

1.8: Limits on Populations

Biotic Potential

Definition: A measure of an organism's ability to produce viable offspring;

There are four main factors that affect the biotic potential:

1. Birth potential: the maximum number of offspring per birth
Ex: whooping crane females lay two eggs per year, and only one chick survives
2. Capacity for survival: the number of offspring that reach reproductive age
Ex: the female sea turtle lays many eggs, but only a few of her offspring even reach the sea, and fewer still reach maturity
3. Procreation: the number of times that a species reproduces each year
Ex: elk mate only once per year, during the fall
4. Length of reproductive life: the age of sexual maturity and the number of years the individual can reproduce
Ex: African elephants reach sexual maturity at about 15 years of age, but may reproduce until they are 90

Animals with HIGH Biotic Potential

Ex: Mice

- Have 10-20 offspring every 1-2 months
- Spend very little time in the womb (less than 1 month)
- Spend very little time rearing the offspring (less than 1 month)

Animals with LOW Biotic Potential

Ex: Bear

- Have 1-3 offspring every 2-3 years
- Spend many months in the womb (7.5 months)
- Spend 1-2 years rearing offspring

Environmental Limitations

	Factors that cause a population to increase	Factors that cause a population to decrease
Abiotic	Favourable light Favourable temperature Favourable chemical environment	Too much or too little light Too cold or too warm Unfavourable chemical environment
Biotic	Sufficient food Low number of predators Few diseases	Insufficient food High number of predators Many diseases

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For example, a fern plant produces more than 50 000 spores in a single year. If all fern spores germinated, fern plants would cover all of North America within two generations of the first plant. This doesn't happen because of the limiting biotic and abiotic factors.

Carrying capacity

Definition: the maximum number of individuals of a species that can be supported indefinitely by an ecosystem

The carrying capacity is determined by the availability of resources, such as food and water. A population can exceed the carrying capacity of the ecosystem, but not for long. All ecosystems tend towards equilibrium; when a population exceeds its carrying capacity, things will happen (disease, migration) to reduce the population and restore balance.

Density Dependent Factors

Definition: affect a population because of the density of the population

Ex: food supply, water quality, sunlight, disease, territory, competition for mates

Density Independent Factors

Definition: affect members of a population regardless of population density

Ex: fire, flood, climate change, drought

Worksheet 1.8: Limits on Populations

1. Cedar waxwings are one of the few birds that can withstand the cold and lack of available food during winters. To ease the strains of winter, bird watchers in Barrie provide cedar waxwings with seeds during winter months.
 - a) Would the seeds alter the carrying capacity of the ecosystem? Explain.
 - b) Provide a hypothesis that explains why bird watchers have noted an increase in the falcon population in recent years.

2. Fill in the following table based on the following data:
 - Larger mammals generally live longer than smaller ones.
 - Pregnant female elephants carry their young for nearly 18 months.
 - Elephants reach sexual maturity at 15 years.
 - Elephants usually produce one offspring each birth.
 - Most elephants wait more than 5 years between births.
 - Female elephants care for their young for more than 10 years.
 - Mice often produce litters of 6 or more.
 - After about 6 weeks, mice reach sexual maturity.
 - In a natural setting, few mice are older than 2 years.
 - A pregnant female mouse will carry her young for 22 days.
 - Mice will breed every 6 weeks or less.

Biotic potential	Elephant	Mouse
Offspring per birth		
Capacity for survival		
Procreation		
Maturity		

Refer to the table and write a paragraph comparing the biotic potentials of elephants and mice.

3. A scientist studying wolves near Kirkland Lake notices a steady decline in the population of wolves for four consecutive years.
 - a) Make a prediction about how the population of wolves will affect the population of moose. Give your reasons.
 - b) What might cause the wolf population to begin increasing again?

4. Technological advances in agriculture have changed the carrying capacity for humans of most ecosystems.
 - a) Give some examples of agricultural advances and how they have affected carrying capacity.
 - b) Has the planetary carrying capacity for humans been reached, or can the human population grow larger without reaching capacity? Explain your position.