Communities

All species that live together in an ecosystem

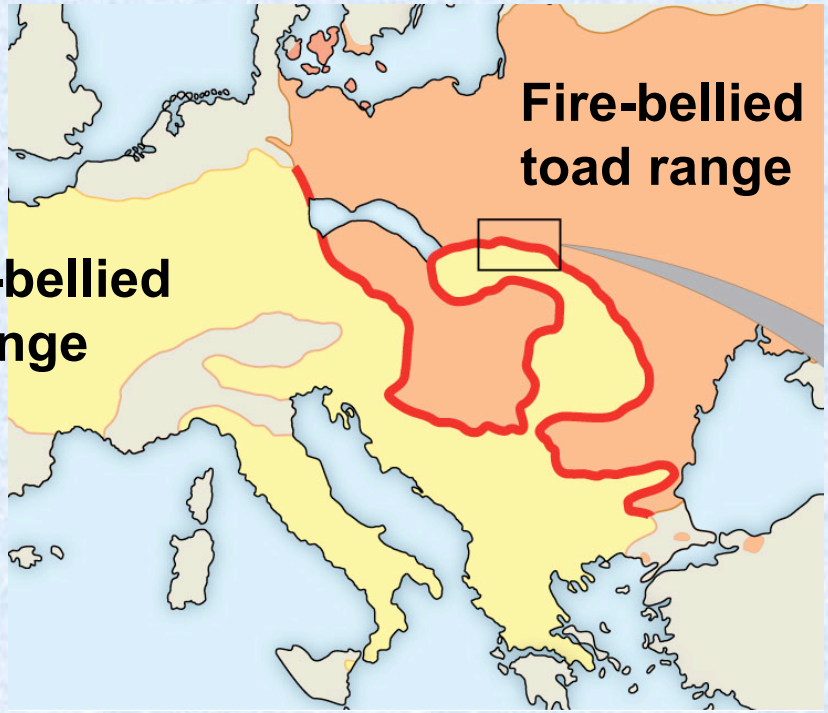
Biotic interactions connect species in the community

Abiotic & biotic factors determine where species live in on earth

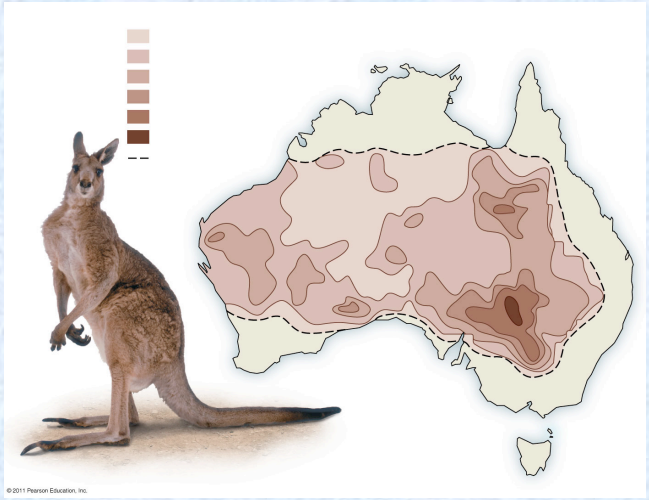
(i.e. where communities occur)

Biogeography
the study of species distributions

- *Where species occur on earth*
- *What factors control where species live?*



To understand what factor controls where a species lives,
Ask: "Why is it absent from other areas?"



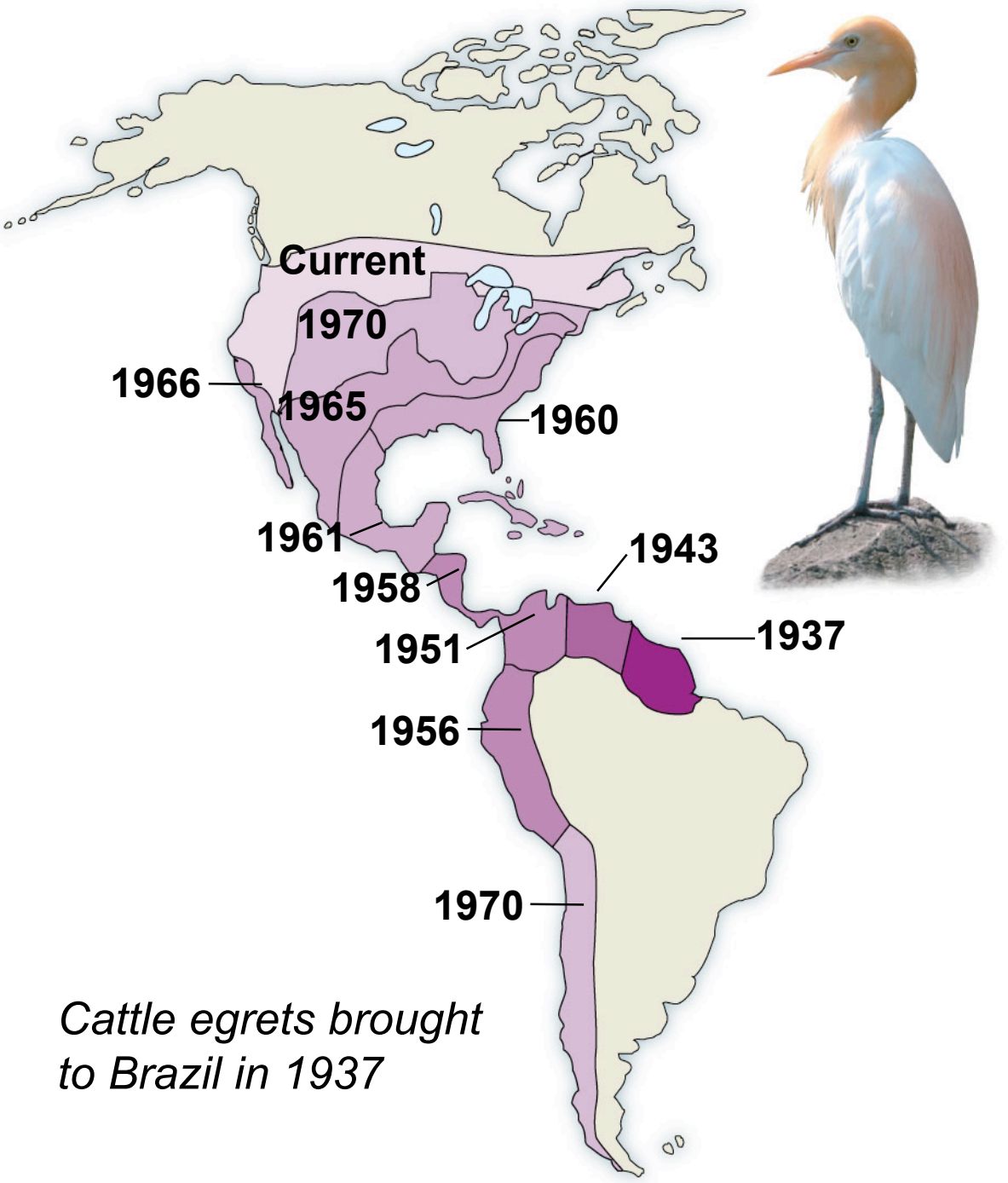
Distribution & abundance of Red Kangaroos in Australia

Factors that affect distributions

- ***Dispersal***
  - Can it get there?
- ***Habitat selection & Behavior***
  - Does it recognize the habitat or find resources it needs?
- ***Biotic interactions***
  - Do other species prevent it from being there?
- ***Abiotic factors***
  - Do physical or chemical conditions restrict it?

Range expansions of introduced species show the influence of dispersal on distribution

The ability to survive in a new environment means that the abiotic conditions are similar to original habitat

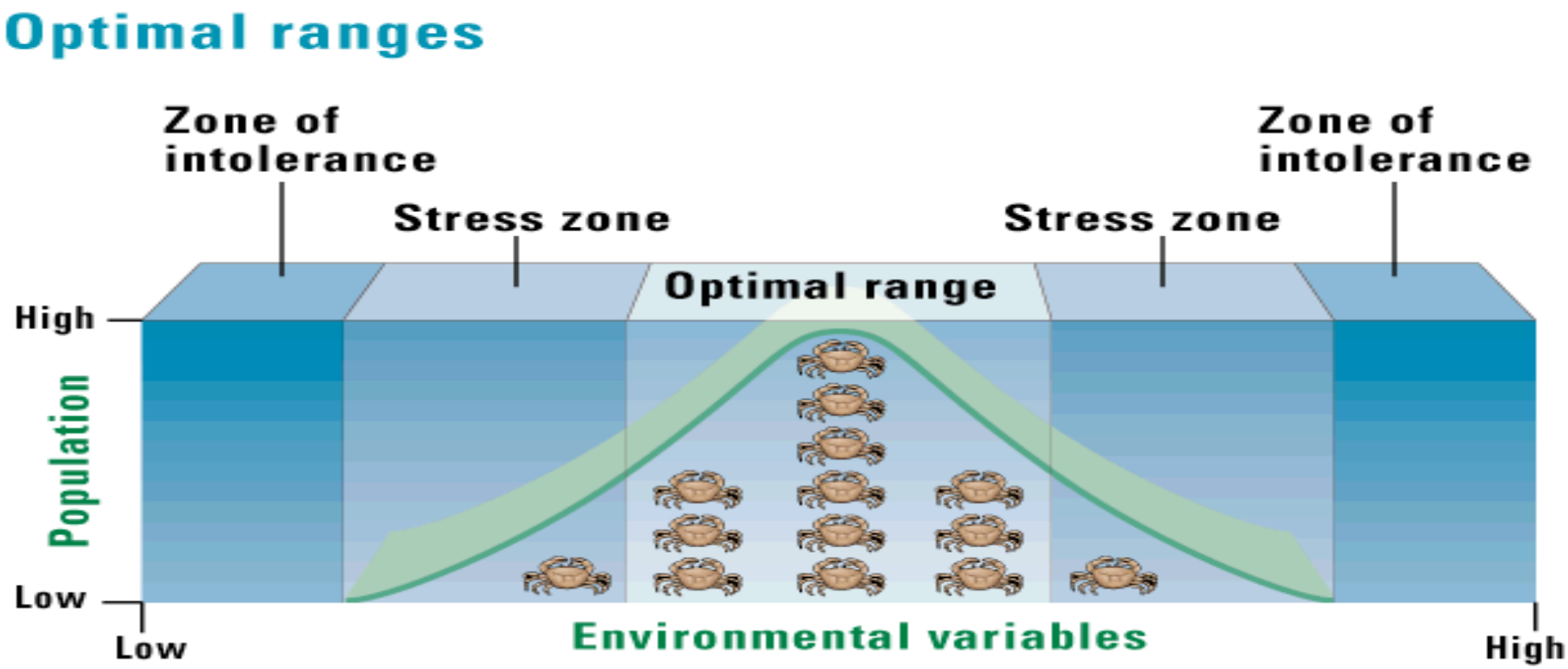


Cattle egrets brought to Brazil in 1937

Why do abiotic factors have a strong influence on species distributions?

Physiological Tolerance Limits

Each species functions best under a certain range of abiotic conditions



Why is Temperature

the main influence on where species live?

It affects all cellular processes

Low temperature

- reactions occur slowly

- water freezes at 0^oC

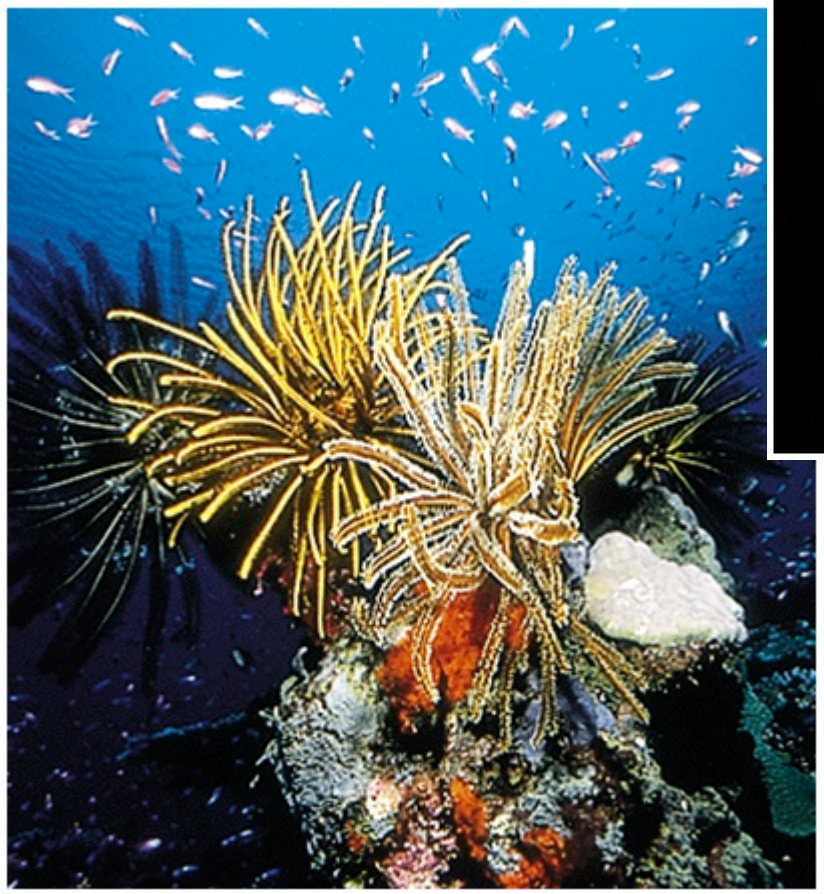
High temperature

- enzymes denature above 45^oC

Every species has a unique range of temperatures under which it can survive

Influence of temperature on distributions

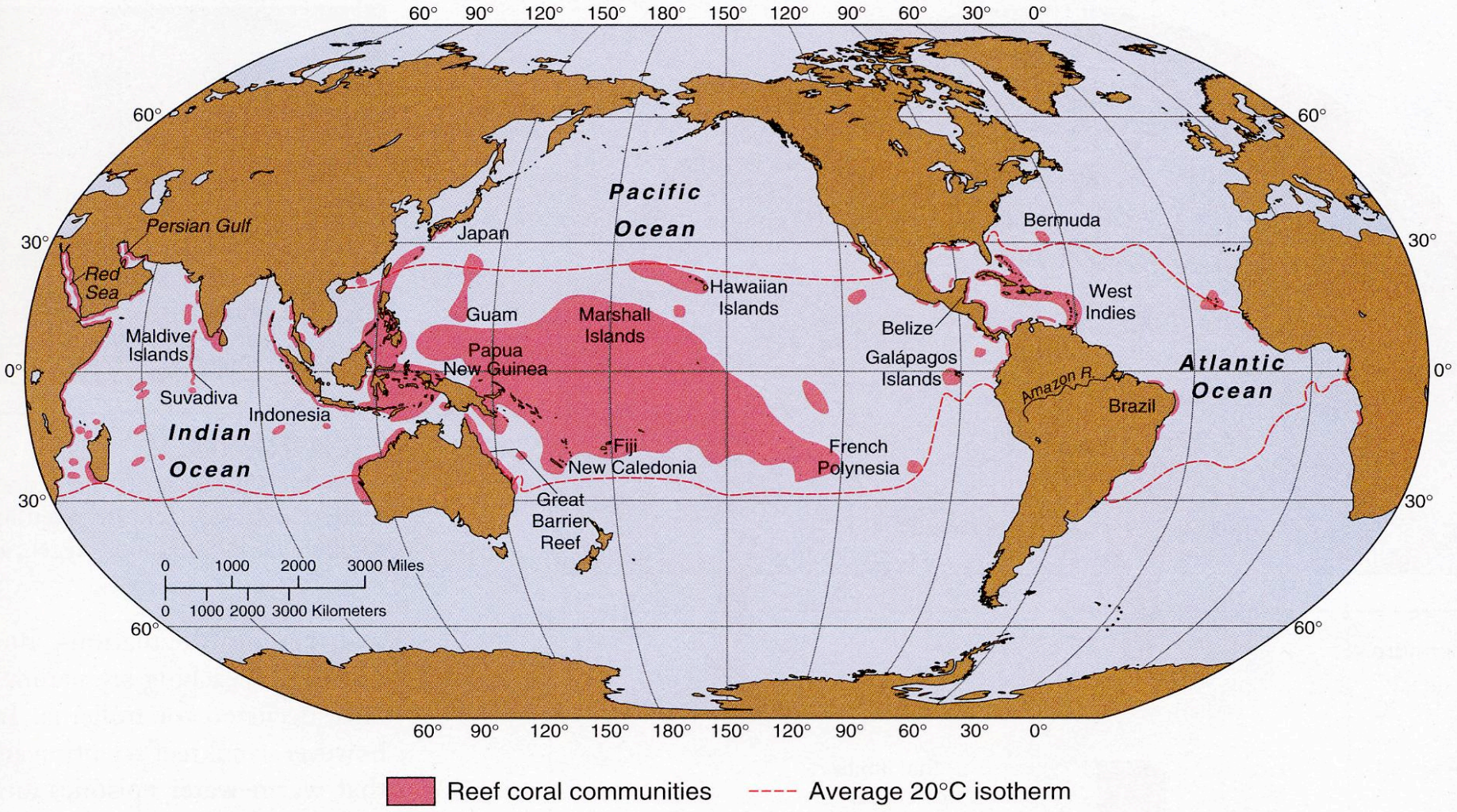
Monarch butterflies only overwinter in areas where it doesn't freeze



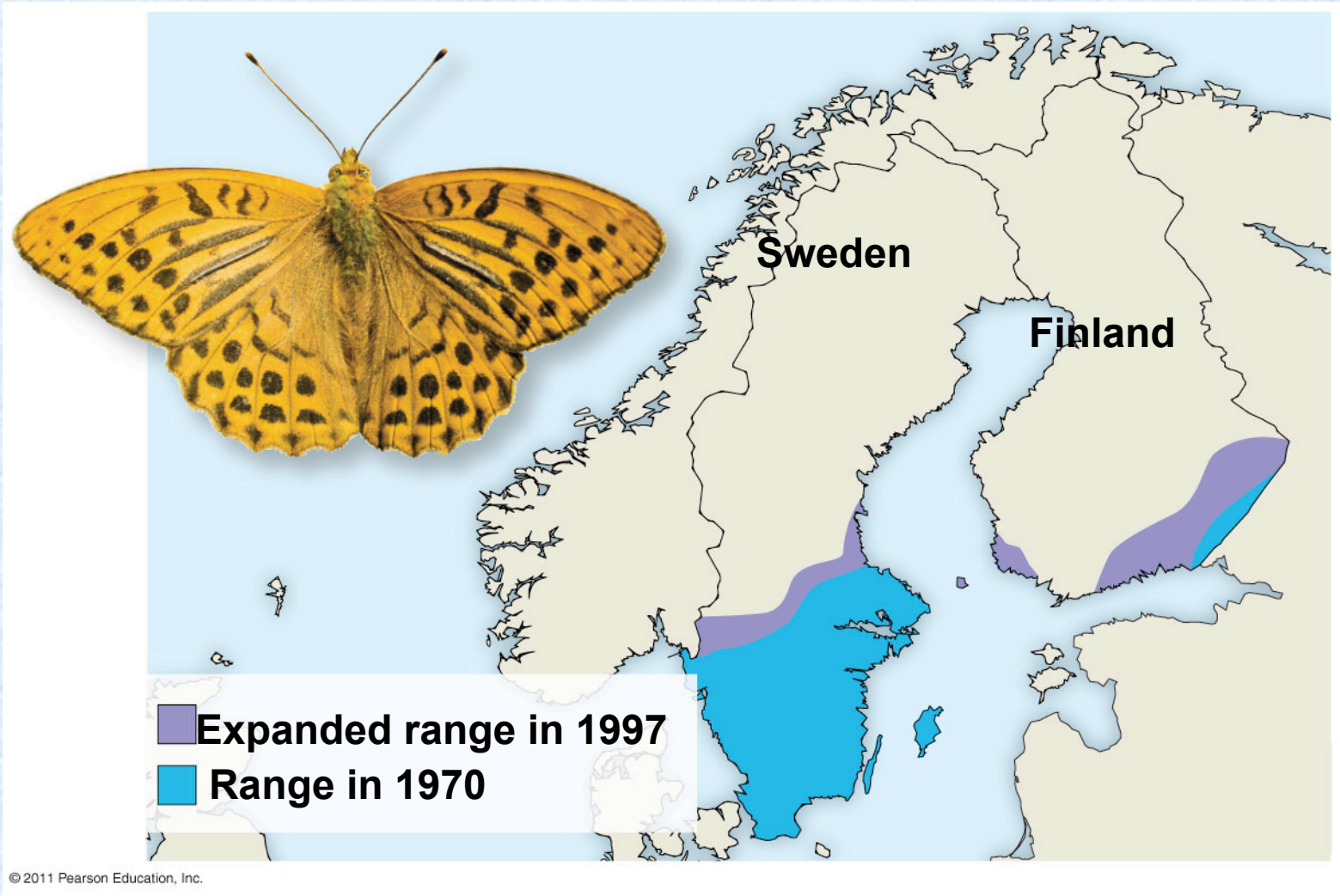
Reef building corals inhabit only warm waters

Temperature influences species distributions

Coral Reefs only occur in water warmer than 68°F (20°C)



Climate change affects species distributions



Distribution of species

determined by

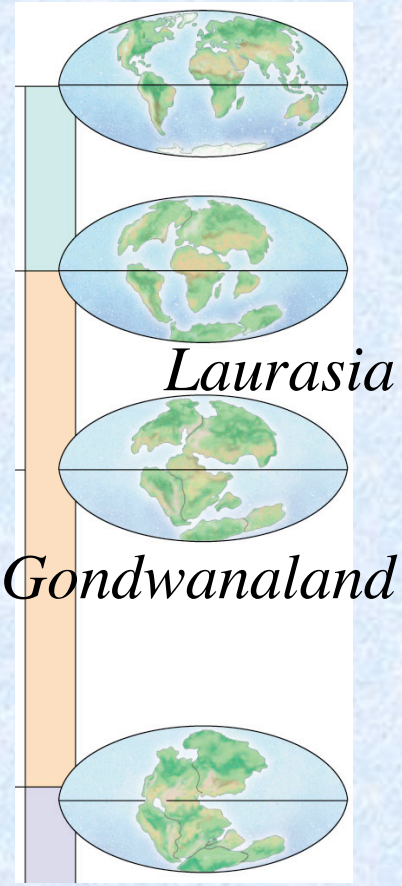
Evolutionary history & Ecological interactions

Continental drift

- **Species ranges change as continents move**

E.g. Marsupial mammal distributions

- *Marsupials evolved in Gondwanaland*
- *This land separated into S. hemisphere continents*
- *Today located mainly in S. hemisphere*
- *Moved into N. Am. after land bridge formed*



Habitat: a location in ecosystem

- **Place that a species lives**

" the address of the species"

Ex: forest - tree canopy, understory, in soil

Niche: a species way of life

- **All resource requirements of a species**

  e.g. food, shelter, mates

- ***All abiotic & biotic factors it can tolerate***

" the occupation of the species"

Each species has its own unique niche

Fundamental Niche

All conditions a species can tolerate

The niche is a species property

i.e. Each species has its own unique niche

Every species has a set of abiotic & biotic factors under which it can survive that characterizes its niche

The degree to which 2 species niches overlap (i.e. are similar) determines the impact of one on the other in the community

- **If 2 species have different niches, little or no competition for resources**

- **If 2 species have similar niches, competition for resources will be strong**

All species in the community can tolerate the range of abiotic conditions in that ecosystem

Each species has its own tolerance limits

Example: Trees of the redwood forest along a soil water gradient

Different species prefer different conditions

Wet: Sycamore

Moist: Redwood

Dry: Douglas fir

Realized Niche

Conditions species actually lives in due to presence of other species

Biotic interactions determine the realized niche of each species

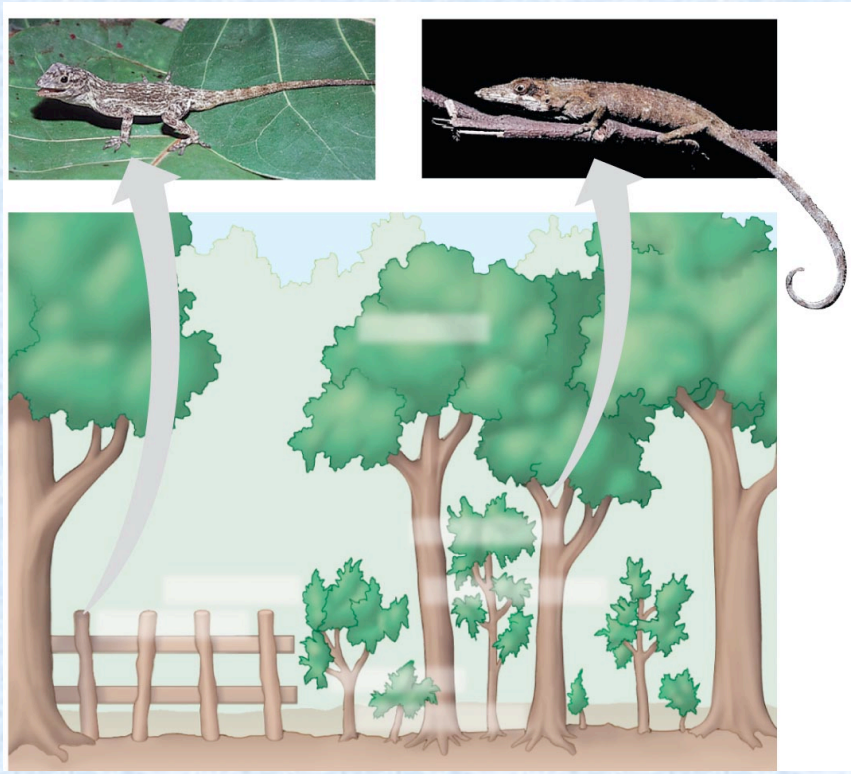
Both lizard species fundmental niche

- feed on insects in sun or shade

Each lizard species realized niche

- one feeds in sun

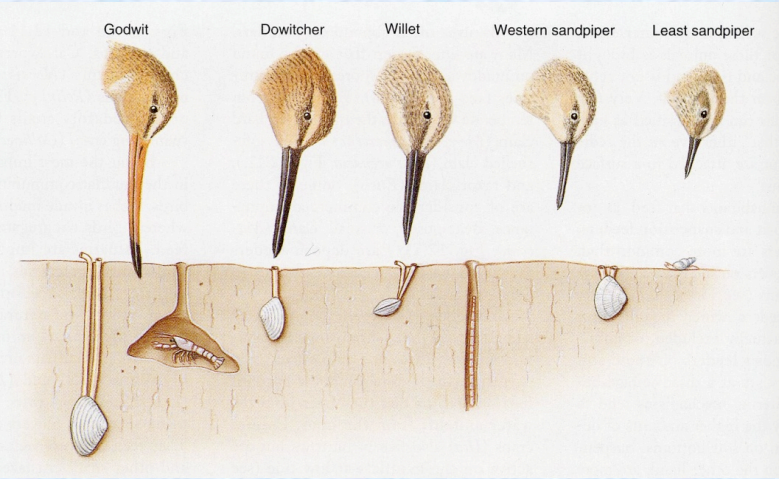
- the other feeds in the shade



Resource Partitioning

- **Allows for Coexistence by: Sharing resources**
  - **Both species use resources in different ways**

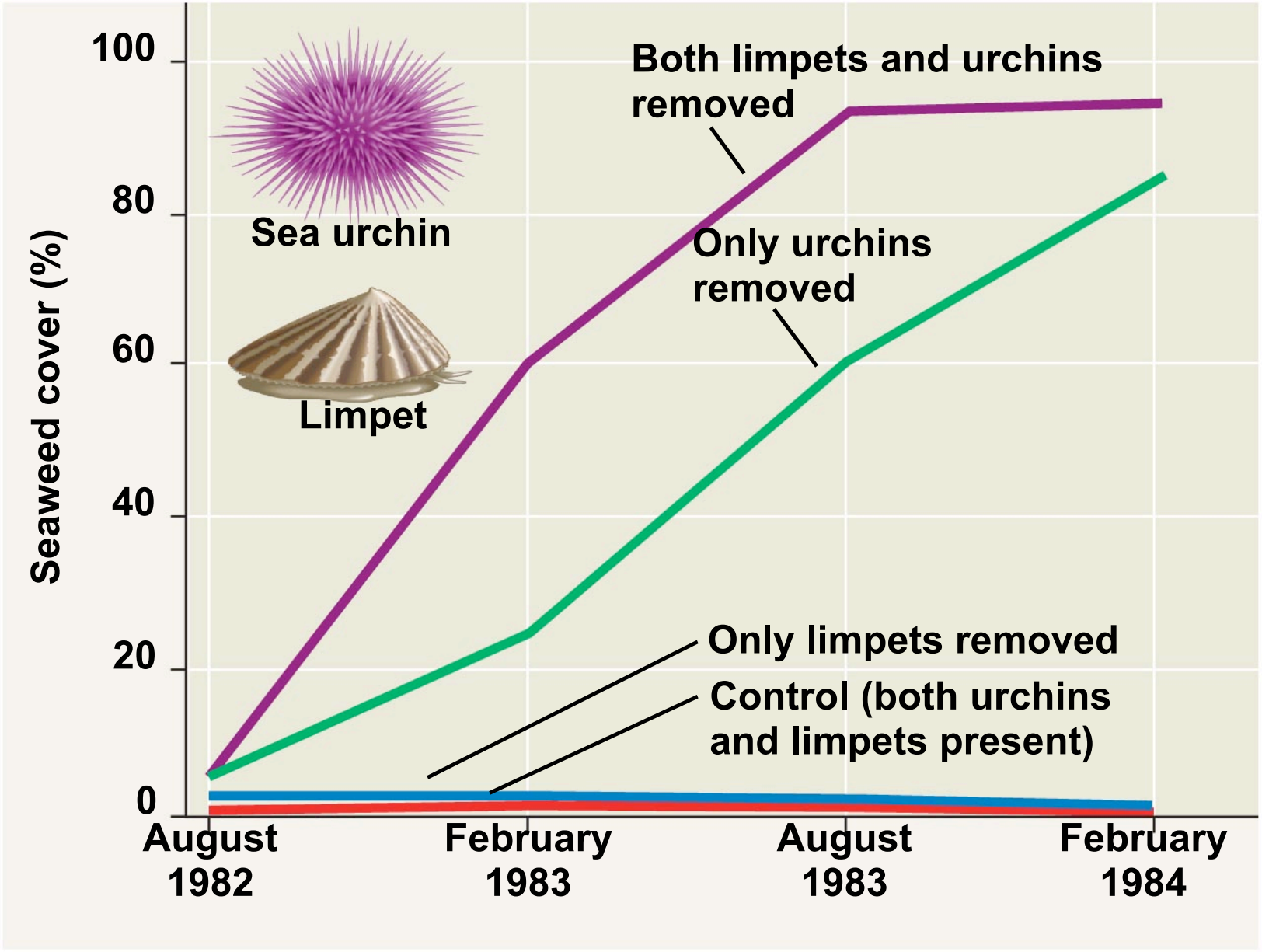
- **Causes *Character Displacement***
  - ***the evolution of differences among species to reduce competition***



Shorebirds eat same type of food but feed at different depths due to different beak sizes

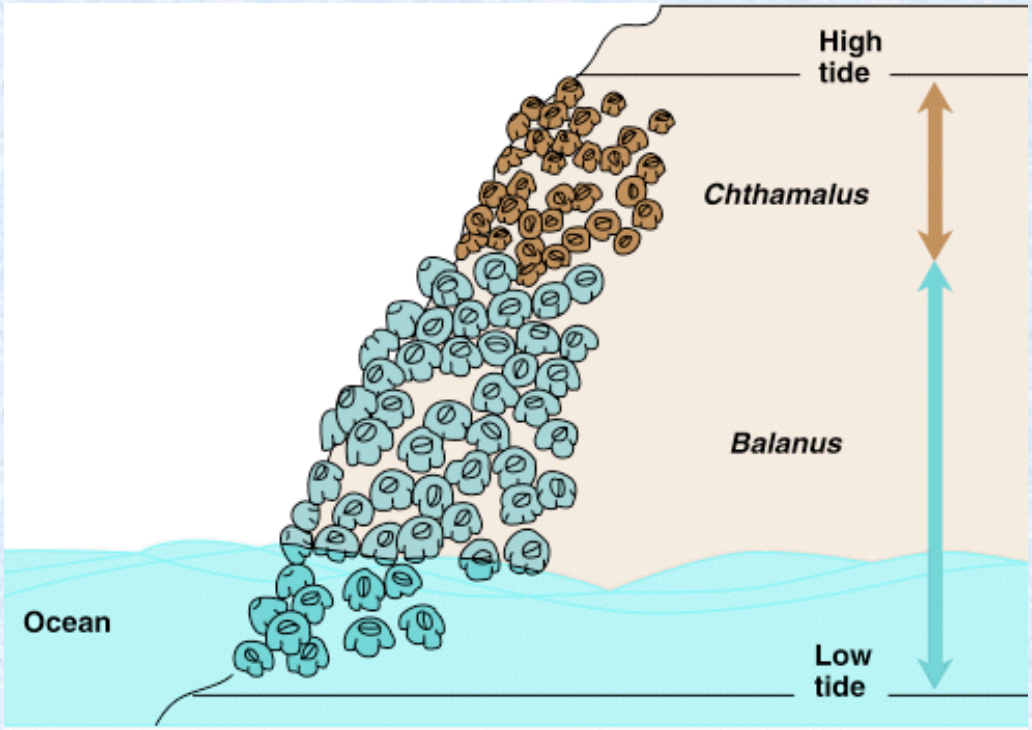
RESULTS

Herbivore impact on Seaweeds



Why do these barnacle species live in different places on rocks?

Different niches!



- <u>Abiotic factors</u>
  - Temperature
  - Water level
- <u>Biotic</u>
  - Interactions with others species

2 Species of Barnacles in a Rocky Intertidal Habitat

- Barnacles are sessile filter feeders as adults
- Planktonic larvae can settle anywhere
- Natural selection determines where they can stay

Ecological Roles

Producers → **Consumers**

↘ ↙

Decomposers

Producers make food

Photosynthesis

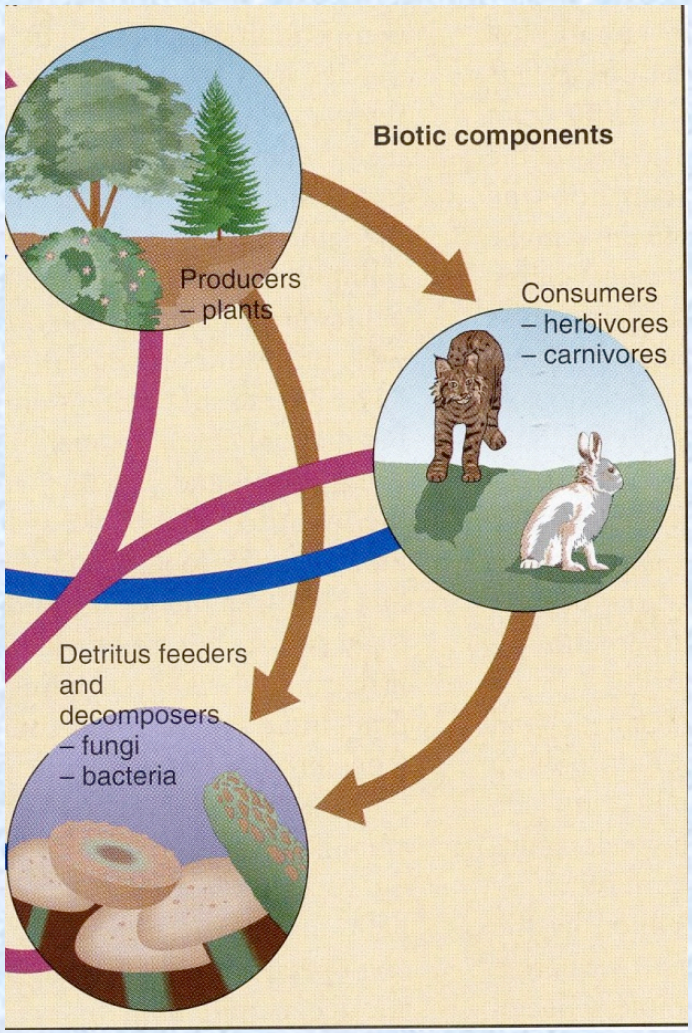
Plants, Algae, Cyanobacteria

Consumers eat food

Animals & Protozoans

Decomposers break down dead bodies

Bacteria & Fungi

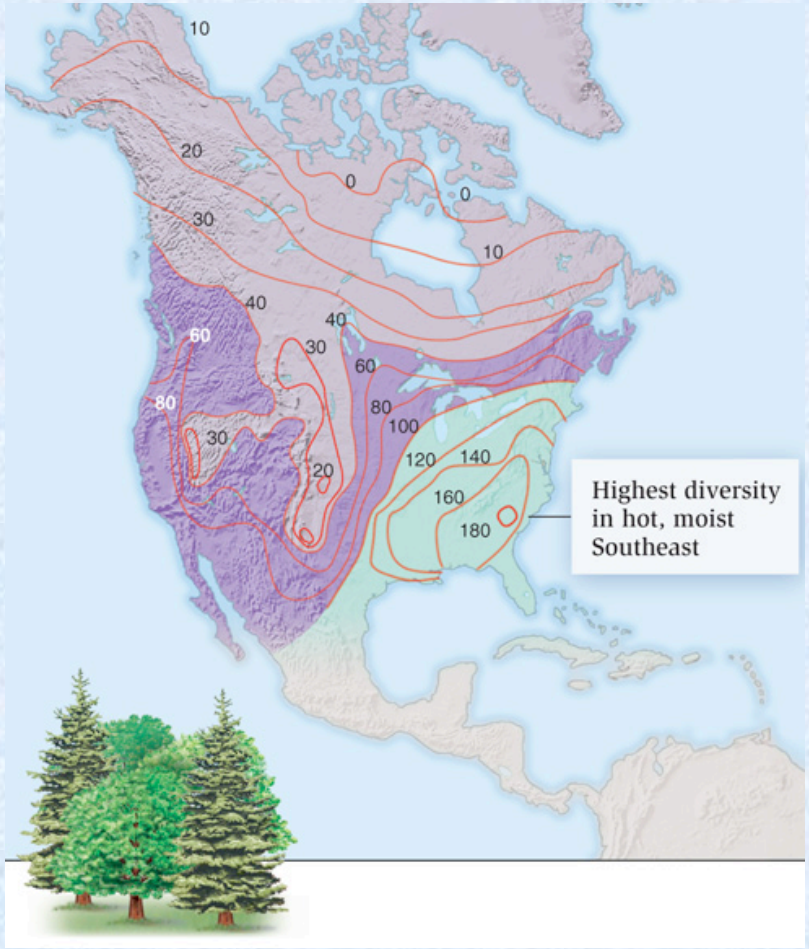


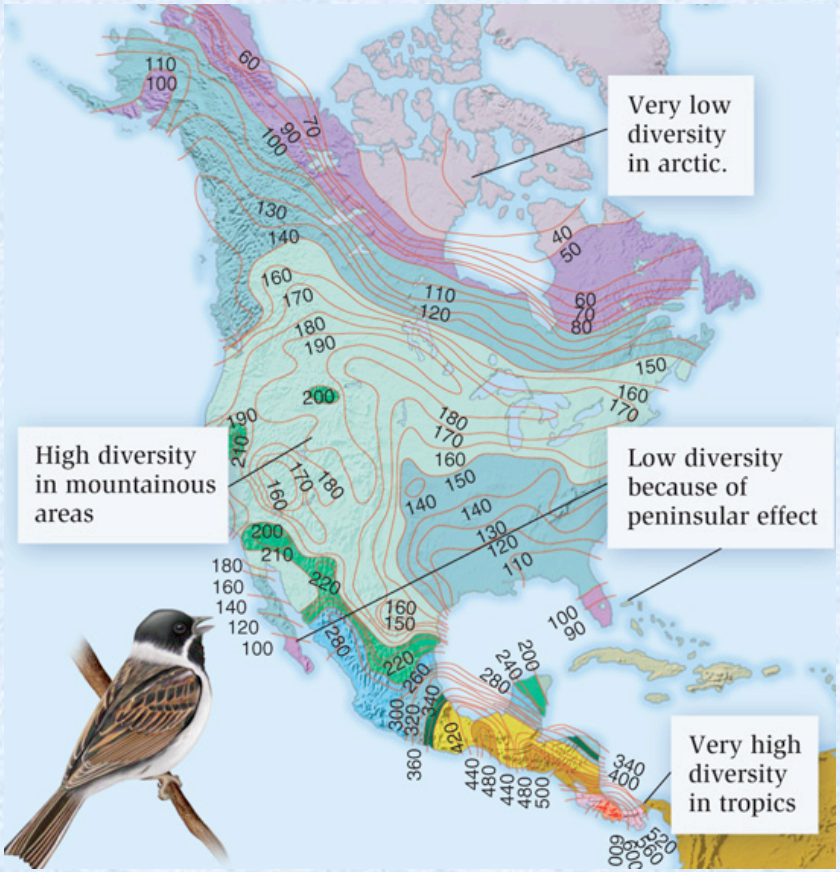
Community properties

- **Species Richness**
  - **also called Biodiversity**
- **Dominance**
- **Species Diversity**
- **Stability - ability to resist change**
  - **Keystone species**
  - **Succession**

Species Richness - # of species

Increases from poles to equator





Dominance

- **A dominant species is the largest or most abundant species**

- **Low diversity communities**
  - **usually has one or more dominant species**
  - **Ex: Redwoods in redwood forest**

- **High diversity communities**
  - **no dominant species**
  - **Ex: Trees in a tropical rainforest**

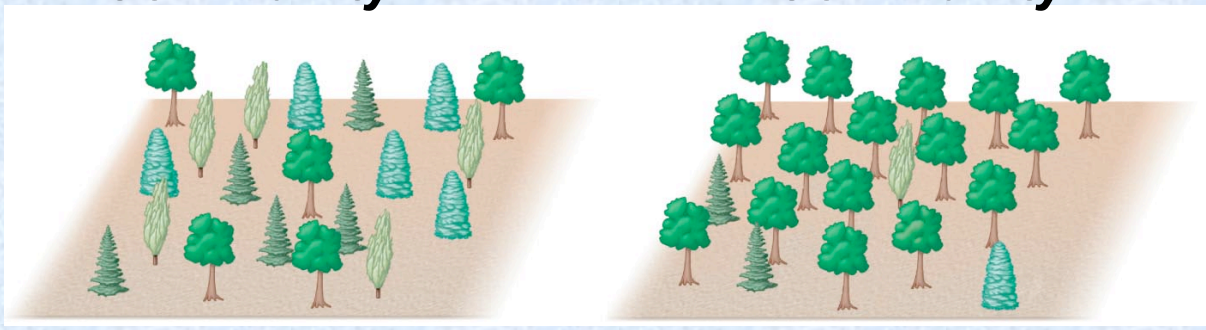
Species Diversity

relative abundance of each species

- **Shannon diversity index (calculation)**
  - **# of species**
  - **# of individuals**
- **High diversity**
  - Many species, small #s of of individuals
- **Low diversity**
  - Few species, large #s of individuals

Community 1 ***Community 2***

HIgh



Low

A:25% **B**:25% **C**:25% **D**:25%

A:80% **B**:5% **C**:5% **D**:10%

Keystone Species

A highly important species in community

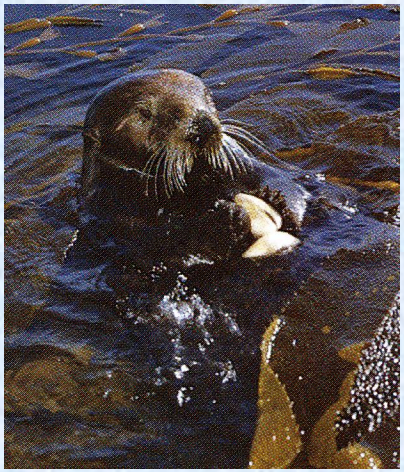
- Other species depend on it
- High biodiversity when present
- Low biodiversity when absent
- Not very abundant, but strong influences on others

Sea stars

Sea otters

Fig Trees

Keystone predators



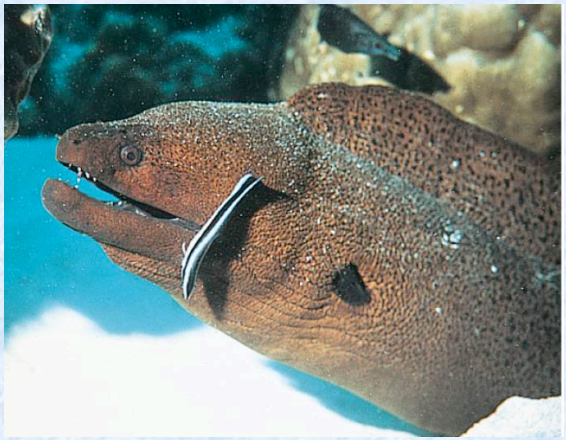
Present -> high species richness (biodiversity)

Absent -> low richness

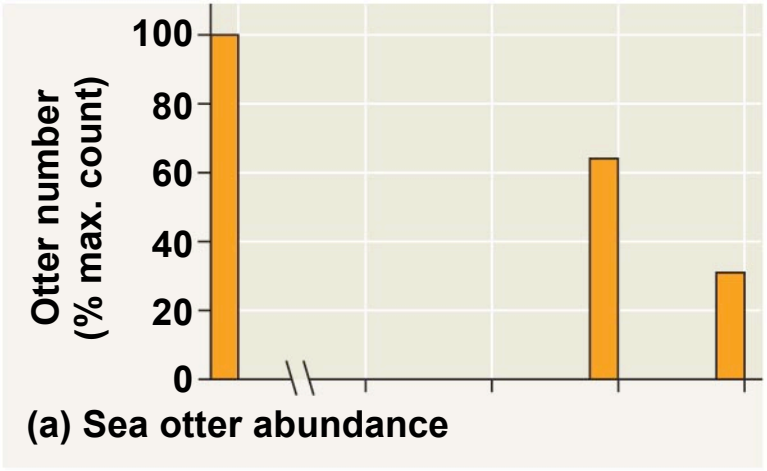
Why?

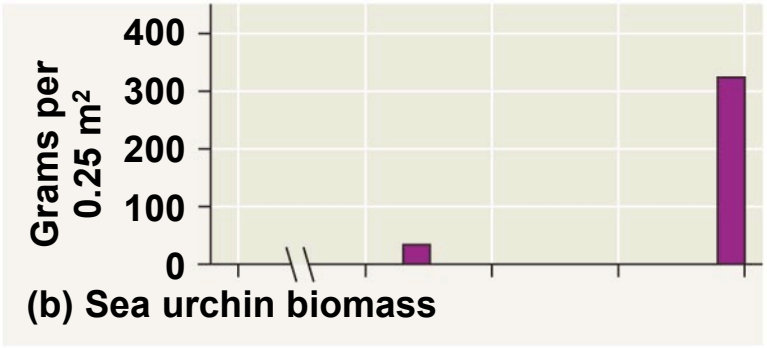
They feed on ecologically dominant species (competitors or herbivores) who reduce biodiversity

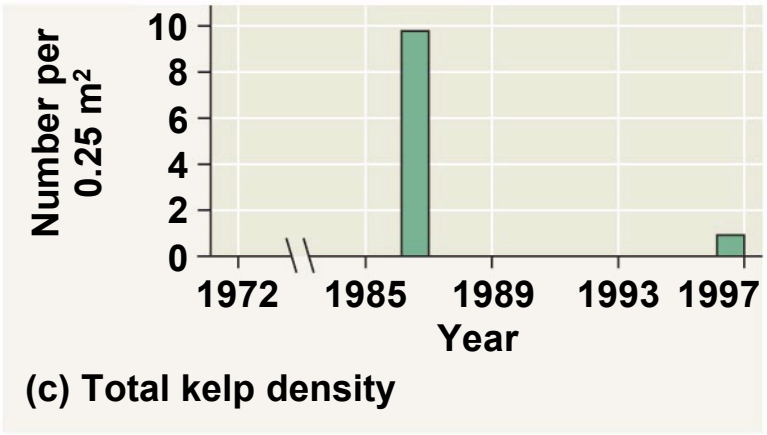
A keystone species can be a Mutualist

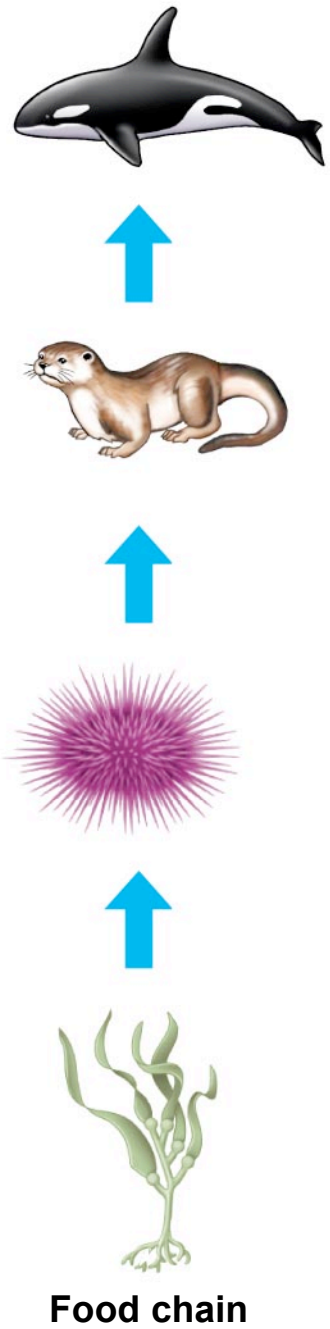


- **Cleaner wrasses (fish)**
  - **get food by eating ectoparasites**
- **Other coral reef fish**
  - **receive parasite removal services**









Sea otters are <u>keystone predators</u>

Sea urchins eat kelp

Otters feed on urchins

- Low urchin #s

High species diversity

Otters absent

- High urchin #s

-eat too much kelp

Low species diversity