# Course Introduction and Wetlands 101

*Wetlands Ecology (EES 6308C)*
*Week 1*

David Kaplan, Ph.D. (dkaplan@ufl.edu)
UF Environmental Engineering Sciences
www.watershedecology.org

# Motivations…why are we here?


www.quokka.wikispaces.com/Causes+of+Endangerment


Word cloud built from the *NYT "Wetlands"* RSS feed via www.wordle.net

# Wetland Ecosystems

*"…[a] horrible desert, the foul damps ascend without ceasing, corrupt the air and render it unfit for respiration…Never was Rum, that cordial of Life, found more necessary than in this Dirty Place."*

*"By draining the Dismal, it will make all the adjacent country much more wholesome…by correcting and purifying the air, which is now infected by the malignant vapours rising continuously from that large tract of mire and filthiness."*

*"After draining, it will have the fittest soil for hemp…"*

*Colonel William Byrd III (1674-1744)*

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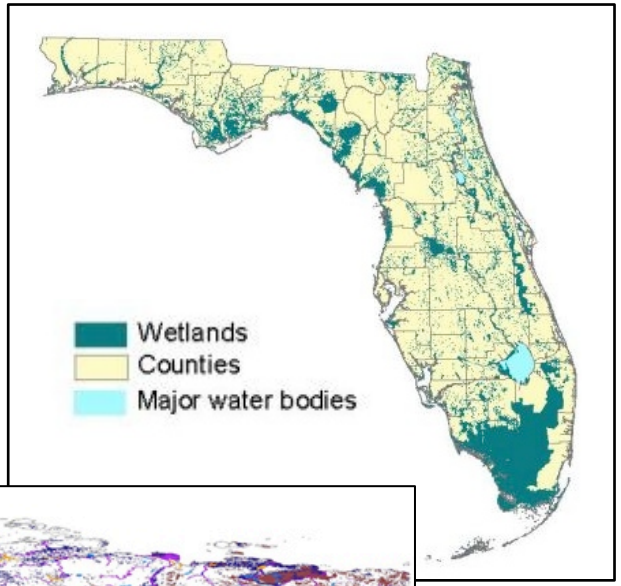
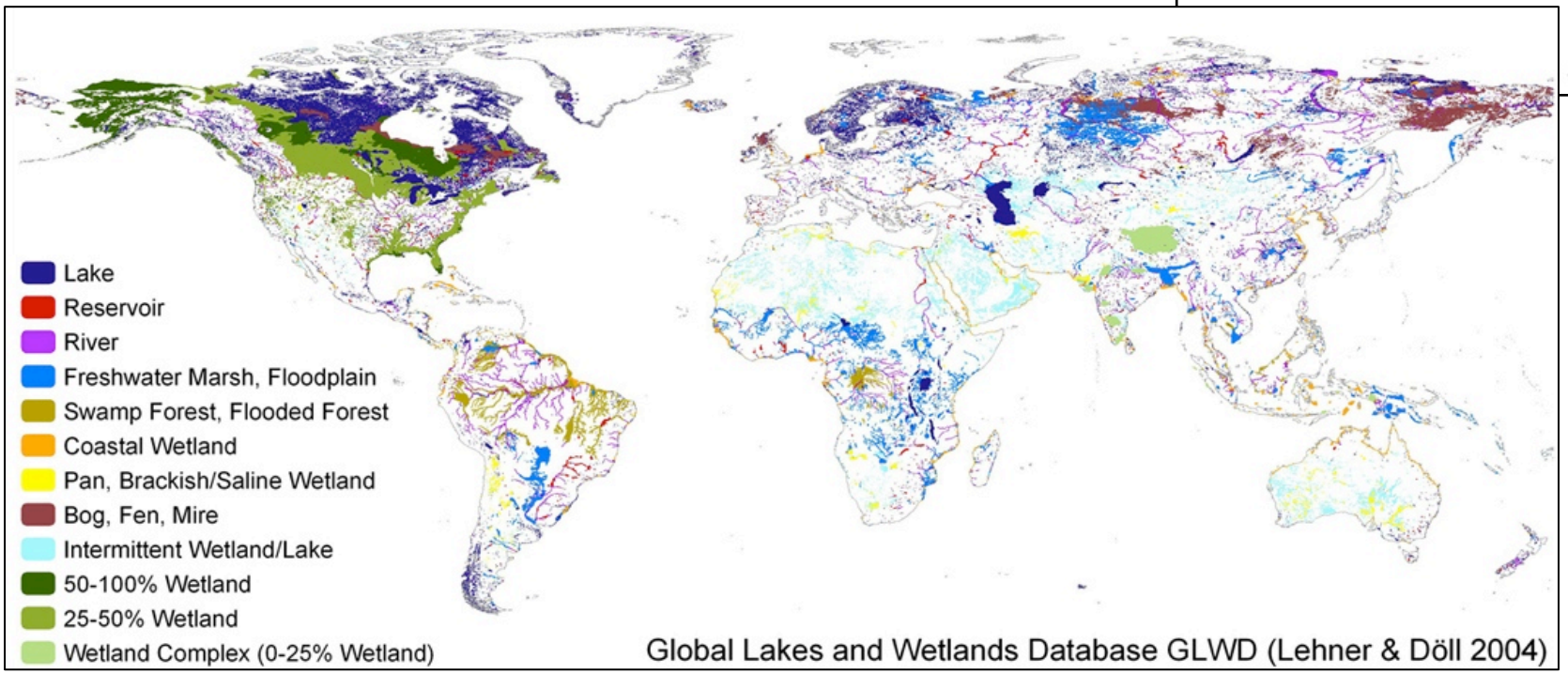
# Wetland Ecosystems

## Wetland Fun Facts

- Make up 6% of Earth's land surface
- Occur in (nearly) all climates
- Regulate global biogeochemical cycles
- Highly **productive** and **diverse** ecosystems



# Overview

## Wetlands 101

**1. Definitions**

2. Form and Function

3. Values

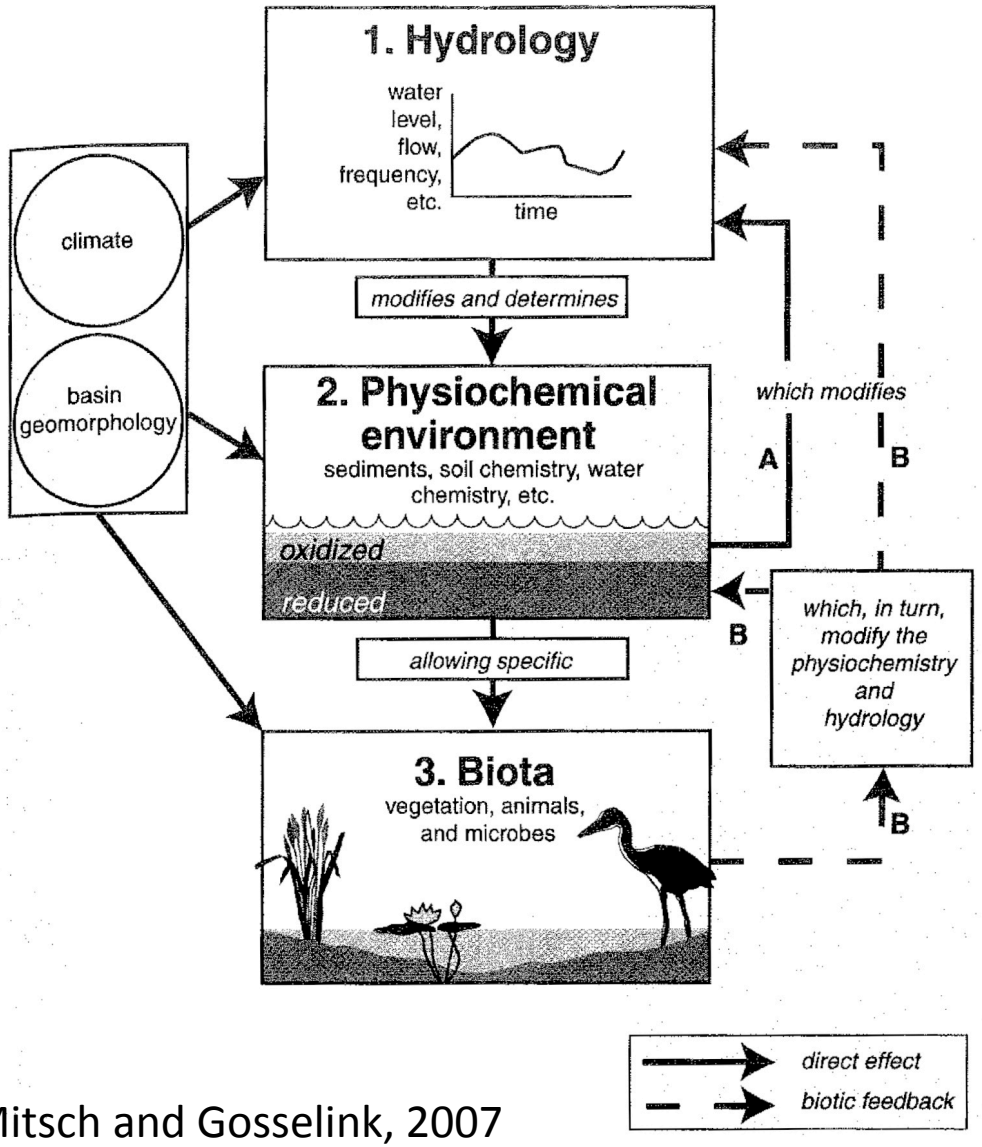
4. Types

Big Cypress National Preserve, FL
(MOFAC, S. Florida State College)

# Wetland Definitions

## What is a wetland?

1. Hydrology
2. Soil
3. Vegetation




Mitsch and Gosselink, 2007

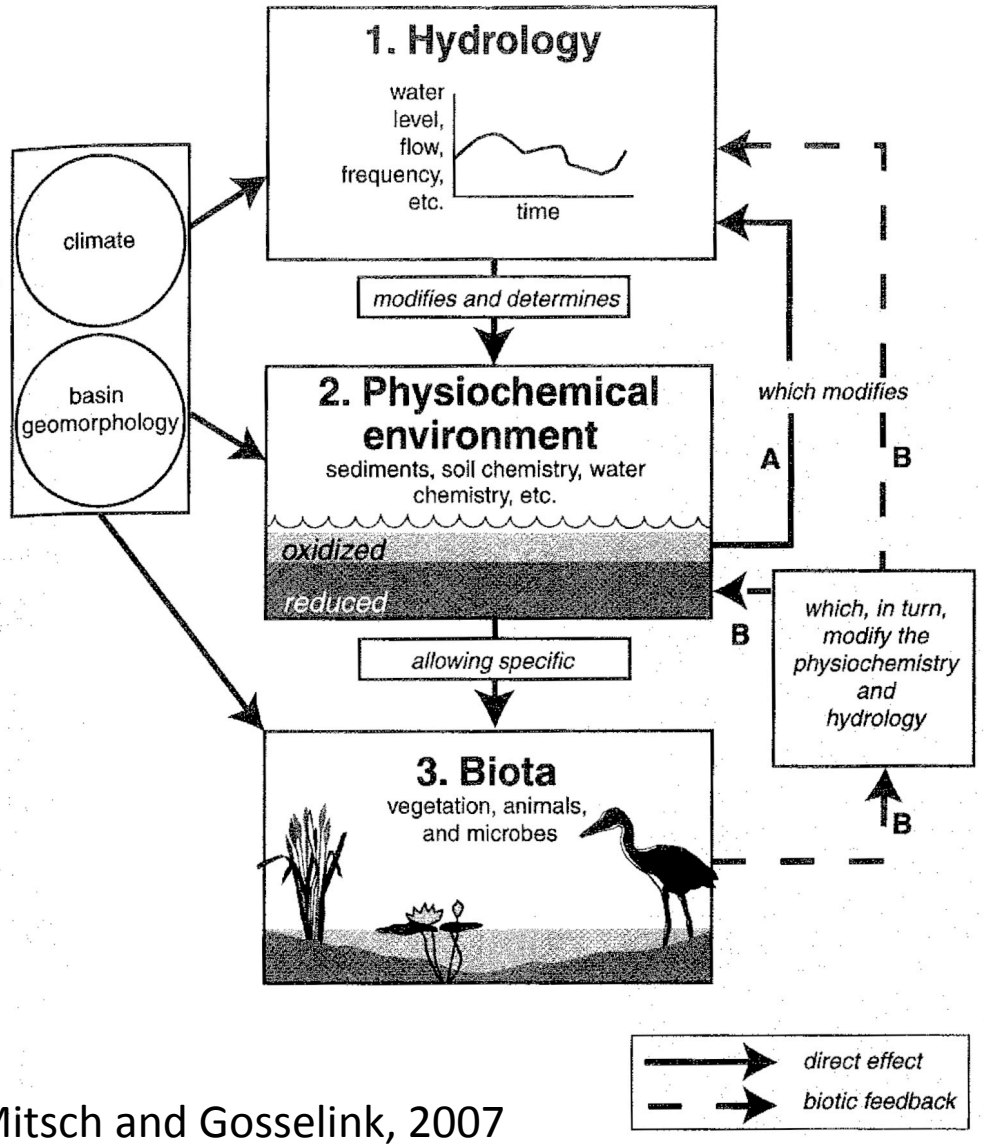
# Wetland Definitions

## What is a wetland?

1. Hydrology
2. Soil
3. Vegetation

Wet enough for **anaerobic conditions**… but not too deep to exclude vegetation

**Anaerobic conditions** create hydric soils and specialized (adapted) flora to tolerate anaerobic conditions

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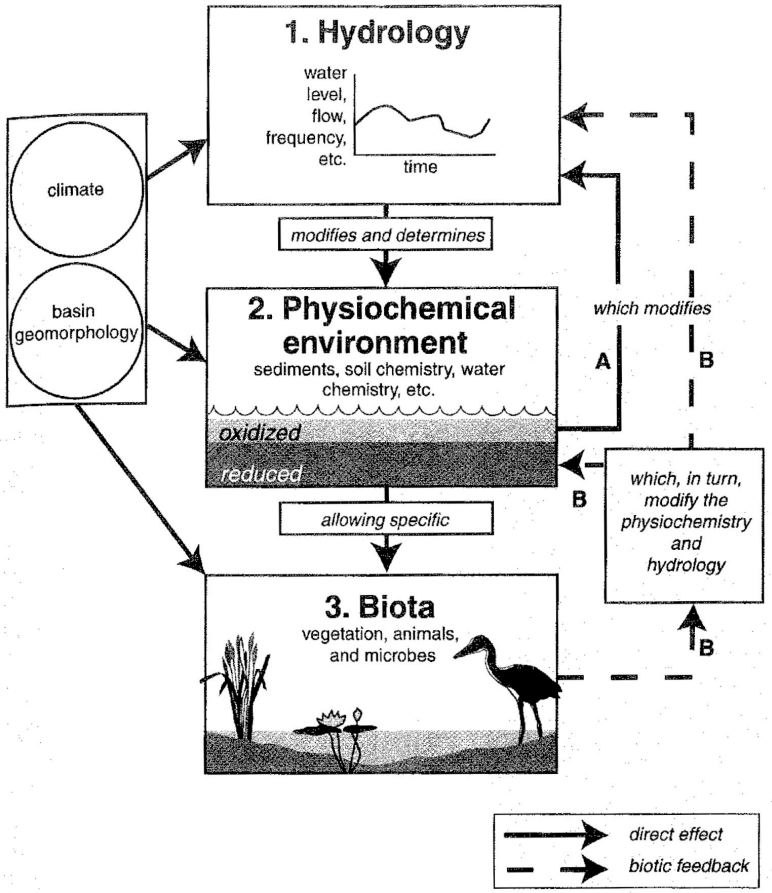
# Wetland Definitions

What is a wetland?

# Wetland Definitions

**<u>Hydrology</u>**: Permanent or periodic inundation at mean water depth <6.6 ft, or the soil saturated to the surface at some time **during the growing season of the prevalent vegetation** → Hydroperiod!




US Army Corp of Engineers Wetlands Delineation Manuel (www.wetlands.com/regs/)

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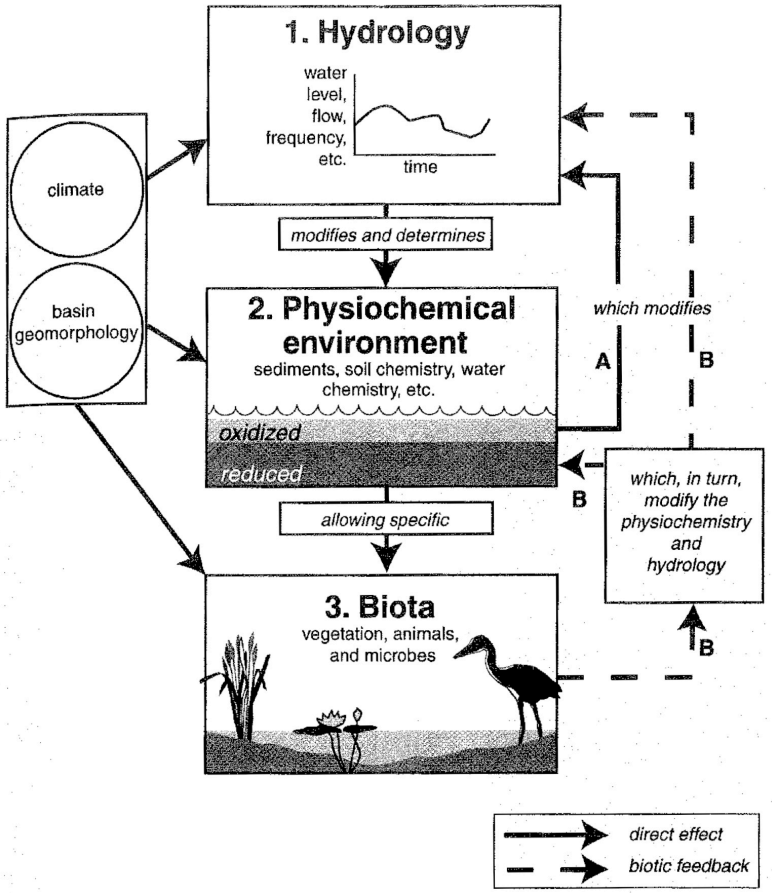
**Hydric Soils**: Presence of hydric soils…possess characteristics that are associated with **reducing (anaerobic) soil conditions**

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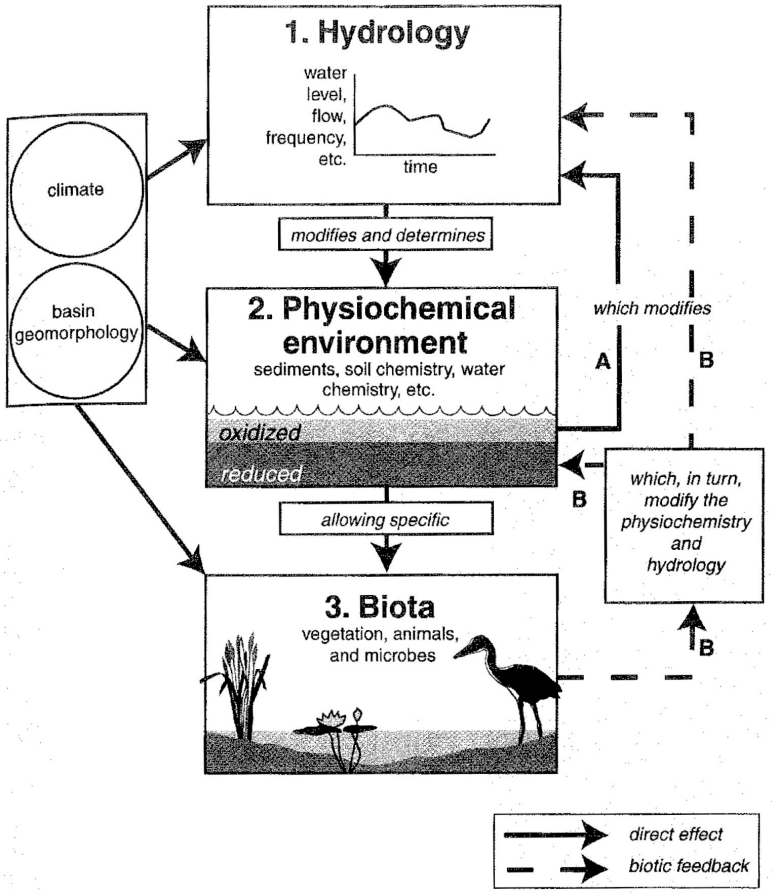
**Vegetation**: Hydrophytic species are present, due to morphological, physiological, and/or reproductive **adaptations**…and have the ability to grow, compete, reproduce, and persist in **anaerobic soil conditions**.

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# MORE Wetland Definitions

**EPA (Section 404 CWA)**:
Those areas that are inundated or **saturated by surface or groundwater** at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of **vegetation typically adapted for life in saturated soil conditions**.

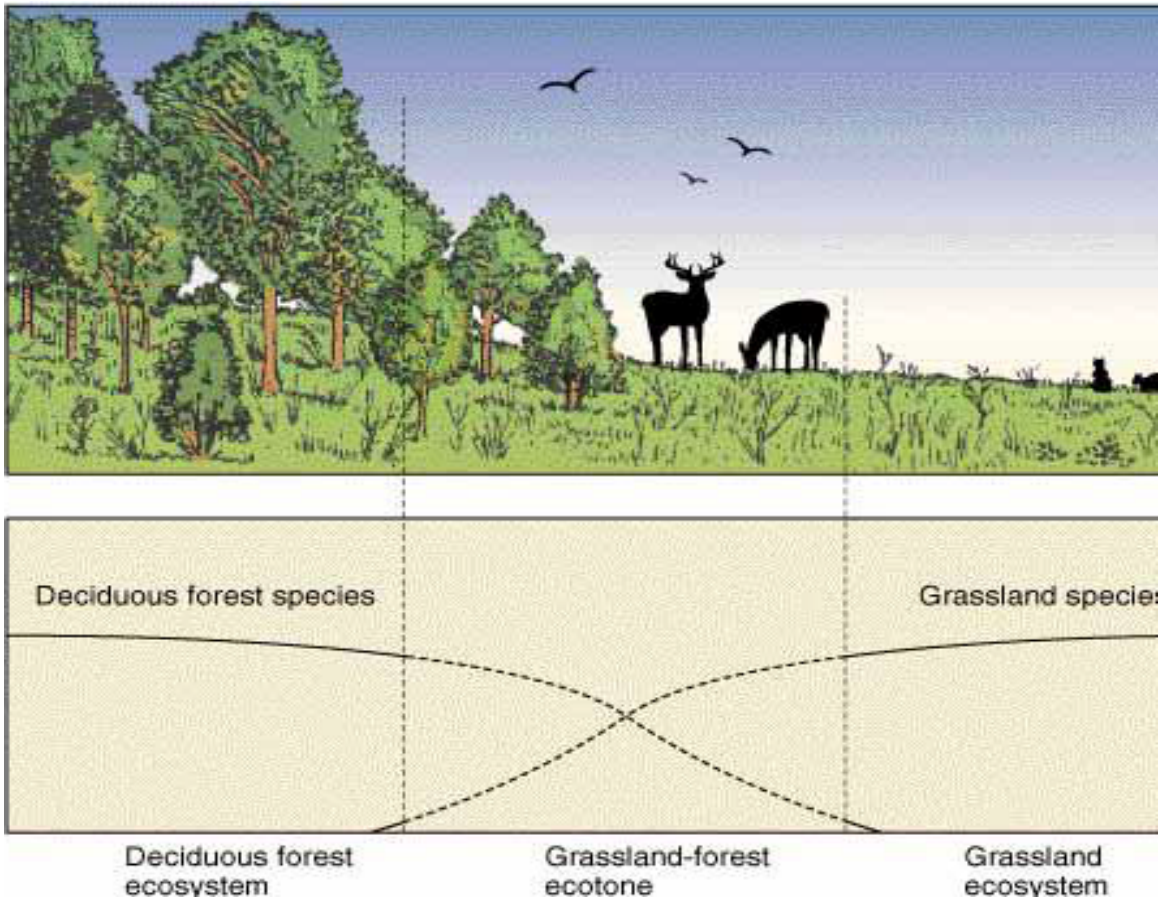
**NRC (1995)**:
…an ecosystem that depends on **constant or recurrent, shallow inundation or saturation at or near the surface** of the substrate. The minimum essential characteristics of a wetland are recurrent, sustained inundation or saturation at or near the surface and the presence of physical, chemical, and biological features reflective of recurrent, sustained inundation or saturation. **Common diagnostic features of wetlands are hydric soils and hydrophytic vegetation**. These features will be present except where specific physiochemical, biotic, or anthropogenic factors have removed them or prevented their development.

# Wetland Definitions

## Wetlands = "Ecotones" or Unique Ecosystems?

**<u>Ecotones</u>**:

- Transitional areas between adjacent ecosystems
- Species live near edge of their tolerance
- Supports unique plant and wildlife species "ecotone specialists"
- Species composition influenced by both communities



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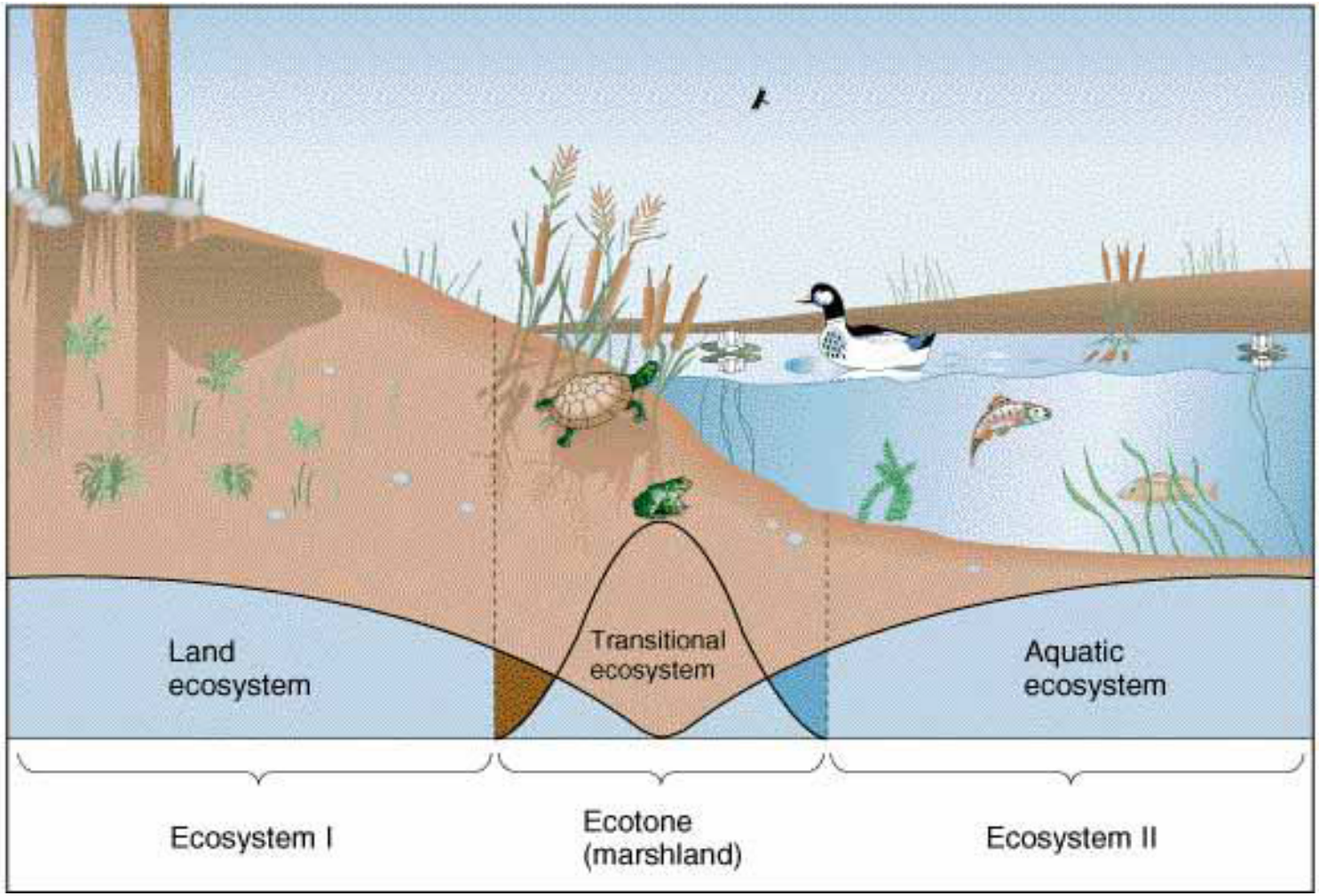


www.apesnature.homestead.com

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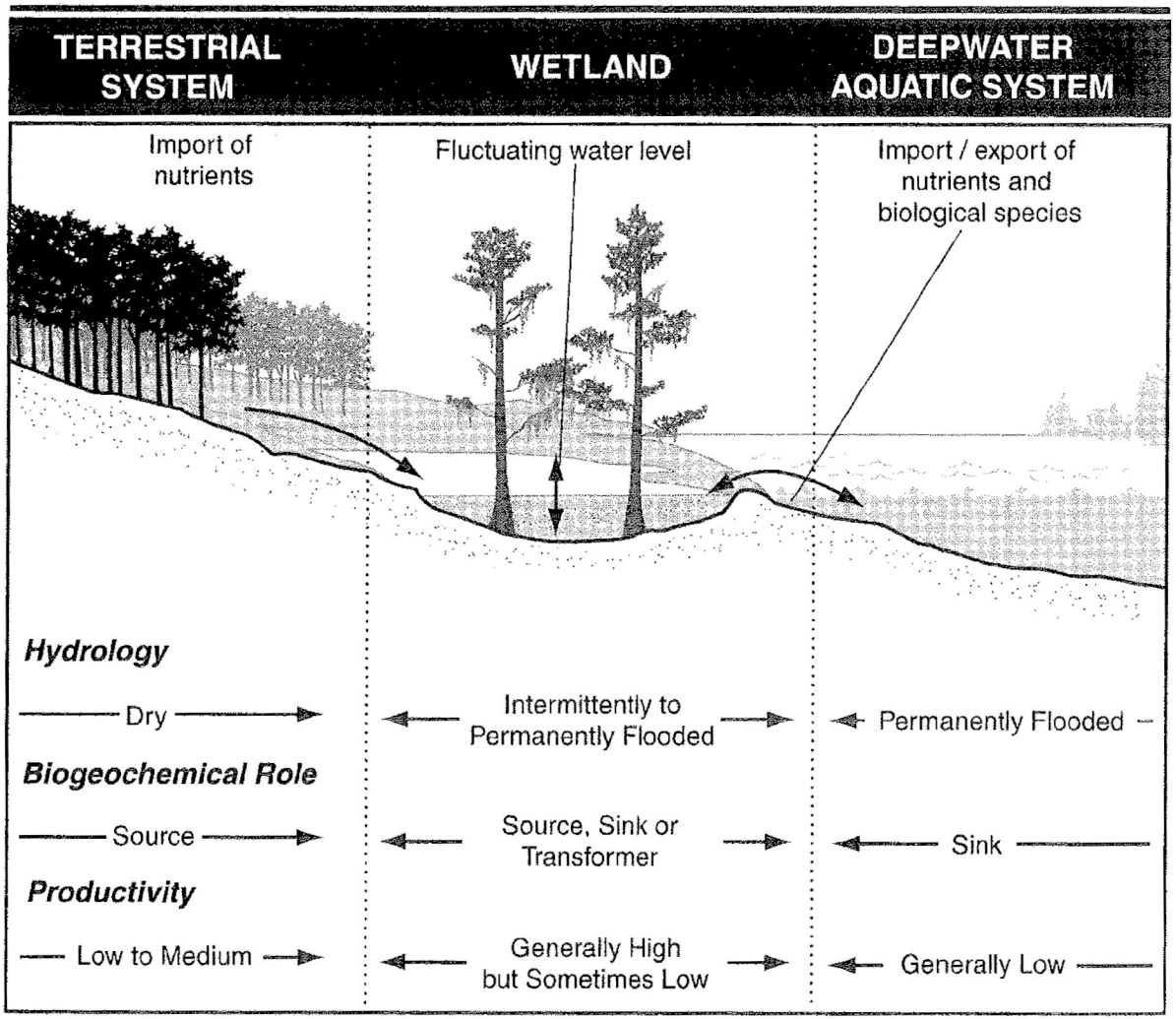

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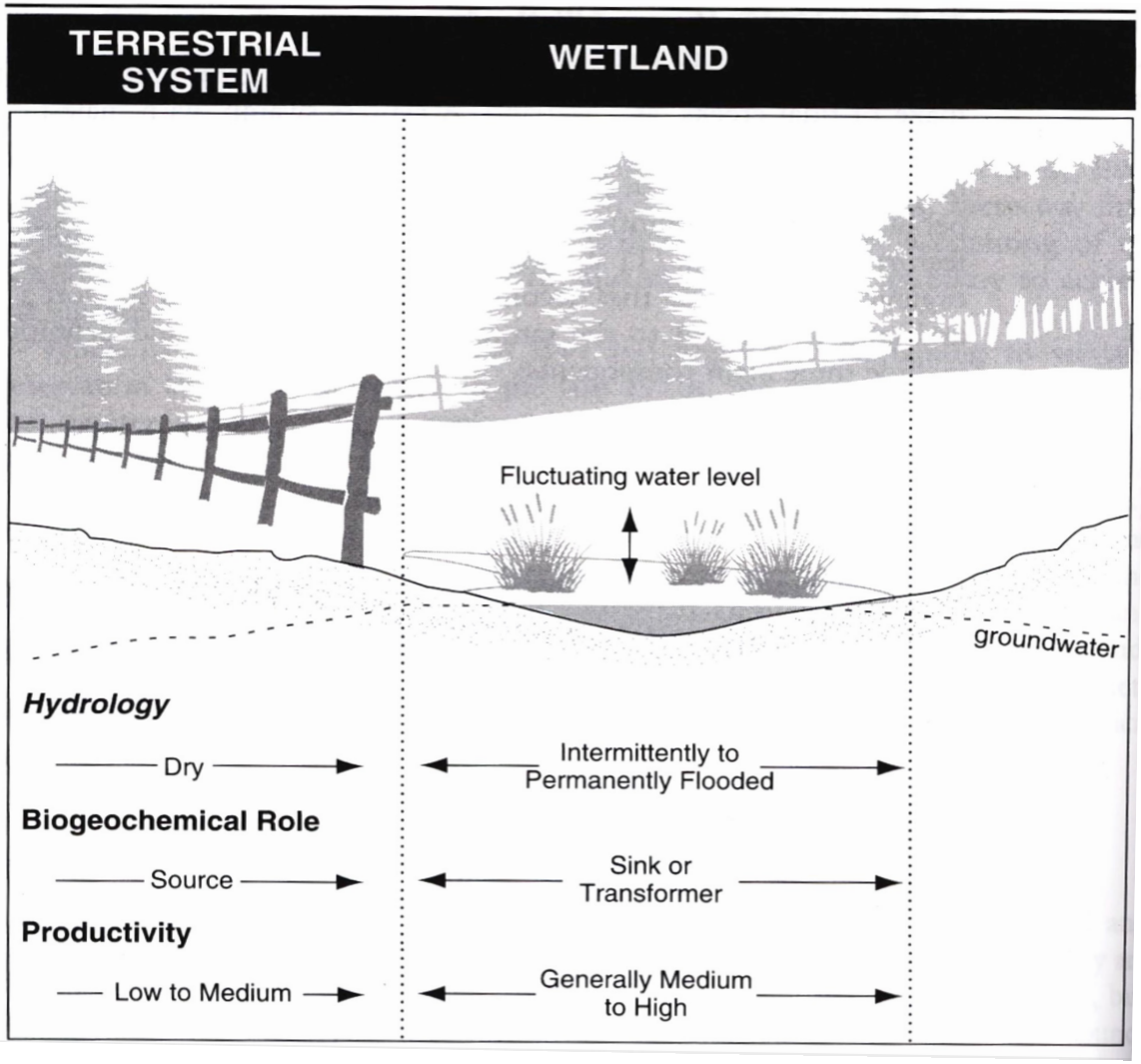


Mitsch and Gosselink, 2007

# Difficulty Defining Wetlands?

1. Varying depth and duration of inudation
2. Often considered as ecotones
3. Wetland plants are adaptive (facultative vs. obligate)
4. Size and structure are variable
5. Wetland condition and human influence varies greatly


**"Take A Break, Why Not!"**
**February 2007**
96"x48"
Catalog #1427
**$200** (shipping not available)

http://derekerdman.com/lup/pntgs/5/take_a_break_why_not.htm

# Resources ("Homework")

1. Books:
   - Wetlands (Mitsch and Gosselink, 2007) – on reserve in Marston Library
   - Wetland Ecosystems (Mitsch et al., 2009)
   - Wetland Ecology (Keddy, 2010)
   - Wetland Biogeochemistry (Reddy and DeLaune, 2008)

2. Journals: Ecological Engineering, Wetlands, Wetland Ecology and Management, Water Resources Research, Journal of Environmental Quality, Ecology, Restoration Ecology, Ecological Restoration

3. Websites:
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   - FDEP Wetland Evaluation and Delineation: www.dep.state.fl.us/water/wetlands/delineation/
   - National Wetlands Inventory: www.fws.gov/wetlands/

- **Wetlands Seminar @ 11:45 on Wednesdays in the Phelps Lab, Center for Wetlands**

# Assignments

**Assignment 1:** A semester-long, partially-guided field exercise to find and identify **25 species** of wetland plants (of your choosing) and create a wetland plant identification guide. The first part of this assignment is to visit a local wetland and describe 5 **different** plants you believe to be "wetland plants." Detailed instructions on data collection to follow.

**Assignment 2**: Choose a common wetland type, a specific nearby wetland, or a large, well-studied system. Get started now reading and cataloging information pertaining to your chosen wetland system, while also formulating hypotheses for **Assignment 3**.

# Overview

## Wetlands 101

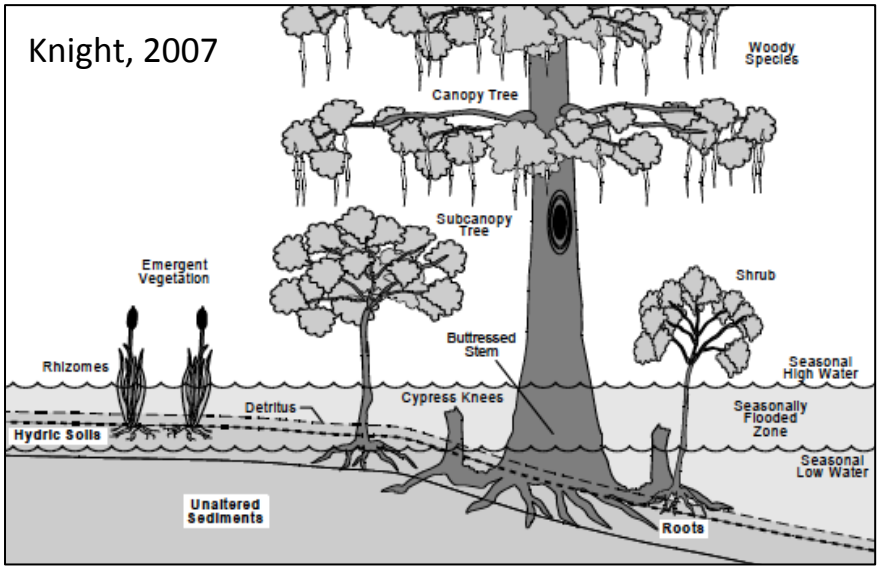
1. Definitions
2. **Processes**
3. Functions
4. Types

Big Cypress National Preserve, FL
(MOFAC, S. Florida State College)

# Drivers, Structure, and Function

## Forcing Functions

- Sunlight
- Water flows (rain, runoff, SW, GW, etc,)
- Wind and atmospheric gasses
  - $CO_2$, $O_2$, $N_2$
- Seeds/propagules




## Wetland Structure

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## Wetland Function

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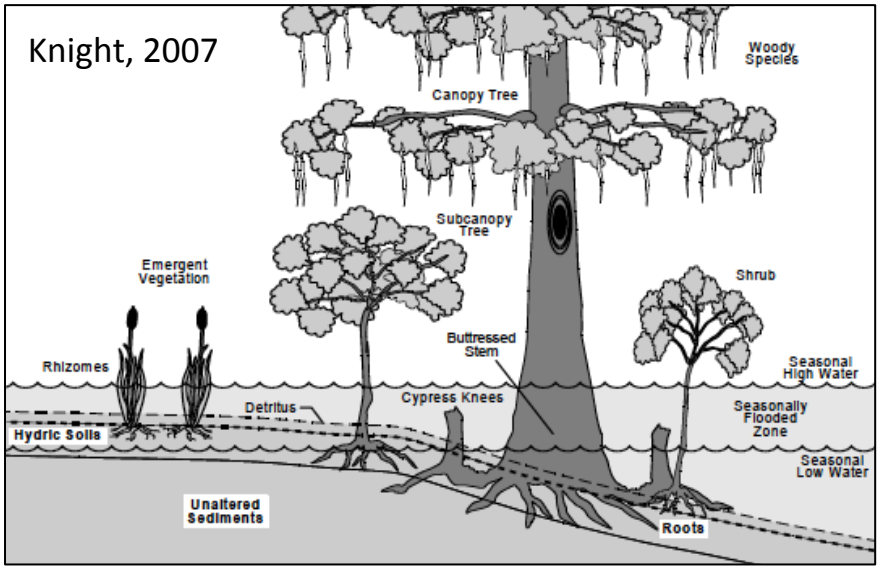



## Wetland Structure

- Water
- Soil (organic + mineral) & detritus
- Plants
- Animals
- Others?

## Wetland Function

- $1^0$ productivity (plants)
- $2^0$ productivity (consumers)
- Peat formation
- Water storage and purification
- Evapotranspiration

# Wetland Structure

## What is a wetland?

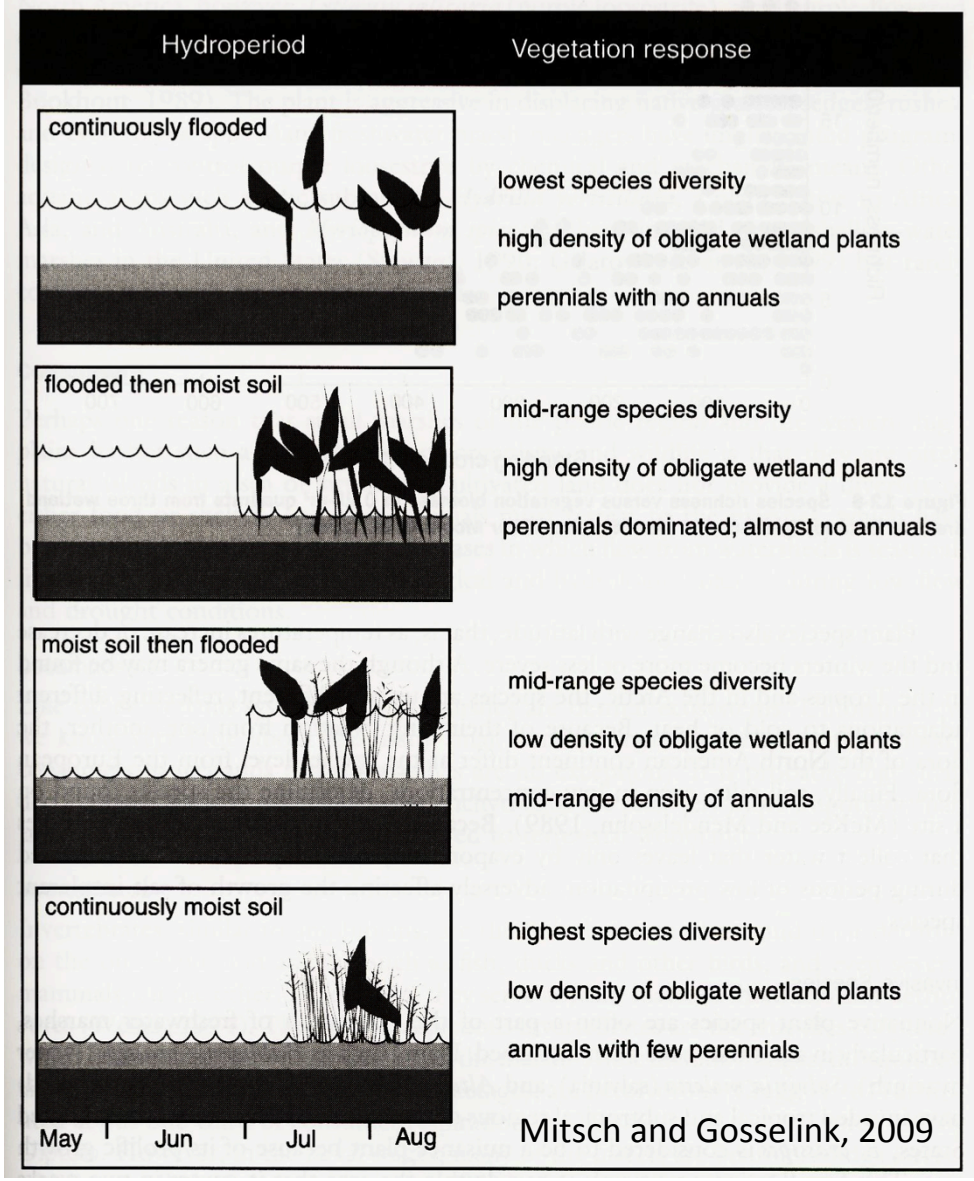
1. Hydrology
2. Soil
3. Vegetation

**Anaerobic conditions** created by flooding and saturation create hydric soils and specialized (adapted) flora to tolerate lack of oxygen

# Wetland Structure: Hydrology

"Areas with evident characteristics of wetland hydrology are those where the presence of water has an overriding influence on characteristics of vegetation and soils due to anaerobic and reducing conditions, respectively." (USACE)

# Wetland Structure: Hydrology

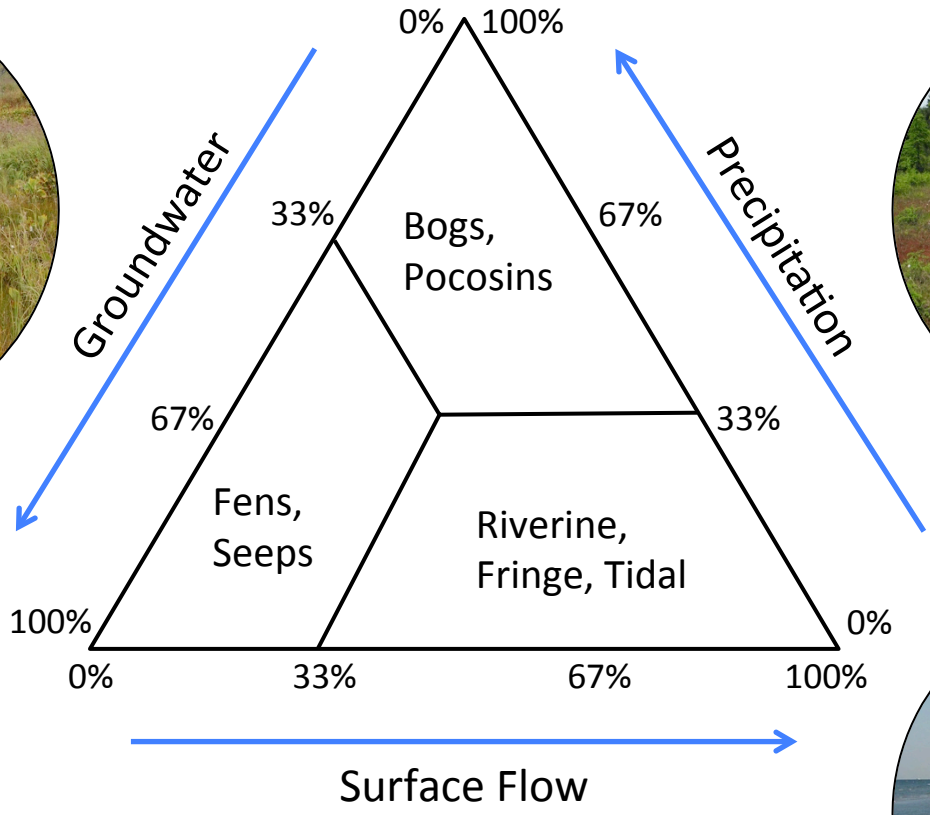



## Hydroperiod

- Seasonal pattern of the water level of a wetland
- "Hydrologic signature"
- Characterizes wetland types
- Consistent pattern creates wetland stability
- Drives plant reproductive strategies & adaptations

# Wetland Parameters: Hydrology

Seep Wetland




Bog Wetland

Tidal saltmarsh

Adapted from Reddy and DeLaune. 2008

# Wetland Structure: Hydric Soils

"…a soil that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part." (NRCS)

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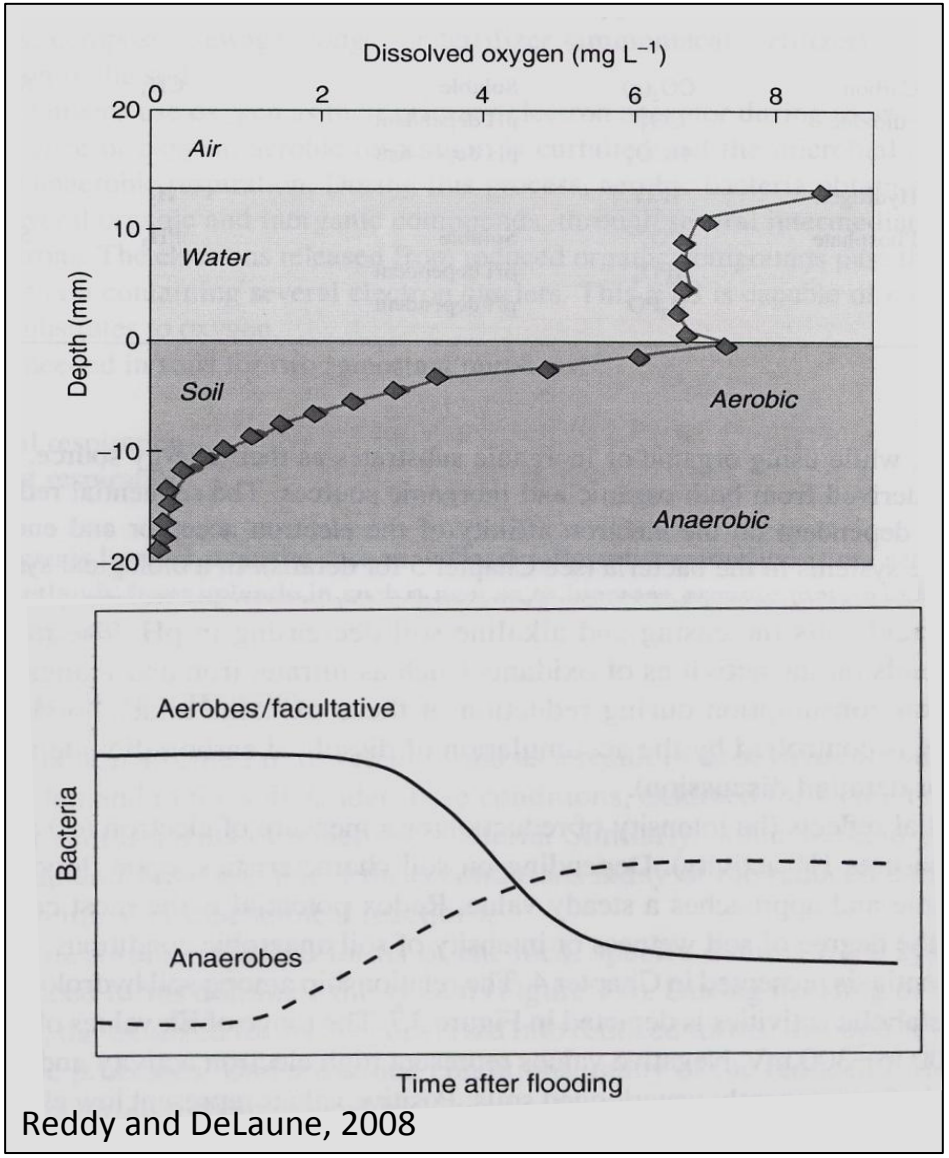



Reddy and DeLaune, 2008

# FIELD INDICATORS OF HYDRIC SOILS

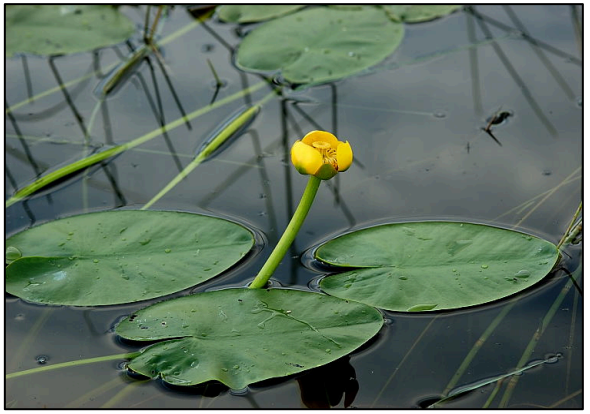
| All Soils | Sandy Soils | Loamy and Clayey Soils |
|---|---|---|
| A1. Histosols | S1. Sandy Mucky Mineral | F1. Loamy Mucky Mineral |
| A2. Histic Epipedon | S2. 2.5 cm Mucky Peat or Peat | F2. Loamy Gleyed Matrix |
| A3. Black Histic | S3. 5 cm Mucky Peat or Peat | F3. Depleted Matrix |
| A4. Hydrogen Sulfide | S4. Sandy Gleyed Matrix | F4. Depleted Below Dark Surface (A11) |
| A5. Stratified Layers | S5. Sandy Redox | F5. Thick Dark Surface (A12) |
| A6. Organic Bodies | S6. Stripped Matrix | F6. Redox Dark Surface |
| A7. 5 cm Mucky Mineral | S7. Dark Surface | F7. Depleted Dark Surface |
| A8. Muck Presence | S8. Polyvalue Below Surface | F8. Redox Depressions |
| A9. 1 cm Muck | S9. Thin Dark Surface | F9. Vernal Pools |
| A10. 2 cm Muck | S10. Alaska Gleyed | F10. Marl |
| A11. Depleted Below Dark Surface | | F11. Depleted Ochric<br>F12. Fe-Mn Masses |
| A12. Thick Dark Surface | | F13. Umbric Surface |
| A13. Alaska Gleyed | | F14. Alaska Redox Gleyed (A14) |
| A14. Alaska Redox | | F15. Alaska Gleyed Pores (A15) |
| A15. Alaska Gleyed Pores | | F16. High Plains Depressions |
| A16. Coast Prairie Redox | | F17. Delta Ochric |
| | | F18. Reduced Vertic |
| | | F19. Piedmont Flood Plain Soils |
| | | F20. Anomalous Bright Loamy Soils |

# Wetland Structure: Hydrophytic Vegetation

**Hydrophytes**: flood-tolerant plant species with adaptations to tolerate or avoid **stress**

Red mangrove (*Rhizophora mangle*)

Bald cypress (*Taxodium distichum*)



Spatterdock (*Nuphar lutea*)

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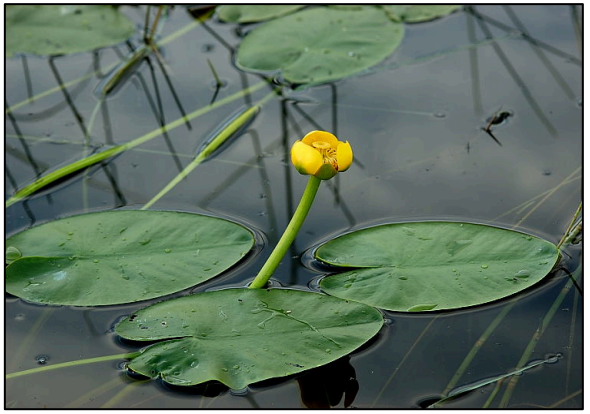

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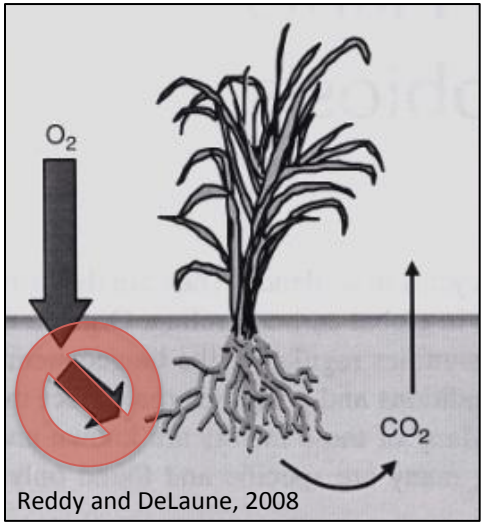



Reddy and DeLaune, 2008

Anoxia → Reduced $O_2$ for root metabolism

- Root development
- Nutrient uptake & transport
- Photosynthesis
- Anaerobic processes → accumulation of toxins

# Wetland Structure: Hydrophytic Vegetation

## Adaptations for dealing with anoxia:

### Structural/Morphological

- Aerenchyma tissue
- Adventitious roots
- Fluted trunks
- Lenticels
- Pneumatophores
- Rapid growth
- Shallow root systems
- Stem hypertrophy

### Physiological

- Altered nutrient absorption
- Anaerobic respiration
- Pressurized gas flow
- Rhizosphere oxygenation

### Whole Plant

- Seed production timing
- Buoyant seeds
- Vivipary
- Persistent seed bank
- Rot-resistant roots, tubers, seeds

Get $O_2$ to the Roots (or, get roots to $O_2$)!

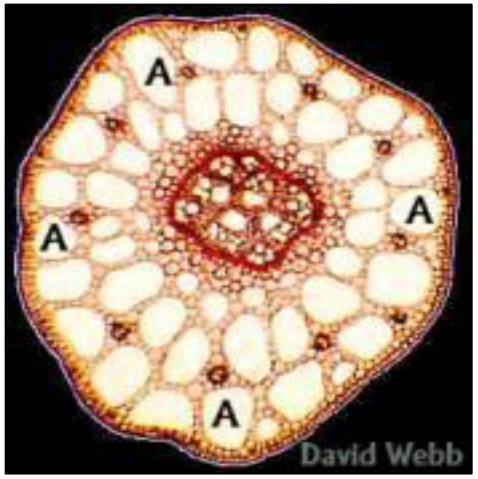
Reproduce!

Mitsch and Gosselink, 2007 (Table 6.2)

# Wetland Structure: Hydrophytic Vegetation

Aerenchyma – tissue containing large, air-filled intercellular space

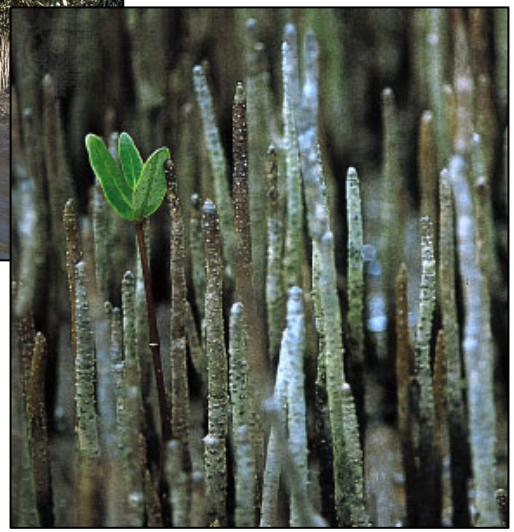
- Allows exchanges of gasses between atmosphere and plant roots
- Produced under flooded conditions
- Passive flow




# Wetland Structure: Hydrophytic Vegetation

Pneumatophores – aerial roots

- Black mangrove (*Avicennia germinans*) → "snorkels"
- Cypress (*Taxodium spp.*) → "knees"

# Overview

## Wetlands 101

1. Definitions
2. Form and Function
3. **Values**
4. Types

Everglades National Park (www.Everglades-Seres.org)

# Wetland Functions and Values

# Wetland Functions and Values


Also: GW recharge, Food, Fiber & Fuel…others?

Vermont Department of Environmental Conservation (www.vtwaterquality.org/wetlands/)

# Wetland Types

| 7 Major Wetland Types | |
|---|---|
| Coastal (~5%) | Inland (~95%) |
| 1. Tidal salt marsh | 4. Freshwater marsh |
| 2. Mangrove forest (swamp) | 5. Freshwater swamp |
| 3. Tidal freshwater marsh | 6. Riparian wetland |
| | 7. Peatlands |

Wetland Type a Function of:

- Physiogeograhpic setting
- Hydroperiod
- Vegetation

# Wetland Types (an abbreviated list…)

| | |
|---|---|
| **Bog** | Peat accumulation usually dominated by moss. Receives only direct precipitation; characterized by acid water, low alkalinity, and low nutrients. |
| **Fen** | Peat accumulation; may be dominated by sedge, reed, shrub or forest. Receives some surface runoff and/or ground water, which has neutral pH and moderate to high nutrients. |
| **Mire** | Used mainly in Europe to include any peat-forming wetland (bog or fen). |
| **Marsh** | Permanently or periodically inundated site characterized by nutrient-rich water. In Europe, must have a mineral substrate and lack peat accumulation. |
| **Playa** | Shallow, ephemeral ponds or lagoons that experience significant seasonal changes in semi-arid to arid climates. Often have high salinity or may be completely dry. |
| **Slough** | Widely used term for wetland environment in a channel or series of shallow lakes. Water is stagnant or may flow slowly on a seasonal basis. Synonym--bayou. |
| **Swamp** | Characterized by forest, shrub, or reed cover (fen). Particularly a forested wetland in North America. Depends on nutrient-rich ground water derived from mineral soils. |
| **Wet meadow** | Open prairie, grassland or savannah with waterlogged soils but without standing water for most of the year. |
| **Open water** | Deeper, normally perennial pools within wetlands and shallow portions of lakes and rivers. Typically home to submerged macrophytes. |

From Mitsch and Gosselink, 2007

**Also see Cowardin et al., 1979 ("Classification of Wetlands and Deepwater Habitats of the United States ")**

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# Next Time: Introduction to Ecology


http://www.epubbud.com/book.php?g=B66VF6FJ