Introduction

- Wetland cover: decreased by 90% since European settlement
- Need to protect and manage remaining wetlands
- Remnant wetlands faced with multiple pressures:
  1. Hydrological alterations
  2. Loss of area and connectivity
  3. Invasion by weeds
  4. Degradation of WQ
  5. Fire
- Key requirement is to assess wetland condition
  - Help set conservation priorities
  - Monitor wetland condition
  - Identify important detrimental pressures to then alleviate

Wetland condition

- Condition assessments focus on three key features of wetlands:
  - Hydrology (permanently or intermittently wet areas)
  - Presence of hydric (often anoxic) soils
  - Presence of vegetation adapted to anoxia



Condition assessments

- Wetland Condition Index (Clarkson et al 2003)
- 5 indicators assessed in field
  - Hydrological integrity
  - Physico-chemical parameters
  - Ecosystem intactedness
  - Browsing, predation and harvesting
  - Dominance of native plants
- Score each indicator 0 – 5
- WCI ranges 0 - 25

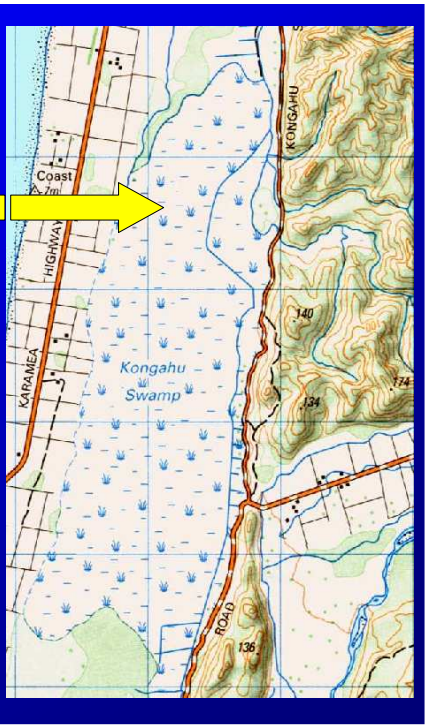
- Index of Ecological Integrity (Ausseil et al 2008)
- 6 spatial indicators
  - Natural vegetation
  - Imperviousness
  - Introduced fish
  - % cover woody weeds
  - Artificial drainage
  - N-leaching risk
- Extracted from GIS
- Apply weighting functions
- IEI ranges 0 - 1

This study

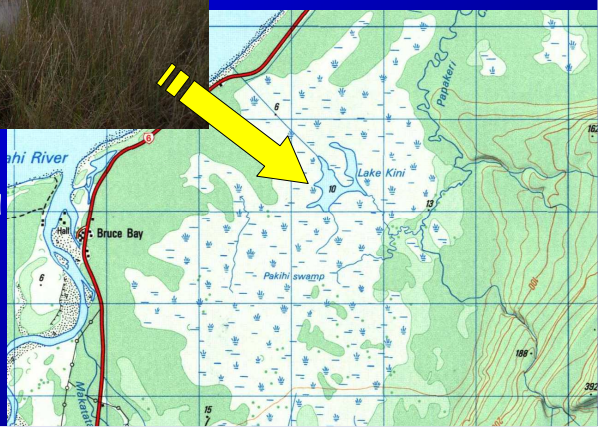
- Assessed whether invertebrate communities responded to changes in wetland condition (as measured by WCI or IEI)
  - These methods assess wetland condition at a catchment scale, and focus on plant communities
- No methods currently assess wetland condition for aquatic components of wetlands
  - Are they relevant?

Methods

- Sampled 29 wetlands on West Coast
  - Wide range of land uses (dairy, tussock, native forest)
- Collect duplicate kick net samples from each of 3 open water habitats
- Spot measurements of pH, conductivity, nutrients (NH_4, NO_3, DRP, TDP)



Kongahu Swamp- North Westland
Modified dairy farm
WCI = 8.5
IEI = 0.35



Lake Kini - South Westland
Undisturbed native bush
WCI = 24.2
IEI = 0.79

Analysis

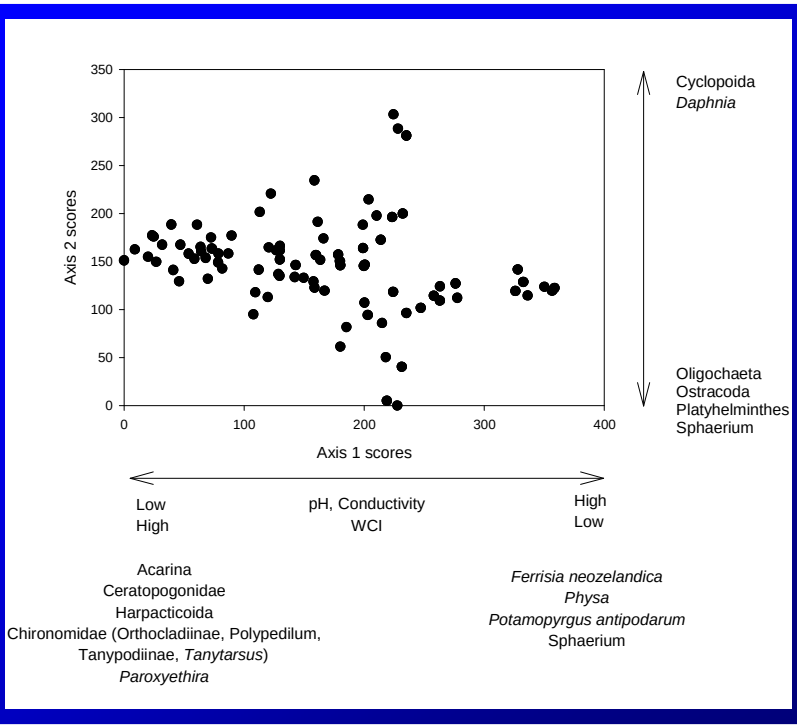
- Known that wetlands are composed of bogs, swamps, fens
  - Differences in pH and nutrient status
- Three stage analysis
  1. DCA on invertebrate data, correlations of axis to environmental variables
  2. TWINSPAN classification of invertebrate data to see if discrete groups existed
  3. SMR to assess relationships between biota and WQ / condition

The fauna

- 119 taxa, dominated by:
  - midges (*Tanytarsus*, Orthocladiinae, Tanypodinae)
  - Oligochaetes
  - *Potamopyrgus*
  - Copepods & Ostracods
  - Nematodes
  - *Xanthocnemis*
- Typical wetland fauna

1. DCA Ordination

- Axis 1 & 2 – explained 55% and 29% of variation
- Low gradient lengths (3.5)
  - suggests low degree of species turnover
  - taxa have wide niches
- Axis 1: +vely correlated to pH, conductivity
- -vely correlated to WCI
- Axis 2 : no correlations
  represents an unknown axis



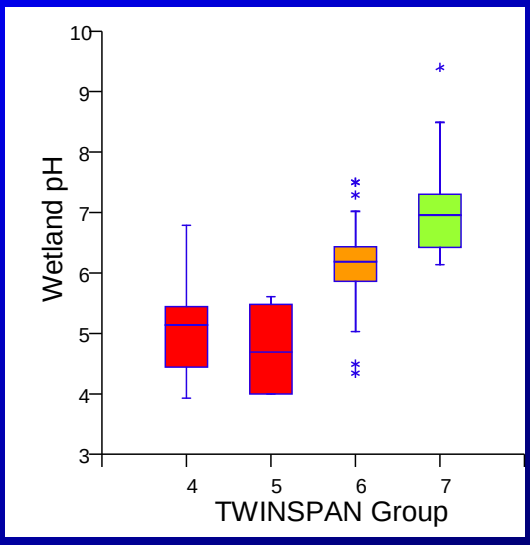
2. TWINSPAN

- 3 divisions in TWINSPAN: 4 defined groups
- ANOVAs of WQ and health scores
  - pH differed the most between groups

Variable	F-ratio
pH	32.9
Conductivity	4.1
DRP	2.4
NH_4	1.4
TDN	2.2
TDP	2.3
WCI	4.2
IEI	3.6

Decreasing level of importance

- Strong separation of TWINSPAN groups according to pH
- Data divided into 3 groups:
  - Low pH < 5.6
  - Moderate pH 5.7 – 6.3
  - High pH > 6.3



- Divided data into three pH groups
- Each group had a wide range of condition

Condition	pH group	Min	Max
WCI	Low	8.5	24.7
	Moderate	5.8	24.1
	High	5.8	24.7
IEI	Low	0.354	0.954
	Moderate	0.252	0.961
	High	0.252	0.961

- Each group had a wide range of nutrient regimes

Condition	pH group	Min	Max
Conductivity (μScm^{-1})	Low	20	337
	Moderate	24	213
	High	51	335
TDN (mg l^{-1})	Low	153	1180
	Moderate	136	3200
	High	110	1170
TDP (mg l^{-1})	Low	1.1	34
	Moderate	4.2	122
	High	4.0	402

- Confident that we sampled a wide range of bogs, fens and swamps
- SMR used to establish any relationships

3. SMR of invert data

- SMR of WQ and condition scores of 20 most common taxa
- Most models were significant, but variable explanatory power

pH class (no. models)	Variable	No. of models
Low (14)	Nutrients	12
(r^2 = 0.29)	pH	4
	IEI	3
	WCI	1
Moderate (13)	Nutrients	7
(r^2 = 0.37)	pH	2
	IEI	2
	WCI	3
High(10)	Nutrients	7
(r^2 = 0.51)	IEI	3
	WCI	2

- Nutrients selected in most models
- Wetland condition (either WCI or IEI) selected in only a few models

Conclusions

- Lack of strong relationships to condition scores
  - Reflects the fact that landscape-based methods may not be scoring things relevant to aquatic biota
  - E.g., hydrological integrity, connectivity, dominance of native plants, imperviousness etc may not be influencing aquatic biota
- May also reflect presence of eurytopic taxa
- Challenge now to find out what is influencing invertebrate communities and develop new scoring systems

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