

# Chapter 4: Ecosystems and Communities

**Question:** How do organisms within a community affect one another?

**Describe TWO interactions in your notebook.**

# Chapter Mystery: The Wolf Effect



# A history of wolves in Yellowstone

- As mining declined in the early 1900's, ranching and farming rose in the west
- USWFS Animal Control killed 1,800 wolves and 23,000 coyotes in U.S. National Forests in 1907
- By 1926 the last packs had been removed from Yellowstone through trapping and hunting



# What happened once wolves were removed?



# 1995 reintroduction of 14 wolves

What are the **positive and negative effects** of adding or removing a species to an ecosystem?

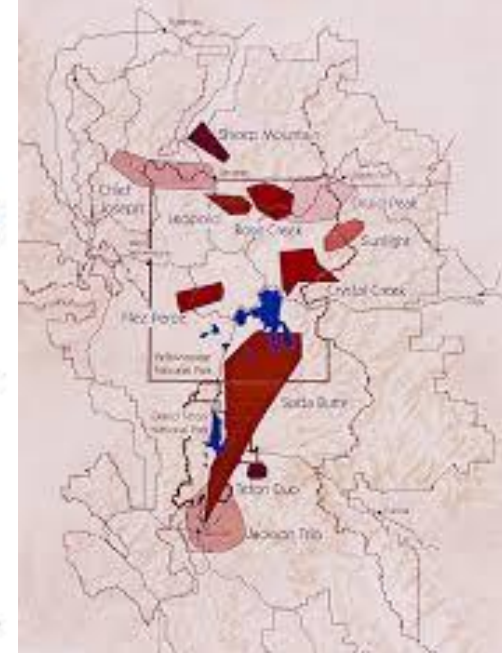


2013 Yellowstone Wolf Pack Territories



\* No-cats present, unless in western territory only.  
\* Territory reflects NPS membership only. Delta Pack territory likely extends further southeast.

Greater Yellowstone Wolf Pack Territories, 1999



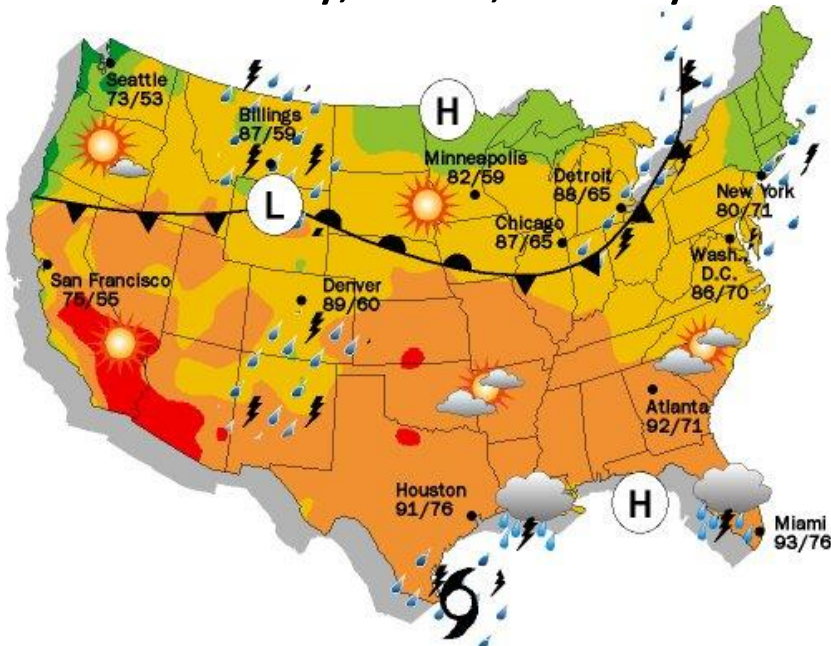
# 4.1 Climate

## Weather

- Day-to-day conditions
- Based on season as well as short-term events
- Ex: Rainy, clear, cloudy

## Climate

- Average conditions over many years
- Ex: Hot, dry summer, Cold dry winter
- **Microclimates** can form in small areas (city effect, sides of trees and buildings)



# The Greenhouse effect

A T M O S P H E R E



Net incoming solar radiation:  
240 Watt per m<sup>2</sup>

Some solar radiation is reflected by the atmosphere and earth's surface  
**Outgoing solar radiation:**  
103 Watt per m<sup>2</sup>

Some of the infrared radiation passes through the atmosphere and is lost in space  
**Net outgoing infrared radiation:**  
240 Watt per m<sup>2</sup>

G R E E N H O U S E G A S E S

CO<sub>2</sub>  
NO<sub>x</sub>  
methane

Solar radiation passes through the clear atmosphere.  
**Incoming solar radiation:**  
343 Watt per m<sup>2</sup>

Some of the infrared radiation is absorbed and re-emitted by the greenhouse gas molecules. The direct effect is the warming of the earth's surface and the troposphere.

Surface gains more heat and infrared radiation is emitted again

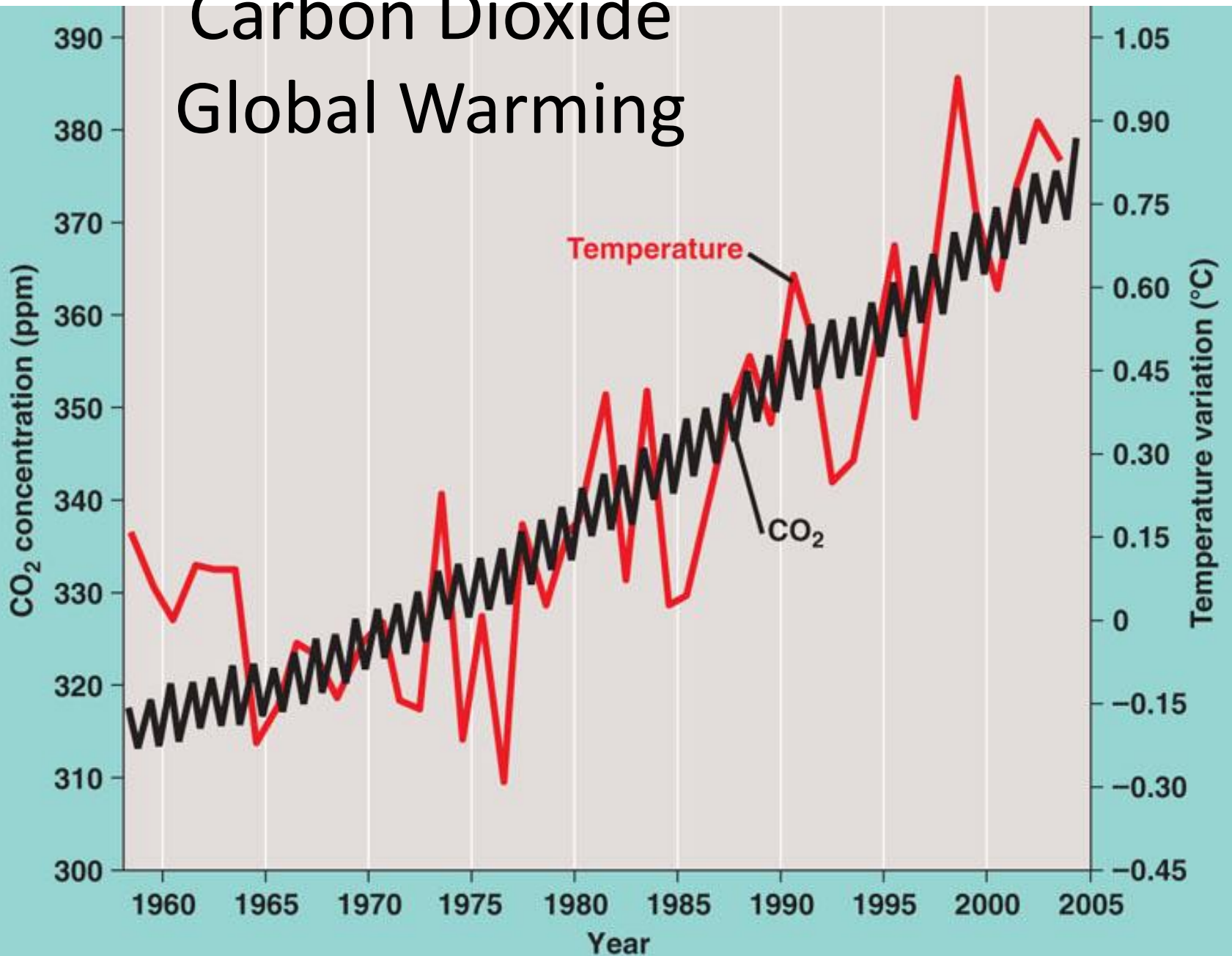
Solar energy is absorbed by the earth's surface and warms it..  
**168 Watt per m<sup>2</sup>**

... and is converted into heat causing the emission of longwave (infrared) radiation back to the atmosphere

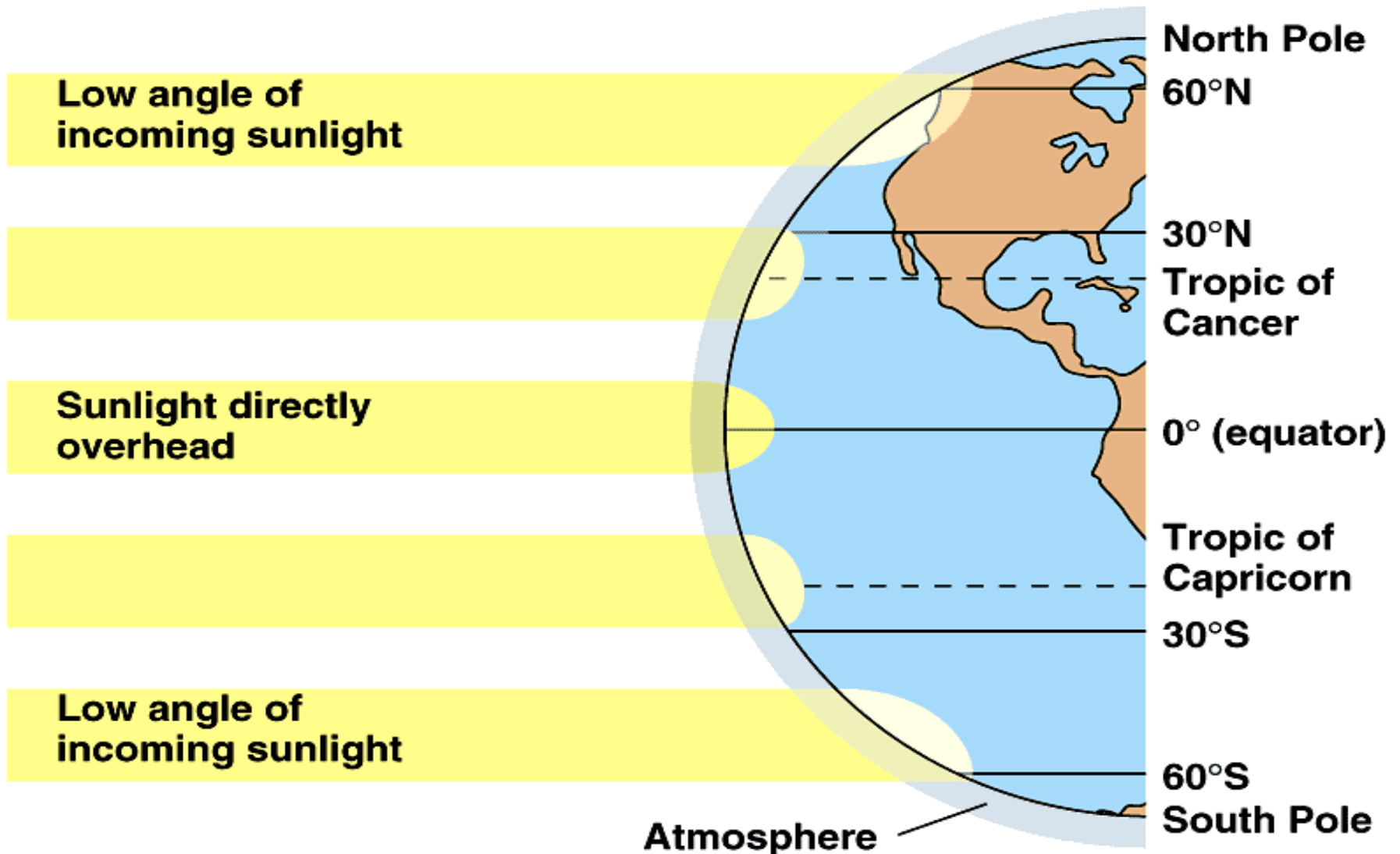
E A R T H



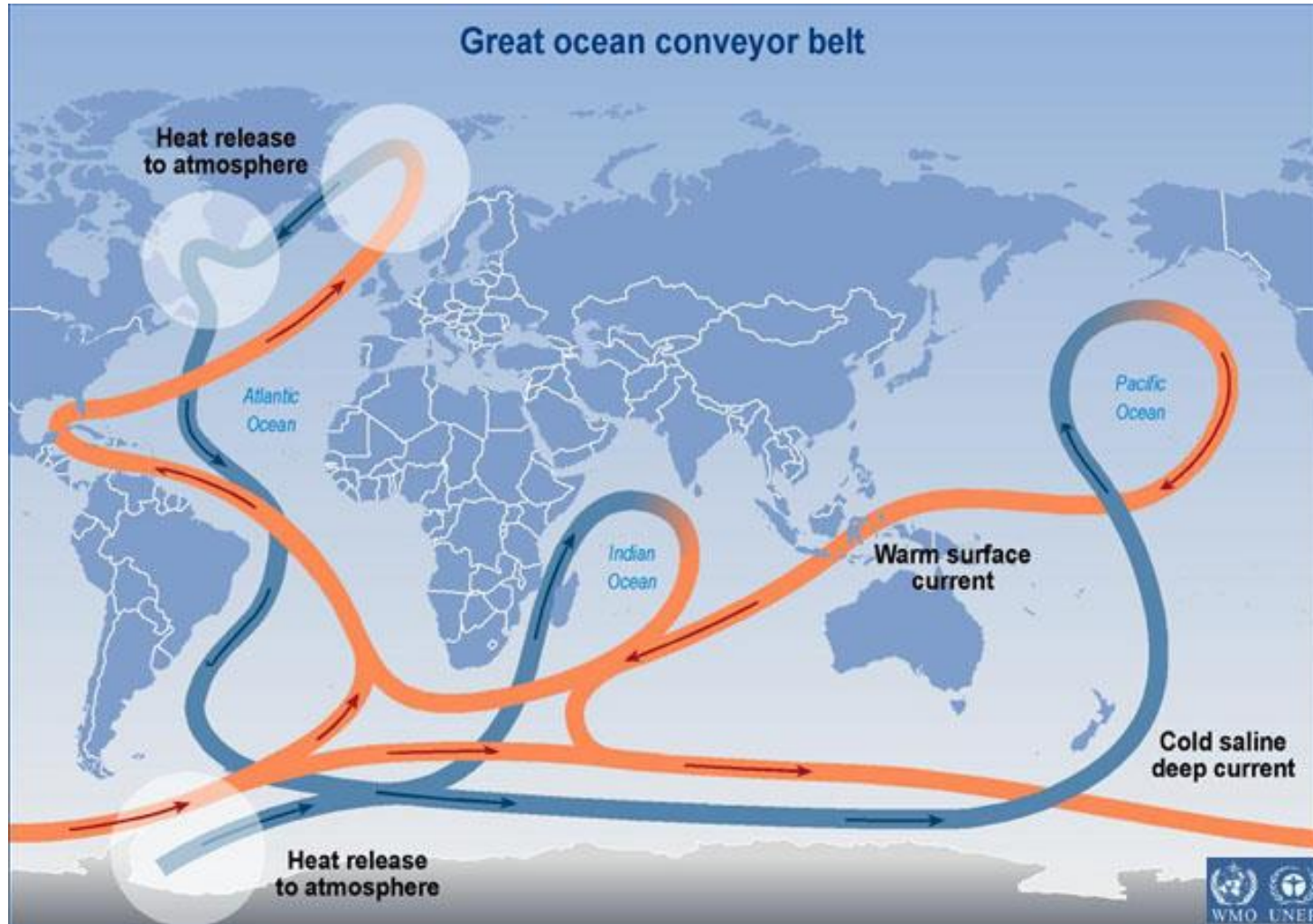
# Carbon Dioxide Global Warming



# The Effects of Latitude on Climate



# Global Heat Transport



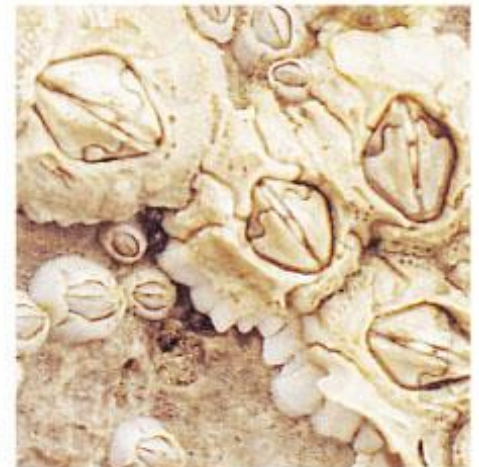
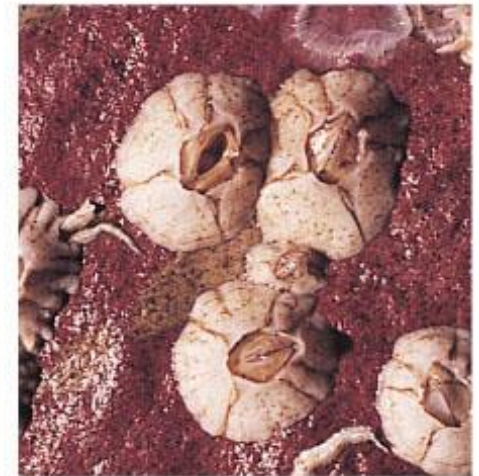
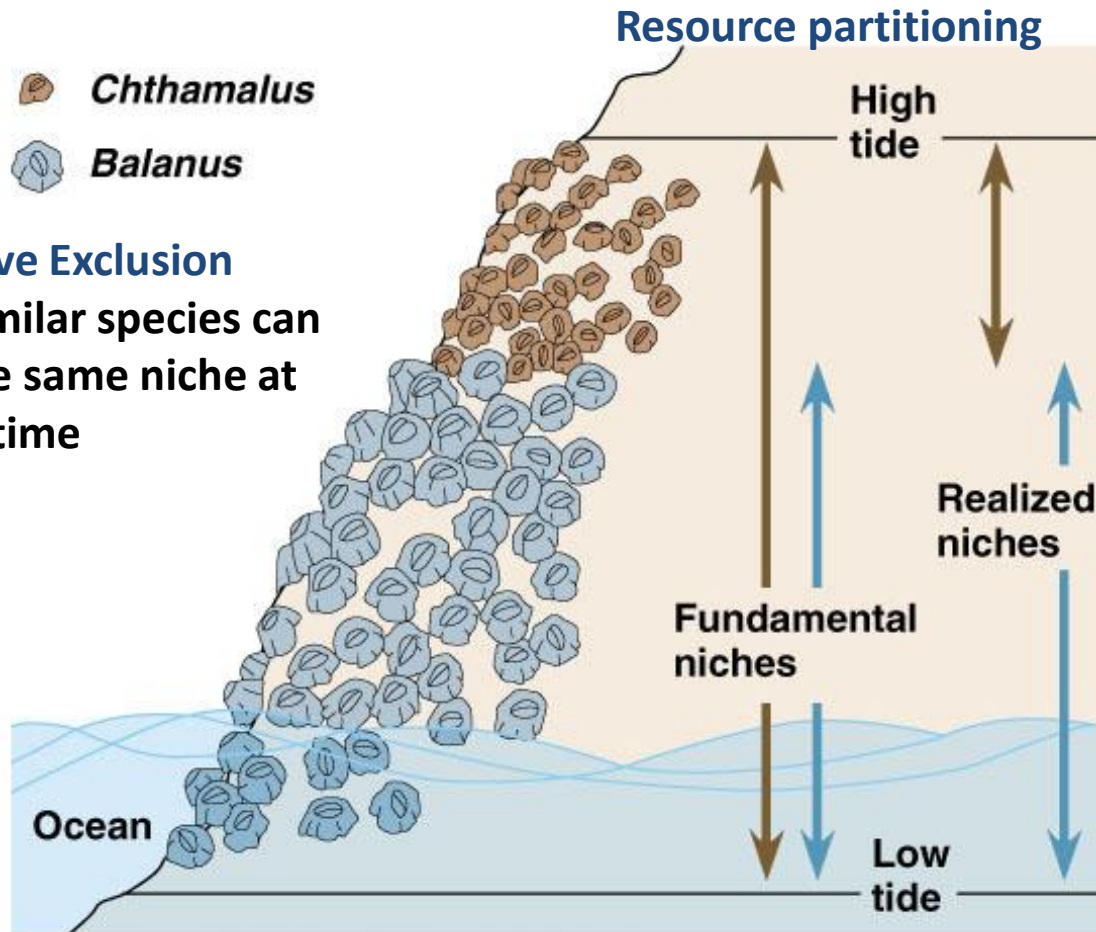
# 4.2 Niches and Community Ecology

- Community
  - group of species living close enough together for potential interaction
- Community Ecology
  - study of interactions among all populations in a common environment



# Niches

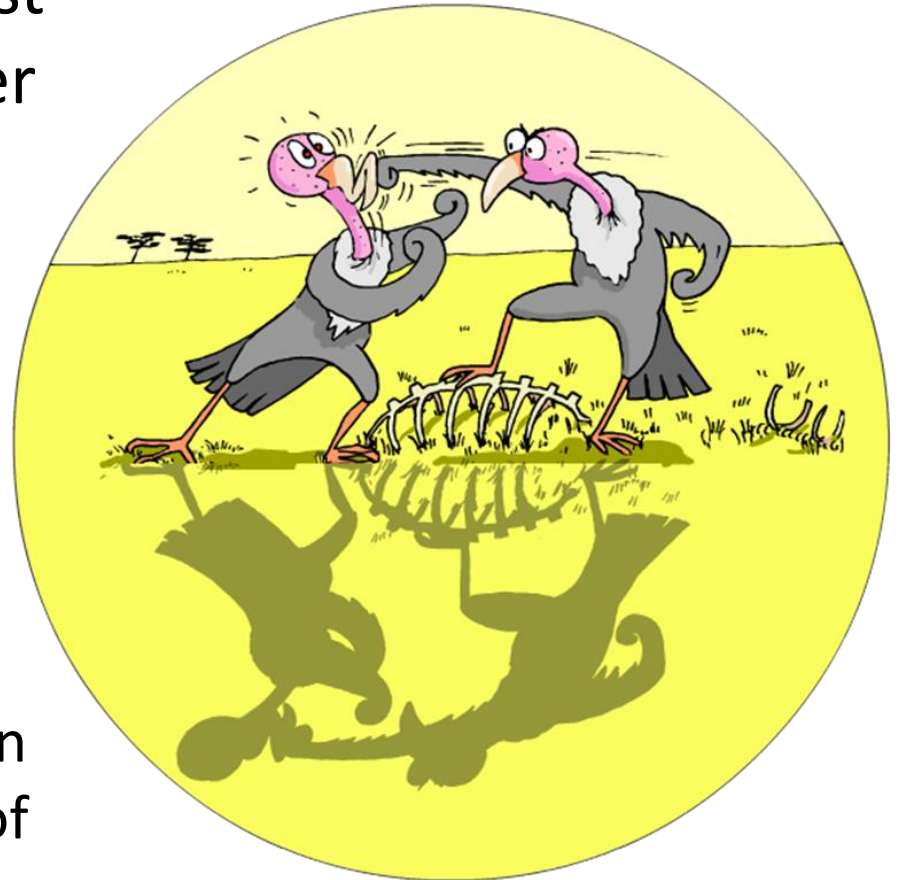
- An organism's **niche** is its *ecological role in a community* based on its **tolerance** for the habitat



**Competitive Exclusion**  
No two similar species can occupy the same niche at the same time

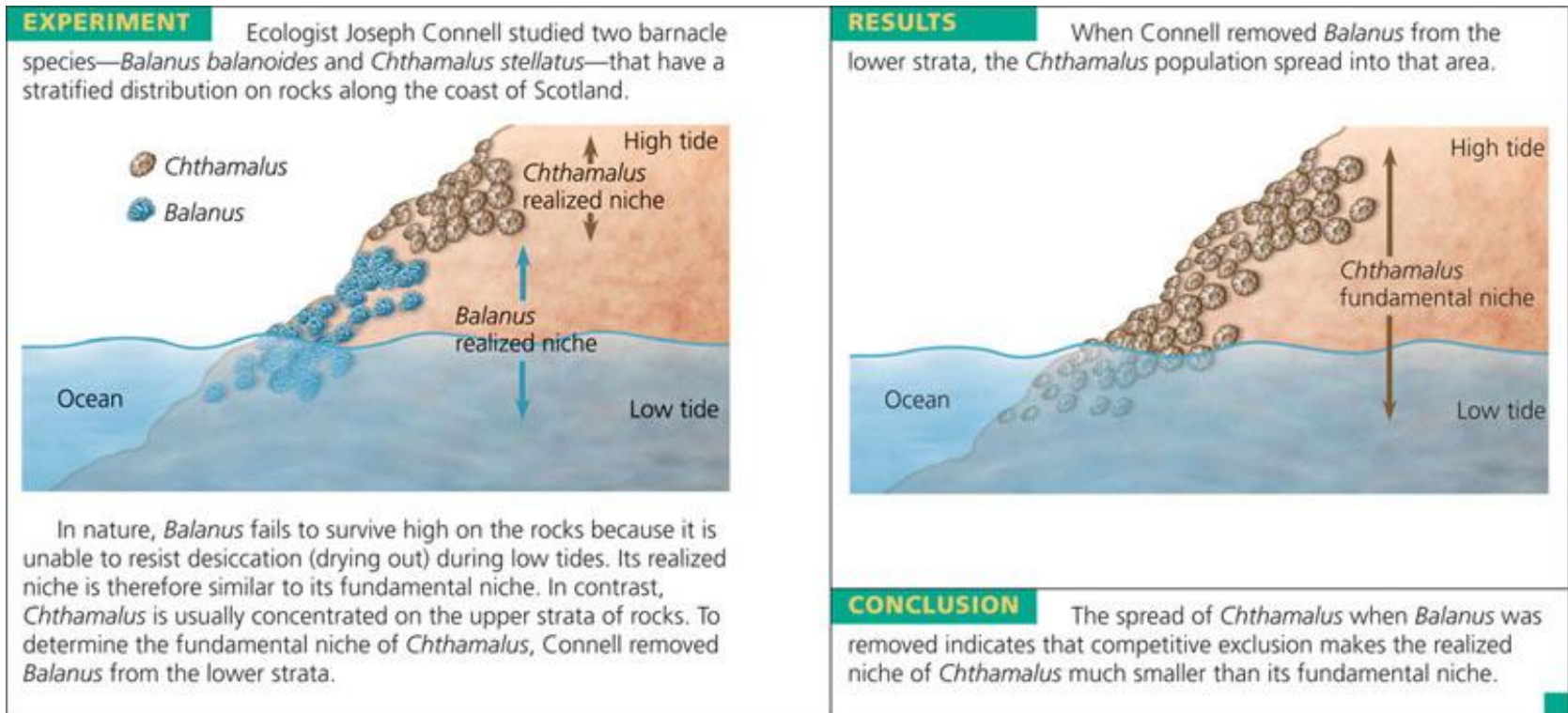
# Competitive Exclusion

- Direct competition almost always produces a winner and a loser
- Winner stays and the loser moves or dies
- Competition can be
  - **inter-specific:** between two different species
  - or **intra-specific:** between two members or groups of the same species



# Niches & competition

- What happens when two barnacles want to live in the same place?



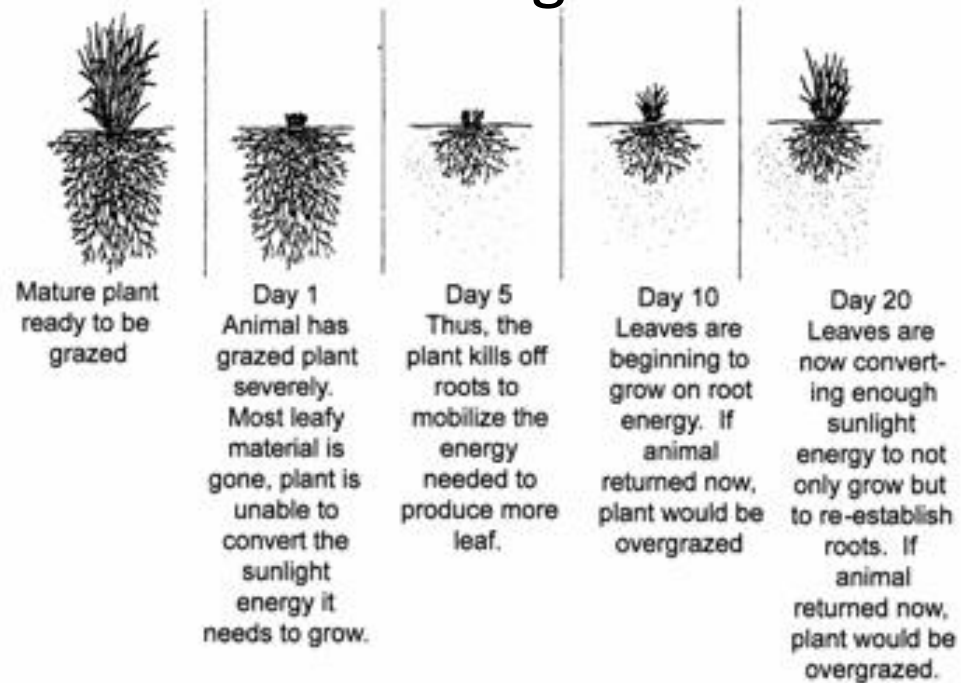
# Herbivore-Plant relationships

Herbivores can affect the **size and distribution of plants** in an area by eating certain “favorites”

Ranchers use **grazing rotations** to keep plants from being “overgrazed” so they will continue to grow back



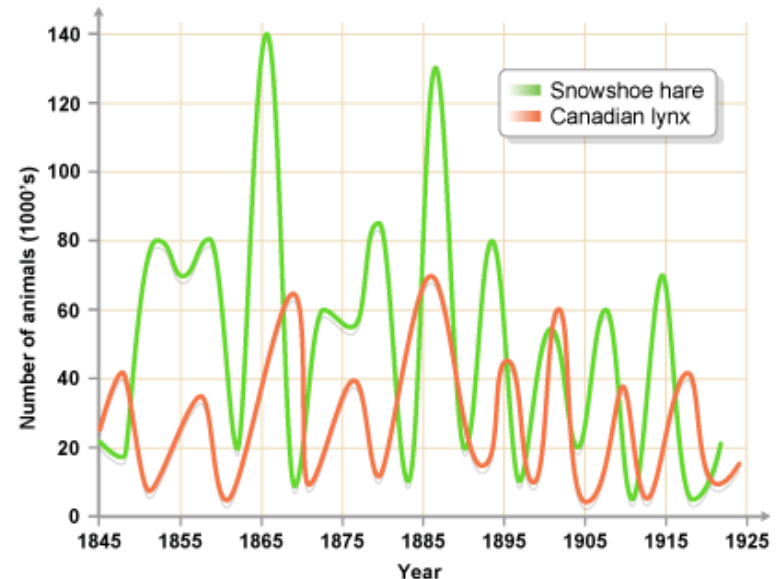
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# Predator-Prey relationships

- Often, predators are **prey-specific**
- Populations are **directly related**, but the effects can take time to show in the community
- As one population increases, another will decrease or increase



# Predation and Herbivory drive Evolution!

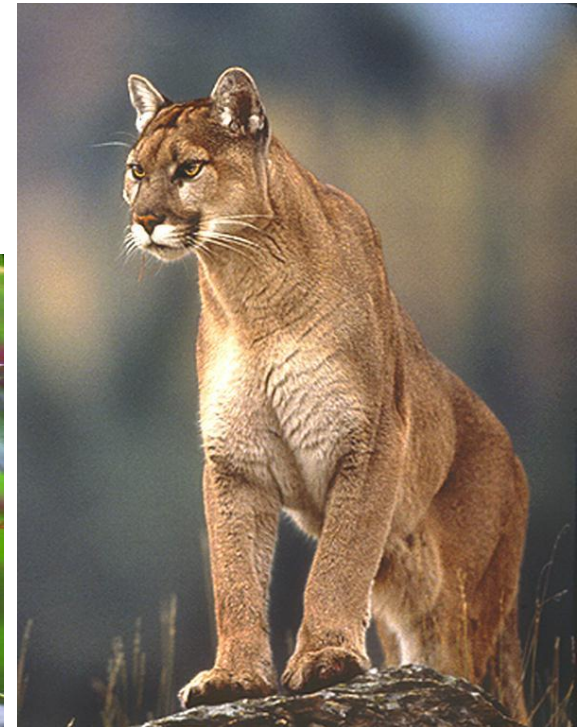
- Predators adaptations
  - Used to locate & subdue prey
- Prey adaptations
  - Used to elude & defend themselves



**horns, speed, coloration**



**spines, thorns, toxins**



# Case Study: Isle Royale National Park (MI)



# Inter-specific interactions

- Symbiotic interactions
  1. **Competition (-/-)**
    - compete for limited resource
    - 2 species can't coexist if their niches are identical
  2. **Predation or Parasitism (+/-)**
    - One benefits, the other is harmed or killed
  3. **Mutualism(+/+)**
    - Both benefit
  4. **Commensalism (+/0)**
    - One is helped, the other is unaffected





commensalism



mutualism



predation



competition

04-2005



**Caiman with butterflies**

Mark Cowan, U. Michigan, 2016

# Community structure

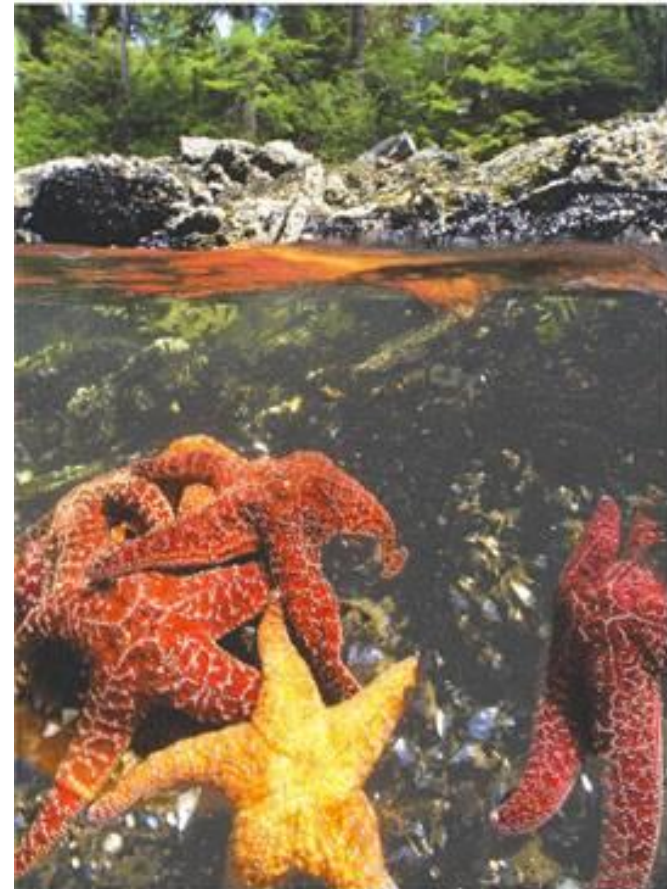
- If we remove a species from a community, it will change the entire community structure

## Dominant species

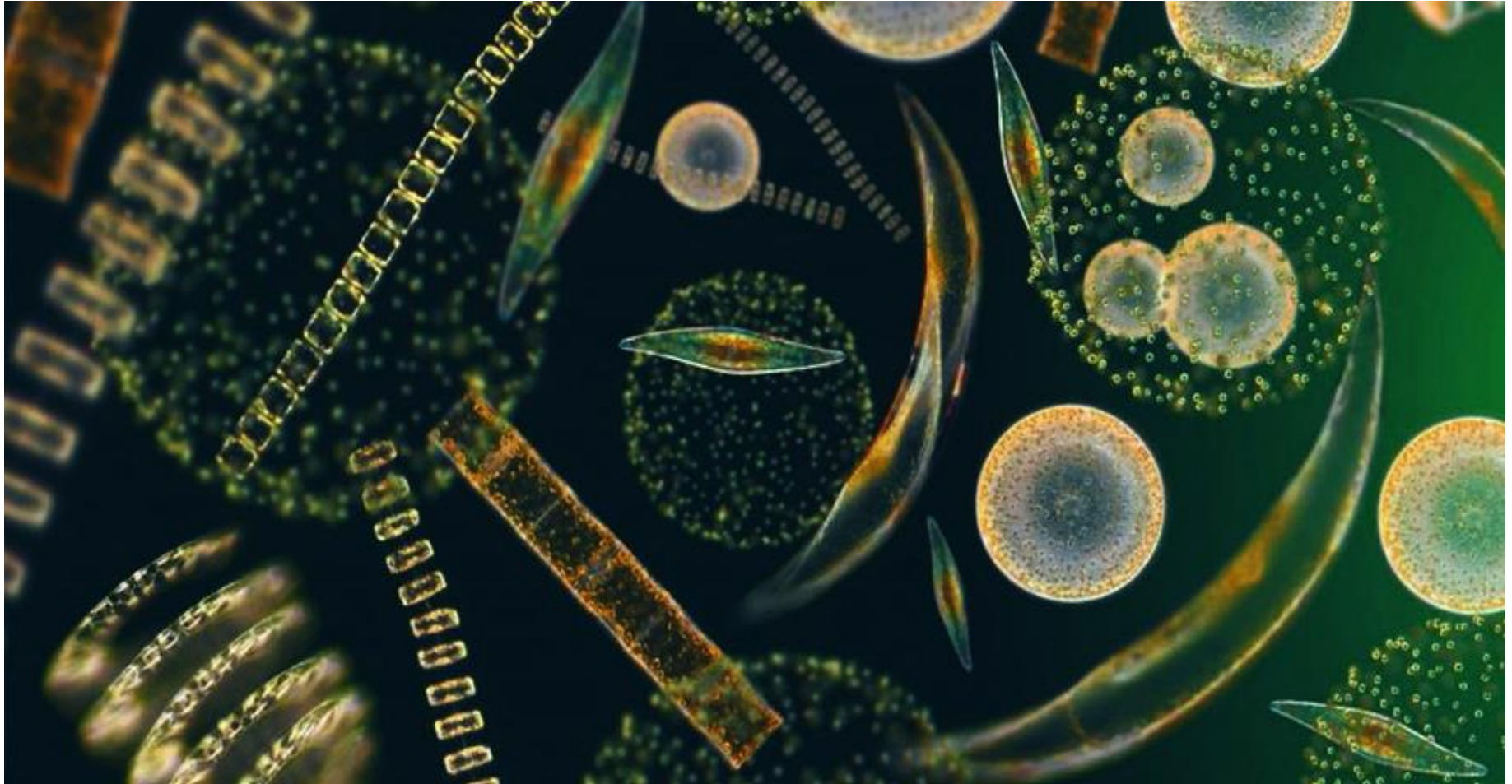
- most abundant species or highest biomass (total weight) community

## Keystone species

- exert important regulating effect on other species in community



# Phytoplankton in the ocean are a Dominant Species





# Wolves in Yellowstone are a Keystone Species



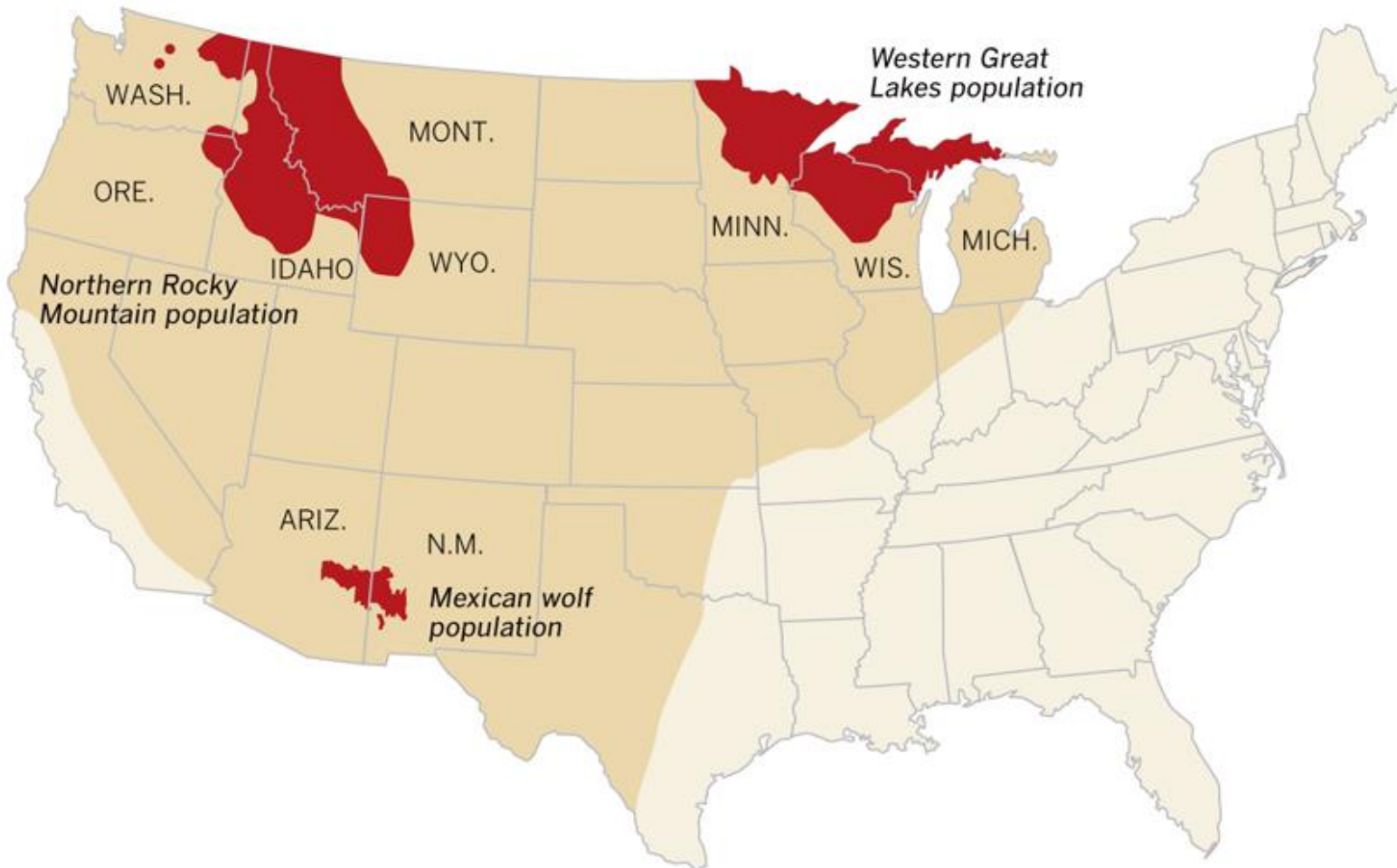
# Wolves affect other species, too

- Willow, Aspen, and Cottonwood trees increased
- Beaver populations increased (wood for lodges)
- Coyotes, Ravens and other scavengers increased
- Elk, Bison and Deer populations have decreased



# Current disputes about management. . .

**Wolf distribution**      ■ Current range      ■ Historic range



## 4.3 Ecological Succession (p.106)

- A series of predictable changes in an ecosystem over time
- Ecosystems will change due to
  - Time
  - Ecosystem disturbances
  - Large or small-scale changes in climate
  - Changes in plant and animal populations

# Changes over Time



**Mt. St. Helens 1979**

# BOOM!

Explodes with 20X the power of the atomic bombs  
dropped on Hiroshima



USGS, 1980 / Jim Valance

Video of MT ST Helen's Eruption May 18, 1980 (4 min) <http://www.history.com/topics/us-states/washington/videos/mount-st-helens-erupts>

# Changes over Time

- The pattern of a community changes over time
  - Species will change (especially in the case of a disturbance)
    - May take years or decades



# Primary succession

Begins with  
virtually lifeless  
area without soil,  
then...

- make soil {
- bacteria
  - lichens & mosses
  - grasses
  - shrubs
  - trees



McBride glacier retreating





Primary Succession  
from mosses & lichens  
= **pioneer species** (first  
species to colonize an  
area after disturbance)

to shrubs & trees



# Secondary succession

- Existing community cleared, but soil is left intact



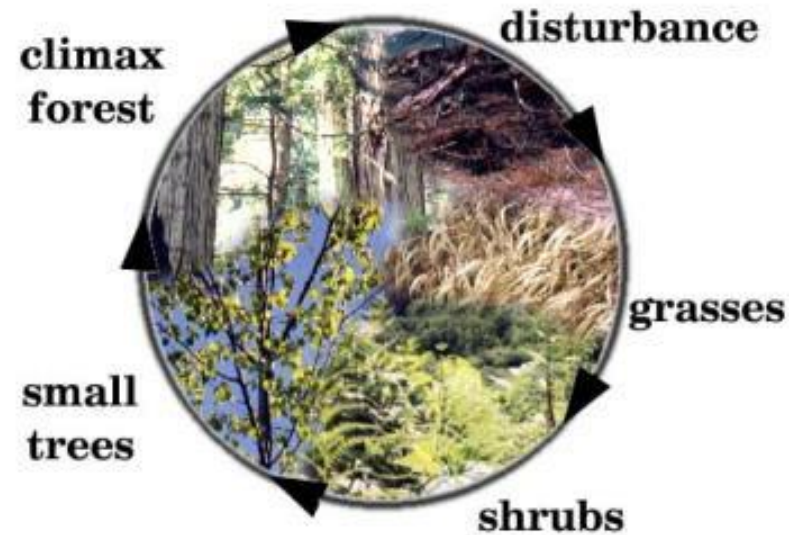
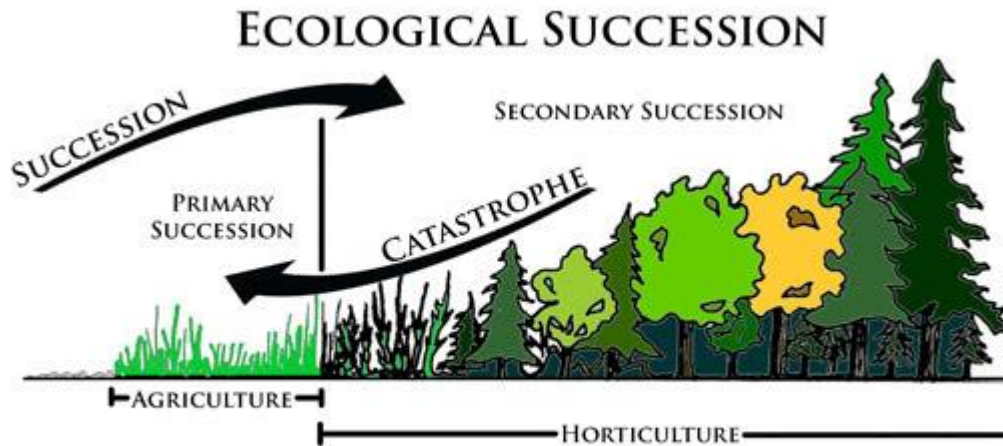
**(a) Soon after fire.** As this photo taken soon after the fire shows, the burn left a patchy landscape. Note the unburned trees in the distance.



**(b) One year after fire.** This photo of the same general area taken the following year indicates how rapidly the community began to recover. A variety of herbaceous plants, different from those in the former forest, cover the ground.

# Climax forest

- The “final stage” of natural succession for specific location
  - stable plant community
  - remains unchanged as long as site is undisturbed
    - Old-growth forest
    - Mature grassland

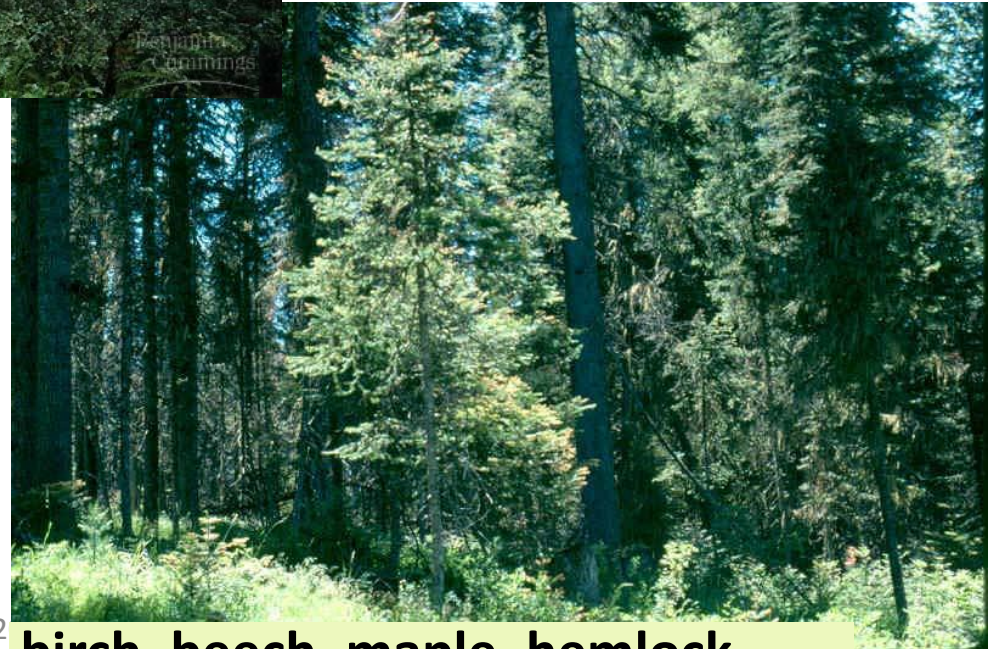


# Climax forest



The species mix of climax forest is dependent on the **abiotic factors** of the region

- solar energy levels
- temperature
- rainfall
- fertility & depth of soil



2 birch, beech, maple, hemlock

# Disturbances

Most communities are in a state of non-equilibrium due to disturbances

- fire, weather, human activities, etc.
- not all are negative



**(a) Before a controlled burn.**  
A prairie that has not burned for several years has a high proportion of detritus (dead grass).



**(b) During the burn.** The detritus serves as fuel for fires.



**(c) After the burn.** Approximately one month after the controlled burn, virtually all of the biomass in this prairie is living.

# Disturbances

- Disturbances are often necessary for community development & survival



## But. . .humans don't like disturbances

- 1935 USFS rule: all wildfires out by 10 A.M. the morning after they were first spotted
- High need for lumber during World War II
- Fires that destroyed timberland were deemed unacceptable



# Fire Suppression

- Smokey Bear!
- Post WWII mascot of the USFS to educate the public about putting out campfires
- By 1960's less than 2 million acres of forest burned/year
- **Unintended consequences?**

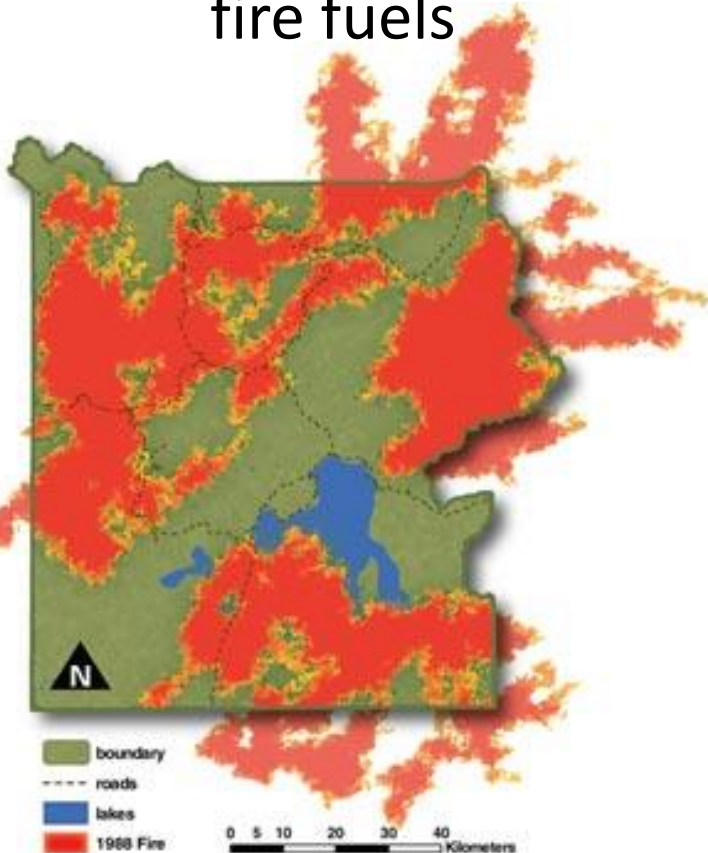


*Remember - Only you can*  
**PREVENT THE MADNESS!**



# Yellowstone Fires 1988

- \$120 million to fight fires
- \$3 million structure loss
- Suppression had increased fire fuels



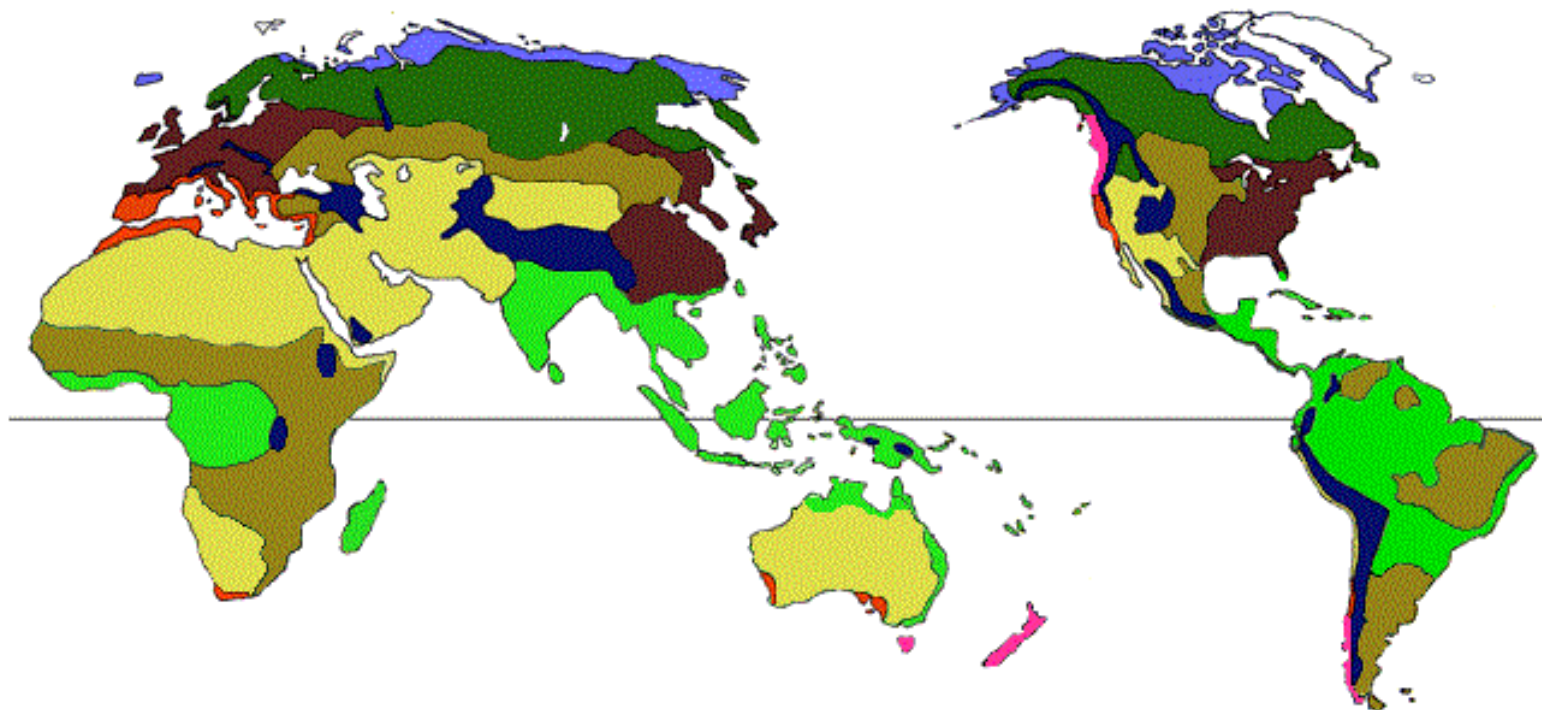
# Ecological cycle now

fire is part of a natural community cycle

- **Controlled burns**
- **Fight fires where structures are threatened**
- **Let fires burn in wilderness**

# 4.4 Biomes

- Locations on Earth that have similar climate, soil, animals, plants and other abiotic factors



# Tropical Rainforest



# Tropical Dry Forest



# Tropical Grassland/Savanna



# Desert



# Temperate Grassland





# Temperate Woodland/Shrubland



# Temperate Forest



# Northwestern Coniferous Forest



# Boreal Forest (Taiga)



# Tundra



# Mountain Ranges



# Polar Ice Caps



# 4.5 Aquatic Ecosystems

- Defined by multiple factors
  1. Water Depth
    - Photic Zone
    - Aphotic Zone
    - Benthos
  2. Temperature and Currents
  3. Nutrient Availability



# Rivers and Streams



# Freshwater Lakes



# Freshwater Wetlands: Bogs



# Freshwater Wetlands: Marshes



# Freshwater Wetlands: Swamps



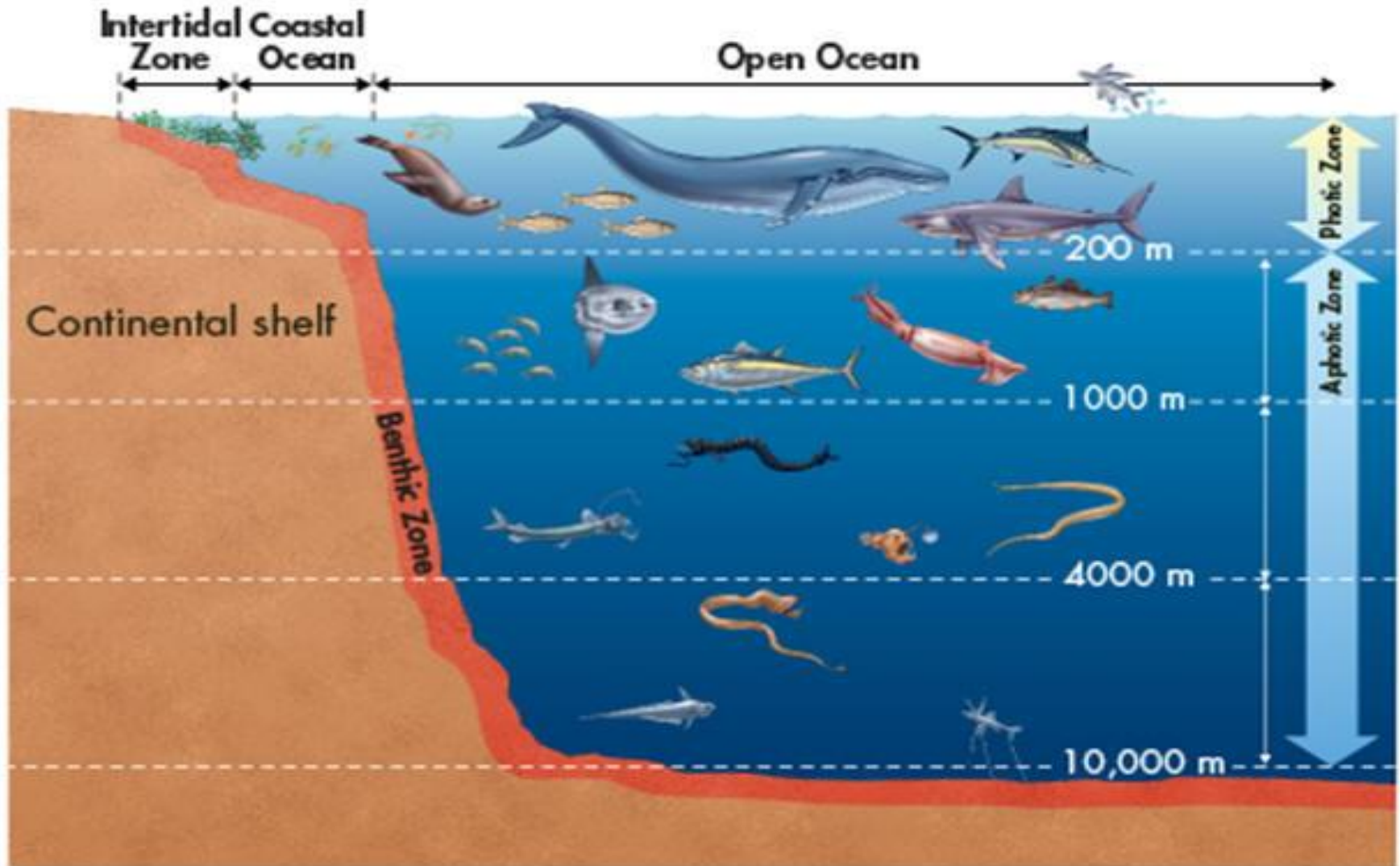
# Estuary: Salt Marsh



# Estuary: Mangrove Swamp



# Marine Ecosystems





# Different zones based on distances

- Distance from shore:
  - Intertidal
  - Coastal
  - Open Ocean
- Reach of Sunlight:
  - Photic
  - Aphotic
  - Abyssal
- Depth:
  - Continental Shelf
  - Benthic

