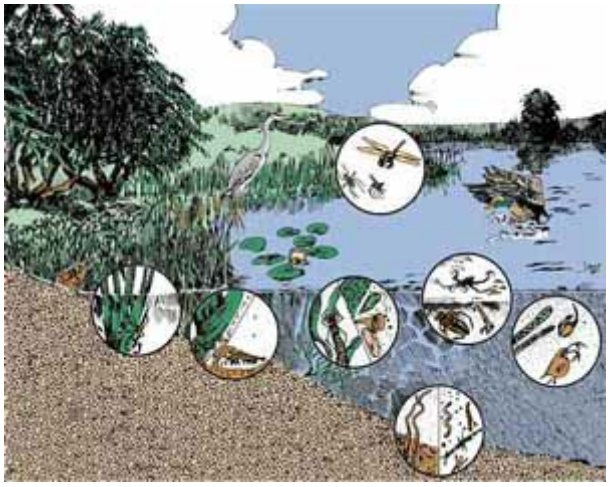
Wetlands- Freshwater



http://www.epa.gov/owow/wetlands/construc/freewatr.html

What is a wetland? *Why is it important to define wetlands?*

Given that wetlands are not always wet nor not always land, defining wetlands can be challenging.
Some macrophytes (vascular plants) are obviously adapted to aquatic life (emergent, floating, submergent forms), but other wetland plant species less obviously so. *Why do specific species of plants respond differently to saturated soils (what is the problem that macropyhtes must overcome)?*

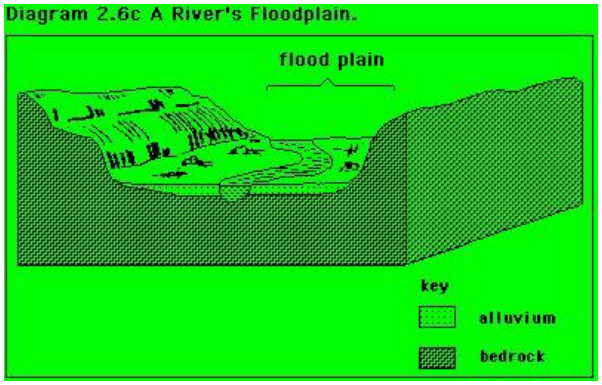
How are wetlands delineated?

- **Hydrophytic Vegetation**
- **Hydric Soils**
- **Wetland Hydrology**

Types of wetlands:

Marshes versus **Swamps** *What is the difference between the two?*

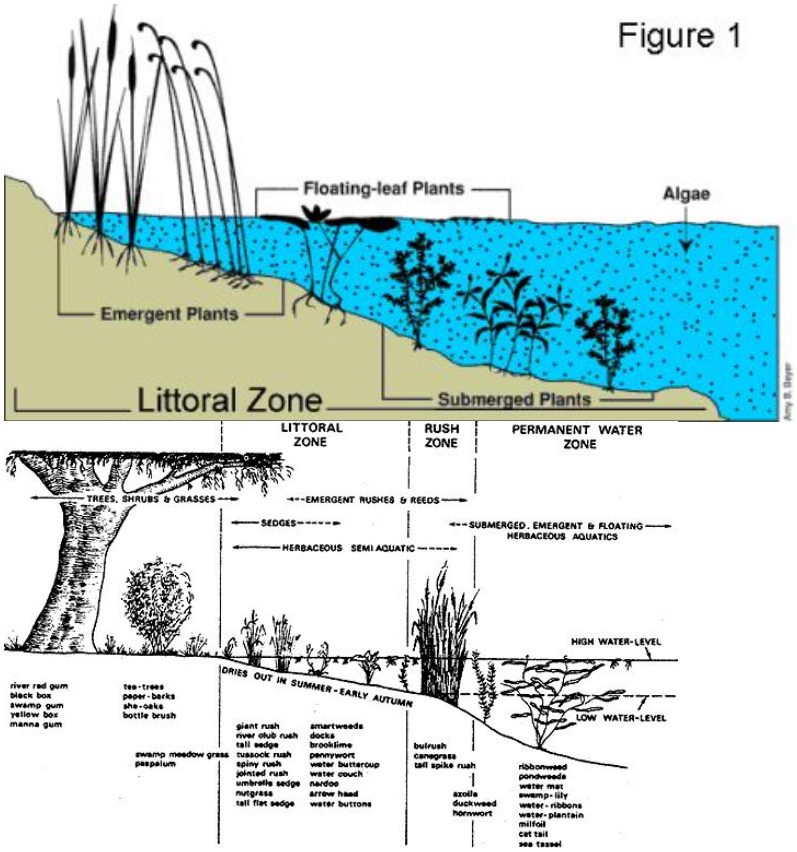
Seasonal Wetlands versus **Permanent Wetlands** (*would permanent wetlands have a seasonal component?*)



Freshwater versus **Marine (salt marshes and mangrove swamps)**

Which are more predictable in terms of water movement?

The **littoral zone** of lakes composed of vascular plants can also be considered as wetlands.



http://www.dnr.state.mn.us/ecological_services/apm/apmguide3.html

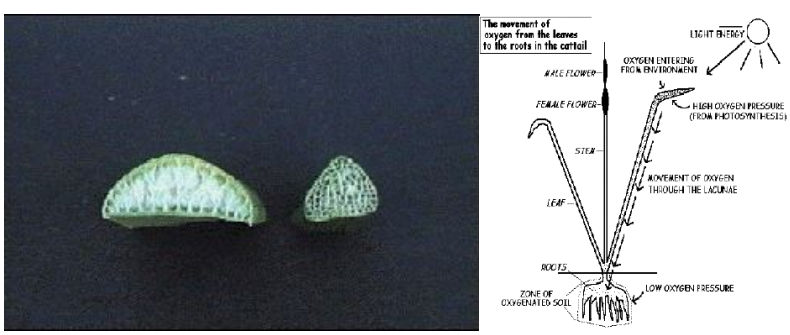
What conditions are needed for development of a broad littoral zone? What is needed for open water to be maintained?
How might these areas affect lake ecosystems?

Ecology of wetlands

Waterlogged soils are usually anoxic interfering with gas exchange for photosynthesis and respiration, and producing toxic substances (e.g. H_2S, NH_4).

Adaptations:

- **lacunae in emergent plants**



- **biochemical pathways of detoxification**

- **buttrusses, knees, and adventitious roots** (roots that arise other than from the primary roots above the anoxic zone)

Figure C3. Adventitious roots

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What might be a major factor in explaining zonation (i.e. the distribution of plant species) in a wetland?

Where do wetland plants get most of nutrients from? As a result, dissolved inorganic carbon is thought to often limit productivity of submerged macrophytes due to high demand relative to rate of atmospheric diffusion, and a thick diffusive boundary layer. around plants. *How might dissected leaves in submergent plants aid in carbon dioxide uptake?*

While primary productivity of wetlands is very high, wetland macrophytes are relatively slow growers, reducing the protein content of tissues. *What does this mean in terms of flow of energy to higher trophic levels in macrophyte dominated ecosystems relative to those dominated by phytoplankton or benthic algae?*

With the colonization of wetland plants, how might the rest of the community change?

Macrophytes provide additional surface area for microbes to grow ("biofilms"), so benthic algae may also contribute significantly to primary production (productivity can exceed that of macrophytes).

Would phytoplankton and zooplankton hang out in wetlands?

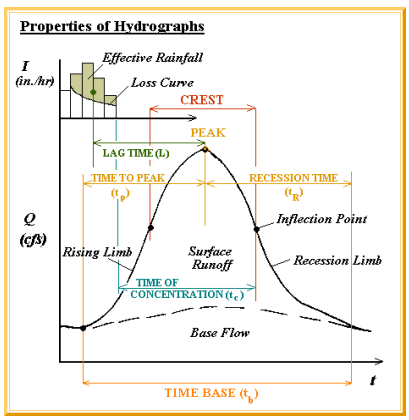
Benefits of wetlands

- **Life support for wildlife and fisheries**
  - Food source

    But if wetland macrophytes rarely consumed directly how is energy transferred to higher trophic levels?
    - Detrital pathways
    - Grazing on attached algae
  - Protection from predators (*Who? How?*)
  - Drinking water source for wildlife

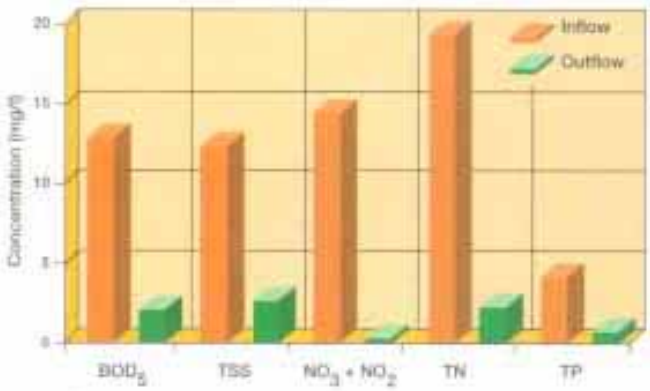
- **Slowing of flood waters / flood prevention** ("hydrological buffering")

  Reducing and desychronizing peak runoff
  What does the area under the hydrograph curve represent, and how can peak flow be reduced?
  (Q is discharge in cubic feet per second)



http://www.eng.fiu.edu/evrglads/cwr3103/lectures/lectur10/lectur10.htm

- **Water quality improvement**



http://www.epa.gov/owow/wetlands/construc/carobay.html

- **Decrease suspended sediments** *How?*
- **Tie up or alter toxins and nutrients**
  - Sedimentation of compounds absorbed to inorganic particles *(What happens to water velocity in wetlands and how does this affect sedimentation?)*
  - Adsorption onto inorganic precipitates (e.g. $CaCO_3$)
  - Assimilation by macrophytes
  - Denitrification

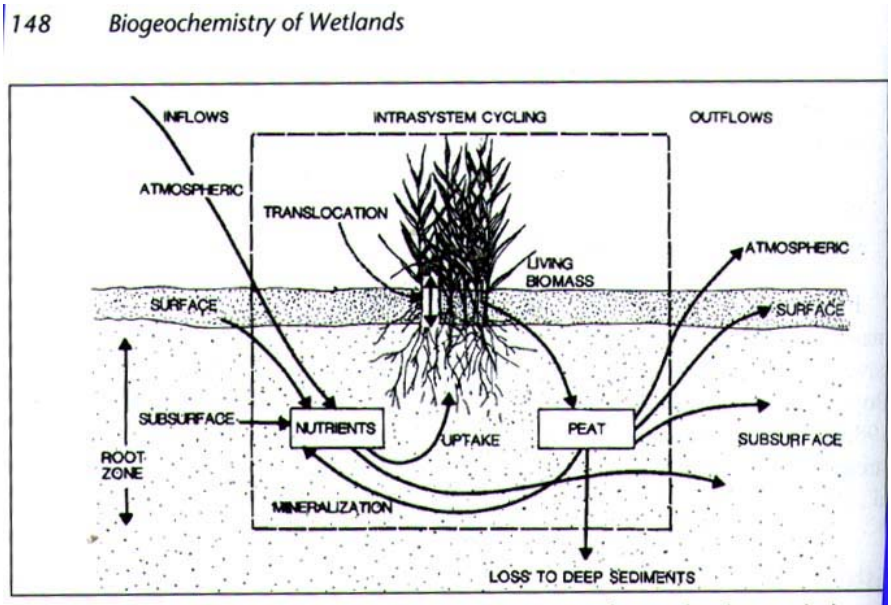


Figure 5–14. Generalized diagram of components of a wetland mass balance including inflows, outflows, and intrasystem cycling.

- **Decrease in pathogens** *How?*

In wetlands constructed for treatment of wastewaters, phosphorus retention depends on factors such as water residence time and soil chemistry, and nitrogen reduction depends largely on encouraging bacterial denitrification.

Wetland protection

Perception on the value of wetlands has shifted, and can be seen in the following examples of legislation:

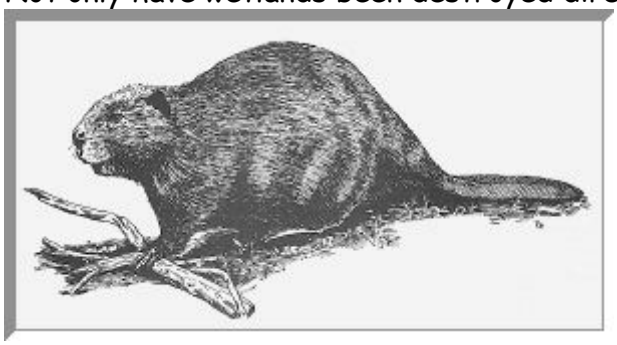
- **Swamp Land Act of 1850 and other flood control acts through much of the 20th century.**
- **404 program of the Clean Water Act of 1972**
- **Water Resources Development Act of 1990 resulting in the practice of** compensatory mitgation.

Success has been limited and difficult to evaluate.

Impacts on water through changes in the landscape

Historically destruction of wetlands by draining and filling has been extensive (80-90% in many states). The value of wetlands for flood control and water purification has been estimated at ~$15,000 / ha / year.

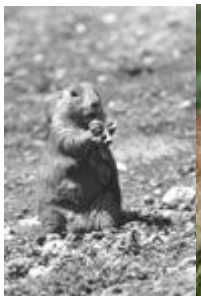
Not only have wetlands been destroyed directly, but the creation of wetlands has been impaired.

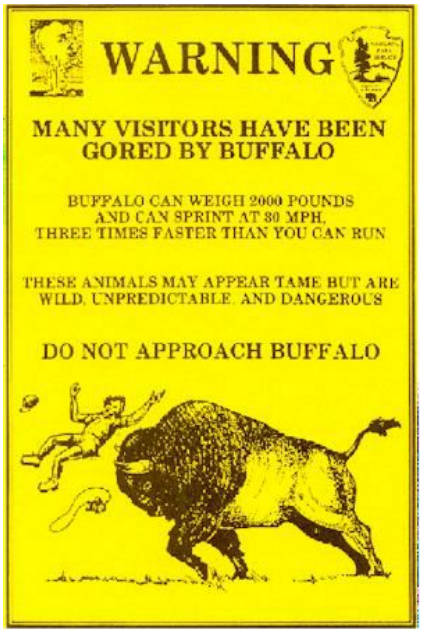


Since European colonization, beaver in North America have declined from 200 million to 10 million resulting in a 300,000 miles^2 reduction in wetlands

In general, other aspects of the North American landscape have been altered such that the ability of natural systems to 'purify' water is reduced:

- Reduction in ground water recharge of prairies





- Reduction in filter-feeding mussels in streams and rivers

Anodonta suborbiculata, Heelsplitter.

- Reduction in flood plains due to levees and dams (and other alterations of flow)

http://www.regis.berkeley.edu/photo.html

- Deforestation

What do forests have to do with aquatic ecology?