Previous Lecture

- *Populations are Structured*
- Basic descriptive attributes of populations:
  - Density (+estimation techniques; quadrat/mark-recapture)
  - Distribution
  - Dispersion (+estimation technique; index of dispersion):
- Practice Problem Video on Mark-Recapture on website.

Lecture 2

All Populations Potentially Grow Exponentially

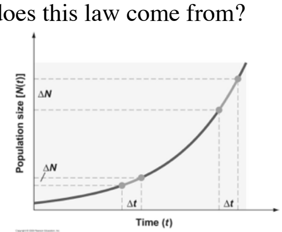
A. Exponential population growth* (Smith&Smith Chapter 9)

B. Next: Exponential growth modified by age structure (next time; S&S Chap. 9)

**Faite attention! Exponential growth theory is one of the most important concepts in all of ~~Ecology/~~ ~~Biology/~~science!*

Exponential Growth

- The 'Law of Exponential Growth' is the ______________________________
- Where does this law come from?



Exponential Growth

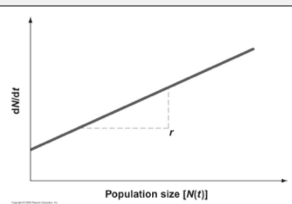
- Individuals have some maximum birth rate (b)
- Individuals have some minimum death rate (d)
- The "per capita population growth rate", r, is ______________

Exponential Growth

- Total rate = per capita rate * capitas
- Population growth rate (dN/dt):

Exponential Growth

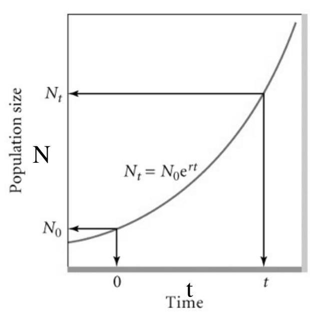
- This is an equation for a line, whose slope is r:



Exponential Growth

- BUT, what kind of population growth (N vs. time) is predicted by this equation?

N vs. time



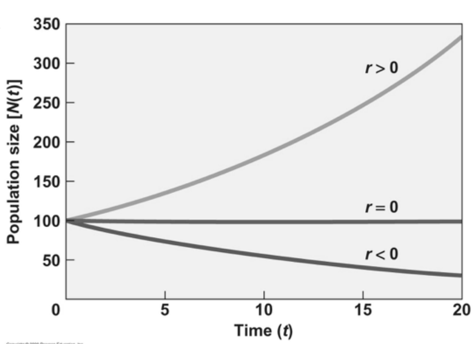


Fig. 9.3, S&S

Version 2 of the exponential growth equation replaces e^r with a different constant

Real World Exponential Growth

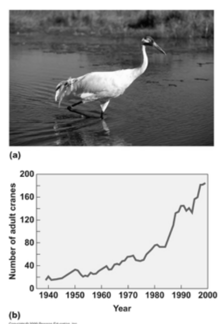


Fig. 9.6, S&S

Real World Exponential Growth

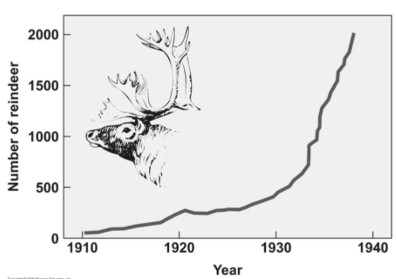
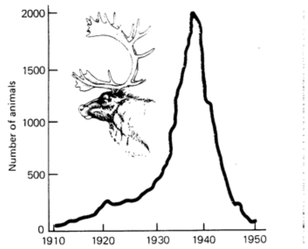


Fig. 9.5, S&S

Exponential Growth In the REAL World?



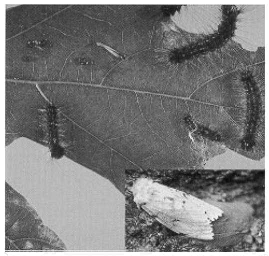
Reindeer on the Pribilof Islands

Realized Exponential Growth

- Rabbits in Australia
- Gypsy moth in North America
- Locusts in Africa
- Plague in Europe
- Lemmings in the Arctic
- Etc...

Rabbits in Australia

Gypsy Moth in North America

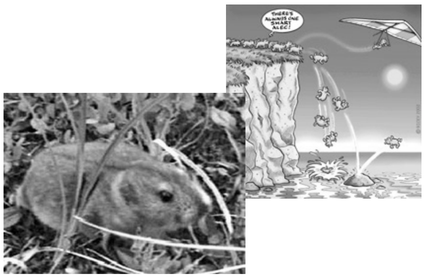


Locusts

Plague

Bacterium: *Yersinia pestis* ('black death')

Lemmings



Sample Problem

- *E. coli* cells propagate by binary fission. They don't 'give birth' in the traditional sense. However, if the effective 'birth rate' of these cells is 6 cells/cell*hr, and death rate is 0, and the initial population consists of 100 cells, how long would it take to reach a population size of 4.92×10^{43} cells, enough to cover planet Earth 1 meter deep in bacteria?
- SEE PRACTICE PROBLEM VIDEO 2!

Another sample problem!

- If you wanted to leave $1,000,000 to one grandchild in 60 years, how much would your initial investment have to be in order to accomplish this, assuming a 10% continuously compounded interest rate?
- SEE PRACTICE PROBLEM VIDEO 2!

Another thought problem

- Facts: A penny is 19.05 mm in diameter. A penny is 1.52 mm thick. It is 384,400 km to the moon. I start stacking pennies in adjacent stacks (in a single row of stacks). The first stack has 1 penny, the second, 2, the third, 4, etc., doubling each time.
- How wide would row of penny stacks be when the last stack reaches to the moon?

Summary

- All populations potentially grow exponentially
- Exponential growth is a "compound interest" phenomenon
- Occasional "outbursts" of exponential growth do occur in nature