Biosenosa; Komunitas Biotik

Compiled From Various Sourcess
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Why are ecological interactions important?

- **Predation**
  (one organism feeds on another)

- **Competition**
  (organisms attempt to use the same resource)

- **Symbiosis**
  (two organisms live closely together)

How has predation influenced evolution?

<u>Adaptations</u> to avoid being eaten:

spines (cactii, porcupines)
hard shells (clams, turtles)
toxins (milkweeds, some newts)
bad taste (monarch butterflies)

camouflage
aposematic colors
mimicry

Predation

Predation – one species feeds on another → enhances fitness of predator but reduces fitness of prey

Examples include:

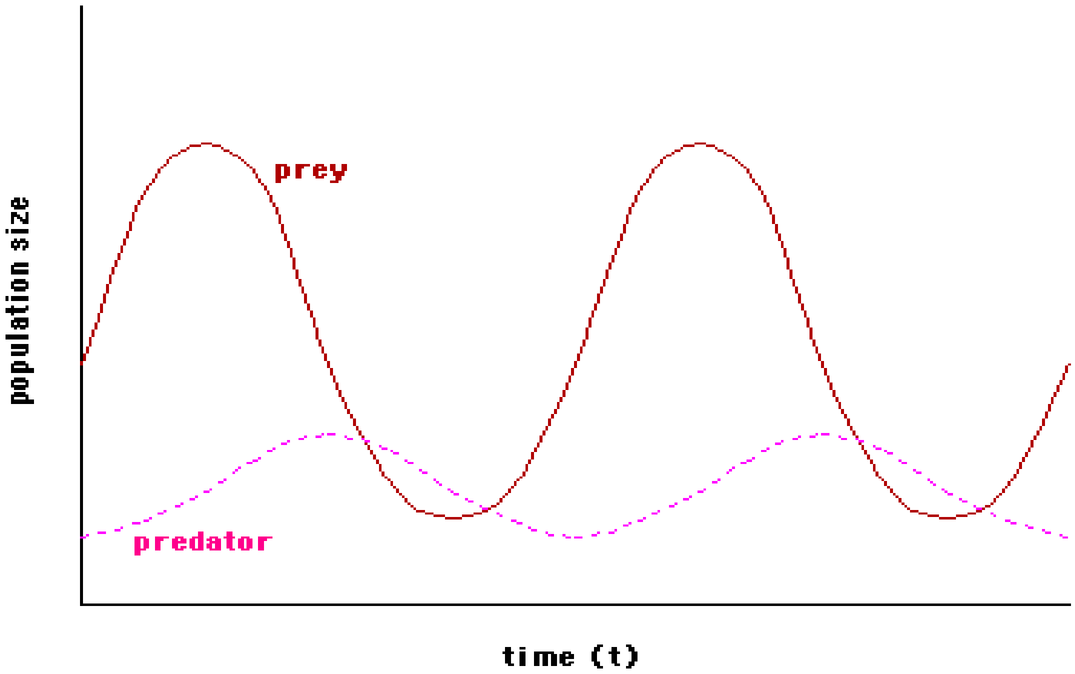
Red Tail Hawk feeding on a small mammal

Blue Whale feeding on krill, (a small shrimp-like animal)

1st order consumers eating plants

Predator – Prey Interactions

- Predation is a key <u>regulator</u> of animal populations



Predator-prey population dynamics are conne

Predators kill prey → *affects prey death rate*

$$dN_{prey}/dt = rN_{prey} - pN_{prey}N_{predator}$$

change in prey population

per capita rate of growth
without predation

deaths due to predation

Predator-prey population dynamics are conne

Predators kill prey → *affects prey death rate*

$$dN_{prey}/dt = rN_{prey} - pN_{predator}N_{prey}$$

predation rate

- prey population size depends on number of predators
- with few predators, prey population grows
- with many predators, prey population shrinks

Predator-prey population dynamics are conne

Predators eat prey → *affects predator birth rate*

$$dN_{predator}/dt = cpN_{prey}N_{predator} - dN_{predator}$$

change in predator population

births due to predation

death rate

Predator-prey population dynamics are conne

Predators eat prey → *affects predator birth rate*

$$dN_{predator}/dt = cpN_{prey}N_{predator} - dN_{predator}$$

conversion rate *of prey to baby predators*

predation rate

- predator population size depends on number of prey
- with many prey, predator population grows
- with few prey, predator population shrinks

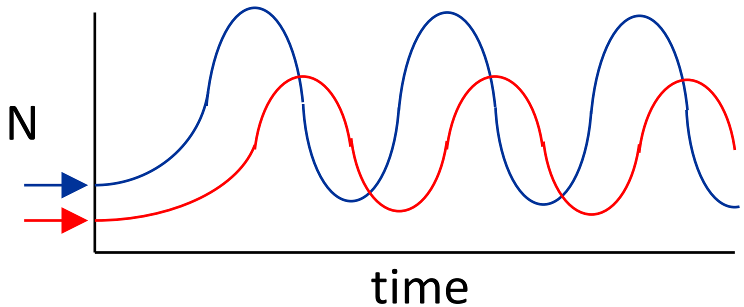
Predator-prey population dynamics are conne

Predators kill and eat prey → *affects prey death rate*
→ *affects predator birth rate*

$$dN_{prey}/dt = rN_{prey} - pN_{predator}N_{prey}$$

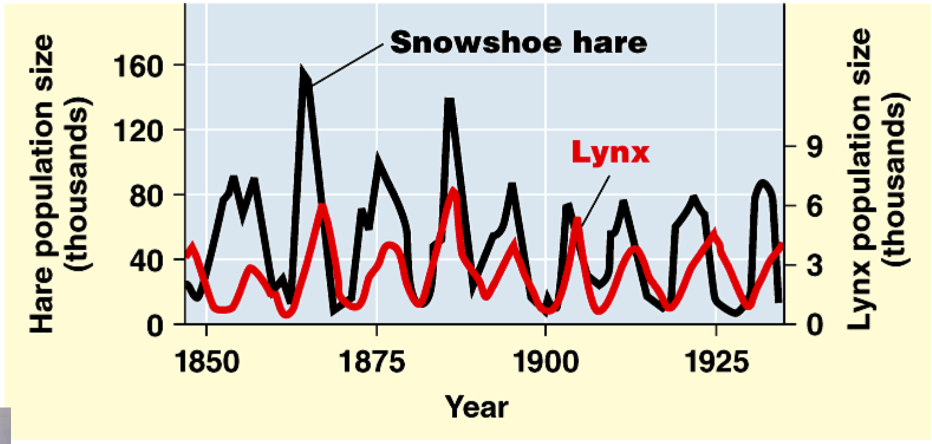
$$dN_{predator}/dt = cpN_{prey}N_{predator} - dN_{predator}$$

- with few predators, prey population grows
- with many prey, predator population grows
- with many predators, prey population shrinks
- with few prey, predator population shrinks



Lotka-Volterra models describe predator and prey population cycling.

Real world predator and prey populations can cycl in size.



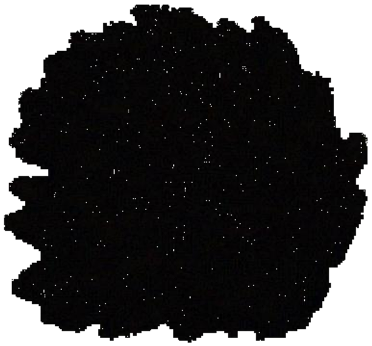
Factors Affecting Carnivory

- Prey size
  - Usually take animals that are smaller than themselves *(provides most energy gain for the least energy cost)*
  - Large prey is harder to chase and subdue.
  - Higher risk of being injured when taking large prey

Keystone species affect community structure

Predators can allow coexistence of competing pre

competitors



Barnacles **Mussels**

Balanus ***Mytilus***

(Paine 1966)

Keystone species affect community structure

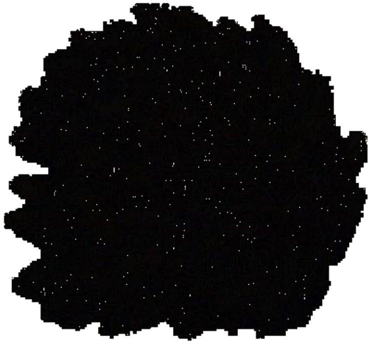
Predators can allow coexistence of competing pre

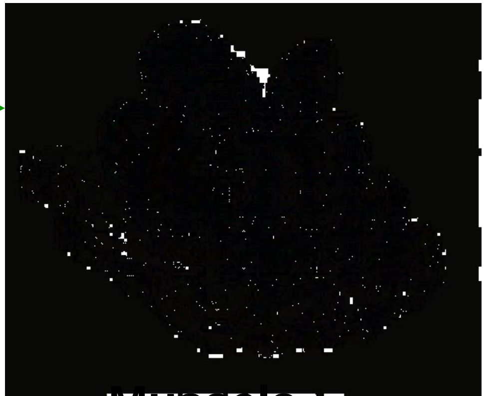
predator

Starfish

Pisaster

competitors





Barnacles

Balanus

Mussels

Mytilus

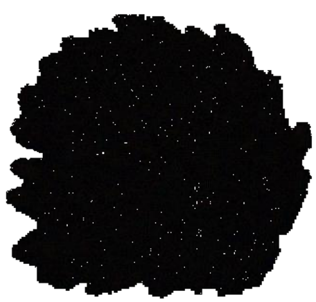
(Paine 1966)

How can we test the effect of a predator on community structure?

<u>Experiment</u> - Remove the predator

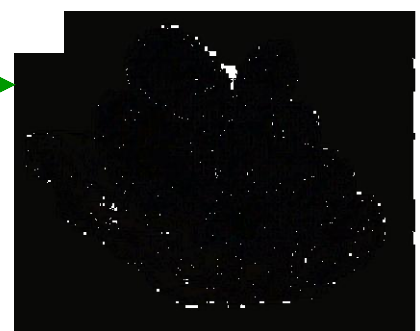
Starfish

Pisaster



Barnacles

Balanus

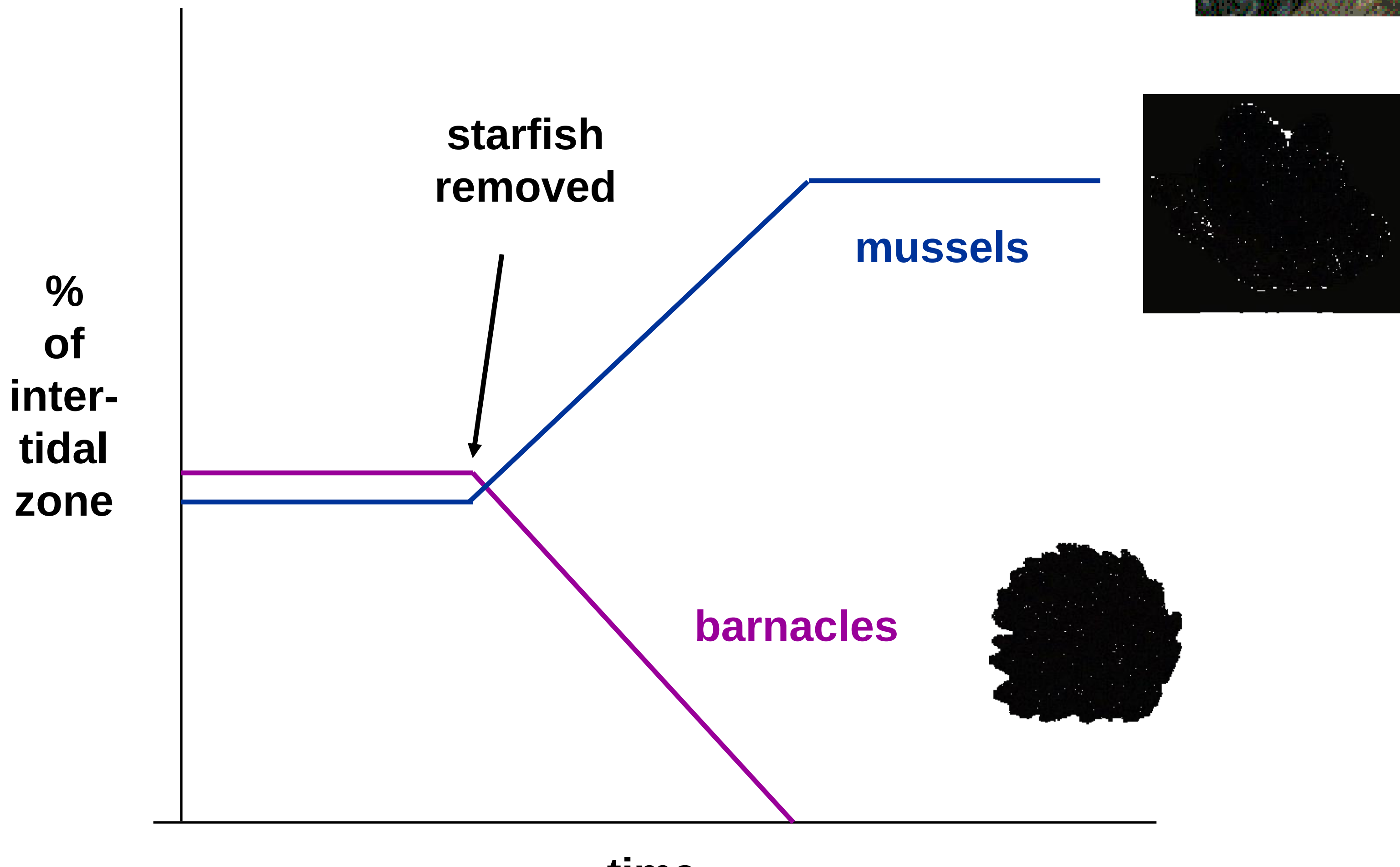


Mussels

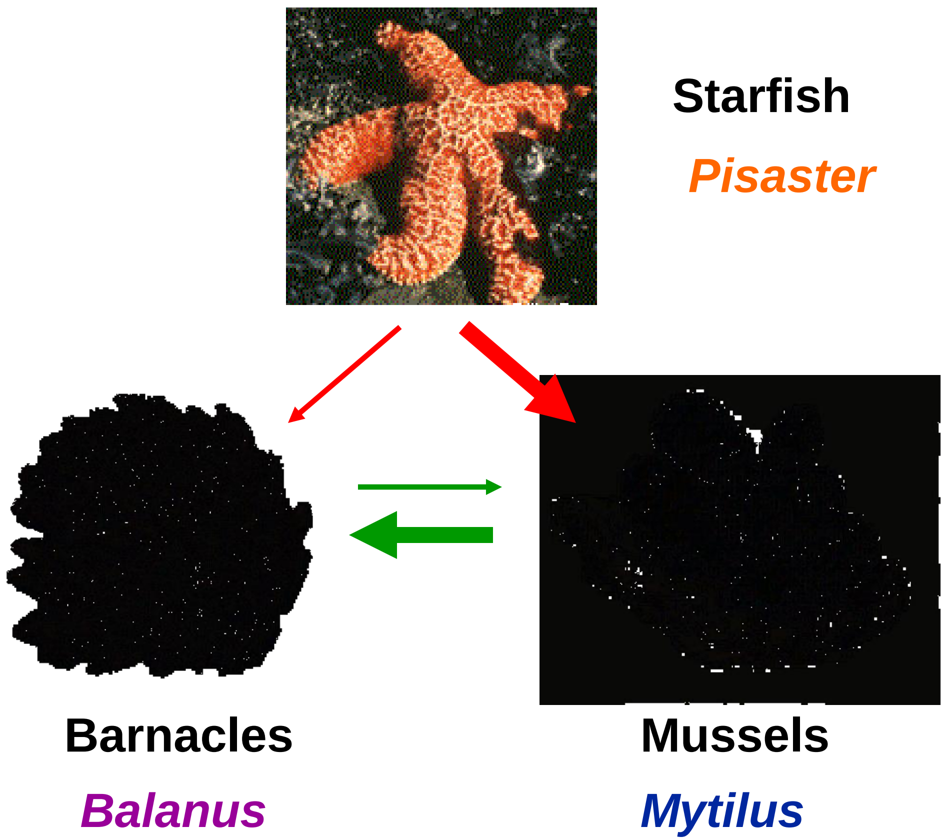
Mytilus

What is the effect of the predator on the structure of this community?

- starfish allow coexistence of competitors



<u>How</u> do starfish promote coexistence?



Starfish are <u>picky</u> – they prefer mussels (dominant compe
which allows barnacles (weaker competitor) to coexist.

Keystone species affect community structure disproportionately to their abundance.

Picky predators can promote coexistence among competing prey species.

Competitive exclusion is prevented when the dominant competitor is the preferred prey.

Animal Defenses Against Predators

- Chemical defenses
  - poisons and stings
- Defensive coloration
  - aposematic coloration (warning coloration)
    - individuals advertise poisonous nature
  - cryptic coloration
    - camouflage (blending coloration)

- <u>Animal defenses against predators</u>

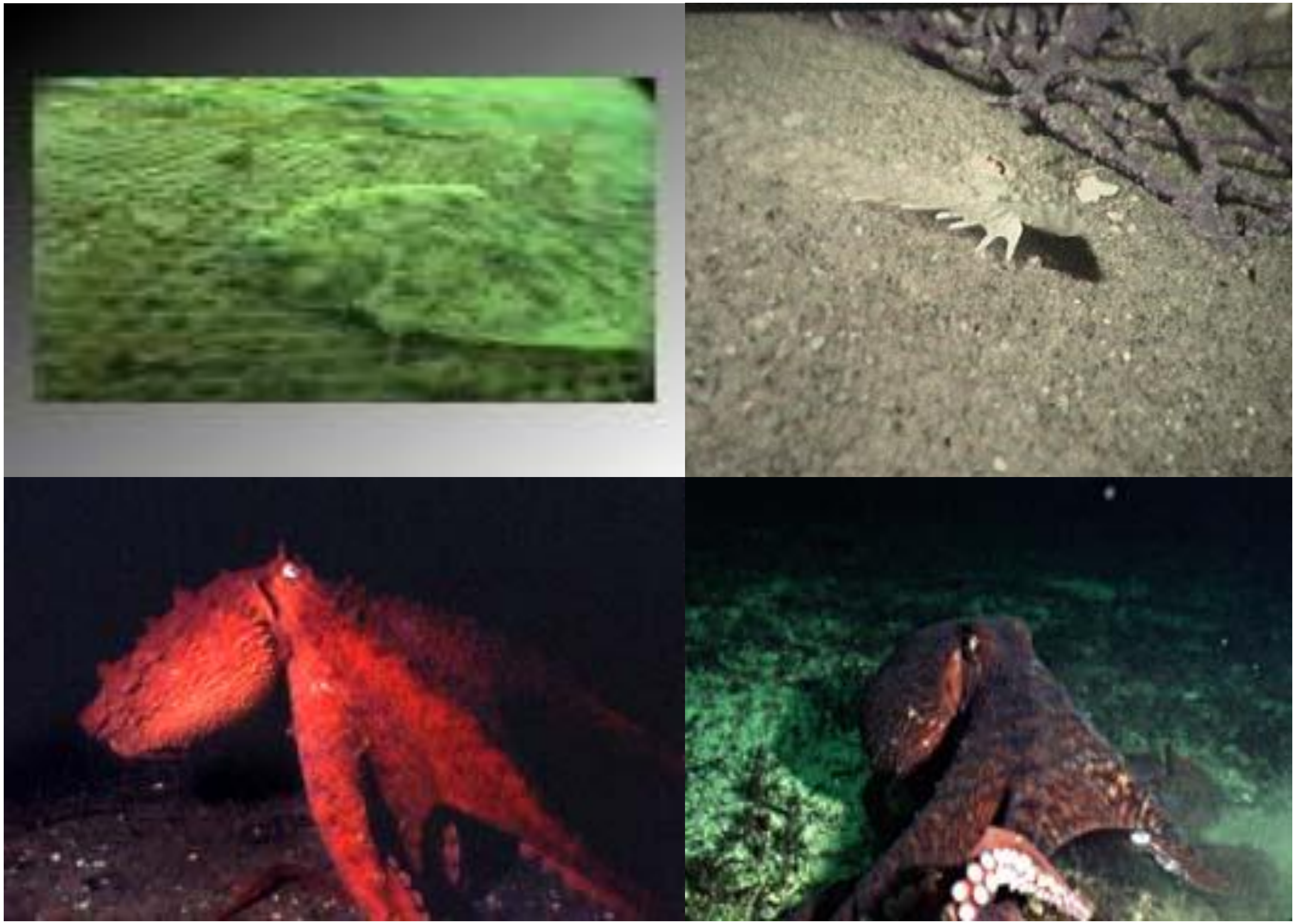
  – Camouflage

    - Cryptic coloration *(making themselves difficult to spot)*
    - Defensive markings *(confuse and discourage predators)*

Camouflage – blending in

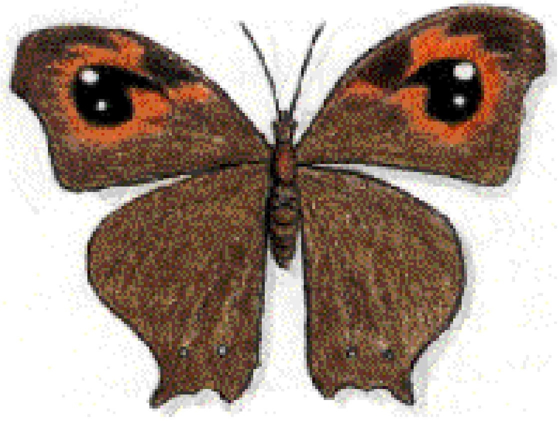
Crypsis *(Coloration, Body Type, or Behavior That Disguises Animal)*

Crypsis in marine species



- Defensive markings *(used to confuse or discourage predators)*

  - Fake eye spots
    - Predators can't locate the head
    - Prey may appear much larger



- Mechanical defenses
  - *Sharp quills or spines*

- Chemical defenses
  - Production of distasteful and toxic compounds
  - Usually associated with warning colors
    - *Bright conspicuous color patterns*

Aposematic colors – warning

- Aposematic Coloration

Monarch Butterfly

Retains cardiac poisons from when it was a larvae

Cobalt Blue Poison Dart Frogs

- Golden dart frog (*Phyllobates terribilis)*
  - Most poisonous animal known to man
  - Tetradotoxin (TTX)
    - Potent neurotoxin
    - 10,000 times more lethal than cyanide
    - Enough poison in one frog to kill up to 200 people
    - Causes convulsions and paralysis

- Rough skinned newt
  - Also produces TTX
  - Enough poison to kill 7 people

Predator-Prey Arms Race
The Coevolution of Two Species

(Mutual influence on the evolution of two species due to their interactions with each other)

- Rough skinned newt

- Common garter snake
  - Becoming more tolerant of TTX poison

- Mimicry *(Animal Closely Resembles Another Species)*

  -Batesian *(harmless species resembles dangerous species* Palatable insects resemble brightly colored, distasteful species*)*

  -Mullerian *(dangerous species resembling each other)*

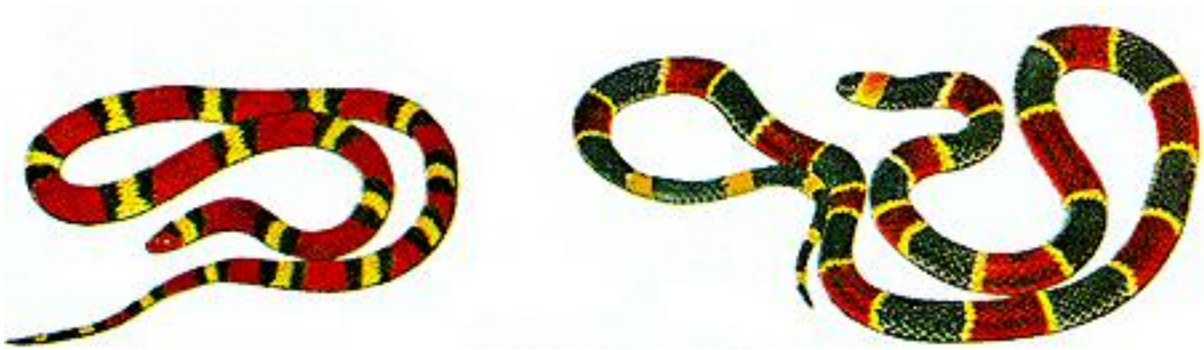
  - Predators learn to avoid both after tasting one
  - Example: (Bees and wasps)

Batesian Mimicry and Warning Coloration

- Arizona Coral Snake

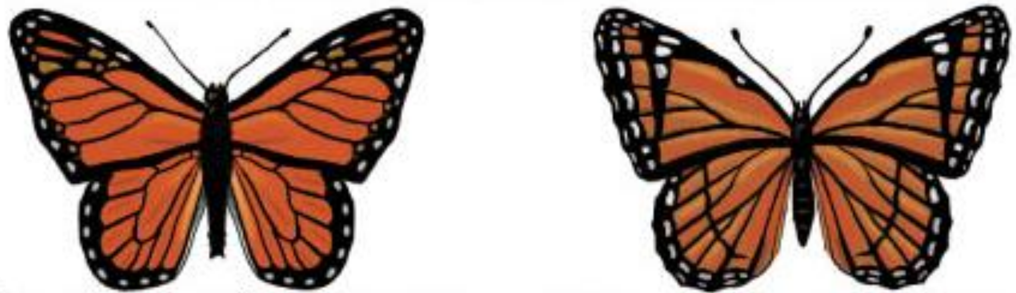
- Arizona Mountain King Snake

Mimicry – look like something that is dangerous or tastes bad



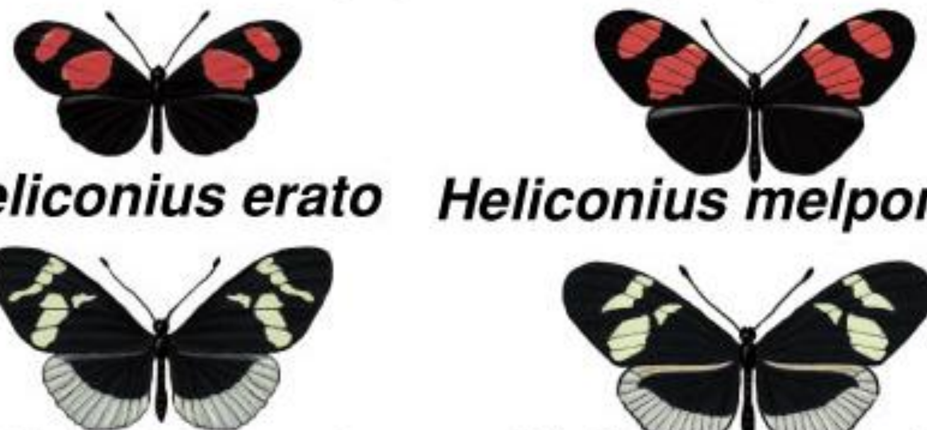
Mimicry – look like something that is dangerous or tastes bad

Mullerian mimicry – convergence of several unpalatable species



Danaus plexippus *Limenitis archippus*

(a) Batesian mimicry: Monarch (*Danaus*) is poisonous; viceroy (*Limenitis*) is palatable mimic



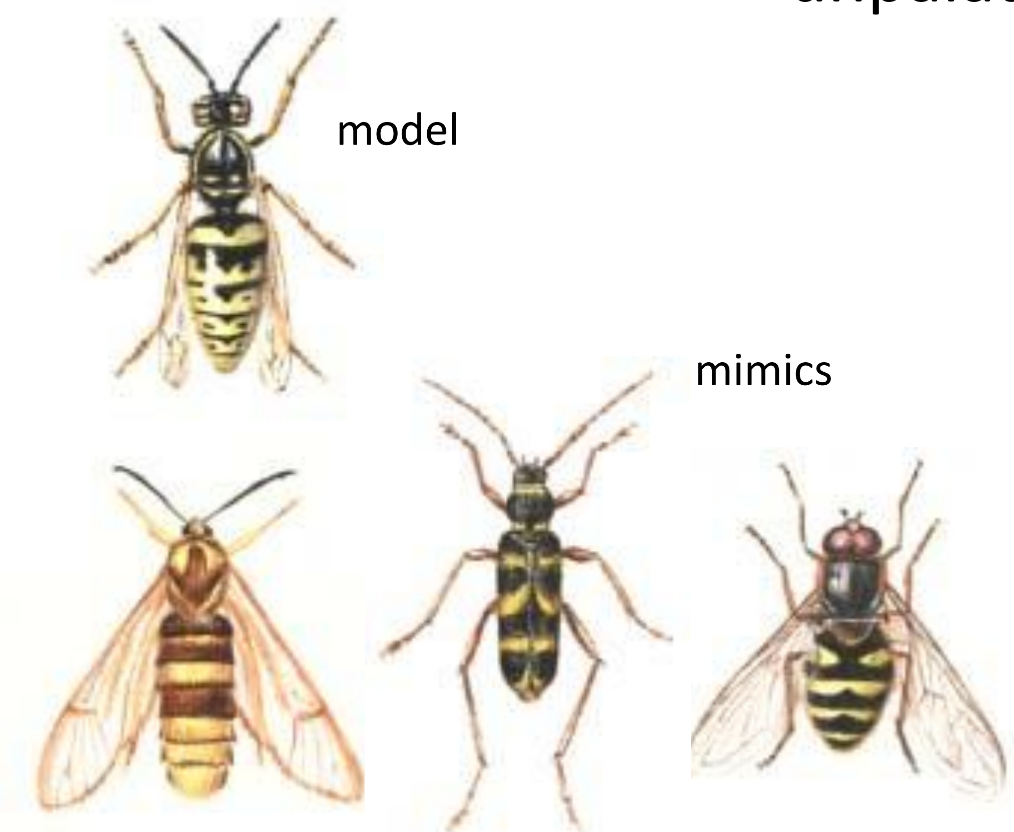
Heliconius erato *Heliconius melpomene*

Heliconius sapho *Heliconius cydno*

(b) Müllerian mimicry: two pairs of mimics; all are distasteful

Mimicry – look like something that is dangerous or tastes bad

Batesian mimicry – palatable species mimics an unpalatable species



model

mimics

mimic

model

Types of predators

- Carnivores – kill the prey during attack

- Herbivores – remove parts of many prey, rarely lethal.

- Parasites – consume parts of one or few prey, rarely lethal.

- Parasitoids – kill one prey during prolonged attack.

Coevolution and Symbiosis

- Coevolution involves long-term mutual evolutionary character adjustments of two or more species.
  - predator-prey interactions
  - symbiotic relationships
    - two or more kinds of organisms live together in permanent relationships
      - commensalism, mutualism, and parasitism

Commensalism

- One species in symbiotic relationship benefits while the other is neither helped or hurt.
  - tropical fish and sea anemones
- No clear distinction between mutualism as it is difficult to determine if the second member of the relationship benefits.
  - can easily transform into parasitism

Mutualism

- Both species in relationship benefit.
  - mutual cooperation
    - ants and acacias

Parasitism

- Parasite is much smaller than the prey and benefits while inflicting some form of harm to the prey.
  - ectoparasites
    - external parasites - lice
      - parasitoids - lay eggs on living hosts
  - endoparasites
    - internal parasites
      - extreme specialization

Interactions Among Ecological Processes

- Predation reduces competition
  - reduce numbers of competitive species
- Parasitism can counter competition
  - Parasite may affect sympatric species and thus influence interspecific interactions.
- Indirect effects
  - Presence of one species may affect a second species through interactions with a third species.

Interactions Among Ecological Processes

- Keystone species: Species that have a particularly strong effect on community composition; **top predators**