IGNITE FUNZA

LIFE SCIENCES — GRADE 11

POPULATION ECOLOGY

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IGNITE FUNZA EDUSOL

REVEALING POTENTIAL

Understand populations. Interpret graphs. Master ecological calculations. Prepare for the exam.

INTRODUCTION TO POPULATION ECOLOGY

Population ecology is the study of populations, including their size, density, distribution, growth and the factors that affect them.

Population	A group of organisms of the **same species** living in the **same geographical area** at the **same time**, with the potential to reproduce.

Levels of organisation

Organism One individual	→	**Population** Same species	→	**Community** Different populations	→	**Ecosystem** Biotic + abiotic	→	**Biosphere** All ecosystems

Key population characteristics

- **Population size:** total number of individuals.
- **Population density:** number of individuals per unit area or volume.
- **Distribution:** how individuals are arranged in an area.
- **Population growth:** change in population size over time.

POPULATION SIZE & CHANGE

Population size changes because individuals are added to or removed from a population.

FACTOR	EFFECT	MEANING
Births	↑	New individuals are added.
Deaths	↓	Individuals are removed.
Immigration	↑	Individuals move into the population.
Emigration	↓	Individuals move out of the population.

POPULATION CHANGE
Population change = (Births + Immigration) − (Deaths + Emigration)

Population density

Population density	The number of individuals of a species per unit area or volume.

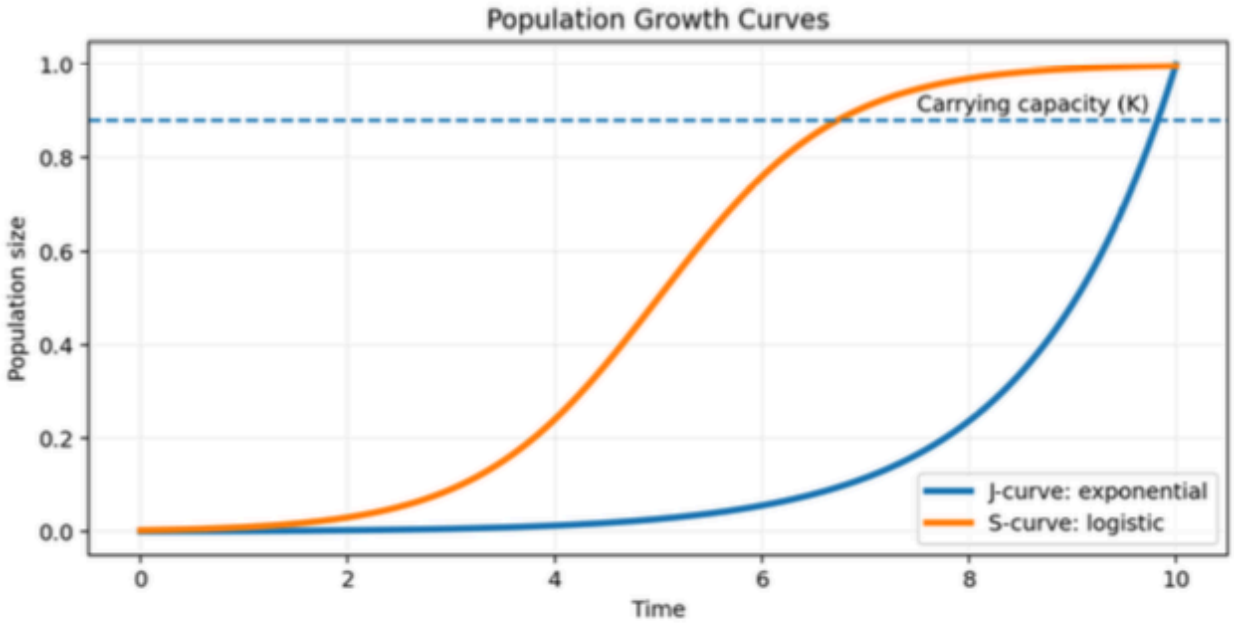
Example: 500 antelope occupy 100 km². Density = 500 ÷ 100 = **5 antelope/km²**.

FACTORS AFFECTING POPULATION GROWTH

DENSITY-DEPENDENT	DENSITY-INDEPENDENT
Competition	Drought
Predation	Floods
Disease	Fires
Parasitism	Extreme temperatures
Effects generally become stronger as population density increases.	Storms / earthquakes / other natural disasters

Limiting factor	Any biotic or abiotic factor that limits the growth, size or distribution of a population.

POPULATION GROWTH



3.1 Exponential growth — J-curve

Occurs when resources are abundant and conditions are favourable. The population increases rapidly.

Typical conditions: abundant food and water, little competition, few predators and low disease pressure.

3.2 Logistic growth — S-curve

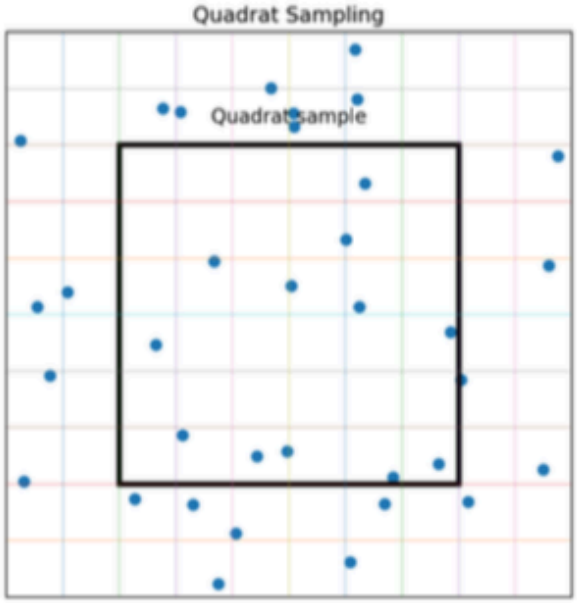
Occurs when resources become limiting. Growth slows as the population approaches the environment's carrying capacity (K).

CARRYING CAPACITY (K)
The maximum number of individuals of a population that an environment can support sustainably over a long period.

SAMPLING POPULATIONS

Scientists often cannot count every organism in a population. Sampling allows them to study a representative part of the population and estimate the whole.

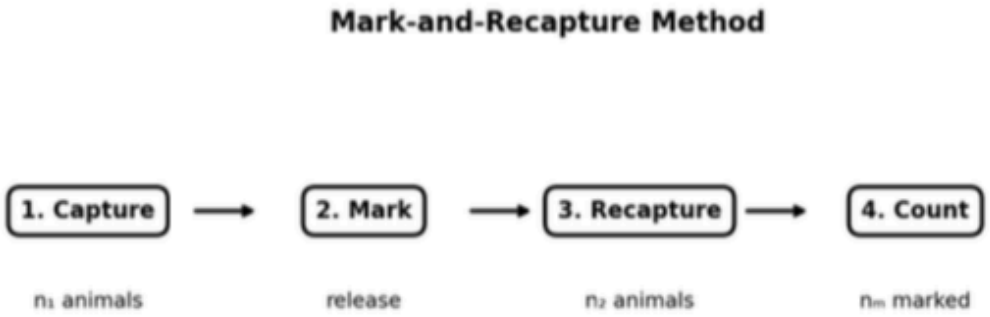
6.1 Quadrat sampling



- Place quadrats randomly or systematically.
- Count organisms inside each quadrat.
- Repeat at several locations.
- Calculate an average and use it to estimate abundance or density.

Useful for plants and organisms that are stationary or move very slowly.

6.2 Mark-and-recapture



ESTIMATING POPULATION SIZE — LINCOLN INDEX

FORMULA
Estimated population size (N) = (n■ × n■) ÷ n■

Where:

- **n■** = number of animals marked in the first capture
- **n■** = total number of animals captured in the second capture
- **n■** = number of marked animals recaptured in the second capture

Worked example

First capture: 100 fish are marked and released. Second capture: 80 fish are caught, of which 20 are marked.

CALCULATION
N = (100 × 80) ÷ 20 = **400 fish**

For reliable estimates, marks should not harm the animals, marked animals should mix with the population, marks should remain visible, and individuals should have a reasonable chance of being captured.

PREDATION

Predation	An interaction in which a **predator** captures, kills and consumes a **prey** organism.

Predation: predator benefits, prey is harmed



Effects on populations

- The predator benefits because it obtains food and energy.
- The prey is harmed because it is captured and killed.
- Predation can regulate prey population size.
- Predator and prey population sizes can influence one another.

Predator adaptations

Examples include speed, sharp claws, strong jaws, camouflage and specialised hunting behaviour.

Prey adaptations

Examples include camouflage, warning colours, protective structures, speed, herding and anti-predator behaviour.

SYMBIOSIS

Symbiosis	A close and often long-term association between organisms of **different species**.

Types of Symbiosis

Mutualism	+ / +	both benefit
Commensalism	+ / 0	one benefits; other unaffected
Parasitism	+ / −	parasite benefits; host harmed

Mutualism (+ / +)

Mutualism	Both species benefit.

Example: bees obtain nectar while helping flowers with pollination.

Commensalism (+ / 0)

Commensalism	One species benefits while the other is not significantly affected.

Example: an epiphytic plant uses a tree for support without significantly affecting the tree.

Parasitism (+ / –)

Parasitism	The parasite benefits while the host is harmed.

Example: a tapeworm obtains nutrients from a human host.

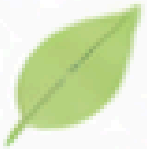
COMPARE THE INTERACTIONS

INTERACTION	SPECIES 1	SPECIES 2	KEY IDEA
Competition	–	–	Both compete for limited resources.
Predation	+	–	Predator benefits; prey is harmed.
Mutualism	+	+	Both species benefit.
Commensalism	+	0	One benefits; other is not significantly affected.
Parasitism	+	–	Parasite benefits; host is harmed.

COMPETITION

Competition occurs when organisms require the same limited resources in the same place at the same time. Because the resource is limited, not all individuals can survive or grow optmially.

RESOURCES ORGANISMS MAY COMPETE FOR



Food



Water



Space



Shelter

Light



Mates



Nutrients



Territory

EFFECTS OF COMPETITION

- Slower growth
- Less reproduction
- Injury or death
- Survival of the fittest (best adapted individuals)

IMPORTANT

Competition can occur between individuals of the **SAME SPECIES** (intraspecific) or between individuals of **DIFFERENT SPECIES** (interspecific).

INTRASPECIFIC COMPETITION

Competition between individuals of the SAME species.

EXAMPLES

- Male impalas fighting for females.
- Trees of the same species competing for light.
- Seedlings competing for water and nutrients.



CHARACTERISTICS

- Individuals have similar needs.
- They are often more intense because they occupy the same
- It can lead to territorial behaviour, dominance and hierarchies.

RESULT

Only the strongest/best adapted individuals survive and reproduce.

INTERSPECIFIC COMPETITION

Competition between individuals of DIFFERENT species.

EXAMPLES

- Lions and hyenas competing for the same prey.
- Weeds and crop plants competing for water, light and nutrients.
- Baboons and vervet monkeys competing for fruit on a tree.

