Plant Phosphorus, Nitrogen, and Carbon and Soil Phosphorus in North Dakota Wetlands

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Introduction

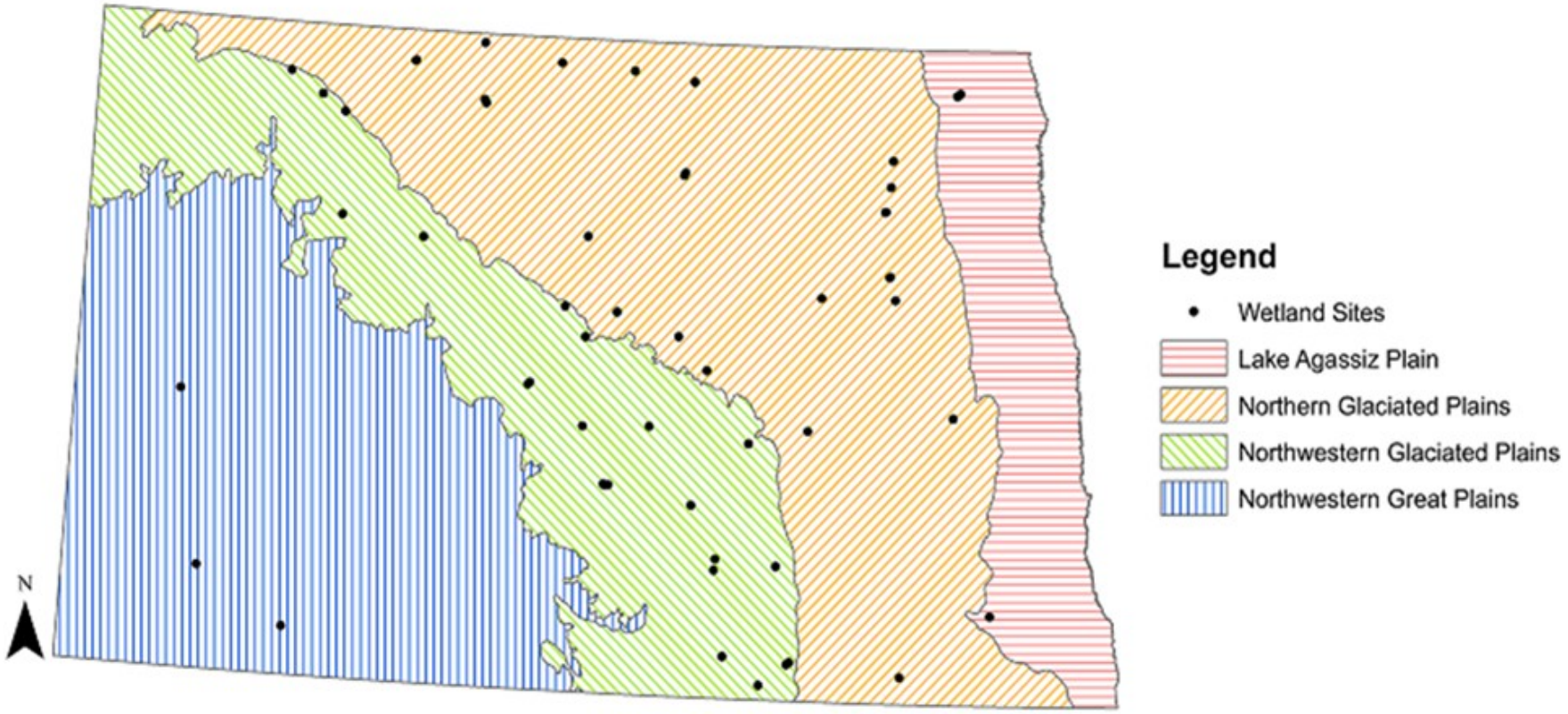
- Summer 2011
- Statewide wetland study as part of NWCA
- Nutrient levels
  - May reflect human activities
  - Are highly influenced by runoff from adjacent lands
  - Can drive changes in plant communities
  - Can alter wetland function

Objectives

1) Compare biomass of different plant types
2) Compare floristic quality between landscape positions and surrounding land uses
3) Compare plant C:N, P, and N:P of different plant types, landscape positions, and surrounding land use
4) Correlate plant P with floristic quality and cattail biomass
5) Correlate soil P with cattail biomass

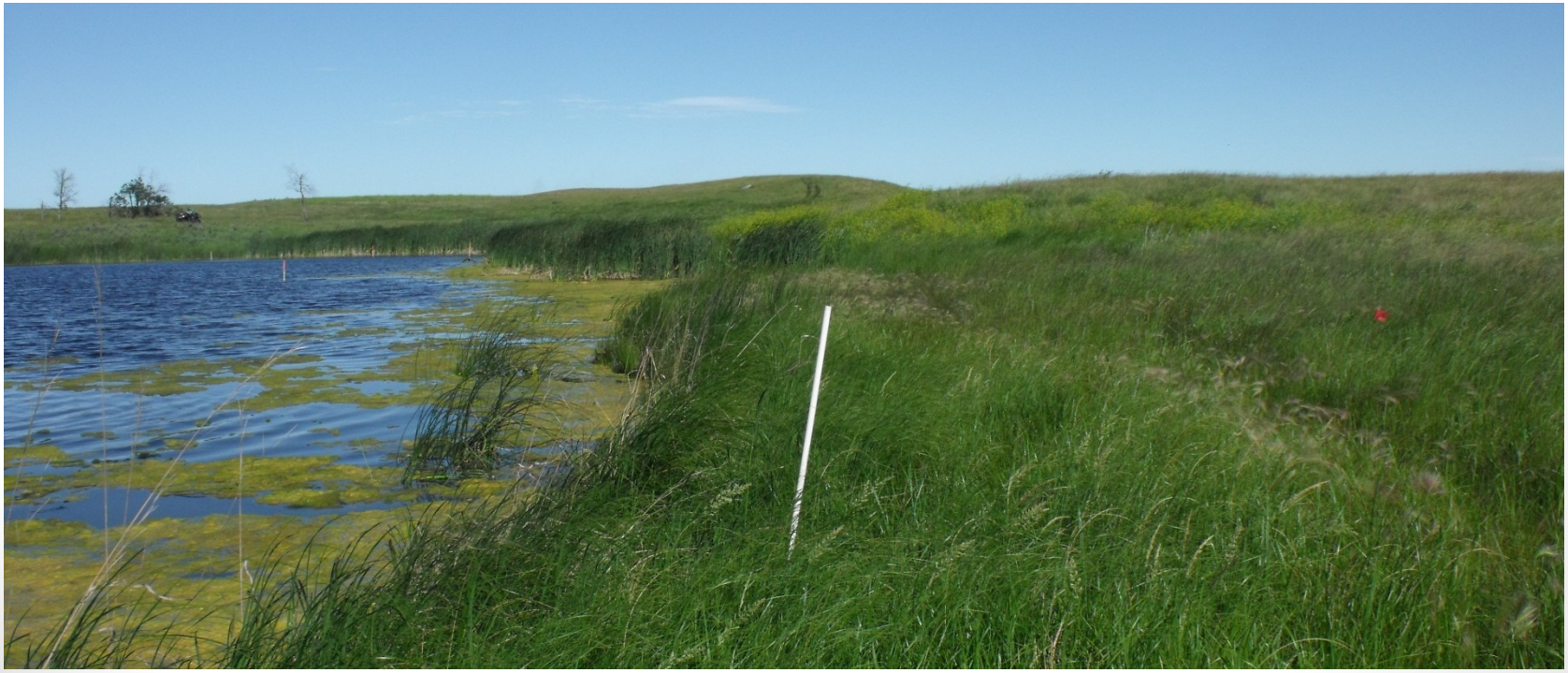
Site Locations

- 55 wetlands statewide



Plant Sampling Methods

- Plant samples collected at 3 landscape positions
  - Upland, wet meadow, shallow marsh
  - Five 0.25 m^2 quadrats clipped
  - Plant types: cattails, grasses & grass-likes, forbs & shrubs
  - Plant samples analyzed for P, N, C



Soil Sampling Methods

- Soil samples collected at 3 landscape positions
  - Upland, wet meadow, shallow marsh
  - Three 500 g soil cores collected at 0-15 cm and 15-30 cm depths
  - Soil samples analyzed for P
  - Olsen and water soluble extractions

Floristic Quality

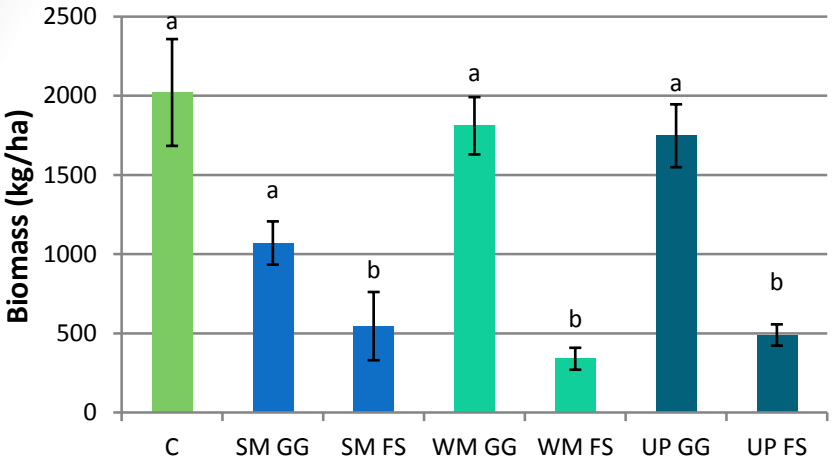
- List of all plant species
- Floristic quality calculated using the Floristic Quality Index (FQI) developed for the Dakotas
- Species assigned c-value based on tolerance to disturbance
- FQI = average c-value multiplied by the square root of the total number of species

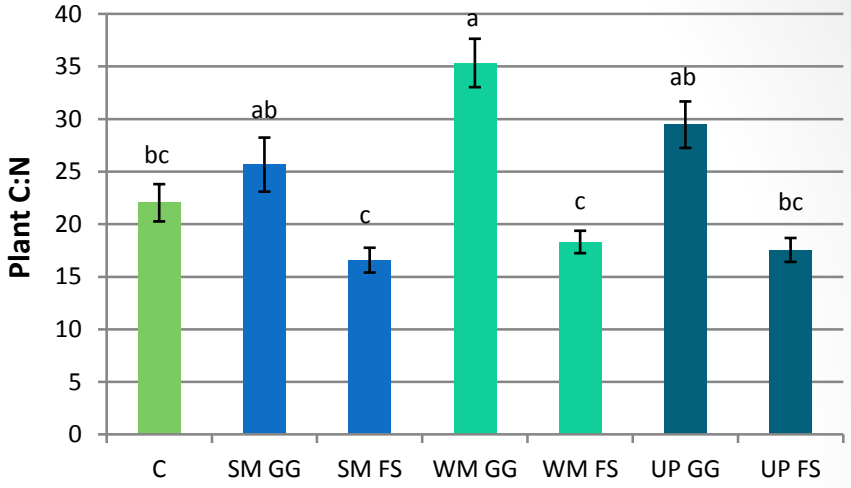
Statistics

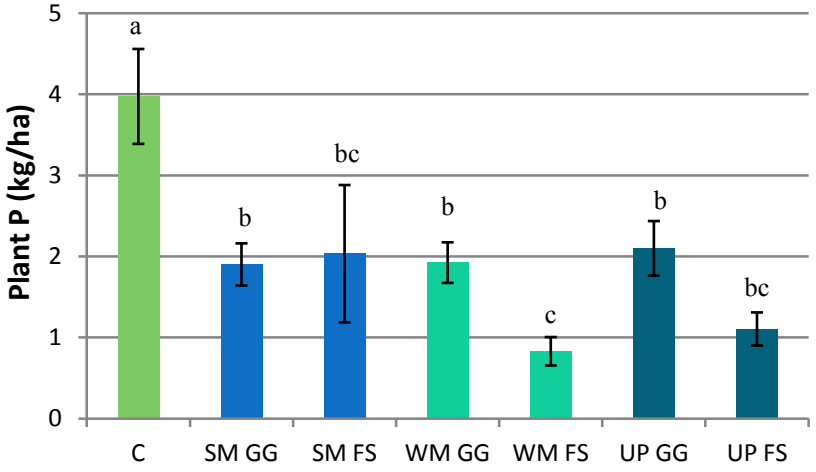
- Multi-response Permutation Procedures (MRPP)
  - Plant type (cattails, grasses & grass-likes, forbs & shrubs)
    - Biomass and plant C:N, P, N:P
  - Landscape position (shallow marsh, wet meadow, upland)
    - FQI scores and plant C:N, P, N:P
  - Land use (cropland, grazed/hayed, idle)
    - FQI scores and plant C:N, P, N:P
- Linear regressions
  - FQI scores & plant P
  - Cattail biomass & shallow marsh plant P

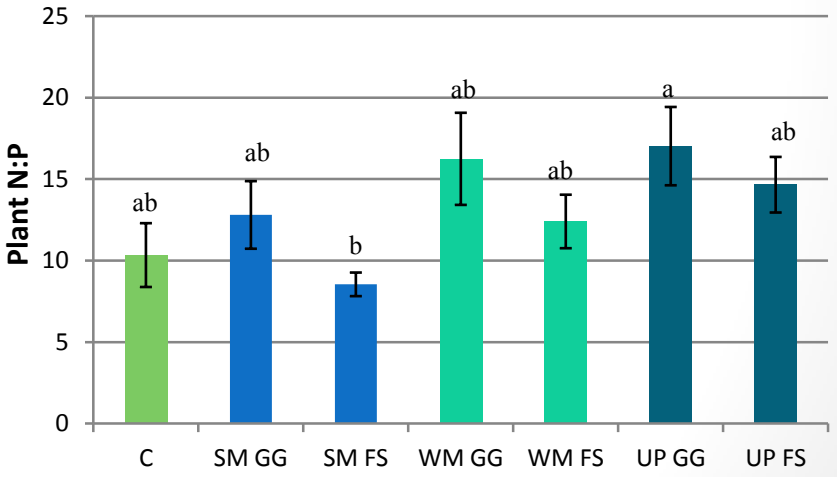
Results: Plant Type

C = cattails, SM = shallow marsh, WM = wet meadow, UP = upland, FS = forbs & shrubs, GG = grasses & grass-likes



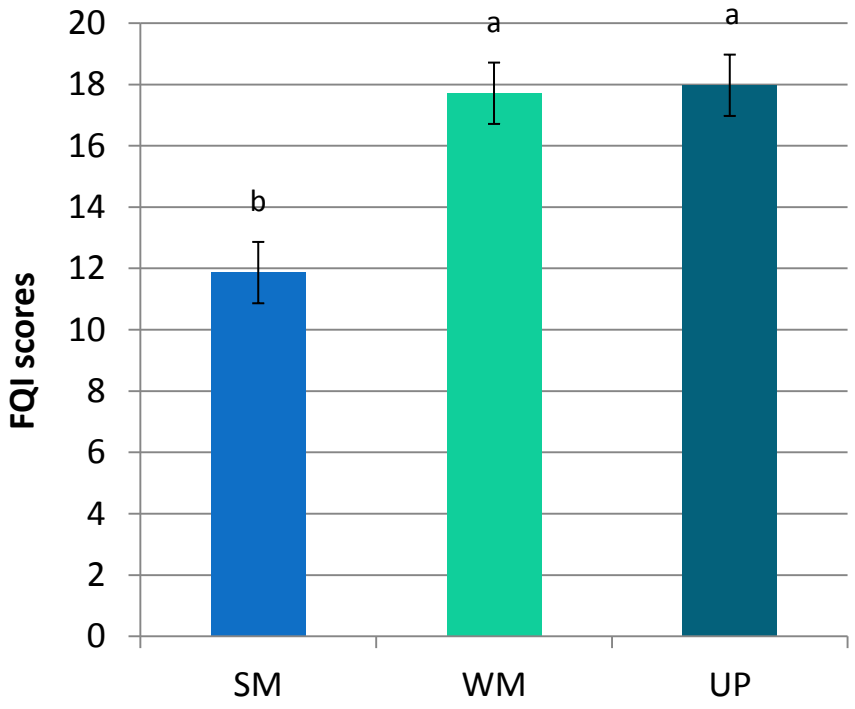






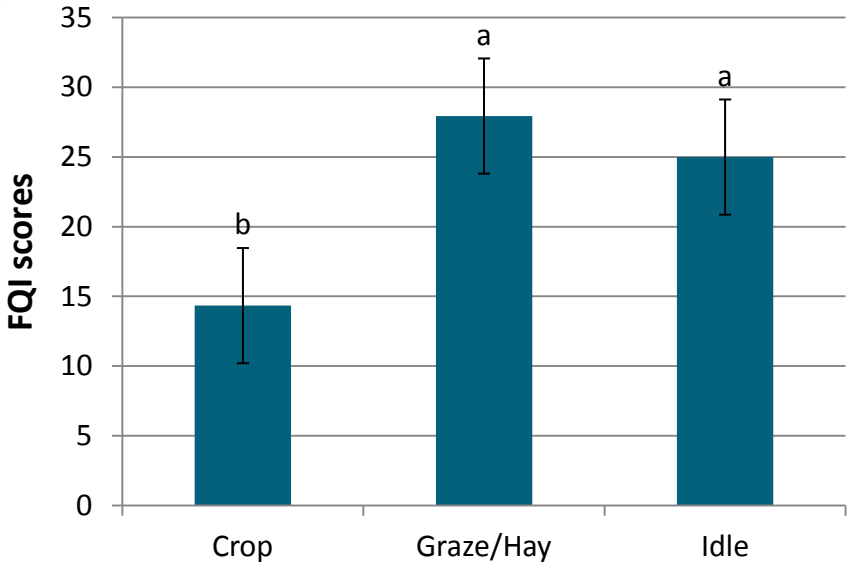
- MRPP with Bonferroni correction

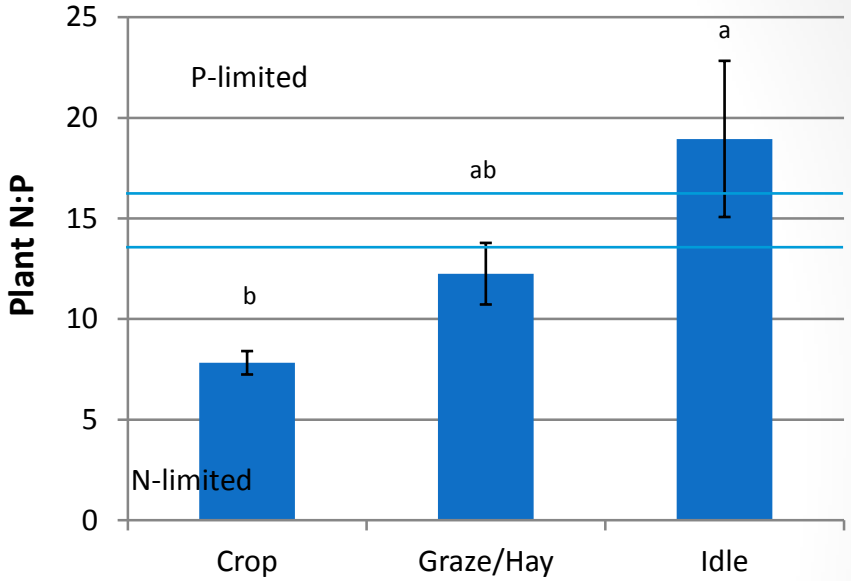
Results: Landscape Position



- SM = shallow marsh
- WM = wet meadow
- UP = upland
- MRPP with Bonferroni correction
- Plant C:N, N:P, P not significantly different

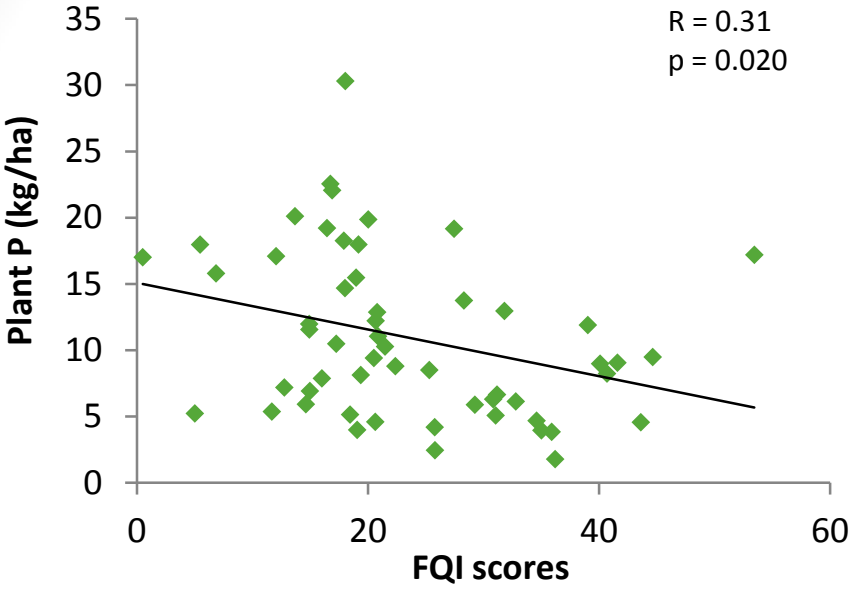
Results: Land Use

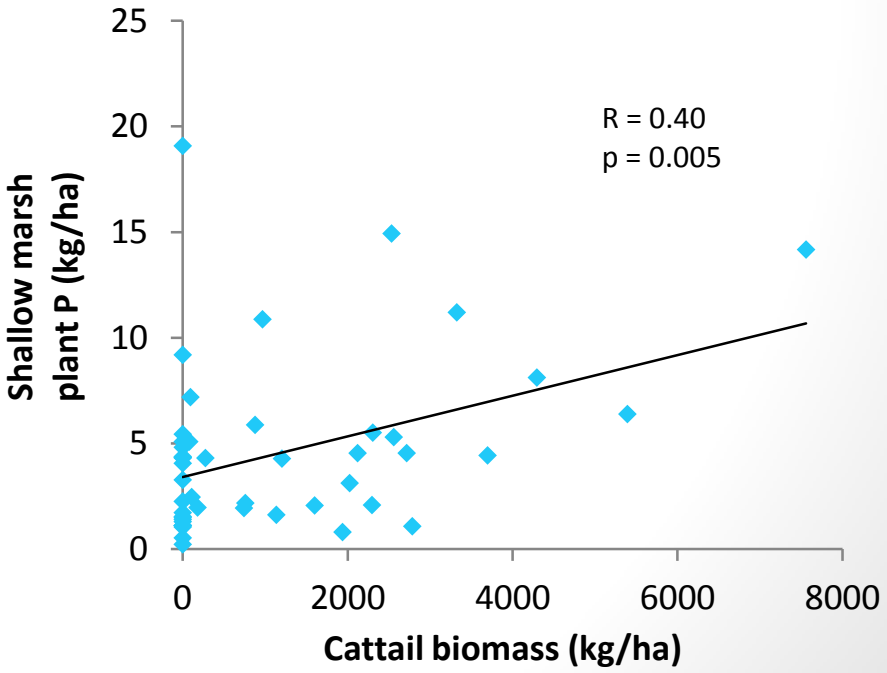




- MRPP with Bonferroni correction
- No significant differences for surrounding land use for plant C:N or P

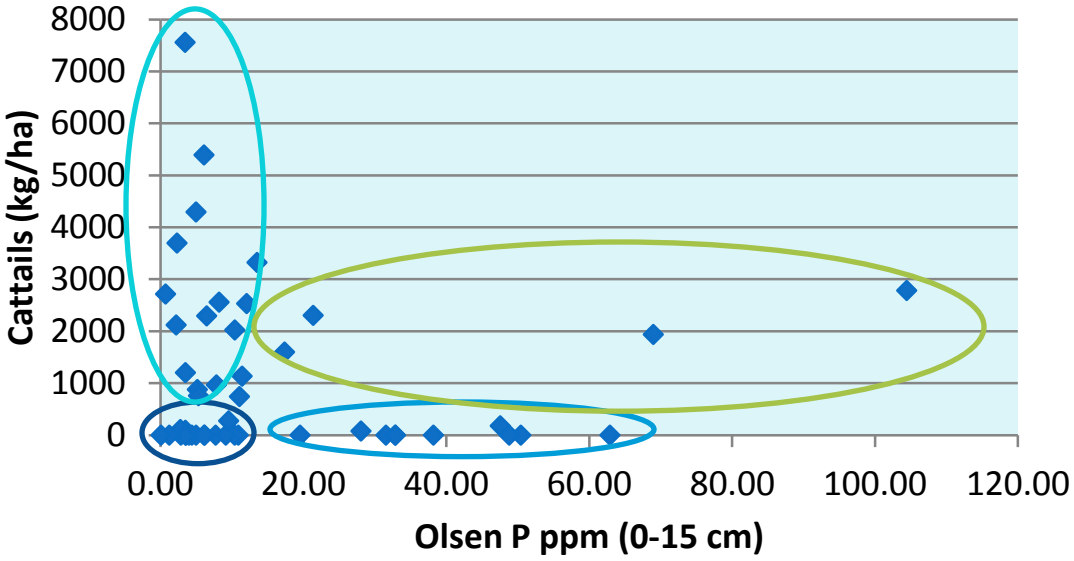
Results: Linear Regressions

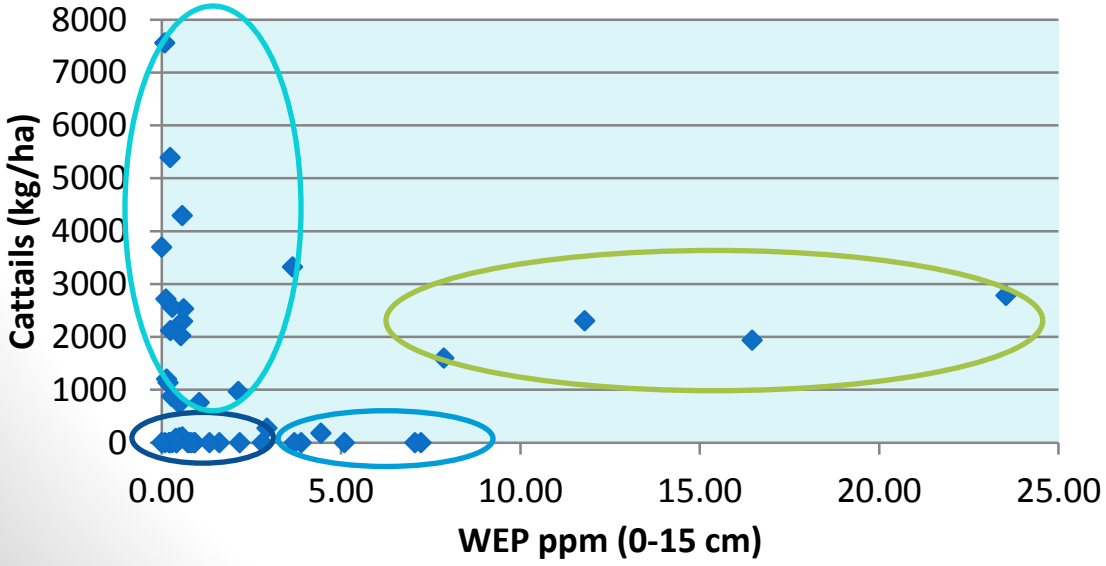




- Low R values
- Soil P was not correlated with cattail biomass

Results: Cattail Biomass & Soil P





- Conceptual models
- 4 “states”
  - Low soil P & low biomass
  - High soil P & low biomass
  - High soil P & high biomass
  - High soil P & low biomass

Conclusions

- Cattails and grasses & grass-likes tended to store the highest amounts of biomass and nutrients
- No differences in nutrients for landscape position
- Floristic quality lower in shallow marsh than wet meadow and upland
- Cattails store high levels of P; may reduce soil P
  - May affect nutrient cycling
  - Cattails remove soil P, senesce, release P back into wetland

Conclusions

- Cropped wetlands have lower FQI scores than other land uses
  - Reduced diversity and biological condition
- Cropped and grazed/hayed wetlands N-limited
  - Prairie landscape historically N-limited
  - Cropland may have severe N-limitation
- Idle wetlands P-limited
  - May be due to increased graminoid cover
  - May lead to declines in diversity

Thank You!

NDSU, NDDoH, EPA, NRCS, ND Dept of Ag

Questions?