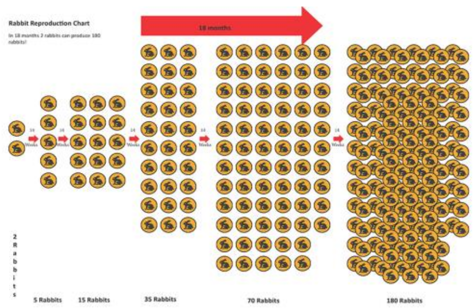
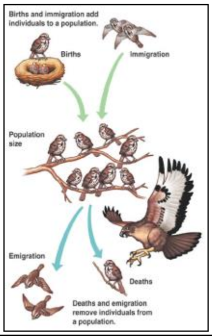
3. Population Growth

- Populations are not stagnant, they change over time



- 4 factors determine how a population changes:

1. Natality (birth rate)
2. Mortality (death rate)
3. Immigration (individuals moving into a population)
4. Emigration (individuals moving out of a population)



- Population change (P.C.) can be calculated as:

P. C. = Births – Deaths + Immigration- Emigration

Example: Calculate the population change in a wolf pack where the wolves experience the birth of 3 pups, the death of a lone wolf, and 1 wolf leaving the pack. No animals moved into the pack.

Solution: Population Change

= Births – deaths + immigration - emigration

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= 3 – 1 + 0 – 1

= 1 wolf

- Population growth rate refers to how fast a population grows
- It is calculated as a percentage
- Population Growth Rate can be calculated as:

$$\text{Growth Rate} = \frac{\text{Population Change}}{\text{Initial Population}} \times 100$$

The pack originally had 15 wolves. What is the Population Growth Rate for this wolf pack?

Solution:

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$$= 6.67\%$$

Carrying Capacity

- Is the number of organisms an ecosystem can support

- There are 4 main factors which can affect carrying capacity

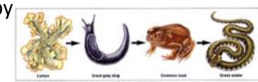
Factors Affecting Carrying Capacity:

1. <u>Materials and Energy</u>

   -Species require energy from the sun, water, and nutrients to survive.

2. <u>Food Chains</u>

   - All populations are limited by their source of energy.



3. <u>Competition</u>

   - Individuals compete for resources such as food (animals), nutrients (plants), shelter, light, and water.

   - Competition occurs among members of the same species (<u>intraspecific competition</u>) and between different species (<u>interspecific competition</u>).

4. <u>Density</u>

   - Populations need space to live.
   - Population health is often affected by its density.

a) Density – Dependent Factors

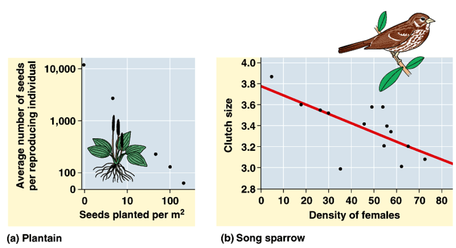
- Factors that affect a population because of its density are called <u>density-dependent factors.</u>

  E.g.

  Food supply, competition for mates, spread of disease. (usually <u>biotic</u> factors)

- Density-dependent factors <u>increase</u> their effect on a population as population density increases. This is a type of <u>negative feedback</u>.

Examples of Negative Feedback



Resource limitation in crowded populations can stop population growth by <u>reducing reproduction</u>.

b) Density – Independent Factors

- Factors that affect a population regardless of its density are called <u>density-independent factors.</u>

E.g.

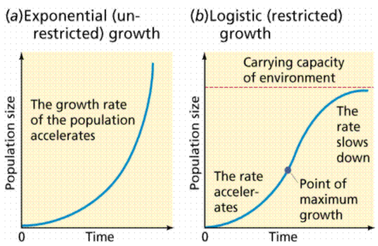
Forest fires, Flood, Habitat destruction, Pollution (usually <u>abiotic</u> factors)

- Density-independent factors are <u>unrelated</u> to population density, and there is <u>no feedback</u> to slow population growth.

Population Growth

<u>Population Growth Models</u>

There are two main types of population growth:

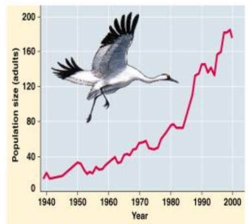


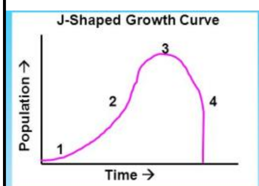
(a) Exponential Growth

- describes an idealized population in an unlimited environment
- Occurs as long as there is a plentiful <u>supply</u> of the resources it needs
- When resources run out, the population crashes
- J shaped curve

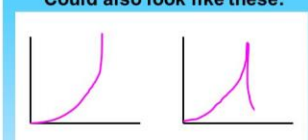
Characteristic of closed populations

= affected by only natality, mortality (game farm, biosphere)



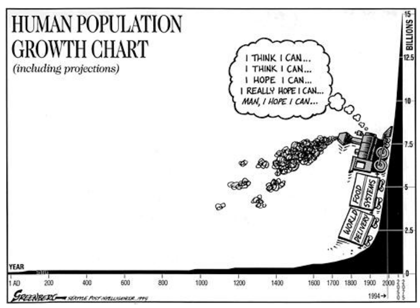


Could also look like these:

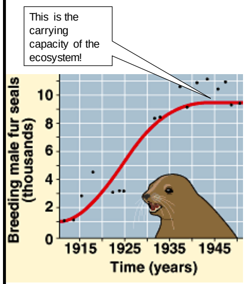


Four phases:

1. **Lag – slow; not enough reproducing organisms**
2. **Growth - exponential**
3. **Stationary - natality = mortality**
4. **Death - decline (Not always present)**



(b) Logistic Growth



- Typically, resources in an ecosystem are limited - no population can grow forever!
- This results in a maximum number of organisms that an ecosystem can support – called the CARRYING CAPACITY.
- The population will remain at this level as long as there is the same amount of resources.
- S shaped curve

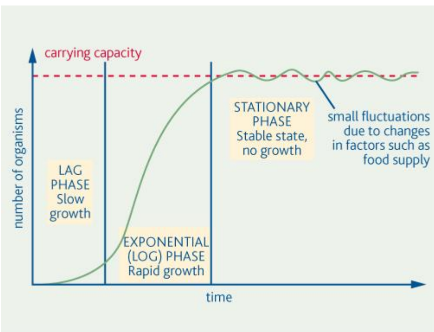
Characteristic of open populations

= affected by all 4 growth factors

(natality, mortality, immigration, emigration)

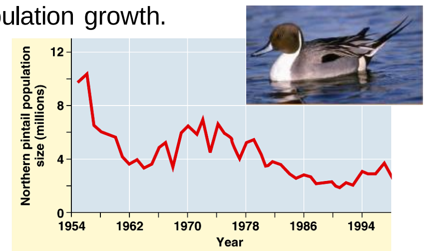
Carrying Capacity

- If the number of organisms in a population is below the ecosystem's carrying capacity, births exceed deaths and the population grows.
- If the number of organisms rises above the carrying capacity, the deaths will exceed the births. This pattern will continue until the population is once again at or under the carrying capacity.

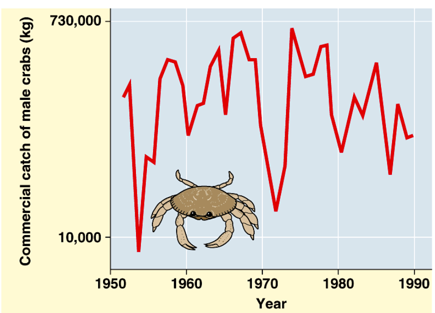


Population dynamics reflect a complex interaction of biotic and abiotic influences

- Carrying capacity can vary.
- Year-to-year data can be helpful in analyzing population growth.



- Some populations fluctuate erratically, based on many factors.



- Other populations have regular boom-and-bust cycles.
  - A good example involves the lynx and snowshoe hare that cycle on a ten year basis.