Conservation Biology
Fall 2008
Biology 3100:422/522
TR 10:45 - 12:00 (ASEC 583)

What is Conservation Biology?
The study of the origin, maintenance, and preservation of biological diversity.

Course Topics:
- Biodiversity
- Conservation Genetics
- Extinction
- Invasive Species
- Habitat Fragmentation
- Reserve Design
- Restoration
- Plus additional topics.

Textbook:

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Fall 2008 - Bio 342
Flora & Taxonomy
T 1-1:50, TH 1-4
3 units
Instructor: Dr. Randy Mitchell
Explores the identification and biology of flowering plants.
- Use taxonomic keys
- Discuss the general patterns and principles of plant evolution and systematics
- Prepare a plant collection
- Learn about the plants of Ohio

Ideal for anyone wanting to understand more about plants - field biologists, teachers, molecular biologists, gardeners, and many others.
- Formal - lectures, labs, field trips, inquiry, and exploration.

Muddy points for chapter 11
Spring 2008
- Age structure (1)
- Exponential growth (3)
- Geometric vs. exponential growth (13)
- Logistic Model of growth (5)
- Causes of density dependent growth (14)
- Human population growth (5)
- General (1)
- Chi-square test (1)
- Metapopulations (1)

Exponential growth
- Please give some worked examples – not just graphs.
- What is the difference between the realized per capita rate of increase (r) and the intrinsic rate of increase (r-max).
- What conditions produce exponential growth?
  - I thought of the example of the whooping cranes and then wondered, "Why doesn't it work like that for condors?" Is it a product of their low offspring rate? Are the new protections just not enough? How are populations induced to exponential growth, especially those populations that are stable or declining?

Please give some worked examples – not just graphs
- Elephants
- Continuous breeders (give birth year-round).
  - r = 0.0215
    - Instantaneous per capita rate of increase
    - The ‘interest rate’
    - \( N_t = N_0 e^{rt} \)
    - In 200 years, starting with 100 elephants:
      \( N_{200} = 100 e^{0.0215 \times 200} = 100 e^{4.30} \approx 100 \times 73.8 = 7,370 \)
Please give some worked examples – not just graphs

- Elephants
  - Continuous breeders (give birth year-round)
  - \( r = 0.0215 \)
    - Instantaneous per capita rate of increase
    - The ‘interest rate’
  - \( N_t = N_0 e^{rt} \)
    - In 200 years, starting with 100 elephants:
      - \( N_{200} = 100 e^{0.0215 \times 200} \)
      - \( = 100 e^{4.30} \approx 100 \times 73.8 = 7,370 \)
    - In 400 years:
      - \( N_{400} = 100 e^{0.0215 \times 400} \)
      - \( = 100 e^{8.60} \approx 100 \times 5431 = 543,166 \)

Realized per capital rate of increase \((r)\) vs. intrinsic rate of increase \((r_{\text{max}})\).

- Terms related to per capita population growth rate
  - \( r = \) Intrinsic rate of increase = per capita rate of increase
  - \( r_{\text{max}} = \) maximum \( r \) in the absence of constraints
  - \( r_{\text{realized}} = \) realized \( r = \) actually occurring now = \( dN/dt \)
  - \( dN/dt = \) Rate of population growth
  - \( \Delta N = \) change in population size = rate of population growth
  - \( \lambda = \) finite rate or increase = geometric rate of increase = population multiplication factor
  - \( R_0 = \) Net Reproductive rate

- They are all at least partly distinctive and different
**Geometric vs. Exponential growth**

- **How are they different?**
  - Geometric growth
    - Non-overlapping generations
    - Reproduction in pulses
    - \( N_t = N_0 \lambda^t \)
    - Examples
      - Bear
      - Deer
      - Insects
      - Annuals
      - ‘Breeding season’
  - Exponential growth
    - Overlapping generations
    - Reproduction is continuous
    - \( N_t = N_0 e^{rt} \)
    - Examples
      - Humans
      - Bacteria
      - Viruses
      - Potentially breeding any time

- For purely geometric or exponential growth, log graphs show a straight line

- Both models have similar assumptions:
  - Closed populations (No immigration or emigration)
  - Constant birth and death rates
  - No age, size, or genetic structure
  - No time lags
  - Appropriate population model
  - Discrete generations requires a geometric equation
  - Continuous generations requires an exponential equation

- **When to use which equation?**
- How to apply the equations to predict population size
- Please explain them more.
- What do the graphs indicate about the environment?
Geometric vs. Exponential growth

- Both grow with acceleration (compounding interest), differ in when reproduction occurs.
- Can be compared by converting \( \lambda \) to \( r \) and vice versa: \( \lambda = e^r \)

Doubling Time is a good way to compare growth rates of different species:

\[
T_{\text{double}} = \frac{\ln(2)}{r}
\]

<table>
<thead>
<tr>
<th>Species</th>
<th>( r )</th>
<th>( T_{\text{double}} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>T Phage</td>
<td>300</td>
<td>3.3 Minutes</td>
</tr>
<tr>
<td>E. Coli</td>
<td>59</td>
<td>17 Minutes</td>
</tr>
<tr>
<td>Paramecium</td>
<td>1.6</td>
<td>10.5 Hours</td>
</tr>
<tr>
<td>Brown Rat</td>
<td>0.012</td>
<td>57 Days</td>
</tr>
<tr>
<td>Milk Cow</td>
<td>0.001</td>
<td>1.9 Years</td>
</tr>
<tr>
<td>Beech Tree</td>
<td>0.0001</td>
<td>57 Days</td>
</tr>
<tr>
<td>Humans</td>
<td>0.00005</td>
<td>38 Years</td>
</tr>
</tbody>
</table>

Limits to growth

- Pheasants on an Island with no predators, lots of food
- Smooth curve extrapolates first year’s growth (l)
- Food probably became limiting

Logistic Model of growth

- Fig 11.14 – Please explain this graph.
  - Is this sigmoid growth?
- Pg 259 – Why do the figures show variation around the carrying capacity? Is carrying capacity really a fluctuating maximum that changes with the environment?

\[
\frac{dN}{dt} = r_{\text{max}} N \left( 1 - \frac{N}{K} \right)
\]