Population Ecology

Ecology is the study of the interactions of organisms with their physical and biological environments. More specifically population ecology is the study of the fluctuations in population size and the factors that affect population size.

A population is a group of organisms of the same species that live in the same habitat and can breed freely.

Population size is the total number of individual organisms in a population. There are several factors that affect population size:

- Natality – birth rate in animals, or the seed production of plants
- Mortality – death rate
- Immigration – organisms moving into a population to stay
- Emigration – organisms leaving a population and not returning

It is therefore safe to assume that populations will, as a result of the above factors:

- Grow when birth and immigration exceed death and emigration
- Decline when death and emigration exceed birth and immigration
- Remain stable when birth and immigration are equal to death and emigration

In a closed population there is no immigration or emigration, so only birth and death affect the population size of a closed population.

One method of determining the demographics\(^1\) is the mark-recapture technique. It is useful for tracking the movement of individuals in a population, as well as, determining the size of a population.

Method

1) Mark out an area to conduct the test
2) Capture as many individuals of the population as possible, and mark them
3) Release the marked individuals back into their habitat
4) Allow them enough time to mix with the unmarked members of the same species
5) Recapture as many individuals of the population as possible again
6) Count the total number and count the number of marked individuals. Then use the following formula:

\[ P = \frac{M \times C}{R} \]

Note:
- \( P \) = Estimated population
- \( M \) = Total number of marked individuals
- \( C \) = Total numbers of individuals caught in the second sample
- \( R \) = Total number of marked individuals in second sample.

Precautions to make sure it is a reliable result:

- The population must be closed i.e. No emigration or immigration allowed
- The marking must not damage the individual or affect its movement or behaviour
- The right amount of time must pass so that there are no deaths or births, but also so that they have enough time to mix with the unmarked individuals

Note: To determine the movement of animals after the initial capture and marking they are then recaptured in another area into which they have moved

\(^1\) The statistics of a population

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**Survival and Growth of populations**

Populations **survive** when individuals survive and reproduce. In order for this to happen they must tolerate the habitat, obtain energy and nutrients (i.e. food), cope with competition and avoid predators. All the requirements necessary for the survival and reproduction of an organism is called the **ecological niche**.

Populations **grow** if a group of individuals enter an unoccupied area with no shortage of food or other resources, as well as no predators. They will reproduce and the population size will increase until they reach the maximum possible growth rate under ideal environmental conditions.

As numbers increase, individuals of the same species start to compete for resources, space and suitable mates. This builds up **environmental resistance**. Eventually, when resources became scarce and the environment can no longer support any more growth of a species the growth of the population stops. This mean the environment has reached its **carry capacity**. Birth and death rates balance when growth stops. This pattern is typical of a **logistic type of growth from**.

**Limiting factors**

Factors that build up environmental resistance and stop a population from growing are known as **limiting factors**. These include:

- Shortage of food, water and oxygen – Affects most populations
- Lack of light – Affects the growth of plants as light is needed for photosynthesis
- Lack of territory or space
- Lack of shelter
- Predators
- Disease and parasites
- Accumulation of toxic waste

**Fluctuation of population size**

Population size fluctuates seasonally and annually. When a population reaches carrying capacity, it does not stay completely constant but fluctuates because of changes in environmental resistance. If the population rises above carry capacity competition or predation will increase and cause the population size to decrease. If the population falls below carrying capacity environmental resistance decreases and the population rises again.

**Stable and unstable**

A **stable population** is a population that, when over the carry capacity, decreases. When it is below the carry capacity it increases. It fluctuates above and below the carry capacity of its environment.

An **unstable population** develops if the population far exceeds the carry capacity. This can result in the habitat deteriorating rapidly and the carry capacity lowers. This can also result in the habitat eventually not being able to support a population and the population size decreasing rapidly or even becoming extinct.

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*The total number of factors that stop a population from reproducing at its maximum rate*

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