Final Exam

Final exam is 12:30-3:30PM Tuesday May 16, 2006.

http://ib.berkeley.edu/courses/bio11/examinfo.html

Extra credit score will appear on your final exam.

Review Session

- Friday May 12, 109 Dwinelle @ 4 PM

Community Structure & Biodiversity

1. Community structure
   - Species interactions
     - Commensalism
     - Mutualism
     - Competition
     - Predation
     - Parasitism
2. Community Stability & Instability
   - Succession model
   - Keystone species
   - Exotic species
3. Biodiversity
   - Biogeography
   - Threats to biodiversity
   - Conservation biology

Community Structure

- Niche
  - The sum of all activities and relationships in which individuals of a species engage as they secure and use the resources necessary to survive and reproduce.
- Habitat
  - Where a species lives, the physical environment.
- Community
  - Populations that interact with one another in a habitat.

Community Structure

A community is composed of 5 factors:

1. Climate and topography
   - Temperature
   - Rainfall
   - Type of soil
2. Resources
   - Types of food
   - Quantity of food
   - Other resources
3. Adaptive traits of inhabitants
4. Competition, Predation, mutualistic interactions
5. Population sizes

Habitats Desert

Habitats
Desert

Habitats
Desert

Habitats
Desert

Habitats
Chaparral

Habitats
Chaparral

Habitats
Chaparral

Habitats
Rainforest

Habitats
Rainforest

Habitats
Canopy

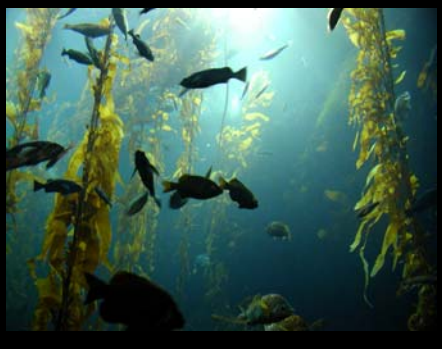
Habitats
Coral Reefs

Habitats
Coral Reefs

Habitats
Kelp Forest

Habitats
Kelp Forest

Habitats
Kelp Forest



Habitats
Mangroves

Habitats
Mangroves

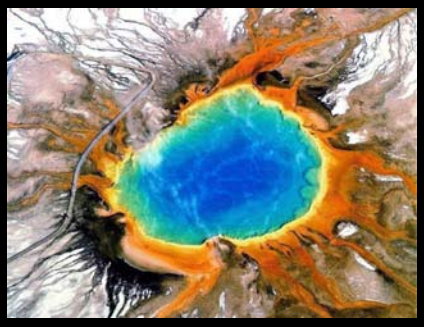
Habitats
Mangroves

Habitats
Extreme Environments

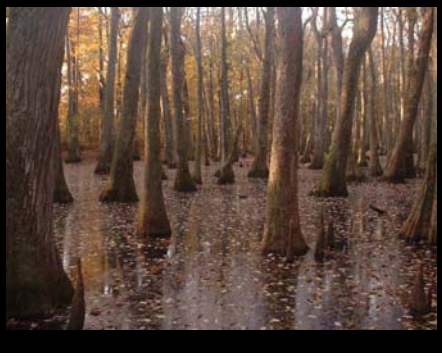
Habitats
Extreme Environments

Habitats
Extreme Environments

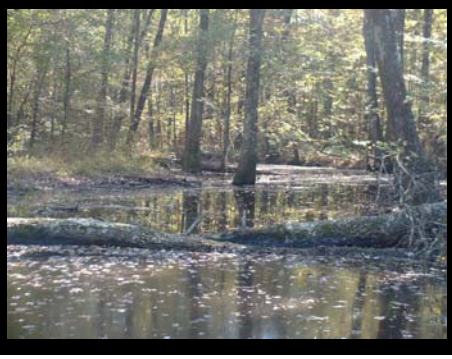
Habitats
Extreme Environments



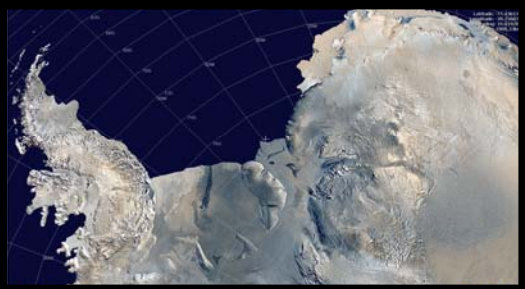
Habitats
Swamps



Habitats
Swamps



Habitats
Antarctica



Habitats
Antarctica

Habitats
Antarctica

Habitats
Intertidal

Habitats
Intertidal

Habitats
High Plains

Habitats
High Plains

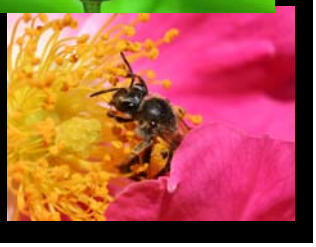
Habitats
Mountains

Species Interactions
Symbiosis

- Commensalism
  - One species benefits, other is unaffected.
- Mutualism
  - Both species benefit.
- Interspecific Competition
  - One or both species may be harmed.
- Predation
  - One species benefits at the expense of another.
- Parasitism
  - One species benefits at the expense of another.

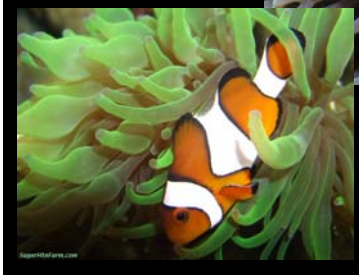
Mutualism

Pollination



Mutualism

Protection



Obligatory Mutualism

Lichen

Fungi & Photosynthetic bacteria of protist

Competitive Interactions

- Intraspecific
  - Competition for resources among individuals of the same species.
- Interspaecific
  - Competition for resources among individuals of different species.
- Competitive exclusion
  - when 2 species compete for the same food sources.
- Resource partitioning
  - When different species require the same resource but utilize different parts of the resource such that both may survive.

Predator-Prey Interactions

- Coevolution
  - 3 predator-Prey models
- Adaptations of predators and Prey
  - Camouflage
  - Aposematic coloration
  - Mimicry
  - Behavior

Coevolution

When two or more species exert selective pressures on one another.

- Predator-prey interactions
- Parasite host interactions

- Predator-Prey models:
  1. Type I
     - spiders
  2. Type II
     - Wolves
  3. Type III
     - Predators that can switch prey.

Coevolution

Type I

Independent of prey abundance. Predator removes constant proportion of prey over time.

Type II

Predation patterns dependant on abundance of prey. As abundance increase predation increases then levels off as predators are sated.

Type III

Predation is very low with low abundance and highest at intermediate prey population sizes. This type or interaction involved predators that can switch to other food sources as prey populations change

Parasite-Host Interactions

- Parasites
- Parasitoids
- Social parasites

Community Stability

- Succession Model
- Climax Pattern Model

Community Stability

- Succession Model
  - Primary succession
    - Invasion of barren habitat
  - Secondary succession
    - Recovery of damaged habitat

Succession Model

Primary succession

Pioneer species colonize a new habitat.

- Opportunistic colonizers
  - High dispersal rates
  - Fast developers
  - High fecundity
  - Short life cycles
  - Tolerance to extreme conditions

Mosses

Spiders

Lichens

Succession Model

Primary succession

Pioneer species

Colonize new habitats:

- Volcanic islands or volcanic slopes and valleys after eruptions.
- Glacial remains.
- Severe fire damage.

Over time pioneering species improve soil and other environmental conditions (shade, food, housing, etc).

Succession Model

Primary succession

Pioneer species

As the pioneering species improve the new habitat replacement species begin to take over.

Often these are mutualists with nitrogen-fixing bacteria enabling them to grow in nitrogen-poor soil.

Over time these replacement species contribute to the accumulation of more organic wastes and remains, which favors the invasion of yet newer species.

Each succesional species crowds out the other until a collection of species stabilizes with the prevailing environment; a **Climax Community**

Succession Model

Secondary succession

- A damaged habitat with intact soil and resources will recover quite quickly without the successful invasion of pioneering species.
- A Climax Community is a stable, self-perpetuating array of species in equilibrium with one another and their habitat.

Community Instability

- Forces that disrupt the delicate balance of a climax community.
  - Climatic changes
  - Volcanoes
  - Human impact
- Carrying capacity – habitat resources limit number of species and population sizes.
- Keystone Species – a species with a major impact on the community.
- Introduced species (exotics) – Invasive species trying to colonize an established community.

Keystone Species

Sea Stars (*Pisaster ochraceus*)

- California Interdidal patrol
- Sea stars are the main predator of mussels.
- Mussel colonies will expand very rapidly in the absence of sea stars and will displace chitons, barnacles and limpets.
- Remove sea stars and 7 different intertridal invertebrate disappeared.

Sea Stars (*Pisaster ochraceus*)

Sea Stars and barnacles

Limpets, mussels and barnacles

Limpets

Chiton

Mussels

Barnacles

Keystone Species

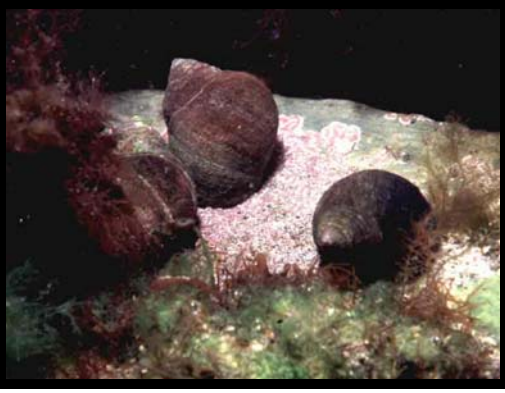
Periwinkles (*Littorina littorea*)

- Eat intertidal algae.
- In tide pools - eat *Enteromorpha,* an aggressive algae that out competes other tide pool algae.
- Lower tidal zone – eat less dominant algae.

- Periwinkle helps promote tide pool diversity, but reduces diversity in lower tidal zone.

Periwinkle (*Littorina littorea*)

Periwinkle (*Littorina littorea*)



Enteromorpha algae

Enteromorpha algae

Introduced Species (Exotics)

More than 4,500 in US.

- Soybeans
- Rice
- Wheat
- Corn
- Potatoes

For food crops

Introduced Species (Exotics)

More than 4,500 in US.

- Fire ants – lizards, quails, native ants
- Bark beetle – destroy Elm trees
- Zebra mussel – displace native bivalves
- Sea Lamprey – kills trout in great lakes
- European Starling – native cavity-nesting birds
- Water hyacinth – native water plants

To name a few.

Introduced Species (Exotics)

Kudza Vine (*Pueraria montana*)

- Intentionally introduced from Japan (1876)
- Has no native competitors or enemies and grows very fast unhindered. Has blanketed much of Georgia and is moving north rapidly.

Kudza Swallowing Forest

Kudza Swallowing Trailer

Introduced Species (Exotics)

Rabbits in Australia (1800)

- Released in Australian outback for food and sport hunting.
- Habitat had plenty of resources for rabbits and no natural predators.
- Within 6 years there were hundreds of thousands of rabbits.
- There are now estimated to be over 300 million.
- Rabbits ate everythingm burrows destroyed root systems. They devastated much of Australian outback and turned it into arid desert.

Introduced Species (Exotics)

Rabbits in Australia (1800)

Attempts to eliminate them have failed and backfired.

- Bounties
  - Plowed
  - Fumigated
  - Shot
  - Dynomited

2,000 mile fence failed

1951 - Introduced flea/mosquito-borne virus, which killed many rabbits. But alleles providing resistance to virus swept through population and the rabbit population recovered.

1991 – a virus was accidentally released and many rabbits died. 1996 they intentionally released this virus into other parts of the outback.

Rabbits

Australian Rabbit Fence

Biodiversity

- Biogeographic Patterns
  - Mainland
  - Marine
  - Islands
    - Sources of natural experiments for biogeographers.

Biodiversity

- MacArthur and Wilson
  - Equilibrium model of Island biogeography

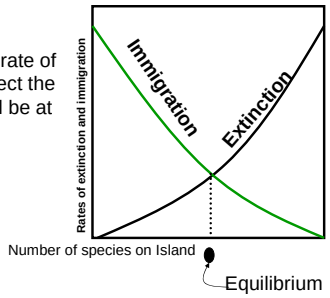
Why do Islands have less diversity than neighboring mainlands?

Species are more vulnerable to extinction on islands and immigration rates are lower.

- Small populations are vulnerable to:
  - Severe storms
  - Droughts
  - Disease
  - Genetic drift

Island Biogeography

When the rate of extinction and the rate of immigration intersect the island diversity will be at equilibrium.

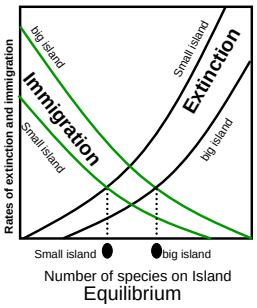


Island Biogeography

Area Effect

Larger islands support more diversity than small islands.

Larger islands tend to have more geographic diversity.

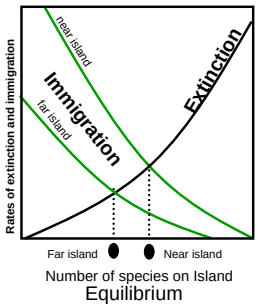


Island Biogeography

Distance Effect

Immigration rates are lower for distant islands.

Distant islands are colonized by long-distant dispersers.



Island Biogeography

The area and distance effects are applicable to mainland habitats that are being fragmented by:

- Expanding
- Human populations
- Deforestation
- Mining, agriculture
- Farming
- Pollution …

Conservation Biology

1. Systematic survey biological diversity
2. Decipher biodiversity's evolutionary and ecological origins
3. Employ methods of maintaining biodiversity in ways that can benefit the human population. Its major goal is to conserve and utilize, in sustainable ways, as much biodiversity as possible.

Strip Logging

- Allows tropical woods to be logged in a profitable, sustainable way
- Sloped forested area is logged in strips, working up the slope
- Runoff from logged areas flows to regenerating forest, enhancing its growth

Fig. 25.11, p. 416

Riparian Zones

- Narrow corridors of vegetation along streams or rivers.
- Rich in endemic species.
- In the American West, cattle have destroyed most riparian vegetation.
- Rotating cattle away from riparian zones saves endemic species and provides richer grazing.
- Provides refuge, food, shade for wildlife.

Riparian Zone

By restoring riparian zones along agricultural and urban area, water resources are preserved, wildlife have a place to live and everybody benefits.