1. Today: Water

2. Lecture schedule updates on your website
3. 206 Lab Website for handouts and assignments
   - No lab this week, meet at van next week

- next installment of Group Project:
  Oral Presentations (26 April-01 May), sign up today
- Thanks: (Potter, Boyle, Mangin, Robichaux)
- Exam III on Wednesday 19 April

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Aquatic and Marine Environments

A. Salinity

B. Layers:
   1. Temperature
   2. Sunlight
   3. Dissolved O2
   4. Nutrients
      - carbon
      - nitrogen (nitrate)
      - phosphorus (phosphate)

Marine Environments

- 71% earth’s surface is ocean
- coastal vs. open sea
- 10% area, 90% species high NPP
- nutrients
- sunlight

1. Estuaries
2. Coastal Wetlands
   - mangroves
   - salt marshes
3. Coral Reefs

Aquatic Environments

- Only 1% earth’s surface:
  1. Lakes
     - oligotrophic, nutrients, clarity, NPP
  2. Streams
     - Watershed, Runoff
  3. Rivers
  4. Inland Wetlands
     - Marshes, swamps, floodplains
Aquatic Environments

- oligotrophic
- eutrophic

Fig 3-18, Miller, 2003

Aquatic Environments

Freshwater Ecosystem Services

Marine Ecosystem Services

Marine Ecosystem Degradation

Cyprinodon macularius (Endangered since 1986)

Desert Pupfish
Family Cyprinodontidae

- 1.14 inches long max. age of three years
- females are gray and drab males are bluish, turning bright blue during spring breeding season.
- feed on insect larvae and other organic matter from pond bottom.
- prefer shallow pond depths, about 12 to 18 inches deep.

Cyprinodon macularius Desert Pupfish

This tiny fish was once part of a widespread population, the range of which included the Colorado, Gila, San Pedro, Salt and Santa Cruz rivers and their tributaries in Arizona and California. The ancestors of the Quitobaquito and Sonoyta river pupfish are believed to have been cut off from their relatives in the Colorado River drainage about one million years ago.

The warm, slightly brackish water at Quitobaquito is ideal habitat for pupfish. Pupfish can tolerate salinity levels ranging from normal tap water to water three times saltier than the ocean. Therefore, they are well suited to desert environments where high evaporation rates create water with high salinity levels.

Although the water temperature at the spring is a constant 74°F, the water temperature in the pond fluctuates greatly during the year, from about 40°F or cooler in January to almost 100°F in August, especially in shallow areas... very tolerant of rapid temperature change and low oxygen content due to summer heat.

Desert pupfish declined due to the introduction and spread of exotic predatory and competitive fishes, water impoundment and diversion, water pollution, groundwater pumping, stream channelization, and habitat modification.

Healthy population of almost 10,000 fish inhabits this oasis. This last refuge of a unique fish is being actively managed.
WATER (Ch 9)

- Organisms made of water
- Hydrogen Bonds
  - Surface Tension
- Broad temp range as liquid
- High Specific Heat
- Energy of phase changes
- Universal Solvent
- Expands when freezes (less dense)

71% planet surface
(97.4% ocean)

2.6% fresh
- ice caps and glaciers (1.98%)
- 0.014% accessible
  lakes, soil, atmosphere
  biota, rivers

100 liters vs. 2.5 teaspoons (14ml)

Reservoirs of Water on Earth

<table>
<thead>
<tr>
<th>Reservoir</th>
<th>Volume ($10^6$ km$^3$)</th>
<th>Percent of Total</th>
<th>Residence T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oceans</td>
<td>1350</td>
<td>97.3</td>
<td>$10^7$-$10^8$ yr</td>
</tr>
<tr>
<td>Glaciers</td>
<td>29</td>
<td>2.1</td>
<td>$10^1$-$10^3$ yr</td>
</tr>
<tr>
<td>Aquifers</td>
<td>8</td>
<td>0.6</td>
<td>2 wks-$10^4$ yr</td>
</tr>
<tr>
<td>Lakes</td>
<td>0.1</td>
<td>0.01</td>
<td>10 yr</td>
</tr>
<tr>
<td>Soil Moisture</td>
<td>0.1</td>
<td>0.01</td>
<td>52 days</td>
</tr>
<tr>
<td>Atmosphere</td>
<td>0.013</td>
<td>0.001</td>
<td>10 days</td>
</tr>
<tr>
<td>Rivers</td>
<td>0.002</td>
<td>0.0002</td>
<td>2 wks</td>
</tr>
<tr>
<td>Biosphere</td>
<td>0.001</td>
<td>0.0001</td>
<td>6 days</td>
</tr>
</tbody>
</table>

Water Use

United States

Power plant cooling 38%
Agriculture 41%
Industry 11%
Public 10%

China

Agriculture 87%
Public 9%
Industry 7%

Water Requirements

1 kilogram
- corn: 1,500 liters (400 gallons)
- beef: 7,000 liters (1,900 gallons)
- rice: 500 liters (130 gallons)

1 kilogram
- steel: 220 liters (60 gallons)
- paper: 880 liters (220 gallons)
- cotton: 6,000 liters (1,600 gallons)

What did the fish say when it ran into a concrete wall?

Dam!

Why build dams?

Why might dams be environmentally harmful?

Glen Canyon Dam, Colorado River, Lake Powell
Ecological Services (e.g., rivers)

Figure 14-10: Some ecological services provided by rivers. Currently, these services are given little or no monetary value when the costs and benefits of dam and reservoir projects are assessed. According to environmental economists, attaching even a crude estimated monetary value to these ecosystem services would help sustain rivers.

Lessons from New Orleans?

Channelization and Floods

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Groundwater and Aquifers

Figure 14-2: The groundwater system. An unconfined aquifer is unconfined with a water table. A confined aquifer is bounded above and below by impermeable layers of rock. Groundwater in this type of aquifer is confined under pressure.

Channelization and Floods

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