Comparing Soil and Hydrological Conditions of Wetlands Reserve Program Restorations and Reference Wetlands along the Deep Fork River of Oklahoma (USA)

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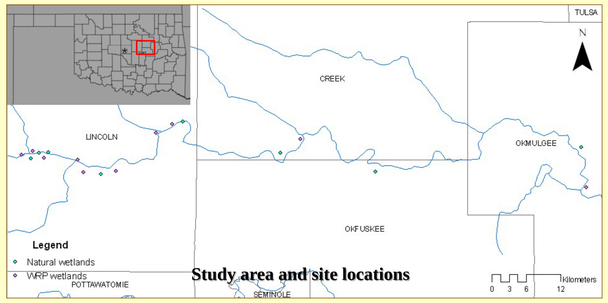


Study area and site locations

ABSTRACT

Wetland restoration is a common method of establishing wetland functions lost after human-induced degradation. The objectives of this study are to evaluate and compare functions of federally-funded wetland restorations conducted under the USDA-NRCS Wetlands Reserve Program (WRP) with those provided by naturally occurring wetlands. The purpose of this study is to determine if the functions provided by the WRP wetland restorations are different from those provided by nearby natural wetland sites. The study area encompasses eight WRP and eight natural riverine wetland sites flooded by the Deep Fork River. The sites occur in the central region of Oklahoma within the Cherokee Prairies and Cross Timbers Major Land Resource Areas. Soils in these wetlands are deep, clayey to loamy Mollisols and Inceptisols. These alluvial soils have formed during the last one thousand years (or less) before present.

Soil biogeochemical and hydrological functions outlined by the US Army Corps of Engineers will be used in the comparison. Hydrological functions to be evaluated include the dynamic, long-term, and subsurface storage of water. Soil biogeochemical functions include nutrient cycling, retention of particulates, and organic carbon export. Data will be gathered from the monitoring of shallow wells, describing soil profiles, measuring redoximorphic potential, the installation of sediment collecting devices, and conducting various soil tests. Soil tests to be conducted include nutrient availability, salinity, percent organic carbon, soil-water content, and hydraulic conductivity. This data will provide quantitative values for selected wetland functions and will be used to find similarities and differences between WRP and natural sites.

WRP wetland site exhibiting managed water levels using water control structures.

Natural wetland site exhibiting emergent vegetation under inundated conditions.

HYPOTHESIS & OBJECTIVES

Problem Statement

Wetlands Reserve Program (WRP) wetland restorations along the Deep Fork River may not provide the same or the appropriate quantity and quality of functions compared to natural, reference riverine wetlands.

Hypothesis

Natural wetlands and managed WRP restorations will differ significantly in the type and quality of functions that they provide. These differences will most likely be a product of both restoration and management techniques applied to WRP wetlands.

Objectives

- Compare hydrologic and biogeochemical functions of WRP and natural wetlands by:
  - Establishing a record for the average number of annual overbank flow events for each wetland,
  - Determining the depth and area of inundation for each wetland,
  - Evaluating each wetland's potential to store subsurface water,
  - Gathering general soils data from soil profile descriptions,
  - Assessing macro-, micro-, and secondary nutrient quantity and availability for each wetland,
  - Gathering organic carbon quantities, and
  - Determining variability in sedimentation rates.

METHODS

Sampling Sites

16 wetlands, 8 natural and 8 WRP restorations.

Functions to be Evaluated/Methodology

Dynamic surface water storage
- Record of all overbank flow events using indirect indicators.

Long-term surface water storage
- Hydroperiod estimation using water depths measured monthly.

Subsurface storage of water
- Monthly measurement of depth to groundwater using one meter monitoring wells.
- Soil water content taken monthly at two shallow depths at four locations.

Nutrient cycling
- Soil fertility tests including macro-, micro, and secondary nutrients as well as pH.
- Total carbon and total nitrogen for C:N ratios of each wetland.
- Intensity of reduction will be measured using platinum-tipped redox probes.

Retention of particulates
- Mass accretion rates will be estimated using plexiglass sediment plates.
- Textural analysis for percent silt will provide evidence of differences in siltation.

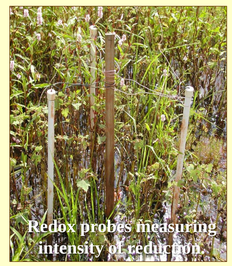
Organic carbon export
- Total carbon will allow for the extrapolation of organic carbon (OC) values.
- OC export will be estimated by assessing total OC and flooding frequency.
- Totals may also allow comparisons of carbon sequestration.

Supplementary Data

Four soil profile descriptions to a depth of 30 cm at each site.
- Including color, texture, structure, consistence, and percent redox features.

Electrical conductivity (EC) readings.

Groundwater monitoring well.



Redox probes measuring intensity of reduction.

Sediment plate showing sediment accretion.

Soil sampling for water content and nutrient levels.

DISCUSSION

- Sampling began in June of 2009 and will conclude in June of 2010.
- General impressions:
  - Variability is very high between both wetland types.
  - Organic matter accumulations is higher for natural sites.
  - More WRP sites exhibit "perched" water tables than do natural sites.
  - Western soils with more red parent material (TF2 soils) show far less intense redoximorphic soils than wetlands in the east.
  - WRP soils exhibit far higher disturbance, compaction, and erosion.
  - Wetlands with longer hydroperiods tend to accrete more sediment.