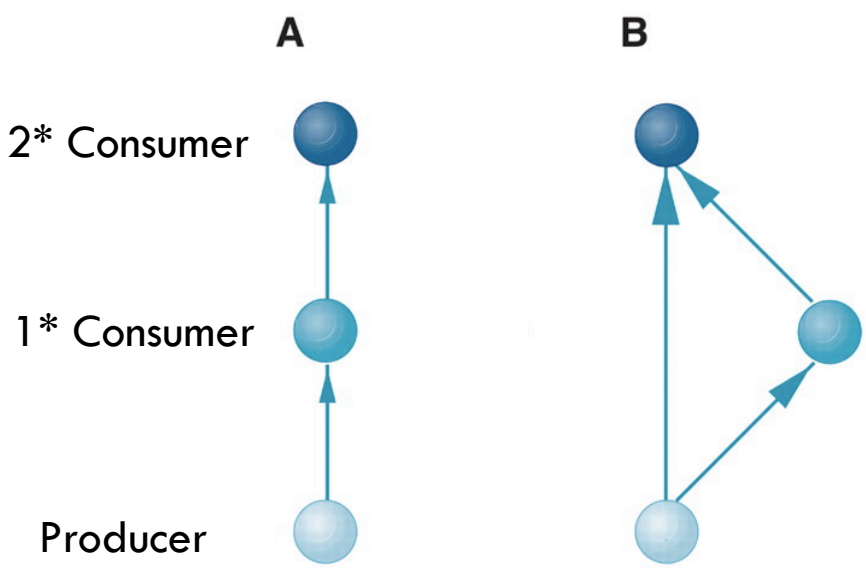
Announcements:

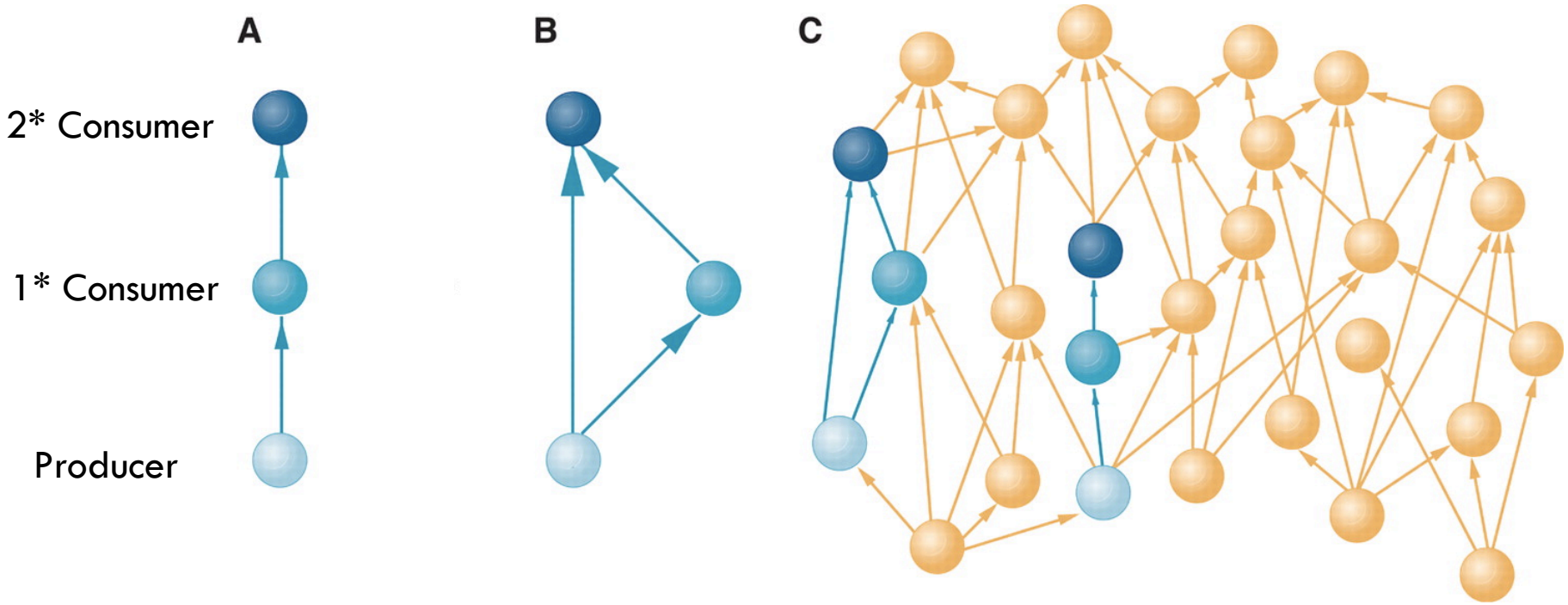
- 2nd Exam: THURSDAY (Oct. 26)
- Same format as first
- My office hours TODAY: 11:45-12:45

Food web complexity and **omnivory**



Omnivory: a species that feeds at multiple trophic levels

Food web complexity and **omnivory**



Omnivory: a species that feeds at multiple trophic levels

Keystone Species & Trophic Cascades

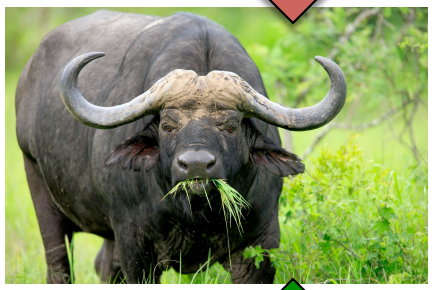
Check out the video (20 min) on the course website to hear Bob Paine talk about how he uncovered the important role of predation in structuring ecological communities

youtube.com/watch?v=hRGg5it5FMI

I'd also like your feedback on the online exercise

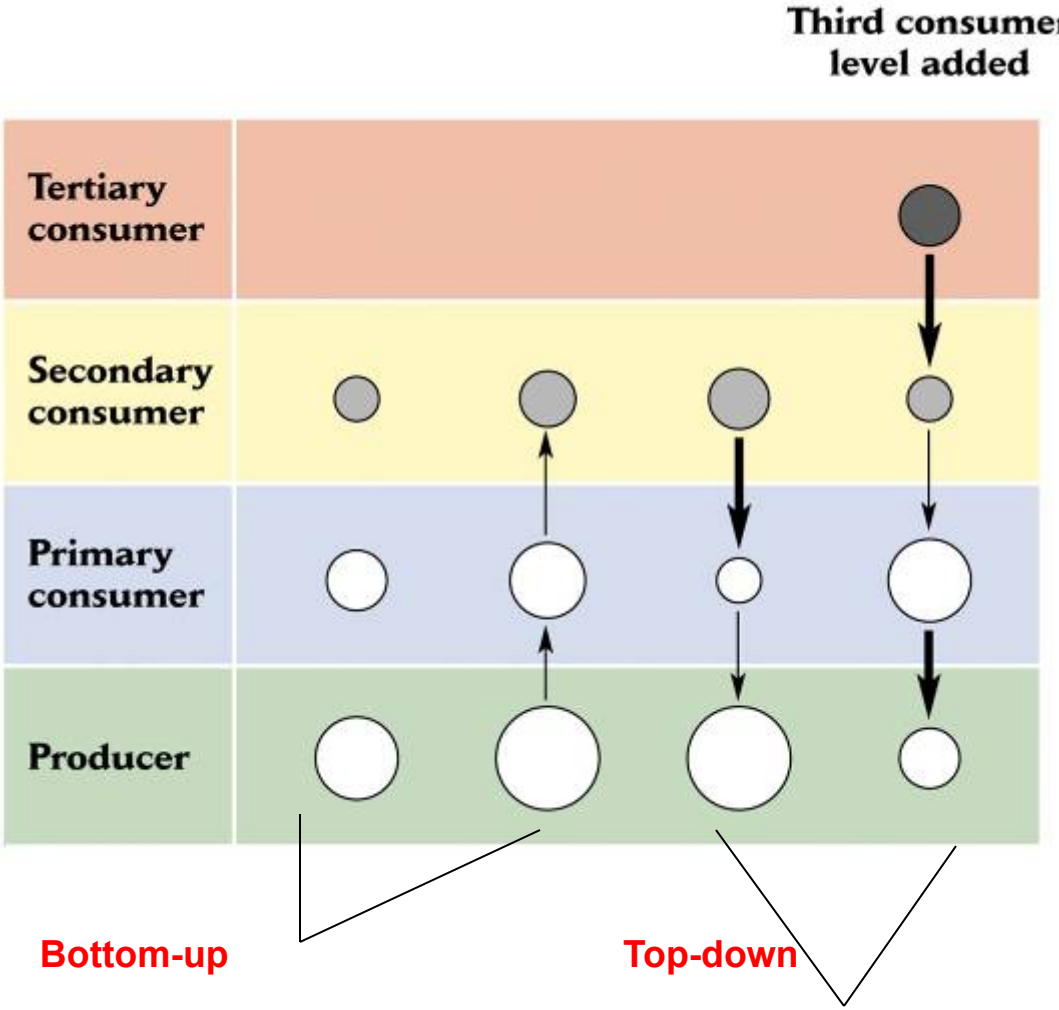
Bottom-up and Top-down control of community structure

What is the relative importance of predation vs. primary production?



….in determining the structure of a community (# of species, trophic levels, abundance)

Bottom-up and Top-down control of community structure

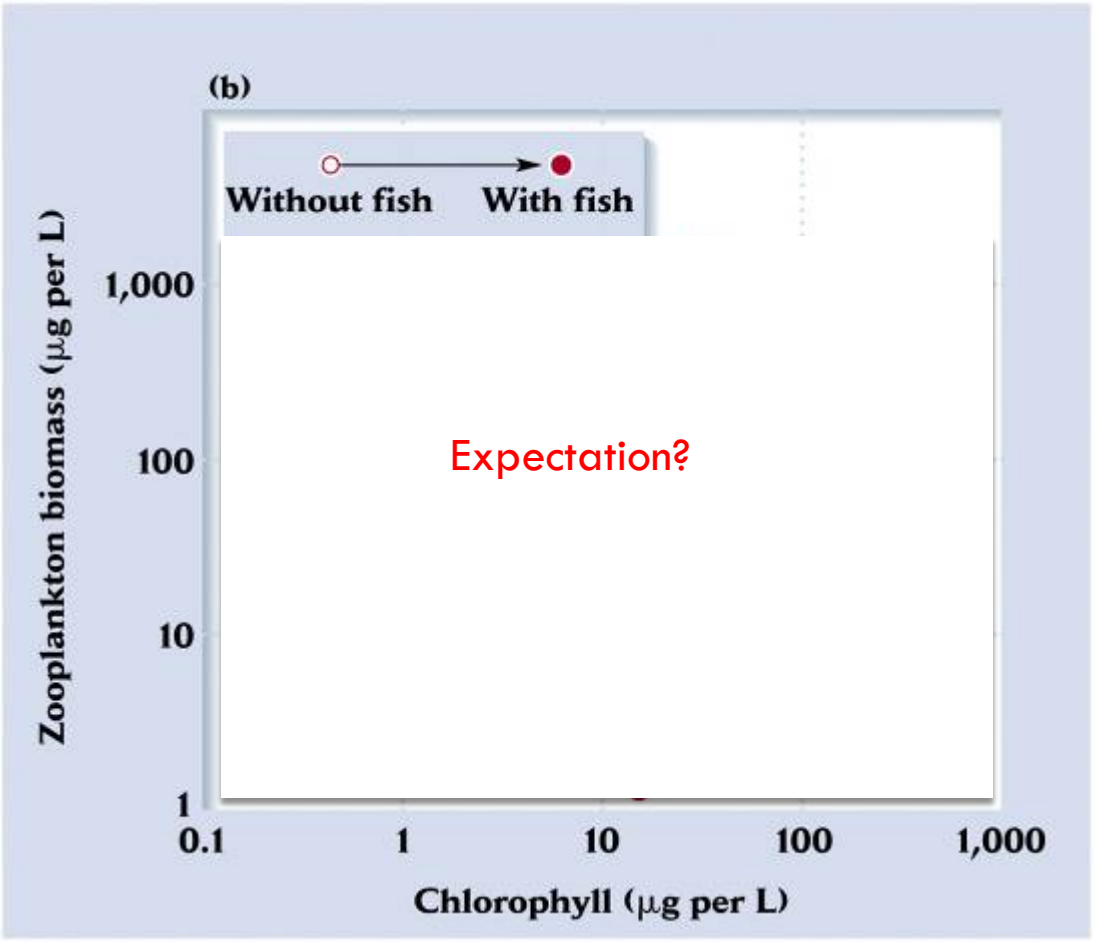


*Arrow convention

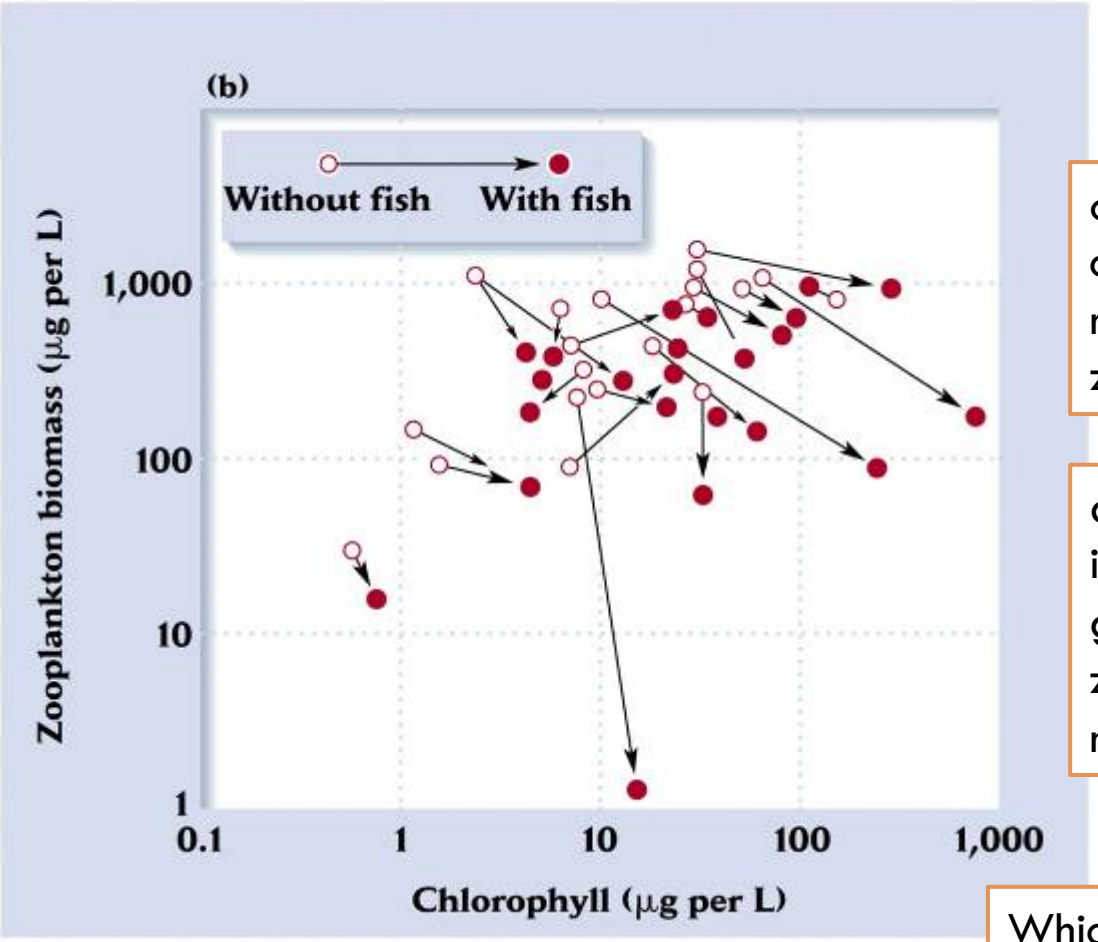
Abundance of species/ trophic groups determined by productivity of producers

Abundance of species/ trophic groups determined by predation (from above)

Top-down and bottom-up control of plankton communities



Top-down and bottom-up control of plankton communities



overall: more chlorophyll ~ more zooplankton

after fish are introduced: generally fewer zooplankton, more chlorophyll

Which paradigm do these data support?

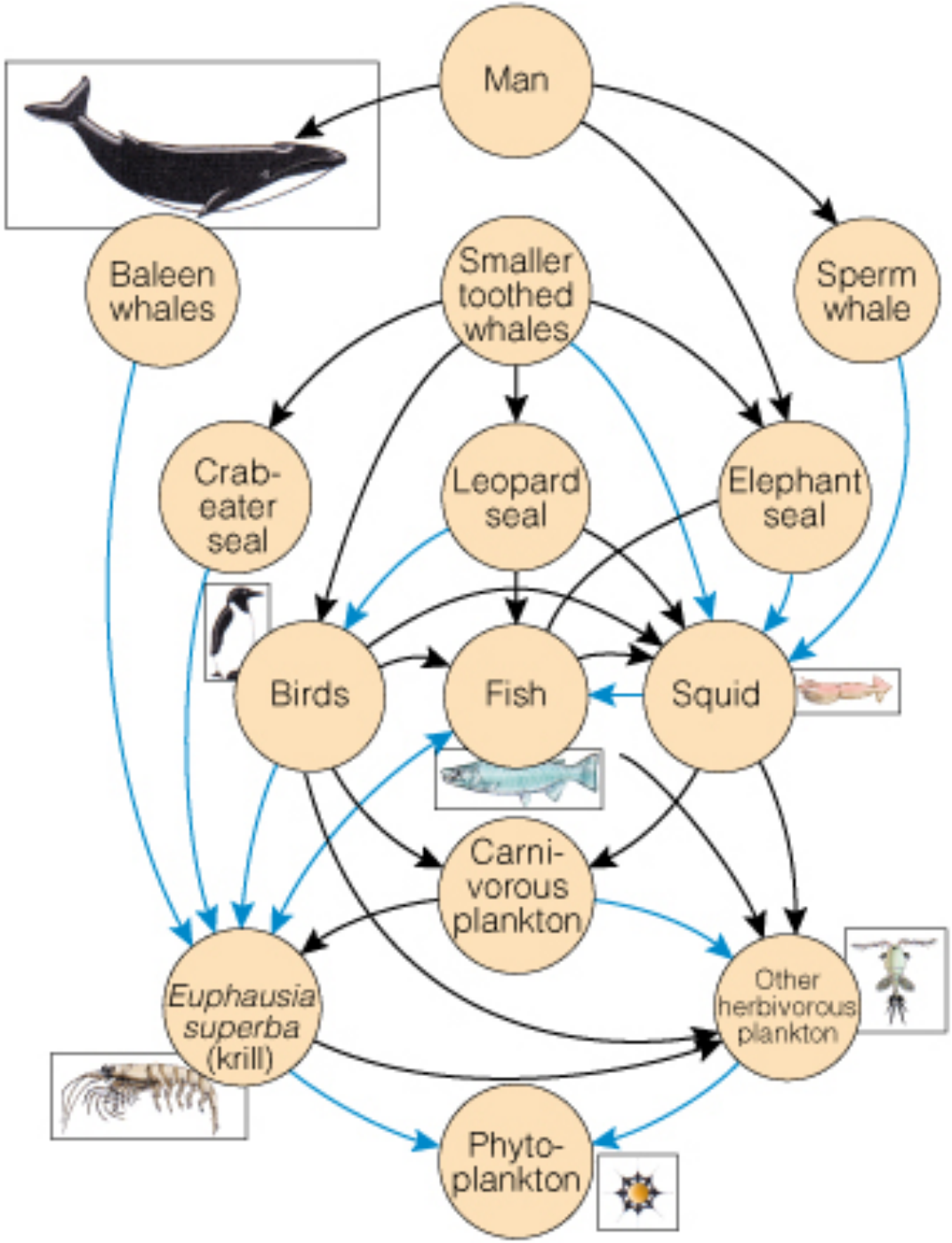
How do we measure the diversity of a community?

Species richness

Count of the number of species in a community

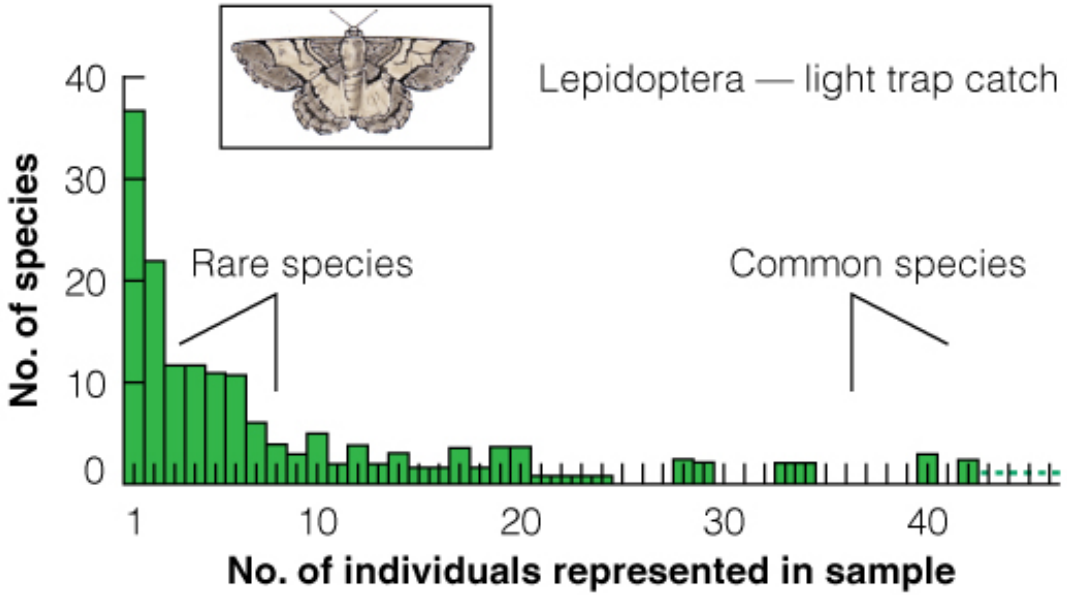
What's the species richness of this community?

The rarest species counts the same as the most abundant…



Species diversity

Many different ways to calculate, but all of them require knowing the *relative abundance of species*



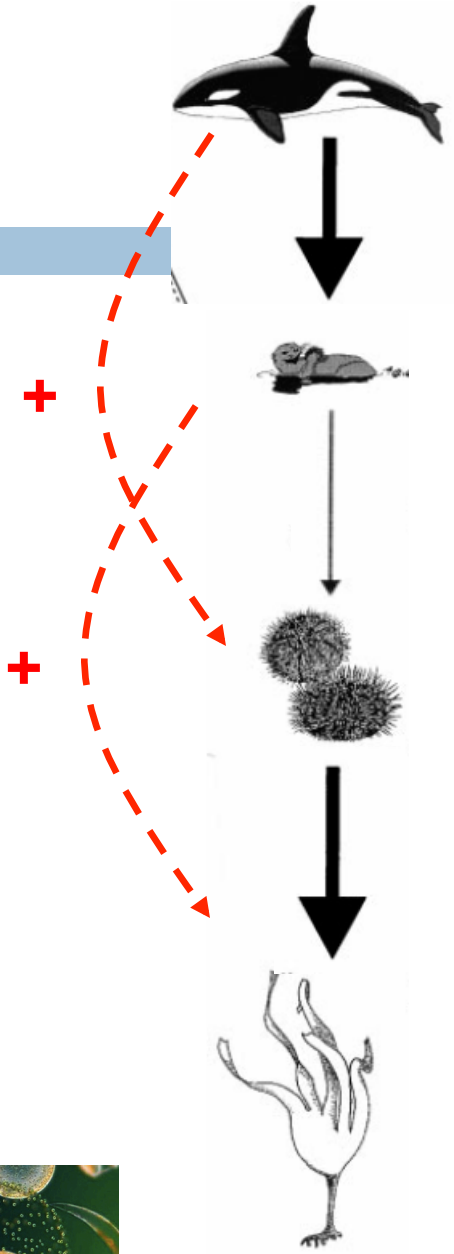
Species Diversity metrics:
"Evenness measures"
"Rarity measures"

Other types of interactions

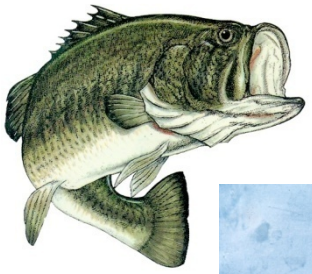
- Positive indirect effects:
  - Trophic Cascade
- Commensalism: +/0
- Mutualism: +/+
- Mechanisms:
  - Coevolution

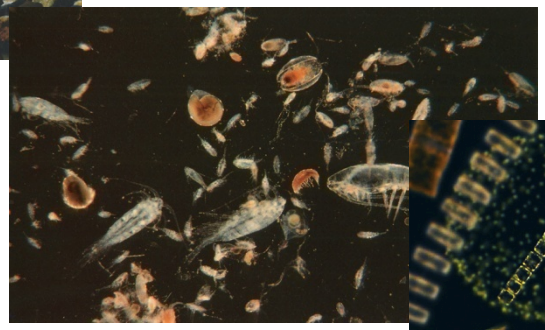
Trophic Cascades

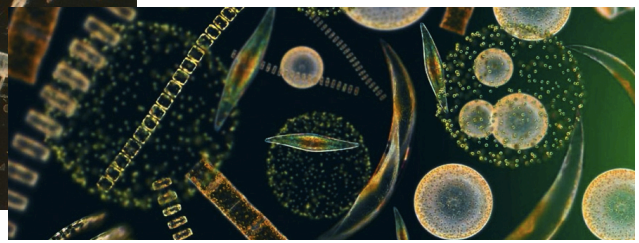
- Positive *indirect* effects
  - often shown as dashed lines



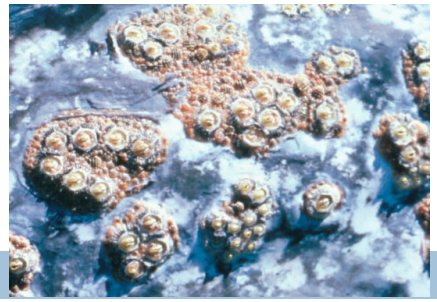
  - "Trophic Cascade"
    - every other trophic level benefits
    - affects primary producers





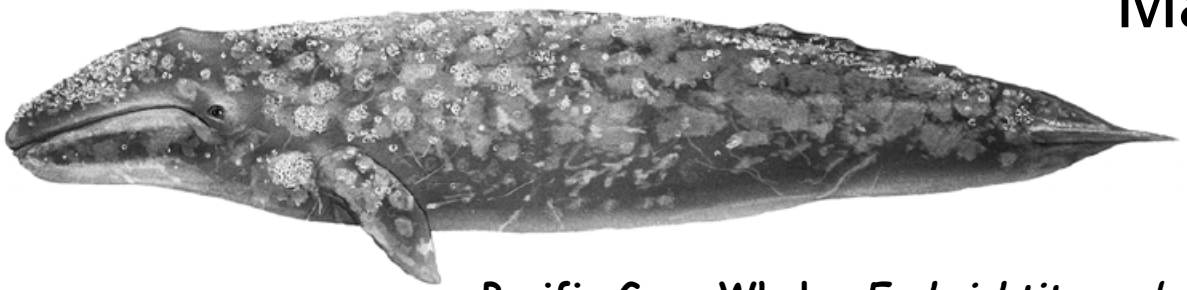


- Commensalism +/0



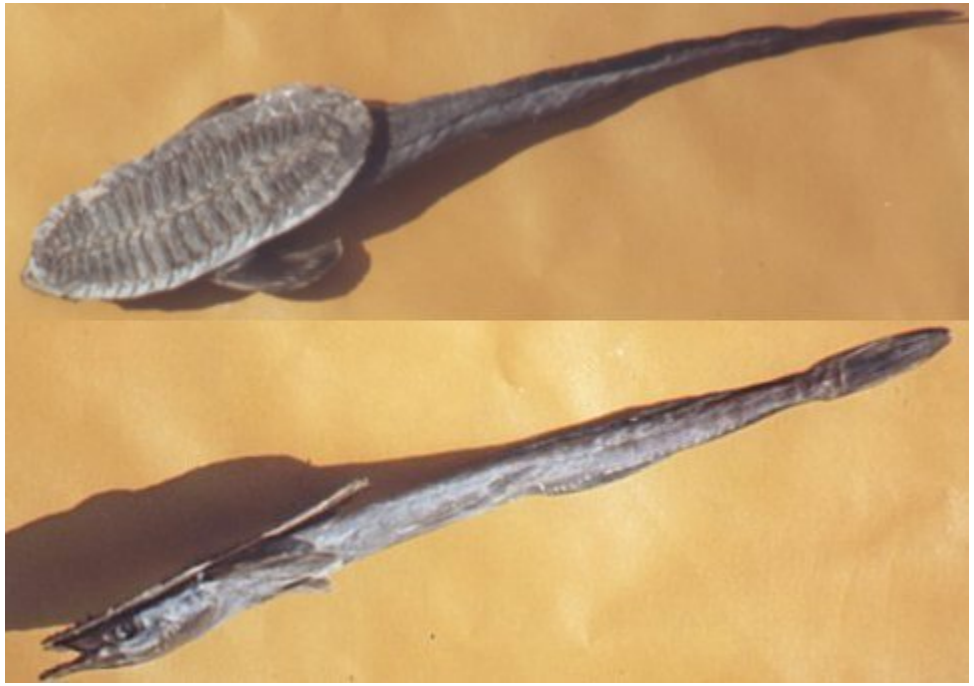
  - Species pairs where one benefits and the other is not affected (neutral)
  - Not well-studied
  - *Assumption of neutral effects for one species may not always be correct
    - Hydrodynamic consequences of barnacles/remoras?

Many baleen whales



Pacific Grey Whale, *Eschrichtitus robustus*

Cryptolepas rhachianecti



Remora (*Remora remora*)

Carrion scavengers following predators

Chris Wilmers, UC-Santa Cruz

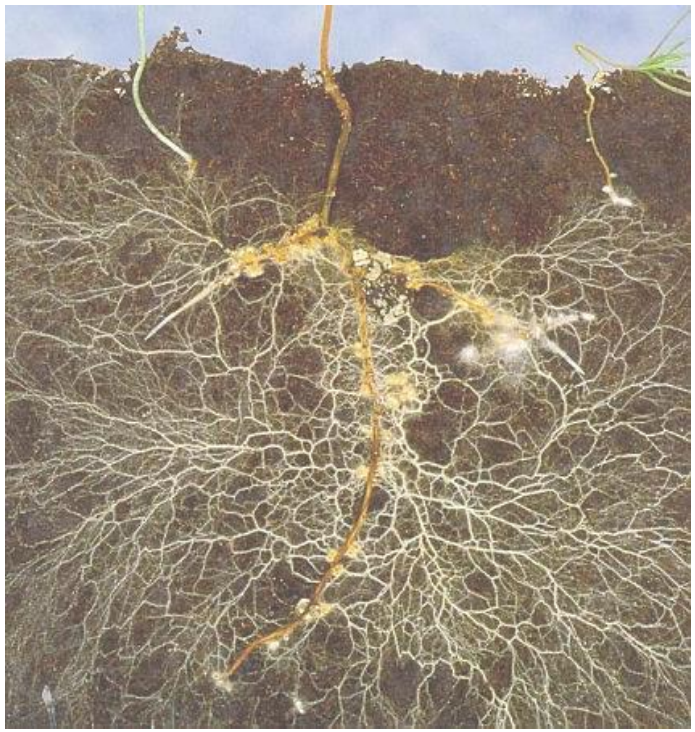
Mutualism +/+

– Species pairs where both benefit

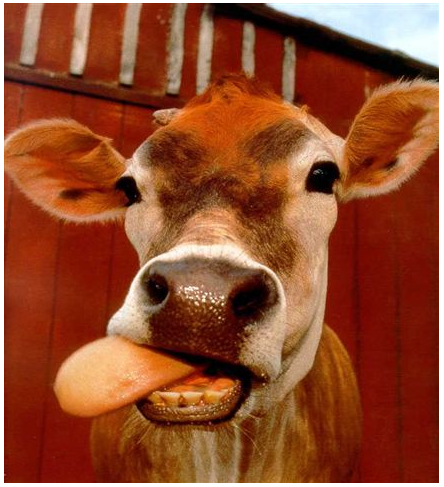
- **Trophic:** complimentary ways organisms obtain energy and nutrients
  - Often highly specialized
- **Defensive:** one species receives food/shelter in return for defense
  - Often highly specialized
- **Dispersive:** one species receives food in return for dispersal (pollen, seeds, fruit)
  - Not usually highly specialized

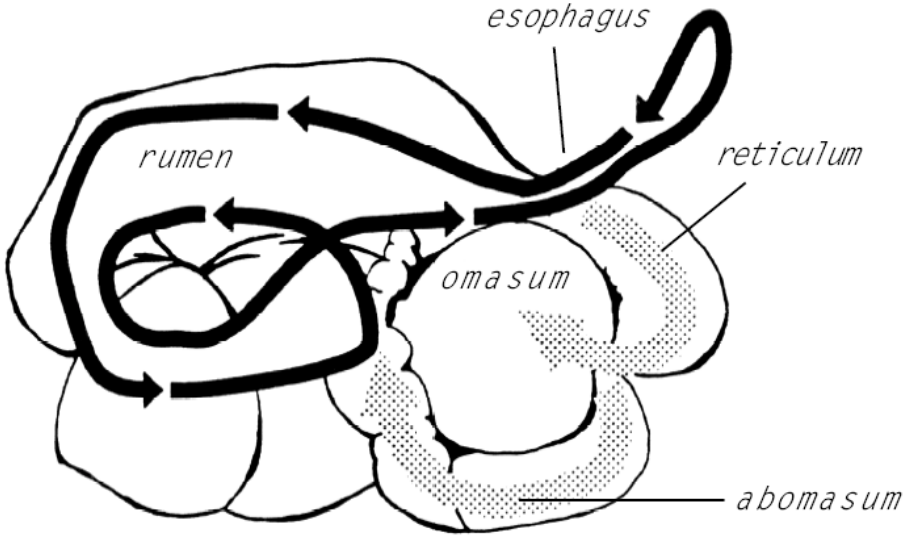
Trophic Mutualism

Ex. Mycorrhizal fungi & plants



Ex. Ruminant animals & gut bacteria

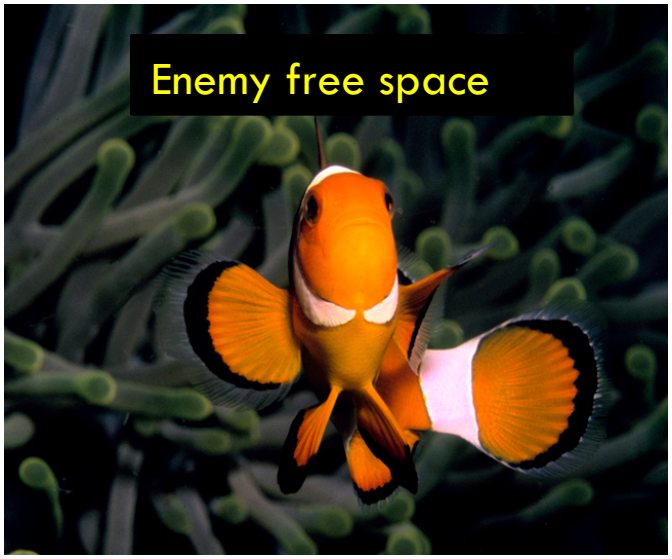




Defensive Mutualism

Ex. Clown anenomefish

anenome nematocysts

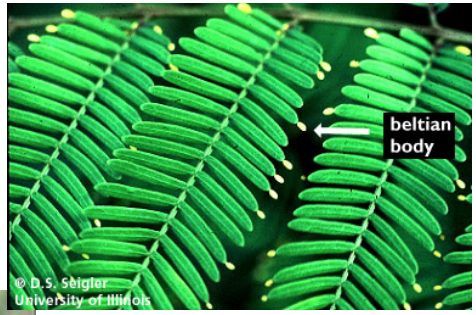


Amphiprion percula

Ex. Ant-Acacia

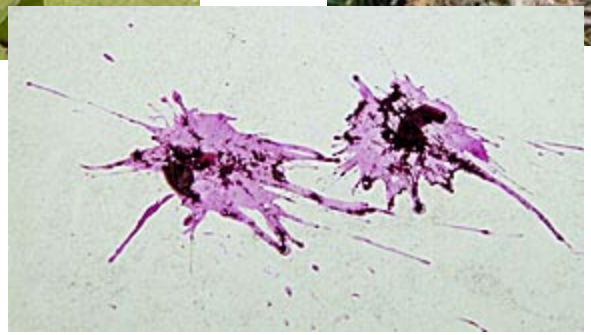
Acacia collinsii

Pseudomyrmex ferruginea



Dispersive Mutualism

Ex. Pollinators and flowers

(a)

Ex. Fruit and frugivores