


March 3 - There was a lot of board work about overlapping and non-overlapping generations before this powerpoint

Did you know...



How Big is Colossal?  
that some of the **largest animals on earth** are not mammals?

that jellyfish have some of the most advanced eyes of **any** animal?


that crabs can weigh over **40 lbs** & have **13 ft. leg spans**?

that coral reefs can be **seen from space**?

that octopuses **eat** sharks?

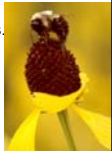
If you would like to know more about these critters and their relatives, then sign up in the fall for:

**Invertebrate Zoology – 3100:453**

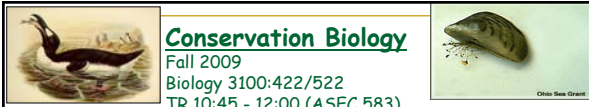


Biology 418 – Field Ecology  
Randy Mitchell Instructor

- Learn:
  - To design and conduct experiments and observations
  - About Ohio's plants, animals and ecological communities.
- Lots of **fieldwork** and **hands-on experience**
- Prerequisite: General Ecology (3100:217).
- **M 12:05-4:10, W 3:20-4:10**
- See [www.uakron.edu/biology/mitchell/ecologylab/](http://www.uakron.edu/biology/mitchell/ecologylab/)




**Conservation Biology**  
Fall 2009  
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:**  
Groom, Meffe, and Carroll. 2006. Principles of Conservation Biology, 3<sup>rd</sup> Ed. Sinauer Associates, Inc. Publishers, Sunderland, MA.



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Muddy points for Chapter 11  
Spring 2009

- Life Tables (2)
- Geometric /Pulsed Growth (3)
- Exponential Growth (6)
- Geometric vs. exponential growth (11)
- Equations (8)
- Logistic Model of Growth (17)
- Carrying Capacity and Limits to Growth (5+ 4)
- Causes of density dependent growth (3)
- Human population growth (3)

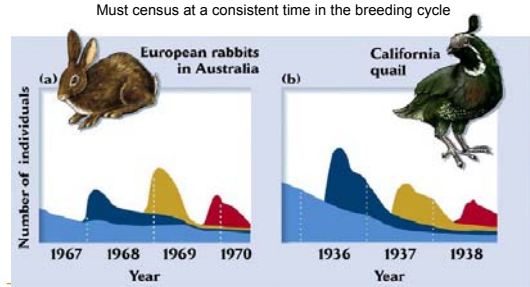
Geometric growth

- What is pulsed reproduction
- How does the math work
- Need another example

## Geometric growth, exponential growth, and the difference between them

- Go to Board

## Geometric Growth: reproduction occurs once a year or in pulses

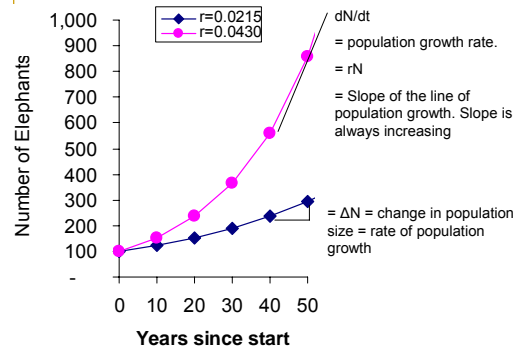
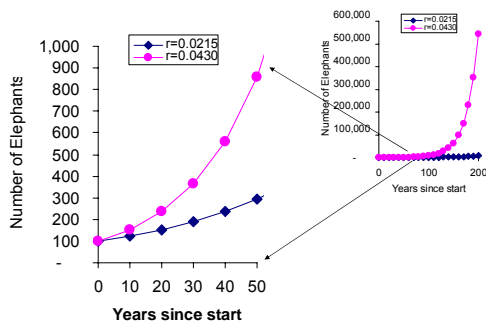


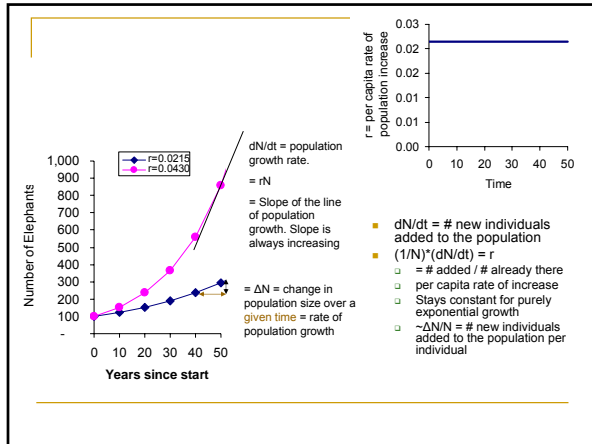
## Exponential growth

- Huh?
- Wow, they can grow fast!
- Tree example (how related to glaciers?)
- Why must resources be abundant for exponential growth?
- $r$  – how is it calculated?

## Exponential Growth

- Go to board

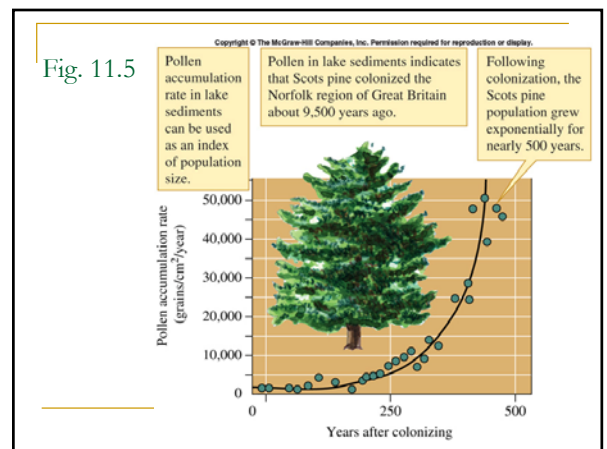
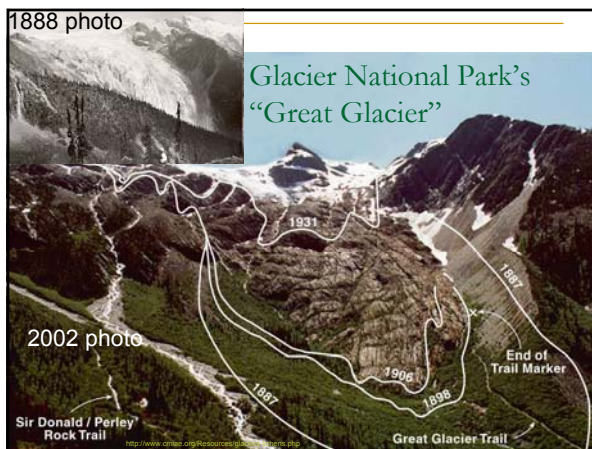
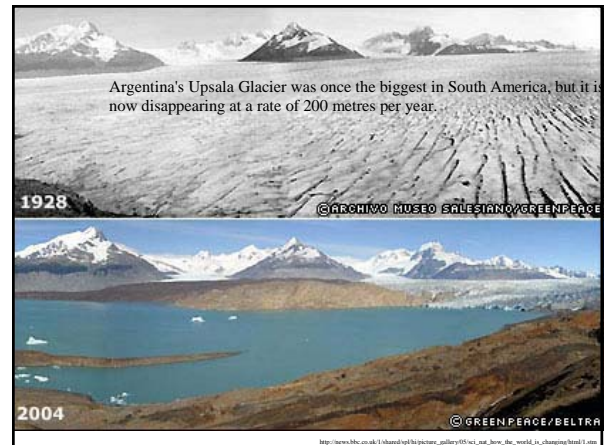
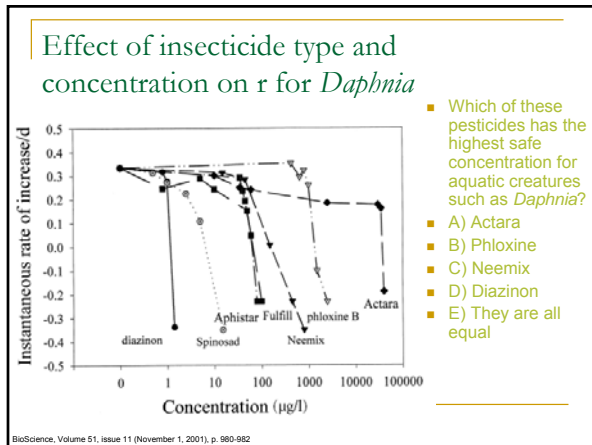




### A better way to calculate r

- $r = \ln(R_0)/T$
- $R_0$  = Average number of offspring left by each female
- Calculate from survival and fecundity for each age class
- $R_0 = \sum(l_x m_x)$

age group	$l_x$	$m_x$	$l_x m_x$
0-9	0.993	0.000	0.000
10-19	0.992	0.140	0.139
20-29	0.987	0.563	0.556
30-39	0.981	0.300	0.294
40-49	0.968	0.018	0.017
50+		0.000	0.000
		1.021	1.006



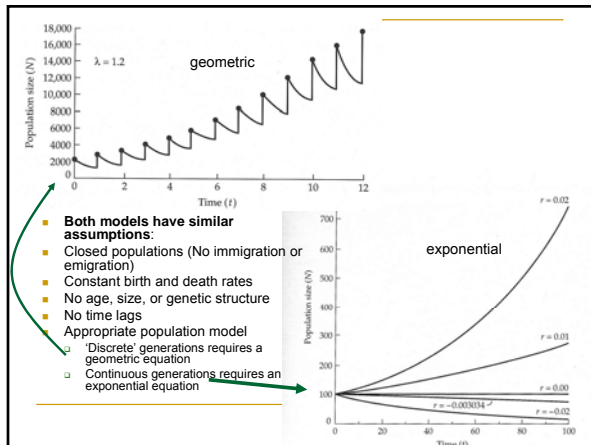
## Geometric vs. Exponential Growth

- Why are there two different equations?
- The curves look the same!
- When to use each model
- How to use the equations
- What is the difference between pulsed and continuous growth?
- What is accounted for in the equations?

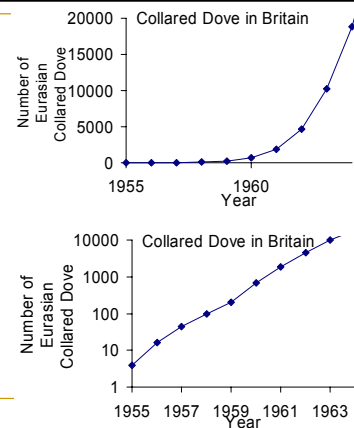
## Geometric vs. Exponential growth

### How are they different?

- |  |  |
|--|--|
| <ul style="list-style-type: none"> <li><b>Geometric growth</b></li> <li>Non-overlapping generations</li> <li>Reproduction in <u>pulses</u></li> <li><math>N_t = N_0 \lambda^t</math></li> <li>Examples                             <ul style="list-style-type: none"> <li>Bear</li> <li>Deer</li> <li>Insects</li> <li>Annuals</li> </ul> </li> <li>'Breeding season'</li> </ul> | <ul style="list-style-type: none"> <li><b>Exponential growth</b></li> <li>Overlapping generations</li> <li>Reproduction is <u>continuous</u></li> <li><math>N_t = N_0 e^{rt}</math></li> <li>Examples                             <ul style="list-style-type: none"> <li>Humans</li> <li>Bacteria</li> <li>Viruses</li> </ul> </li> <li>Potentially breeding any time</li> </ul> |
|--|--|

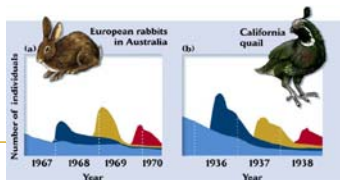


For purely geometric or exponential growth, log graphs show a straight line



## Geometric vs. Exponential growth

- Both grow with acceleration (compounding interest)
- They differ in when reproduction occurs (pulsed vs. continuous)
- Can be compared by converting  $\lambda$  to  $r$  and vice versa:  $\lambda = e^r$
- When censuses are done only once a year for continuous breeding populations,  $\lambda$  is often used instead of  $r$



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

$$T_{\text{double}} = \ln(2) / r ; \text{ (can also calculate from } \lambda \text{)}$$

Species	r	Tdouble
T Phage	300	3.3 Minutes
E. Coli	59	17 Minutes
Paramecium	1.6	10.5 Hours
Brown Rat	0.012	57 Days
Milk Cow	0.001	1.9 Years
Beech Tree	0.0001	19 years
Humans	0.00005	38 Years

## Equations

- General
- I'm not good with math
- How do they work and what do they explain
- Do we have to do calculations?
- Seems like a foreign language