What is essential difference between a snake behind glass versus a wild animal?
Ecology Defined

- intact cells
- physiological properties
- genetics
- some extent behavior
Ecology Defined

- Caged animal is out of context
- Removed from natural surroundings
- Stripped of its natural history
- No loner interfaces with environment
Discipline deals with myriad ways in which organisms
- interact with
- influence
- influenced by
Natural surroundings
Fundamental Difference

Difference from other disciplines
Focus is directed upward and outward from individual to environment
Other disciplines in biology are reductionist:

- Cell biology
- Physiology
- Anatomy
- Genetics
Ecology is holistic
Ecology Definitions

- Painful elaboration of the obvious
  Cavitt’s Mom

- “The total relations of the animal to its organic and inorganic environment”
  Haeckel 1869

If true then what isn’t ecology
Ecology overlaps all these disciplines thus need stricter definition
Ecology Definitions

- “Scientific natural history” Charles Elton, Animal Ecology
- “Study of structure and function of nature” Eugene Odum
- “Scientific study of the distribution and abundance of organisms” H.G. Andrewartha
The science of how organisms interact with their living and non-living environment

“The scientific interactions that determine the distribution and abundance of organisms” Charles Krebs
Ecology Definitions

Definition is
- Specific
- Workable
  - Where are organisms found
  - How many are there
  - Why
Perhaps the **oldest** of the natural sciences
Ecology is not synonymous with environmental problems

- Ecology is a basic science
- Applied sciences use the knowledge generated by basic sciences to solve problems
- Ecology is hierarchical
Hierarchy

- **Individuals**
  - (organisms)

- **Populations**
  - (groups of individuals of 1 species)

- **Communities**
  - (species that interact)

- **Ecosystems**
  - (community + abiotic environment)
Ecology can be studied from multiple perspectives

- Evolutionary - investigating adaptive aspects of ecological phenomena
- Distribution & Abundance - investigating the contemporary processes that determine
  - where an organism occurs (distribution)
  - how many organisms (abundance)
  - how numbers of organisms change (dynamics)
The same system can be studied at multiple levels

**Example:** Bluegill sunfish (Lepomis macrochirus)

- **Large individuals**
  - found in open water
  - feed mostly on zooplankton

- **Small individuals**
  - found in vegetation
  - feed mostly on benthic insects
Why the difference in location?

- **Hypothesis**: bluegill choose habitat with most profitable prey
- **Hypothesis**: small bluegill are safer from predation in the vegetation
- **Hypothesis**: large bluegill aggressively exclude small bluegill from open water
- **Evolutionary hypotheses** -- advantageous for **individuals** to choose certain locations
What determines the number of bluegill in each size class?

- **Hypothesis:** bass predation on young bluegill
- **Hypothesis:** human predation on older bluegill
- **Hypothesis:** limited nest sites
- **Ecological hypotheses -- contemporary population level effects**
How do bluegill affect populations of pumpkinseed sunfish?
How do bluegill affect populations of Daphnia?
What would be the effect of a 2°C increase in water temperature on bluegill populations?

Ecological questions -- contemporary processes affecting distribution and abundance
Ecologists utilize scientific method

2 approaches to answering questions and testing hypotheses in ecology
Observation and Experimentation

1. Observation

Not all ecological phenomena are amenable to experimentation
Natural events can not be manipulated
Scale of question can be important
Ethics of experimentation can be important
Observation or comparative studies often rely on correlation.
Major Goal

Want to understand causality
Leads us to infer that A “causes” B
Problem with correlation

Some other unknown event could be "causing" both to occur
Methods of Approach

So what’s the problem with correlation?
# Baptist Ministers

![Graph showing the number of Baptist Ministers in Wisconsin Counties](image)
The problem is -

What can infer from correlation?

“Correlation does not prove causation”
The number of Baptist Ministers is not causing an increase in the number of Taverns in Wisconsin.
Roots of Ecology lie in natural history so technically it is as old as humans
Balance of Nature

1. Primitive peoples relied on
   a. Hunting
   b. Fishing
   c. Food gathering

   so needed detailed information on when/where to find food

2. Agriculture – increased need for knowledge of relationships of plants and animals to their environments
3. Plagues attracted early writers attention
   a. Exodus
   b. Aristotle - explained plagues of mice and locusts.
4. Principle of Ecological Harmony

Greeks established the term “Balance of Nature” – idea that nature is designed to benefit and preserve each species.
Each species had a special place in nature and extinction does not occur because it would upset the balance of nature.
Balance of Nature

Today you can still find subscribers to this principle.

Why?
1. Graunt 1662
Described human population change quantitatively (father of demography)

- Birth rate
- Death rate
- Sex ratio
- Age structure
2. Leeuwenhoek 1687
Studied reproductive rate of grain beetles, carrion flies and human lice.

Counted # eggs laid by flies and extrapolated (746,496 in 3 months)

1st attempt to calculate theoretical rates of increase for an animal
3. Buffon – Natural History 1756
   First to recognize all organisms are subject to same processes

   Calculated organisms can increase geometrically
   Reproductive rate held in check by food supply
During this time

What prevents populations from reaching a point where they deplete their food supply?

What checks operate against a tendency toward geometric increase?

3 Centuries later ecologists are still asking these same questions
   1841
   Questioned Malthus

   Whenever species threatened with extinction, nature made a corresponding effort to increase fertility

   Used humans in less developed countries
Verhulst 1838 – Derived equation to describe rapid increase and stabilization of populations

Called logistic growth curve
During most of time thinking hadn’t changed from idea of Plato

2 ideas during this time undermined “Balance of Nature”
1. Many spp becoming extinct
2. Resources are limiting and competition is important
Consequences became clear
- Malthus
- Lyell
- Darwin

“Providential Ecology” and “Balance of Nature” replaced with Natural Selection
“Balance of Nature” continues to persist in modern ecology

- natural systems are stable
- systems in equilibrium unless disturbed
20th Century

Ecology as Science

Roots
- Natural History
- Human Demography
- Biometry
- Applied problems in Agriculture, Medicine
Struggle to understand how nature works

Alfred Lotka – Metropolitan Life Insurance Co

Laid groundwork for mathematical ecology
Until 1960's ecology not considered important science

What happened?
Increase in human population
Destruction of natural environment

Caused public outcry and realization of problems