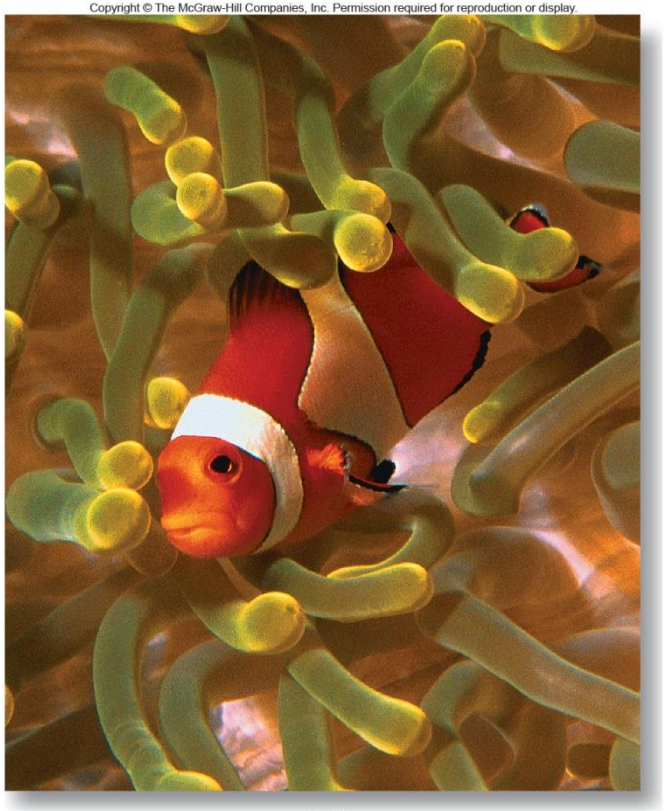
# Community Ecology
## Chapter 56





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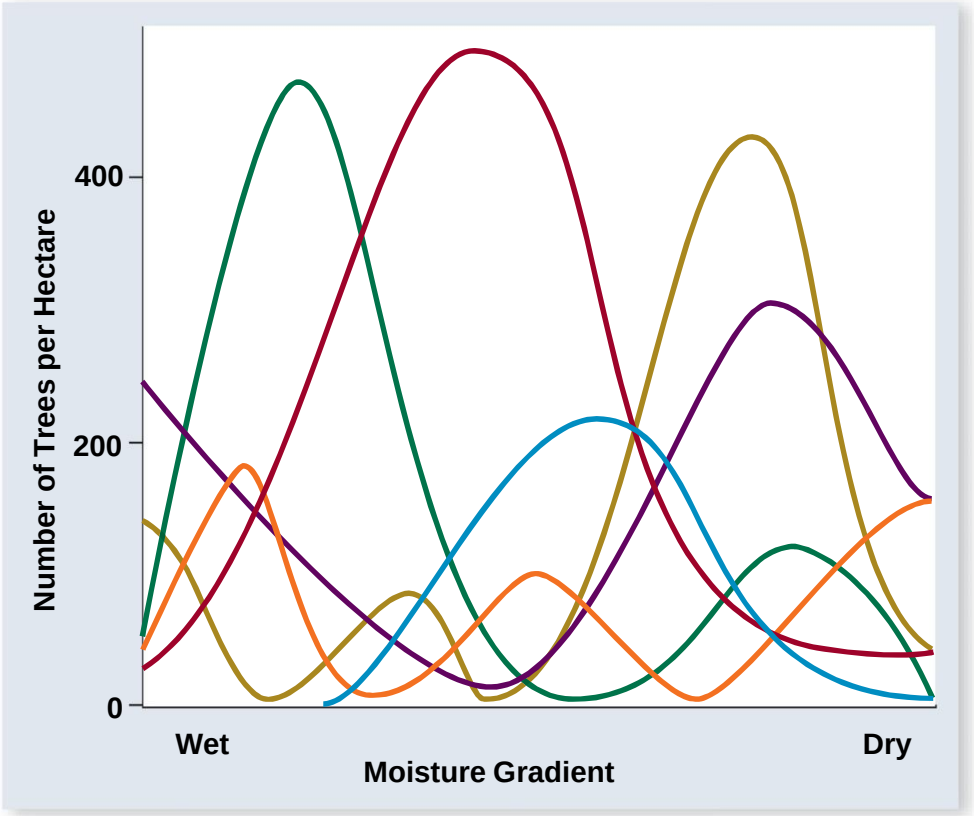
# Biological Communities

- In communities, species respond independently to changing environmental conditions
- Community composition changes gradually across landscapes



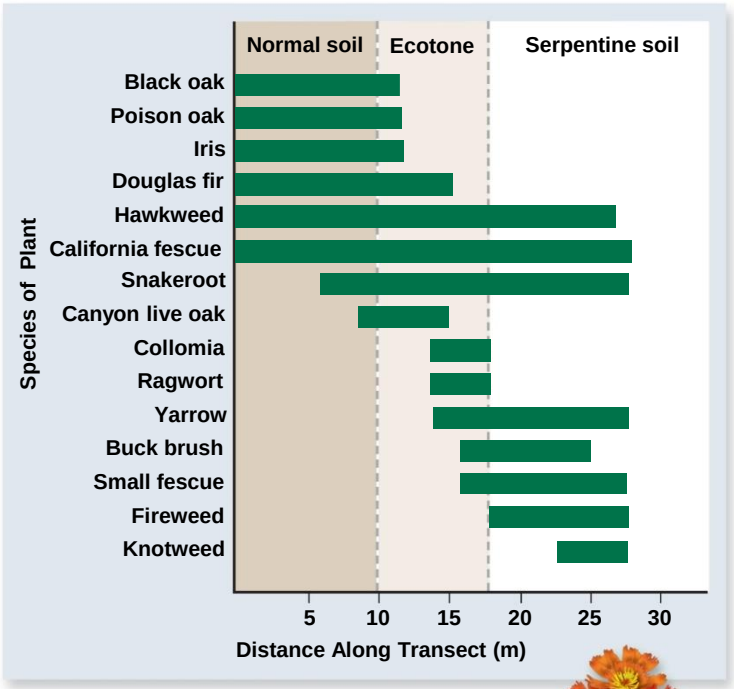

Abundance of tree species along a moisture gradient in the Santa Catalina Mountains of southeastern Arizona, from The Economy of Nature, 4e, by Robert E. Ricklets. Copyright 1973, 1979 by Chiron Press, Inc. © 1990, 2000 by W.H. Freeman and Company. Reprinted by permission

- Abundance of tree species along a moisture gradient in the Santa Catalina Mountains of Southeastern Arizona
- Each line represents the abundance of a different tree species
- Community composition changes continually along the gradient

# Biological Communities

- Sometimes the abundance of species in a community does change geographically in a synchronous pattern
- Ecotones: places where the environment changes abruptly






# Ecological Niche

- Niche: the total of all the ways an organism uses the resources of its environment
  - Space utilization
  - Food consumption
  - Temperature range
  - Appropriate conditions for mating
  - Requirements for moisture and more

# Ecological Niche

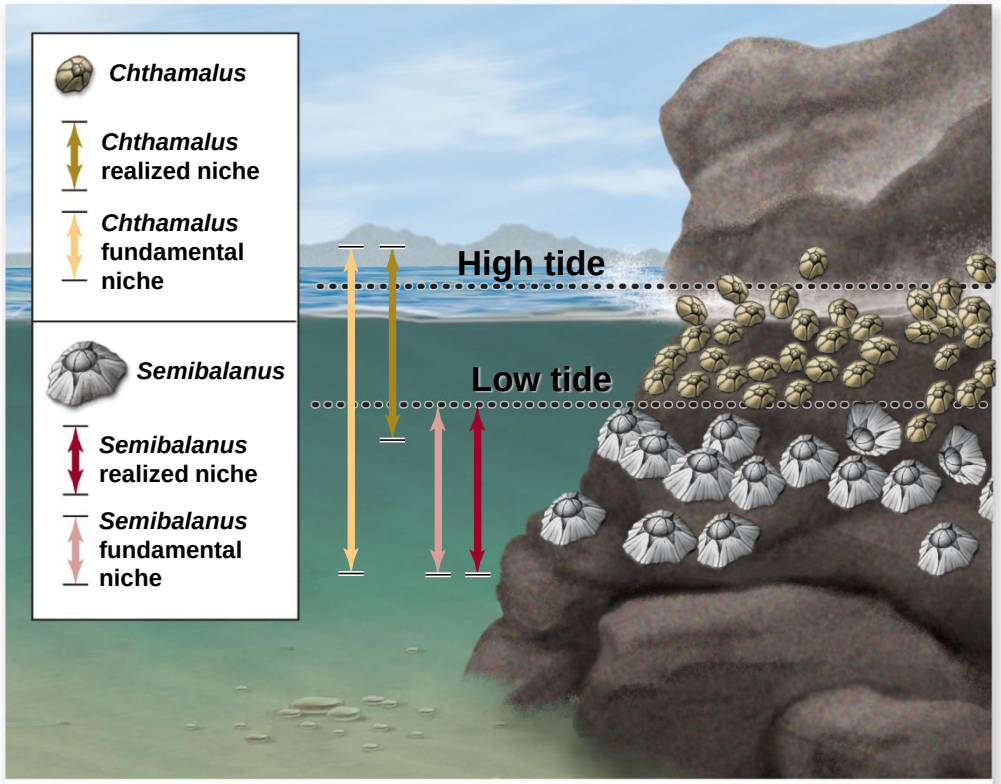
- Interspecific competition
  - Occurs when two species attempt to use the same resource and there is not enough resource to satisfy both
- Interference competition
  - Physical interactions over access to resources
- Exploitative competition
  - Consuming the same resources

# Ecological Niche

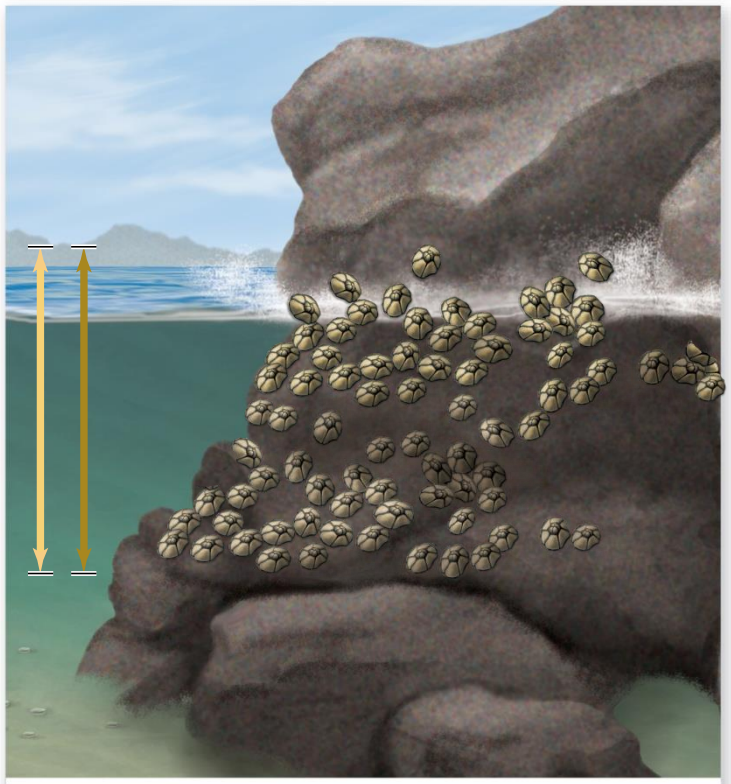
- Fundamental niche
  - Entire niche that a species is capable of using, based on physiological tolerance limits and resource needs
- Realized niche
  - Actual set of environmental conditions, presence or absence of other species, in which the species can establish a stable population
- Other causes of niche restriction
  - Predator absence or presence
  - Absence of pollinators
  - Presence of herbivores

# Ecological Niche






***S.balanoides* and *C.stellatus* competing**

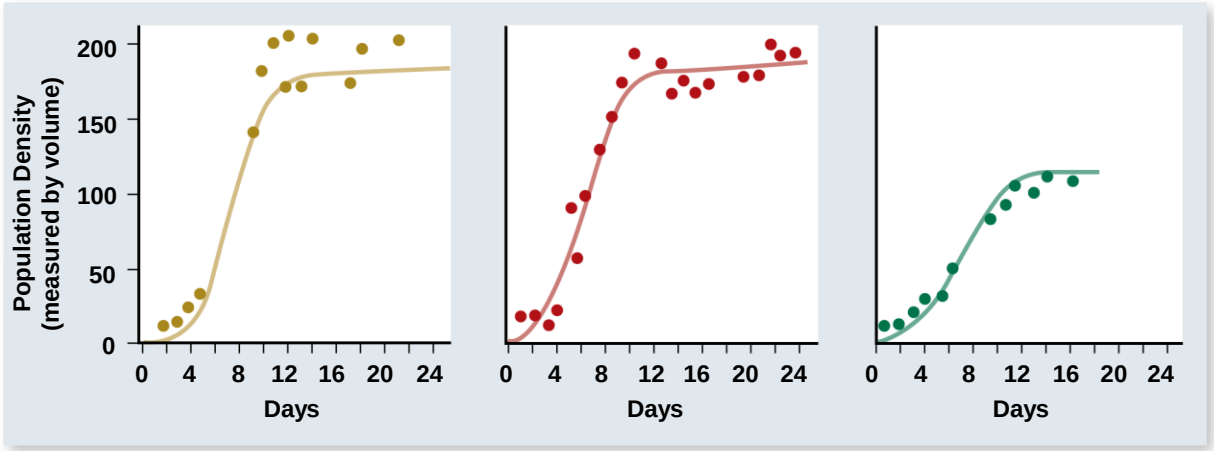


***C.stellatus* fundamental and realized niches are identical when *S.balanoides* is removed.**

J.H. Connell's classical study of barnacles

# Ecological Niche

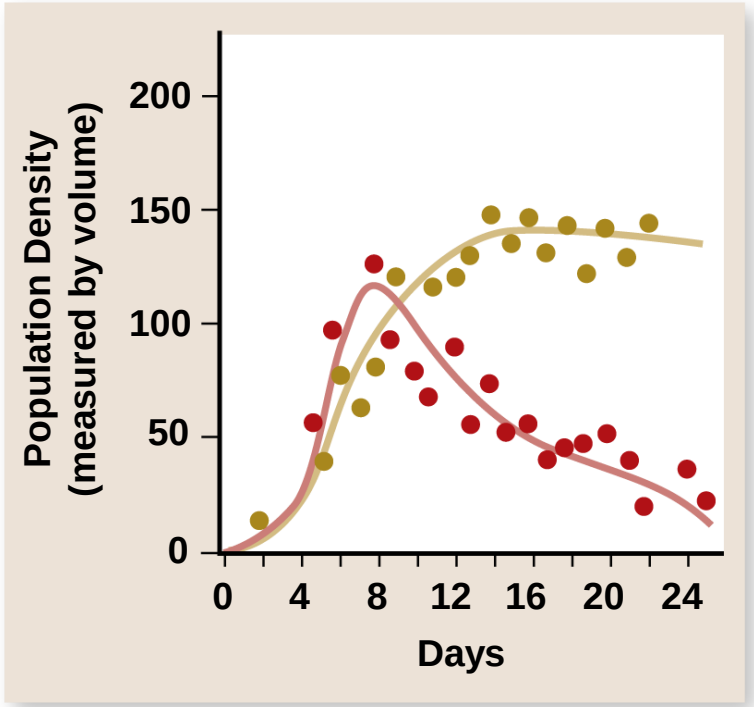
- Principle of competitive exclusion
  - If two species are competing for a limited resource, the species that uses the resource more efficiently will eventually eliminate the other locally
- G.F. Gause's classic experiment on competitive exclusion using three *Paramecium* species shows this principle in action




*a.*

Data from Begon et al., Ecology, 1996. After: W.B. Clapham, Natural Ecosystems, Clover, Macmillan





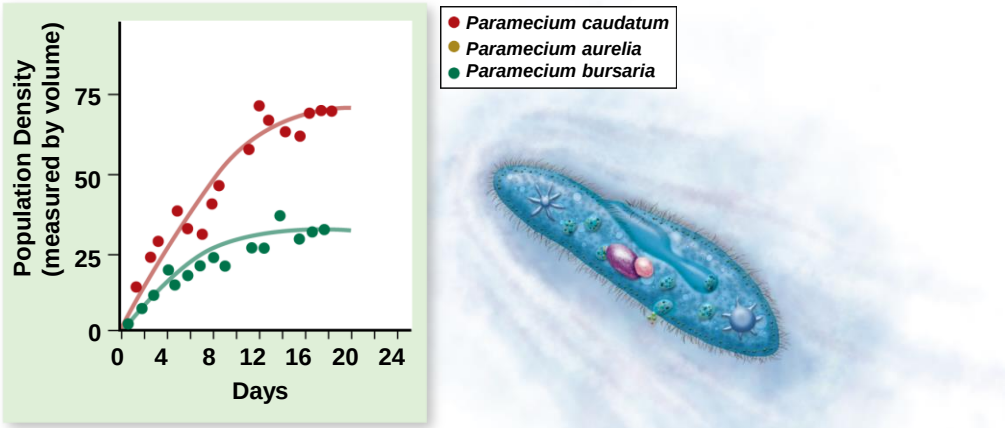

***b.***

Data from Begon et al., Ecology, 1996. After: W.B. Clapham, Natural Ecosystems, Clover, Macmillan

# Ecological Niche

- *Paramecium caudatum* and *P. bursaria*
  - Expected same results – one winner
  - Both species survived by dividing resources
    - Realized niche did not overlap too much

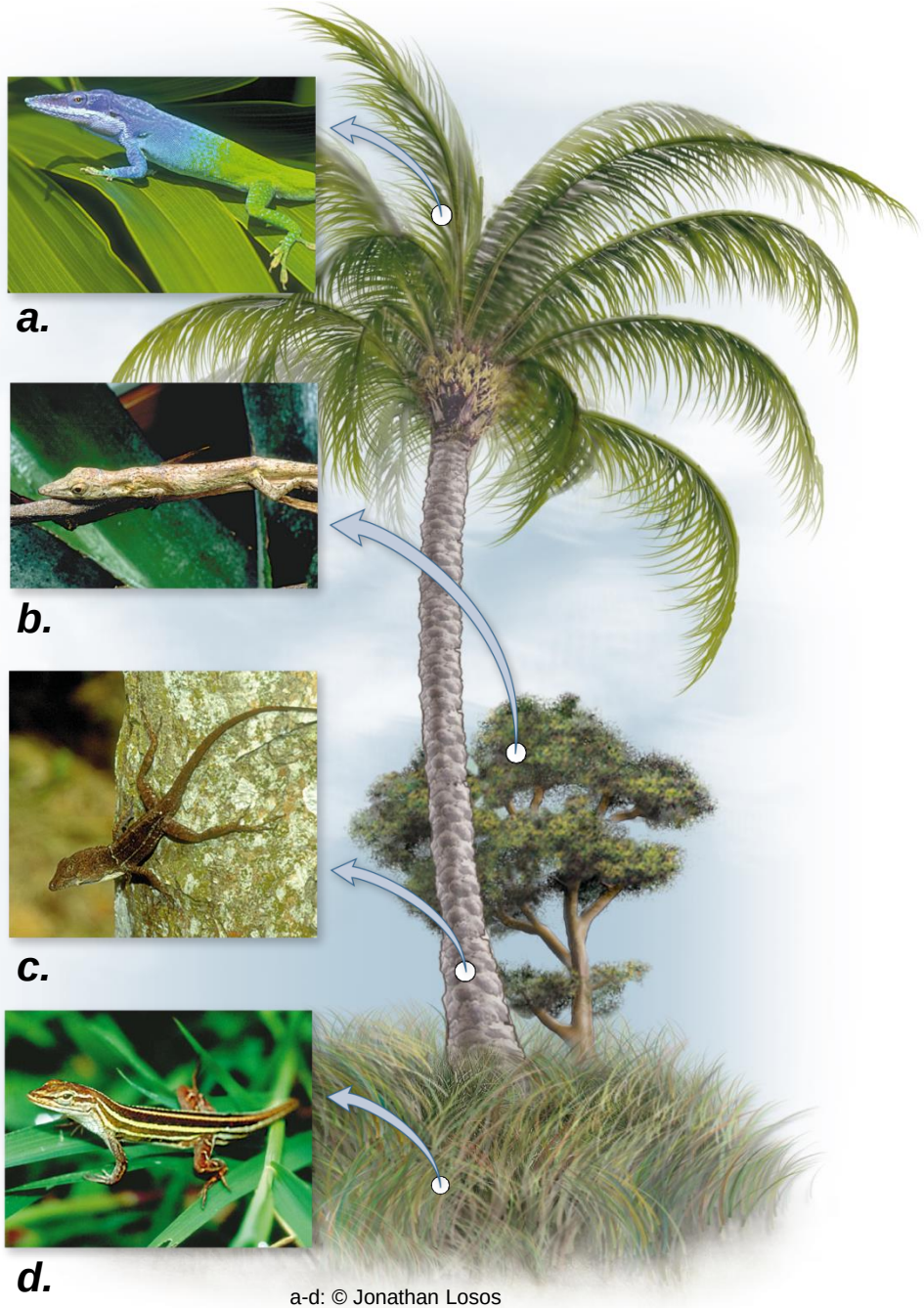





*c.*

Data from Begon et al., Ecology, 1996. After: W.B. Clapham, Natural Ecosystems, Clover, Macmillan

- Resource partitioning among sympatric lizard species
- Subdivided niche to avoid direct competition

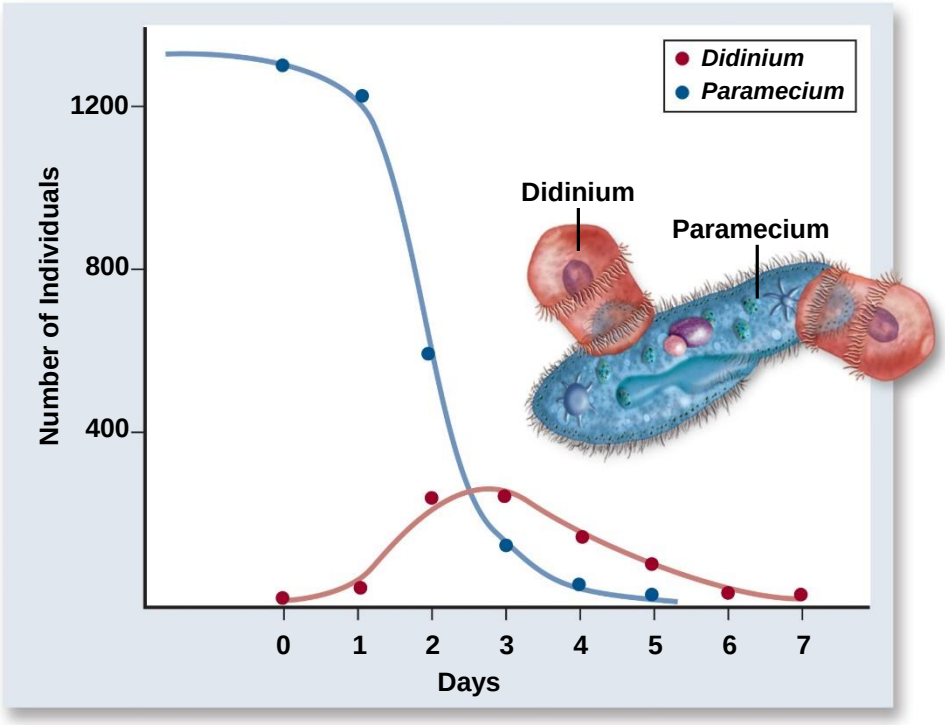



a-d: © Jonathan Losos

# Predator–Prey

- Predation
  - Consuming of one organism by another
- Predation strongly influences prey populations





# Predator–Prey

- Prey populations can have explosions and crashes
  - White-tailed deer in Eastern U.S.
  - Introduction of rats, dogs, cats on islands
- Predation and coevolution
  - Predation provides strong selective pressure on the prey population
  - Features that decrease the probability of capture are strongly favored
  - Coevolution race may ensue

# Predator–Prey



***a.***

***b.***



- Plants adapt to predation (herbivory) by evolving mechanisms to defend themselves
  - Chemical defenses: secondary compounds
    - Oils, chemicals to attract predators to eat the herbivores, poison milky sap, and others
  - Herbivores coevolve to continue eating the plants

***a.*** ***b.***

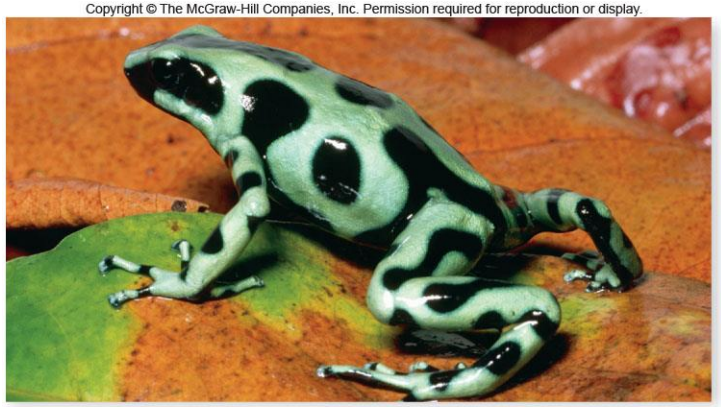
a-b: © Lincoln P. Brower

- Chemical defenses in animals
  - Monarch butterfly caterpillars feed on milkweed and dogbane families
  - Monarchs incorporate cardiac glycosides from the plants for protection from predation
  - Butterflies are eaten by birds, but the Monarch contains the chemical from the milkweed that makes the birds sick

# Predator–Prey

Poison-dart frogs of the family Dendrobatidae produce toxic alkaloids in the mucus that covers their brightly colored skin





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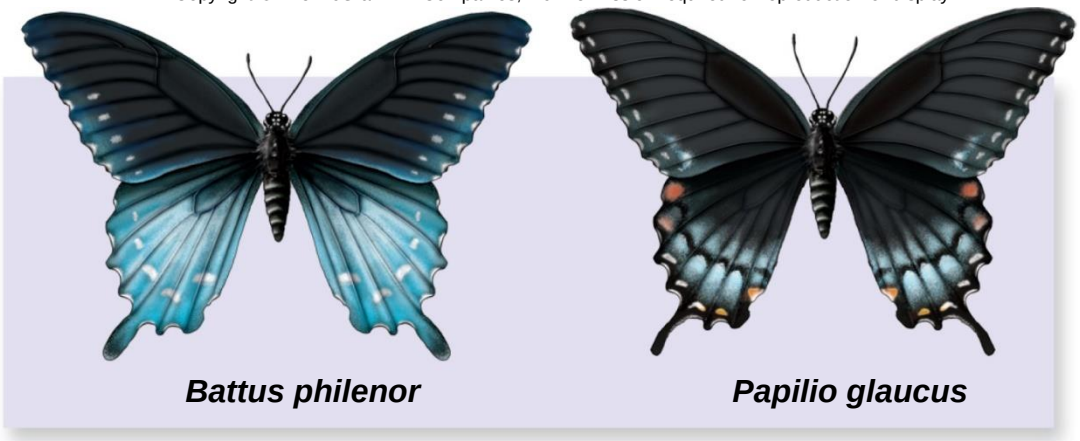
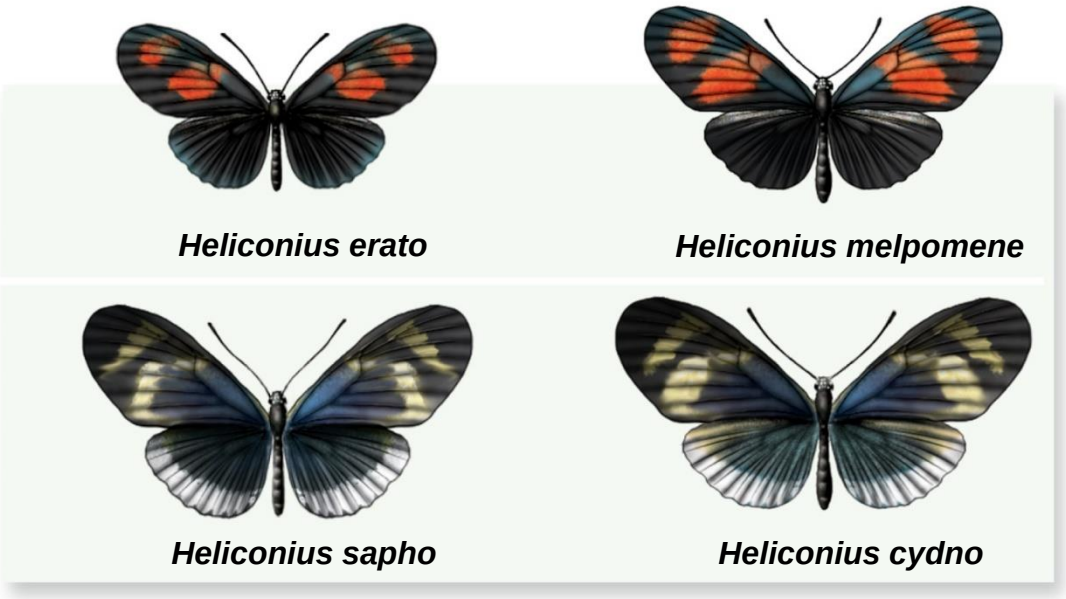
- Defensive coloration
  - Insects and other animals that are poisonous use warning coloration
  - Organisms that lack specific chemical defenses are seldom brightly colored
    - Camouflage or cryptic coloration help nonpoisonous animals blend with their surroundings
    - Camouflaged animals do not usually live together in groups

# Predator–Prey

- Mimicry allows one species to capitalize on defensive strategies of another
  - Resemble distasteful species that exhibit warning coloration
  - Mimic gains an advantage by looking like the distasteful model
  - Batesian mimicry
    - Mimics look like distasteful species
  - Müllerian mimicry
    - Several unrelated but poisonous species come to resemble one another




**a.** **Batesian mimicry: Pipevine swallowtail butterfly (*Battus philenor*) is poisonous; Tiger swallowtail (*Papilio glaucus*) is a palatable mimic.**




**b.** **Müllerian mimicry: Two pairs of mimics; all are distasteful.**

# Mimicry

# Species Interactions

- Symbiosis
  - 2 or more kinds of organisms interact in more-or-less permanent relationships
  - Potential for coevolution
  - Three major types of symbiosis
    - Commensalism
    - Mutualism
    - Parasitism



# Species Interactions

- Commensalism benefits one species and is neutral to the other
  - Spanish moss: an epiphyte hangs from trees



# Species Interactions

- Mutualism benefits both species
  - Coevolution: flowering plants and insects
    - Ants and acacias
      - Acacias provide hollow thorns and food
      - Ants provide protection from herbivores

# Mutualism



© Alex Wild/Visuals Unlimited

Ants of the genus Pseudomyrmex live within the hollow thorns of certain species of acacia trees in Latin America

# Species Interactions

- Parasitism benefits one species at the expense of another
  - External parasites
    - Ectoparasites: feed on exterior surface of an organism
    - Parasitoids: insects that lay eggs on living hosts
      - Wasp, whose larvae feed on the body of the host, killing it

# Species Interactions

- Internal parasites
  - Endoparasites live inside the host
  - Extreme specialization by the parasite as to which host it invades
  - Structure of the parasite may be simplified because of where it lives in its host
  - Many parasites have complex life cycles involving more than one host

# Species Interactions

- *Dicrocoelium dendriticum* is a flatworm that lives in ants as an intermediate host with cattle as its definitive host
- To go from the ant to a cow, it changes the behavior of the ant
- Causes the ant to climb to the top of a blade of grass to be eaten with the grass



# Species Interactions

- Ecological processes have interactive effects
  - Predation reduces competition
    - Predators choice depends partly on relative abundance of the prey options
    - Superior competitors may be reduced in number by predation
    - This allows other species to survive when they could have been outcompeted

# Species Interactions



***a.***

***b.***



Starfish eat barnacles, allowing other species to thrive instead of being crowded out by the explosive population of barnacles

# Species Interactions

- Keystone species
  - Species whose effects on the composition of communities are greater than one might expect based on their abundance
  - Sea star predation on barnacles greatly alters the species richness of the marine community
  - Keystone species can manipulate the environment in ways that create new habitats for other species
    - Beavers

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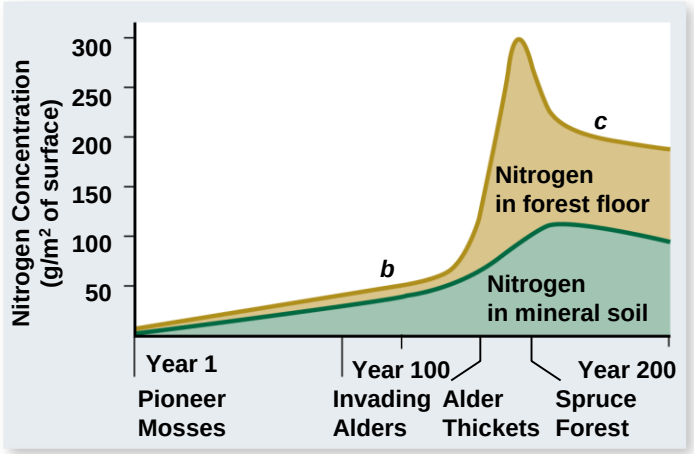
Beavers construct dams and transform flowing streams into ponds, creating new habitats for many plants and animals

# Succession and Disturbance

- Succession
  - Communities have a tendency to change from simple to complex
    - Primary succession occurs on bare, lifeless substrate
      - Open water
      - Rocks
  - Organisms gradually move into an area and change its nature




***a.***

***b.***

***c.***

***d.***

b-d: © Tom Bean

# Succession and Disturbance

- Secondary succession
  - Occurs in areas where an existing community has been disturbed but organisms still remain
    - Field left uncultivated
    - Forest after a fire
- Succession happens because species alter the habitat and the resources available in ways that favor other species entering the habitat

# Succession and Disturbance

- Three dynamic concepts in the process
  - Tolerance: early successional species are characterized by *r*-selected species tolerant of harsh conditions
  - Facilitation: early successional species introduce local changes in the habitat. *K*-selected species replace *r*-selected species
  - Inhibition: changes in the habitat caused by one species inhibits the growth of the original species

# Succession and Disturbance



***a.***

***b.***



Succession after a volcanic eruption