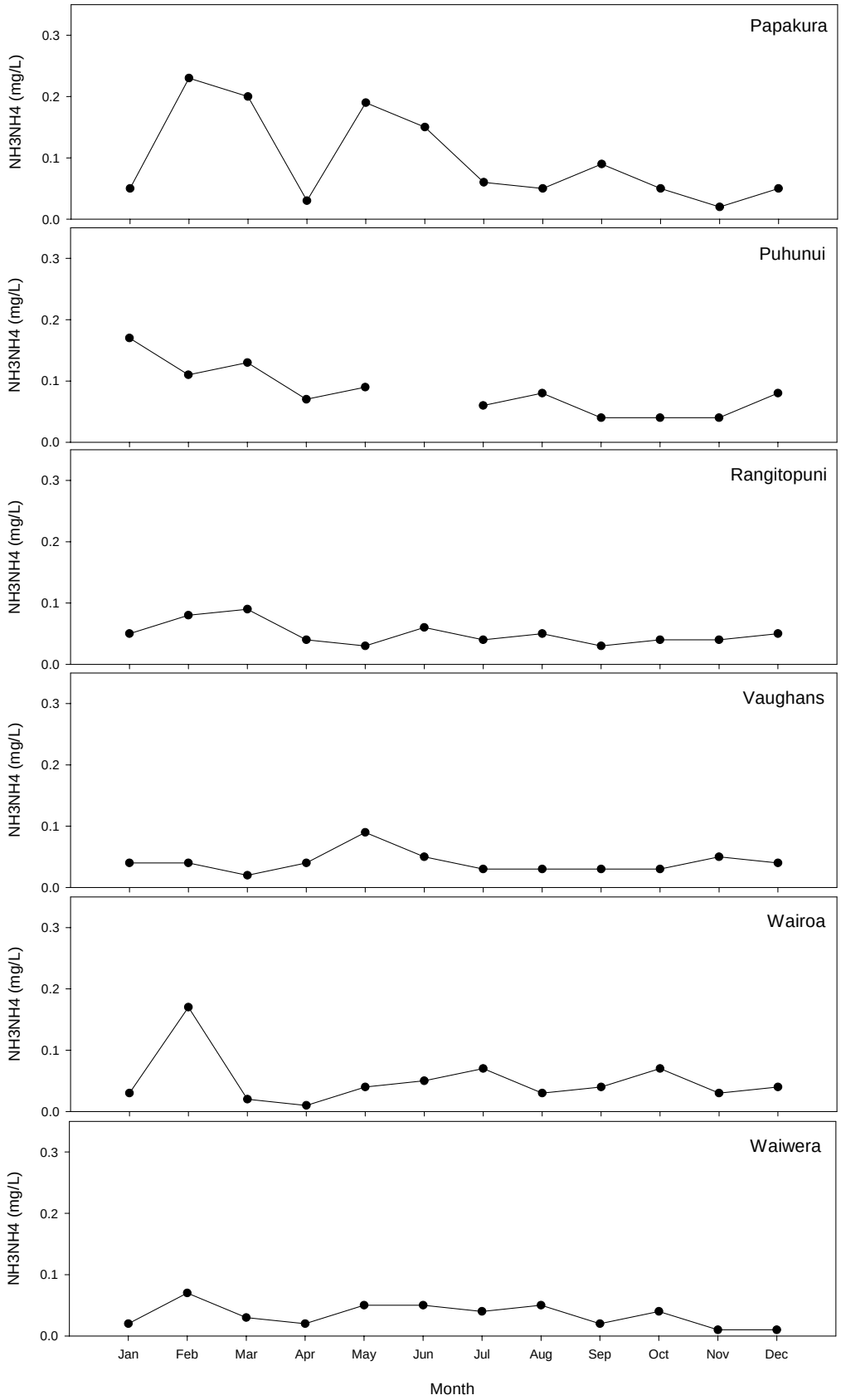

Waiwera
Turbidity (NTU)
0
20
40
60
80
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

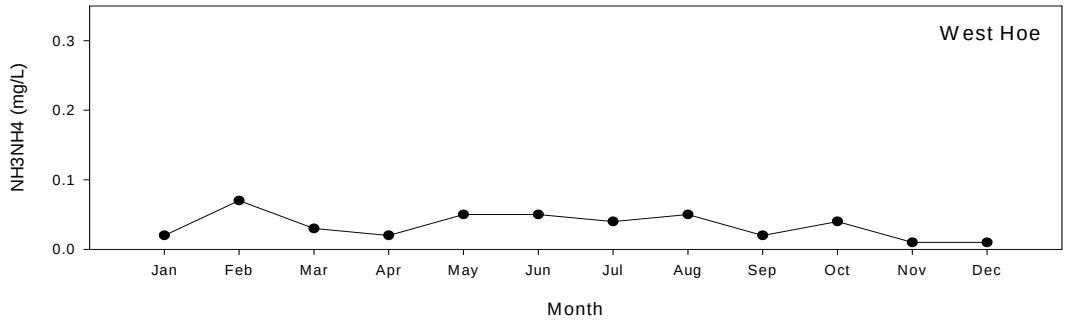

Mahurangi @ town bridge
Turbidity (NTU)
0
20
40
60
80
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Month

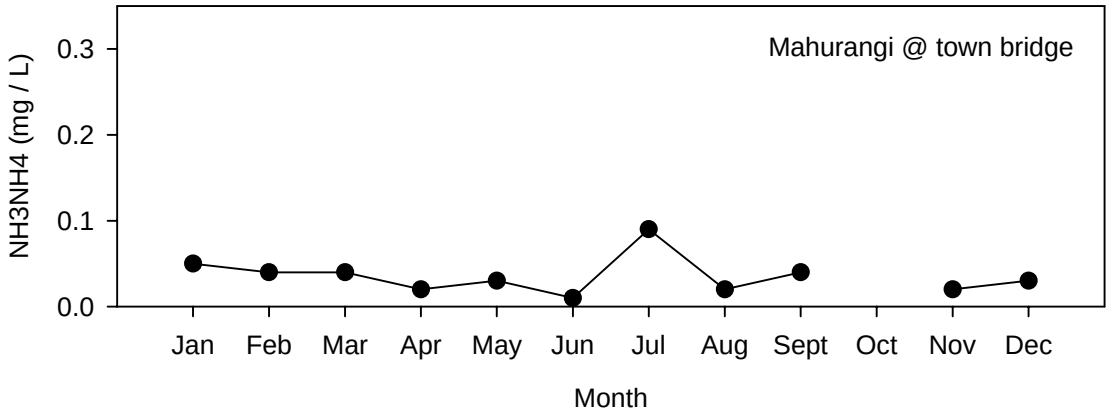

Mahurangi @ intake jetty
Turbidity (NTU)
0
20
40
60
80
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Month

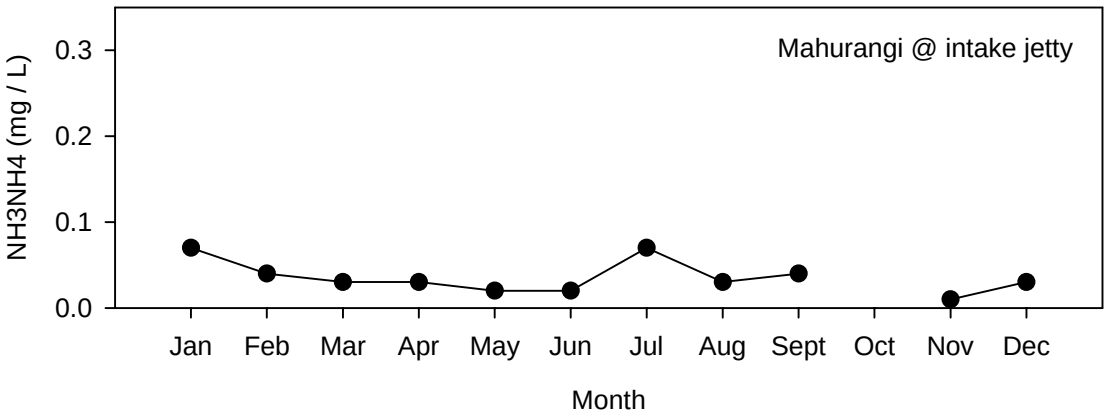

Cascade
Hoteo
Kumeu
Lucas
Mahurangi
Matakana
NH3NH4 (mg/L)
0.0
0.1
0.2
0.3
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

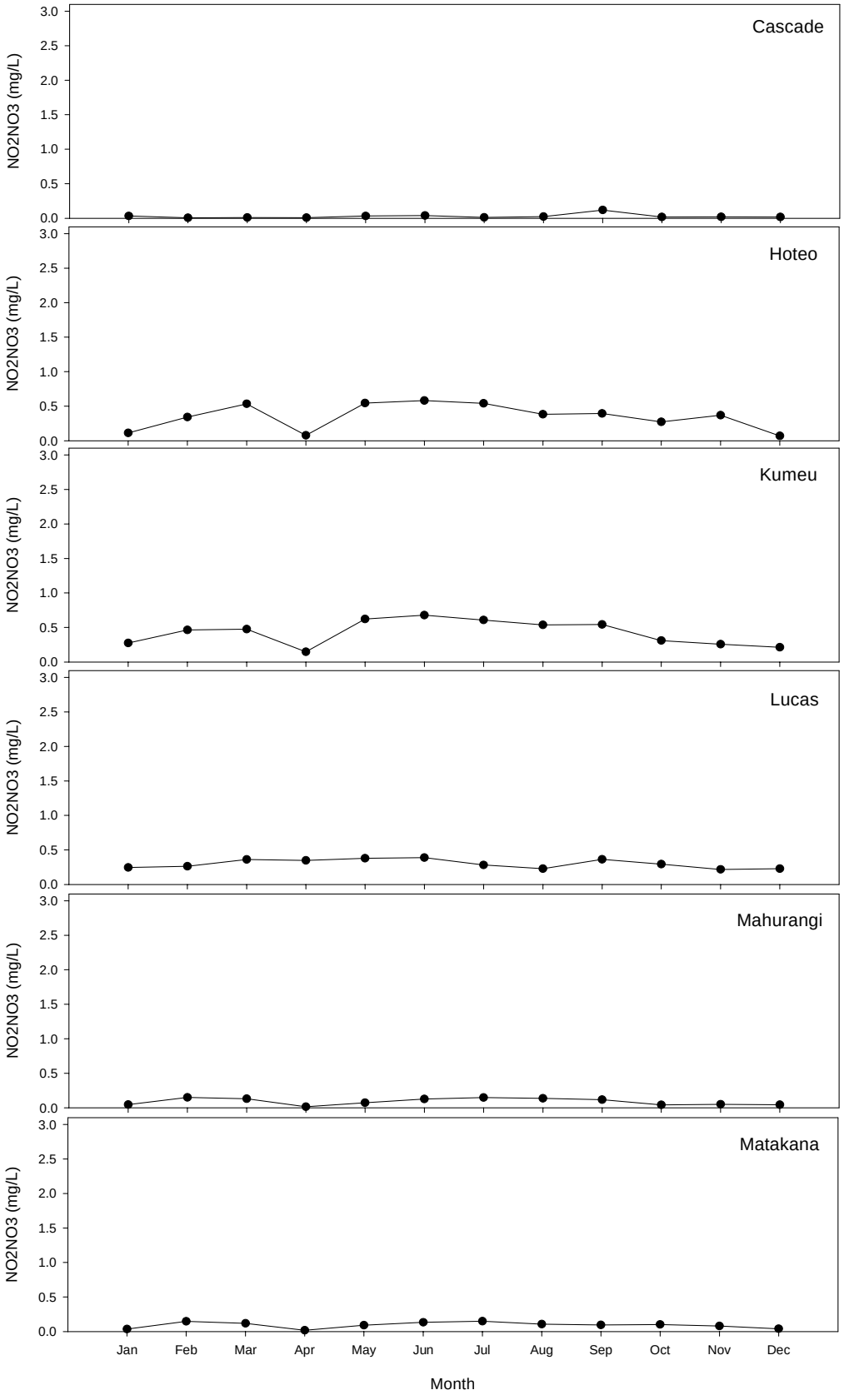

Ngakaroa
Oakley
Okura
Opanuku
Otara
Oteha
0.47
NH3NH4 (mg/L)
0.0
0.1
0.2
0.3
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

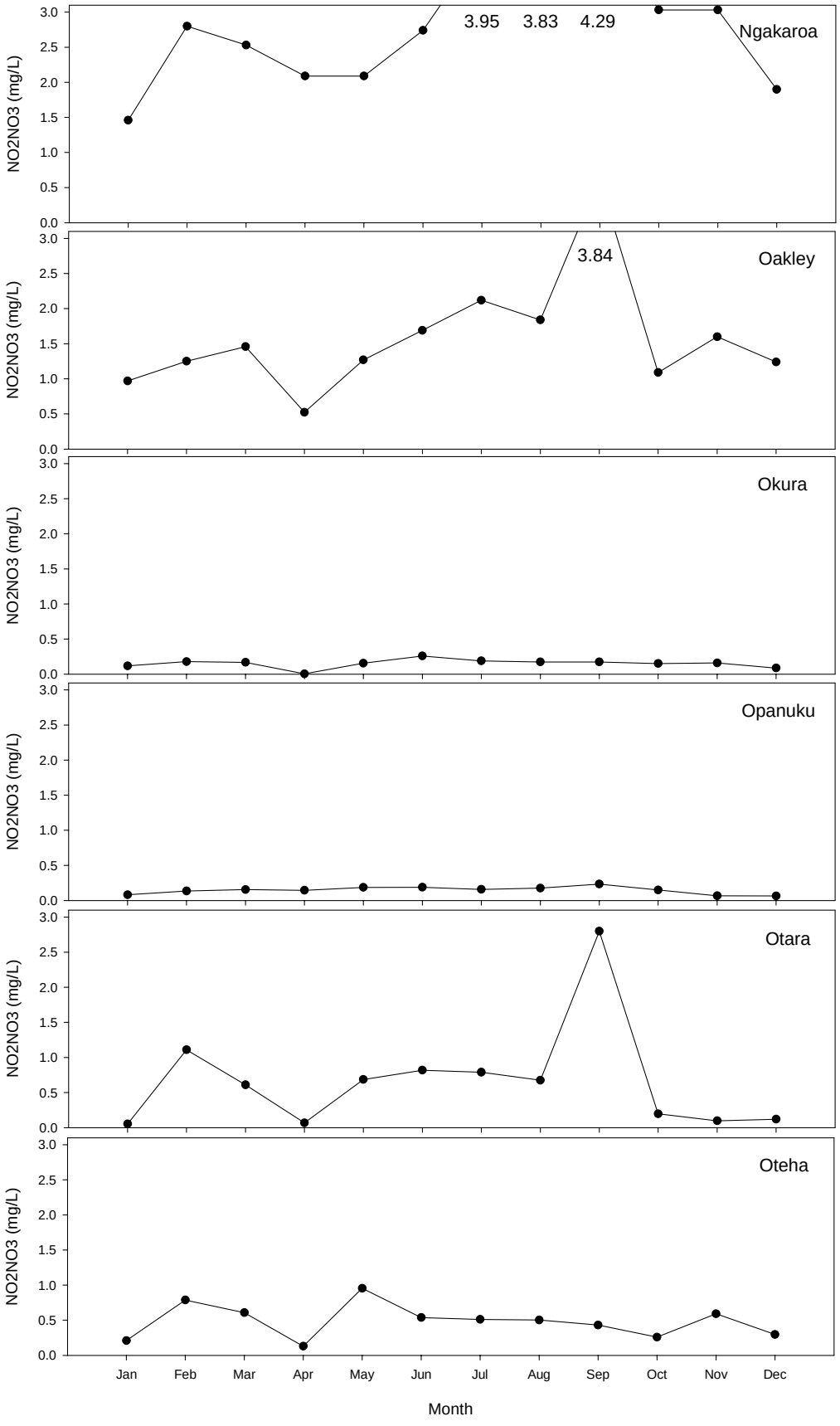

Papakura
Puhunui
Rangitopuni
Vaughans
Wairoa
Waiwera
NH3NH4 (mg/L)
0.0
0.1
0.2
0.3
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

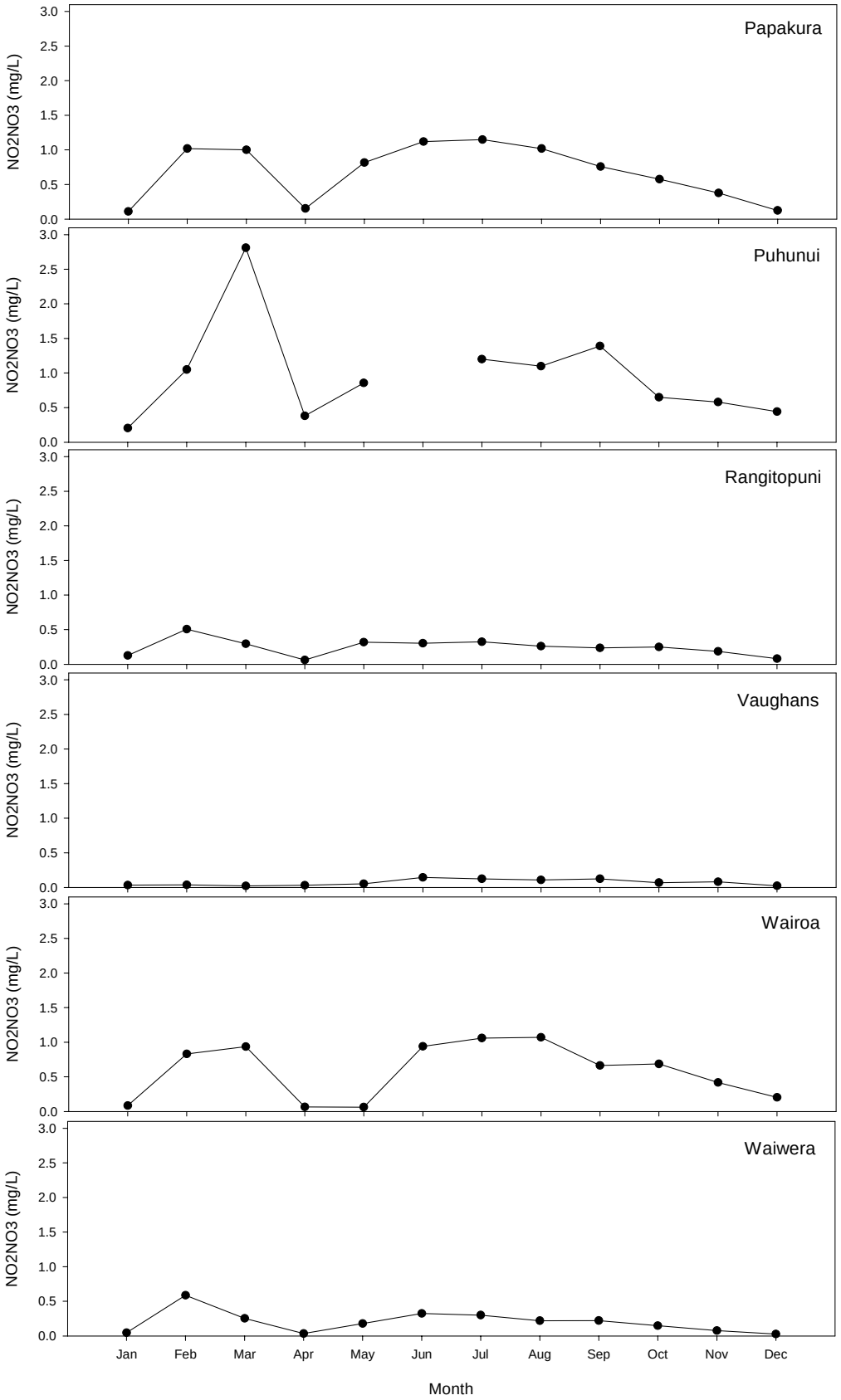

West Hoe
NH3NH4 (mg/L)
0.3
0.2
0.1
0.0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

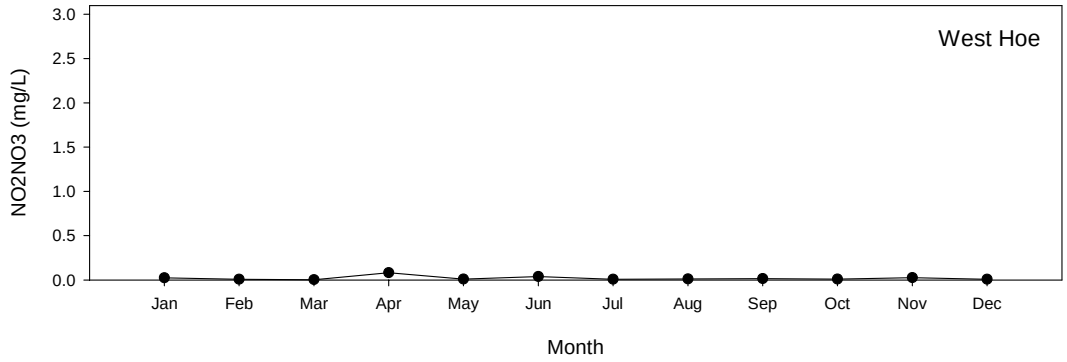

Mahurangi @ town bridge
NH3NH4 (mg / L)
0.3
0.2
0.1
0.0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Month

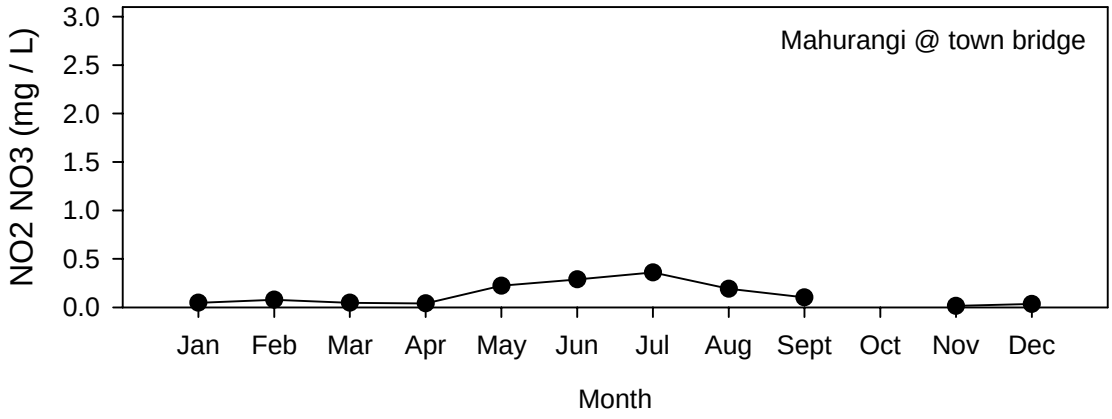

Mahurangi @ intake jetty
NH3NH4 (mg / L)
0.3
0.2
0.1
0.0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Month

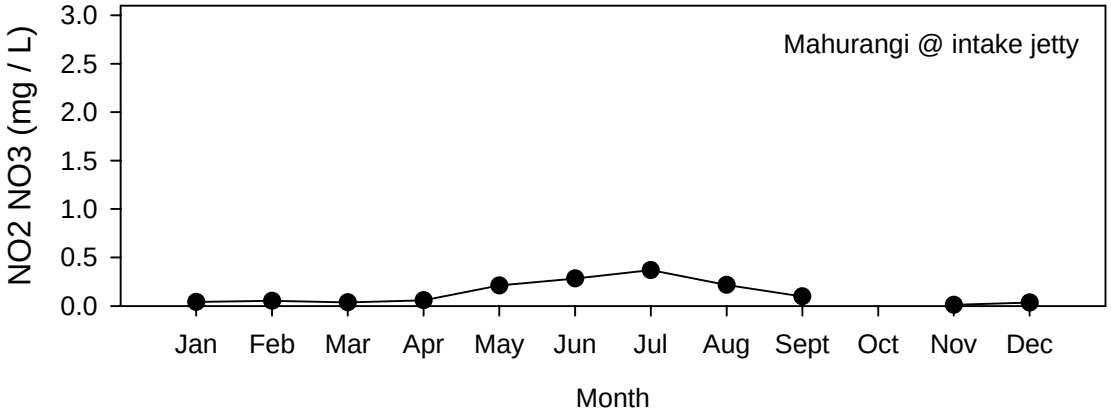

Cascade
Hoteo
Kumeu
Lucas
Mahurangi
Matakana
NO2NO3 (mg/L)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

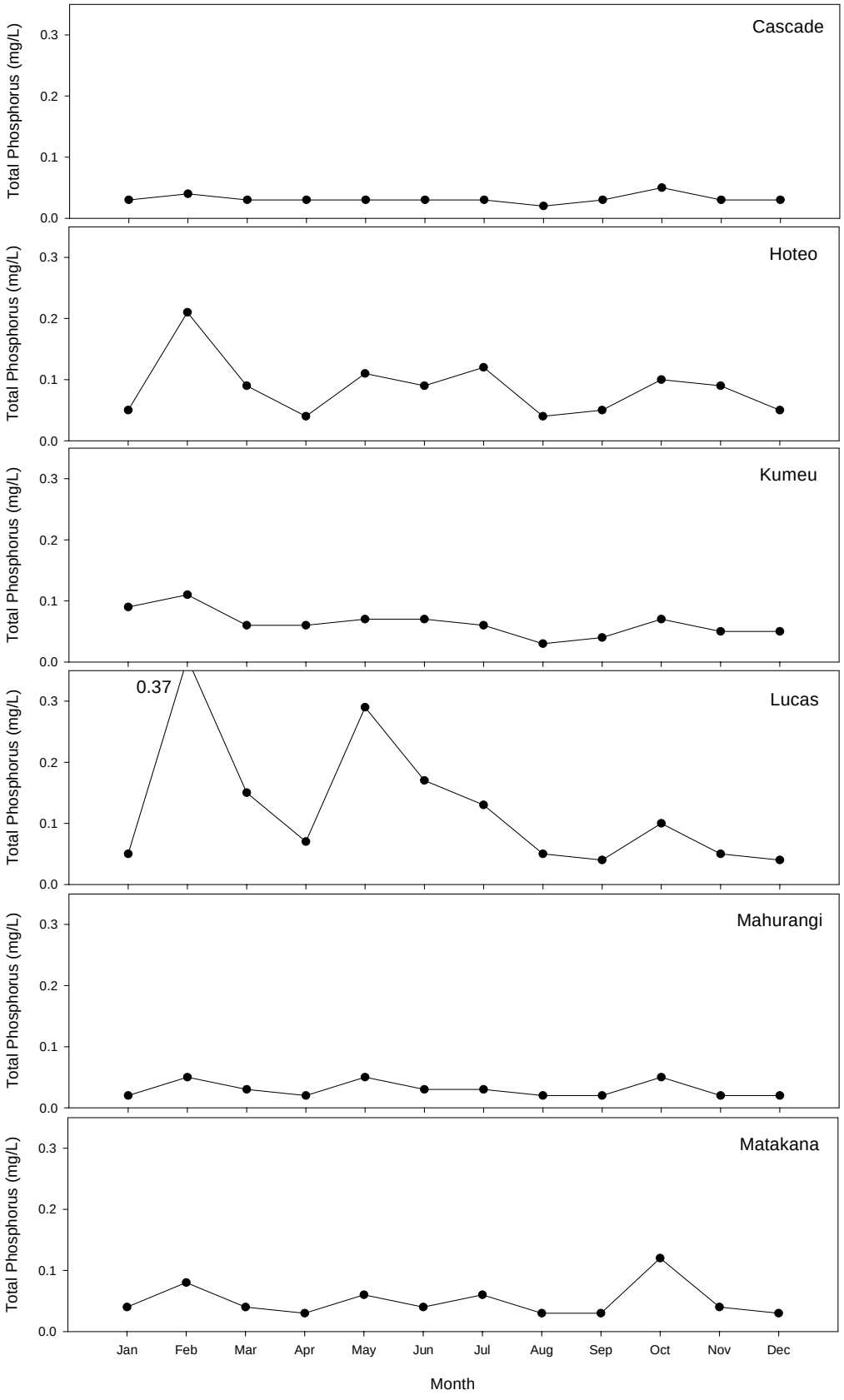

Ngakaroa
3.95
3.83
4.29
Oakley
3.84
Okura
Opanuku
Otara
Oteha
NO2NO3 (mg/L)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

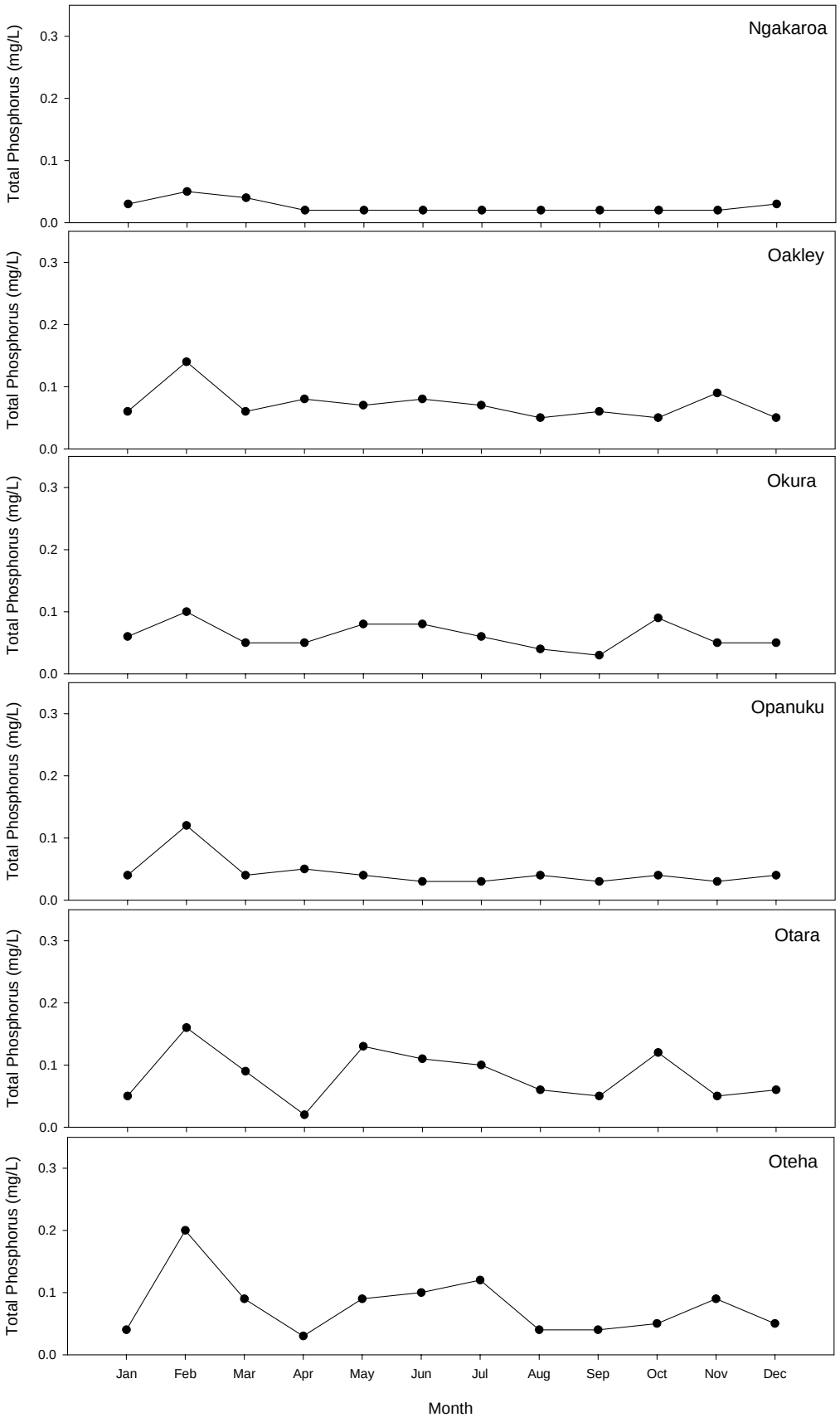

Papakura
Puhunui
Rangitopuni
Vaughans
Wairoa
Waiwera
NO2NO3 (mg/L)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

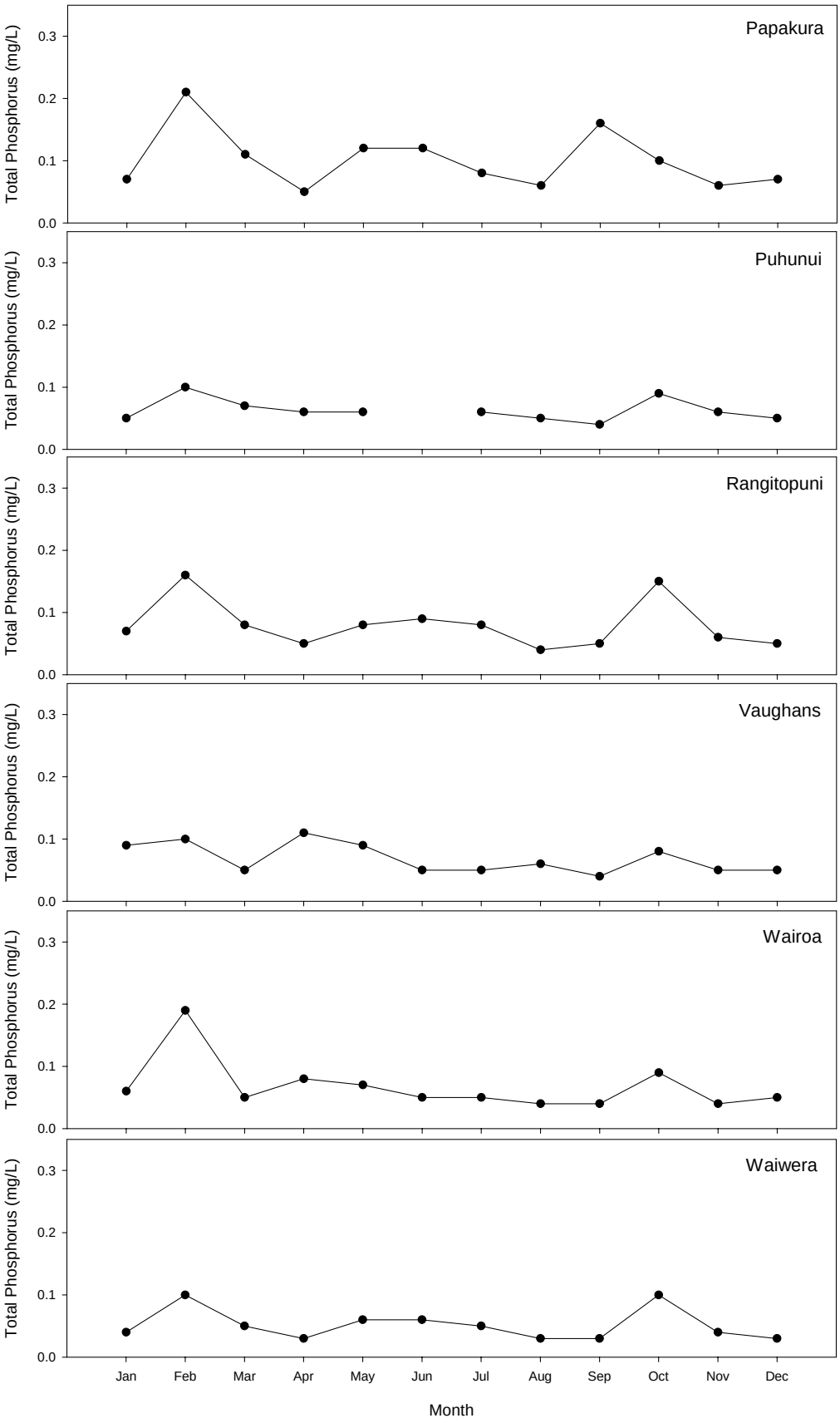

West Hoe
NO2NO3 (mg/L)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

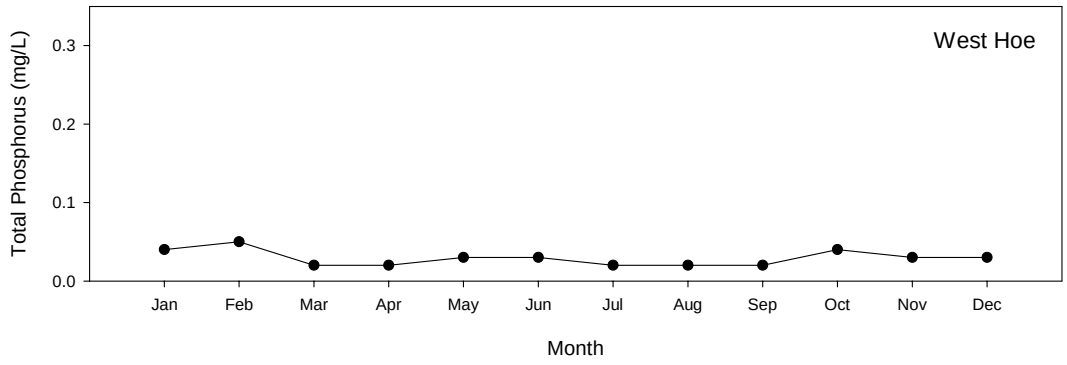

Mahurangi @ town bridge
NO2 NO3 (mg / L)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Month

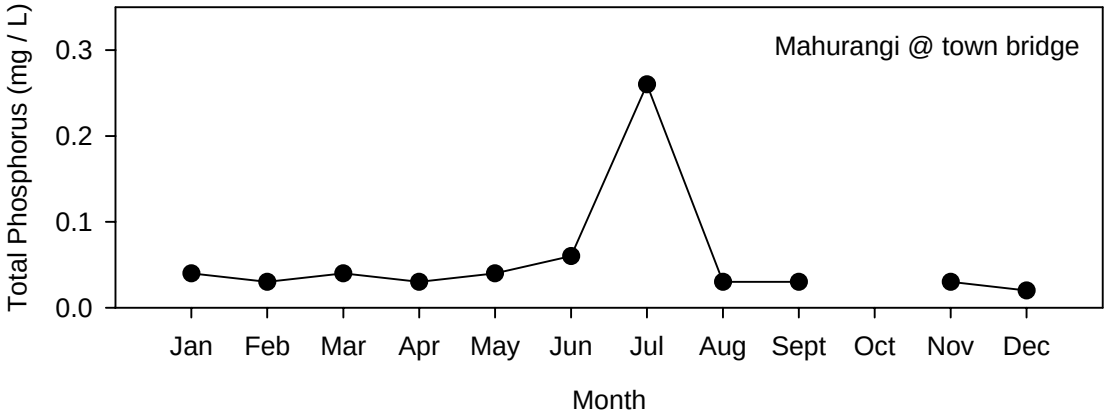

Mahurangi @ intake jetty
NO2 NO3 (mg / L)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Month

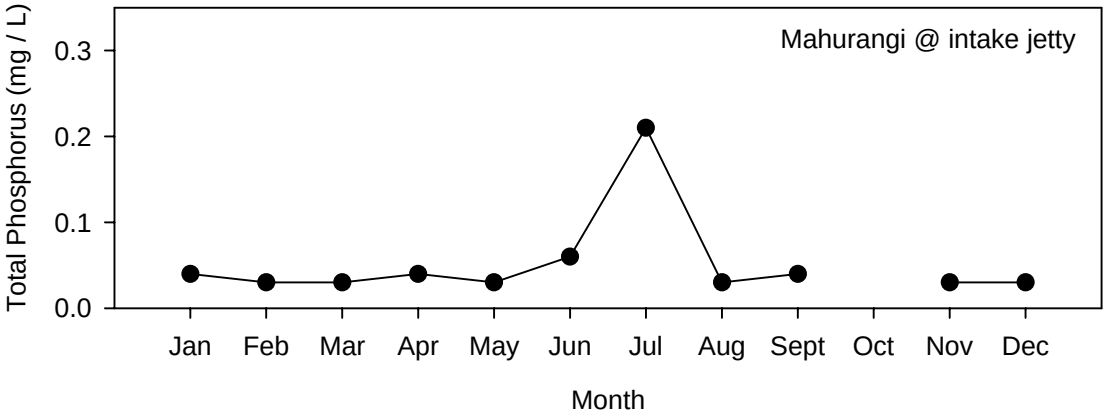

Cascade
Hoteo
Kumeu
Lucas
Mahurangi
Matakana
0.37
Total Phosphorus (mg/L)
0.0
0.1
0.2
0.3
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

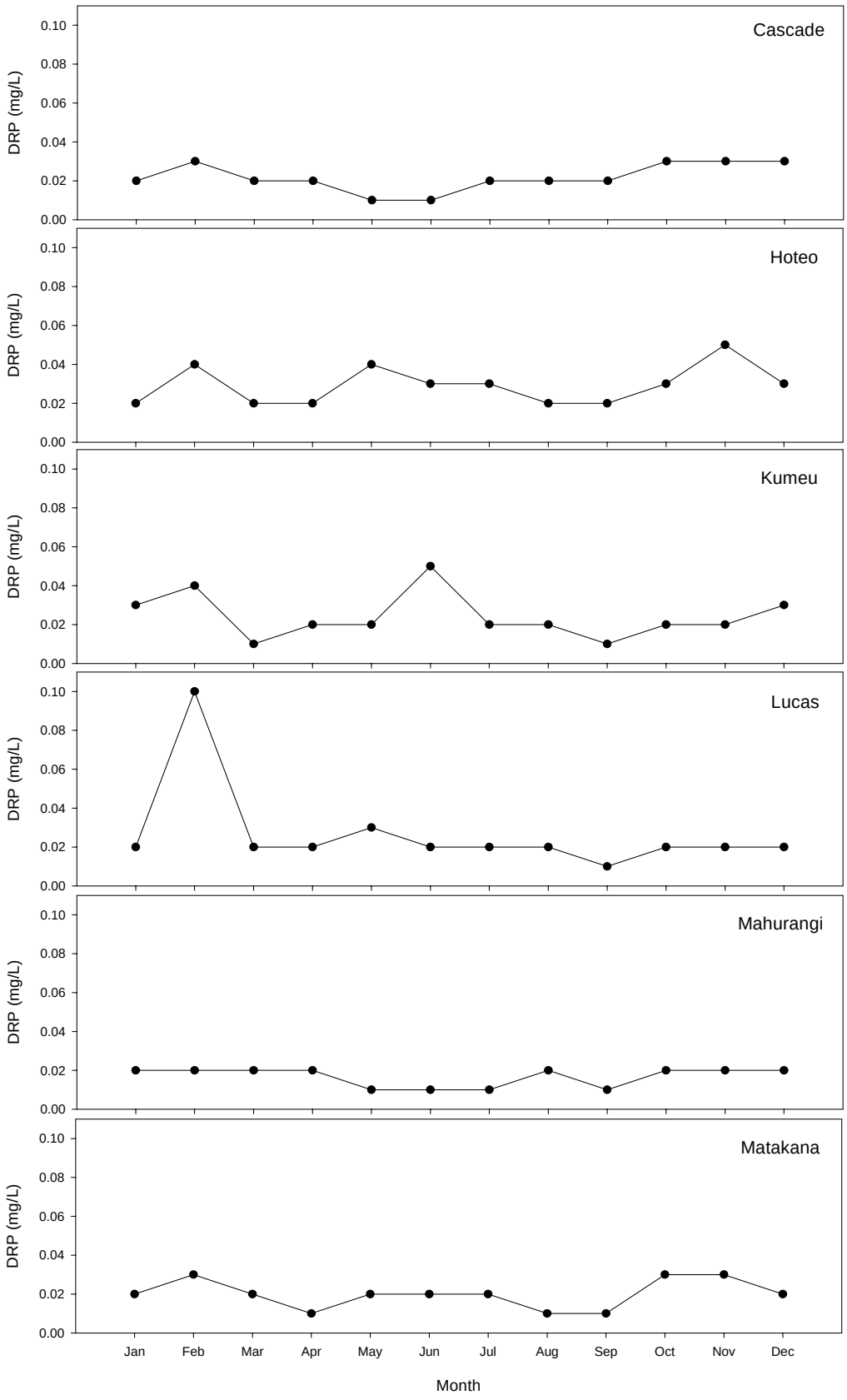

Ngakaroa
Oakley
Okura
Opanuku
Otara
Oteha
Total Phosphorus (mg/L)
0.0
0.1
0.2
0.3
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

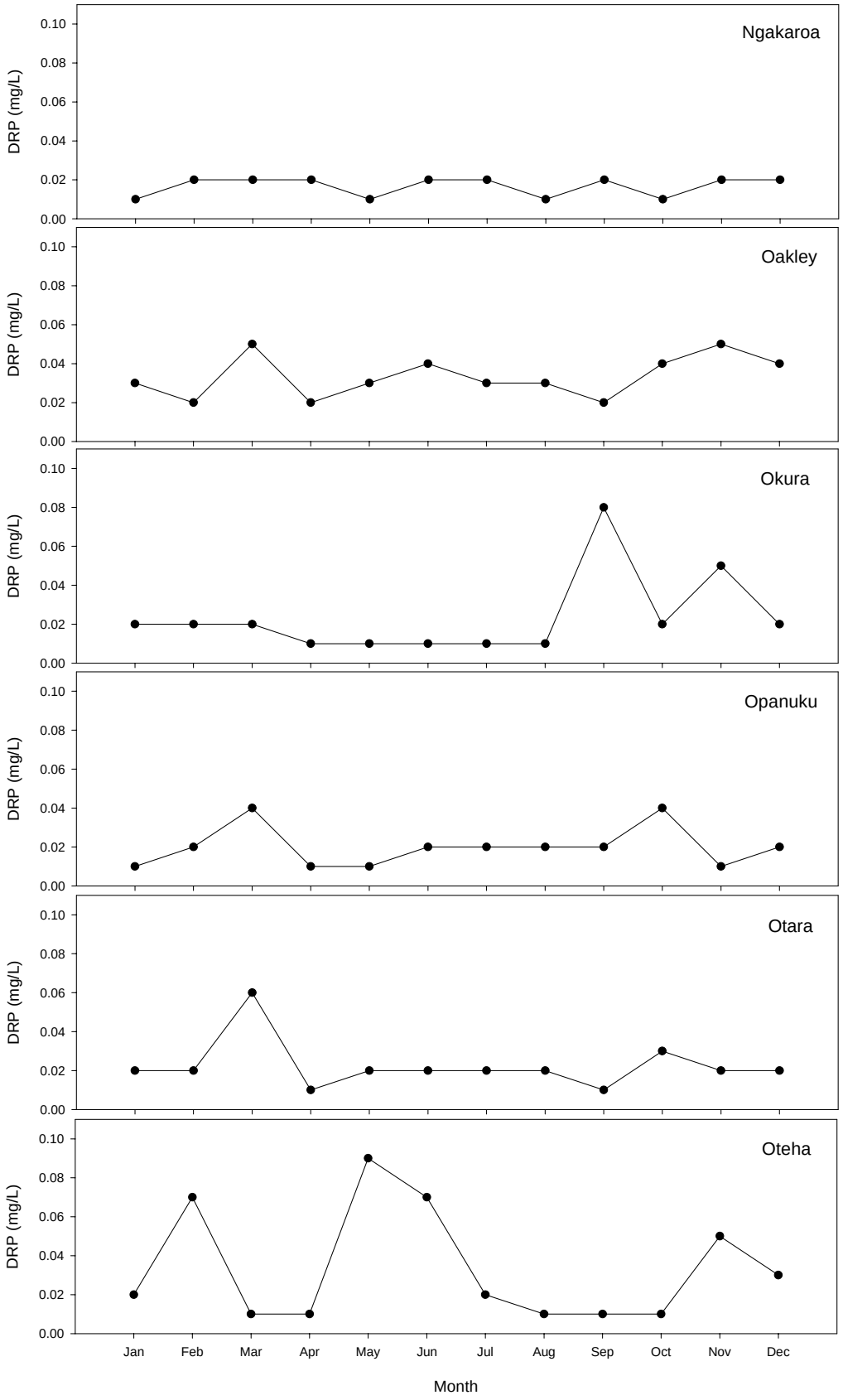

Papakura
Puhunui
Rangitopuni
Vaughans
Wairoa
Waiwera
Total Phosphorus (mg/L)
0.0
0.1
0.2
0.3
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

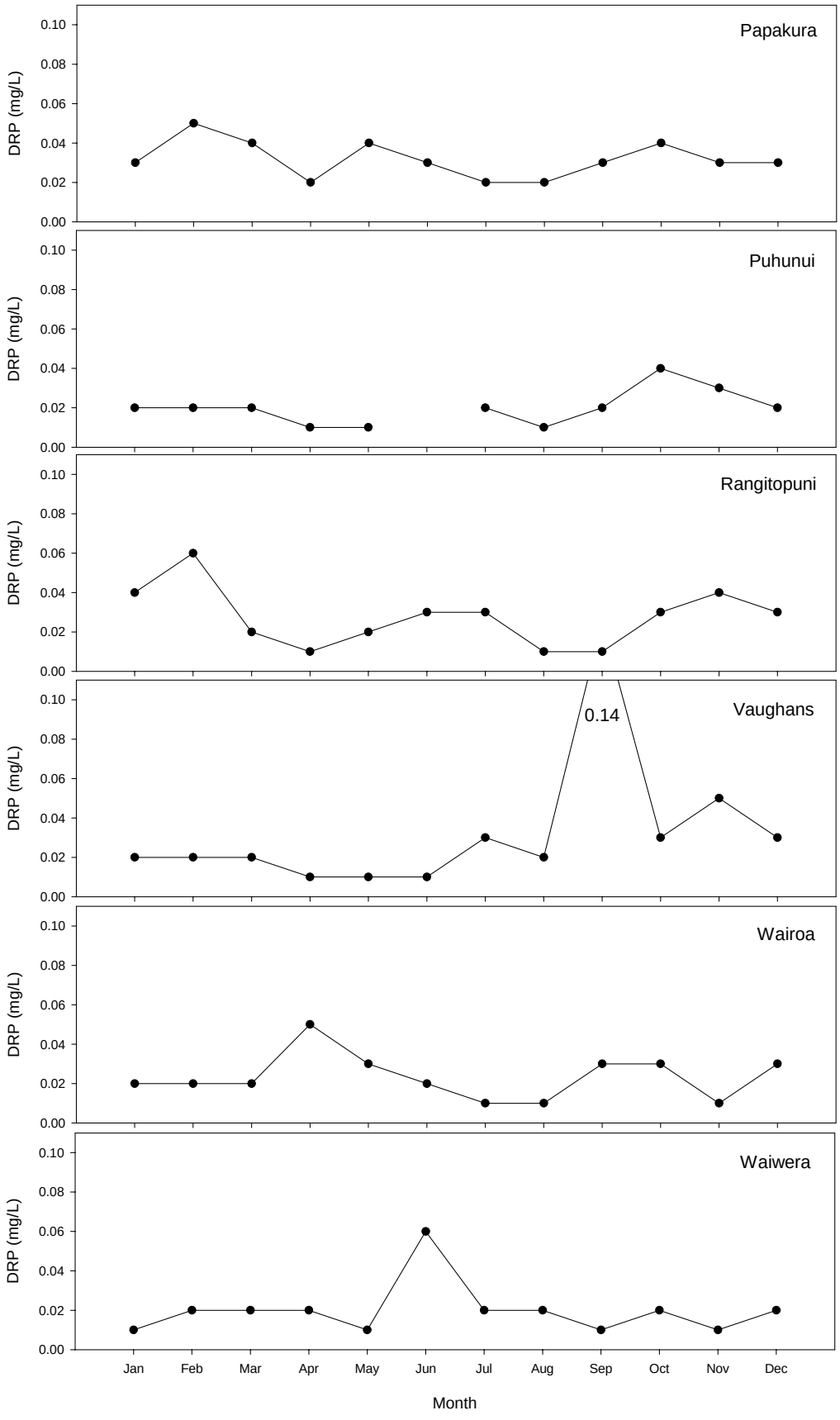

West Hoe
Total Phosphorus (mg/L)
0.0
0.1
0.2
0.3
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

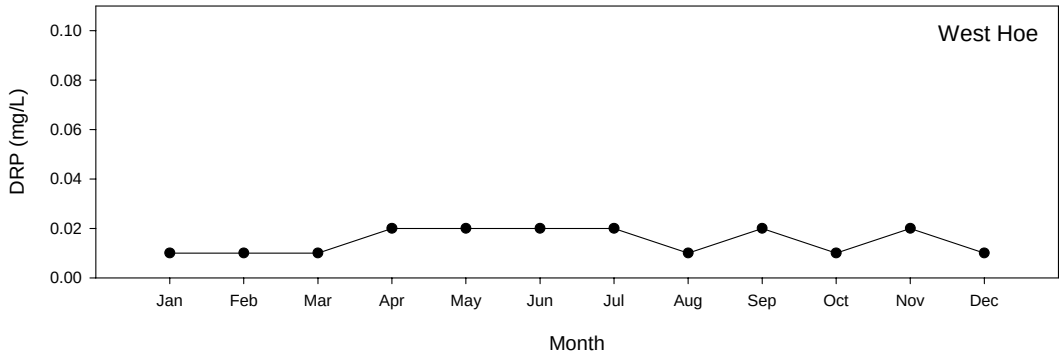

Mahurangi @ town bridge
Total Phosphorus (mg / L)
0.0
0.1
0.2
0.3
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Month

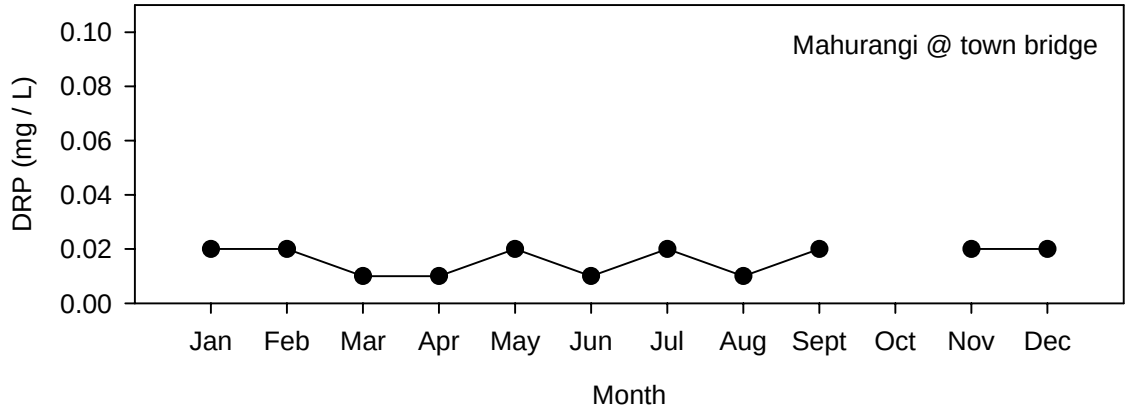

Mahurangi @ intake jetty
Total Phosphorus (mg / L)
0.0
0.1
0.2
0.3
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Month

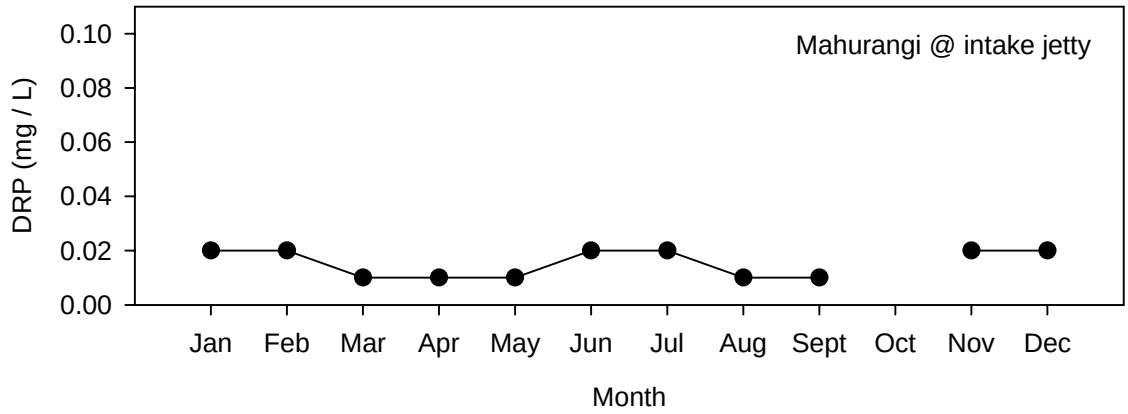

Cascade
Hoteo
Kumeu
Lucas
Mahurangi
Matakana
DRP (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

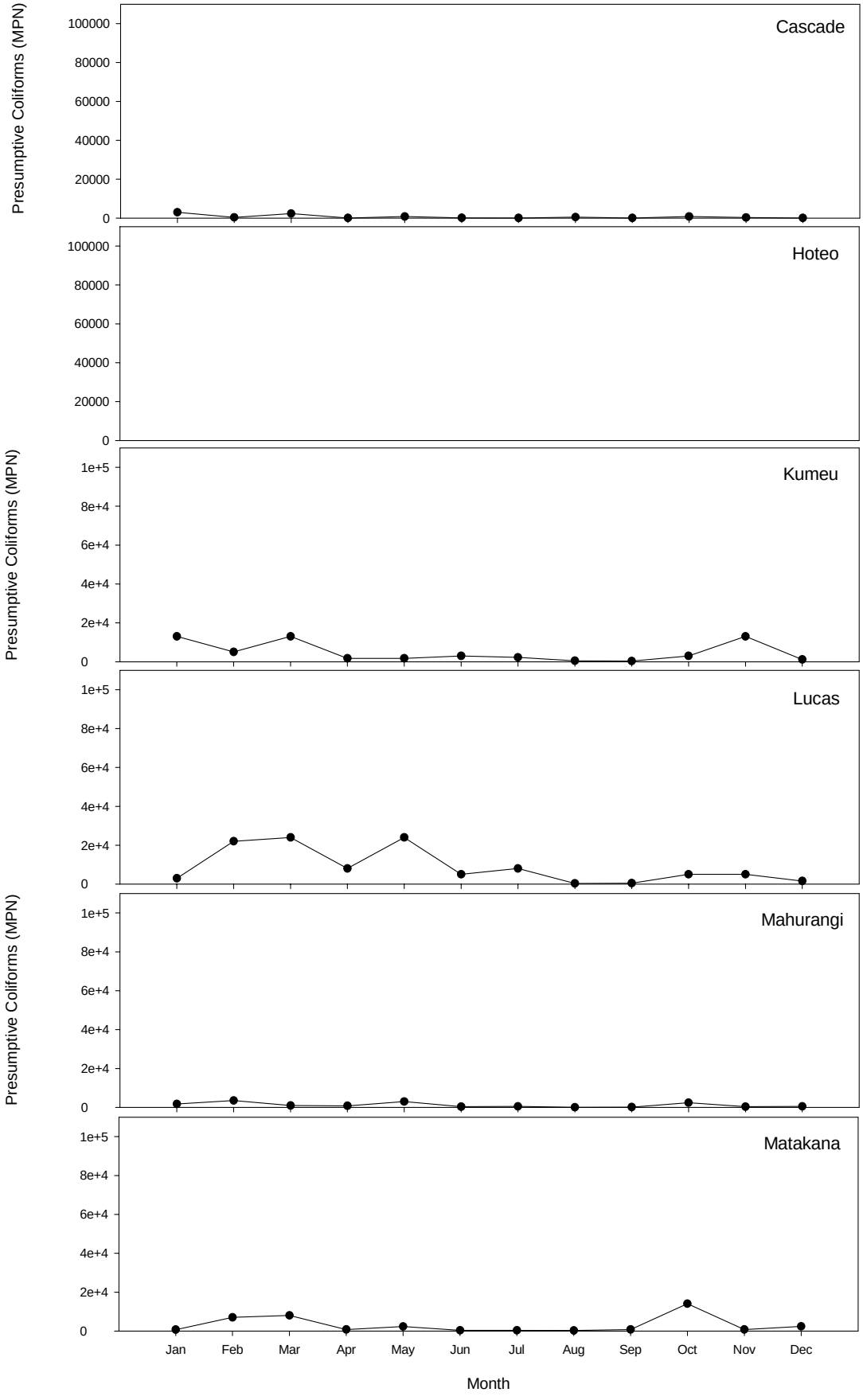

Ngakaroa
Oakley
Okura
Opanuku
Otara
Oteha
DRP (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

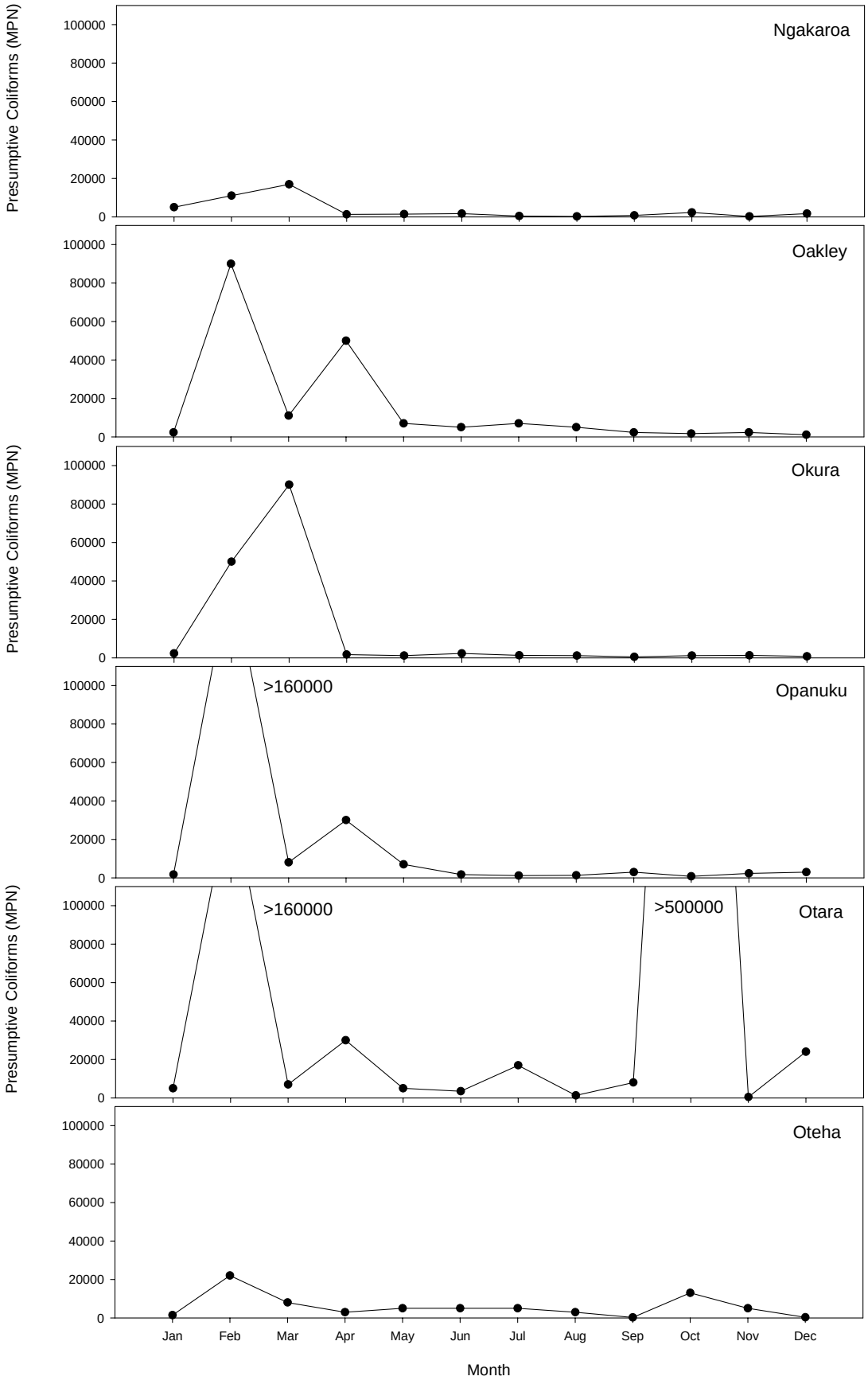

Papakura
Puhunui
Rangitopuni
Vaughans
0.14
Wairoa
Waiwera
DRP (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

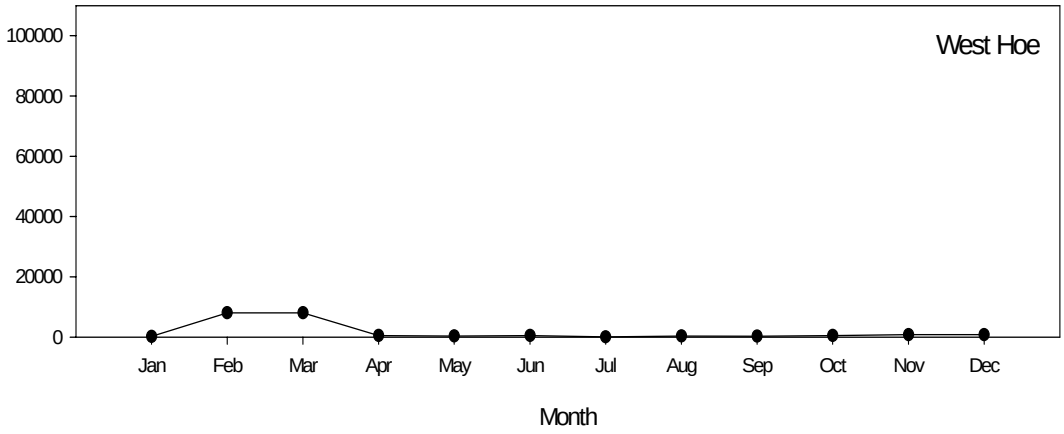

West Hoe
DRP (mg/L)
0.10
0.08
0.06
0.04
0.02
0.00
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

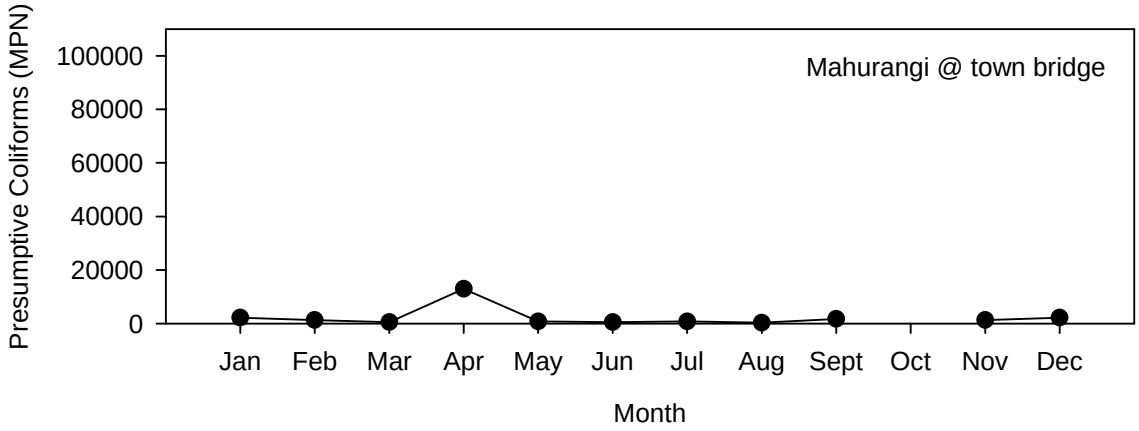

Mahurangi @ town bridge
DRP (mg / L)
0.10
0.08
0.06
0.04
0.02
0.00
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Month

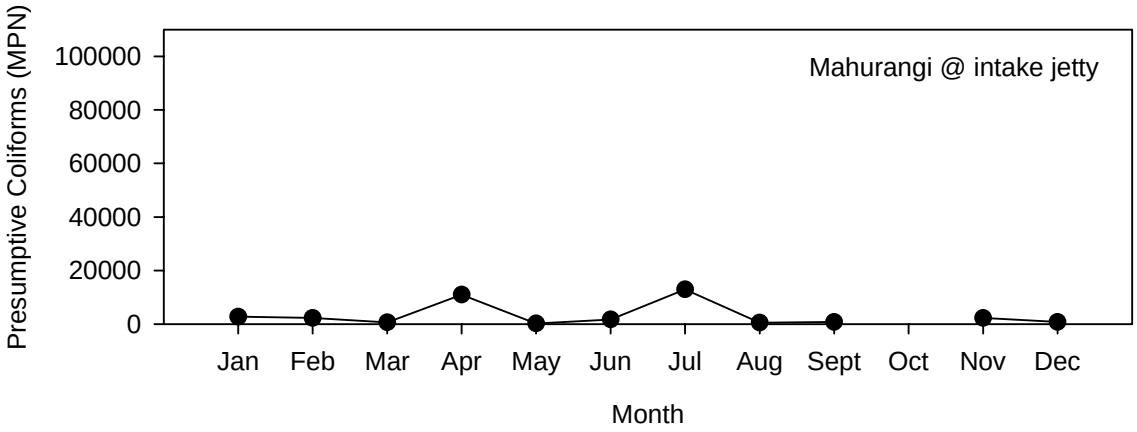

Mahurangi @ intake jetty
DRP (mg / L)
0.10
0.08
0.06
0.04
0.02
0.00
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Month

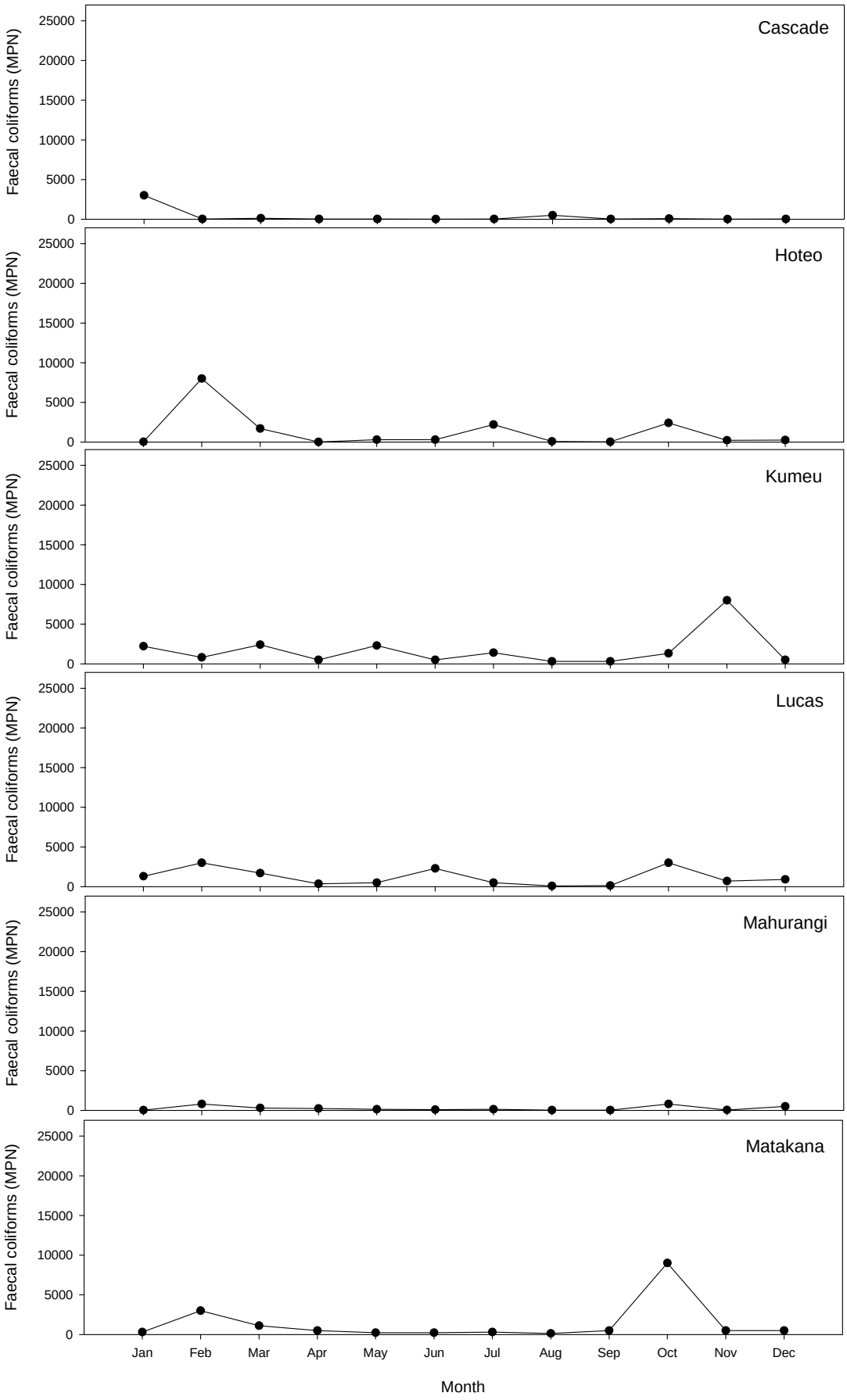

Cascade
Hoteo
Kumeu
Lucas
Mahurangi
Matakana
Presumptive Coliforms (MPN)
100000
80000
60000
40000
20000
0
1e+5
8e+4
6e+4
4e+4
2e+4
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

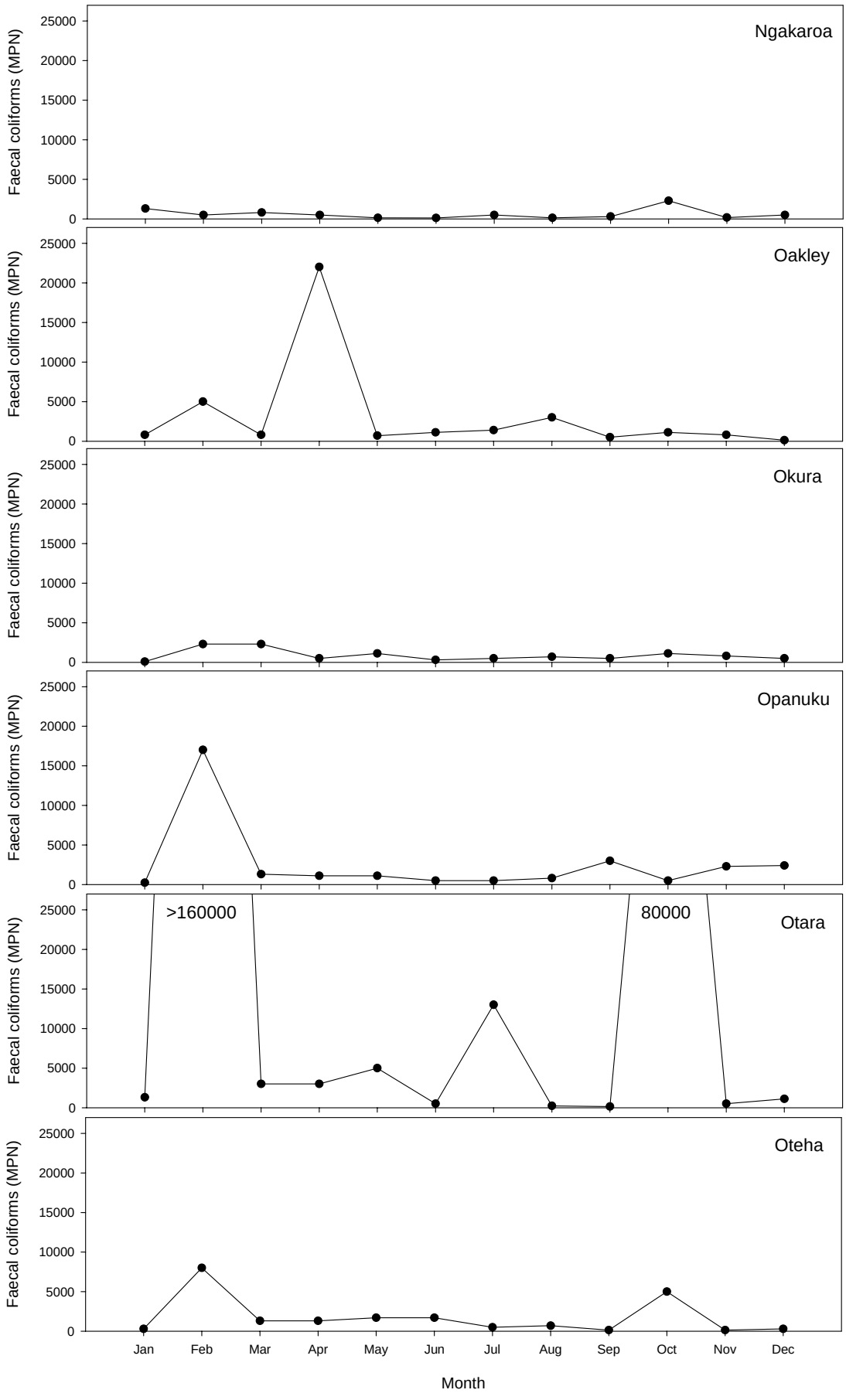

Presumptive Coliforms (MPN)
Ngakaroa
Oakley
Okura
Opanuku
Otara
Oteha
>160000
>160000
>500000
0
20000
40000
60000
80000
100000
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

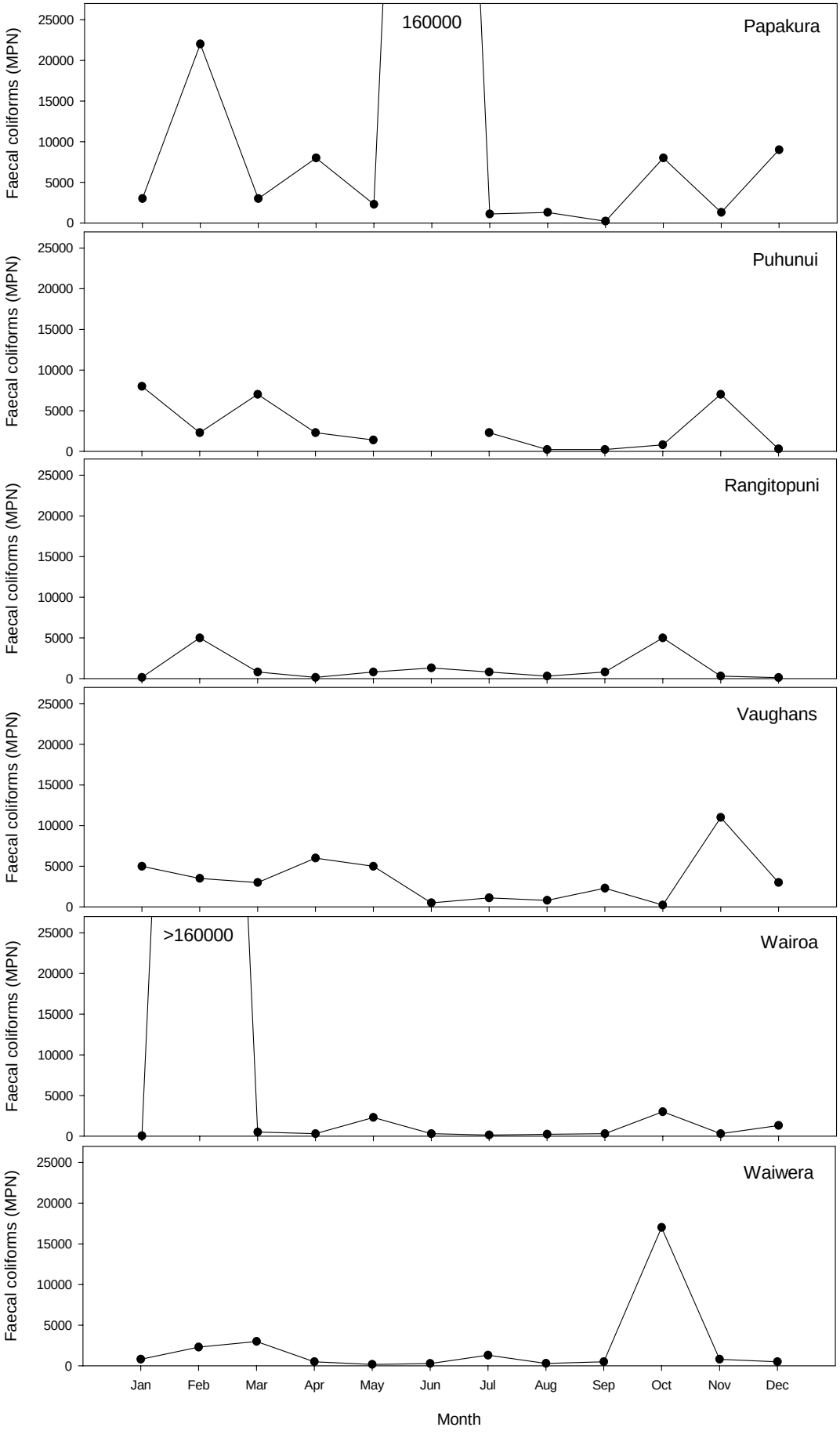

West Hoe
100000
80000
60000
40000
20000
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

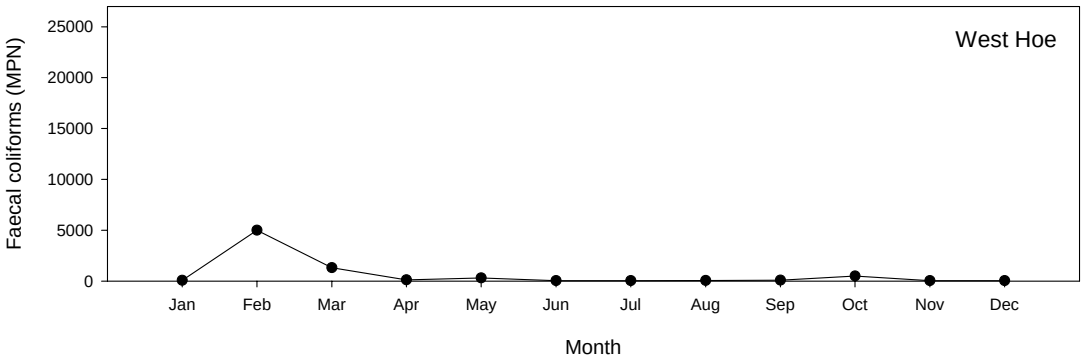

Mahurangi @ town bridge
Presumptive Coliforms (MPN)
100000
80000
60000
40000
20000
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Month

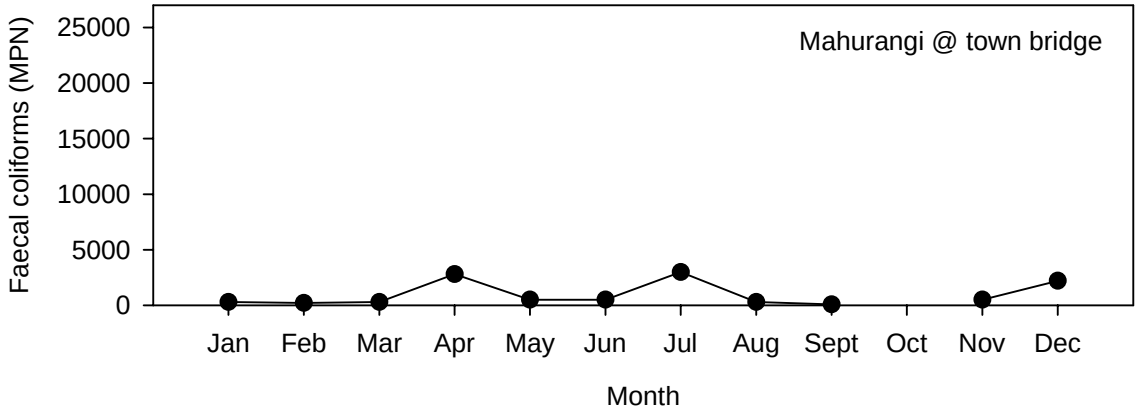

Mahurangi @ intake jetty
Presumptive Coliforms (MPN)
100000
80000
60000
40000
20000
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Month

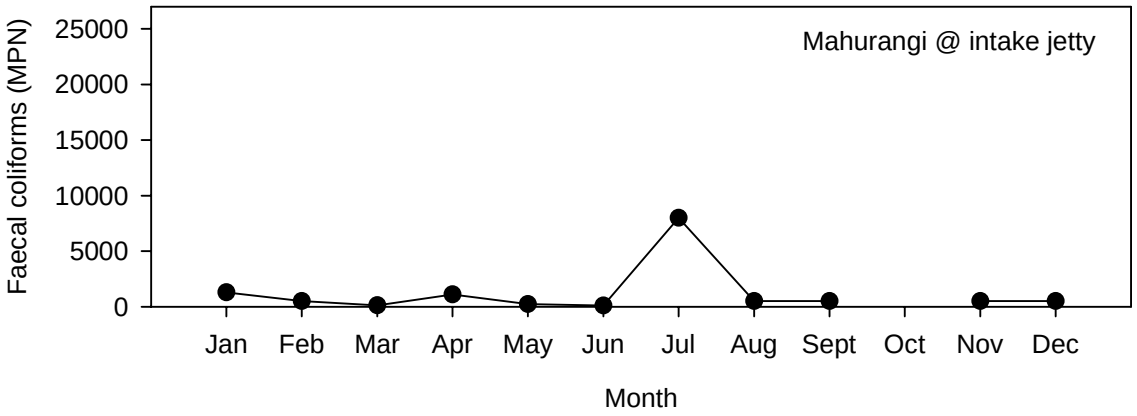

Cascade
Hoteo
Kumeu
Lucas
Mahurangi
Matakana
Faecal coliforms (MPN)
0
5000
10000
15000
20000
25000
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month


Ngakaroa
Oakley
Okura
Opanuku
Otara
Oteha
>160000
80000
Faecal coliforms (MPN)
0
5000
10000
15000
20000
25000
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month


Papakura
160000
Puhunui
Rangitopuni
Vaughans
Wairoa
>160000
Waiwera
Faecal coliforms (MPN)
0
5000
10000
15000
20000
25000
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month


West Hoe
Faecal coliforms (MPN)
25000
20000
15000
10000
5000
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month


Mahurangi @ town bridge
Faecal coliforms (MPN)
25000
20000
15000
10000
5000
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Month


Mahurangi @ intake jetty
Faecal coliforms (MPN)
25000
20000
15000
10000
5000
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Month

8 Appendix 2: lakes water quality parameters - 2004 summary tables, and time series plots to 1998.

8.1 Lake Kereta

Annual mean and median chemical and bacteriological quality of Lake Kereta

Date	Depth (m)	BOD (mg/L)	Chl a (mg/L)	Chloride (mg/L)	EC (mS/m)	FaeC[1] (MPN/100mL)	PresC[1] (MPN/100mL)	NH_4-N (mg/L)	NNN[1] (mg/L)	DRP (mg/L)	TP (mg/L)	pH	SS (mg/L)	TKN (mg/L)	Turb (NTU)	Secchi[2] (m)
26-Feb-04	0	<2.0	0.0007	42.6	24.8	30	170	0.01	0.018	<0.01	0.03	8.4	2.5	0.9	2.00	
27-May-04	0	<2.0	0.0037	42.0	24.6	170	500	<0.01	0.012	<0.01	0.02	7.4	<0.9	0.4	2.26	
20-Aug-04	0	<2.0	0.0017	37.6	23.8	11	17	0.01	0.004	<0.01	0.02	8.1	0.5	0.5	0.99	
03-Dec-04	0	<2.0	0.0033	40.0	24.3	300	500	0.01	<0.002	<0.01	0.02	9.9	4.9	0.4	1.36	
Mean			0.0024	40.6	24.4	128	297	0.01	0.011		0.02	8.5	2.6	0.6	1.65	
Median			0.0025	41.0	24.5	100	335	0.01	0.012		0.02	8.2	2.5	0.5	1.68	

N.B. mg/L = g/m3 = g m-3

1 NNN represents nitrate + nitrite nitrogen. FaeC = Faecal coliforms; PresC = Presumptive coliforms.

2 Secchi depth not measured at this site.

8.2 Lake Kuwakatai

Annual mean and median chemical and bacteriological quality of Lake Kuwakatai

Date	Depth (m)	BOD (mg/L)	Chl a (mg/L)	Chloride (mg/L)	EC (mS/m)	FaeC (MPN/100mL)	PresC (MPN/100mL)	NH_4-N (mg/L)	NNN[1] (mg/L)	DRP (mg/L)	TP (mg/L)	pH	SS (mg/L)	TKN (mg/L)	Turb (NTU)	Secchi[2] (m)
26-Feb-04	0	<2.0	0.0207	39.3	21.5	4	80	<0.01	0.028	<0.01	0.05	7.5	1.9	1.50	2.1	1.9
27-May-04	0	3.4	0.0329	38.0	21.6	50	130	<0.01	0.005	0.01	0.06	7.8	8.3	0.60	4.9	1.4
20-Aug-04	0	5.7	0.0740	37.1	22.3	2	4	0.01	0.003	<0.01	0.05	8.5	11.0	0.80	3.6	1.4
03-Dec-04	0	3.4	0.0369	37.8	22.6	2	22	0.11	0.032	0.01	0.04	7.4	3.7	0.57	1.6	1.2
Mean		4.2	0.0411	38.1	22.0	15	59	0.06	0.017	0.01	0.05	7.8	6.2	0.87	3.1	1.5
Median		3.4	0.0349	37.9	22.0	3	51	0.06	0.017	0.01	0.05	7.7	6.0	0.70	2.9	1.4
26-Feb-04	5	4.9		37.2	22.4			<0.01	0.003	<0.01	0.04	8.1	8.4	0.60	2.3	
27-May-04	5	<2		38.9	22.7			0.16	0.026	0.01	0.03	7.4	0.8	0.26	0.7	
20-Aug-04	5	<2.0	0.0106	38.2	21.5	30	80	0.02	0.018	<0.01	0.04	7.5	1.4	1.10	1.5	
03-Dec-04	5	2.6	0.0321	38.4	21.5	50	130	<0.01	0.005	0.01	0.04	7.7	5.1	0.60	2.8	
Mean		3.8	0.0214	38.2	22.0	40	105	0.09	0.013	0.01	0.04	7.7	3.9	0.64	1.8	
Median		3.8	0.0214	38.3	22.0	40	105	0.09	0.012	0.01	0.04	7.6	3.3	0.60	1.9	

N.B. mg/L = g/m3 = g m-3

NNN represents nitrate + nitrite nitrogen. FaeC = Faecal coliforms; PresC = Presumptive coliforms.

8.3 Lake Ototoa

Annual mean and median chemical and bacteriological quality of Lake Ototoa

Date	Depth (m)	BOD (mg/L)	Chl a (mg/L)	Chloride (mg/L)	EC (mS/m)	FaeC (MPN/100mL)	PresC (MPN/100mL)	NH_4-N (mg/L)	NNN[1] (mg/L)	DRP (mg/L)	TP (mg/L)	pH	SS (mg/L)	TKN (mg/L)	Turb (NTU)	Secchi[2] (m)
26-Feb-04	0	<2.0	0.0039	41.0	21.1	2	23	<0.01	0.013	<0.01	0.02	7.7	1.1	0.3	0.80	3.5
27-May-04	0	<2.0	0.0020	40.3	20.9	<2	23	0.03	0.008	0.01	0.01	7.2	1.2	1.0	0.40	7.5
20-Aug-04	0	<2.0	0.0086	39.2	21.7	<2	<2	0.02	0.014	<0.01	0.01	8.1	0.7	0.6	0.58	6.0
23-Nov-04	0	<2.0	0.0095	39.7	21.5	2	17	0.02	<0.002	0.01	0.02	8.8	2.2	0.5	1.04	2.1
Mean			0.0060	40.1	21.3	2	21	0.02	0.012	0.01	0.02	8.0	1.3	0.6	0.71	4.8
Median			0.0063	40.0	21.3	2	23	0.02	0.013	0.01	0.02	7.9	1.2	0.6	0.69	4.8
26-Feb-04	10	<2.0	0.0046	40.3	21.2	<2	30	<0.01	0.020	<0.001	0.02	7.6	1.4	0.5	1.00	
27-May-04	10	<2.0	0.0064	40.8	21.1	<2	8	0.04	0.009	0.01	0.02	7.4	2.0	0.6	0.77	
20-Aug-04	10	<2.0		39.3	21.7			0.02	0.014	<0.01	0.02	8.0	1.0	0.9	0.75	
Mean			0.0055	40.1	21.3		19	0.03	0.014	0.01	0.02	7.7	1.5	0.7	0.84	
Median			0.0055	40.3	21.2		19	0.03	0.014	0.01	0.02	7.6	1.4	0.6	0.77	
26-Feb-04	20	<2.0	0.0051	40.5	21.8	<2	<2	0.21	0.021	<0.01	0.02	7.3	6.6	1.4	3.60	
27-May-04	20	<2.0	0.0019	40.3	21.1	4	30	0.03	0.009	0.01	0.02	7.5	2.5	0.4	0.76	
20-Aug-04	20	<2.0		39.1	21.7			0.02	0.013	<0.01	0.01	7.9	0.8	0.7	0.59	
23-Nov-04	20	<2.0		39.3	21.8			0.02	<0.002	<0.01	0.02	7.6	1.4	0.5	1.17	
Mean			0.0035	39.8	21.6	4	30	0.07	0.014	0.01	0.02	7.6	2.8	0.8	1.53	
Median			0.0035	39.8	21.8	4	30	0.03	0.013	0.01	0.02	7.5	2.0	0.6	0.97	

NNN represents nitrate + nitrite nitrogen. FaeC = Faecal coliforms; PresC = Presumptive coliforms..

8.4 Lake Pupuke

Date	Depth (m)	BOD (mg/L)	Chl a (mg/L)	Chloride (mg/L)	EC (mS/m)	FaeC (MPN/100mL)	PresC (MPN/100mL)	NH_4-N (mg/L)	NNN[1] (mg/L)	DRP (mg/L)	TP (mg/L)	pH	SS (mg/L)	TKN (mg/L)	Turb (NTU)	Secchi[2] (m)
04-Mar-04	5	<2	0.0039	37.9	29.1	13	17	<0.01	<0.002	0.02	0.03	8.4	2.4	0.3	1.2	4.3
15-Apr-04	5	<2	0.0083	37.9	27.6	4	8	<0.01	0.005	<0.01	0.02	8.4	1.7	0.7	0.9	3.8
26-May-04	5	<2.0	0.0018	37.7	27.0	13	30	<0.01	0.037	0.01	0.02	8.0	1.8	0.4	1.0	6.8
13-Aug-04	5	<2	0.0014	37.0	26.5	2	4	0.01	0.025	<0.01	0.02	8.0	1.5	<0.2	0.9	3.6
24-Nov-04	5	<2.0	0.0039	36.7	27.5	2	23	0.01	0.027	0.02	0.04	8.8	0.9	<0.20	0.6	4.2
Mean			0.0039	37.4	27.5	7	16	0.01	0.024	0.02	0.03	8.3	1.7	0.5	0.9	4.5
Median			0.0039	37.7	27.5	4	17	0.01	0.026	0.02	0.02	8.4	1.7	0.4	0.9	4.2
04-Mar-04	25	<2	0.0034	37.0	28.9	13	13	<0.01	0.041	0.01	0.03	7.9	0.8	0.3	0.3	
15-Apr-04	25	<2		37.5	27.4	<2	<2	<0.01	0.036	<0.01	0.01	7.7	<0.8	0.4	0.4	
26-May-04	25	<2.0		37.3	27.1	17	220	<0.01	0.085	0.01	0.01	7.5	1.2	<0.20	0.4	
13-Aug-04	25	<2	0.0068	37.0	26.0			0.02	0.031	<0.01	0.02	7.9	1.3	<0.2	0.9	
24-Nov-04	25	<2.0	0.0020	36.2	27.7			0.01	0.078	0.01	0.02	8.0	0.4	<0.20	0.7	
Mean			0.0041	37.0	27.4	15	117	0.02	0.054	0.01	0.02	7.8	0.9	0.4	0.6	
Median			0.0034	37.0	27.4	15	117	0.02	0.041	0.01	0.02	7.9	1.0	0.4	0.4	
04-Mar-04	50	<2	0.0024	36.2	29.4	<2	4	0.41	0.002	0.01	0.08	7.6	4.9	0.5	6.2	
15-Apr-04	50	2.9		36.9	27.6	11	17	0.28	0.015	0.02	0.06	7.3	3.6	0.9	4.8	
26-May-04	50	3.6		37.3	37.3	4	30	0.48	0.035	0.06	0.08	7.2	6.9	0.6	5.3	
13-Aug-04	50							0.02	0.027	<0.01	0.01			0.6		
24-Nov-04	50	<2.0	0.0029	35.8	27.7			0.01	0.090	0.01	0.02	7.8	0.4	0.3	0.7	
Mean		3.3	0.0027	36.6	30.5	8	17	0.24	0.034	0.03	0.05	7.5	4.0	0.6	4.2	
Median		3.3	0.0027	36.6	28.6	8	17	0.28	0.027	0.02	0.06	7.5	4.3	0.6	5.0	

NNN represents nitrate + nitrite nitrogen. FaeC = Faecal coliforms; PresC = Presumptive coliforms. .a) Surface measurement