Ecology is the study of the relationship among organisms (living things) and between living things and their environment.

Our Earth is also called the Biosphere- It is that part of the Earth that supports life and contains the following two elements..

1) The Biotic Environment- everything that is or was recently alive, and

2) The Abiotic Environment- all the non-living surroundings of the Biotic environment- (soils, weather, solar radiation, gravity, atmosphere, water, rocks and other non-living material)

1. Population is a group of the same species occupying a certain area.

2. Community consists of all populations at one locale (ex: a coral reef population or tree-land population)

3. An ecosystem contains the community organisms and abiotic factors (ex, energy flow, chemical cycling)

Concept of Community

-Species diversity includes species richness &. species evenness

Structure of the Community:

-Interactions include: competition for resources, predator-prey interaction, parasite-host interaction

-Commensalism, Mutualism, and Parasitism

-Habitat and Ecological Niche

Prey Defenses:

-Plants: sharp spines, tough leathery leaves, poisonous chemicals, chemicals that act as hormone analogues to interfere with insect larval development.

-Animals: camouflage, warning coloration, causing harm or fright to predators, and association with other prey

Heterotrophs

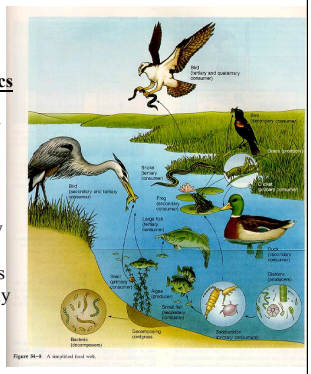
1. Herbivores
2. Carnivores
   A. Primary consumer
   B. Secondary consumer
   C. Tertiary Consumer
3. Omnivores
4. Detritivores
5. Decomposers

Energy flow in an ecosystem is a consequence of 2 fundamental laws of thermodynamics:

1**. First Law of Thermodynamics** - states energy can neither be created nor destroyed; it can only be changed from one form of energy to another.

2. Second Law of Thermodynamics - when energy is transformed from one form to another, there is always some loss of energy from the system, usually as low grade heat.

•Food Webs shows the complex feeding relationships that exist in nature.



Trophic Levels

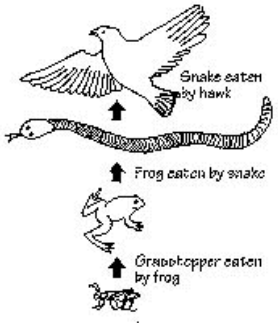
1. Food chain - represents passage of energy through the populations in a community.

2. Trophic level is a feeding level of one or more populations in a food web

a. first trophic level

b. second trophic level

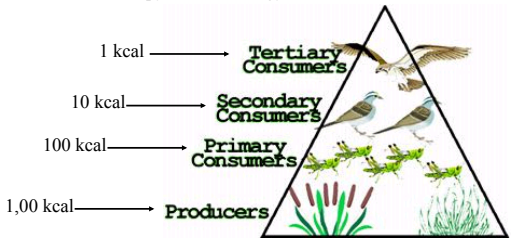
c. third trophic level



Ecological Pyramids

-shows the trophic structure of an ecosystem as a graph representing biomass, organism number, or energy content of each trophic level in a food web.

Pyramid of biomass & pyramid of energy



Net Primary Productivity

- **Net Primary Production** (NPP) is the amount of new biomass added in a given time period
- Only NPP is available to consumers
- Ecosystems vary greatly in NPP and contribution to the total NPP on Earth
  - **Limited by light, nutrients and other abiotic factors**
- **Secondary** is the amount of chemical energy in food converted to new biomass

Population Ecology

- **Population ecology** is the study of populations in relation to their environment, including environmental influences on density and distribution, age structure, and population size
- Big Questions:
  - How are populations structured
  - How are populations affected by the environment

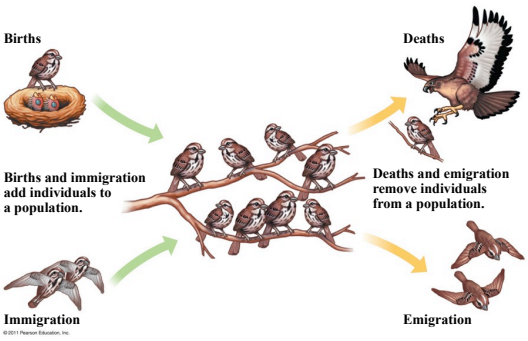
Population growth: Theory

- Populations grow in two ways
- **Natality** = Birth Rate
- **Immigration** = Individuals entering the population

Populations decline in two ways

- **Emigration** is the movement of individuals out of a population
- **Mortality** = Death Rate

Figure 53.3

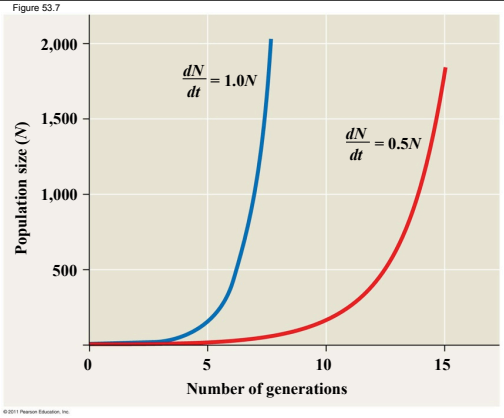


Growth = (births + immigration)-(deaths + emigration)

Model 1: Exponential Growth

- Exponential Growth = ideal growth of a population without any limits $\frac{dN}{dt} = r_{max}N$
- Can be expressed by change in Number of individuals (dN)/change in time (dt)
- r= the "per capita rate of increase"
- Higher r value leads to faster increase

Figure 53.7



The logistic model: Nearing Carrying Capacity

- Exponential growth cannot be sustained for long in any population
- A more realistic population model limits growth by incorporating carrying capacity
- **Carrying capacity** (K) is the maximum population size the environment can support
- Carrying capacity varies with the abundance of limiting resources

The Logistic Growth Model

- The logistic model starts with the exponential model and adds an expression that reduces per capita rate of increase as N approaches K

$$\frac{dN}{dt} = r_{max} N \frac{(K - N)}{K}$$

Figure 53.9

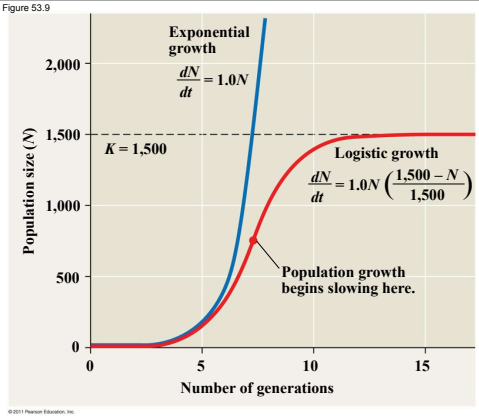
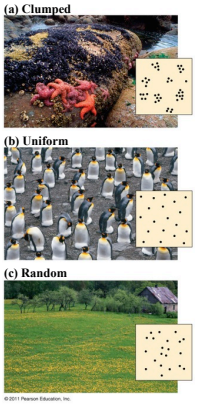


Figure 53.4

Population distribution



Influenced by resources or behavior

Can be influenced by territory or behavior

Not influenced by others in population

Population demographics

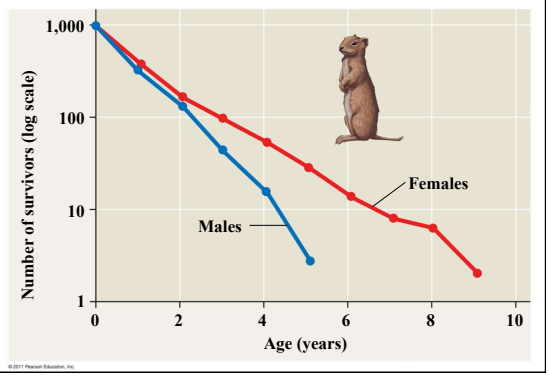
- Demography: The study of population statistics and how they change over time
- Demographic data can be arranged in tables (life, reproductive) or graphs (survivorship curves)

Table 53.2 Reproductive Table for Belding's Ground Squirrels at Tioga Pass

Age (years)	Proportion of Females Weaning a Litter	Mean Size of Litters (Males + Females)	Mean Number of Females in a Litter	Average Number of Female Offspring*
0–1	0.00	0.00	0.00	0.00
1–2	0.65	3.30	1.65	1.07
2–3	0.92	4.05	2.03	1.87
3–4	0.90	4.90	2.45	2.21
4–5	0.95	5.45	2.73	2.59
5–6	1.00	4.15	2.08	2.08
6–7	1.00	3.40	1.70	1.70
7–8	1.00	3.85	1.93	1.93
8–9	1.00	3.85	1.93	1.93
9–10	1.00	3.15	1.58	1.58

Source: P. W. Sherman and M. L. Morton, Demography of Belding's ground squirrel, Ecology 65:1617–1628 (1984).
*The average number of female offspring is the proportion weaning a litter multiplied by the mean number of females in a litter.

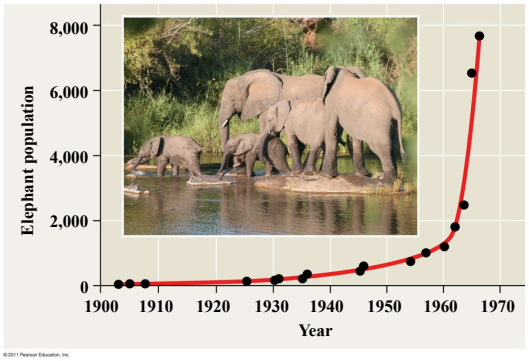
Figure 53.5



How do real populations grow?

- The J-shaped curve of exponential growth characterizes some rebounding populations
  - For example, the elephant population in Kruger National Park, South Africa, grew exponentially after hunting was banned
  - This is typical of populations well below the carrying capacity

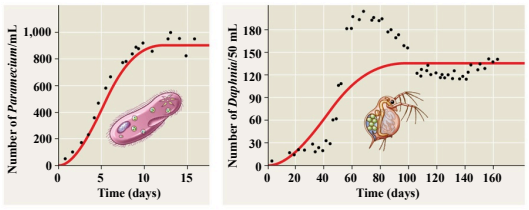
Figure 53.8



The Logistic Model and Real Populations

- The growth of laboratory populations of paramecia fits an S-shaped curve
- These organisms are grown in a constant environment lacking predators and competitors
- The populations generally oscillate around the carrying capacity

Figure 53.10



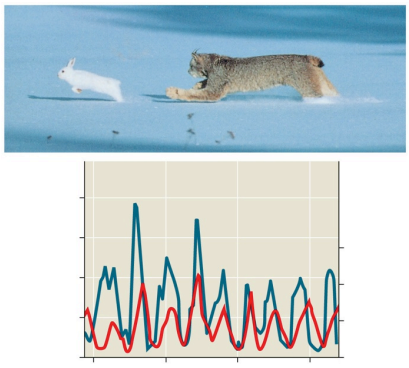
(a) A *Paramecium* population in the lab

(b) A *Daphnia* population in the lab

- ***K*-selection**, selection for traits that maximize reproductive success at high population densities

- ***R*-selection**, Selection for traits that maximize success at low population Densities

- There are two general questions about regulation of population growth
  - What environmental factors stop a population from growing indefinitely?
  - Why do some populations show radical fluctuations in size over time, while others remain stable?



Competition for Resources

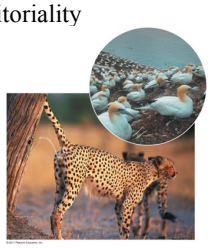
- increasing population density intensifies competition for resources and results in a lower birth rate

Predation:

As a prey population builds up, predators may feed on that species

Waste accumulation

Territoriality



Disease

Human Population Growth:

The underlying cause of ecological problems

7 Billion and counting!

- Human Population growth has been in a period of accelerated exponential growth

Figure 53.24

The decrease in growth is not uniform across the globe