POPULATION ECOLOGY

CH. 36

Which of the following best describes a population?

A. All of the organisms in a rainforest.

B. The entire population of fairy shrimps that live in a pond.

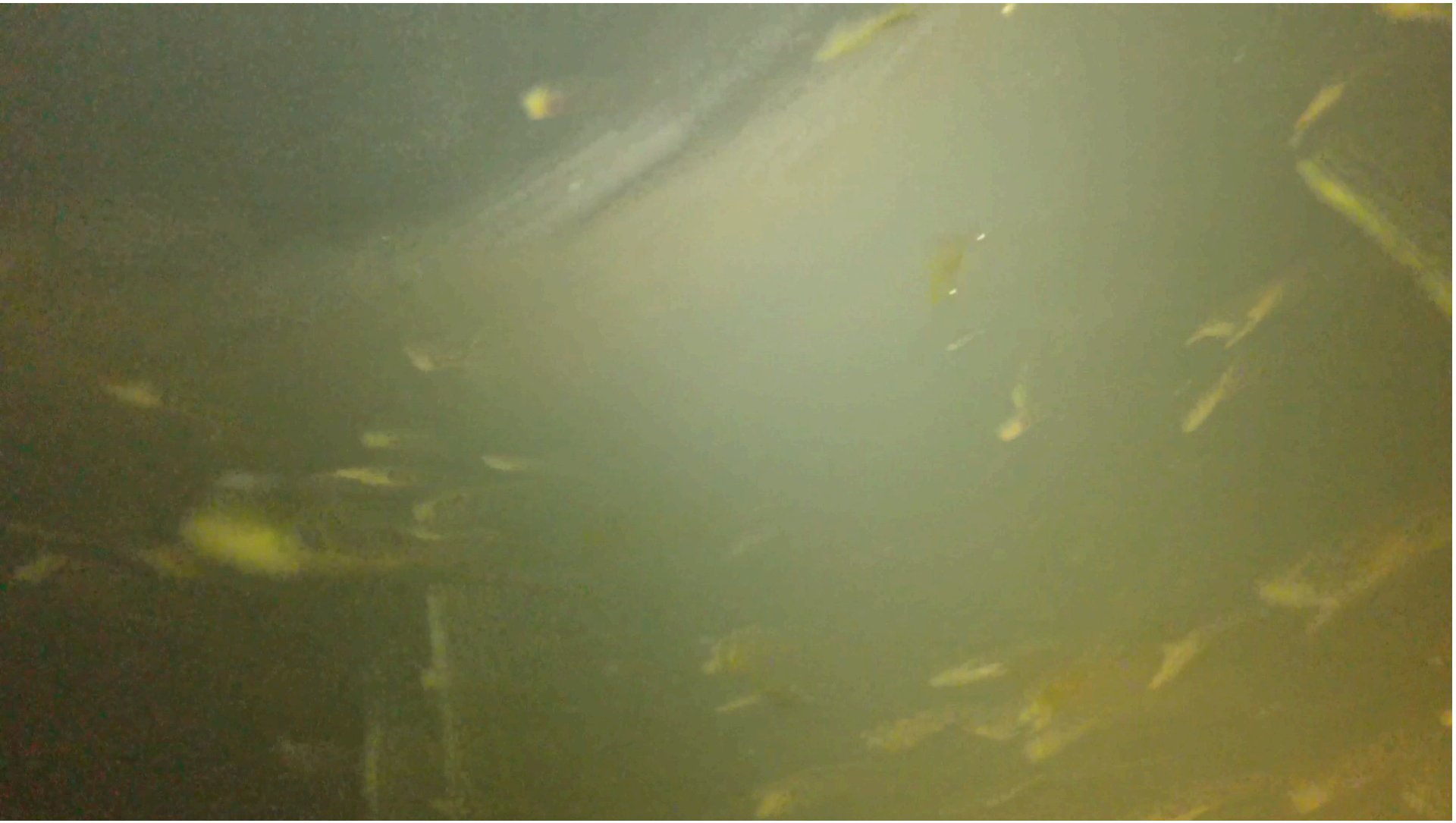
C. Every community college student in the state of California.

Which of the following best describes a population?

A. All of the organisms in a rainforest.

B. The entire population of fairy shrimps that live in a pond.

C. Every community college student in the state of California.



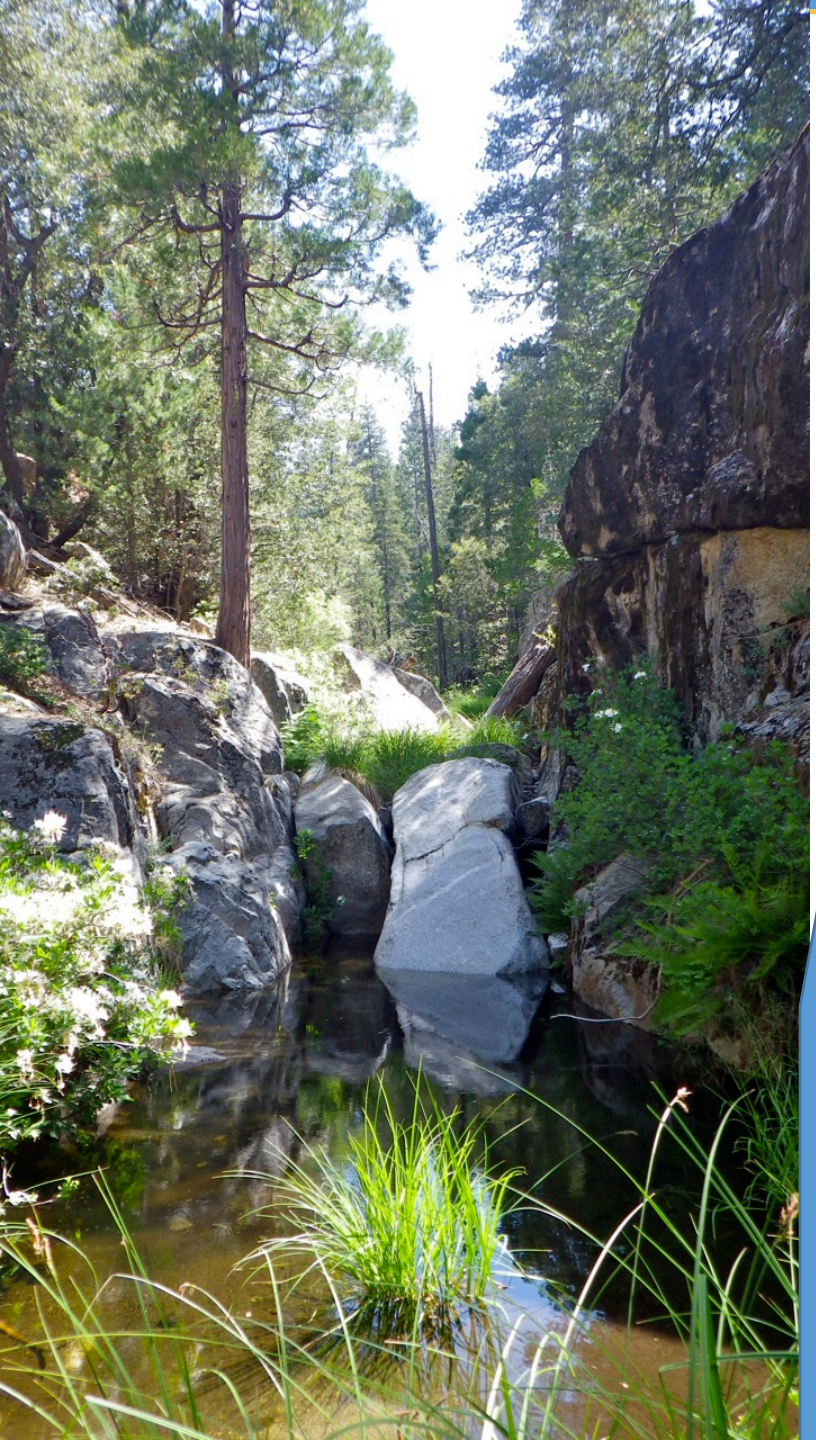
Question: What kinds of data would a population ecologist collect to understand the population dynamics of fairy shrimp in a vernal pool?

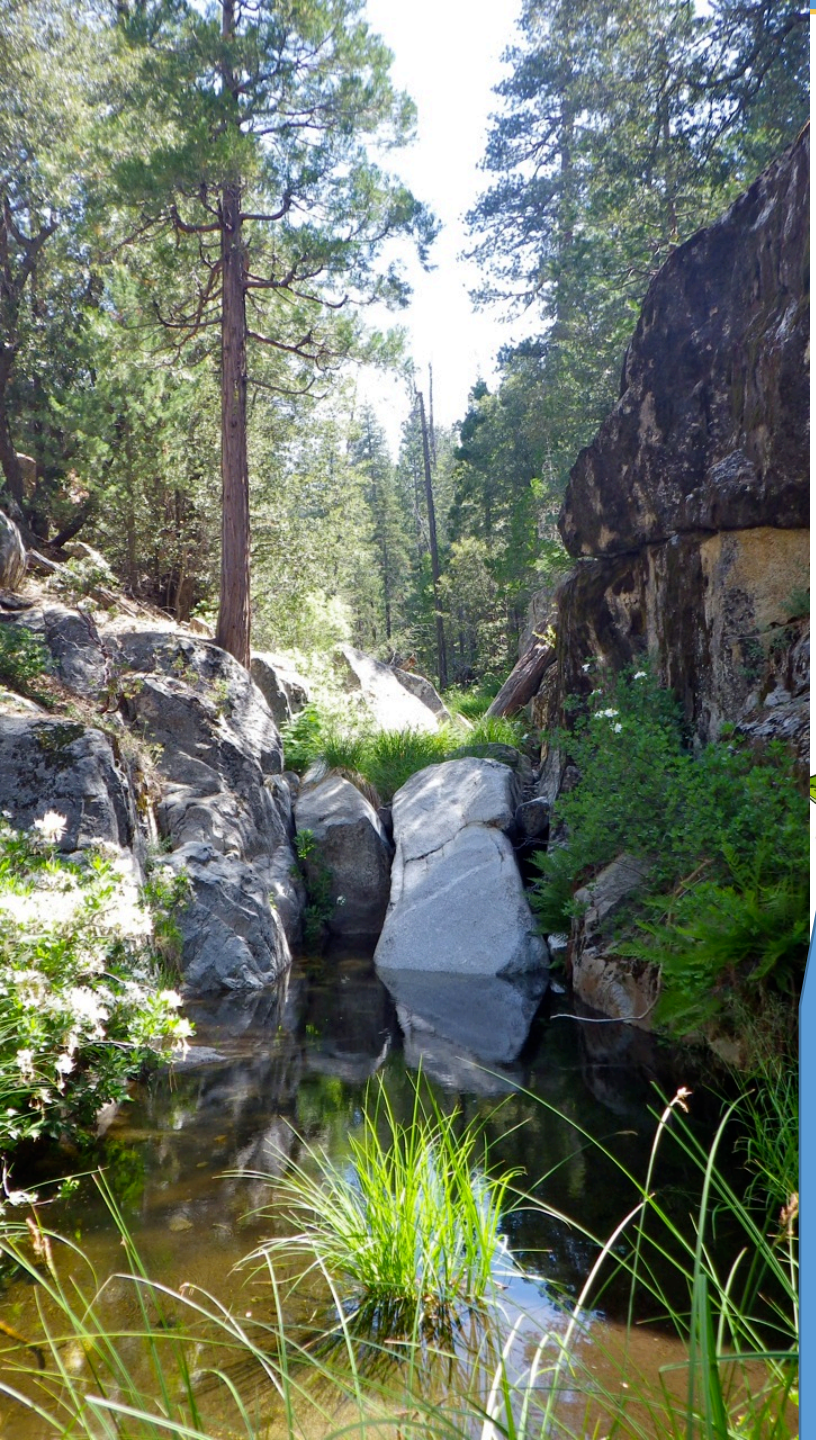
Dispersion Pattern Describes the way individuals are spaced within their area.

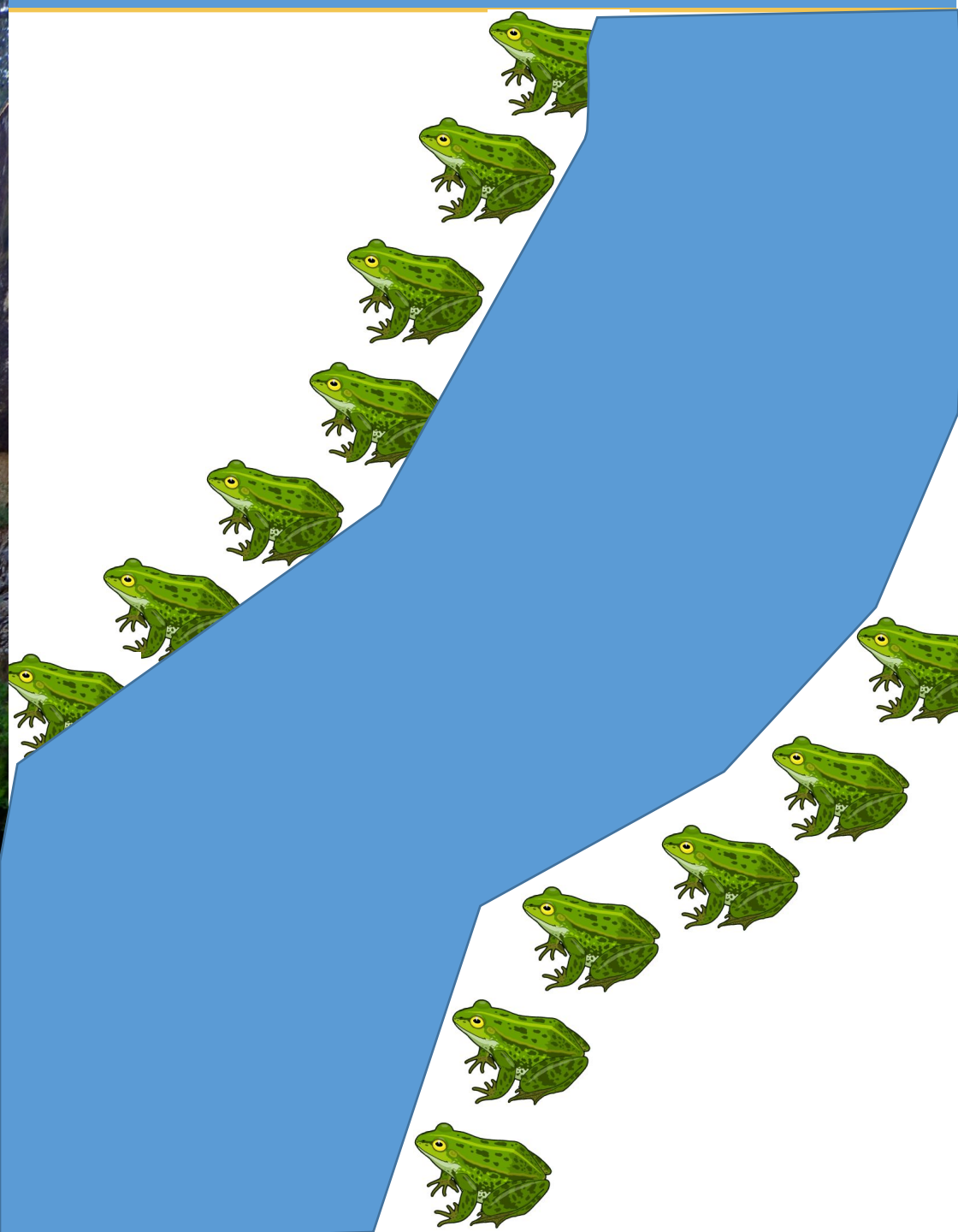
1. Uniform

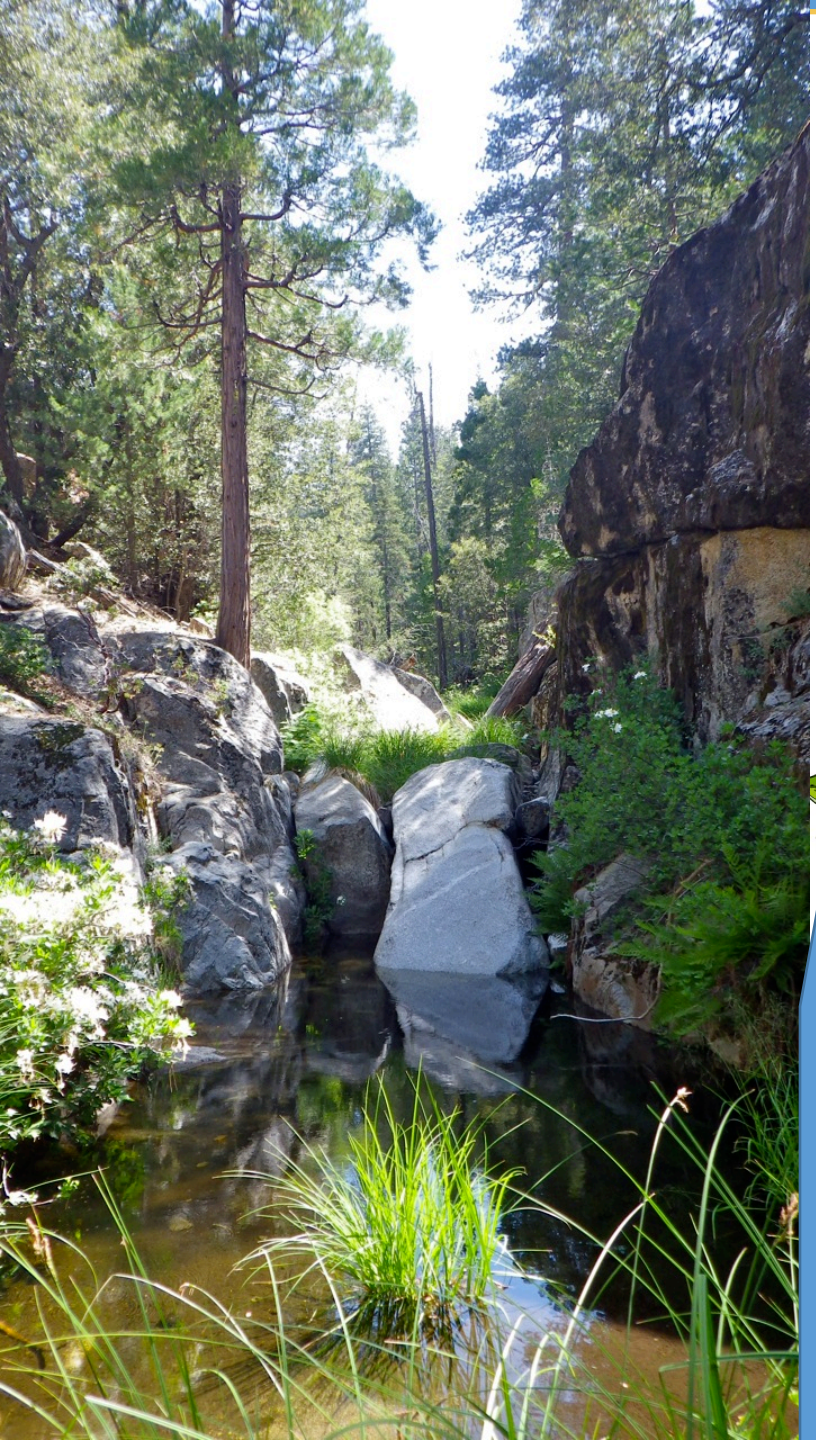
2. Clumped

3. Random





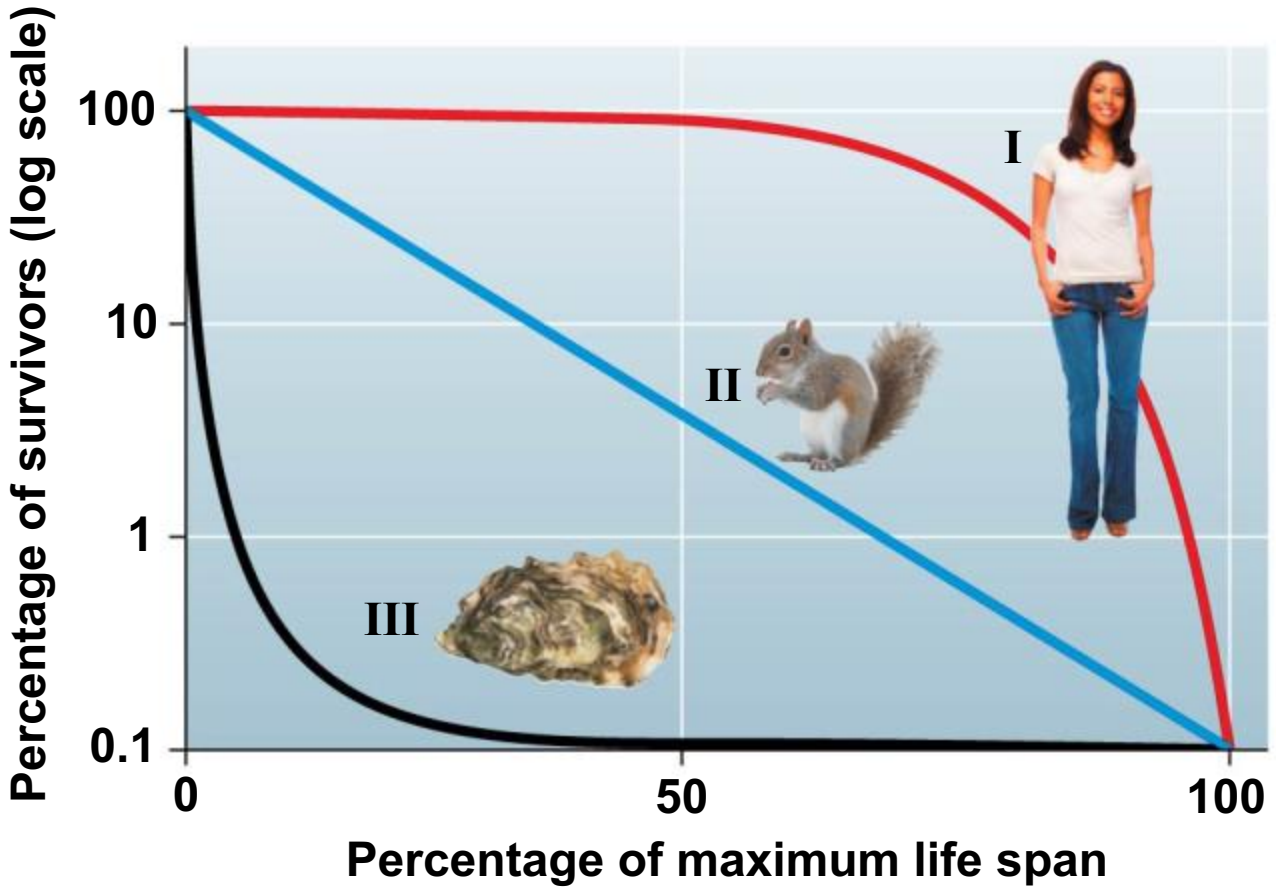




Clumped Dispersion

Survivorship Patterns Vary Depending on a Species Natural History

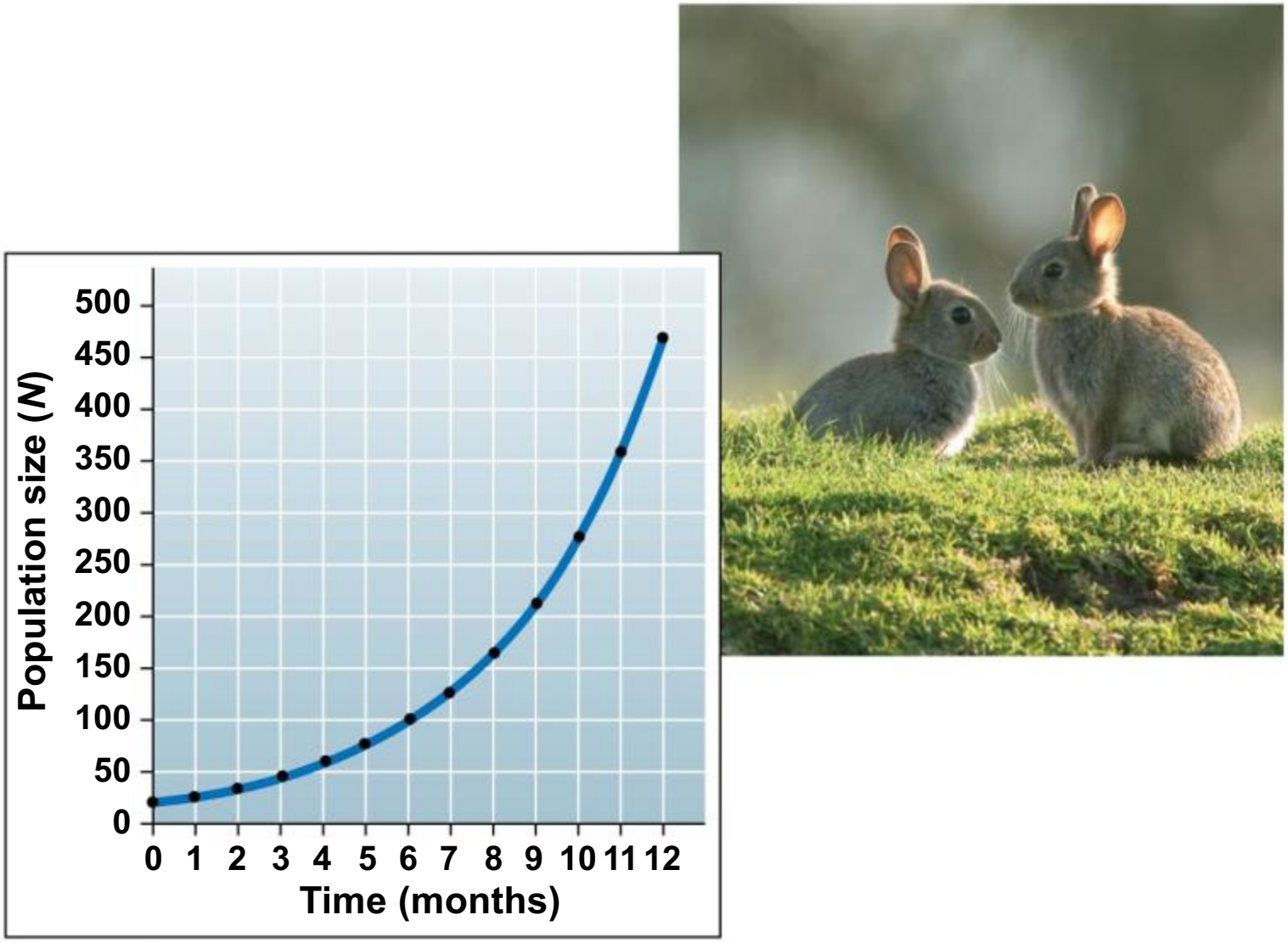
Figure 36.3b



36.4 Idealized models predict patterns of population growth

- The rate of population increase under ideal conditions is called exponential growth. It can be calculated using the **exponential growth model** equation, $G = rN$, in which
  - G is the growth rate of the population,
  - N is the population size, and
  - r is the **per capita rate of increase** (the average contribution of each individual to population growth).
- Eventually, one or more **limiting factors** will restrict population growth.

Figure 36.4a-0

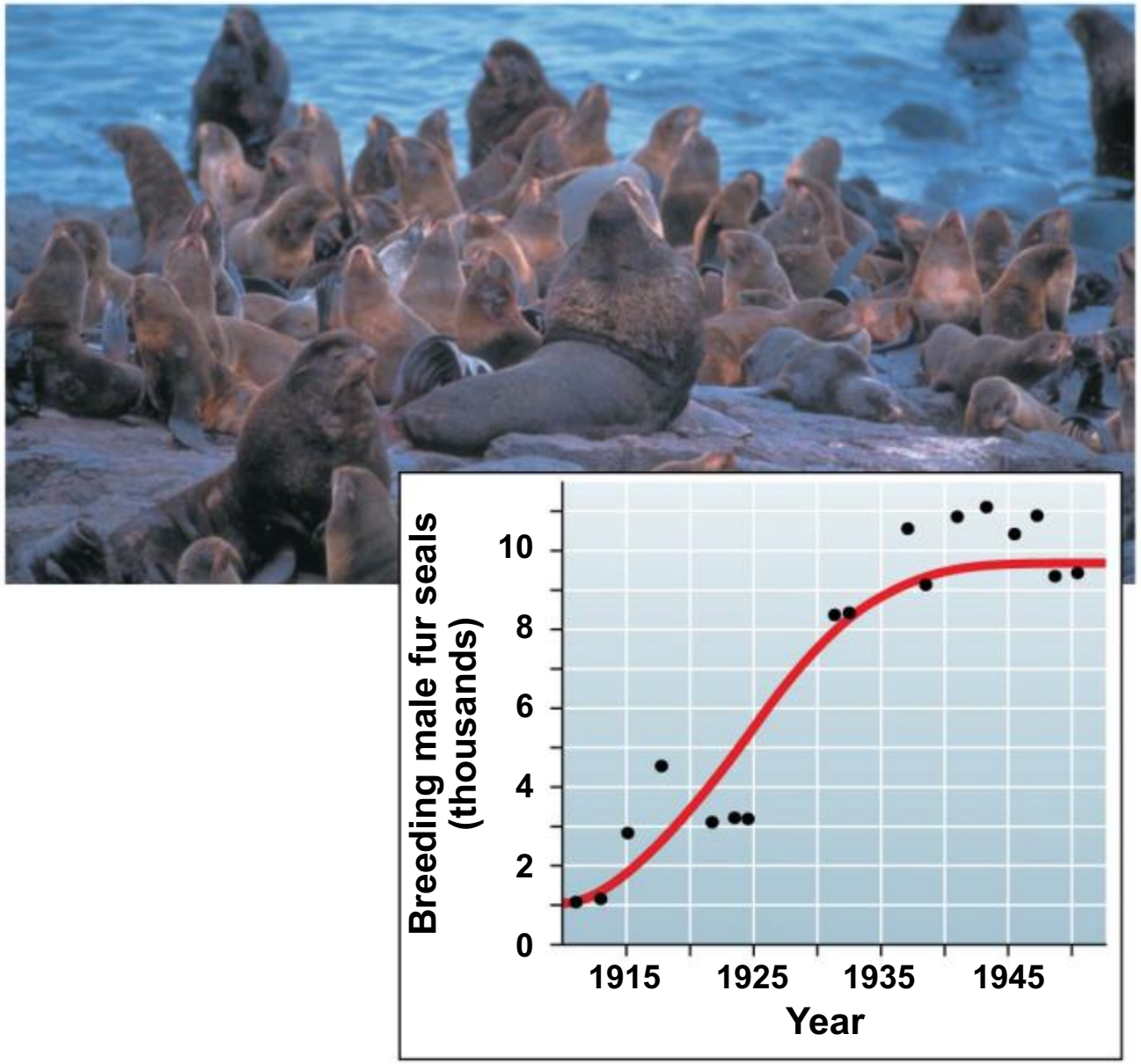


36.4 Idealized models predict patterns of population growth

- The **logistic growth model** is a description of idealized population growth that is slowed by limiting factors as the population size increases.
- To model logistic growth, the formula for exponential growth, *rN*, is multiplied by an expression that describes the effect of limiting factors on an increasing population size.
- *K* stands for **carrying capacity**, the maximum population size a particular environment can sustain.

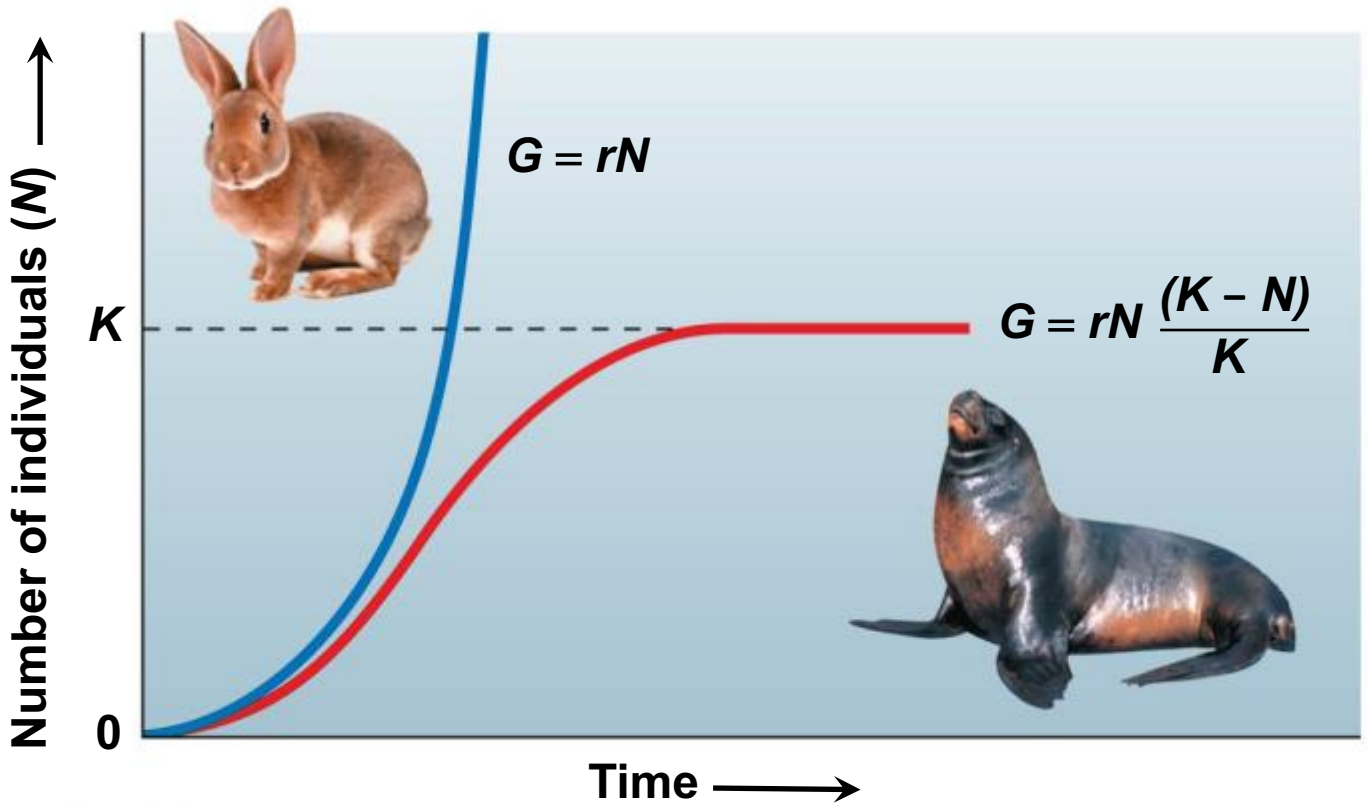
$$G = rN\frac{(K - N)}{K}$$

Figure 36.4b-0



Data from K. W. Kenyon et al., A population study of the Alaska fur-seal herd, *Federal Government Series: Special Scientific Report—Wildlife* 12 (1954).

Figure 36.4c



36.5 Multiple factors may limit population growth

- The logistic growth model predicts that population growth will slow and eventually stop as population density increases.

- At higher population densities, **density-dependent** rates result in
  - declining births and/or
  - increases in deaths.

Which of the following best describes an exponential growth model?

A. As a population of seabirds increases the available nesting sites can no longer increase and the population growth rate slows.

B. A bacteria colony is developing in a petree dish and when they run out of food the colony stopb growing.

C. By colonizing other planets for limited resources humans are able to increase their total population size, despite widespread environmental degradataion.

Which of the following best describes an exponential growth model?

A. As a population of seabirds increases the available nesting sites can no longer increase and the population growth rate slows.

B. A bacteria colony is developing in a petree dish and when they run out of food the colony stop growing.

C. By harvesting resources on distant planets humans are able to increase their total population size, despite widespread environmental degradation.

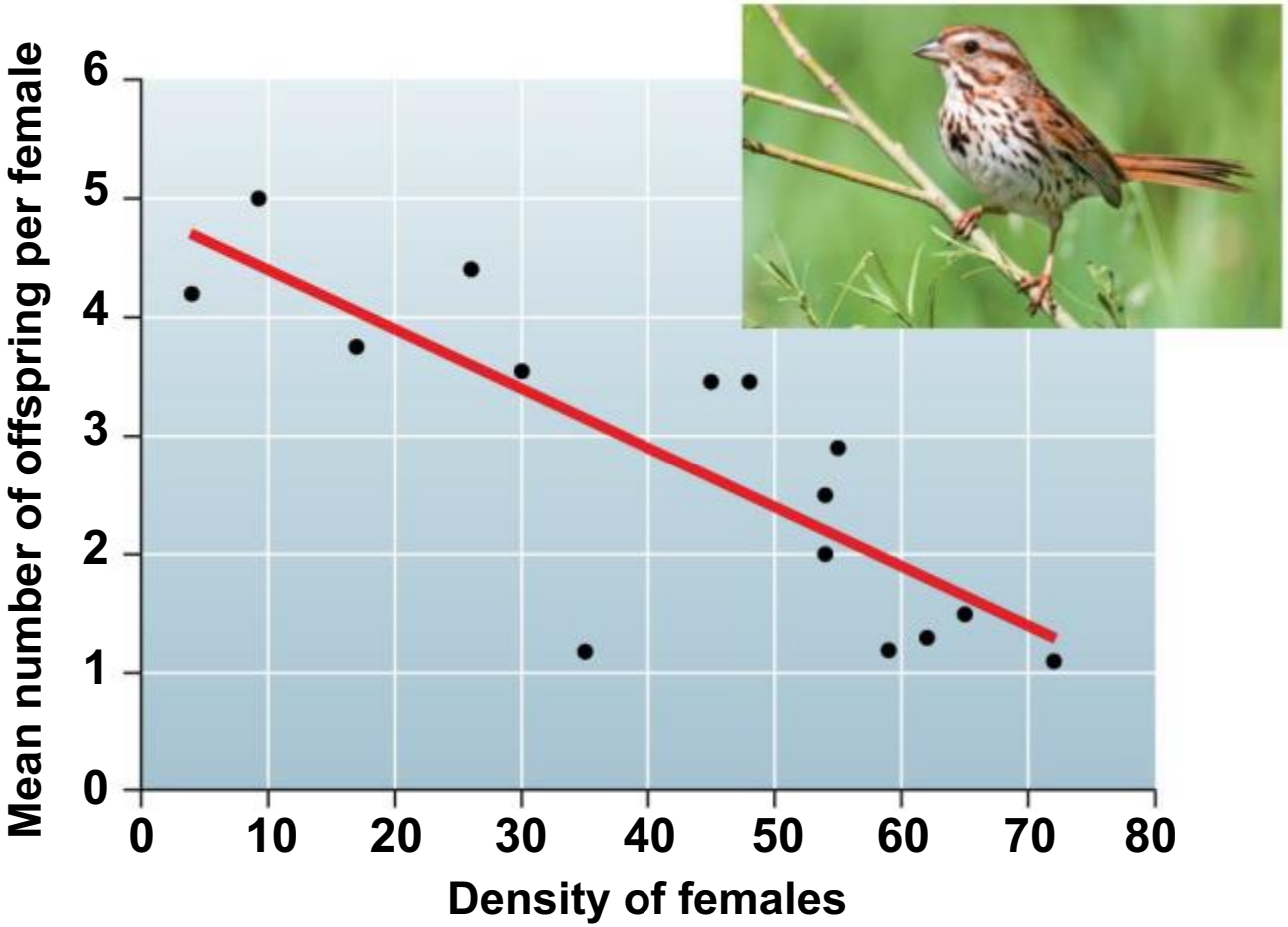
Which of the following best describes an exponential growth model?

A. As a population of seabirds increases the available nesting sites can no longer increase and the population growth rate slows.

B. A bacteria colony is developing in a petree dish and when they run out of food the colony stopb growing.

C. By harvesting resources on distant planets humans are able to increase their total population size, despite widespread environmental degradation.

Figure 36.5a-0



Data from P. Arcese et al., Stability, Regulation, and the Determination of Abundance in an Insular Song Sparrow Population. *Ecology* 73: 805–882 (1992).

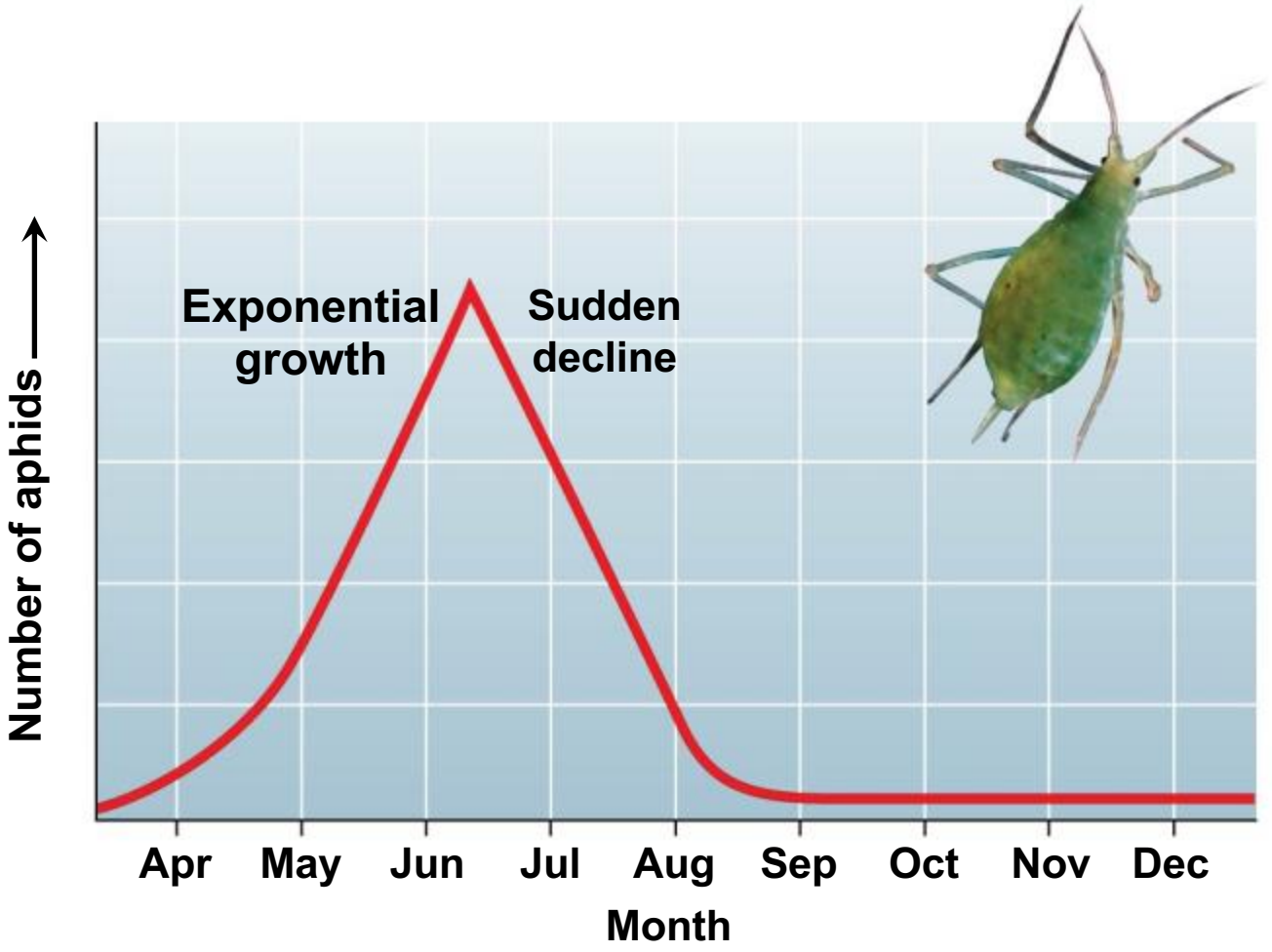
36.5 Multiple factors may limit population growth

- **Intraspecific competition**
  - is competition between individuals of the same species for limited resources and
  - is a density-dependent factor that limits growth in natural populations.
- **Limiting factors may include**
  - food,
  - nutrients, or
  - nesting sites.

36.5 Multiple factors may limit population growth

- In many natural populations, abiotic factors such as weather may affect population size well before density-dependent factors become important.
- **Density-independent factors** are unrelated to population density. These may include
  - fires,
  - storms,
  - habitat destruction by human activity, or
  - seasonal changes in weather (for example, in aphids).

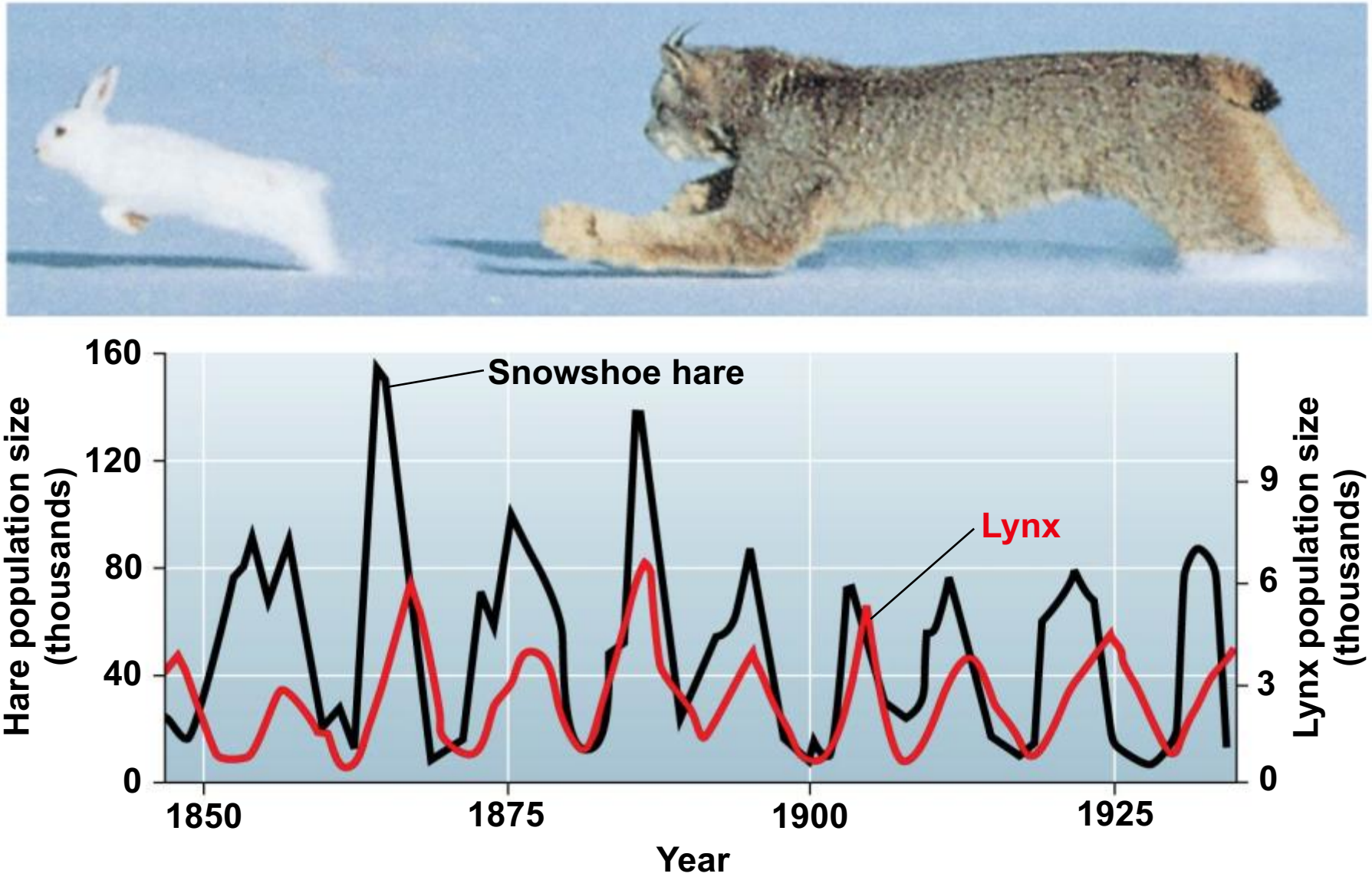
Figure 36.5c-0



36.6 SCIENTIFIC THINKING: Some populations have "boom-and-bust" cycles

- Some populations fluctuate in density with regularity.
- Boom-and-bust cycles may be due to
  - food shortages or
  - predator-prey interactions.
- A striking example is a populations of the snowshoe hare and the lynx.

Figure 36.6-0



Data from C. Elton and M. Nicholson, The ten-year cycle in numbers of the lynx in Canada, *Journal of Animal Ecology* 11 : 215–244 (1942).

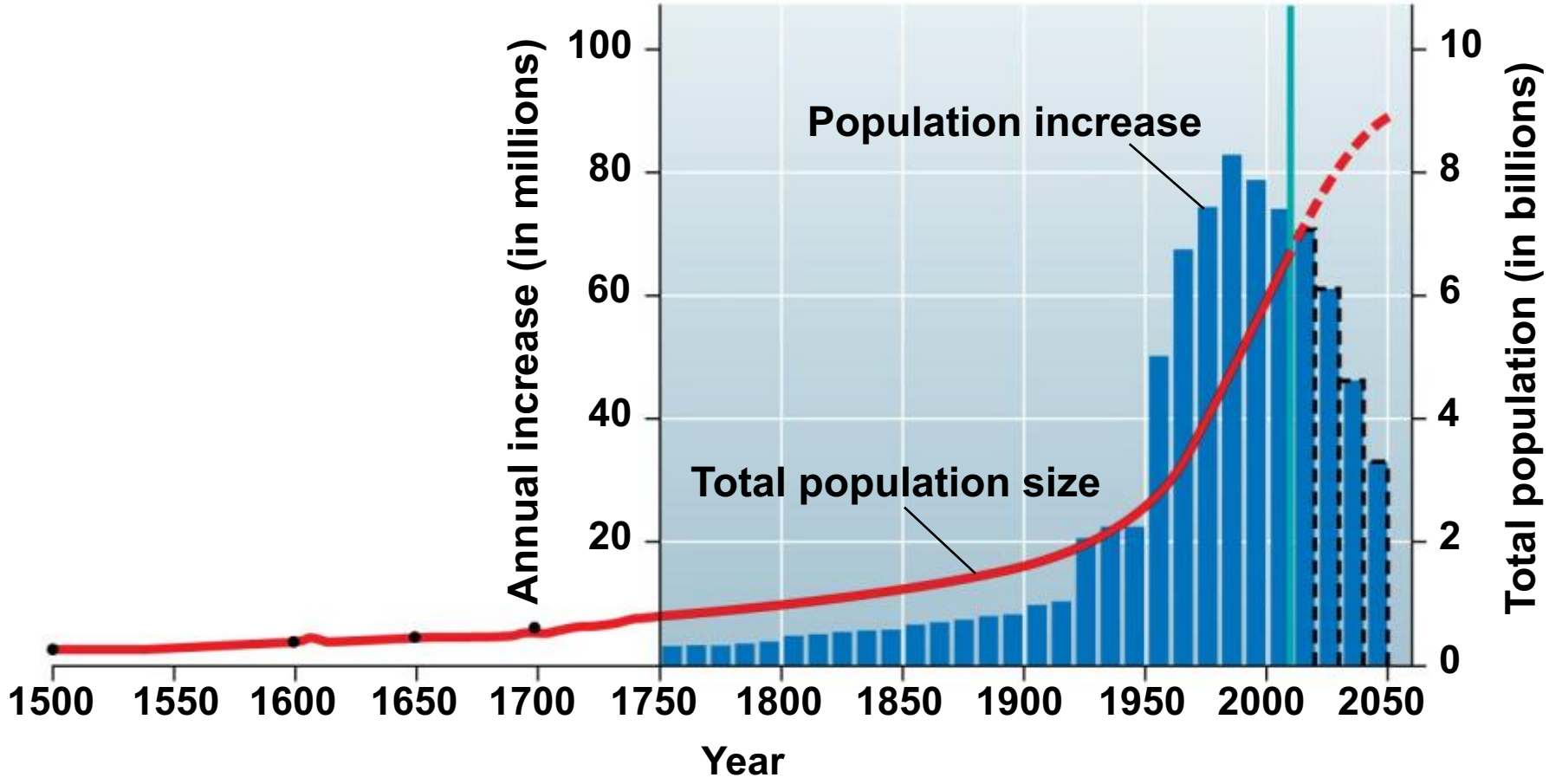
The Human Population

The human population continues to increase, but the growth rate is slowing

The human population continues to increase, but the growth rate is slowing

https://www.census.gov/popclock/

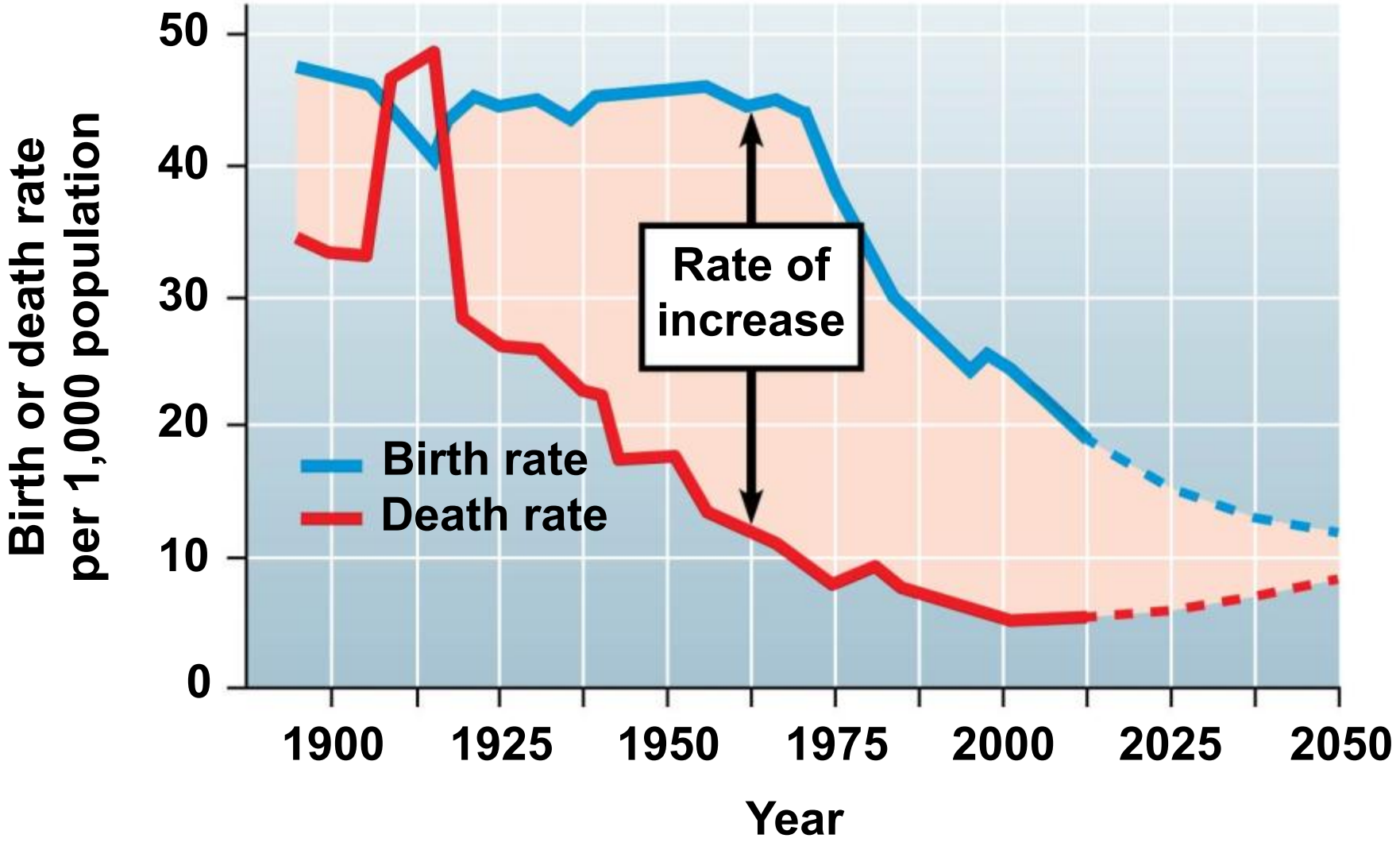
Figure 36.9a



Adapted from *The World at Six Billion*, United Nations Publications (1999).

http://www.census.gov/popclock/

Figure 36.9b

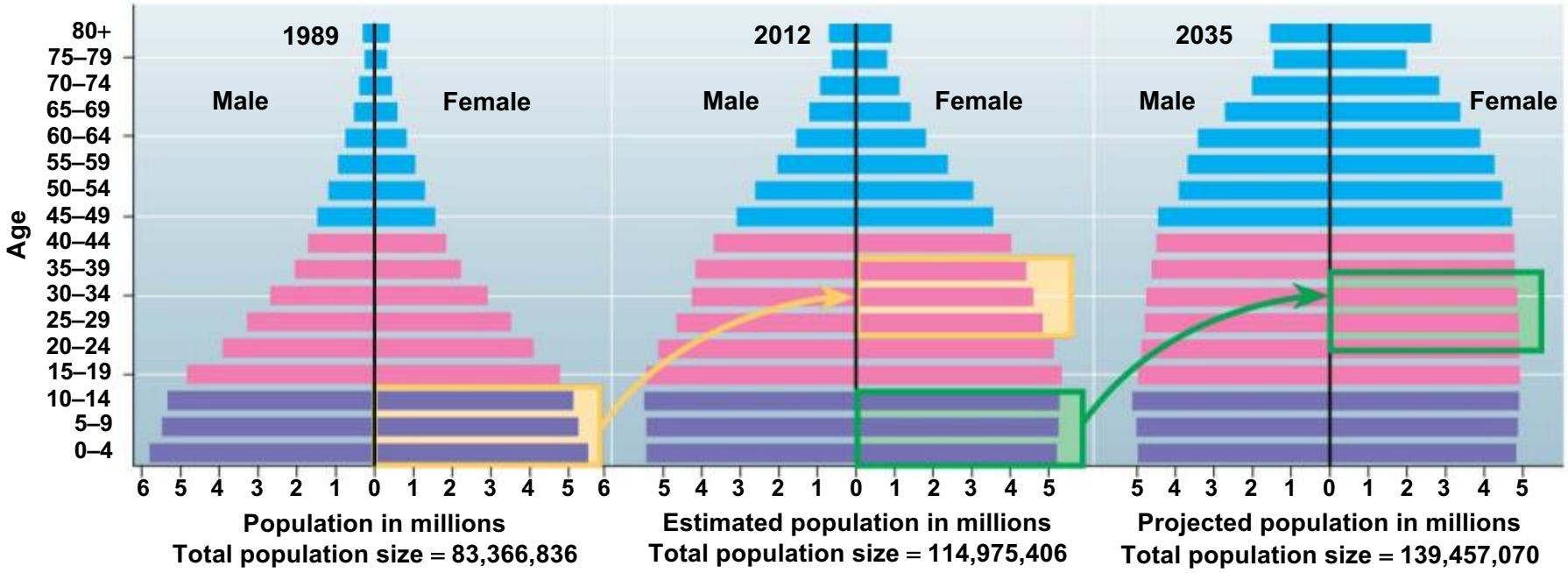


Adapted from Transitions in World Population, *Population Bulletin* 59: 1 (2004).

36.9 The human population continues to increase, but the growth rate is slowing

- In the developing world
  - death rates have dropped,
  - but high birth rates persist, and
  - these populations are growing rapidly.

Population momentum in Mexico

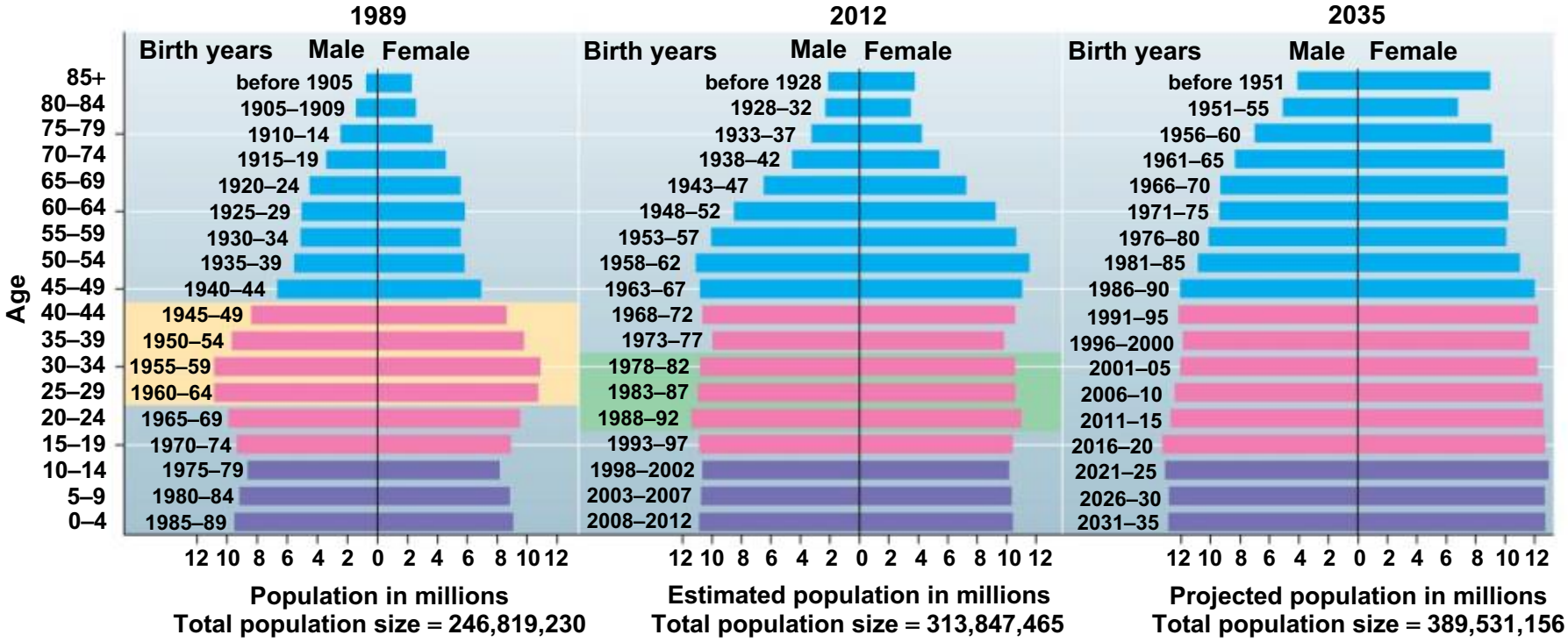


Adapted from International Data Base, U.S. Census Bureau (2013).

36.10 CONNECTION: Age structures reveal social and economic trends

- Age-structure diagrams reveal
  - a population's growth trends and
  - social conditions.
- For instance, an expanding population has an increasing need for schools, employment, and infrastructure, and a large elderly population requires that extensive resources be allotted to health care.

Age structures for the United States



Data from International Data Base, U.S. Census Bureau website, (2013).

36.11 CONNECTION: An ecological footprint is a measure of resource consumption

- The U.S. Census Bureau projects a global population of
  - 8 billion people within the next 20 years and
  - 9.5 billion by the mid-21st century.
- Do we have sufficient resources to sustain 8 or 9 billion people?
- To accommodate all the people expected to live on our planet by 2025, the world will have to *double* food production.

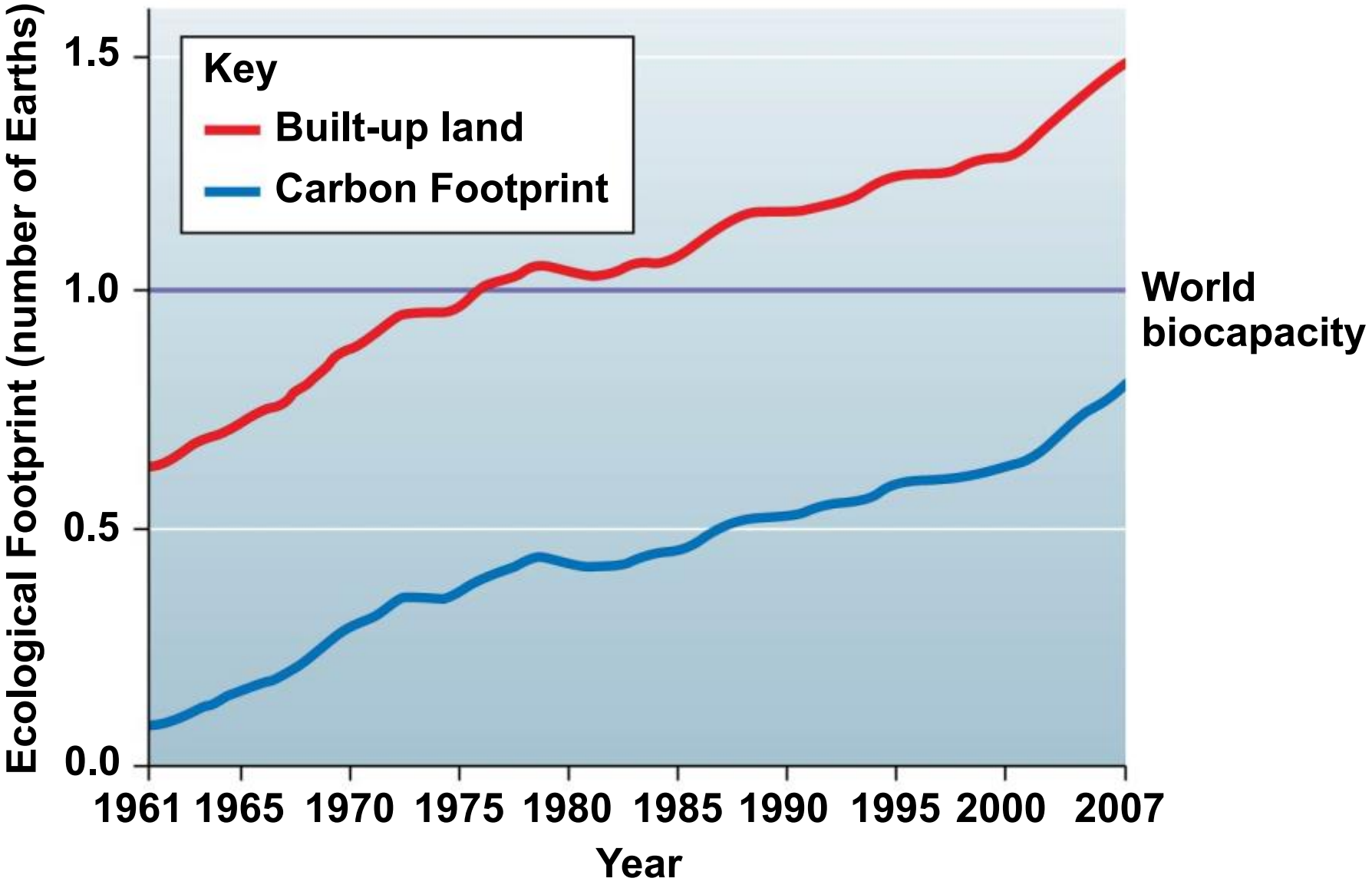
36.11 CONNECTION: An ecological footprint is a measure of resource consumption

- An **ecological footprint** is an estimate of the amount of land required to provide the raw materials an individual or a nation consumes, including
  - food,
  - fuel, and
  - housing.

36.11 CONNECTION: An ecological footprint is a measure of resource consumption

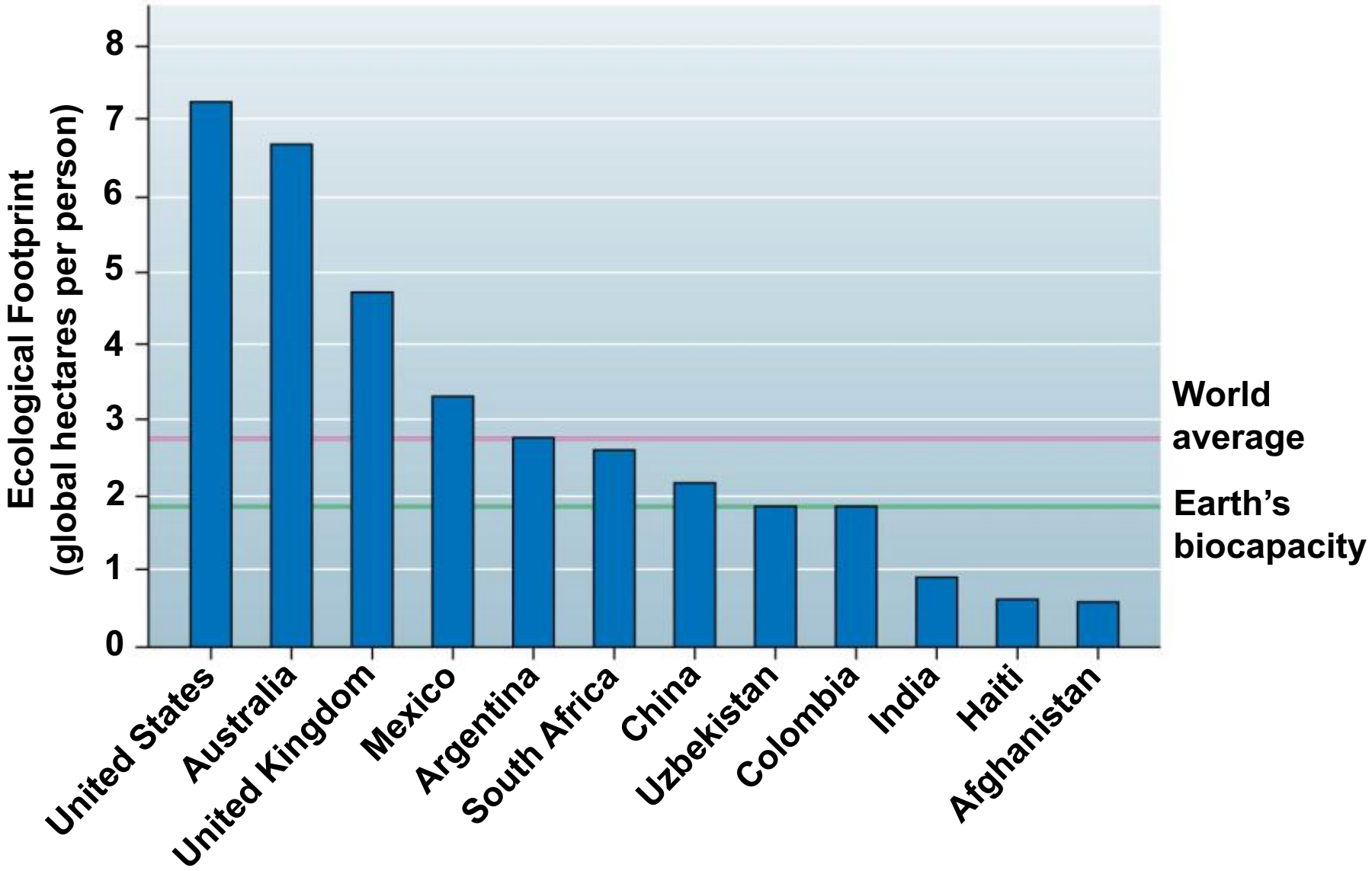
- Comparing our demand for resources with Earth's capacity to renew these resources, or biocapacity, gives us a broad view of the sustainability of human activities.
- When the total area of ecologically productive land on Earth is divided by the global population, we each have a share of about 1.8 global hectares (1 hectare, or ha, = 2.47 acres; a *global hectare*, or gha, is a hectare with world-average ability to produce resources and absorb wastes).

Figure 36.11a



Data from B Ewing et al., The Ecological Footprint Atlas, *Oakland: Global Footprint Network* (2010).

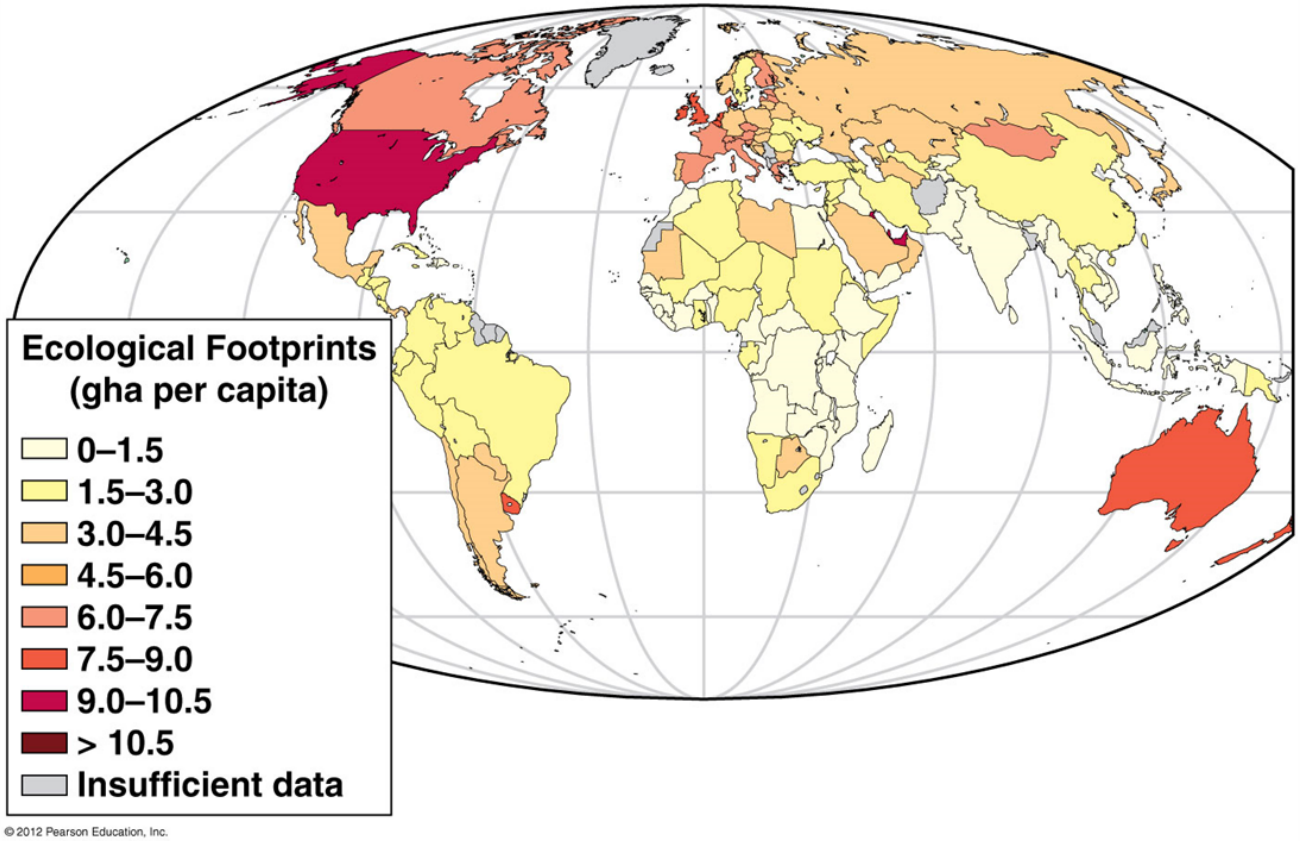
Figure 36.11b



Adapted from Living Planet Report 2012: Biodiversity, Biocapacity, and Better Choices, World Wildlife Fund (2012).


CONSUMERISM FOR BEGINNERS
LOOK HONEY, I BOUGHT SOMETHING TODAY!
OH DARLING, I'M SO PROUD OF YOU!


725



If everyone on the planet lived my lifestyle, we would need:

= 5.56 Earths

US Average 6.35 Earths