

Concept in Wetland Ecology



Wetlands (EPA, America's Wetlands)

- "Wetlands are areas where water covers the soil, or is present either at or near the surface of the soil all year or for varying periods of time during the year, including during the growing season.
- Water saturation largely determines how the soil develops and the types of plant and animal communities living in and on the soil.
- Wetlands may support both aquatic and terrestrial species.
- The prolonged presence of water creates conditions that favor the growth of specially adapted plants and promote the development of characteristic wetlands soils."

Main types of wetlands

- Marshes
 - Tidal
 - Nontidal
 - Wet Meadows
 - Prairie Potholes
 - Vernal Pools
 - Playa Lakes
- Swamps
 - Forested Swamps
 - Bottomland Hardwoods
 - Shrub Swamps
 - Mangrove Swamps
- Bogs
 - Northern bogs
 - Pocosins
- Fens



Marshes

- Frequently or continually inundated with water
- Emergent soft-stemmed vegetation adapted to saturated soil conditions
- All types receive most of their water from surface water, and many marshes are also fed by groundwater
- Nutrients are plentiful and the pH is usually neutral leading to an abundance of plant and animal life



Non-tidal marshes

- Most prevalent and widely distributed wetlands in North America.
- Mostly freshwater marshes
- Occur along streams in poorly drained depressions, and in the shallow water along the boundaries of lakes, ponds, and rivers.
- Water levels in these wetlands generally vary from a few inches to two or three feet, and some marshes, like prairie potholes, may periodically dry out completely

Non-tidal marshes: prairie potholes

- Prairie potholes are depressional wetlands found most often in the Upper Midwest
- The area is home to more than 50 percent of North American migratory waterfowl
- many species dependent on the potholes for breeding and feeding.



Non-tidal marshes: Playa lakes

- Playa lakes are round hollows in the ground in the Southern High Plains of the United States
- Carved by wind or formed by land subsidence (they are sinkholes)
- Store water where there are no permanent rivers or streams
- Playas support an astounding array of wildlife



Non-tidal marshes: Vernal pools

- Seasonal depressional wetlands that occur under the Mediterranean climate conditions of the West Coast
- Collect water during winter and spring rains
- During a single season, pools may fill and dry several times
- Habitat for numerous rare plants and animals that are able to survive and thrive in these harsh conditions
- Plants and animals spend the dry season as seeds, eggs, or cysts

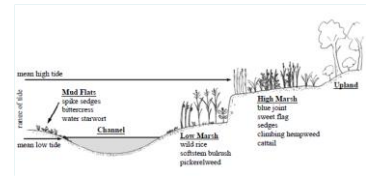


Non-tidal marshes: wet meadows

- Commonly occurs in poorly drained areas such as shallow lake basins, low-lying farmland, and the land between shallow marshes and upland areas
- Typically drier than other marshes except during periods of seasonal high water
- Grasses, sedges, rushes, and wetland wildflowers proliferate in the highly fertile soil of wet meadows

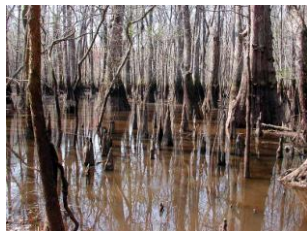
Tidal marshes

- Communities of EMERGENT herbs, grasses or low shrubs rooted in soils that are alternately inundated and drained by tidal actions
- Found mostly at higher tidal levels in area of protected water and in association with estuaries



Swamps

- A swamp is any wetland dominated by woody plants
- Forested and shrub swamps
- Characterized by saturated soils during the growing season, and standing water during certain times of the year
- The highly organic soils of swamps form a thick, black, nutrient-rich environment for the growth of water-tolerant trees



Forested Swamps

- Often inundated with floodwater from nearby rivers and streams
- Sometimes covered by many feet of very slowly moving or standing water
- Sometimes referred to as Bottomland hardwood swamp



Shrub swamps

- Shrubby vegetation such as Buttonbush, Willow, Dogwood (*Cornus* sp.), and Swamp Rose (*Rosa palustris*) predominates
- Found along slow moving streams and in floodplains often adjacent to forested swamp



Mangrove swamps

- Mangrove swamps are coastal wetlands found in tropical and subtropical regions (inside the 25° latitude limit)
- Characterized by halophytic (salt loving) trees, shrubs and other plants growing in brackish to saline tidal waters



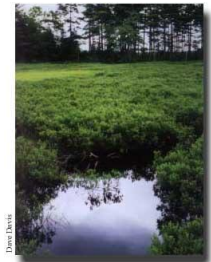
Bogs

- Characterized by spongy peat deposits, acidic waters, and a floor covered by a thick carpet of sphagnum moss
- Most of their water from precipitation rather than from runoff, groundwater or streams
- Low in the nutrients needed for plant growth, a condition that is enhanced by acid forming peat mosses



Northern Bogs

- Low temperatures and short growing seasons where ample precipitation and high humidity cause excessive moisture to accumulate
- Often form in old glacial lakes



Pocosin

- Algonquin Native American word for "swamp on a hill"
- No standing water present in pocosins, but a shallow water table leaves the soil saturated for much of the year
- Found in broad, flat, upland areas far from large streams, they are ombrotrophic like northern bogs, meaning rain provides most of their water



Fens

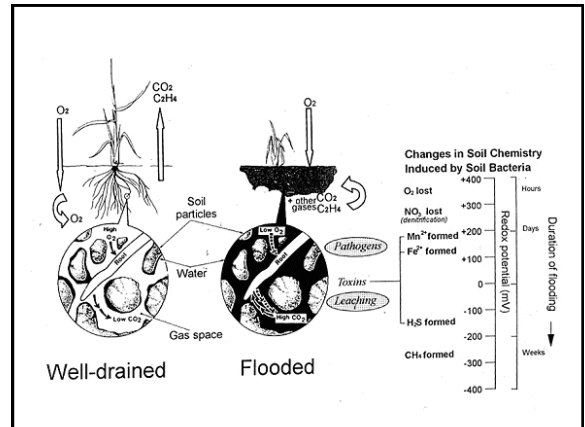
- Fens, are peat-forming wetlands that receive nutrients from sources other than precipitation
- Fens differ from bogs because they are less acidic and have higher nutrient levels
- Often covered by grasses, sedges, rushes, and wildflowers
- Over time, peat may build up and separate the fen from its groundwater supply



Challenges of wetland life

Challenges of wetland life

- Free water supply
- Abnormally hostile environment for the roots
 - Lack of oxygen
 - Phytotoxicity
 - Salinity
 - Lack of nutrients
 - Cycles of wetting and drying



Anatomical and morphological adaptation to lack of oxygen

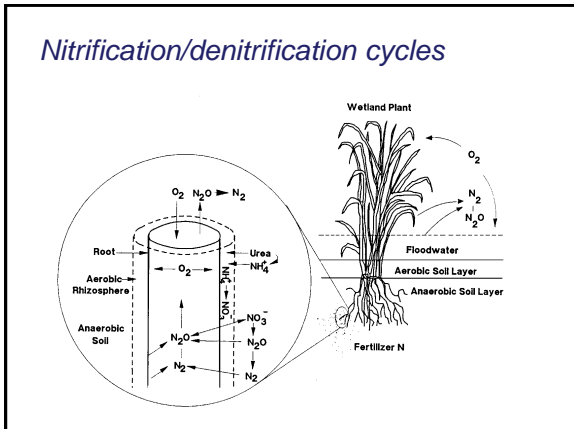
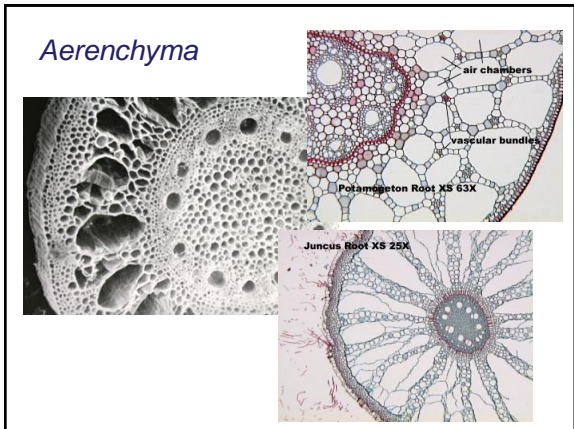
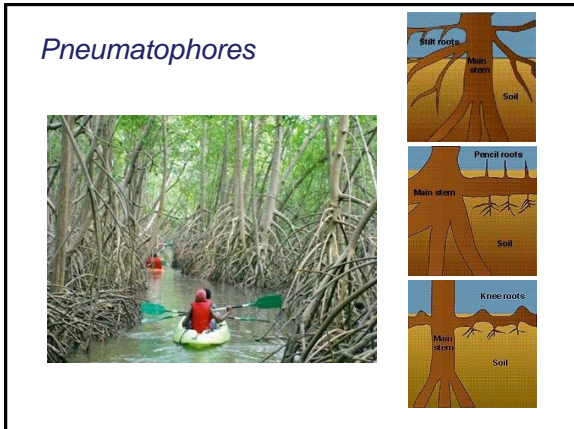
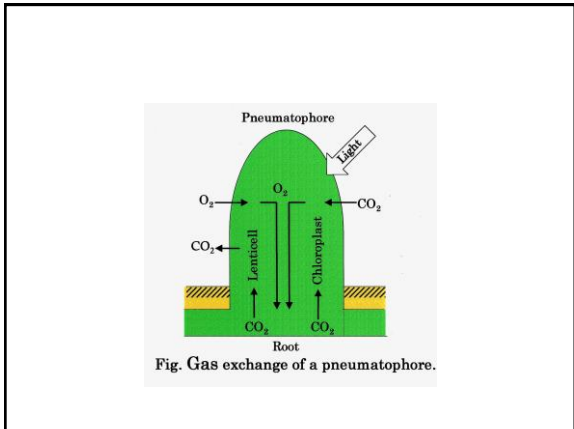
Pneumatophores

- Transport oxygen to the places that need it: the root system
- Transport of CO₂ back to the atmosphere
 - Pneumatophores
 - Aerenchyma
 - Adventitious roots

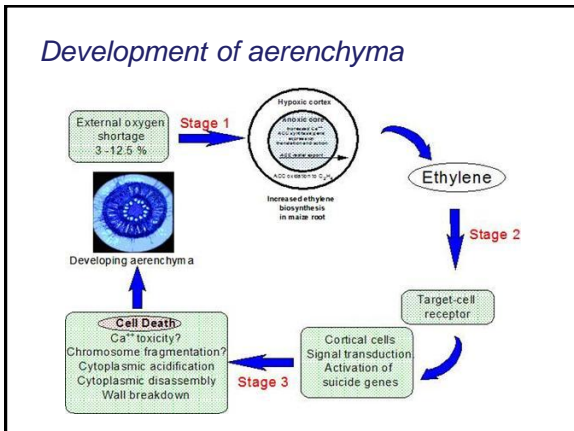


Cypress knees. (Photo: Steve Tweddle)





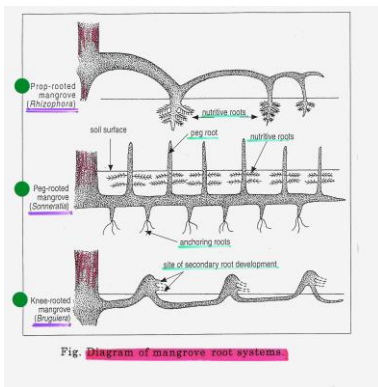
- ### Ethylene (C₂H₄): importance growth hormone
- Flooding increases production of C₂H₄ in wetland plants + trapped in roots
 - Initiates aerenchyma formation
 - Initiates adventitious root growth in oxygenated surface soil
 - Internode elongation (reach the surface faster)
 - Leaf epinasty



Oxygen and gas transport limits phytotoxicity



Development of adventitious roots



Other adaptations

- Nitrogen fixation in Cyanobacteria
- When long periods of flooding, plants forced to rely upon anaerobic metabolism

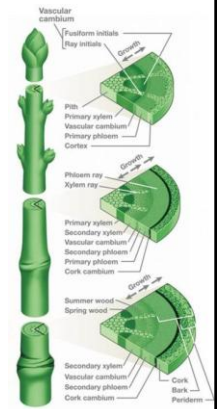


Carnivorous plants

- http://www.youtube.com/watch?v=KYGwg_zehf6c

Mostly monocotyledons

- No secondary thickening
- No non-photosynthesizing respiring tissue
- Higher net productivity



Summary of conditions: salt marsh

- Fluctuating salinity
- Temperature fluctuations
- Nutrient fluctuations
- Tidal effects: daily, seasonal, and storm events



Salt marsh: description of substrate

- Substrate is typically mud, similar to estuarine sediments w high salt content
- perfusion of salt water coupled w high rate of evaporation
- Anaerobic
- within marsh rate of sedimentation height in lower part of marsh than in upper
- purple sulfur bacteria

Composition and distribution of plants in a marsh

- dominant plants are halophytes-emergent flowering plants grow in soil w high salt content
- upper portions of plants are above water even during periods of high tide, so both terrestrial and
- aquatic components “wet feet”

Composition and distribution of plants in a marsh

- very few species able to adapt to these conditions-low diversity
- tolerant organisms show a high degree of taxonomic similarity over a wide geographic area
- dominant plants worldwide are grasses of genus *Spartina* and species of *Juncus* and *Salicornia*

Productivity of wetlands

- Wetlands rarely droughted often receive supplementary nutrient inputs
- Reedmarsh: world’s most productive wild vegetation
- Mostly monocotyledons

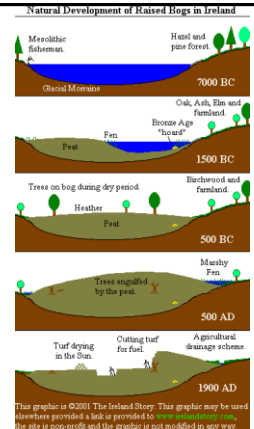
Productivity of wetlands

- Habitat limits accumulation of living biomass
- Annual production must be immediately recycled
- Or it must accumulate as peat
- Typically wetlands produce more that they decompose, so they accumulate peat and trap sediment

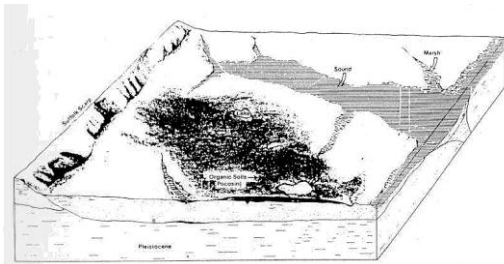
Productivity of wetlands: coastal environments

- Tidal pulsing of salt-marshes and mangroves subsidizes the nutrient cycle and maintains juvenility by constantly resetting the successional clock
- High productivity but do not out-yeild the most fertile systems
- Energy spent on osmoregulation, direct ion-pumping as in salt-glands or production of succulent tissue

Evolution of wetlands



Evolution of wetlands



Habitat provided by wetland



Habitat provided by wetland: salt marshes and mangroves

- Organic productivity relatively high
- High standing crops
- Few organisms feed directly on the dominant plant
- Wetlands produce large quantities of detritus, which play a major role in the dynamics of the particular system or estuary

Habitat provided by wetland: salt marshes and mangroves (Cont'd)

- Leaves, stems and prop roots presnet surfaces for epibiotic organisms
- Increases both primary and secondary productivity of the habitata
- Epibiota significant food sources for fish and invertebrates
- Roots, stems ans leaves reduce current velocity

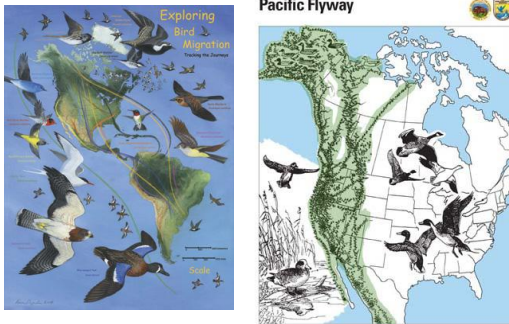
Habitat provided by wetland: salt marshes and mangroves (Cont'd)

- Increase in sedimentation of both inorganic and organic matter
- Allochthonous and autochthonous material decomposes, thus recycling in the systems
- Root system generally binds sediments and retards erosion
- Above-vegetation and lateral zonation presents a wide variety of habitats for protection and growth of fish, birds and invertebrates

Wetlands: crucial habitat for birds



Wetlands: crucial habitat for migratory birds



Summary of Wetland functions

- **Filter.** They filter pollutants and excess nutrients out of water, as it soaks into the ground.
- **Sponge.** They absorb stormwater and heavy snowmelt, reducing the risk of flood. This slow absorption also allows for much of the water to soak through the soil, recharging our ground water supply.
- **Nursery.** Many species of amphibians, mammals, reptiles and birds rely on the safe wetland environment to raise their young. Wetlands often lack the large fish species and other predators that may feed on their young.

Summary of Wetland functions (Cont'd)

- **Hotel.** Many migrating waterfowl, shorebirds, and songbirds rely on stopping at wetlands during their migrations in the spring and fall. Wetlands offer a wide variety of high protein organisms for them to feed on, allowing them to refuel.
- **Home.** In addition to the other wildlife mentioned, countless small organisms (insects, worms, snails, leeches, crustaceans) and plants make wetlands their home. Wetlands offer a very unique habitat.
- **Recreation destination.** They provide beautiful views and plenty of opportunities for recreation (birdwatching, canoeing, hunting, exploring).