Wetland Organisms
Wetland Definition Diagram
Stress Experienced In Wetlands

- Anoxia
- Salt Concentrations
- Water Fluctuation
Anoxic Conditions

- Soils saturated/inundated
- Anaerobic Conditions
- May vary with season
Salt Concentrations

High salinity flux from

Sea

High tide

or

25 psu  20 psu  15 psu

Decreased river flow

A

Area of maximum salinity change

Low tide

or

25 psu  20 psu  15 psu

Increased river flow

B

Chesapeake Bay

10 km
Salinity gradient types

- **Intermittent (Seasonal) estuary:** in Mediterranean climates, estuary forms during rainy season, dries or cut off in dry season.
- Salinity varies across seasons.
Water Fluctuation

- Tidal Systems

- Non-Tidal Systems
Protists

- **Anoxia (respiration)**
  - Ability to use internal organic compounds as electron acceptors
  - Ability to use inorganic ions in respiration
  - Ability to use specific electron acceptors rather than oxygen
    - sulfate

- **Salt (osmotic & toxicity)**
  - Complex potassium in cytoplasm
  - Enzymes function normally
Vascular Plants

◆ Anoxia
  – Structural
  – Nutrient absorption
  – Metabolic
  – Whole Plant Strategies

◆ Salt
  – Barriers
  – Secretory organs

◆ Water
  – Photosynthesis
Structural Adaptations

- Aerenchyma
- Adventitious Roots
- Lenticels
- Pneumatophores
- Pressurized Gas Flow
- Rhizosphere Oxygenation
Aerenchyma

The air spaces found in the stems and roots of herbaceous wetland plants.

- Lends stability
- Allows oxygen to diffuse from the leaves (exposed to the atmosphere) to the roots that are often surrounded by saturated/anaerobic soils.
Aerenchyma
Adventitious Roots

Adventitious Roots: roots that develop above the hypoxic zone and assists with the transfer of oxygen to the roots.

- Prop Roots
- Pneumatophores
- Knees
Prop Roots

- Prop roots are roots produced above the anoxic zone that are able to function normally in anaerobic environments. They are covered in numerous small pores called lenticles. The prop roots terminate below the waterline in long spongy air-filled submerged roots.

- Lenticels are small pores found on the above-ground roots of some wetland plants. They aide in oxygen transport to roots located below the water line.
Prop Roots
Lenticels
Pneumatophores

- Pneumatophores are spongy root projections usually 20 – 30 cm (8 – 12 in.) high and 1 cm (0.4 in.) in diameter that assist in oxygen transfer to the roots during low tides. There are often thousands of pneumatophores associated with one plant.
Pneumatophores
Knee Roots

Knees are similar to pneumatophores in that they originate from the plant roots. However, they are much larger and much less numerous. It is thought that they improve gas exchange, however, this is currently only a theory.
“Knee” Roots
Root Adaptations
Plank Roots
Pressurized Gas Flow

- Air moves into internal gas spaces of aerial leaves
- Forced down to roots by gradient of temperature and water vapor pressure
Oxidized Rhizosphere

Pore Linings
Physiological Adaptations

- Nutrient Absorption
- Anaerobic Respiration
- Malate Production
Nutrient Absorption

- Normal metabolism in roots
- Nitrogen – some wetland plants absorb ammonium
- Iron/Manganese – oxidized rhizospheres protect
- Sulfur – detoxification mechanisms
Rhizosphere Oxygenation
Anaerobic Respiration
Whole Plant Strategies

- Dormancy during flooding
- Seed Production in non-flooded season
- Buoyant Seeds
- Vivipary
Whole Plant Strategies

Floating Seeds

Vivipary

Arenchyma

Rigid Stems

Buttressed Trunks

Shallow Roots

Floatation
Vivipary
Adaptations to salt - plant

Some: salt gland - eliminates excess salt, maintains water balance. E.g., *Spartina alterniflora*

Vascular marsh plants either:

✦ **Succulent**: have high water concentration
  To reduce water loss, have: few stomata, reduced leaf area, photosynthetic stems.
  Rid salts by shedding leaves

✦ Other **halophytes** (salt dwellers): rid salts by
  a) salt-secreting glands;
  b) thin cuticles & many stomata → high transpiration
Salt Adaptations

- Barrier Cells in roots
- Secretory Cells
Changes in Photosynthesis

- **C$_3$** Biochemical Pathway
  - Phosphoglyceric Acid
  - Much more common

- **C$_4$** Biochemical Pathway
  - Oxaloacetic Acid
  - Arid/wetter
  - Use CO$_2$ More Effectively
Animals

◆ Anoxia
  – Specialized organs for gas exchange
  – Mechanism to improve oxygen gradient
  – Better circulation system
  – Decrease activity during oxygen stress
  – Shifts metabolic pathways

◆ Salt
  – Move
  – Control internal osmotic concentrations
Salinity adaptations - faunal

- Behavioral: burrow, close up
Salinity adaptations - larvae

- Many larvae cannot osmoregulate
- Many estuarine inverts - pelagic larvae
- E.g., *Callinectes sapidus*, *Eriocheir sinensis* are catadromous
Wetland Delineation

Purpose
- Jurisdictional
- Scientific

Definition
U.S. Army Corps of Engineers:
inundated or saturated by surface or ground
water at frequency /duration sufficient to
support vegetation adapted to saturated soil
conditions.

Diagnostic Characteristics
- Vegetation
- Soils
- Hydrology
## Vegetation Indicator Status Categories

<table>
<thead>
<tr>
<th>Category</th>
<th>Symbol</th>
<th>Likelihood of Occurring in Wetland</th>
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<tbody>
<tr>
<td>Obligate Wetland</td>
<td>OBL</td>
<td>&gt;99%</td>
</tr>
<tr>
<td>Facultative Wetland</td>
<td>FACW</td>
<td>&gt;67% to 99%</td>
</tr>
<tr>
<td>Facultative</td>
<td>FAC</td>
<td>33% to 66%</td>
</tr>
<tr>
<td>Facultative Upland</td>
<td>FACU</td>
<td>1% to &lt; 33%</td>
</tr>
<tr>
<td>Obligate Upland</td>
<td>UPL</td>
<td>&lt;1%</td>
</tr>
</tbody>
</table>
Wetland Soil Indicators

- NRCS Hydric Soil
- Field Indicators
  - Organic Soils
  - Mineral Soils
    - Gleyed
    - Chroma 1 with or without mottles
    - Chroma 2 with mottles
  - Sulfidic Material
  - Sandy Soils
    - High organic content at surface
    - Streaked
Hydrology Indicators

- Recorded Data
  - U.S. Corps of Engineers
  - USGS
  - State / Local Agencies

- Field Data
  - Soil Saturation
  - Watermarks
  - Drift Lines
  - Sediment Deposits
Delineation Method

- **Preliminary Data**
  - USGS Quadrangle Maps
  - NWI Maps
  - Soil Survey
  - Stream Gage
  - EISs
  - State Wetland Determinations
  - Local Wetland Inventories
  - Aerial Photographs

- **In-Field Data (transects)**
  - Visual Changes
  - Chose Representative Points
  - Characterize Each Change
    - Vegetation
    - Soils
    - Hydrology