RIPARIAN WETLANDS - wetlands adjacent to rivers or streams, often on nutrient rich alluvial soils, at least periodically influenced by flooding; zones of interactions between aquatic and terrestrial environment

DEEPWATER SWAMPS – freshwater woody communities with water flooded for most or all of the growing season

Terminology:

- **Bottomland hardwood forest** - historically vast forests in river floodplains in the E and SE U.S.
- **Bald cypress swamps**
- **Streambank vegetation** - in the West
- **Gallery forest** - on the natural levees
- **Floodplain swamp forests**
- **Riverine forest** (but: in Cowardin's classification a system "Riverine Wetlands" does not include tree-dominated wetlands! tree dominated wetlands belong to the Palustrine system)

High species diversity, high density, high productivity

Open systems - large nutrients and energy interchange

Inundation - influx of sediments - positive interaction

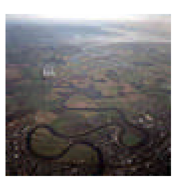
Erosive forces of water and ice - negative interactions

Geographical distribution

- along rivers and streams
- 70% in the US have been changed; 90% in western arid region
- most of European riparian wetlands lost
- tropical and subtropical areas, e.g., Amazon Basin

Hydrology

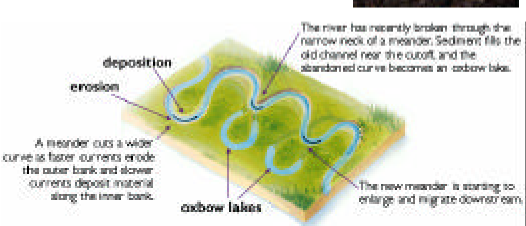
- constant change lateral meandring
- interaction between river channel and flodplain



Features of riparian ecosystems:

-river channel - natural levees (gallery forest)

- meanders, oxbows, backswamps, terraces



Sand bars

-many species get established on sand bars

-cohort of trees of the same age (cottonwood) - estimation of river channel movement

- Cosumnes, cottonwood (*Populus fremontii*) since 1939 major flood

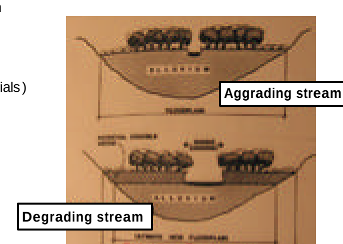
- vegetative reproduction

Channel aggradation

(deposition of alluvial materials)

Channel degradation

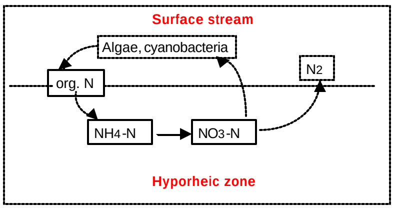
(down-cutting)



Hyporheic zone – saturated sediments directly beneath the wetted stream - an ecotone between the surface water in the channel and the groundwater specific fauna (chironomids)

Effluent (aquifer fed stream) x influent (stream-fed aquifer)stream

Water in the hyporheic zone – different chemical and physical properties (T, pH oxygen, OM, microorganisms)



Flooding

- determines the vegetation and nutrients; export of organic and inorganic materials
- sedimentation rates 1mm-1m!
- frequency and duration of flooding depends on : climate, floodplain level, drainage area, channel slope, soils
    - low frequency - high power floods - determine the pattern of large geomorphic features order of 100-1000y
    - intermediate - medium power - ecosystem structure - zonation in forest 10-100 y
    - high frequency - low power - annually; seed germination; activities of mammals, amphibians, fish
    - catastrophic events
- headwater streams (1st – 3rd order):
    - steep slopes, small catchment areas, V-shaped valleys, shallow soil, steep and frequent hydrographic peaks
- middle (4th – 6th order)
- low elevation rivers (7th and up): broad alluvial valleys, long hydroperiod (flooded for months)
- rivers that are freezing: snow and ice melt effect, damage by ice

Flood Pulse

-exchange of water, sediment, organisms, biomass and energy between the river and the floodplain

- when eliminated, riparian forest can degenerate

(ex. cottonwood & willow establishment

or Rio Grande in New Mexico: elimination of flood pulse => senescing forest, no regeneration; invasion by tamarisk and russian olives, *Eleagnus angustifolia*)

Chemistry

- relatively low organic matter (2-5%)
- nutrient rich
- subsurface flow rich in NO_3-N -- denitrification

Stress

- erosion
- water movement
- ice
- anoxia (not always)
- human impact: pollution, grazing, logging

Vegetation

- dominated by diverse trees adapted to flooding

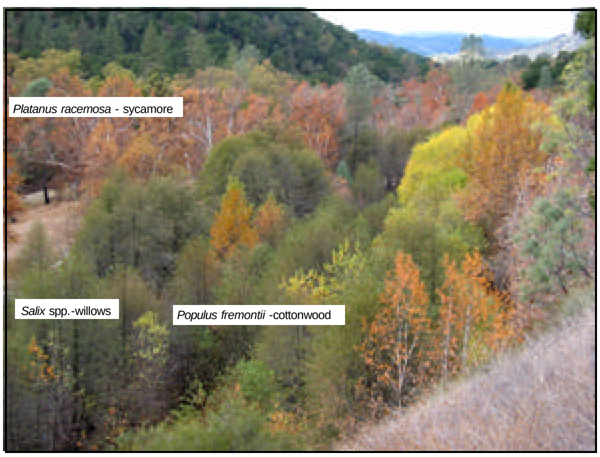
-species diversity: low in western arid (2-4 species), high in SE (31 species in Florida)

- low density of an understory (light limitation & flooding effect; also drying!)

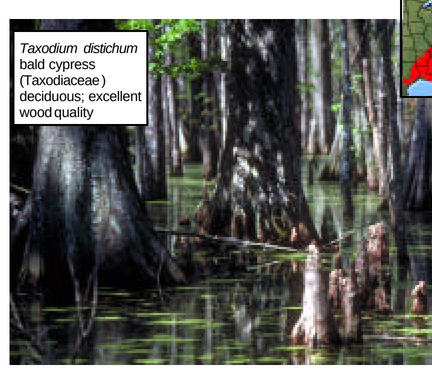
<u>epiphytes !!</u>

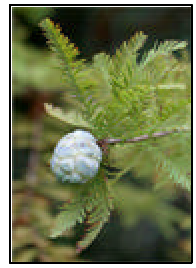
competitors - upland

stress tolerators - bald cypress; ruderals – cottonwood, willows



Deepwater bald cypress swamps





- the fruit of the Bald Cypress is a hard, pear-shaped cone that turns brown and becomes woody as it matures

- not many animals can open the tough fruit, the majority of Bald Cypress cones fall to the ground beneath the tree, some are distributed by water and germinate elsewhere.

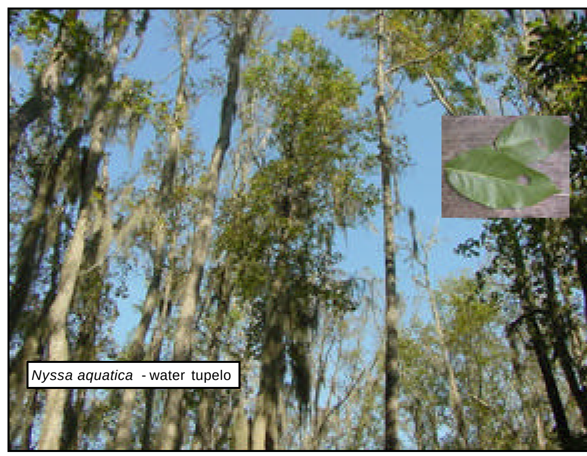
- until the early 1900's, the long-distance dissemination by the Carolina Parakeet.

Carolina Parakeets, *Conuropsis carolinensis*, were common throughout the eastern U.S. when Europeans first arrived; in 1900 there were no more free-flying flocks big enough to maintain the species. The last Carolina Parakeet died in 1914 in the Cincinnati Zoo – no birds left to disseminate Bald Cypress seeds

Taxodium distichum - *Nyssa aquatica* = bald cypress - water tupelo (Louisiana, Mississippi) - extremely long hydroperiod

Taxodium distichum var. *nutans*- *Nyssa sylvatica* = pond cypress - black gum (Georgia, Florida)

Tillandsia usneoides (Bromeliaceae) Spanish moss



Nyssa aquatica - water tupelo

cypress knees – gas exchange, very porous, metabolically very active

CH4 emissions minor but significant component of the whole swamp emission, about 8x more than bare ground

mechanical support in the muddy substrate

young knees grow close to the old stump

penetrate into the old wood,

extract nutrients

buttresses - swolen bases

cypress - 200, 400 (700) y old

Succession

- sand bars *Populus* & *Salix* (poplars and willows) => *Acer negundo* (box elder)

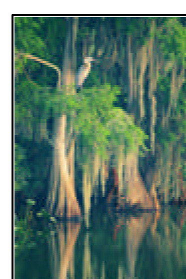
-poor drainage *Taxodium, Nyssa*

Combination of two invaders: **NUTRIA & CHINESE TALO** - (*Sapium sabiferum*) => no *Taxodium* establishment

-nutria eats tender young shoots of *Taxodium* but does not like *Sapium*

+

≠



Central Forest Region: Illinois, Iowa

Acer, Ulmus - Dutch elm disease, *Populus, Celtis*

Eastern Forest Region Appalachian Mts., Upper Ohio, Upper Mississippi

Populus, Salix, Ulmus, Acer

Northern Region - few studies, small rivers,

conifers: *Thuja occidentalis, Picea glauca*

Western Arid & Meditteranean Region: Sacramento, San Joaquin, Rio Grande, 90% Central Valley lost

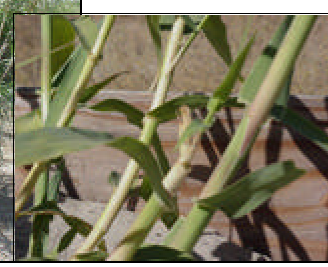
Populus fremontii, Fraxinus latifolius (ash), *Acer negundo* (maple), Sycamore

Tamarisk, salt cedar

Tamarix ramosissima x chinensis (native in Asia; the two species DO NOT !! hybridize in their homeland)

Tamarisk

- problems with rivers: dams, channelization; irrigation
- SW US (California, Arizona)
- deep roots
- once established, native species don't have a chance



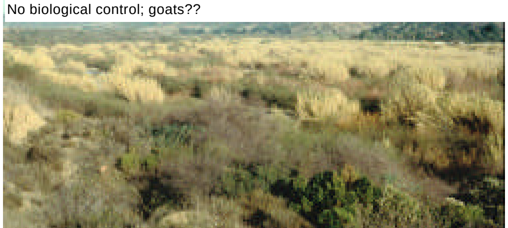
***Arundo donax*, giant reed**

- native in tropical Asia and the Mediterranean region, now widely naturalized in warm temperate to tropical areas
- Australia, New Zealand, US, Hawaii, Pacific islands

Giant reed has been cultivated throughout the world for making mats, as roofing material and as ornamental. It became invasive in most places where it has been planted.

"Once established, giant reed can form huge clones, sometimes covering hundreds of acres. It is highly flammable and resprouts quickly after burning. Fires help transform communities of native plants into solid stands of giant reed, changing riverbank forests from flood - to fire-defined habitats" (Bell, 1996).

No biological control; goats??



Tropical rivers

- differences between seasonally vs. permanently flooded riparian forests
- flooding adaptations (fast sapling growth; use of CO_2 from stems after flooding; pressurized ventilation; large carbohydrate reserves; postanoxic stress – superoxidismutase)
- Refugia of tropical forests during Pleistocene - during the drier, colder periods, tropical forest vegetation replaced by more cold, drought adapted species, refugia of original vegetation along rivers

Functions

Primary production: high (600 - 2100 g/m2/y; average about 1000 g/m2/y)

less frequent flooding - higher primary production than permanent flooding

Standing biomass: 100 - 300 t/ha

biomass affected by ice damage, strong water currents, erosion

Decomposition: usually fast (wetting x drying)

Export of organic material, both dissolved and particulate

Consumers

- very diverse; "edge effect"

- reasons for high diversity: woody plant communities

- diversity of habitats

- organisms that complete their life cycles in connection with the main channel x those that require floodplain (lateral interaction

-pockets of detritus -- refugia for invertebrates -- food for fish

- corridors

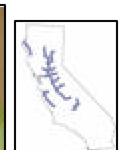
- cypress swamps - alligator, snakes, turtles

Valley elderberry longhorn beetle (VELB) (*Desmocerus californicus dimorphus*)

-endemic to the upland riparian areas of the Central Valley of California (the watersheds of the American, San Joaquin, and Sacramento Rivers and tributaries below about 900 meters).

- may overlap with that of *D. c. californicus* along the eastern edge of the Coast Ranges and in the southern San Joaquin Valley

- Habitat for VELB consists of elderberry shrubs (*Sambucus* sp.). Adults feed on the elderberry leaves and flowers, mating pairs are typically observed on an elderberry shrub, eggs are laid on the stem or leaves of an elderberry plant. Invasion of the exotic Argentine ant (Linepithema humile Mayr) into riparian habitats may present a threat to the distribution and survival of VELB



Impact on riparian systems

-stream channelization - lowering the water table, removing bank vegetation => faster flow, stream degradation

- gravel mining

- pollution

- grazing - bank deterioration, erosion

- reserviors

- diversion of water for irrigation

-timber harvest, erosion

- introduced species

Importance of riparian buffers

- help maintain the integrity of stream channels and shorelines

- reduce the impact of upland sources of pollution by filtering and trapping sediments and transforming nutrients

- supply food, cover and thermal protection to fish and other wildlife

- provide corridors for wildlife migrations