Let's Set Some Nutrient Standards for Wetlands

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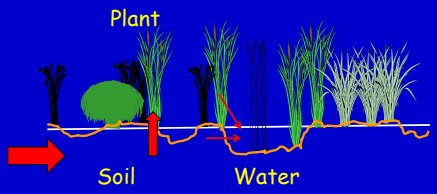
New Zealand Foundation for Research Science and Technology Contract CO9X0508

Resource Management Plans:

- Objectives: Maintenance of water quality and associated functions and values of waterways.
- Plans are largely silent for wetlands.
- Patterns and ranges of water quality parameters in wetlands are not well-established.
- Environmental classification.
- Set some standards!!

Distribution of nutrients

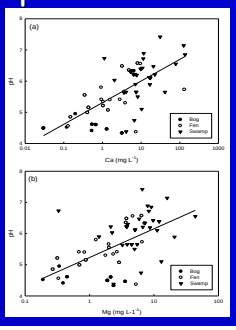


Wetland nutrient database

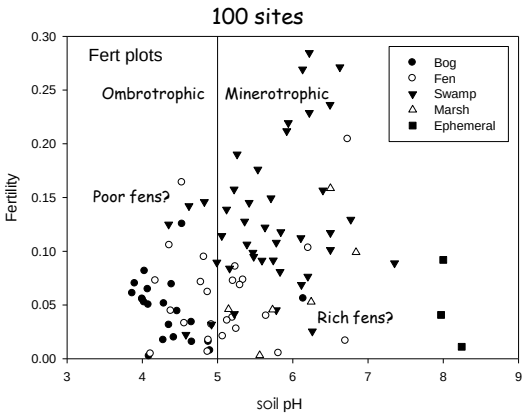
- Soil nutrients and plant tissue nutrient concentrations.
- > 600 plots from 100 wetlands.
- Data on species composition, physico-chemical properties, nutrient concentrations (soils and plants) throughout NZ, related to wetland classification.

Key Point 1: pH is the most important variable

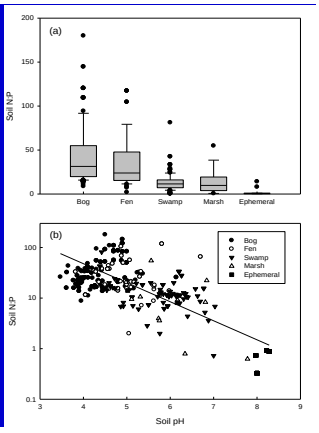
pH strongly linked to Ca (and Mg) concentr-ations



Actually driven by <u>two</u> pH equilibria: organic acids (low pH) and the bicarbonate system (high pH)



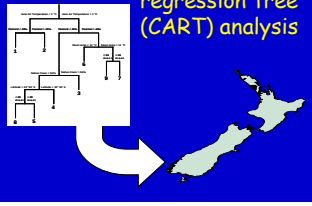
Change in the nature of nutrient limitation along the ombrotrophic to minerotrophic gradient

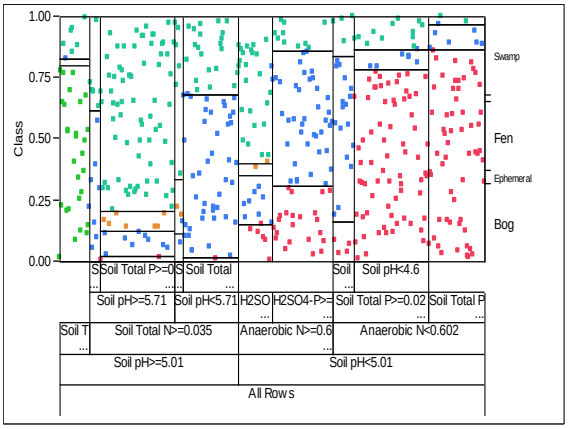


Key Point 2: environmental classification based on nutrients

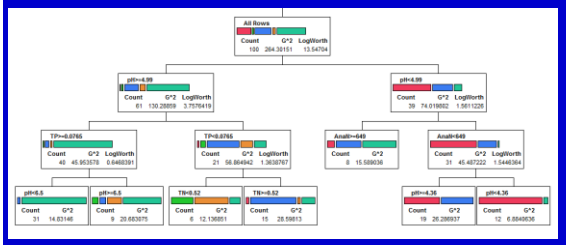
Database of 100 wetlands – all nutrient data

Classification and regression tree (CART) analysis

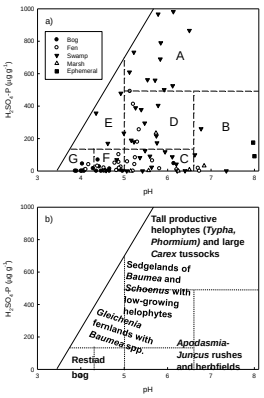




100 sites



Leaf	Description
A	Eutrophic swamps
B	Alkaline systems (rich fens, marshes, and swamps)
C	N-depleted marshes and ephemeral sites
D	P-depleted rich fens, marshes and swamps
E	Mesotrophic poor fens and swamps
F	Oligotrophic bogs and poor fens
G	Ultra-oligotrophic bogs



Key Point 3: we're not so special: we can learn from other temperate regions

"Go ahead… save my wetland…"

Range of surface soil nutrients in NZ & North America

Parameter		Bogs	Fens	Swamps & marshes
Soil pH	New Zealand	4.4 (3.6 – 5.0)	5.0 (4.1 – 6.3)	5.9 (5.0 – 7.0)
	North America	3.0 – 5.0	5.0 – 7.5	6.0 – 8.0
Soil Total N (%dw)	New Zealand	0.7 (0.2 – 5.7)	0.9 (0.2 – 2.9)	1.8 (0.3 – 5.1)
	North America	1.1 (0.5 – 2.6)	1.4 (0.7 – 1.8)	2.0 (0.4 – 1.7)
Soil Total P (%dw)	New Zealand	0.03 (< 0.01 – 0.7	0.06 (0.01 – 0.36)	0.18 (0.04 – 1.35)
	North America	0.05 (0.03 – 0.16))	0.06 (0.03 – 0.10)	0.10 (0.01 – 0.70)

(median values with ranges in brackets)

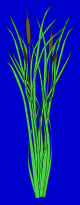
North American data Bedford et al. (1999) Ecology 80: 2151-2169

Protection of botanical diversity in NY peatlands:

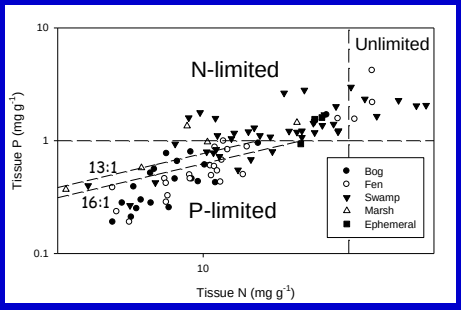
- Groundwater nitrate loading in catchment must be < 4 mg m^{-2} day^{-1}.
- Calcium loading in catchment must be < 80 mg m^{-2} day^{-1}.

- Based on findings of Drexler & Bedford (2002) for North American peatlands with very similar ranges of nutrient availability

Key Point 4: Monitoring based on soil (long-term) and plant tissue (sensitive, short-term) indicators

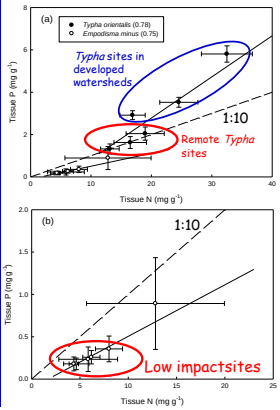


Plant tissue nutrients (site clusters)



Monitoring

Site clusters for *Empodisma minus* (an ombrotrophic species) and *Typha orientalis* (a minerotrophic species)



Summary

- Wetlands are sensitive to eutrophication and we are now in a position to set some scientifically robust standards for protecting them.

1. The most important, over-riding variable is pH.
2. CART approach has provided an environmental classification scheme on which to base rules.
3. NZ wetlands have just as much variation in wetland nutrient status as North America and Europe – approaches taken overseas can help us.
4. For monitoring, the soil and tissue nutrients are both good indicators of nutrient enrichment and are useful for nutrient monitoring across all wetland types.