Predation and food webs

Let the fishin' begin!

Fig. 20.1

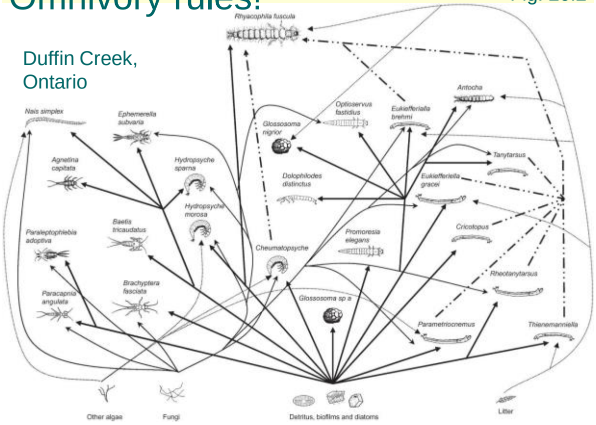
Lecture outline

- Food webs and methods
- Adaptations to predation
- The Trophic Cascade
- Abiotic controls on predation

Omnivory rules!

Fig. 20.2

Duffin Creek, Ontario



Comparing food webs

136 E.J. Rosi-Marshall and J.B. Wallace

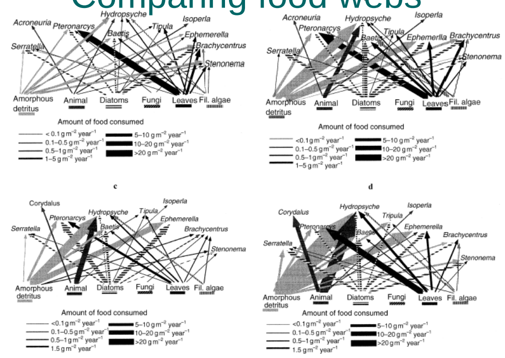


Fig. 2 Annual flow food web for (a) Coweeta Creek (fifth order stream), (b) Conley (fifth), (c) Prentiss (sixth), (d) Iotla (seventh). The webs illustrate the rates of consumption (g m^{-2} year^{-1}) of each trophic interaction. The width of the arrows indicate the rate of flow, i.e. a thicker arrow is a higher flow rate, and the pattern of the arrow indicates the food resource, i.e. lightly shaded is amorphous detritus.

Documenting feeding

- Gut content analysis
  - Amorphous detritus
  - What's there vs. what's not
- Fecal analysis
- Ingestion vs. assimilation
- Feeding and growth experiments
- Essential fatty acids
- Stable isotopes

Limnogale mergulus
Photo by K. Barnes & J. Benstead

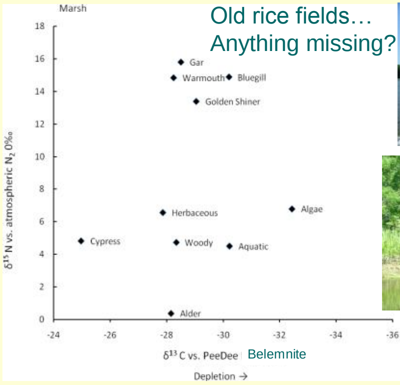
Limnogale latrine site
© Photo by Link Olson

Stable isotopes

- Several isotopes exist that can be used to document food webs
- The most common ratios used are $^{15}N/^{14}N$ and $^{13}C/^{12}C$, expressed in parts per thousand
- Nitrogen is heavier as you move up the food web (+3 to 5‰)
- Organisms track the C ratio in their food

Example of isotopes in food webs

Old rice fields…
Anything missing?

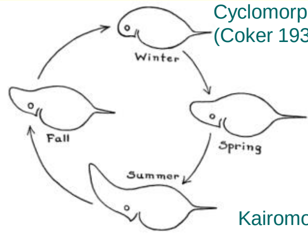


Bayer 2011

Some adaptations to predation

Ruffe

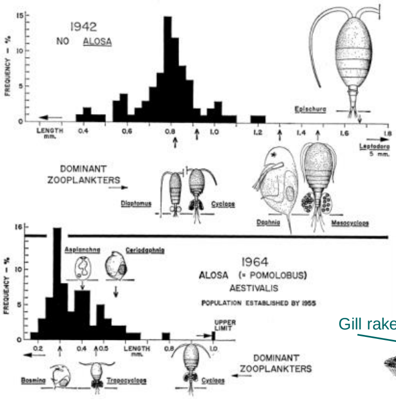
Cyclomorphosis (Coker 1939)



Kairomones?

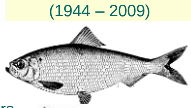
Daphnia lumholtzi (invasive)

Size rules in freshwater

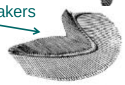


Brooks & Dodson (1965)
3,337 G.S. citations as of 28 November 2016

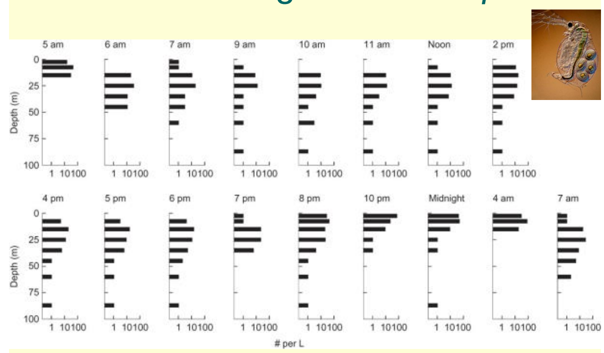
Stanley Dodson (1944 – 2009)



Gill rakers



Diel vertical migration of *Daphnia*



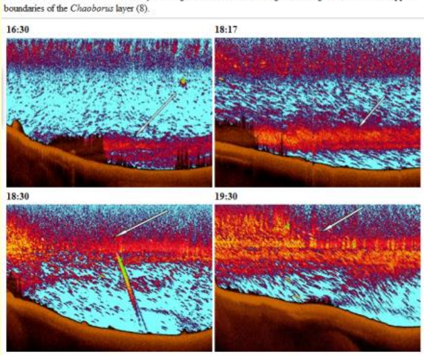
What about drift?

Fig. 20.5

Daphnia meets *Chaoborus*

Image: Spike Walker

Anything you can do, I can do better



Diel Vertical Migration of *C. punctipennis*

Sonar images indicate the migration of *Chaoborus* in Mendums Pond over time. By sunset the organisms had risen from the bottom of the basin finally reaching the surface waters during the evening. Arrows indicate upper boundaries of the *Chaoborus* layer (8).

Chaoborus grows up

Kungu cake

Foraging can be modified by food density (OFT)

When selective?

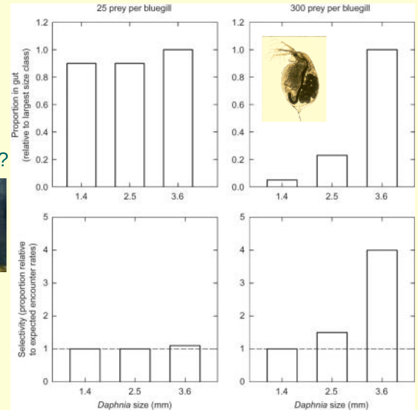
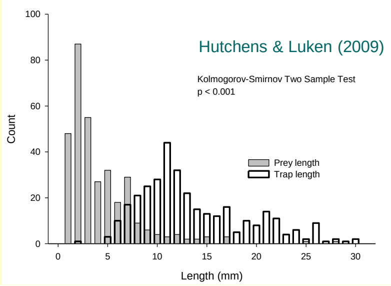


Fig. 20.6

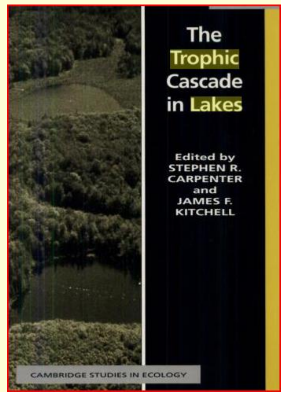
OFT and insectivorous wetland plants

- Darwin (1875) proposed that Venus flytraps select the largest prey possible by leaving small open spaces between spines shortly after closure, which allowed "small and useless fry to escape"; why?



The Trophic Cascade

- Postulated since 1880 that predators can control herbivores and increase biomass of producers
- **Top-down** versus **bottom-up** control
- May use **biomanipulation** to control trophic state



The Trophic Cascade (2)

Does the number of trophic levels matter?

4

3

2

1

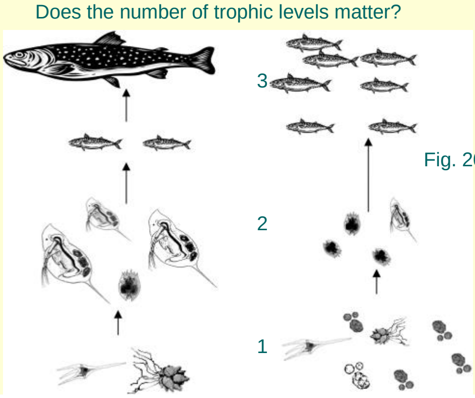
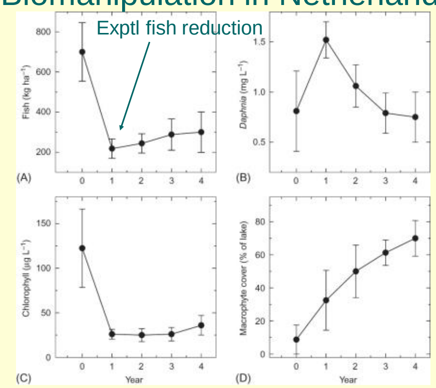


Fig. 20.8

Biomanipulation in Netherland lakes



Shallow, eutrophic lakes; # of trophic levels in Yr 0?

Fig. 20.9

Abiotic controls on predators

- Sure, predators are/can be important…
- But, can we also (sometimes) explain why certain predators are present, and…
- Do a decent job of explaining much of the overall community structure of our system of interest?

Still waters run deep…

Wellborn et al. (1996)

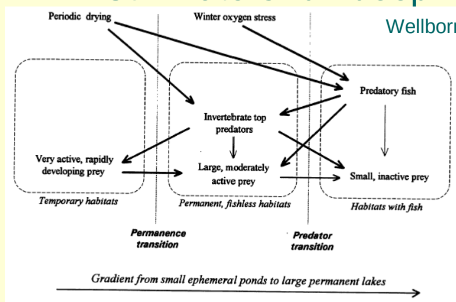


Figure 2 A schematic model of mechanisms generating community structure along the freshwater habitat gradient. Arrows indicate direction of negative effects. Bold arrows indicate very strong effects that act to constrain the distribution of affected species. Thinner arrows indicate weaker trophic interactions that do not prevent coexistence of interacting species. Strong interactions resulting primarily from predation cause distinct transitions in community structure along the gradient. One major transition, the permanence transition, occurs between temporary habitats that contain few predators and permanent habitats that contain significant invertebrate predators. A second major transition in community structure on the gradient, the predator transition, occurs between permanent fishless and fish-containing habitats. Mechanisms causing differential interaction strengths and the critical phenotypic tradeoffs of individuals that mediate species and community transitions along the gradient are described in the text.

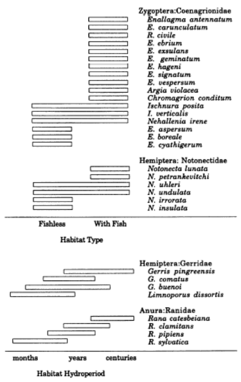


Figure 1 Distribution ranges of Zygoptera (95) and Notonecta (27) across habitats with and without predatory fish, and Hemiptera (157) and Anura (23) across habitats that differ in hydroperiod. Genera and families are distributed across a broad region of the gradient, but individual species are often restricted to a narrow region.

And also influence distributions

Wellborn et al. (1996)