Resilience of a montane fen to agricultural nutrient additions and predictive ability of the vegetation N:P ratio

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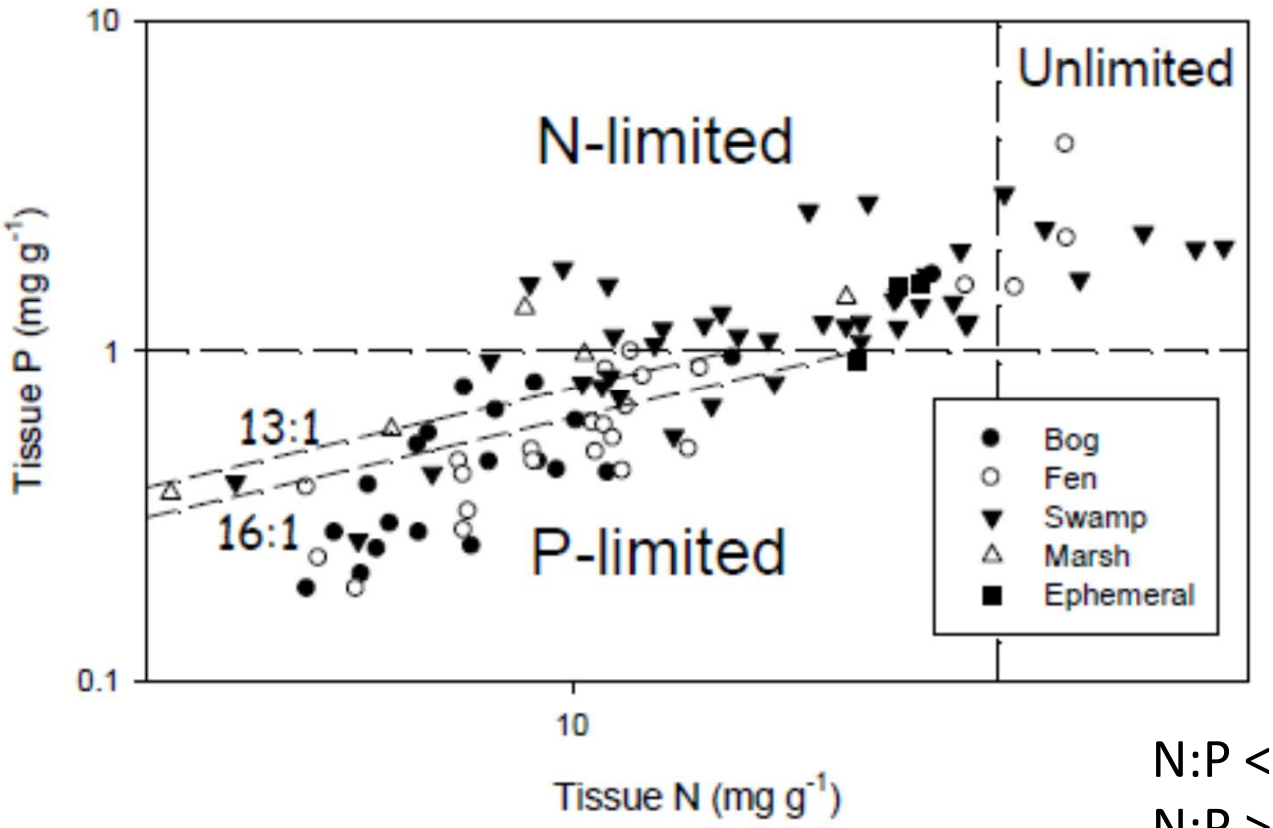
How sensitive are montane wetlands to elevated nutrient inputs from agriculture?

- How do fen communities change as a result of N & P addition?
- Do N:P ratios predict biomass change?
- Do ammonium-N and nitrate-N differ in their effects on plant community biomass and plant tissue concentration?

Plant N:P ratios:

useful indicators of nutrient limitation?

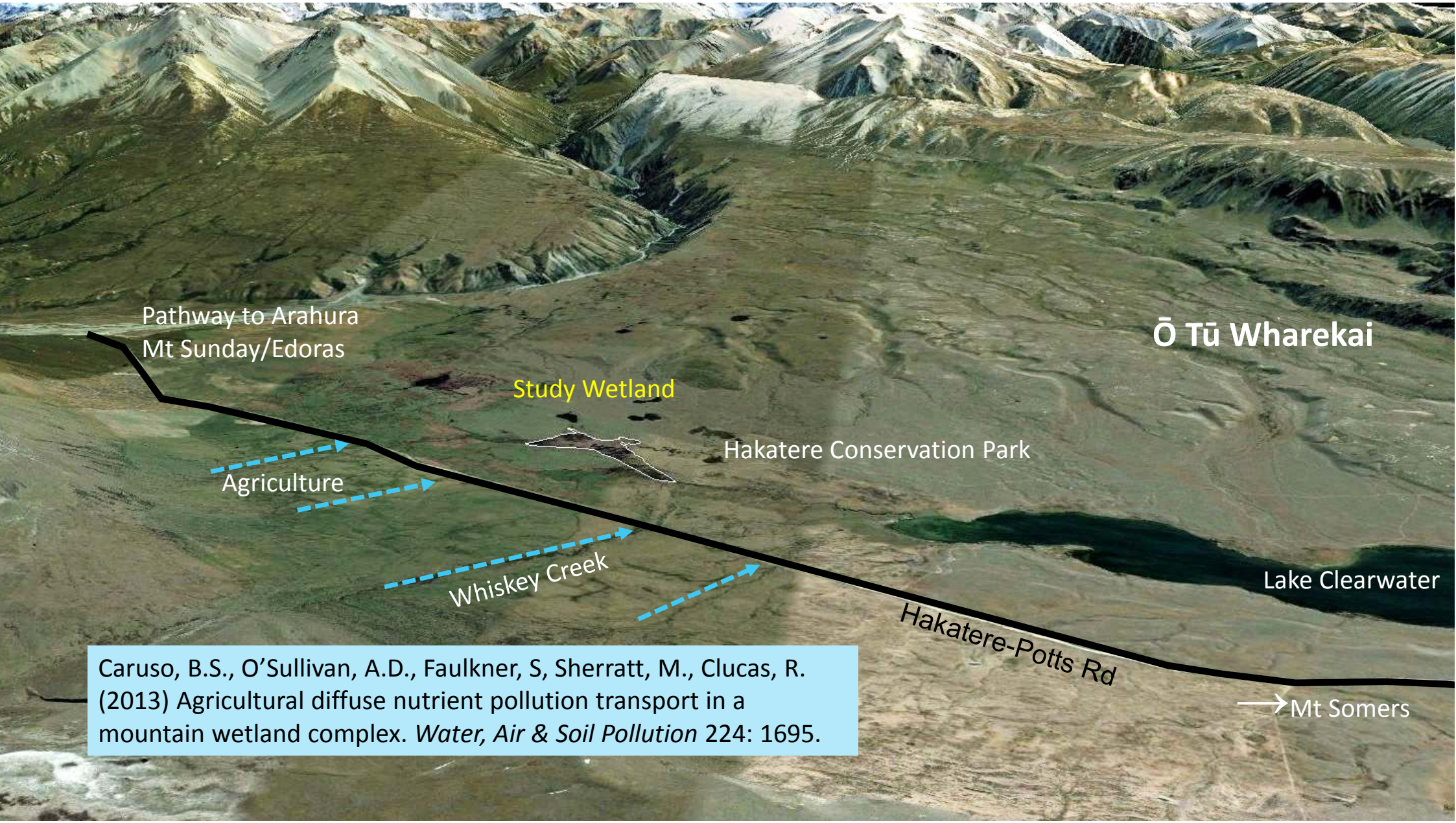


If N:P ratio indicates limitation of N or P, does adding the limiting nutrient result in changes in plant biomass?

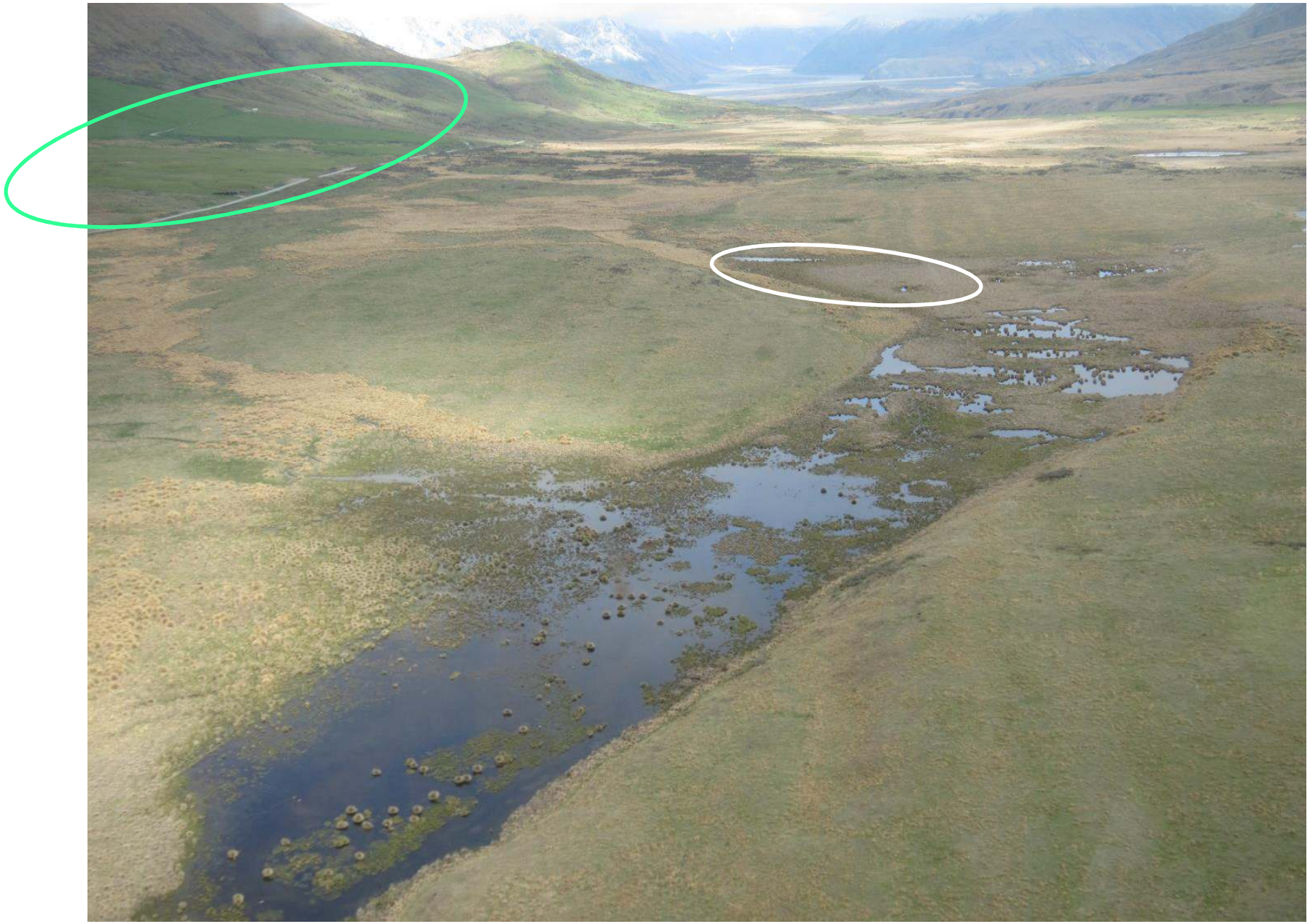
N:P < 13:1 = N-limited vegetation

N:P > 16:1 = P-limited vegetation

N:P 13:1 - 16:1 = limited by both or neither



Caruso, B.S., O'Sullivan, A.D., Faulkner, S, Sherratt, M., Clucas, R. (2013) Agricultural diffuse nutrient pollution transport in a mountain wetland complex. *Water, Air & Soil Pollution* 224: 1695.



Spring
Nov 2012

Nutrient input risk?

- Atmospheric deposition low
- Potential for episodic fertiliser drift
- N loss mainly via groundwater in form of nitrate
- P loss via surface runoff in particulate and dissolved forms
  -potentially also via groundwater

- How much lost?
  - Fertiliser recommendations typically:
    - Fodder 200-250 kg N/ha/yr, 20-30 kg P/ha/yr
    - Pasture 100-150+ kg N/ha/yr, 20-30 kg P/ha/yr
    - Proportion lost/attenuated/exported ?
      -denitrification losses entering wetland
- Estimated potential loadings to wetland
  - 35 & 70 kg N/ha/yr and 20 kg P/ha/yr

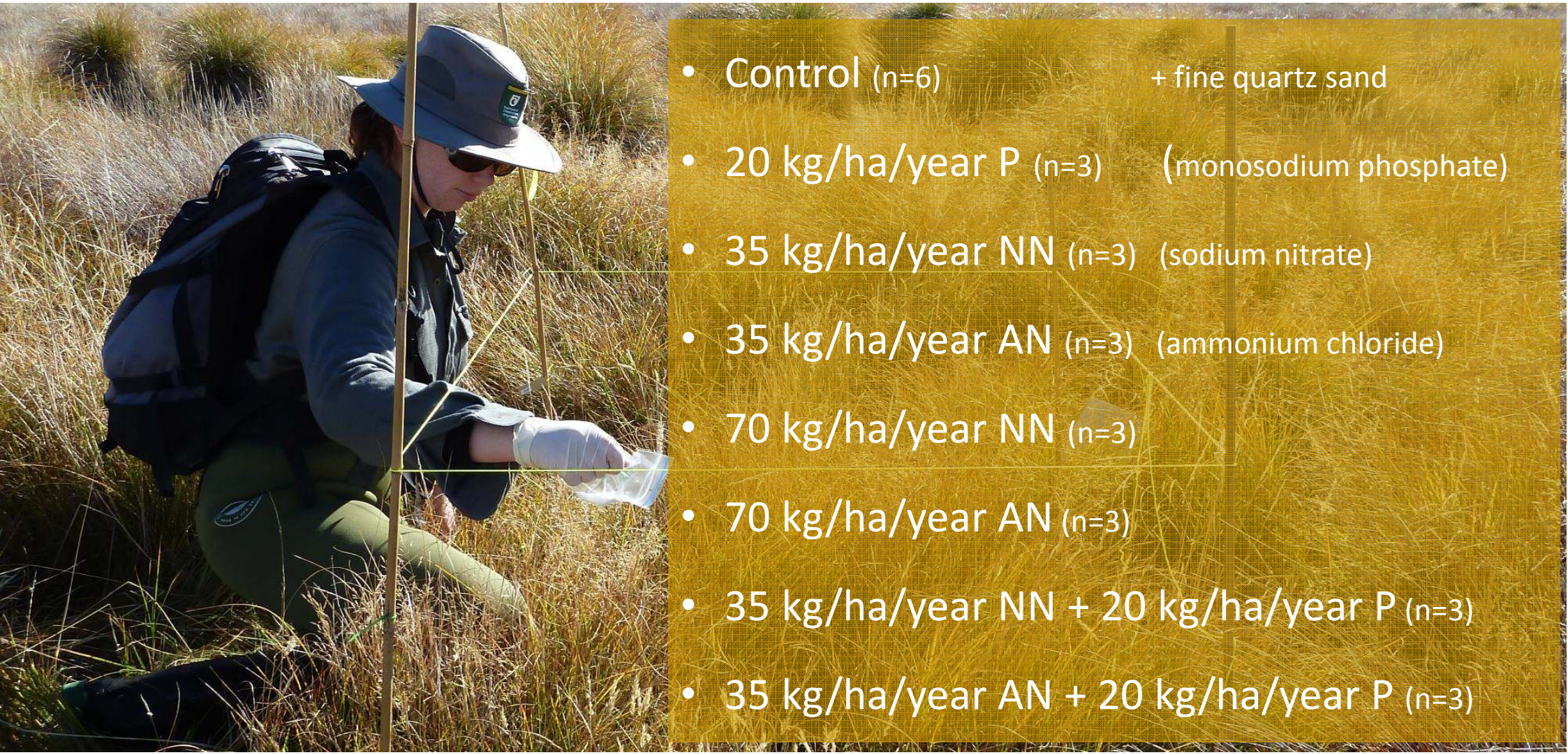
3 dominant plant communities

Chionochloa rubra (2x2m)

Carex diandra (1x1m)

Schoenus pauciflorus (1x1m)

Root in-growth cores



- Control (n=6) + fine quartz sand
- 20 kg/ha/year P (n=3) (monosodium phosphate)
- 35 kg/ha/year NN (n=3) (sodium nitrate)
- 35 kg/ha/year AN (n=3) (ammonium chloride)
- 70 kg/ha/year NN (n=3)
- 70 kg/ha/year AN (n=3)
- 35 kg/ha/year NN + 20 kg/ha/year P (n=3)
- 35 kg/ha/year AN + 20 kg/ha/year P (n=3)

Fertilise 3x/year for 3 years

October (spring), December (early summer) and February (late summer) ; April 2012 – December 2014


At Start & End
Species % Cover
Max & Ave height
Tips/bases N&P analysis


Harvest


Sort


Weigh

Results

- Plant tissue analysis indicated the communities were N or N & P co-limited
- After 3 years fertilisation

➢ No significant difference in aboveground biomass or root ingrowth between treatments

➢ Plant species cover increased measurably in high N treatments, consistent with N limitation

- Similar for nitrate and ammonium-N addition

➢ Associated decreases in species richness at highest levels of N addition

- Loss similar for native and introduced species

Conclusions

- High natural variability in standing biomass makes measuring a significant change difficult
  - more replication/fewer treatments would help
- These montane fen plant communities appear relatively resilient to 3 yrs of elevated nutrient loadings
- Dominated by slow-growing stress-tolerators with limited ability to rapidly increase their biomass.
  - May instead increase rate of turnover, and/or reduce nutrient resorption from senescing tissues
  - May take many years to show measurable biomass responses
- Dominant species showed measurable increases in cover at highest levels of N addition + reductions in sp. richness
  - Advisable to limit further agricultural intensification in the catchment
  - Need to guard against introduction of weeds capable of exploiting elevated nutrient inputs
- Results not inconsistent with N:P ratio theory
  - Insufficient time or vegetation sensitivity to determine utility at this stage

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