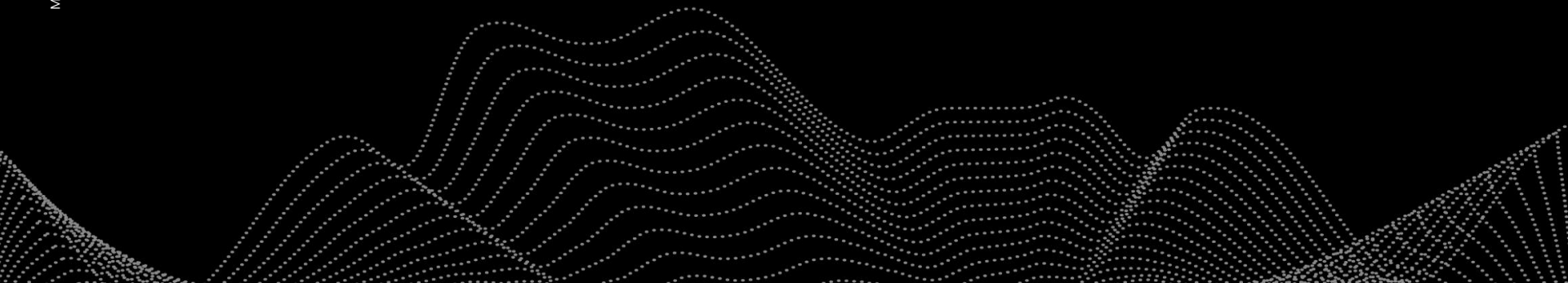




Wetlands & nutrients

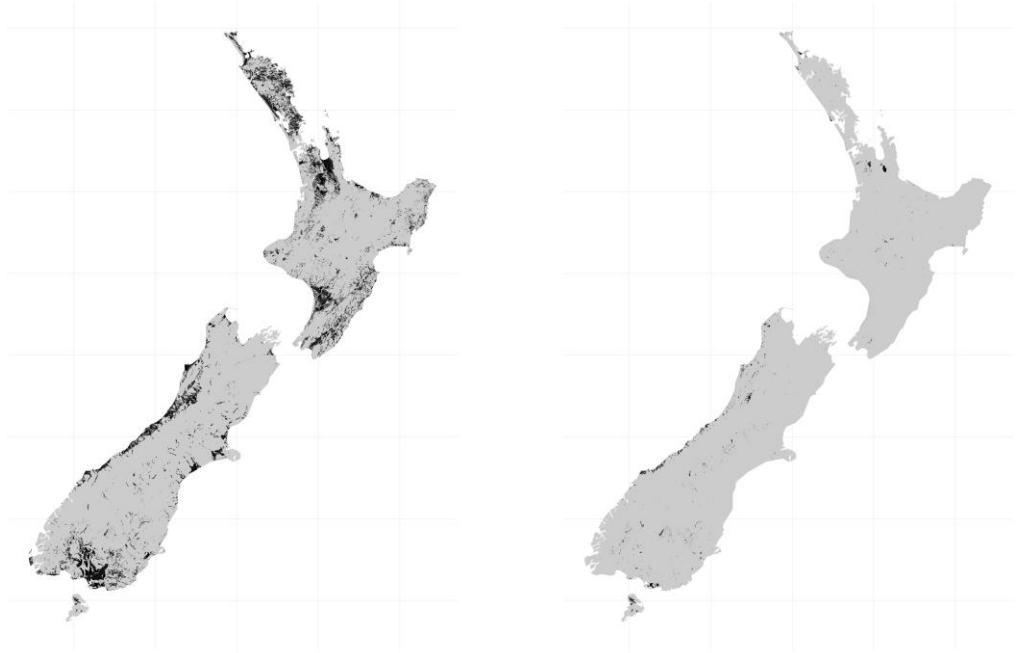
Olivia Burge





- Affect natural plant communities
- Weeds [willow (*Salix*), reed sweet grass (*Glyceria*), royal fern (*Osmunda*)... & raupō (*Typha*)
- Reflect changes in wider environment

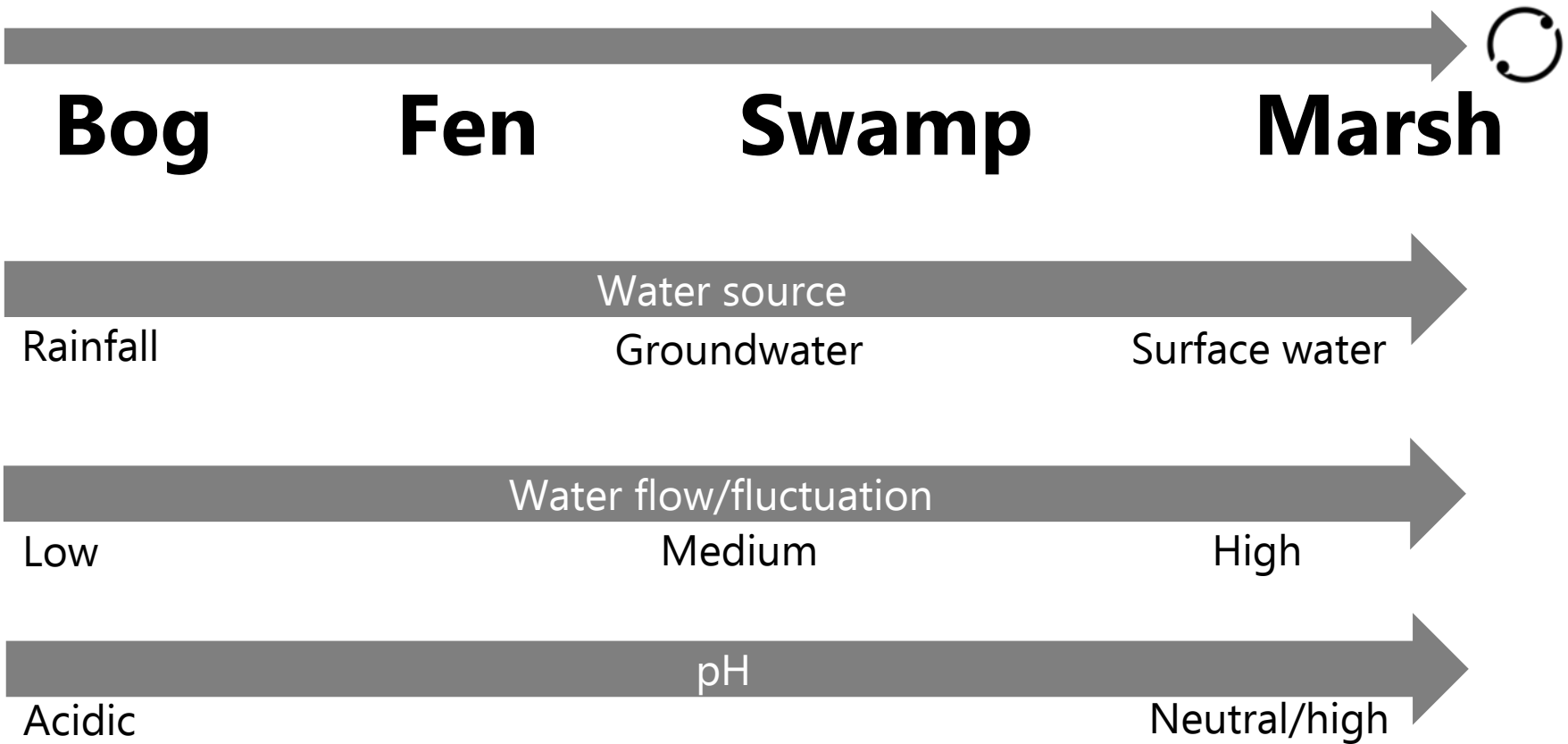
Nutrients are important



Wetland nutrients vary naturally by wetland type









Bog **Fen** **Swamp** **Marsh**



Water source

Rainfall

Groundwater

Surface water



Water flow/fluctuation

Low

Medium

High



pH

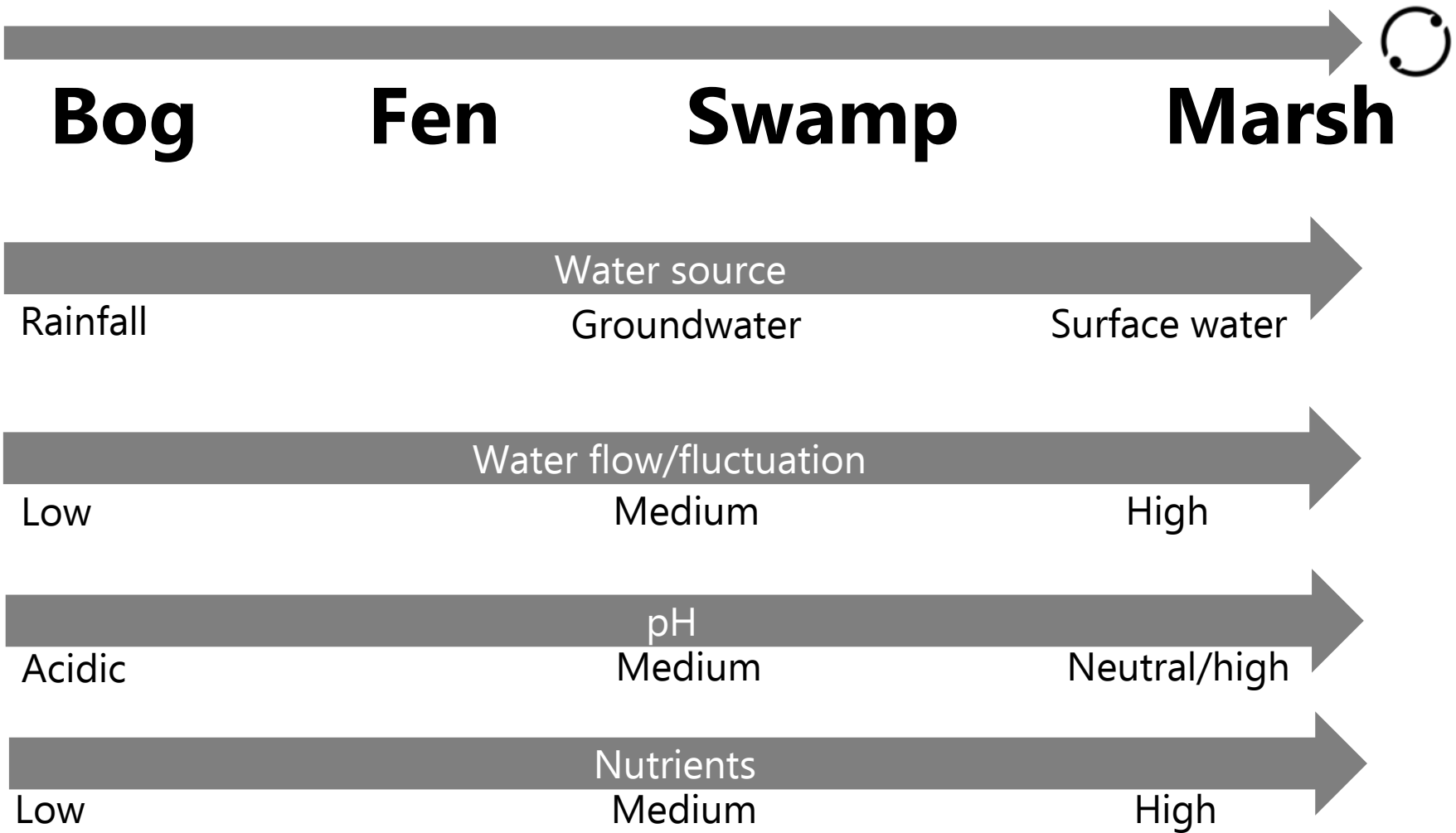
Acidic

Medium

Neutral/high

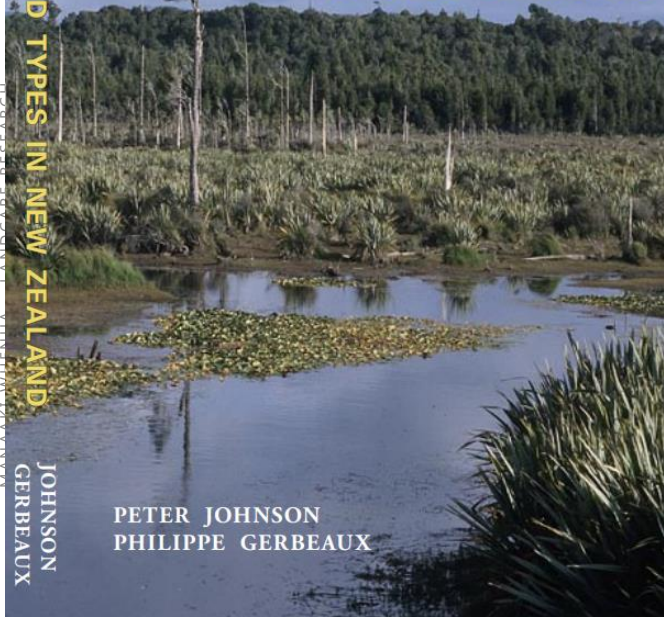


Nutrients



WETLAND TYPES IN NEW ZEALAND
JOHNSON
GERBEAUX

Wetland Types in New Zealand



PETER JOHNSON
PHILIPPE GERBEAUX

Swamp

Marsh

Water source

Postglacial history of New Zealand wetlands and implications for their conservation

Matt S. McGlone

Landcare Research, PO Box 40, Lincoln 7640, New Zealand (Email:mcglonem@landcareresearch.co.nz)

Published on-line: 9 March 2009

medium

high

pH

Medium

Neutral/high

Nutrients

Medium

High

Low

Nutrients can change within wetlands

- Wetland soil nutrients can differ naturally





Nutrients can change within wetlands

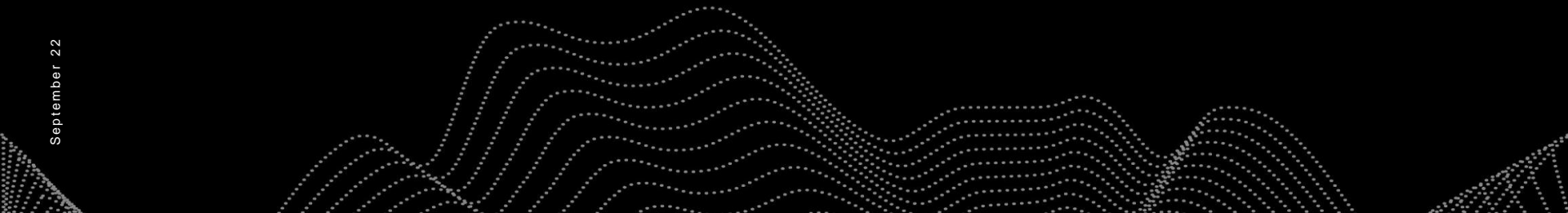
- Wetland soil nutrients can differ naturally
- But all can be affected by **anthropogenic input**
 - Surface water flow
 - Aerial deposition
 - Drains! (Otakairangi, Northland[1])

Important abbreviations!

- “N” means nitrogen
- “P” means phosphorus



So how to detect (ecologically relevant) anthropogenic input?





Limitations of soil nutrient testing

1. Total soil N & P
2. Plant available soil N & P

Plants as bio-indicators

1. Total soil N & P
2. Plant available soil N & P
3. Foliage N & P ('Blood tests' for plants)





1

Predict whether N or P is more 'limiting' using the **N:P ratio**



2

Correlate foliar N & P to soil N & P



1

Predict whether N or P is more 'limiting' using the **N:P ratio**





Which nutrient will have the most effect? The foliar N:P ratio

- Looks at the relative amount
- N:P ratio
 - High ratio number suggests P limitation
 - Low ratio number suggests N limitation
- Need to add both nutrients to see which provokes a response in the vegetation
- Work established it as an indicator for wetlands in the 90s



Testing the N:P ratio as a predictor of biomass response

- Ō Tū Wharekai (Ashburton Lakes)



Photo credit: Chris Tanner/NIWA

ORIGINAL ARTICLE

Frontiers in Ecology and the Environment | WILEY

Plant responses to nutrient addition and predictive ability of vegetation N:P ratio in an austral fen

Olivia Rata Burge^{1,2} | Beverley R. Clarkson³ | Kerry A. Bodmin² | Scott Bartlam³ | Hugh A. Robertson⁴ | James P. S. Sukias² | Chris C. Tanner²



Testing the N:P ratio as a predictor of biomass response

- Ō Tū Wharekai (Ashburton Lakes)
- Vegetation N:P predicted N-limitation



Photo credit: Chris Tanner/NIWA

ORIGINAL ARTICLE

Frontiers in Ecology and the Environment | WILEY

Plant responses to nutrient addition and predictive ability of vegetation N:P ratio in an austral fen

Olivia Rata Burge^{1,2} | Beverley R. Clarkson³ | Kerry A. Bodmin² | Scott Bartlam³ | Hugh A. Robertson⁴ | James P. S. Sukias² | Chris C. Tanner²



Testing the N:P ratio as a predictor of biomass response

- Ō Tū Wharekai (Ashburton Lakes)
- Vegetation N:P predicted N-limitation
- Realistic 'farm run-off' levels of N and P added for four years



Photo credit: Chris Tanner/NIWA

ORIGINAL ARTICLE

Frontiers in Ecology and the Environment | WILEY

Plant responses to nutrient addition and predictive ability of vegetation N:P ratio in an austral fen

Olivia Rata Burge^{1,2} | Beverley R. Clarkson³ | Kerry A. Bodmin² | Scott Bartlam³ | Hugh A. Robertson⁴ | James P. S. Sukias² | Chris C. Tanner²



Testing the N:P ratio as a predictor of biomass response

- Ō Tū Wharekai (Ashburton Lakes)
- Vegetation N:P predicted N-limitation
- Realistic 'farm run-off' levels of N and P added for four years
- Above-ground biomass harvested after four years



Photo credit: Chris Tanner/NIWA

ORIGINAL ARTICLE

Frontiers in Ecology and the Environment | WILEY

Plant responses to nutrient addition and predictive ability of vegetation N:P ratio in an austral fen

Olivia Rata Burge^{1,2} | Beverley R. Clarkson³ | Kerry A. Bodmin² | Scott Bartlam³ | Hugh A. Robertson⁴ | James P. S. Sukias² | Chris C. Tanner²



N:P ratio predicted response to fertilisation

- ✓ Increase in biomass (28%) with N
- ✓ No biomass response to P



Photo credit: Nelson Boustead



Correlate foliar N & P to
soil N & P

Predict whether N or P is
more 'limiting' using the
N:P ratio



- Relationship doesn't need to be 1:1
- Because of 'luxury' P uptake, expect a stronger relationship with P
- Used the NZ wetland database, + data from councils (n > 1600)
- Single species analysis (n = 12)



- Relationship doesn't need to be 1:1
- Because of 'luxury' P uptake, expect a stronger relationship with P
- Used the NZ wetland database, + data from councils (n > 1600)
- Single species analysis (n = 12)



Manaaki Whenua
Landcare Research

Wetland plant foliage nutrients as indicators of soil nutrients

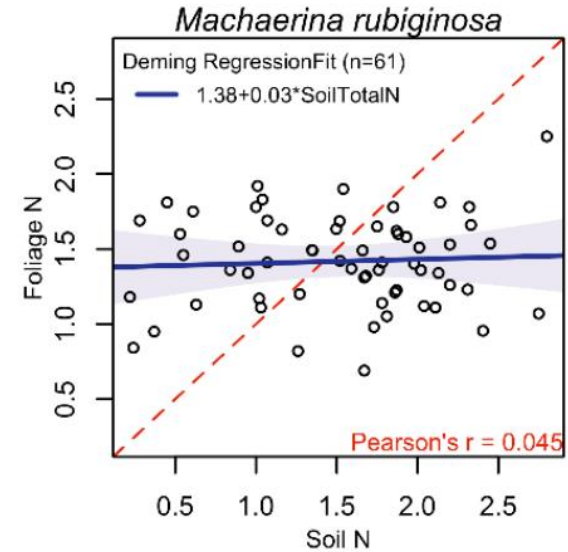
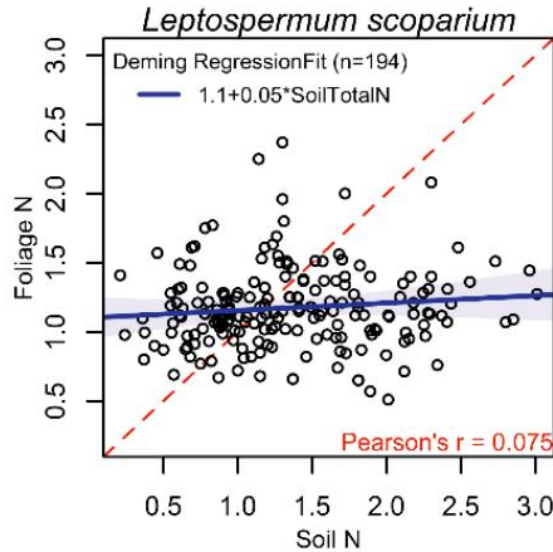
Envirolink Grant: 2123-HBRC260

Olivia R Burge, Beverley R Clarkson, Andre Eger, Neil Fitzgerald

Manaaki Whenua – Landcare Research

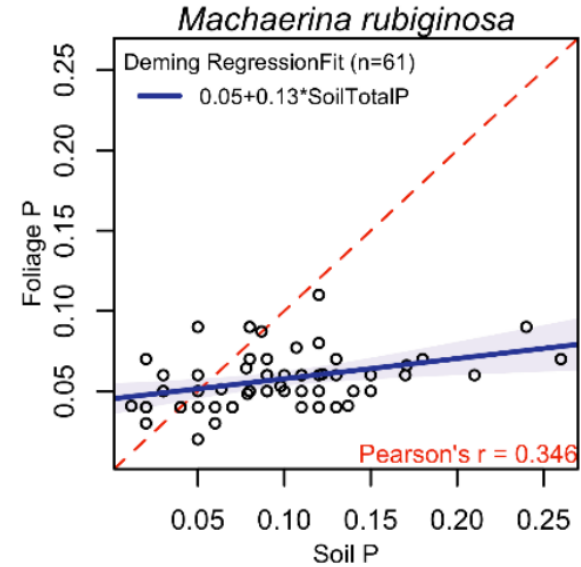
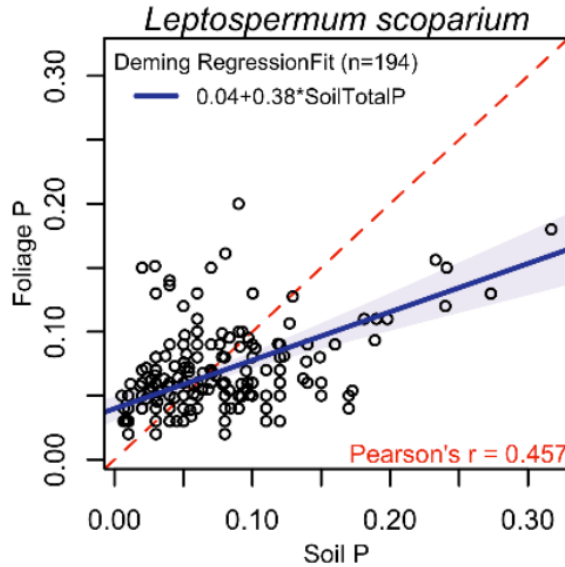
Correlate foliage & soil

- No for soil N



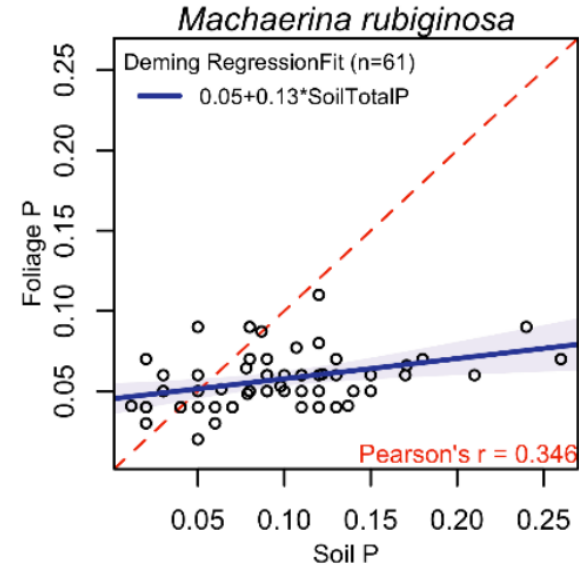
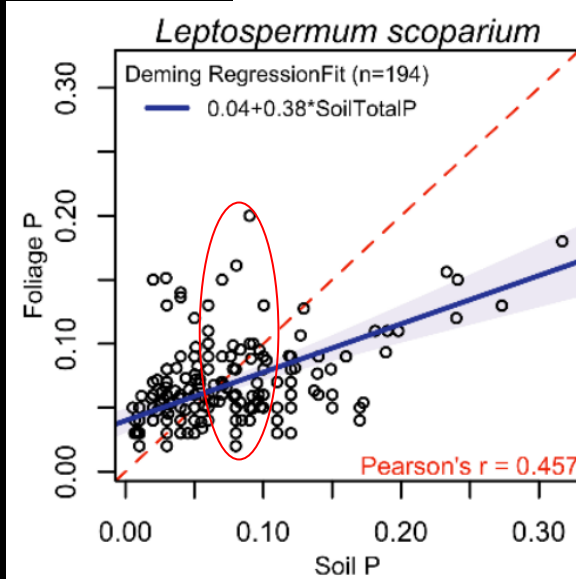
Correlate foliage & soil

- No for soil N
- Better but probably not good enough for soil P



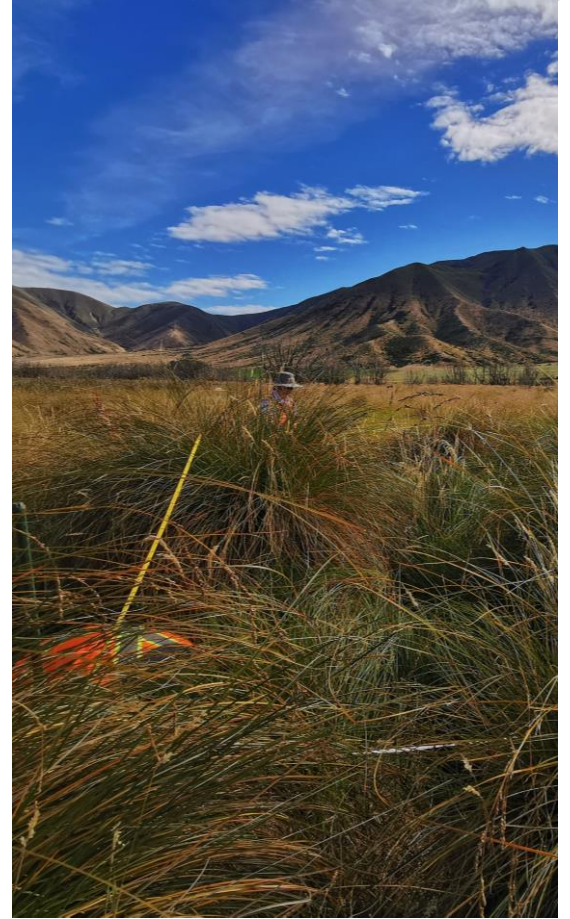
Correlate foliage & soil

- No for soil N
- Better but probably not good enough for soil P



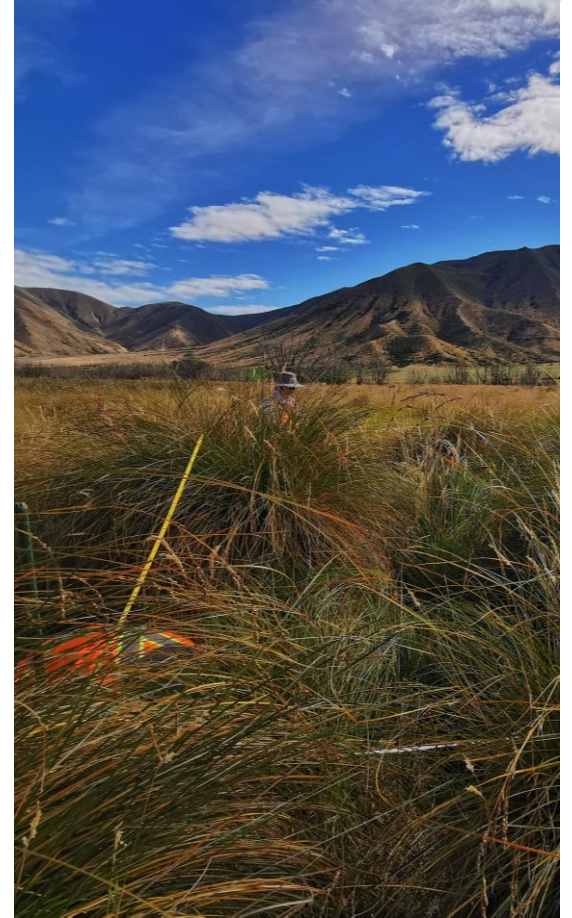
Future work

- Species selection – rarer species vs dominant species



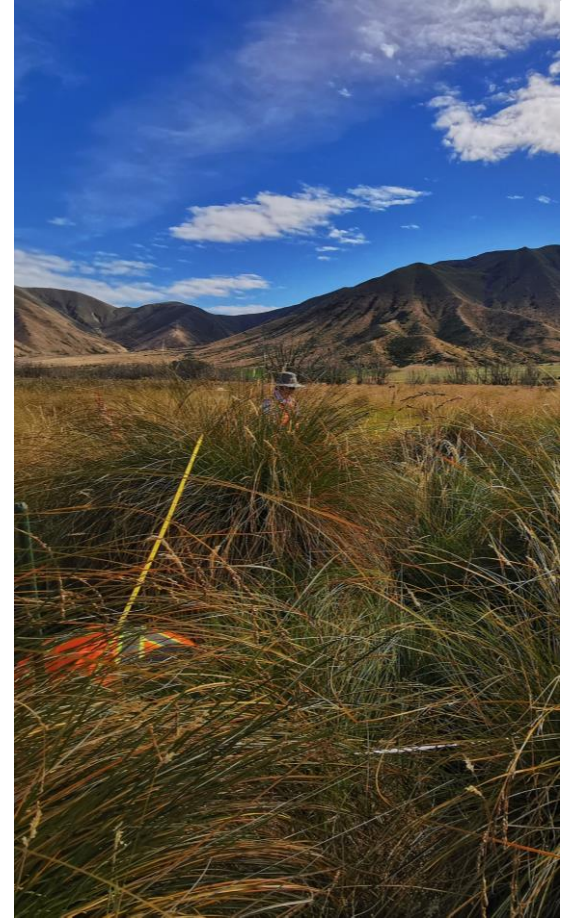
Future work

- Species selection – rarer species vs dominant species
- Using the H' index!
 - H' == nutrient conservatism (or not)



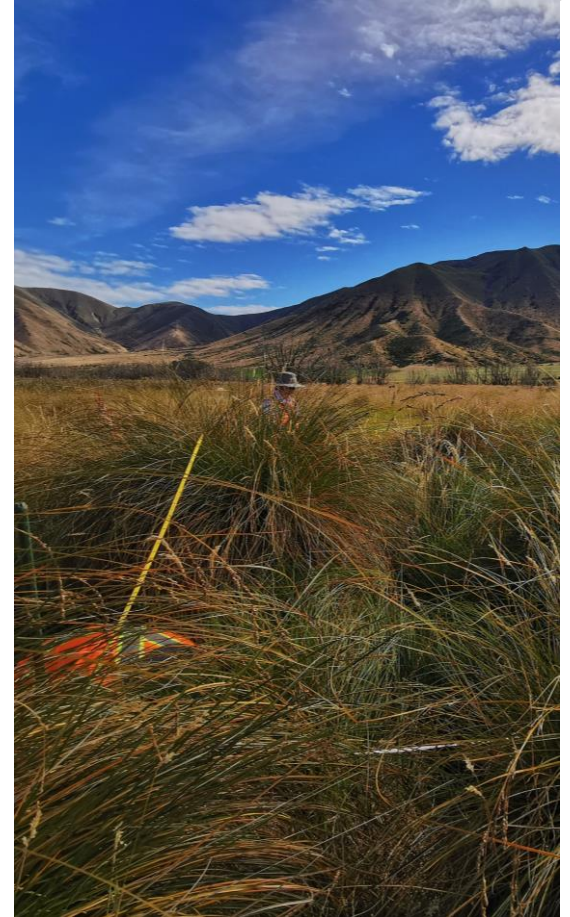
Future work

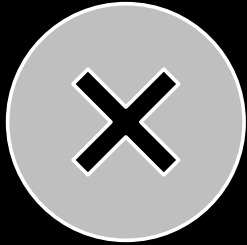
- Species selection – rarer species vs dominant species
- Using the H' index!
 - H' == nutrient conservatism (or not)
 - Take the average of all the species in the plot



Future work

- Species selection – rarer species vs dominant species
- Using the H' index!
 - H' == nutrient conservatism (or not)
 - Take the average of all the species in the plot
 - Allows cessation of foliage monitoring once enough species have an H' index





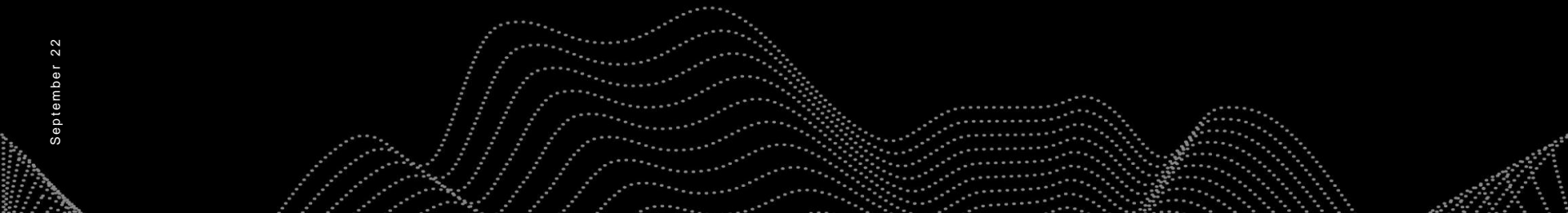
[at this time] Correlate
foliar N & P to soil N & P

Predict whether N or P is
more 'limiting' using the
N:P ratio



3

Linking wetland vegetation communities to nutrients





Linking wetland vegetation communities to nutrients

- Biomass response from new species
- Time-lag – may differ among plant communities



Linking wetland vegetation communities to nutrients

- Biomass response from new species
- Time-lag – may differ among plant communities
- With increasing amounts of plot data available – how do plant communities change along nutrient gradients



Linking wetland vegetation communities to nutrients

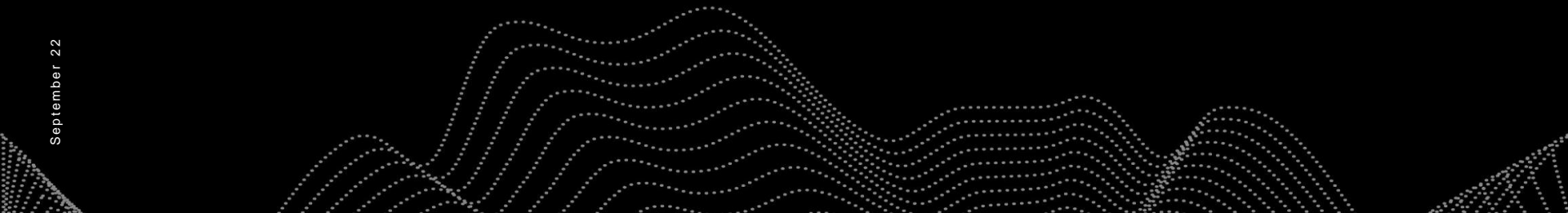
- Biomass response from new species
- Time-lag – may differ among plant communities
- With increasing amounts of plot data available – how do plant communities change along nutrient gradients
- [not change *within* a wetland]



Linking wetland vegetation communities to nutrients

- Biomass response from new species
- Time-lag – may differ among plant communities
- With increasing amounts of plot data available – how do plant communities change along nutrient gradients
- [not change *within* a wetland]

A classification clusters vegetation plots into 'groups'





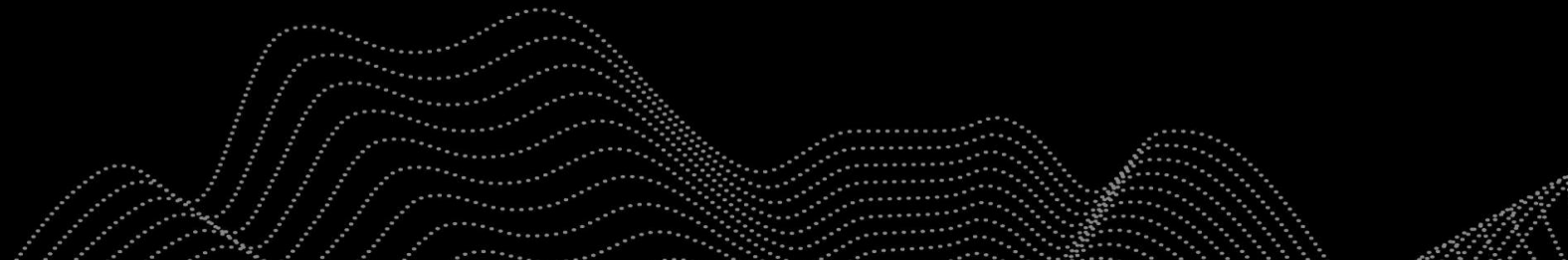
160

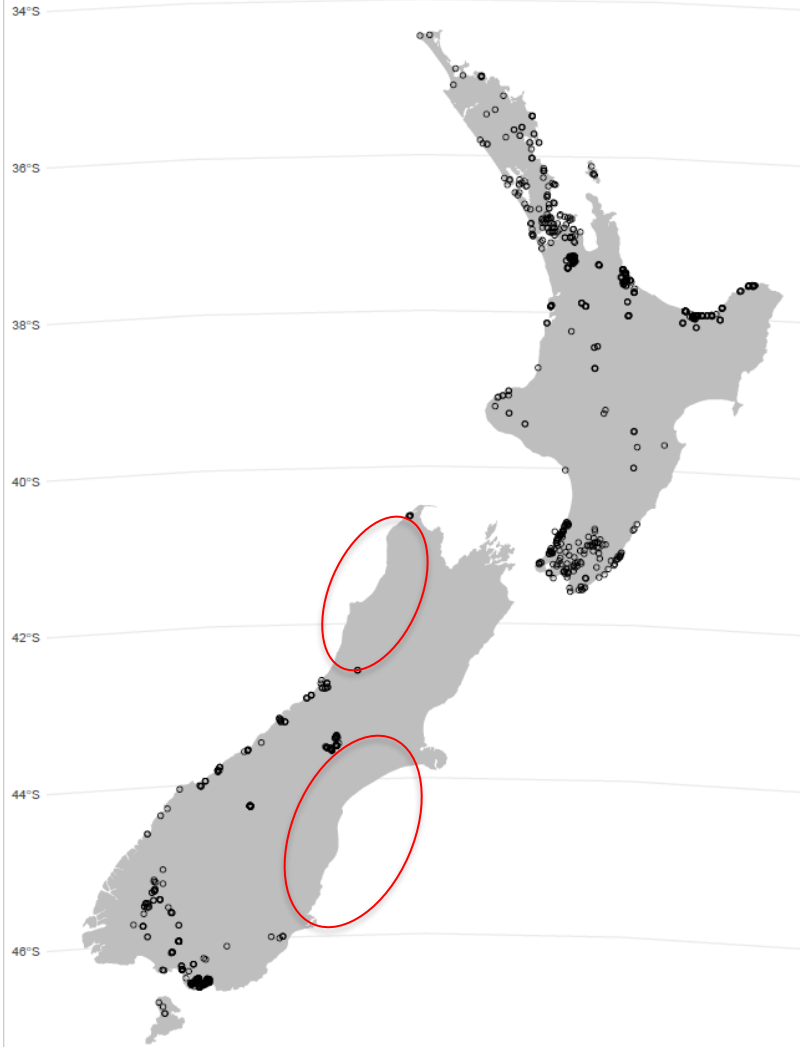
DOI: 10.20417/nzjcol.40.18

Expanding an existing classification of New Zealand vegetation to include non-forested vegetation

Susan K. Wiser^{1*†}, Fiona J. Thomson^{1†} and Miquel De Cáceres^{2,3}

A classification clusters vegetation plots into 'groups'





Progress to date



Key questions

- Do we have enough data to reflect NZ wetland diversity – across wetland types?
- How tightly are plant communities linked to soil N and P?



Summary



Early work – we can predict whether N or P is more 'limiting' using the N:P ratio



We cannot yet correlate foliar N & P to soil N & P and infer change



We may be able to better link foliar and soil N & P



We are working to classify NZ's wetland vegetation and link it to soil nutrients