Species interactions in lakes

Limnology
Lecture 10
**Ecological community**

**Assemblage** – a set of species that co-occur in space and time

**Community** – a set of interacting species that co-occur in space and time

**Guild** – a set of species that co-occur in space and time and exploit the same class of resources in a similar way
Community concepts

Super-organism (Clements)
- Integrated, self-regulating system
- Emergent properties ~ Gaia hypothesis
- Communities → distinct units across gradients

Individualistic (Gleason)
- Independent responses to environment
- Environment as filter
- Communities → assemblages of independently determined species distributions
Niche – n-dimensional hypervolume of environmental conditions in which a population has positive population growth
Niche partitioning

**FIGURE 7.4** Range of morphological and size variation in species of chydrid water fleas. The ratio of length of the largest to the smallest is about 24; the ratio of volumes is about $24^3$, or 15,625.
Niche vs. neutral

Niche dynamics
Species patterns driven by match between species traits and environment
Species niches determine dynamics
Deterministic

Neutral dynamics
Species patterns driven by random events
Species equivalent in all ways
Stochastic
Neutral species and “random walks”
Example of neutral species

Enallagma damselflies

Humans and damselflies use small shape variations in reproductive organisms to tell species apart

Ecologically pretty much the same
Food chain

Tertiary consumer

Secondary consumer

Primary consumer

Producer
A pelagic food web
Complex food webs
Indirect effects

Top-down: predator-controlled
Trophic cascade

The enemy of my enemy is my friend

Indirect effects

Top-down: predator-controlled
Indirect effects in lakes

Figure 3. Time course of ecosystem response to a strong piscivore year class (solid line) and a partial winter kill of piscivores (dashed line).

Carpenter et al. 1985
Keystone predation
Keystone predation

1. Asymmetric competition
2. Selective predation on superior competitor
Keystone predation

Predator-Mediated

Asymmetric

Competition

[Graph showing the number of species present from 1963 to 1973. The graph compares 'With Pisaster (control)' and 'Without Pisaster (experimental)' conditions.]

With Pisaster (control)

Without Pisaster (experimental)
Keystone predation in lakes
Keystone predation in lakes
Keystone predation in lakes
Intermediate disturbance hypothesis

- Biological processes (less support)
- Fewer species can survive disturbance (more support)
Intermediate disturbance hypothesis

Fig. 4. Diversity index ($H'$) and species number at the end of the experiments. 2-12 d: length of the disturbance interval in days; und.: undisturbed treatment. The dashed lines serve to provide orientation only. The higher value of $H'$ and species number corresponds to the replicate $\times 1$ of the former figures. Experiment 1: 225% increase of the natural mixing depth (4 m), experiment 2: 150% increase of the natural mixing depth.

Floder & Sommer 1999
Intermediate disturbance hypothesis in rivers

Townsend & Scarsbrook 1997
Size efficiency hypothesis

Observations → Theory → Experimental manipulation

Observation: planktivorous fish → size and species composition of zooplankton communities
Observations → Theory → Experimental manipulation

Hypothesis: Predator size-selectivity changes zooplankton size/composition

1. Filter-feeding zoop compete for small food particles
2. Large zoop filter more efficiently (filter area ~ body length²) and can exploit large resources
3. Large zoop are competitively superior (w/o predation)
4. Planktivorous fish selectively remove large zoop

Prediction: Large zoop dominate in lakes without alewife
Size efficiency hypothesis

Observations → Theory → Experimental manipulation

1. Planktivorous fish absent until accidental introduction of *Alosa* sp. in Crystal Lake

2. After introduction, size distribution and species composition changed in line with predictions

SE hypothesis has mixed but generally positive support; competitive mechanism less supported