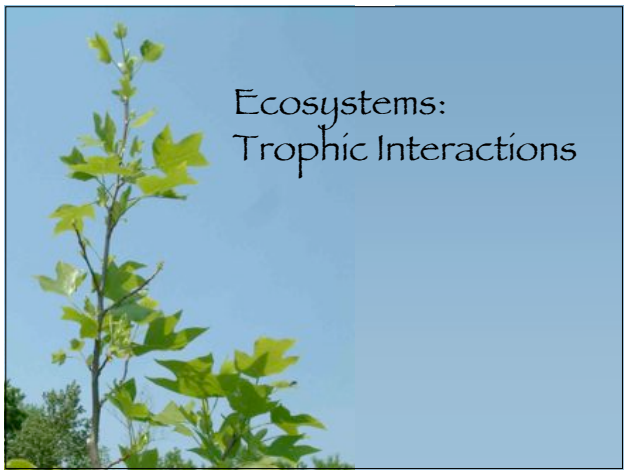


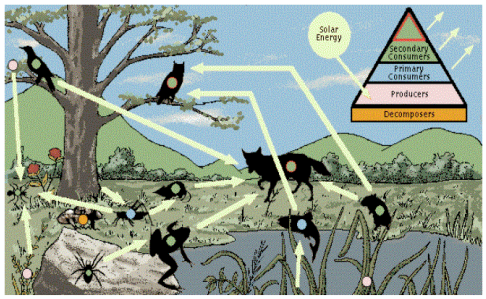
Ecosystems

- Most restoration discussion focuses on the ecosystem
- Ecosystem: biotic community plus its abiotic environment
  - Restoration typically focuses on the assemblages of organisms (biotic)
  - Trophic interactions

Trophic Interactions

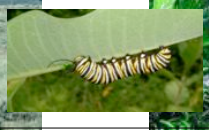
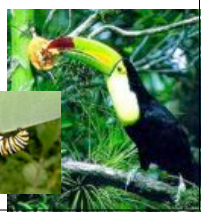
- Predator-prey
- Plant-herbivore
- Plant-parasite
- Multi-trophic
- Plant-mycorrhiza
- Plant-pollinator
- Trophic cascades

Trophic Interactions: Food webs



Plant-herbivore

- Long standing co-evolutionary relationship between plants and animals
- Herbivores need plants
- Plants need herbivores

Plant-herbivore

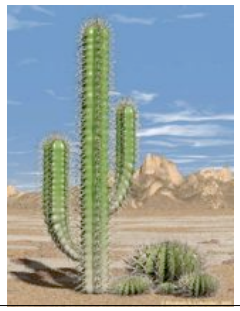

- Plants produce an enormous array of secondary chemicals to combat herbivores
  - Basis of pharmaceutical industry

cyanide, caffeine, cocaine, mescaline, latex, curare, nicotine, morphine, quinine, codeine,

and many, many, more…..

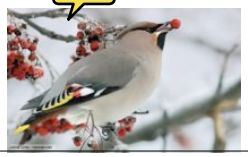
Plant-herbivore

- Mechanical defenses

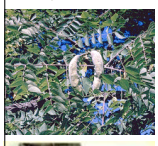


Plant-herbivore

- Plants need herbivores for seed dispersal
- Produce nutritious fruit to attract animals
  - Some seeds won't germinate unless they have gone through the gut
  - Small mammals forget where they buried their nuts



Plant-herbivore



- Kentucky Coffeetree (*Gymnocladus dioicus*)
- Threatened Provincially and Nationally
- Seeds won't germinate without removing seed coats
- Toxic to most animals
-

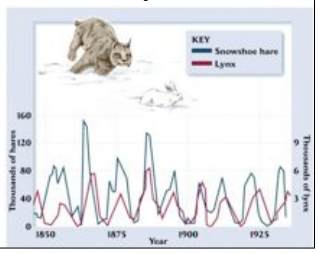
http://www.amnh.org/learn/musings/FA01/h_mb.htm

Plant-herbivore

- Abundance of herbivores closely linked to abundance of primary producers (and…)
  - Food limitation
- Community composition can depend on specific food preferences of herbivores
  - Reduce competitors for other plant species

Predator-prey

- Tightly linked relationship, strong dependence
- Abundance of herbivores closely linked to abundance of predators
  - Predator limitation



Predator-prey

- Prey may escape predator limitation:
- In time or space:
  - Migration, hibernation, behavioural adaptations
- By defence, being too large, breeding quickly
- These species tend to be limited by food (disease & parasitism)

Predator-prey

- Changes to predators result in explosions of herbivores
  - E.g. huge deer populations in SW Ontario due to loss of wolves & cougars
  - Cascading effects on vegetation…

Plant-parasite

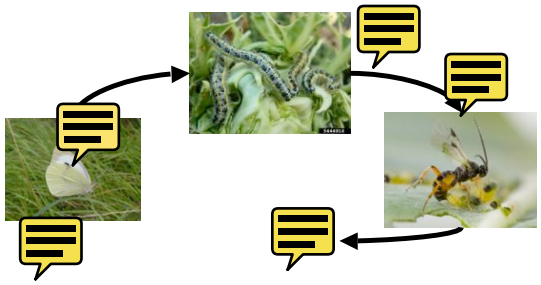
- Parasites can affect succession patterns and community composition
  - Indirectly by depressing herbivore populations
    - E.g. *Myxoma* virus reduced rabbits, many acorns sprouted and grassland turned into oakland
  - Directly by eliminating plant species

Plant-parasite

- E.g. American Chestnut blight
  - *Cryphonectria parasitica*
  - Introduced from Asia in early 1900
  - Wiped out 99% of chestnuts in 30 years
  - Dramatically changed deciduous forest composition in North America

Multi-trophic

- Indirect plant defence using natural enemies



http://observationsofanerd.blogspot.com/2009/05/this-weeks-sci-fi-worthy-parasite.html

Plant-mycorrhiz

- Symbiosis between plant roots and fungi
- >80% of plants have mycorrhizae
  - Many are totally dependent on them (e.g. orchids)

Plant-mycorrhiza

- Mycorrhizae help young plants establish
- Fungal communities may influence seedling recruitment & community composition

Without inoculation With inoculation

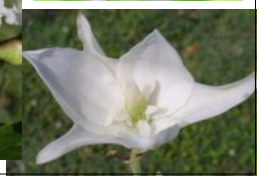
image by Laura Marx, Kenyon College

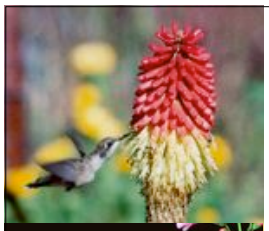
Plant-pollinator

- >90% of 250,000 a perms pollinated by animals
- Almost 300,000 flower-visiting animals
  - Insects, birds, bats, small marsupials
  - Pollination syndrom

Plant-pollinator

- Insect pollinated flowers:
  - White, pink, purple
  - Shape to fit insect
  - Scent





Plant-pollinator

- Bird-pollinated flowers:
  - Tubular
  - Red
  - No scent

Plant-pollinator

- Bat-pollinated flowers:
  - Whitish
  - Open
  - Musty or unpleasant odour
- Common in Tropics

Plant-pollinator

- Plants of different sexes require pollen transfer from another plant
- For animal pollinated plants a decrease in pollinators = severe decrease in reproduction

Plant-pollinator

- Threats: Fragmentation, pesticides, competition from non-native species
  - Specialist relationships more vulnerable than generalist

Plant-pollinator

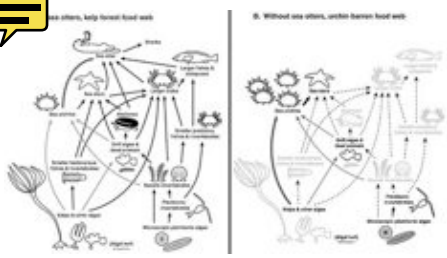
- Cucumber tree (*Magnolia acuminata*)
- Endangered Provincially and Nationally
- Pollinated by beetles
- Fragmentation
  - Only 12 natural populations, only 3 regenerating

Trophic Cascades

- Reciprocal consumer-resource effects that alter the abundance, biomass or productivity of a population, community or trophic level **across more than one link** in a food web
  - Species level: subset of community, affecting only a few species
  - Community level: substantial alteration of food web

Trophic Cascades

- Most intensively studied in aquatic ecosystems



Trophic Cascades

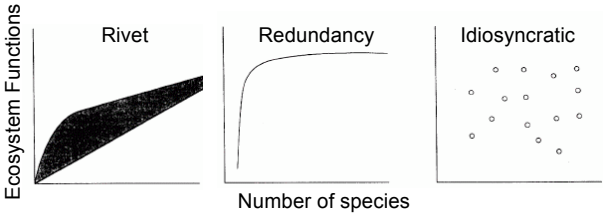
- Terrestrial: loss of large predators

Trophic Cascades

- Top-down: top predator removal
- Bottom-up: changes in plant abundance or quality
- Can originate from any level

Diversity & Ecosystem Function

- What happens to ecosystem function as biodiversity increases?



Diversity & Stability

- Does diversity lead to stability?
- Usually
  - More species means more redundancy and less effects on the whole community from disturbances

Importance for Restoration

- Various kinds of interactions have to be considered in restoration
- Focus on function, keystone species
- Realistic goals