7.014

Lectures 33,34,35

May 4,6,9

Species Interactions – *2005*

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Freeman, Scott. *Biological Science*. Upper Saddle River, NJ: Prentice Hall, 2002. Figure 49-14 upper left. ISBN: 0130819239.

Consumptive competition occurs when organisms compete for the same resources. These trees are competing for nitrogen and other nutrients.

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Preemptive competition occurs when individuals occupy space and prevent access to resources by other individuals. The space preempted by these barnacles is unavailable to competitors.

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Freeman, Scott. *Biological Science*. Upper Saddle River, NJ: Prentice Hall, 2002. Figure 49-14 middle left. ISBN: 0130819239.

Overgrowth competition occurs when an organism grows over another, blocking access to resources. This large fern has overgrown other individuals and is shading them.

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Freeman, Scott. *Biological Science*. Upper Saddle River, NJ: Prentice Hall, 2002. Figure 49-14 middle right. ISBN: 0130819239.

Chemical competition occurs when one species produces toxins that negatively affect another. Note how few plants are growing under these *Salvia* shrubs.

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Freeman, Scott. *Biological Science*. Upper Saddle River, NJ: Prentice Hall, 2002. Figure 49-14 lower left. ISBN: 0130819239.

Territorial competition occurs when mobile organisms protect a feeding or breeding territory. These red-winged blackbirds are displaying to each other at a territorial boundary.

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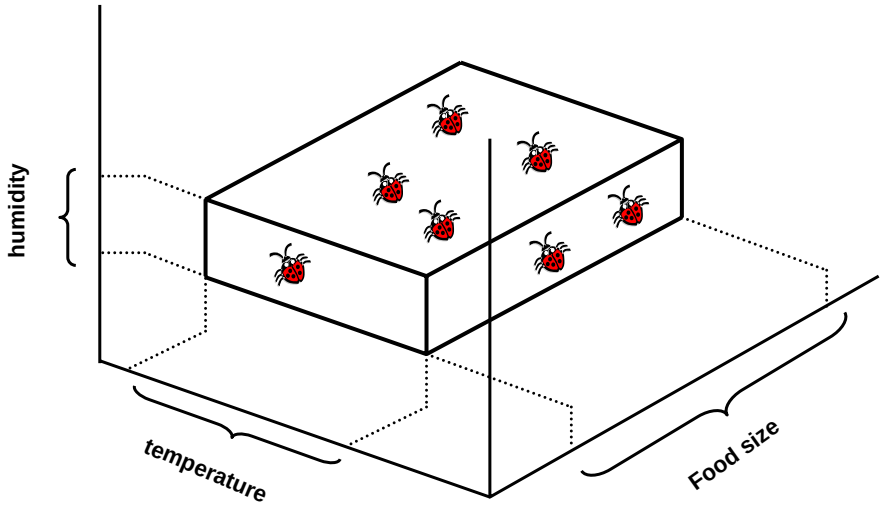
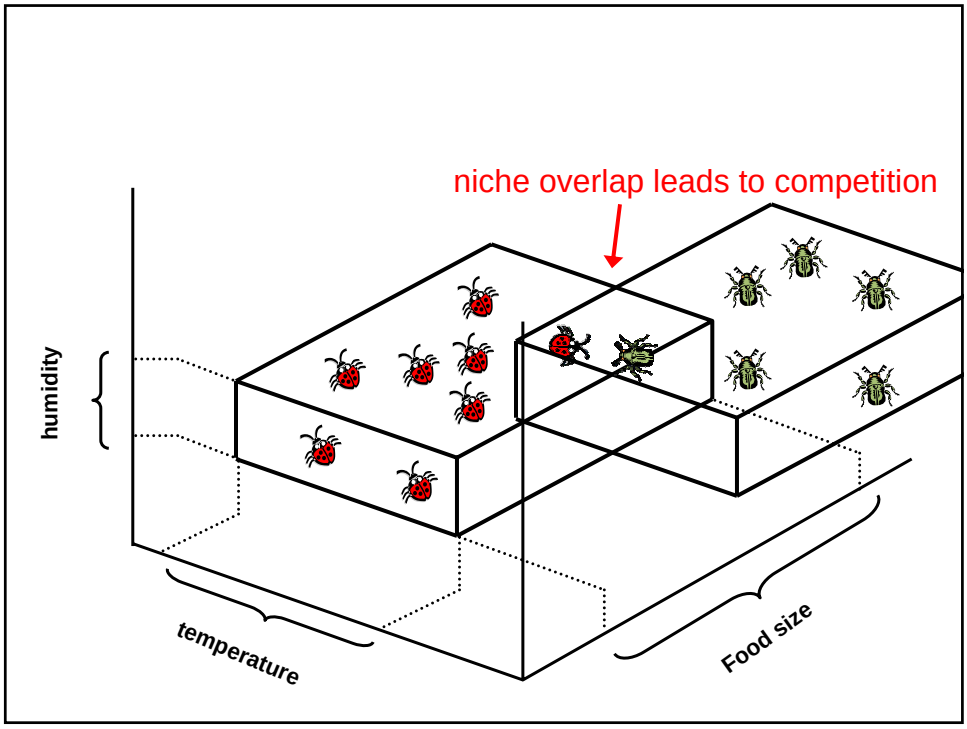
Freeman, Scott. *Biological Science*. Upper Saddle River, NJ: Prentice Hall, 2002. Figure 49-14 lower left. ISBN: 0130819239.

Encounter competition occurs when organisms interfere directly with each other's access to specific resources. Here, spotted hyenas and vultures fight over a kill.

The Fundamental Ecological Niche:

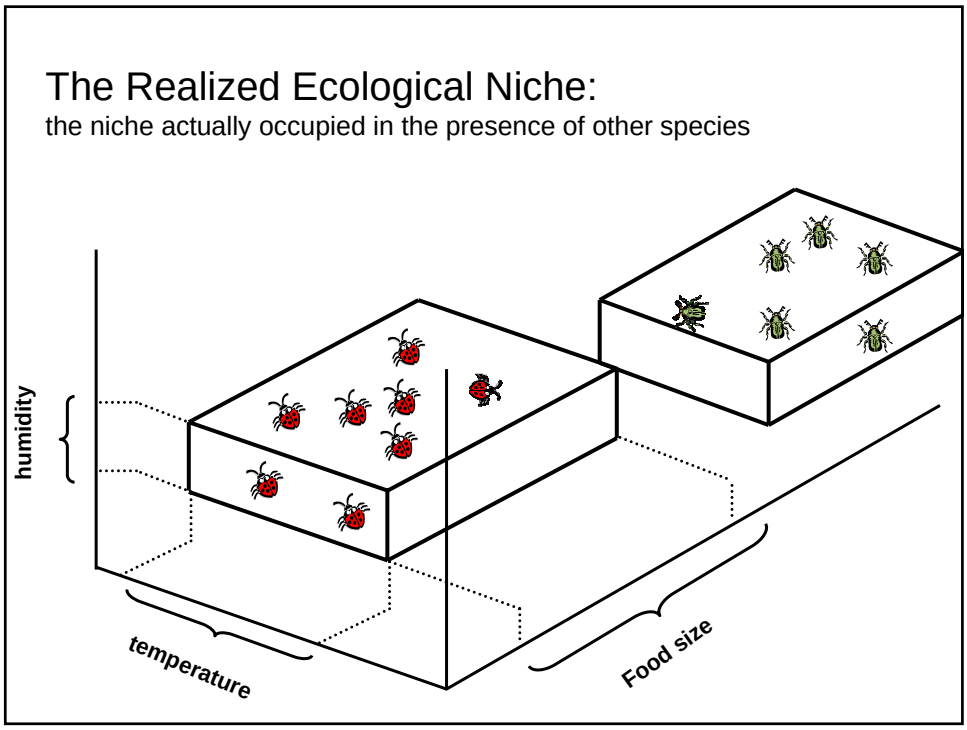
"An n-dimensional hyper-volume every point on which a species can survive and reproduce indefinitely in the absence of other species" (Hutchinson)





The Realized Ecological Niche:

the niche actually occupied in the presence of other species



One species eats seeds of one size range

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Partial niche overlap: competition for seeds of intermediate size

Partial niche overlap can lead to *Niche Partitioning* and *Competitive Coexistence*

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Complete niche overlap

Strong niche overlap can lead to *Competitive Exclusion*

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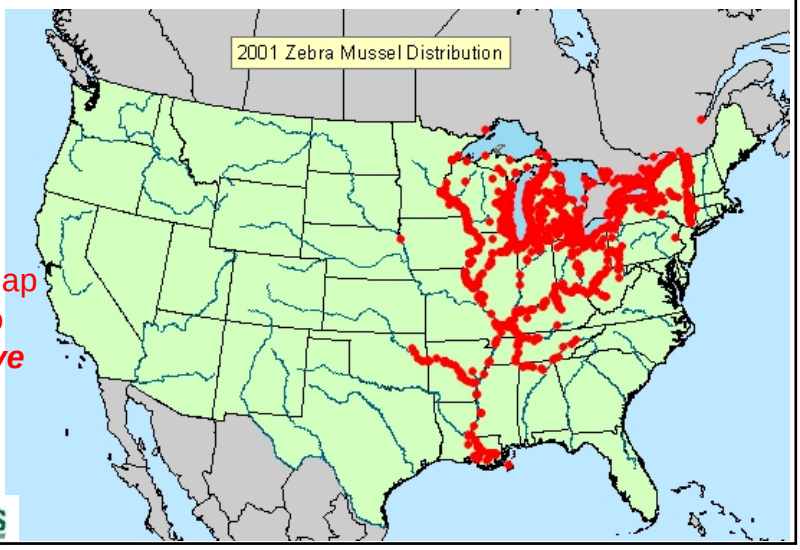
The Spread of Introduced Zebra Mussels in the United States (1998 – 2001)



Extensive niche overlap can lead to ***competitive exclusion***

Image taken from USGS Web site: http://www.usgs.gov.

Connell's Barnacles

Pelagic larvae are sessile as adults

A classic ecological experiment demonstrating niche partitioning

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Observed Distributions: **Is this due to competition?**
Or differential tolerance of desiccation?

Do an Experiment!

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Freeman, Scott. *Biological Science*. Upper Saddle River, NJ: Prentice Hall, 2002. Figure 49-15b. ISBN: 0130819239.

***Chthamalus* survives better without competition.**

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Connell's Barnacles

Pelagic larvae are sessile as adults

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Balanus outcompetes *Chthamalus* but is more vulnerable to desiccation

Chthamalus is resistant to desiccation but is outcompeted by *Balanus*

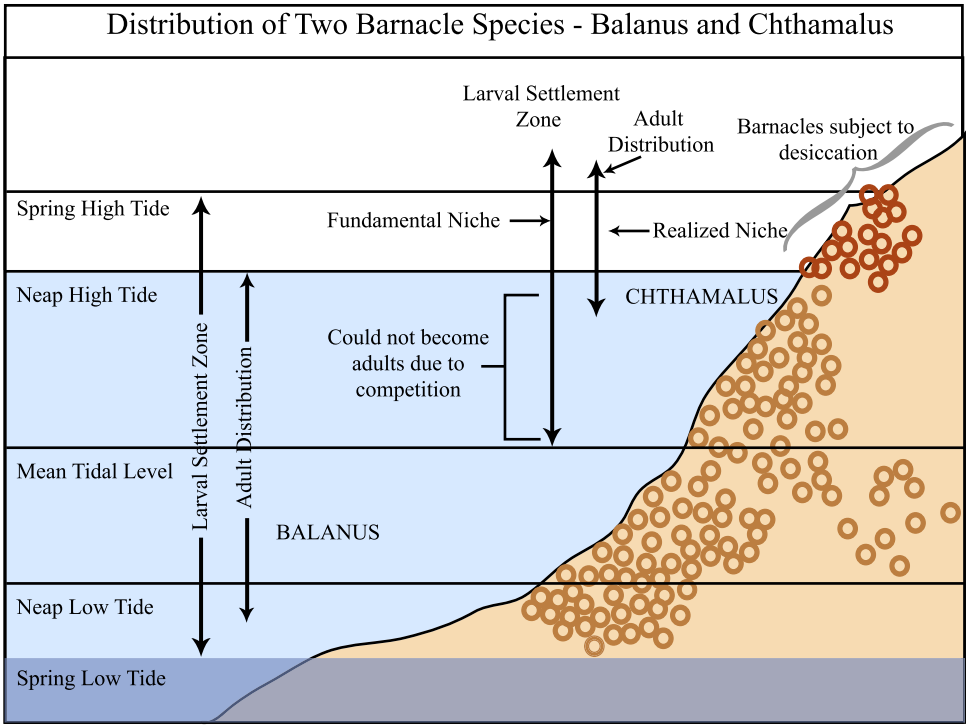
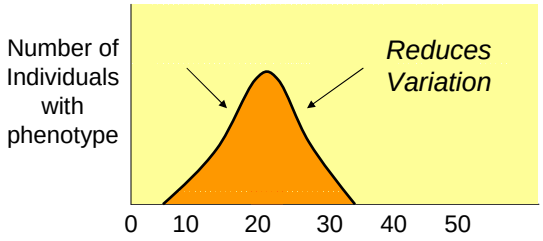


Figure by MIT OCW.

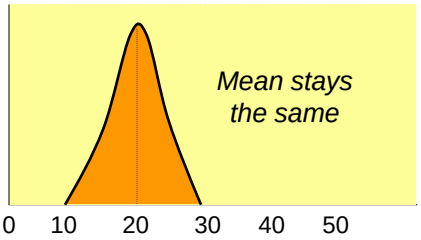
Stabilizing Selection

Medium-sized individuals favored



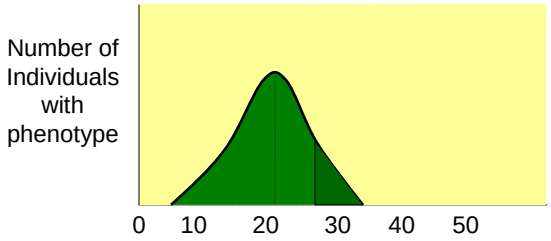
Peak gets higher and narrower

Selection



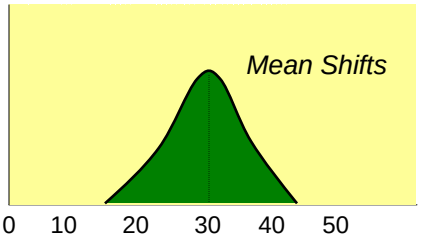
Directional Selection

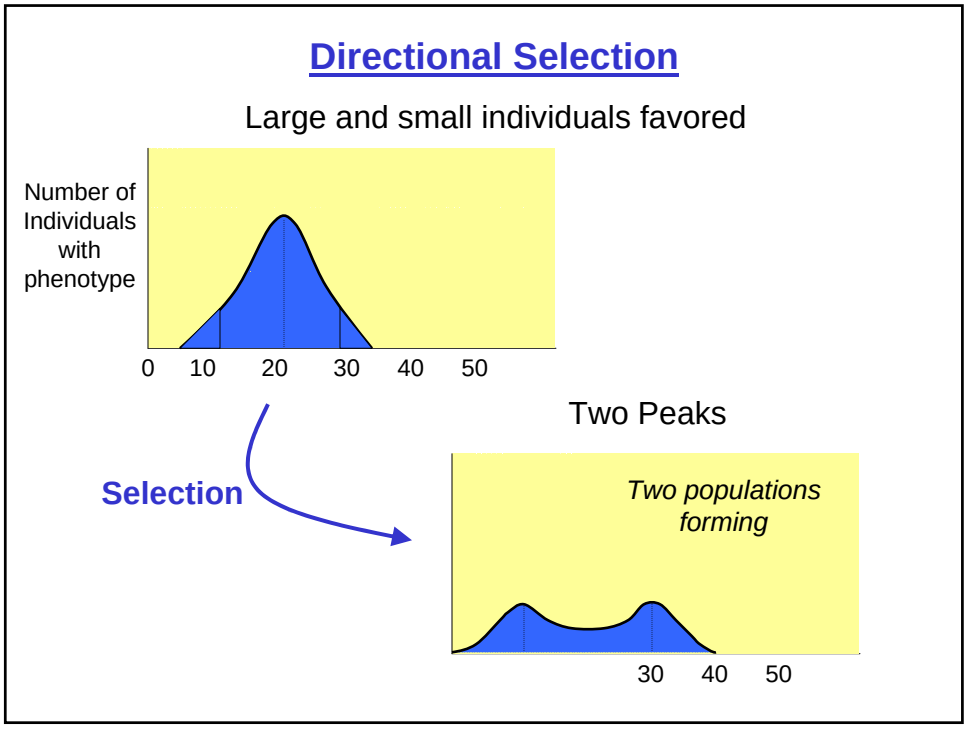
Larger individuals favored

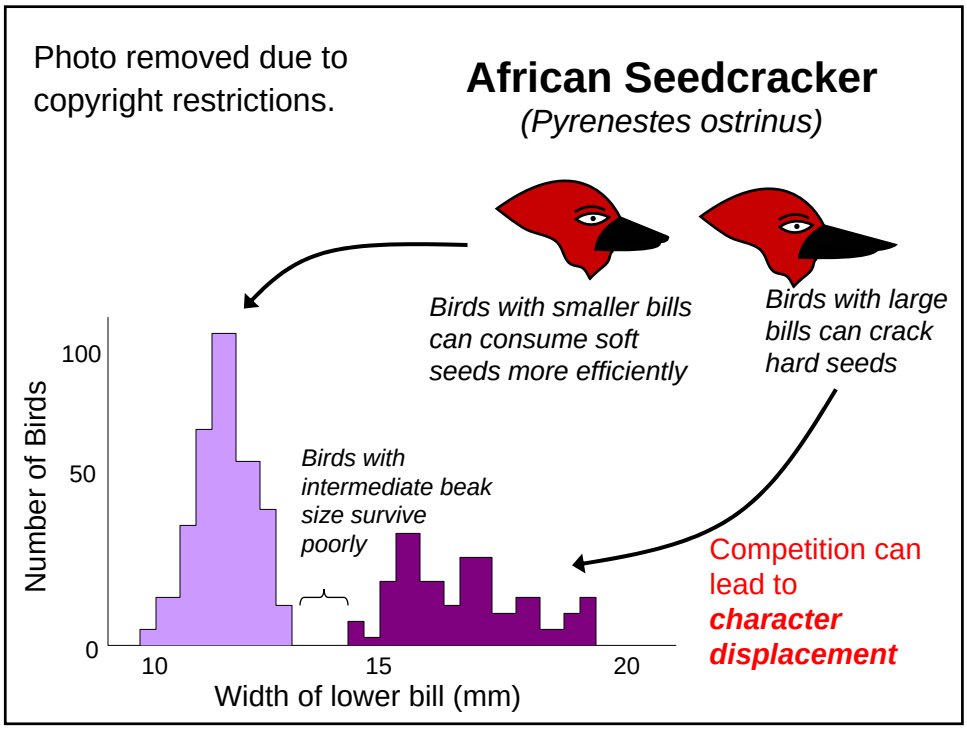


Peak shifts in one direction

Selection







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Galapagos Finches

Photos removed due to copyright restrictions.

Hawaiian Honeycreepers

Figure by MIT OCW.

Adaptive Radiation to Exploit a Variety of Food Sources Results in Speciation and a variety of Beak Shapes

Predation

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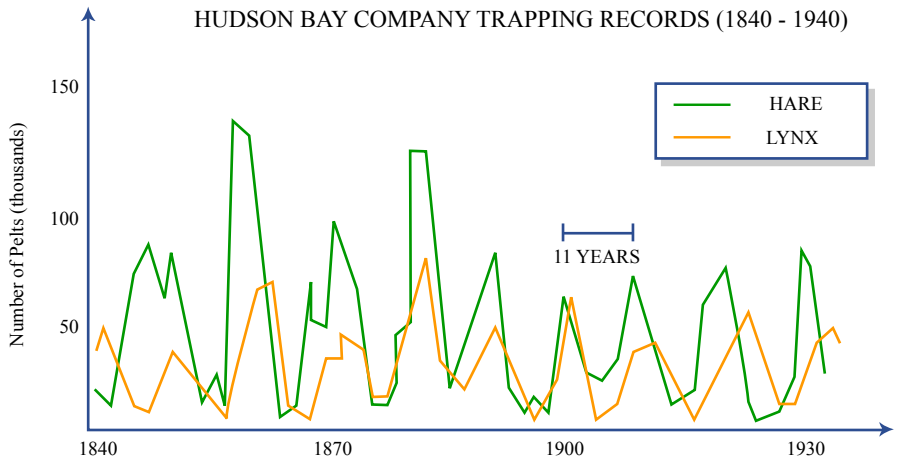
Please see:
Freeman, Scott. *Biological Science*. Upper Saddle River, NJ: Prentice Hall, 2002, chapter 49. ISBN: 0130819239.

Snowshoe Hare and Lynx Population Population Cycles

Lepus americaus *Lynx canadensis*

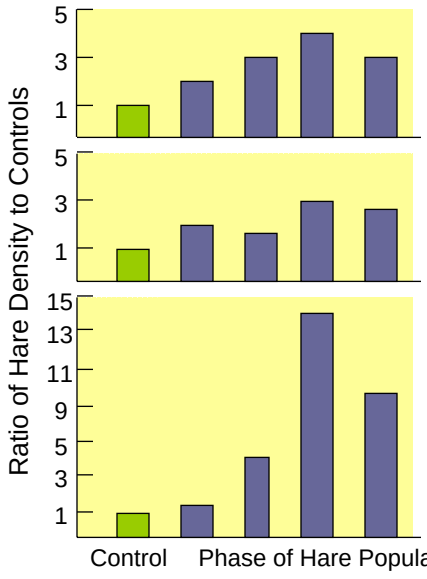


What drives the oscillation?

Image by MIT OCW.

Field Experiments - Lloyd Keith (1960's to 1980's)

What accounts for population cycles?
Food Supply or Predation?



Food Supply Increased

Predators Excluded

Food Supply Increased & Predators Excluded

CONCLUSION:

Food Supply & Predation both affect population cycles.

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Please see:
Ricklefs, Robert E. *The Economy of Nature*. New York, NY:
W. H. Freeman, November 21, 2000, p. 372. ISBN: 071673883X.

Keystone predator present

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Prentice Hall, 2002. Figure 49-9 left. ISBN: 0130819239.

Keystone predator absent

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Keystone predator present

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Keystone predator absent

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Evidence for predation as an evolutionary agent:

- Cryptic Coloration
- Physical and Chemical Defenses
- Mimicry


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Cottonwood tree felled by beavers

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Resproutedtrees have more defense compounds.

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Herbivorous larvae have higher survivorship in the face of their own predators (ants) when they have been feeding on resproutedtrees.

Thus --- Leaf beetle larvae sequester anti-beaver compounds and use them as a defense against ants

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Inducible Defenses – Only induced in presence of predator

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Correlation between predation rate and prey defense

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Is prey defense induced by presence of predator?

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Weapons

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Freeman, Scott. *Biological Science*. Upper Saddle River, NJ: Prentice Hall, 2002. Figure 49-7 lower. ISBN: 0130819239.

Mimicry

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Please see:
Freeman, Scott. *Biological Science*. Upper Saddle River, NJ: Prentice Hall, 2002. Figure 49-7 center. ISBN: 0130819239.

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Wickler, Wolfgang. *Mimicry in plants and animals*. Translated from the German by R. D. Martin. New York, NY: McGraw-Hill, 1968. ISBN: 0070701008.

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Wickler, Wolfgang. *Mimicry in plants and animals*. Translated from the German by R. D. Martin. New York, NY: McGraw-Hill, 1968. ISBN: 0070701008.

Camouflage

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Freeman, Scott. *Biological Science*. Upper Saddle River, NJ: Prentice Hall, 2002. Figure 49-7 upper. ISBN: 0130819239.

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Wickler, Wolfgang. *Mimicry in plants and animals*. Translated from the German by R. D. Martin. New York, NY: McGraw-Hill, 1968. ISBN: 0070701008.

Mutualism

- Mutualism is a type of interaction that is beneficial to both species involved.
- It does not involve altruism. The benefits are a by-product of each species' own self-interest.
- The costs and benefits of mutualism vary widely between partners, over time, and from one area to the next.
  (Fig. 49.16a–c)

Treehopper excreting honeydew, which is harvested by ants

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Are ants beneficial to treehoppers?

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But in years where spiders are less abundant, the ants provide no advantage

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Mutualism between ants and fungus

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Mutualism between fish

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