

Biodiversity



Yangtze River Dolphin,
Considered extinct as of 2007



Lecture outline

- Evolutionary considerations
- Current factors affecting diversity
- Invasions
- Extinctions



New species of fairy shrimp from playas

Evolutionary considerations (1)

- Time and reproductive isolation

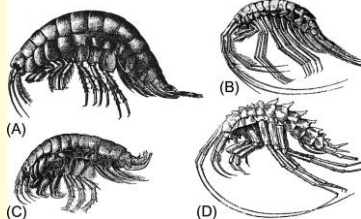
- Lake Baikal and endemic species

- 377 Crustacea
- 86 Turbellaria
- 98 mollusks
- 29 fish
- 1 freshwater seal

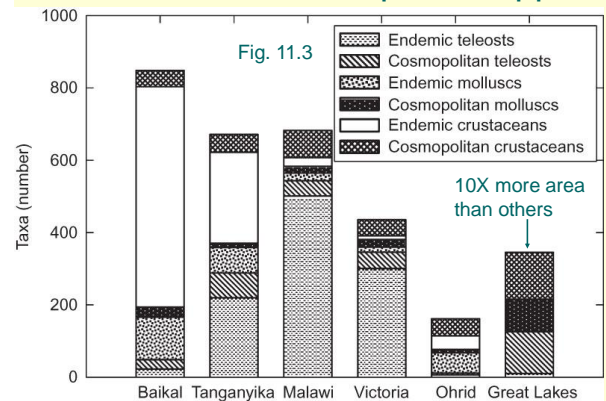


Endemic sculpin

Endemic amphipods; Fig. 11.4

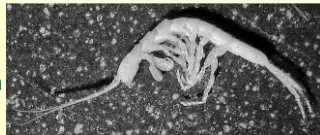


Endemic vs. cosmopolitan spp



Evolutionary considerations (2)

- Time and reproductive isolation
- Temporary pools can have many endemic species
- Unique groundwater fauna related to isolation and poor dispersal ability
- May be similar for hyporheos



Isopod from groundwater, Fig. 11.1a



MT hyporheos



Fig. 1. Nymphs of *Pteronarcys* from the Flathead River in northwestern Montana. Mature nymphs are up to 2 cm long, excluding antennae and cerci.

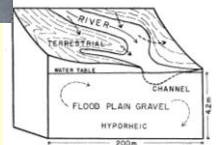


Fig. 2. Habitats utilized by stream organisms of the Flathead River. Dashed arrows indicate circulation of water from channel to hyporheic areas and vice versa. Dimensions refer to minimum floodplain width (200 m) and probable minimum vertical distribution (4.2 m) of hyporheic organisms.

Stanford & Gaufin (1974)

Lecture outline

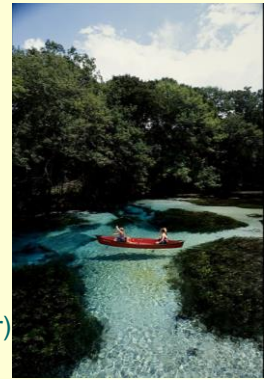
- Evolutionary considerations
- **Current factors affecting diversity**
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Playcard swamp

Current factors

- Habitat type
- Colonization after disturbance or of new habitats
- Species introductions
- Productivity (later)
- Species interactions (later)



Cypress Spring, Fla

Lake habitats & invertebrates

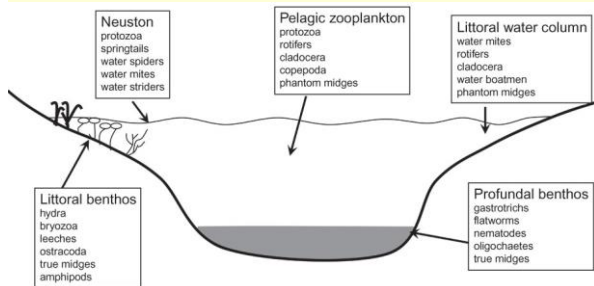
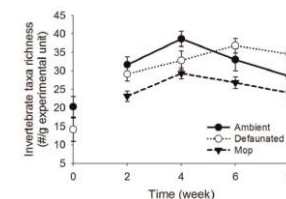
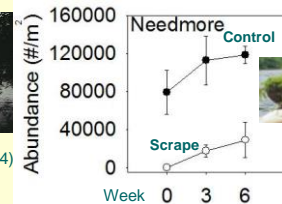


Fig. 11.6

Insect colonization after disturbance



Hutchens et al. (2004)

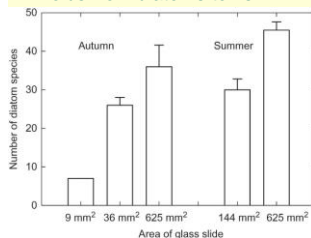


Barker et al. (2014)

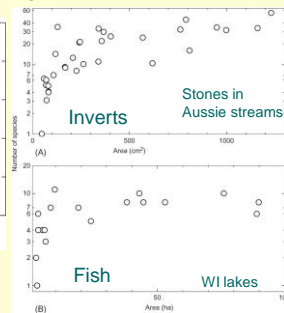
Species-area relationships

- $S = cA^z$
- Holds from diatoms to fish

Figs. 11.7 & 8

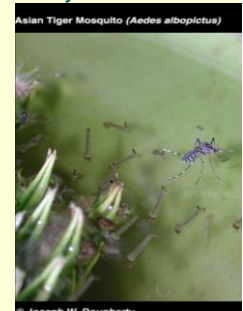


Dr. Ruth Patrick
Nov. 28, 1907
Nov. 28, 2003



Lecture outline

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- **Invasions**
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Invasions of non-native species

- Viewed by some as most permanent form of pollution
- Some findings for fish
 - most invaders fail to establish; many attempts often needed
 - most successful invaders have no significant effects
 - all aquatic systems can be invaded
 - major community effects occur mostly in low-diversity systems
 - top predators are more likely to have strong effects

Moyle & Light 1996



Peter Moyle

Invaders of the Great Lakes

Table 11.1 Some Invaders of the North American Great Lakes

Organism	Year	Source	How Introduced	Effects
Sea lamprey, <i>Petromyzon marinus</i>	~1830	Atlantic	Shipping canals	Decreases native lake trout
Purple loosestrife, <i>Lythrum salicaria</i>	1869	Europe	Ship ballast	See Sidebar 9.4
Alewife, <i>Alosa pseudoharengus</i>	1873	Atlantic	Shipping canals	Suppresses native fish species; new prey for salmon
Chinook salmon, <i>Oncorhynchus tshawytscha</i>	1873	Pacific	Intentional	New piscivore, important sport fish
Common carp, <i>Cyprinus carpio</i>	1879	Europe	Intentional	Destroys habitat for waterfowl and fish
Brown trout, <i>Salmo trutta</i>	1883	Europe	Intentional	New piscivore, important sport fish
Coho salmon, <i>Oncorhynchus kisutch</i>	1933	Pacific	Intentional	New piscivore, important sport fish
White perch, <i>Morone americana</i>	~1950	Atlantic	Shipping canals	Competes with native fish
Eurasian watermilfoil, <i>Myriophyllum spicatum</i>	1952	Eurasia	Not known	Competes with native plants
European ruffe, <i>Gymnocephalus cernuus</i>	1986	Europe	Ballast water	Competes with native fish and eats eggs
Zebra mussel, <i>Dreissena polymorpha</i>	1988	Europe	Ballast water	Biotouling; outcompetes native species

(After Mills et al., 1994, and other sources)

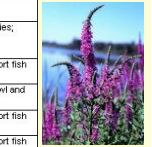
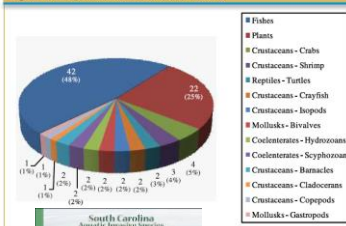


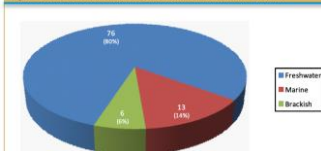
Figure 3. Groups Introduced into South Carolina



SC aquatic invasions



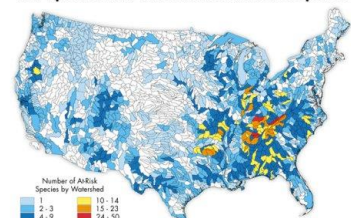
Figure 5. Marine versus Freshwater Introductions in South Carolina



Lecture outline

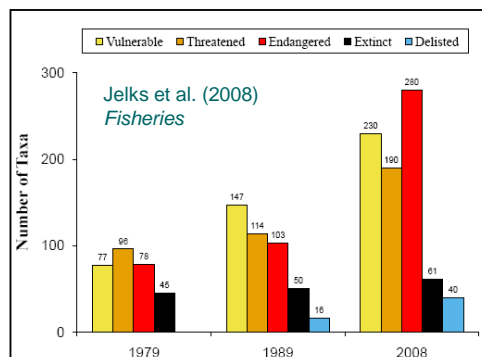
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Hot Spots for At-Risk Fish and Mussel Species



NatureServe

Figure 2. Numbers of imperiled North American freshwater and diadromous fish taxa in each status category as listed previously by the AFS Endangered Species Committee in Deacon et al. (1979), Williams et al. (1989), and this list (2008). Extinct taxa for each year are cumulative based on estimated dates of extinction, whereas delisted taxa are the number of taxa excluded since the previous list.



Fish in peril

Extinctions (1)

- Freshwater systems are extremely vulnerable
- Since 1900, 123 spp of freshwater animals have gone extinct
- Combined extinction rates for mussels, crayfish, gastropods, amphibians, and fishes in NA average 3.7% per decade
 - 5X higher than any terrestrial habitat

Extinction Rates of North American Freshwater Fauna

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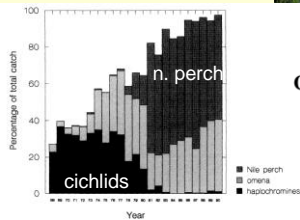
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1999, Conservation Biology

Extinctions (2)

- Lake Victoria—300 cichlid species evolved in last 12,000 years, 200 extinct following 1954 introduction of Nile Perch and pollution



Catastrophic Change in Species-Rich Freshwater Ecosystems

The lessons of Lake Victoria

Les Kaufman

1992, BioScience