Wetlands and Climate Change: A Summary of Current Wetland Scientific Findings

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Climate Change is a land use change and ecosystem change problem, as well as a carbon emissions problem.

"Climate Change is a global issue that manifests itself locally." – Dr. William Moomaw, Tufts University and IPCC author

West Haven, CT
Photo: West Haven Dept. of Planning & Development

Taiwan
Photo: G. Davies
Biological Carbon Sequestration

Image: USGS
Undisturbed North American peatlands sequester approximately 32 million tons of C per year. - Bridgham et al., 2006

Globally, wetlands store approximately 300 – 700 billion tons of carbon. – Bridgham et al., 2006

Don’t buy peat moss!

Photo: G. Davies
**Saltwater** wetlands/estuarine environments sequester CO$_2$ efficiently and emit relatively little CH$_4$.

**Older** freshwater wetlands (i.e. undisturbed) sequester more C than they emit.

**Forested** wetlands - sequester large amounts of C in tree biomass.

**Younger** freshwater wetlands and disturbed wetlands can be net C emitters until switchover time, when they then become net C sequesters.

Photos: G. Davies
REFERENCES


Disturbance: Resetting the Carbon Clock

Carbon cycle & microbial processes differ at different stages of succession.

Image: www.BeyondtheBeauty.com
Can We Unscramble the Eggs?

Carbon sequestration function is not always replicable after disturbance (within decades to thousands of years).

Photos: G. Davies.
Global carbon storage in terrestrial ecosystems

Global extent of peatlands

High Carbon Ecosystems

ALL TROPICAL FORESTS

TIDAL SALT MARSH

Photos: G. Davies

COASTAL WETLANDS
- salt marshes
- sea grass beds
- mangrove swamps

Waquoit Bay National Estuarine Research Reserve, Falmouth, MA
Spruce and Peatland Responses Under Climatic and Environmental Change (S.P.R.U.C.E.) Project

Oak Ridge National Laboratory operated by UT-Battelle, LLC
U.S. Forest Service, Northern Research Station, Marcell Experimental Forest.
High Carbon Ecosystems

INLAND PERMANENTLY FLOODED WETLANDS

TROPICALPEATLANDS

UNDERWATER BIOMASS

GRASSLANDS

LAKES

Photos: G. Davies

Photo: Saint John’s River Water Management District
Climate Resiliency & Adaptation: Wetland Ecosystem Services

- If 10% - 20% of watershed is wetland/lake, you see 60% reduction in peak flow of big storm events \( (Kolka, 2013) \). \( \text{(flood storage, storm damage prevention, water quality, habitat protection, water supply protection)} \)

- Peatland can be small percentage of watershed, but produce 50% of streamflow \( (Kolka, 2013) \). \( \text{(water supply, water quality, habitat)} \)
Climate Resiliency and Adaptation: Wetland Ecosystem Services

- Wetlands store water, & can help offset loss of snowpack, increased drought, buffer adjacent areas from heavy precipitation and severe storms (water quality & quantity, habitat)

- Wetlands function as air conditioners on the landscape, keeping air and water temperatures down. (human health, habitat)

- Coastal & estuarine wetlands provide wave attenuation & erosion control (storm damage prevention, habitat, SLR protection)
How are wetlands being impacted by our changing climate?

Photos: G. Davies
Ecosystem
“Distress Syndrome”

- Reduced biodiversity.
- Reduced nutrient cycling.
- Increased prevalence of diseases.
- Increased dominance of invaders.
- Altered primary and secondary productivity, altered ecosystem processes.
- Predominance of shorter-lived opportunistic species.

- K. Erwin, 2009
Protect large carbon banks.

Accelerate carbon sequestration: Plant trees.

Decelerate carbon Emissions: Ecosystem services instead of gray infrastructure.
Protect water tables, especially in permanently flooded wetlands.

Manage hydrologic systems, including wetlands, in ways that minimize climate impacts.
Soil, Water, Land Conservation

Reforestation

RESILIENCY STRATEGIES

Prevention of forest degradation

Photos: G. Davies
RESILIENCY STRATEGIES

Increase buffers to allow for ecosystem migrations.

Minimize impacts from other stressors.

Photos: G. Davies
RESILIENCY STRATEGIES

Protect large, undisturbed ecosystems.

Maximize connectivity.

Photos: G. Davies
Resiliency Strategies

• Focus on protection, maintenance, health and restoration of ecosystem processes and function.

www.ecobiomes.weebly.com
RESILIENCY STRATEGIES

Plan ecosystem management, restoration & creation at watershed/landscape scales.

Photo: G. Davies
Wetlands Protection, Restoration & Creation is a **3-for-1 Deal**:

- Traditional ecosystem services/functions/values
- Climate adaptation/resiliency
- Carbon sequestration, emission reduction & long-term storage (climate mitigation)

Image: dvdempire.com

Photo: G. Davies
Ideas to Ponder

- Ecosystem functioning and ecosystem services will change as a result of changes in species composition, increases in invasive species, and ecosystem disassembly and re-organization that result from climate changes.

- Urbanization and climate change affect ecosystem processes in similar ways.

- Positive feedbacks: increased drought/drying of floodplains, peatlands, wetlands, which leads to increased C releases.

Photo: G. Davies