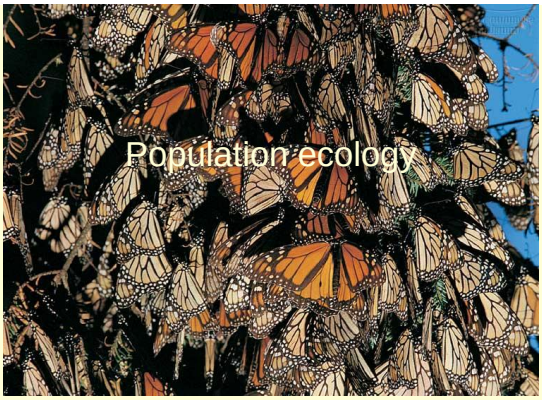


Interacting with the environment

Ecology

- Scientific study of …
- What's an environment?

Does ecology = environmentalism?

Hierarchical levels of ecology

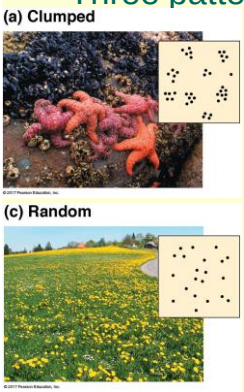
Fig. 52.2

Populations

- What was a population again?
- Two important characteristics:
  - Density
  - Dispersion

African buffalo

Three patterns of dispersion



WHY?

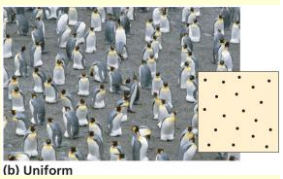


Fig. 53.4

How does population density change?

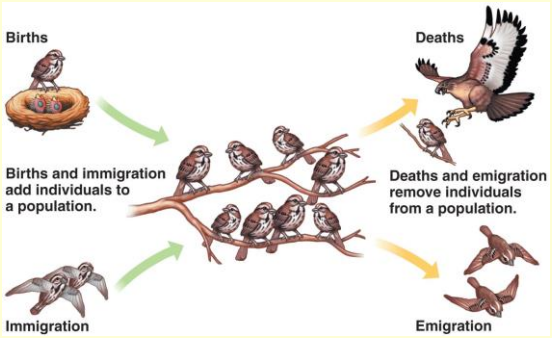


Fig. 53.3

Studying population change: **life tables**

- Age-specific summary of survival in a population

Table 53.1 Life Table for Female Belding's Ground Squirrels (Tioga Pass, in the Sierra Nevada of California)

Age (years)	Number Alive at Start of Year	Proportion Alive at Start of Year*	Death Rate†	Average Number of Female Offspring per Female
0–1	653	1.000	0.614	0.00
1–2	252	0.386	0.496	1.07
2–3	127	0.197	0.472	1.87
3–4	67	0.106	0.478	2.21
4–5	35	0.054	0.457	2.59
5–6	19	0.029	0.526	2.08
6–7	9	0.014	0.444	1.70
7–8	5	0.008	0.200	1.93
8–9	4	0.006	0.750	1.93
9–10	1	0.002	1.00	1.58

Data from P. W. Sherman and M. L. Morton, Demography of Belding's ground squirrel, *Ecology* 65: 1617–1628 (1984).

*Indicates the proportion of the original cohort of 653 individuals that are still alive at the start of a time interval.

†The death rate is the proportion of individuals alive at the start of a time interval that die during that time interval.

Survivorship curves

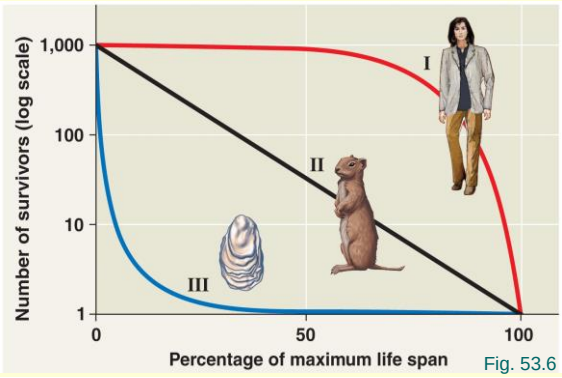


Fig. 53.6

Life history

- Why do some species produce a few young every year, while others produce enormous numbers only once or occasionally?
- Traits affecting reproduction and survival
- Two ways to categorize:
  - **Semelparity**
  - **Iteroparity**
- Is either way better?

Fig. 53.13

Agave, or century plant

Population growth (1)

- How do ecologists model growth in numbers of individuals in a population?
- Ignoring immigration, for a population to grow there has to be ????
  - **$\Delta N / \Delta t = B - D$**
- Where
  - N = population size
  - T = time
  - B = # of births
  - D = # of deaths

Population growth (2)

- It's helpful to convert actual births and deaths to rates so you can determine changes in population number for a population of any size
- Per capita rates of birth and death
  - b = B / # of individuals
  - d = D / # of individuals
- **$\Delta N / \Delta t = bN - dN$**

Focus on little *r*

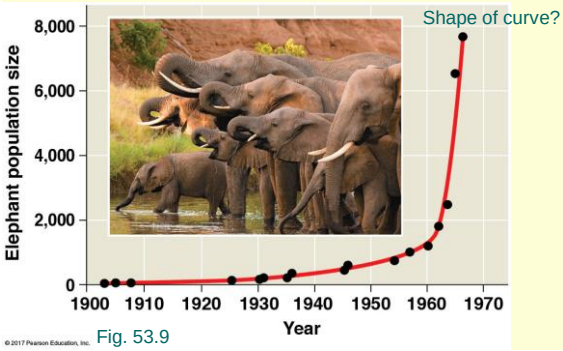
- Per capita growth rate of a population
  - *r*
- *r* = *b* – *d*
  - If *r* > 0 then the population is ?
  - If *r* < 0 then the population is ?
  - If *r* = 0 then the population is ?
- **dN / dt = rN**

Exponential population growth

- Under ideal conditions, a population can grow exponentially for some time
- **dN / dt = rN**
- What does exponential growth look like on a graph?

Exponential growth in action

- African elephants in Kruger National Park, South Africa



Shape of curve?

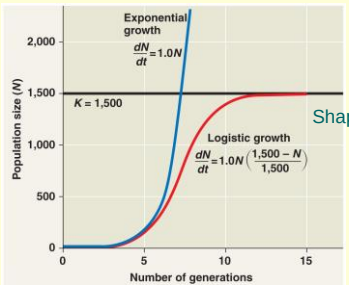
Fig. 53.9

Does exponential growth last forever?

- Eventually too many individuals use up resources, so that resources become limiting
- Hence, environments have a **carrying capacity**, **K**, which is…
- K varies over time and space

Logistic population growth

- Incorporating the idea of limiting resources by decreasing population growth when N nears K
- **dN / dt = rN([K – N]/K)**

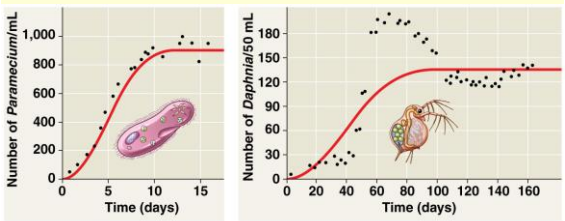


Shape of curve?

Fig. 53.10

Logistic growth in action

- Success?



(a) A *Paramecium* population in the lab

(b) A *Daphnia* population in the lab

Fig. 53.11

Population regulation

- Density-dependent factors help regulate population size

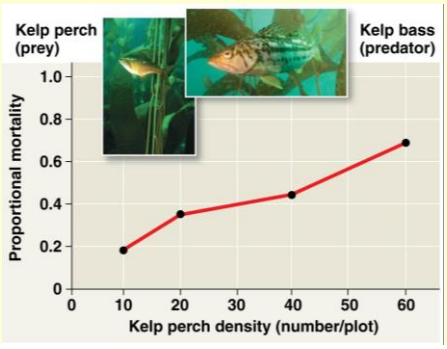


Fig. 53.17

Density-dependent factors are…

Logistic growth and life histories

- Natural selection favors different traits at different densities and in different environments
- **K-selected species** have life history traits sensitive to population size
  - Density-dependent selection
  - Favors competitive ability and efficiency at using resources
- ***r*-selected species** have traits that are density independent
  - Maximum reproductive success in uncrowded environments
  - Poor competitors; favors maximizing *r*
- Names come from ????

The human population

- What type of growth?

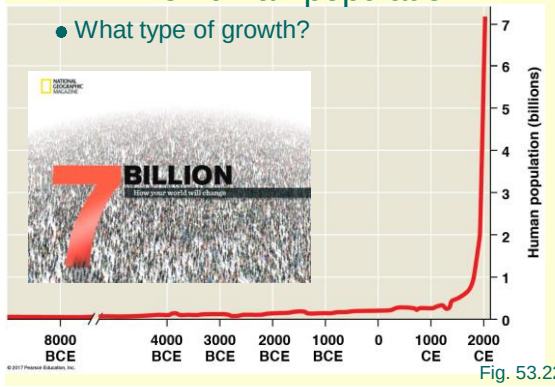


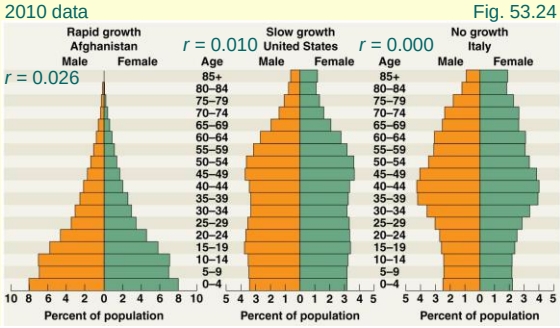
Fig. 53.22

The impact of age structure

- The relative number of individuals in each age

2010 data

Fig. 53.24



Continued exponential growth?

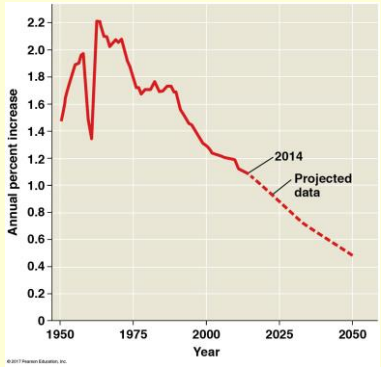


Fig. 53.23

Are all people equal ecologically?

- **Ecological footprint**: area of land required to support a person