



# 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



Fig. 8.2

Eichhornia azurea

Floating vs. submerged

## Some comments

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







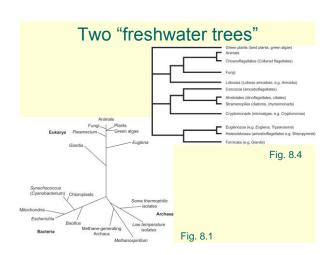
Rich Merritt

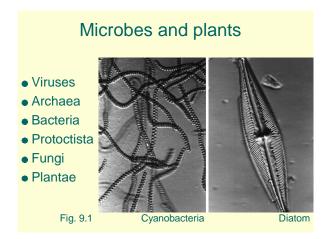
## Classification

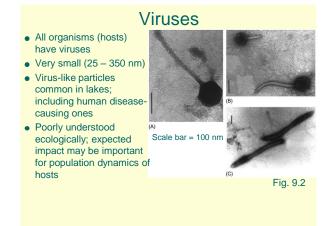
- Based on what?
  - Traditional / taxonomy / phylogeny
  - Functional role
    - Make your own food?
    - Food source?
    - Functional feeding group?
    - Who eats who?
    - Where do you live?
    - How do you get along with others?



Perlodid stonefly =
Predator-engulfer







## Impact of viruses requires testing

APPLIED AND ENVIRONMENTAL MICROBIOLOGY, July 2006, p. 4893–4898 0099-2240/06/\$08.00+0 doi:10.1128/AEM.00319-06

Vol. 72, No. 7

Infection Paradox: High Abundance but Low Impact of Freshwater Benthic Viruses

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- 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

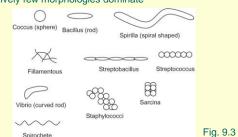
- Morphologically similar to bacteria, but as different from bacteria as eukarya
- Originally thought to be mainly extremophiles (hyperthermic, halophilic, anaerobic)
- Now known to occur in all habitats
- Essential in nutrient cycling (e.g., methanogens)



Yellowstone hot springs

#### 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



SE floodplains and bacteria

• Magnitude: 1.5 x 10<sup>10</sup> cells/L

• Food resource for filterers and gatherers; "microbial loop"

OGECHEE
RIVER

Hydropsychid caddisfly

Fig. 2. Total bacterial cell concentrations by morphological type.

Edwards (1987, L&O)

## Cyanobacteria

- Photosynthetic
- Fix nitrogen with heterocysts
- Float by gas vesicles
- Unique light-harvesting pigments (phycobilins); which wavelengths?

 Produce objectionable odors, tastes, and toxins





Anahaena

## 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

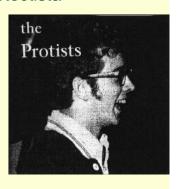


Beach Advisory for Cyanobacteria



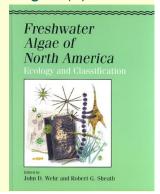
#### Protoctista

- 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





Dinobryon

# 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, Pfisteria piscicida (estuaries), mostly lakes





Pfiesteria piscicida

## 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





Giardia



### 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

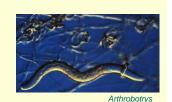




# **Fungi**

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





Vlad Gulis

#### **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
- Recall wetland classification system...
- A wide variety of forms











