Chapter 36: Population Ecology

Honors Biology

2011

1

Population Ecology

- Concerned with changes in population size
- Examines factors that regulate populations over time
  - ex. predation, food sources, human activities
- Helps explain the biodiversity of an environment

2

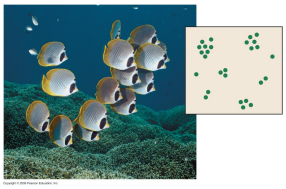
Populations

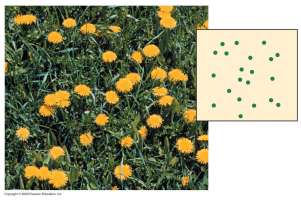
- Population - a group of individuals of the same species living in the same place at the same time
  - Rely on the same resources
  - Influenced by the same environmental factors
  - Likely to interact and breed with each other
- Population Dynamics
  - Interaction between biotic and abiotic factors
  - Populations increase through birth and immigration
  - Populations decrease through death and emigration

3

Population Density

- Population density - number of individuals of a species in the same area or unit of volume
- Dispersion patterns
  - clumped
  - uniform
  - random





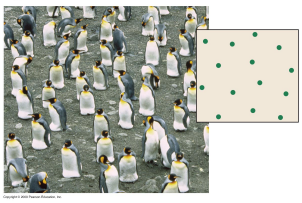


Fig. 36.2A-C

Life Tables

- Life tables - track survivorship over the life span of individuals in a population
  - Help conservationists find weaknesses in the population
- Survivorship Curves - plot of the proportion of individuals alive at each age
  - Type I
  - Type II
  - Type III

TABLE 36.3 LIFE TABLE FOR THE U.S. POPULATION IN 2003

Age Interval	Number Living at Start of Age Interval (*N*)	Number Dying During Interval (*D*)	Chance of Surviving Interval (1−D/N)
0–10	100,000	884	0.991
10–20	99,116	423	0.996
20–30	98,693	941	0.990
30–40	97,752	1,308	0.987
40–50	96,444	2,859	0.970
50–60	93,585	5,825	0.938
60–70	87,760	12,225	0.861
70–80	75,535	22,794	0.698
80–90	52,741	31,401	0.405
90+	21,340	21,340	0.000

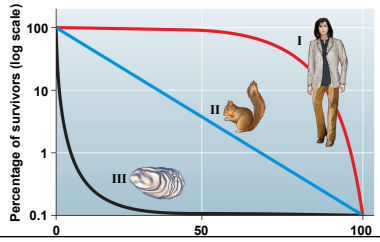


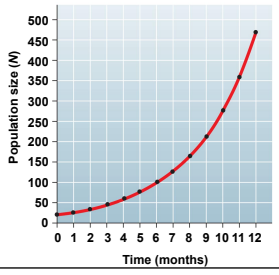
Fig. 36.3

Exponential Growth Model

- Populations change as new individuals are born, die, immigrate, or emigrate
- Exponential growth - rate of population increase under ideal conditions
  - Calculated using the equation G = rN
    - G is the growth rate
    - N is the population size
    - r is the per capita rate of increase (average contribution of each individual to population growth)

TABLE 36.4A EXPONENTIAL GROWTH OF RABBITS, $r = 0.3$

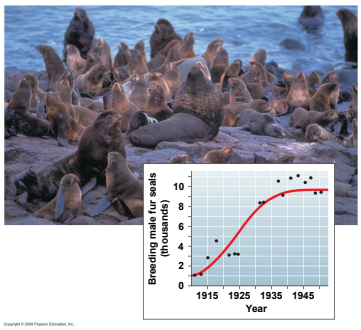
Time (months)	*N*	*G* = *rN*
0	20	6
1	26	8
2	34	10
3	44	13
4	57	17
5	74	22
6	96	29
7	125	38
8	163	49
9	212	64
10	276	83
11	359	108
12	467	140



Logistic Growth Model

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

- This growth model takes limiting factors into consideration
  - Limiting factors - are environmental factors that restrict population growth
  - Population growth slows as population density increases
  - K = Carrying Capacity
    - the maximum number a population can sustain



7

Growth Models Compared

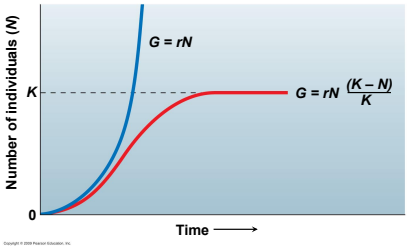


Fig. 36.4C

Exponential vs. Logistic

Carrying Capacity

TABLE 36.4B EFFECT OF *K* ON GROWTH RATE AS *N* APPROACHES *K*, $K = 1{,}000$, $r = 0.1$

N	*rN*	$(K-N)/K$	$G = rN(K-N)/K$
10	1	0.99	0.99
100	10	0.9	9.00
400	40	0.6	24.00
500	50	0.5	25.00
600	60	0.4	24.00
700	70	0.3	21.00
900	95	0.05	0.25
1,000	100	0.00	0.00

8

Population Density

- Population density can be impaced by biotic and abiotic factors

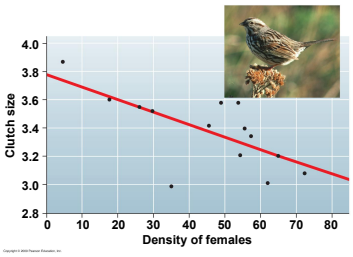
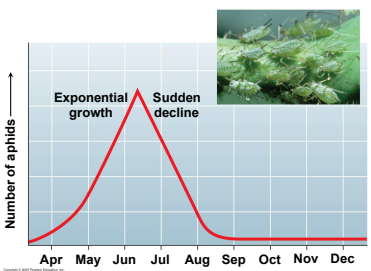


Fig. 36.5A

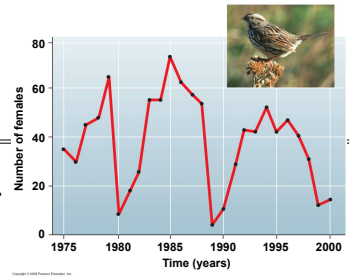
Fig. 36.5B

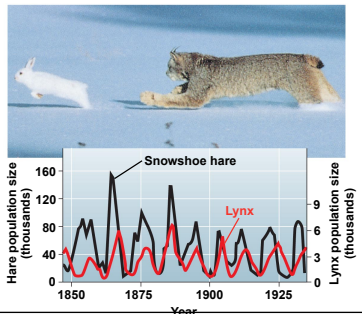


9

Population Fluctuations

- Most populations fluctuate in number
  - Often caused by abiotic factors
- Some populations fluctuate in a predictable way (boom-and-bust cycles)
- Causes:
  - Food Shortages
  - Predator-prey interactions





10

Evolution and Life Histories

- Life history - traits that affect an organism's schedule of reproduction and death
  - r-selected traits
  - K-selected traits

11

r-selected Species

- Small-bodied, short-lived animals
- Develop and sexually mature rapidly
- Have large numbers of offspring
- Offer little or no parental care
- Environments are usually prone to fire, flood, hurricanes, droughts, or cold weather
- Opportunists

12

K-selected Species

- Large-bodied, long-lived animals
- Develop slowly
- produce few, well cared for, offspring
- Population growth is limited by density-dependent factors
- Usually in very competitive environments

13

Population Ecology Applications

- Sustainable resource management - harvesting crops at levels that do not damage the viability of the resource
- Maximum sustainable yield - harvesting the most individuals without forcing the population to decline
- Often economic concerns outweigh environmental concerns
  - ex. cod fisheries

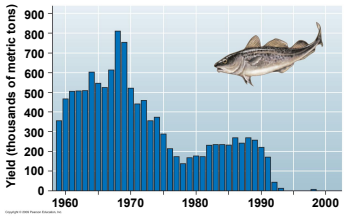


Fig. 36.8

14

Human Population

- Increasing and is expected to continue to increase for several decades
- 95% of increase is in developing nations

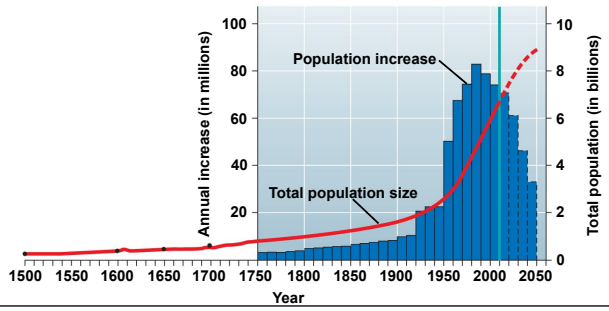


Fig. 36.9A

15

Growth Rate is Decreasing

- The population continues to rise, but the rate of growth is going down

TABLE 36.9 POPULATION CHANGES IN 2006

Population	Birth Rate per 1,000	Death Rate per 1,000	Per Capita Rate of Increase (*r*)
World	20.3	8.5	11.8
More developed nations	11.1	10.4	0.7
Less developed nations	22.4	8.0	14.4

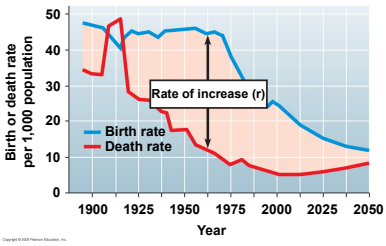


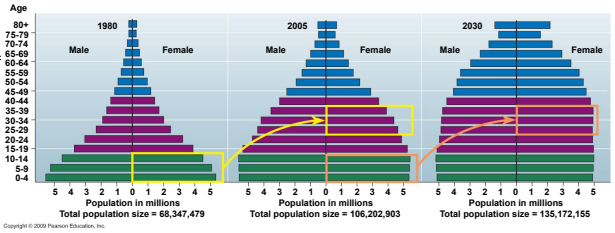
Fig. 36.9B

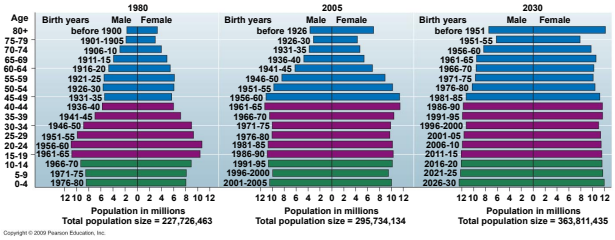
16

Age Structure

Fig. 36.9 & 36.10

- Age Structure - Number of individuals in different age groups
- Population Momentum - increased proportion of women of childbearing age



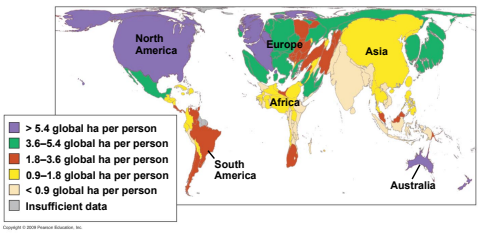


17

Ecological Footprint

Fig. 36.11

- Helps understand how much of a resource is being used
- United States
  - HUGE ecological footprint and ecological deficit



18