What is Ecology?

- The study of the interactions between organisms and their environment.
 - Organism plant, animal, microbe...
 - Environment -
 - Abiotic
 - Non-living components soil, water, nutrients...
 - Biotic
 - Interactions with other organisms competition, predation, symbiosis...
 - Examples -



Organizational levels in Ecology

- Organismal –
- · Population -
- Community –
- Ecosystem -

Questions at different Organizational levels in Ecology

- **Organismal** How individuals are affected by their biotic and abiotic environments.
- **Population** Trends and fluctuations in abundance or density related to biotic or abiotic environment.
- **Community** How do interactions among species determine distribution and abundance of populations in a particular area or habitat.
- **Ecosystem** How do patterns of energy, mass and nutrients flow through ecosystems.

Ecology as a science

- · Ecology is a science...so what is a science?
- Science systematic methodology to develop predictive models about the natural world.
 - Seeks to explain natural phenomena
 - Pose, develop and test hypotheses
 - Does not prove anything, refines models that make predictions about the natural world



Properties of hypotheses

- Must be falsifiable
- Must be testable
- Must make a prediction about some natural phenomenon
- Is neither proven or disproven.
- Observations (results of experiments) either support or do not support a hypothesis

Theory vs. "Theory"

- Common language use of theory conjecture, opinion or speculation
 - E.g. a political pundit has a theory about who will win the presidential election in November 2008
- Scientific use of theory well tested and supported model describing a natural phenomenon
 - E.g. a scientist, using the theory of gravity, can plot the position and speed of the earth in November 2008
 - A theory is formed from hypotheses that are repeatedly tested and supported.
 - A theory is the highest level of scientific understanding

An Ecological Theory

- Populations will compete for limited resources.
- Turn this into a hypothesis...

Environmentalism

- Environmentalism is not a science
 - A political movement or world view
 - Does not make predictions, test hypotheses
 - Seeks to protect and conserve natural environments
 - Belief that humans have a moral obligation to do no harm
- Not to be confused with the science of conservation biology (a subdiscipline within ecology)
 - The ecological study of rare and endangered species.

History of the Environmental Movement

- Early 1900's extinction of passenger pigeon, near extinction of buffalo motivated Woodrow Wilson to form the US National Park System
 - First national parks- Yellowstone and Yosemite
- 1949 Aldo Leopold A Sand County Almanac
- Humans have a moral responsibility to not harm the environment
- 1960 Rachel Carson *Silent Spring* , book that sparked US environmental movement.
- Dangers of pesticide use (DDT)
 Modern environmental groups –
- Greenpeace, Sierra Club

•

• 1973 – Endangered Species Act



Ecology and Environmentalism – blurred lines

 Thomas Malthus (1798) – 1st to have concerns about human population sizes and sustainability – 1st population biologist by extension

Summary

- · Ecology is a science
- · Conservation biology is a science
- · Environmental biology is not a science
- · Ecologists or conservation biologists are scientists and may also be environmentalists
- Environmentalists are not scientists, but • may also be ecologists or conservation biologists



The most important theory in biology...

- · Theory of evolution
- Simply states that the genetic composition of populations changes over time.
- · An example -



UNITED STATES

Natural Selection

- · One mechanism for evolution
- · Requires the following be true
 - Populations are variable
 - Variations are heritable
 - Variations affect individuals ability to acquire resources
 - Resources are limited, individuals compete, and those who are best at getting resources reproduce the most -> are most fit
- These are all hypotheses, we should be able to design experiments to test their predictions.

Environmental Protection Agency

- Started in December 1970
- Major initiatives
- Major initiatives Energy star program Car fuel economy ratings Ban of DDT Clean Air Act Water quality monitoring Regulation of hazardous waste disposal
 - Recent change carbon dioxide

Fitness in the Environment

- In natural selection, all that matters is how many offspring you produce.
- · Fitness is not defined by survival
- · Fitness is defined by number of offspring produced

- Example

- Two birds, Bob and Tom, live in a very harsh environment
 - Bob survives for 5 years, reproduces in three years and produces 6 young
 - Tom only survives two years, reproduces once, but produces 8 young in one year



Traveler with rare TB under federal quarantine Infected man flew to get married; authorities seeking other passengers

Ap Associated Press Updated: 7:21 p.m. CT May 30, 2007

ATLANTA - A man with a form of <u>tuberculosis</u> so dangerous he is under the first U.S. government-ordered quarantine since 1963 had health officials around the world scrambling Wednesday to find about 80 passengers who sat within five rows of him on two trans-Atlantic flights.

The man told a newspaper he took the first flight from Atlanta to Europe for his wedding, then the second flight home because he feared he might die without treatment in the U.S.

Centers for Disease Control and Prevention Director Julie Gerberding said Wednesday that the CDC is working closely with airlines to find passengers who may have been exposed to the rare, dangerous strain. Health officials in France said they have asked Air France-KLM for passenger lists, and the Italian Health Ministry said it is tracing the mar's movements.



TB case? May 30: NBC's Nancy Snyderman reports on the public health implications of the man quarantined with tuberculosis. Nightly News

Modern Example...

- Drought on island reduced seed abundance
- Bird abundance drops with seed abundanceBirds with larger beaks
- can utilize a wider variety of seeds
- Beak size is heritable
- Mean beak size
 changed during drought

















History of Life on Earth

- Earth formed ~5-6 bya
- Not hospitable for life for 1-2 billion years





0

• First fossilized life 3.8 bya (3,800,000,000)









History of Life

- Along with oxygen, earth becomes more stable and livable stable and livable – Ozone (O_3) layer develops – $O_3 - H_1$

 - Fewer asteroids
 - Less volcanic activity
- Until 700-800 mya when Earth freezes MOT /ce - Snowball Earth
 - 10 million years, frozen
 - Simple life under ice near equator survived
 - Volcanic activity release CO₂, nothing to absorb it, global warming melts ice

