POPULATION ECOLOGY

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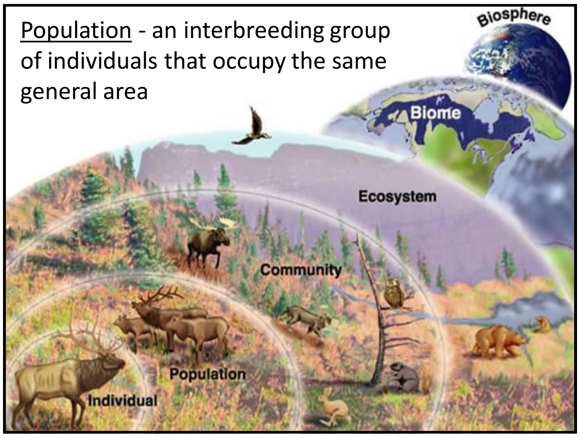

Population - an interbreeding group of individuals that occupy the same general area

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Population Characteristics

- There are three characteristics that all populations have:

1) population density,
2) spatial distribution,
3) and growth rate.

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1. Population Density

- Refers to the number of individuals in relation to the space

Population Density = # of individuals / unit area

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Example: What is the density of a rabbit population of 200 living in a 5 km^2 range?

Solution:
Population Density = # of individuals / unit area

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Solution:
Population Density = # of individuals / unit area
Population Density = 200 rabbits / 5 km^2
Population Density = 40 rabbits / km^2

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- Population density changes over time
- For populations that are studied over a period of years this change can be calculated

$$\text{Rate of Change} = \frac{\text{Change in Density}}{\text{Change in Time}}$$

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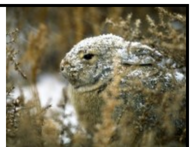

Example:
In 2000 the rabbit population density was 40 rabbits / km^2. By 2010 the rabbit population density was 112 rabbits /km^2. Calculate the Rate of Change.

Solution:

$$\text{Rate of Change} = \frac{\Delta D}{\Delta T}$$

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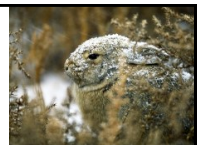

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Solution:

$$\text{Rate of Change} = \frac{\Delta D}{\Delta T} = \frac{112 - 40}{2010-2000} = \frac{72}{10}$$
= 7.2 rabbits / year

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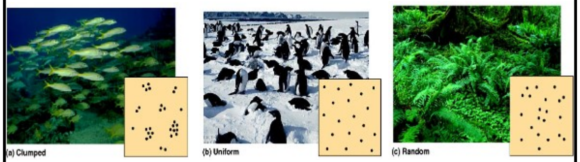
2. Spatial Distribution

- Refers to the pattern of <u>spacing</u> of a population within an area
- 3 types:



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- Results from dispersion – the <u>spreading</u> of organisms from one area to another
- Most often due to the <u>resource availability</u> (which may be limited to due to mountains, oceans, canopy level, or even behavior!)

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How do know how many organisms make up a population?

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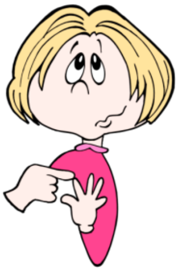
We count them!



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But what about…?

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Population Estimation

- When the number of organisms in a population is hard to count, scientists estimate the total population size
- They do this by first sampling the population and then calculating a population size based on the data
- There are 2 main methods: Mark-Recapture
  Random Sampling

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1. Mark-Recapture Sampling

- Also called 'tagging'
- A sample of organisms is captured and marked and then returned unharmed to their environment
- Over time, the organisms are recaptured and data is collected on how many are captured with marks

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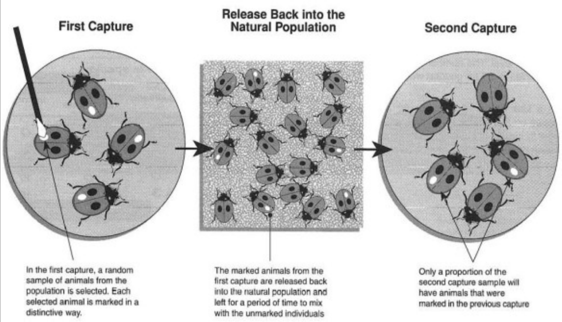

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- Best for mobile populations, such as fish and birds

- Problems occur when no marked organisms are captured

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2. Random Sampling (Quadrat)

- Also called 'quadrat' sampling
- The number of organisms within a small area is counted.
- A sampling frame (quadrat, usually $1m^2$) is used to count the individuals in a mathematical area

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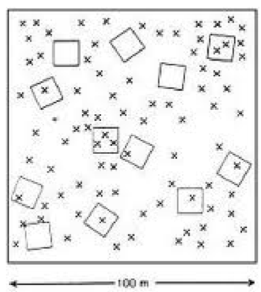
- The plots are often placed randomly throughout the sampling area (or if a grid system is used, then plots are chosen at random).
- Population size and density are then estimated based on the plot representation.



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- Best for large stationary populations, such as trees or coral

- Problems occur when random sampling is not followed

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Using Random Sampling:

1. Find the average # of individuals in the areas you sampled.

   Average = Total # of Individuals / # of Sample Plots

2. Multiply the average by the # of plots to find the population estimate.

   Estimate = Average x # of Plots Total

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Example: Random sampling was used to count the number of silver maple trees in the forest. The number of trees counted in the grid is shown below.

5			3
	4	4	
		1	

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2. Random Sampling (Quadrat)

Solution: 1. Find the average # of individuals in the areas you sampled.

Average = Total # of Individuals / # of Sample Plots

= 5+4+4+3+1 / 5

= 3.4 trees / plot

5			3
	4	4	
		1	

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3. Growth Rate

- Refers to how fast a population grows and is expressed as a percentage
- Population Growth Rate can be calculated as:

Growth Rate = Population Change / Initial Population x 100

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- 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)

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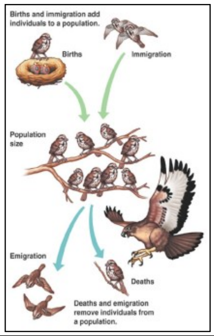

- Population change (P.C.) can be calculated as:

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

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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

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Solution: Population Change

= Births – deaths + immigration – emigration

= 3 – 1 + 0 – 1

= 1 wolf

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

Solution:

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

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$= 0.0667 \times 100$

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$= 0.0667 \times 100$

$= 6.67\%$

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