U.S. Fish & Wildlife Service
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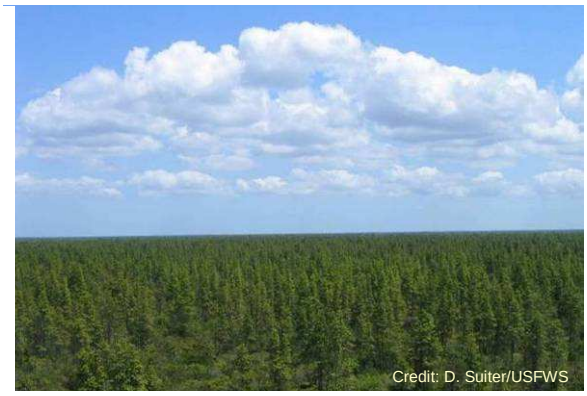
Conserving The Nature of America

Carbon Sequestration Benefits of Peatland Restoration: Attracting New Partners to Restore Habitat on National Wildlife Refuges

U.S. Fish and Wildlife Service's Environmental Contaminants Program partnered with the Service's Refuges and Coastal Programs as well as the North Carolina Department of Environment and Natural Resources to restore extensively altered peatlands at Pocosin Lakes National Wildlife Refuge (NWR). Environmental Contaminants ecologists reduce pollution through prevention and restoration. The Service is dedicated to helping reduce the impacts of climate change, important drivers of which are pollutants such as carbon dioxide and nitrous oxide. Restoring drained peatlands is a quantifiable approach to sequestering these pollutants.



Healthy pocosin wetlands have important wildlife habitat, nutrient storage and water quality functions.

Overview. Restoration at Pocosin Lakes NWR is returning the lands to a more natural state and is expected to sequester tons of carbon while providing other important habitat benefits. Soil and drainage conditions in the altered area promote loss of nutrients to the atmosphere and run-off to sensitive downstream waters. Cooperatively, we've nearly completed restoring 10,820 acres which will result in retention of about 70 million pounds of carbon and 2.2 million pounds of nitrogen per year. Carbon and nitrogen retention benefits can attract new partners to wetland restoration. Environmental Contaminants staff developed site-specific estimates of these sequestration benefits and initiated a study in partnership with the Duke University Wetlands Center to verify our projections, thereby facilitating projects to get important wildlife habitat restored and reduce pollutants associated with climate change.

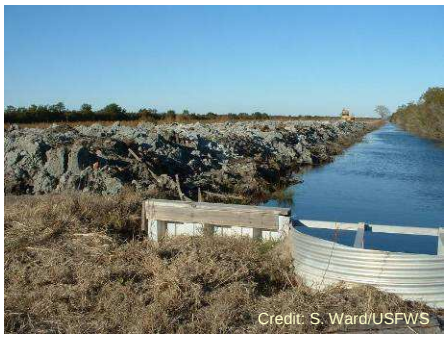
Pocosins are unique wetlands, also known as southeastern shrub bogs. The typically thick layer of peat soils (Histosols) underlying pocosins are chemical sponges over geologic time, locking-up metals, carbon, and nitrogen in vegetation and the deepening soil layer. Under normal saturated hydrologic conditions, decomposition in organic soils is minimized, allowing for accumulation of organic carbon (~40% C content) in peatlands worldwide. Millions of hectares of former peatlands in the U.S. have been drained and converted to agriculture and forestry. North Carolina's Albemarle-Pamlico peninsula is the site of the greatest pocosin acreage in the U.S.; however, 70% of pocosin habitat in NC has been lost since the 1960s and there is a significant restoration need.

Degraded pocosins: an environmental concern

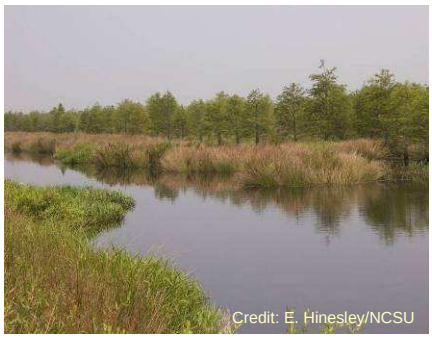
- Drained for agriculture and peat mining
- Drainage caused peat decay and carbon and nitrogen loss
- Drainage canals deliver pollutants to sensitive downstream waters

Restoration Approach

- Install water control structures
- Use raised roads along canals as levees to raise water levels
- Re-saturate drained areas by rainfall
- Promote sheet flow by water level management



Water control structures, and raised roads….



….allow refuge staff to restore water levels

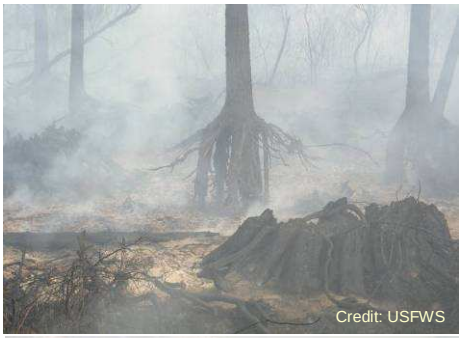
Restoration benefits

Restoring healthy pocosin wetlands provides important benefits to terrestrial and aquatic ecosystems, and human communities:

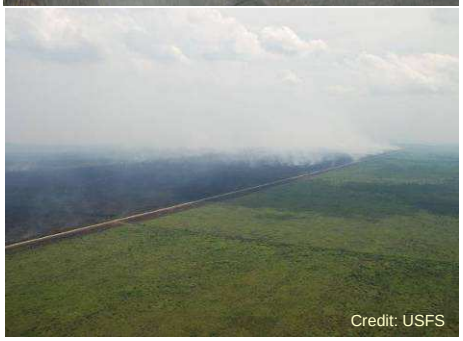
- provides wildlife habitat
- sequesters carbon, nitrogen, and mercury
- protects estuarine water quality
- lessens the frequency and severity of wildfires
- controls flooding

In low-elevation coastal areas, pocosin restoration also plays a key role in the adaption of ecosystems to sea level rise by preventing incremental (via oxidation) and catastrophic (via burning) soil loss and promoting soil formation.

Catastrophic fires in drained peatlands, like this 2008 fire at Pocosin Lakes NWR, can burn away the entire peat lens. Based on the area and depth (over 5-feet of loss in places) of peat burned, an estimated 6 million tons of carbon were released during the fire.



Previously- restored lands on the refuge did not burn in the 2008 fire and helped create an important fire break. Re-saturating peatlands limits the potential for intense peat fires while still allowing the above ground vegetation to burn (a necessary process in pocosin ecosystems)



Pocosin restoration: an ideal carbon (and nitrogen) offset:

Drained
C and N loss via oxidation
SOURCE

→

Restored
C and N sequestration
SINK

Carbon Balance Verification of Peatland Restoration

A carbon and nitrogen budget verification study began this year in cooperation with Duke Wetlands Center. The project provides the science to document the carbon benefits of pocosin restoration estimated through our calculations. Measurements performed on restored, drained and reference sites include:

- Soil respiration and gaseous flux
- Soil carbon content and accumulation rates
- Surface water carbon and nutrient export
- Biomass and net primary productivity
- Carbon transfer from vegetation to soil
- Carbon flux model

Estimated carbon benefits a function of 3 factors:

1) Amount retained that otherwise would be lost without restoration (stop loss)

Rate of peat loss (ft/yr) X Bulk density (kg/ft^3) X Peat C content (%) X CF = lb/ac/yr sequestered

- Rate of peat loss when drained 0.03 ft/yr
- Bulk density 0.2 g/cm^3
- Peat carbon content 43%
- CF = conversion factors for ft^2/ac and lb/kg

= 6100 lb C/ac/yr

2) Amount retained in peat as soil genesis is re-established

Bulk density (kg/ft^3) X Peat depth (ft) X Peat age (yr) X Peat C content (%) X CF = lb/ac/yr sequestered

- Peat depth= 7.6 ft
- Peat age = 7500 yr
- Soil property info as above
- CF = conversion factors for ft^2/ac and lb/kg

= 230 lb C/ac/yr

3) amount retained in the above ground biomass

Above ground biomass (lb/ac) X Biomass C content (%) X Age of mature vegetation (yr) = lb/ac/yr sequestered

- Above ground biomass in pocosin 3300 g/m^2 (29,000 lb/ac)
- Biomass C content 1.0%

= 140 lb C/ac/yr

Total carbon stored by restoration = 6,500 lb C/ac/yr

Positive Climate Impact

Restoration results in immediate carbon sequestration benefits and the project will sequester 1,080 metric tons of CO_2 equivalents per acre at year 100. The actual carbon benefits will continue to accrue for a period equal to the time required for total peat loss absent restoration (or up to 500 years based on peat depth). Restoration projects may be attractive source of carbon and nitrogen credits and could facilitate new partnerships in the future based on low implementation costs on conservation lands (less than $350/ac) and high retention benefits. With nearly a half million acres of degraded pocosin wetlands in need of restoration in North Carolina, there is potential to sequester millions of tons of carbon per year.

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