Aquatic Environments
Chapter 9

Discuss 5 Environments

Wetlands
Lakes
Streams
Coastlines (estuaries)
Oceans

Wetlands

Definition: areas saturated by surface water long enough to support vegetation adapted to saturated soil.

Includes:

Swamps
Marshes
Bogs

Wetland classification

5 major categories:

marine
estuarine
riverine
lacusterine
palusterine

Further classifies into subsystems, classes, subclasses!

Wetland classification

Marine: salt water!
- coral reefs
- rocky shoreline cliffs

Estuarine:adjacent to oceans
- tidal salt marshes
- mangrove swamps

Wetland classification

Riverine:
- river floodplains

Lacusterine:
- associated with lakes,reservoirs,ponds
- nearshore areas

Palusterine: most wetlands
- lots of vegetation
- < 2 m deep
- prairie potholes
- bogs

Wetland function

3 categories

Hydrologic processes
Water quality improvement
Wildlife habitat

Hydrologic process

Intercepting storm water
  Act as a sponge
Stabilize stream banks, shorelines
Recharge and discharge of groundwater

Reduce flood damage
Reduce erosion
Maintain groundwater aquifers

Water quality

Act as sink
  toxins, sediments
  transformed into non-toxic substances
  used by plants or buried in soil

Wildlife habitat

High primary productivity
Abundant food sources for:
  waterfowl
  fishes
  birds
High numbers of endangered species

Wetland protection

1780's: 221 million ac
1980's: <110 million ac

Drain wetlands
  agriculture
  urban/industrial
    development

Draining Wetlands
for Irrigation

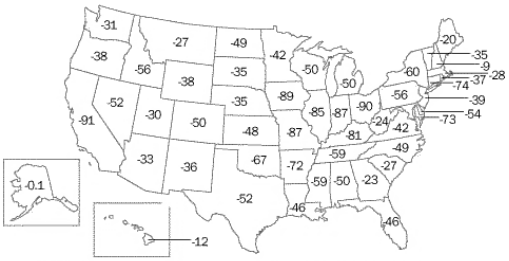
Wetland protection

1950's – 1970's wetland loss:
  458,000 ac/yr

mid 1970's-mid 1980's:
  290,000 ac/yr

80% decline in wetland loss from
  mid 1980's to mid 1990's

Percentage of Wetlands Acreage Lost, 1780's-1980's



Twenty-two states have lost at least 50 percent of their original wetlands. Seven states—Indiana, Illinois, Missouri, Kentucky, Iowa, California, and Ohio—have lost over 80 percent of their original wetlands. Since the 1970's, the most extensive losses of wetlands have been in Louisiana, Mississippi, Arkansas, Florida, South Carolina, and North Carolina.

Source: Mitch and Gosselink. Wetlands. 2nd Edition, Van Nostrand Reinhold, 1993

Wetland protection

Clean Water Act
goal of no net loss of wetlands

Agencies involved:
USFWS
USACOE
EPA
NOAA
NRCS

Lakes

Lake Ecosystems

3 major lake zones
littoral
limnetic
profundal

littoral zone

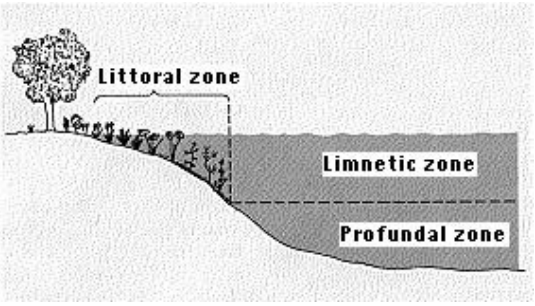
- **shallow marginal region**
- **generally has rooted aquatic plants**
  - **area of greatest productivity**

limnetic zone

- **region of open water**
- **lower limit defined by end of light penetration**
  - **lots of photosynthesis by phytoplankton (algae)**

profundal zone

- (deep water) under limnetic, down to lake bottom
- decomposition most activity here



Thermal stratification

- occurs in lakes at temperate latitudes (e.g., SD)
- Summer - lake is heated by solar radiation; top warms faster than bottom --> stratification occurs
- Most dense water: 4°C (39°F)

Thermal stratification

Epilimnion - top layer (epi = on or above); warm, plenty of oxygen

Thermocline - transition area; water temp. drops >1°C/m (drastic)

Hypolimnion - lower layer (hypo = less than, below); cold water, usually little oxygen

Thermal stratification

Fall - time of mixing --> fall overturn

- surface cools to temp. of hypolimnion, and entire lake circulates
- same temp. & DO throughout

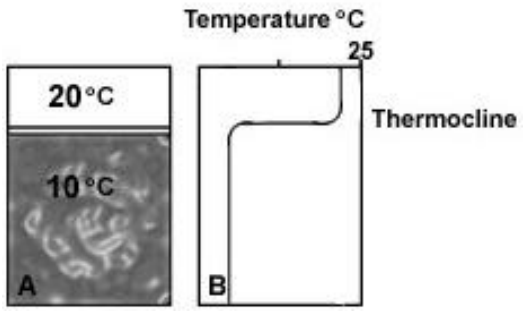
Thermal stratification

Winter - ice on top (0°C)

- water at bottom is 4°C -most dense

Spring - another overturn

Do lakes always stratify?
NO - depends on depth, wind, protection, etc.



Stream Ecosystems

very different from lakes

1. **Current - water is moving (affects organisms, substrate, nutrients, etc.)**
2. **Land-Water Interchange**
3. **Zonation**

Land-Water Interchange

- **greater for streams than lakes**
- **fish food from terrestrial sources (surrounding environment --> trees vs. farming) ==> relates to productivity and energy sources**

Allocthonous organic material - enters stream from outside source

Autocthonous organic material- produced within stream (much higher for lakes)

Stream types

Ephemeral:
flow only during wet season
not all year

Perennial:
year-round flow
sustained by groundwater

Zonation

is longitudinal (lakes are layered; streams change downstream

Upper	Lower
smaller	larger
steep	gradual slope
colder	warmer
trout	catfish

Coastal and Estuarine Environments

Coast

Dynamic:

influenced by wind, rain, waves, tides, currents, seaspray

Types of Coastal Environments

Beaches and dunes
Rocky cliffs
Barrier islands
Coral reefs

Beaches and dunes

Beaches: anywhere there is erodable minerals or sediments

Sand dunes: active sand supply
low precipitation
high winds
up to 50 m high
72 km (45 miles) long

Rocky Cliffs

Pacific coast

Diverse
depends on rock formations

Stable: hard rock (granite)
Weak: weak rock (landslides)

Barrier islands

Nearshore islands formed by wind, waves, and currents

Narrow: (<5 km)
Long (100 km)

Common on Atlantic coast
Padre Island, TX
Cape Canaveral, FL
Cape Cod, MA

Coral Reefs

Formed by algae and animal skeletons

Largest biological constructions on Earth

Found in tropical areas in <100 m depths

Highly productive and sensitive to disturbance

Estuaries

Bays between coastal rivers and the sea transitional zone

Hybrid between rivers and oceans

Estuaries

Tidal influence
Variable water salinity
Turbid

High organism production

60% of marine sport fish spend part of life cycle in estuary (nursery area)

Ocean stats

reservoir for water cycle -> 97% volume of earth's water

about 70% of earth's surface

Pacific Ocean 25% larger than all land area

Average depth - a little more than 2 miles

Salinity – 60x higher than freshwater

Biological Desert?

most is nutrient poor

most production near shore

nutrients available in sediment

nutrient sink - nutrients that reach deep-sea bottom stay there until geologic change - e.g. uplift, volcano

Ocean Zones

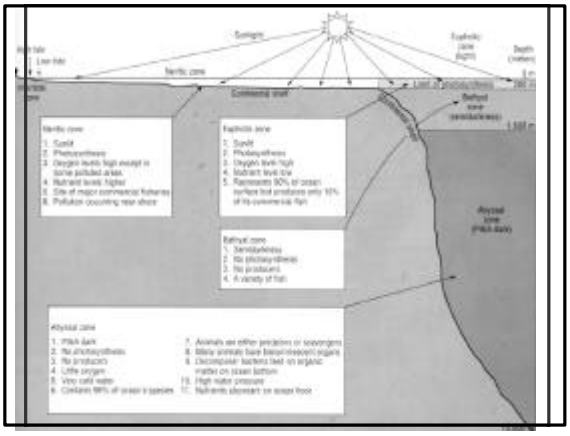
- Neritic = lake littoral zone
  - warmer, nutrient rich, shallow
  - 10 to 200 mi wide, to depth of ~600 ft
  - diverse plant & animal life
- Euphotic = lake limnetic zone
  - open water, down to limit of light penetration (~0-650 ft)
  - Photosynthesis

Ocean Zones

- Bathyl - below euphotic, above abyss
  - semidark, no photosynthesis
  - no producers
- Abyssal = lake profundal zone
  - cold, dark-water zone, ~>3,000 ft
  - specifically adapted plants & animals
- - mostly scavenger spp.

Ocean Resources?

- ❖Limitless
- ❖Can we deplete the ocean resources?



Human Impacts

Human Impacts

greatest environmental damage visible in estuaries, coral reefs

coastal erosion due to: development -- coastlines, barrier islands...

rising ocean (greenhouse effect)

nutrients and sediment influx stopped by dams reduces vegetative growth

land subsidence (oil extraction)

Development

53% of American live near coasts (17% of land)

1994: coastal pop. Increasing at 3,600 people/day

Human Impacts

Habitat destruction

Pollution

Accelerated erosion

Natural Impacts

Hurricanes

Earthquakes

Monsoons

Habitat destruction

Dredging for development
- 1950's-1970: 640,000 ac lost
- 1970's-1980's: 71,000 ac
- 1986-1997: 10,400 ac

Waves from barge traffic
Construction of dams
Nutrient loading

Natural (storms)

Loss of buffer zones (coastal wetlands)
- storm damage more prominent

Hurricane Andrew: 1992
- 75,000 homes destroyed in FL
- $22 billion in damages

Erosion

Natural process

Monterey Bay, CA: loss of 5-10 feet/yr
Long Island, NY: 100 ft lost in last 50 yrs
Cape Shoalwater, WA: 100 ft/yr

Accelerated Erosion

Human-induced

Mineral mining

Dam construction
- sediment to form delta no longer there

Pollution

Increased human use
- sewage
- stormwater drains
- ocean pumping/dumping from ships
- industrial/agricultural runoff

Pollution

- Ocean dumping -- BOD, toxic or dangerous wastes, plastics

e.g., New York City - used to pipe raw sewage out to sea

Oil Pollution

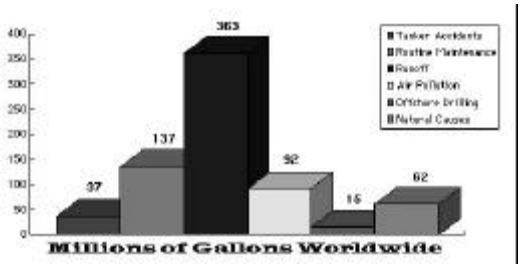
Some is natural - seepage (15%)

Most is man-induced

~7 mil tons released into oceans/year

bad for ocean, waste of a nonrenewable resource

clean-up ($28,000 per 1,000 gal)



Oil Pollution Sources

Oil tanker accidents
- only accounts for about 5% of total
- lots of press - tankers, dead birds, clean-up

Off-shore drilling accidents
- some large, some small
- likely to increase as drilling increases

Crankcase oil (major source)
- **from cars and trucks to rivers to oceans**
- **more of total than oil tankers & drilling**

Airborne hydrocarbons (major source)

evaporates when in contact with air
factories, service stations, filling gas tanks
unburned gas escapes through exhaust
rain brings it down - eventually reaches the ocean

Adverse effects

reduced photosynthesis (limits light penetration)

concentration of chlorinated hydrocarbons pesticides, PCB's, etc.

outright mortality - most in neritic zone
marine fishes & inverts - not as visible as birds

disruption of chemical communication by marine organisms
also nonaversion - lobsters -- attracted to kerosene
a) distracts them from natural food sources
b) attracts to oil spill, outright mortality

long-term exposure to low levels-chronic effects
- humans & other organisms
- cause cancer, tumors
- affect growth, reproduction, etc.

Control

fingerprinting - able to identify source of oil, can identify those responsible for oil problems, regulations may then be possible

abatement techniques - once spill has occurred

skim (vacuum), absorbents (straw, cotton, chalk compounds)
must occur quickly after spill before dispersion and emulsification

decomposition – special bacteria
“oil eaters"