

# INTERACTIONS

Chapter 52 Population Ecology

p.1151-1156, 1158-1168

Chapter 53 Community Ecology

p.1176-1181

# Types of Interactions

- Predation & Herbivory
- Symbiosis

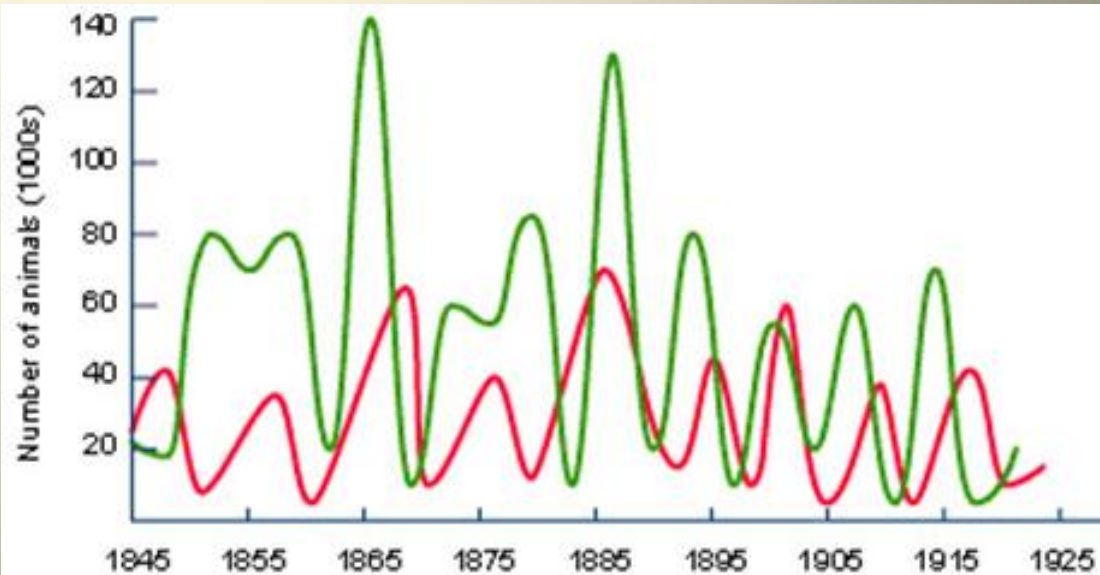
- One organism (predator) kills and eats another organism (prey)
- A subset of predation is cannibalism: when the predator and prey organisms are of the same species

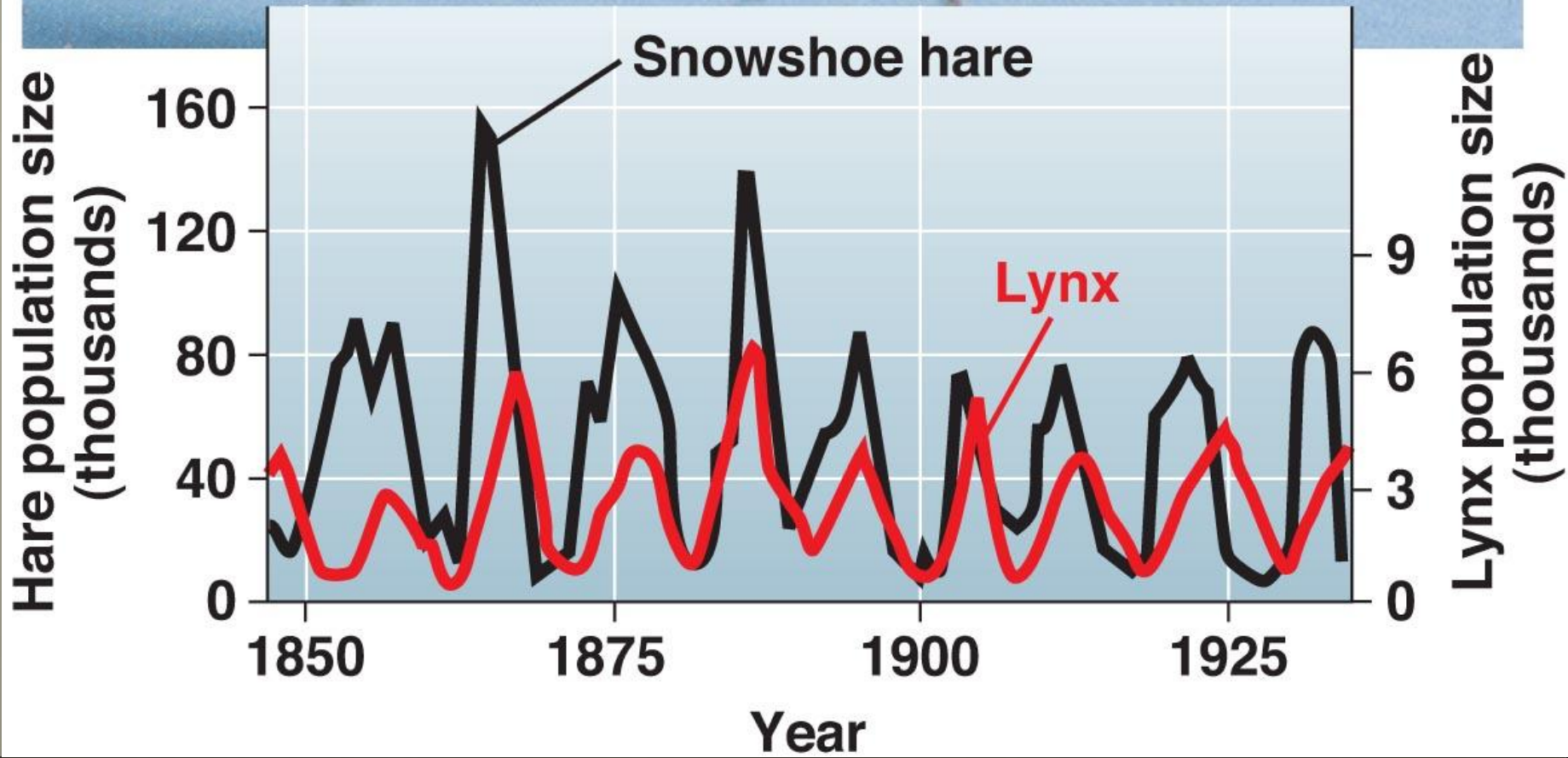
## Predation



# Predator-Prey Cycles

- population cycles: alternating periods of large and small population sizes
- sinusoidal growth: wavelike oscillating growth pattern, typical of predator-prey interactions





# Herbivory



- An organism feeds on a photosynthetic organism (e.g. plant or algae)
- Unlike predation, the organism being fed on might not die
- Example: leaf cutter ants

# How do populations deal with predation and herbivory?

- Defense mechanisms
  - Mechanisms that evolved as a means of protection against predation and herbivory

# Types of Defense Mechanisms

- Camouflage
- Mimicry
- Chemical defense
- Behavioural defense
- Structural defense



# Camouflage

- A type of protective coloration where organism mimics the patterns of its environment



# Mimicry

- A type of protective coloration where organisms resemble another
  - Batesian
  - Mullerian
- Example: Mimic octopus  
<http://www.youtube.com/watch?v=t-LTWFnGmeg>

# Batesian Mimicry

- harmless/palatable species mimics a harmful/unpalatable (e.g. poisonous) one



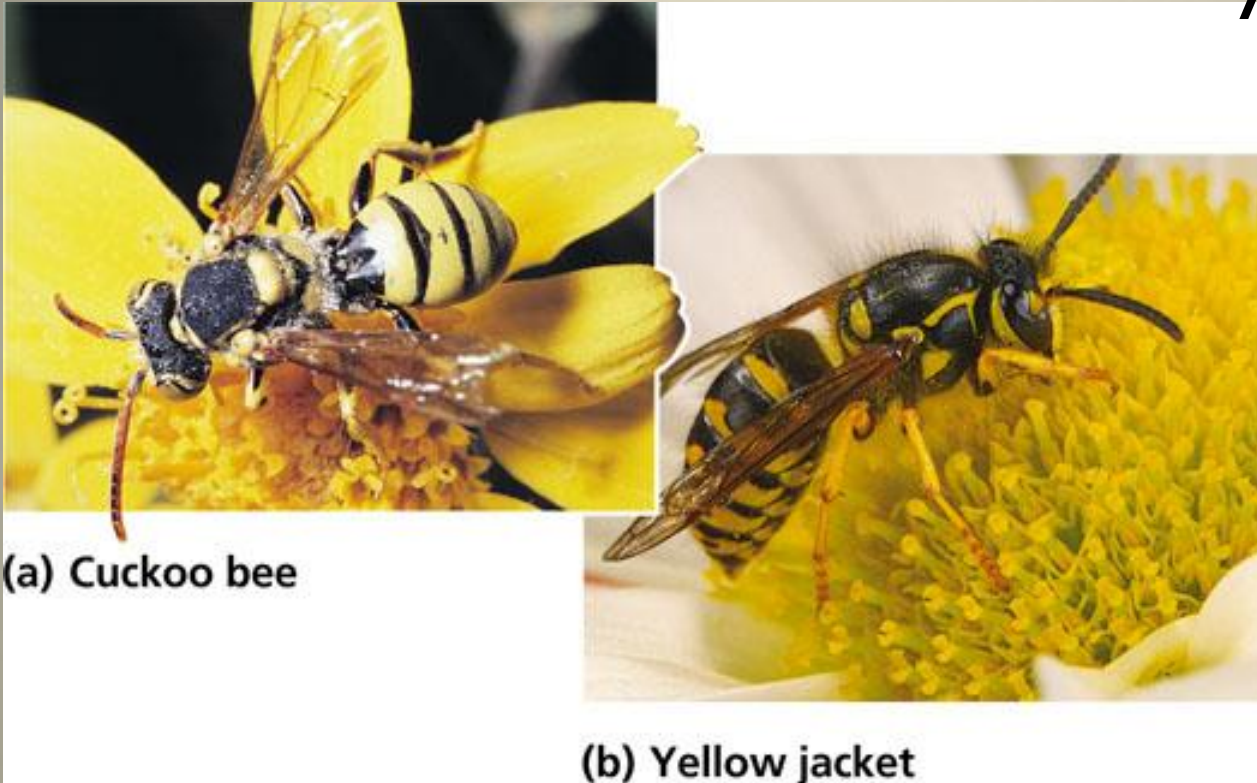
**Poisonous Coral Snake**



**Scarlet King Snake non-poisonous**

<http://oakdome.com/k5/lesson-plans/powerpoint/images/camouflage-pics/mimicry/coral-scarlet-kingsnake-large.jpg>

# Mullerian Mimicry



- Harmful/unpalatable species (e.g. poisonous) that share a common predator mimic each other's warning signals
- Warning signal is not limited to physical appearance

# Butterfly Mimicry Debate

- 1991 paper provides evidence that the Viceroy butterfly is an example of Mullerian mimicry and not Batesian mimicry as it was long thought:

<http://www.nature.com/nature/journal/v350/n6318/abs/350497a0.html>



Viceroy Butterfly (mimic)



Monarch Butterfly

# Chemical Defense

bombardier beetle

- An organism releases noxious odours or concentrates poisons in its body to make itself chemically unattractive
- Noxious chemicals:
  - Skunk
  - Bombardier beetle (<http://www.youtube.com/watch?v=35Swo8OWMgo>)
- Poisons
  - Monarch butterflies
  - Malaysian ants (explode)

# Behavioural Defense

- Passive: hiding, freezing, playing dead
- Active: fleeing, herding, mobbing, using distraction
- Bird mobbing:

<http://www.youtube.com/watch?v=ppy2iiOt6YU>

# Structural Defense

- An external armour that is hard or thorny
- Hard – tortoise
- Thorny – porcupine, prickly pear cactus
- Porcupine:

<http://www.youtube.com/watch?v=acXEjoM3Tkc>



# Classify these defense mechanisms

- Sea cucumber spills its guts  
[http://www.youtube.com/watch?v=wXf\\_YodWw4o](http://www.youtube.com/watch?v=wXf_YodWw4o)
- Hagfish slime attack  
<http://www.youtube.com/watch?v=lZq4Dme7wi4>  
<http://www.youtube.com/watch?v=Bb2EOP3ohnE>
- Blood squirting regal horned lizard  
<http://www.youtube.com/watch?v=gEl6TXrkZnk>
- Pistol shrimp sonic stun gun  
<http://www.youtube.com/watch?v=XC6l8iPiHT8>  
[http://www.youtube.com/watch?v=KkY\\_mSwboMQ](http://www.youtube.com/watch?v=KkY_mSwboMQ)

# Symbiosis

- Two species having a physically close ecological association with each other
  - the two species live together
  - the interaction is long-term
- Classes of symbiosis:
  - **Obligate**: organisms could not survive without each other
  - **Facultative**: species live together by choice

# Types of Symbiotic Relationship

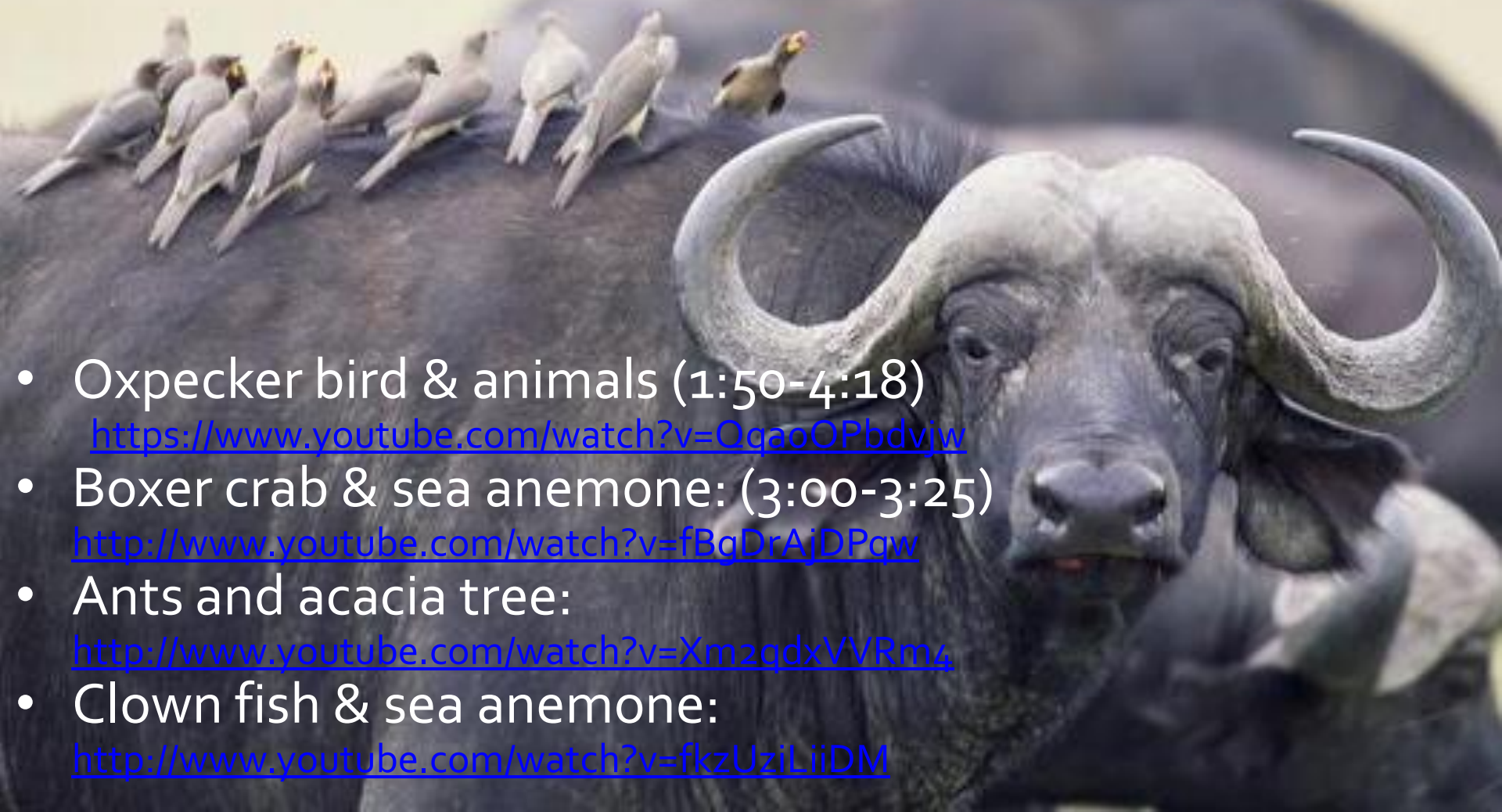
- Mutualism
- Commensalism
- Amensalism
- Parasitism
- Competition

# Mutualism

- Two organisms interact, both benefiting



# Mutualism Examples



- Oxpecker bird & animals (1:50-4:18)  
<https://www.youtube.com/watch?v=OqaoOPbdvjw>
- Boxer crab & sea anemone: (3:00-3:25)  
<http://www.youtube.com/watch?v=fBgDrAjDPqw>
- Ants and acacia tree:  
<http://www.youtube.com/watch?v=Xm2gdxVVRm4>
- Clown fish & sea anemone:  
<http://www.youtube.com/watch?v=fkzUziLiiDM>

# Mutualism Example: Lichen

- Algae: photosynthetic, produces sugar
- Fungi: absorbs nutrients, mineral, water and provides structure (housing)



# Commensalism

- Occurs when one organism benefits and the other neither benefits nor is harmed.



- Example in animals:
  - Shark and Remoras

<https://www.youtube.com/watch?v=Mxpa6gPIbLE>

# Commensalism Example in Plants

- Orchids in the tropical rain forest grow on branches of trees to access light
- Orchids do not affect the growth of the trees

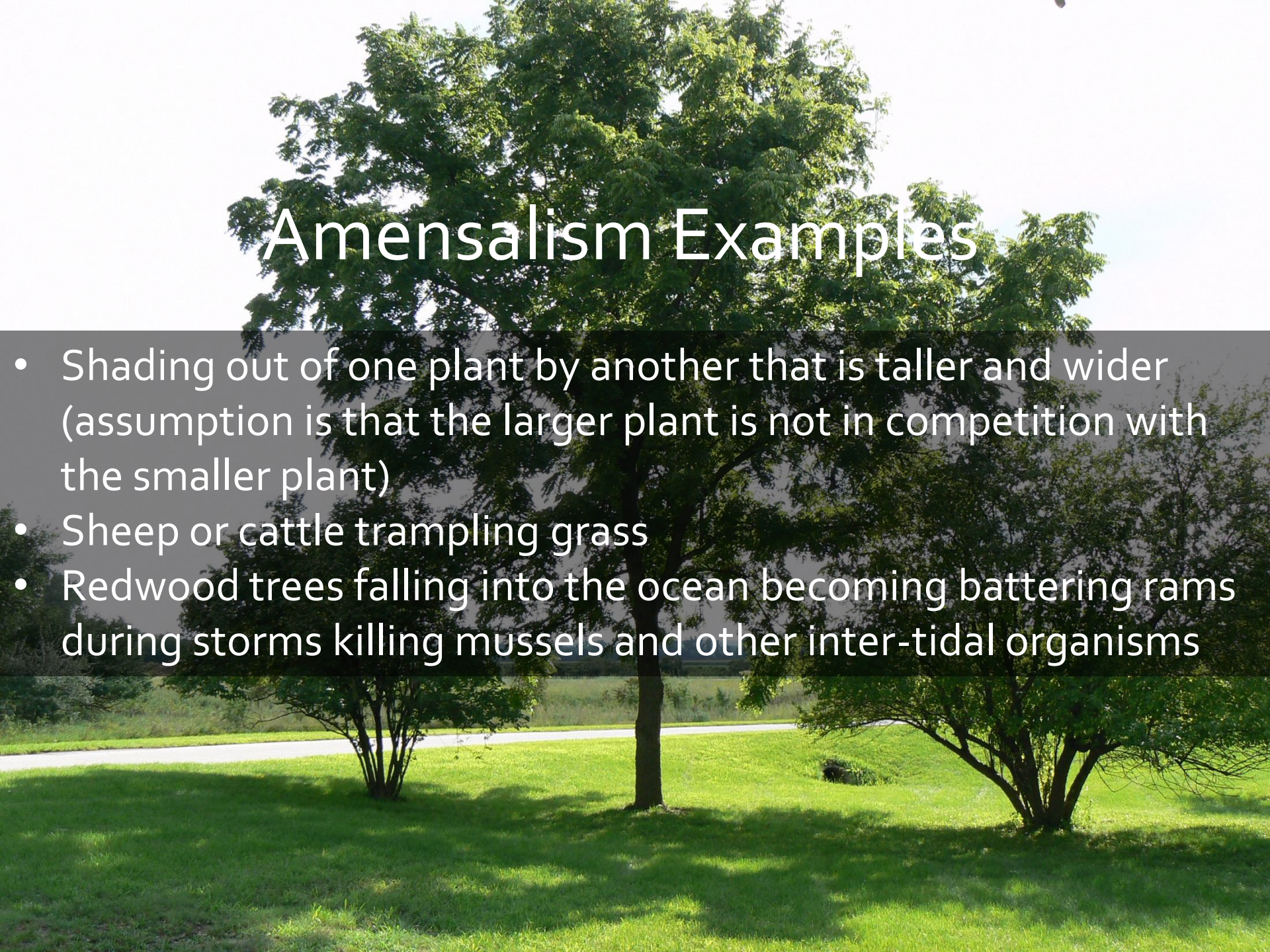


# Amensalism

- One organism inflicts harm or inhibit on the other, while being unaffected itself without cost or benefit
- A relationship that has destructive effect on one organism and no effect on the other

# Amensalism Examples

- Shading out of one plant by another that is taller and wider (assumption is that the larger plant is not in competition with the smaller plant)
- Sheep or cattle trampling grass
- Redwood trees falling into the ocean becoming battering rams during storms killing mussels and other inter-tidal organisms



# Parasitism

- One organisms (parasite) benefits by harming the other (host)



# Parasitism Examples

- Parasitic wasp (<https://www.youtube.com/watch?v=vMG-LWYNcAs>)
- Tapeworm (<https://www.youtube.com/watch?v=bb32go2lls8>)
- Others ([https://www.youtube.com/watch?v=\\_JWR1rzFhco](https://www.youtube.com/watch?v=_JWR1rzFhco))



# Competition

- an interaction in which 2 or more populations lose access to resources
- 2 classes:
  - **Intraspecific**
  - **Interspecific**
- 2 mechanisms:
  - **Interference**
  - **Exploitative**

# Intraspecific Competition



- between members of the same species

# Interspecific Competition

- Competition between members of different species

# Interference Competition

- An organism **directly** alter the ability of another organism to obtain the resource
- Often involves harming another individual
- Example: lions chase hyenas and cheetahs from their kill





# Exploitative Competition

- An **indirect** competition for resources
- An organism has a **superior ability** over another organism to gather the same resource
- The use of resources by one species decreases the amount available for the other
- Example:
  - desert birds have a mobility and visual advantage in foraging for seeds over desert ants
  - fast growing seedlings create shade, reducing the survival of ground-cover plants

# Competition Exclusion Principle

G. F. Guase (1934, Russian Ecologist)

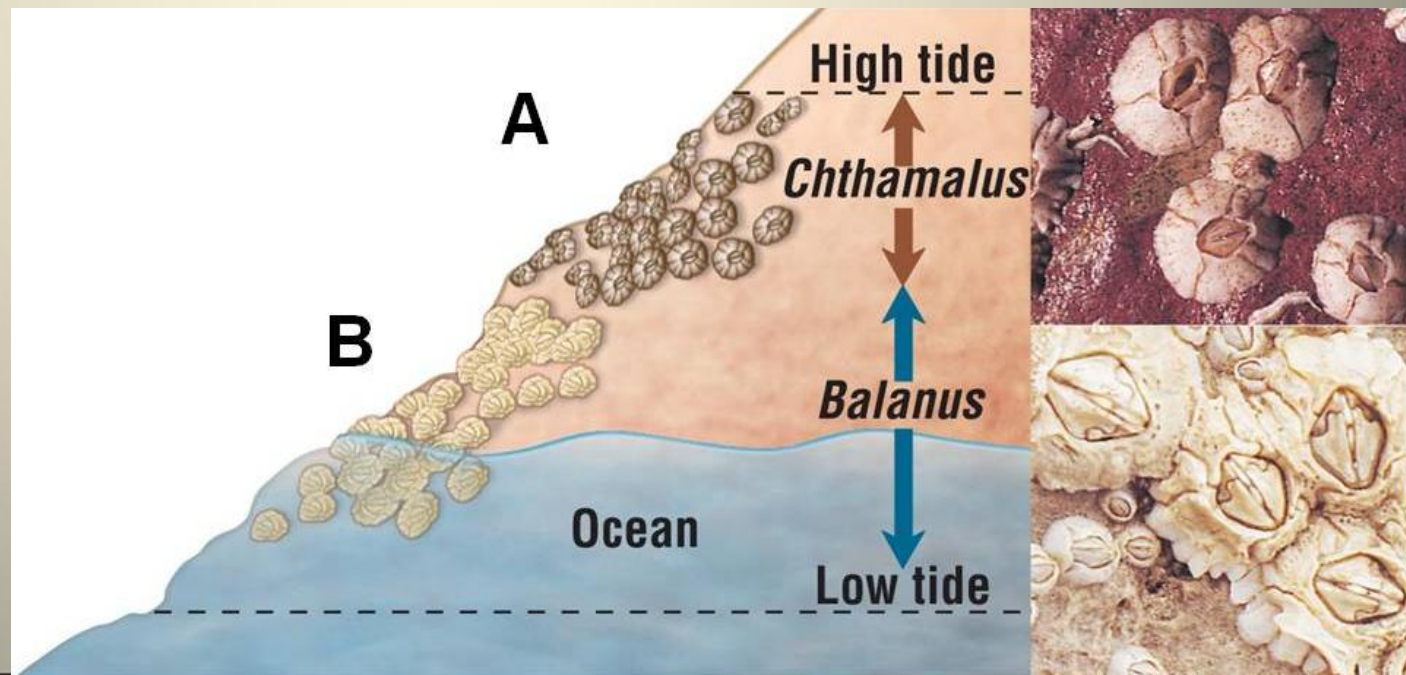
- **Two species with identical niches can not coexist**
- The species that is the better competitor would exclude the other
- Therefore species must have slightly different niches to coexist (examples in resource partitioning)
- **Niche**: A species requirement for biotic and abiotic resources
  - Biotic resources: food, mate etc.
  - Abiotic resource: often things that define the habitat, e.g. temperature, availability of water

# How do populations deal with competition?

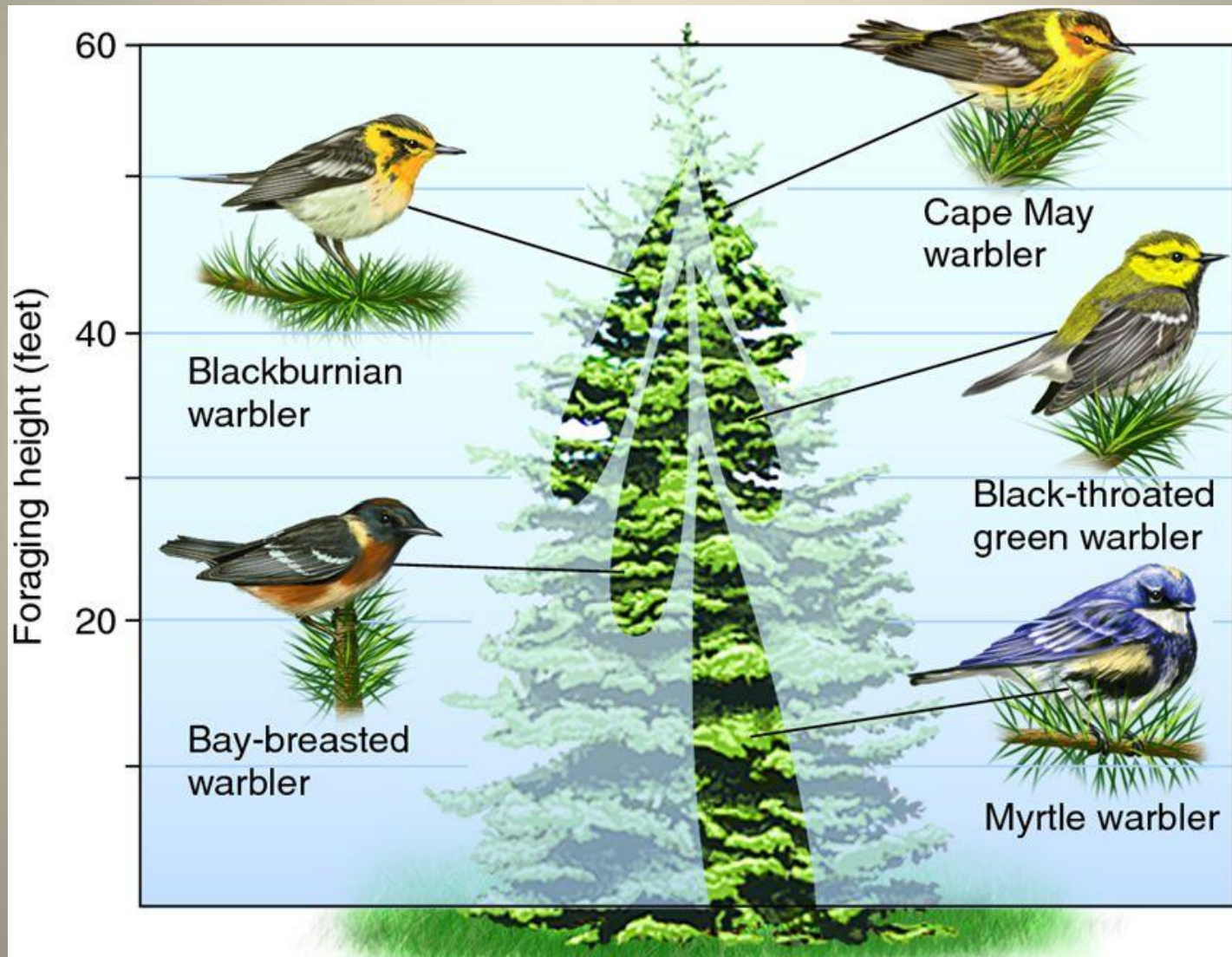
- Resource partitioning
  - A means of dealing with competition by using different resources within a habitat

# Resource Partitioning Example

- Example: Barnacles
  - niche differ in: growth rate & sensitivity to drying
  - *Balanus*: rapid growth, vulnerable to drying
  - *Chthamalus*: slower growth, more resistant to drying



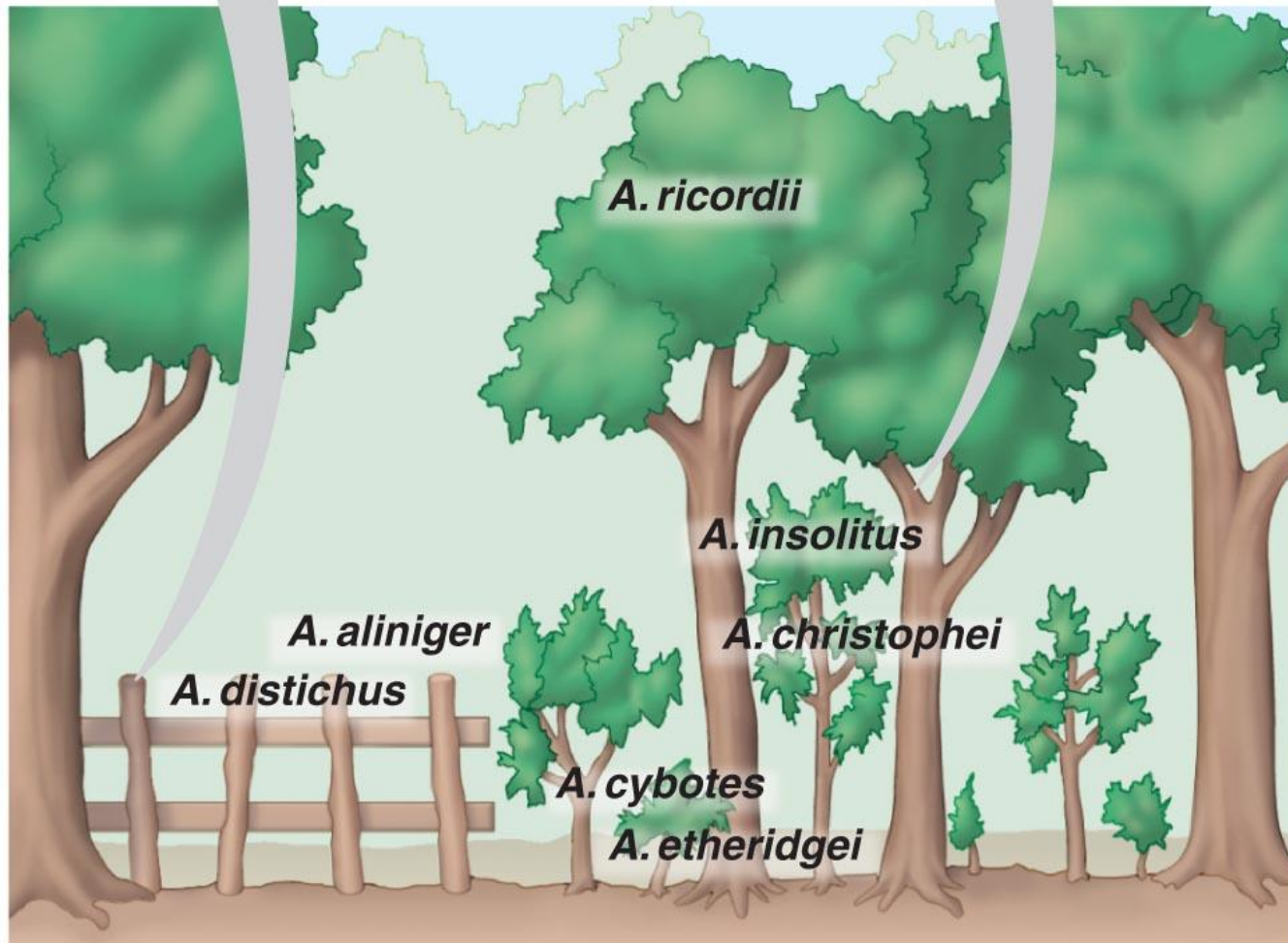
# Resource Partitioning Example



*A. distichus* perches on fence posts and other sunny surfaces.



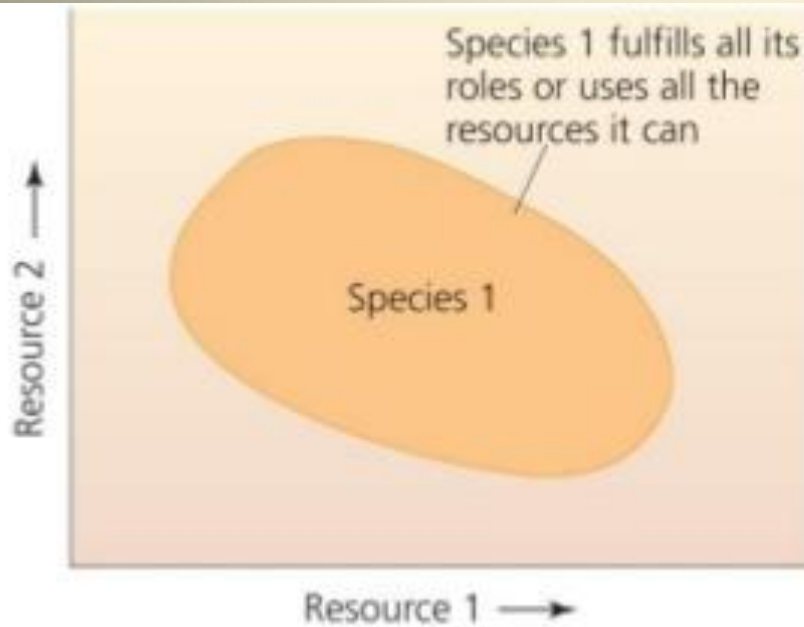
*A. insolitus* usually perches on shady branches.



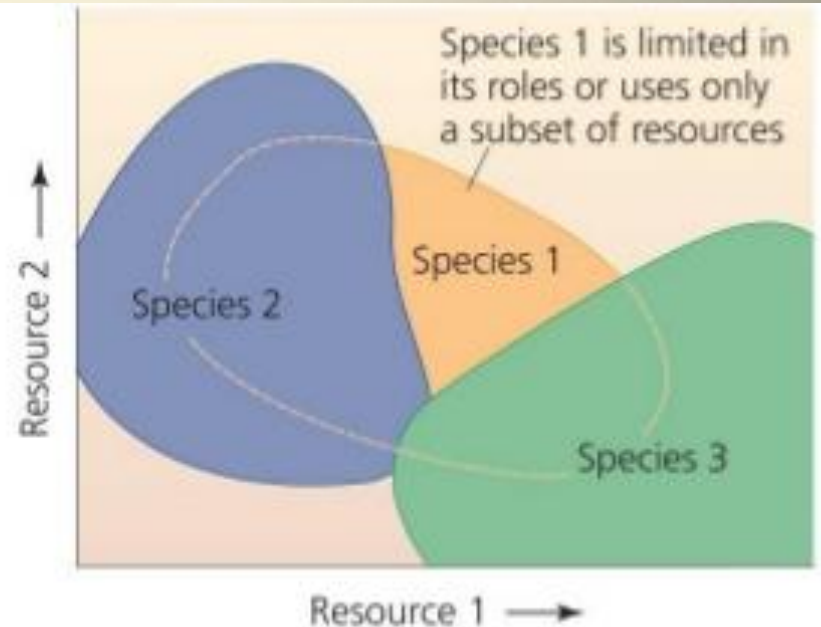
# Niche

- **Niche**: A species requirement for biotic and abiotic resources
- **Fundamental niche**: range of conditions and resources that a species can tolerate and use
  - If fundamental niches of different species overlap, species may be in competition
- **Realized niche**: range of conditions and resources that a species actually uses in nature
  - Usually smaller than fundamental niche because some tolerable conditions are not present in a particular habitat because of limitations imposed by other species

# Niche



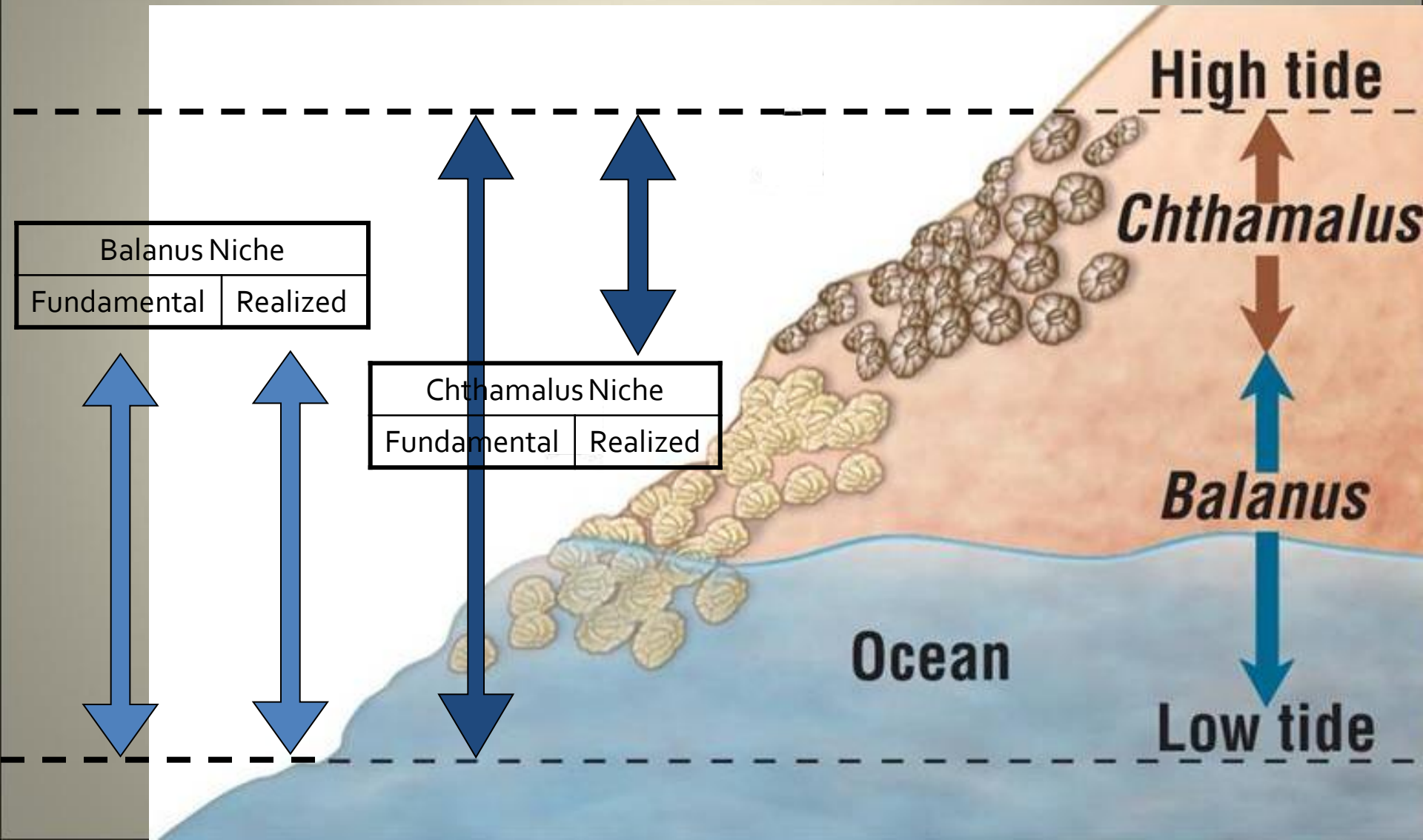
**(a) Fundamental niche**



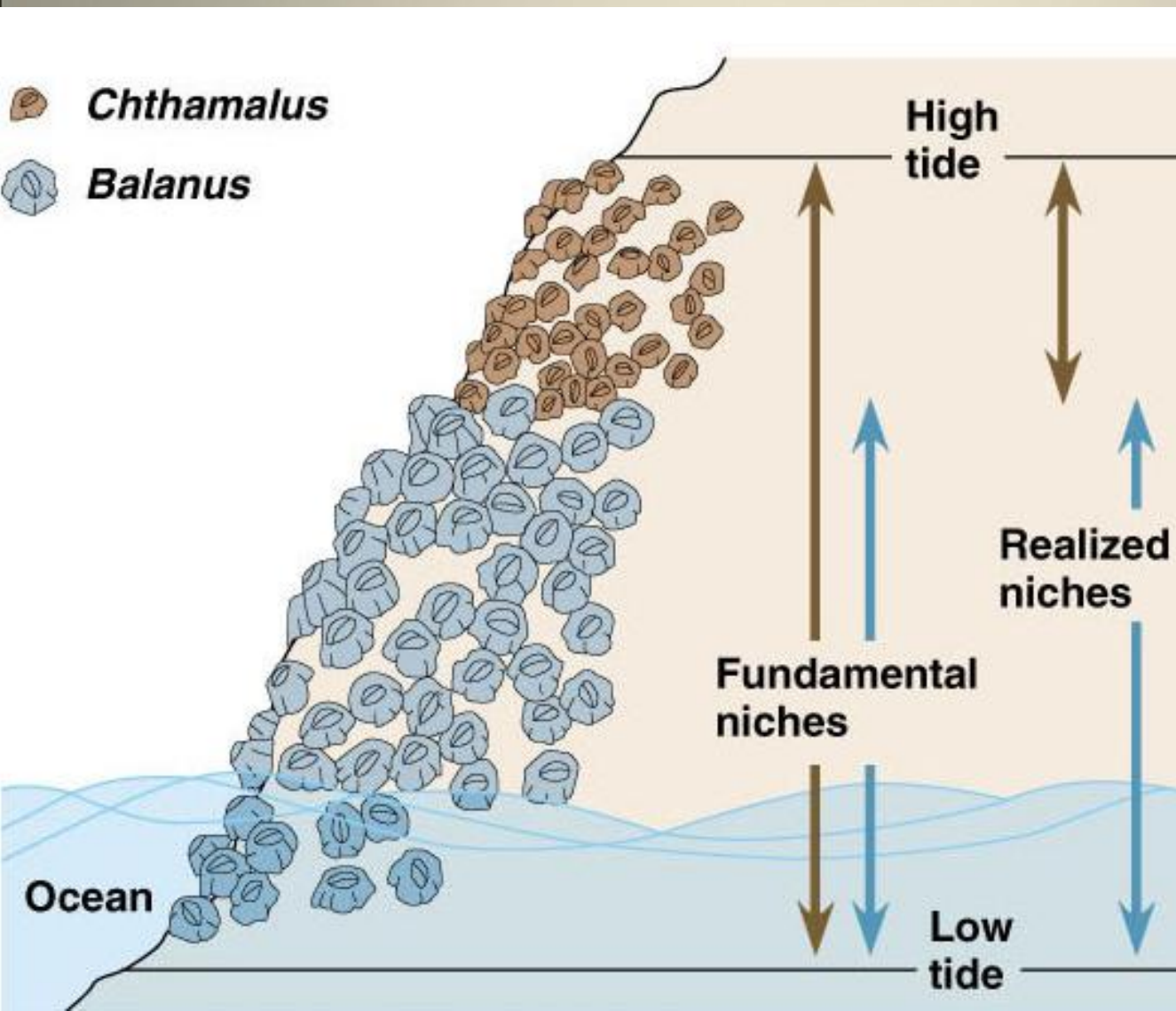
**(b) Realized niche**



# Niche and Resource Partitioning



# Niche and Resource Partitioning



# Summary of Interactions

Interaction	Relationship	Effect	Example
Predation	+/-		
Herbivory	+/-		
Mutualism	+/+		
Commensalism	+/0		
Amensalism	-/0		
Parasitism	+/-		
Competition	-/-		