Organisms: Microbes and Plants
Finally, some biota!

Aquatic organisms overview
- What the heck is a species anyway?
- Classifying organisms
- Microbes and plants

Species concepts
- Biological species concept
- But... what about morphological and ecological species concepts?
- Reality for non-taxonomists: listen to the experts
  - Phylogenetics, molecular methods... see text, rRNA

Some comments
- Past expertise for last generation of ecologists
- Retiring; want a job?

Classification
- Based on what?
  - Traditional / taxonomy / phylogeny
  - Functional role
    - Make your own food?
    - Food source?
    - Functional feeding group?
    - Who eats who?
    - Where do you live?
    - How do you get along with others?

Two “freshwater trees”

Fig. 8.1

Fig. 8.2

Fig. 8.4

Eichhornia azurea
Floating vs. submerged

Perlodid stonefly = Predator-engulfer

J. Bruce Wallace

Rich Merritt
**Microbes and plants**

- Viruses
- Archaea
- Bacteria
- Protoctista
- Fungi
- Plantae

![Cyanobacteria and Diatom](Fig. 9.1)

**Viruses**

- All organisms (hosts) have viruses
- Very small (25 – 350 nm)
- Virus-like particles common in lakes; including human disease-causing ones
- Poorly understood ecologically; expected impact may be important for population dynamics of hosts

![Viruses](Fig. 9.2)

**Impact of viruses requires testing**

- Sampling in littoral zone of a Swiss eutrophic lake found viruses, but…
- Whereas 300 of 5,000 bacterial cells in the water column were infected, only 4 of 15,000 cells in benthic habitats (sediment and biofilm) were infected

**Archaea**

- Morphologically similar to bacteria, but as different from bacteria as eukarya
- Originally thought to be mainly extremophiles (hyperthermic, halophilic, anaerobic)
- Now known to occur in all habitats
- Essential in nutrient cycling (e.g., methanogens)

![Yellowstone hot springs](Fig. 9.4)

**Bacteria**

- Most important organisms in nutrient cycling on earth
- Can only culture < 1% of all species; how many?
- Most identification based on rRNA, metabolic or chemical characteristics
- Relatively few morphologies dominate

![Bacteria](Fig. 9.3)

**SE floodplains and bacteria**

- Magnitude: \(1.5 \times 10^{10}\) cells/L
- Food resource for filterers and gatherers; “microbial loop”

![SE floodplains](Fig. 9.5)
Cyanobacteria

- Photosynthetic
- Fix nitrogen with heterocysts
- Float by gas vesicles
- Unique light-harvesting pigments (phycobilins); which wavelengths?
- Produce objectionable odors, tastes, and toxins

Cyanobacterial toxins

- Produce hepatotoxins and neurotoxins
- Toxins can be bioconcentrated by some organisms (e.g., clams), and influence many different types of animals (e.g., livestock drinking)
- Why toxins?
  - Evolved as protection against zooplankton grazing

Protoctista

- Eukaryotic algae
- Protozoa

Eukaryotic algae (1)

- Photosynthetic; contain chlorophyll a
  - Rhodophyceae
  - Chrysophyceae
  - Bacillariophyceae
  - Dinophyceae
  - Euglenophyceae
  - Chlorophyceae
  - Charophyceae

Eukaryotic algae (2)

- Rhodophyceae: red algae, relatively rare, lotic, also contain phycobilins
- Chrysophyceae: flagellated, planktonic, some ingest particles, oligotrophic lakes

Eukaryotic algae (3)

- Bacillariophyceae: diatoms, have silicon frustule that is useful in paleolimnology and forensics, abundant in many types of freshwaters
- Dinophyceae: dinoflagellates, flagellates, some toxic and cause fish kills, many ingest particles, *Pfiesteria piscicida* (estuaries), mostly lakes

Fig. 9.4
Eukaryotic algae (4)

- **Euglenophyceae**: all unicellular, motile, can ingest particles, eutrophic
- **Chlorophyceae**: green algae, most diverse freshwater algae, all surface water habitats
- **Charophyceae**: stoneworts, *Chara*, can be encrusted with calcium carbonate, thought to be closest relatives to green land plants

**Protozoa**

- Important microbivores
- Some human parasites
- Mastigophora- flagellates
  - Phytomastigophora- green
  - Zoomastigophora- colorless
- Sarcodina- amoeboid protozoa
- Ciliophora- ciliates

**Blackwater river protozoa**

- Flagellates and ciliates very abundant in the Ogeechee River, GA
- Average of 15.6% of total bacteria in water column removed by these protozoa
  - Flagellates always >2X as important as ciliates

**Fungi**

- Aquatic Fungi
  - saprophytic (e.g., aquatic hyphomycetes)
  - some predatory
- Aquatic Lichens
  - symbiosis between fungi and algae
  - can be important in some wetlands

**Plantae**

- Nonvascular plants
- Vascular plants
- Large algae and plants called *macrophytes*, often classified by growth habit

**Nonvascular plants**

- Bryophytes: mosses and liverworts
  - *Sphagnum* globally important in carbon deposition in peat bogs; locally important
  - Some aquatic mosses can be found very deep in oligotrophic lakes
  - Some streams can be dominated by bryophytes
Vascular plants
- Dominant producers in many wetlands, shallow lakes and ponds
- Many wetlands classified based on the vegetation that they contain
- A wide variety of forms

Morphology—Emergents
- Sagittaria latifolia
- Typha latifolia
- Scirpus americanus
- Carex aureolensis

Morphology—Floating
- Azolla caroliniana
- Eichhornia crassipes
- Nymphaea
- Lemna

Morphology—Submersed
- Vallisneria americana
- Myriophyllum

Podostemum ceratophyllum
And insects
- Filterer
- Scraper

Abundance and biomass of total macroinvertebrates per sample
Podostemum surface area (cm²) per sample

Hutchens et al. (2004)