Population Ecology

• Science of Populations

• Applying this science to the human population

• Understanding the problems and solutions related to the human population

Population

group of individuals of same species living in an area
Population size

Number of individuals present at a given time and in a given area

note: this graph only shows countries with a population over 5 million on July 1, 2002 (est.). The color indicates the size:
Orange means a country > 100 million
Blue means a country between 50 and 100 million
Green a country between 40 and 50 million
Yellow a country between 30 and 40 million
Lavender a country between 20 and 30 million
Pink a country between 10 and 20 million
Grey a country between 5 and 10 million.

The size of a population may change through time

What will determine weather a population grows, shrinks, or remains stable?
Annual Growth Rate: % of change

Which populations are growing, shrinking, or remain stable?

Population growth curves show change in population size over time

How does a population grow by a fixed growth rate?
Exponential growth is seen at a fixed percentage

- **J-shaped curve**

- Growth by a fixed %, rather than a fixed amount.

- It takes less time to double the population

**Analogy:**
Similar to growth of money in a savings account

Under which environmental conditions, does exponential growth happen?

**Under unlimited resources**
populations grow exponentially

Endless amount of food, water, space, no predators or disease
Case: Sheep introduced in Tasmania

EARLY 1800’s    Sheep introduced into Tasmania, sheep had unlimited food resources  
                 → exponential growth in 2 decades, resulted in 2.5 million sheep

MID 1800’s    Decreased growth due to dwindling resources and disease

LATE 1800’a    population stabilized at 1.6 million sheep

When resources are limited, can an exponential growth continue forever?

Populations can not grow infinitely

Why?
Resources are limited
and
They restrain exponential population growth,

slowing the growth rate down.
Logistic growth is seen under limited resources

- First, population grows exponentially

- When resources dwindle, growth slows close to zero
  Births = deaths

- Population size stabilizes, this is the maximum number of individuals of a given species that the environment can sustain. This size is called the CARRYING CAPACITY

- S-shaped curve

What was the carrying capacity of sheep in Tasmania?
Will the carrying capacity be the same for rabbits in Tasmania?

Let’s apply what we have learned to the human population!
It took 1.5 million years to reach the 1st billion

2 billion (123 years later)

4 billion in 1974 (44 years later)

*Is this an exponential or logistic growth?*

**Questions to consider**

*What is the future like?*

*Can we keep this exponential growth?*

*What does population ecology tell us?*
What is the carrying capacity for humans?

Estimates range between 4 billion to 16 billion

The variation is due to different levels of consumption of resources

<table>
<thead>
<tr>
<th>Resource</th>
<th>MDC</th>
<th>US</th>
<th>LDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of population</td>
<td>19</td>
<td>5</td>
<td>80</td>
</tr>
<tr>
<td>Daily water use/person</td>
<td>676 g</td>
<td>1512 g</td>
<td>333 g</td>
</tr>
<tr>
<td>Energy use/person</td>
<td>31.1 b</td>
<td>59.4 b</td>
<td>3.8 b</td>
</tr>
<tr>
<td>Persons per motor vehicle</td>
<td>2</td>
<td>1.3</td>
<td>38</td>
</tr>
</tbody>
</table>

Carrying capacity will be determined not only by the number of individuals but the amount of resources each one consumes

Ecological Footprint

- Tool to measure amount of earth surface (land and water) that an individual requires

- Size of land depends on: level of consumption, which includes land needed to provide for all resources a person needs AND land needed to dispose of all waste produced by a person
Ecological Footprints vary between countries

 Residents of some countries use more land
 Why?

 An average person in the US requires 9.7 ha =

 How does Ecological Footprint and Carrying Capacity relate to each other?

 The size of the Ecological Footprint for each of us will determine the Earth’s carrying capacity for humans
What can be done?

Sustainable development

use of goods and services to satisfy human needs and improve quality of life

While

Minimizing use of resources so that they are available for the future use

Find win-win solutions for the human condition and for earth’s environment

Several Changes to Sustainability

• Redefine quality of life
• Industry: mimic natural systems by making processes circular
• Base our decisions on long-term thinking
• Promote research and education

produce responsible technology

\[ I = P \times A \times T \]
Several Changes to Sustainability

Sustainable development involves industry AND the consumer:

- Vote with our ballots
- Vote with our wallets

<table>
<thead>
<tr>
<th>Company</th>
<th>Revenue Net Sales in millions of dollars</th>
<th>Percent of Revenue Allocated to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Merck &amp; Co., Inc.</td>
<td>$40,363</td>
<td>17% 12% 6%</td>
</tr>
<tr>
<td>Pfizer Inc.</td>
<td>29,374</td>
<td>13% 39% 12%</td>
</tr>
<tr>
<td>Bristol-Myers-Squibb Company</td>
<td>18,216</td>
<td>26% 30% 11%</td>
</tr>
<tr>
<td>Pharamcia Corporation</td>
<td>18,144</td>
<td>4% 37% 15%</td>
</tr>
</tbody>
</table>

What are companies trying to get you to buy?
- cheaper vs. quality
- disposable vs. reusable
- more packaging vs. less packaging