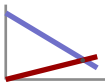


Biodiversity

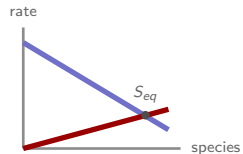
AP Environmental Science ■ Unit 2

AP Environmental Science



What we will cover

- 1 What biodiversity is
- 2 Ecosystem services
- 3 Island biogeography
- 4 Ecological tolerance
- 5 Disruptions and adaptation
- 6 Ecological succession





What biodiversity is

Biodiversity is the variety of life, at three levels: genetic, species, habitat.

More diversity $\Rightarrow$ more resilience. Diversity = richness $\times$ evenness.



Coral reef: high richness and evenness

Biodiversity has three levels, and the exam wants all three

genetic diversity

variety of genes *within* one species – more variety means the population can meet **environmental stressors** ; a **population bottleneck** strips it away

species diversity

species richness (how many) plus evenness (how equally spread)

ecosystem diversity

variety of habitats and communities across a region

Species-rich ecosystems are more **resilient** : when conditions change, varied species can fill the roles the lost ones held.



Ecosystem services

Nature's free work for people, in four groups:

Provisioning

goods: food, water, wood

Regulating

clean air, flood control, pollination

Cultural

beauty, recreation, spirit

Supporting

soil, photosynthesis, cycling

A wetland that cleans water for free is worth the treatment plant we would otherwise build.

The four kinds of ecosystem service

provisioning

products taken directly: food, fresh water, timber, fibre

regulating

processes that keep conditions stable: climate regulation, water filtration, pollination, flood control

supporting

the ones the others rest on: soil formation, nutrient cycling, photosynthesis

cultural

non-material value: recreation, beauty, spiritual and educational worth

Anthropogenic activity disrupts these, and the cost is **economic as well as ecological** – which is the point the essay question wants made.

Island biogeography, and what disturbs an ecosystem

island size

a **larger** island supports more species – more habitat, larger populations, lower extinction

distance

a **nearer** island receives more colonists from the mainland

so

big, near islands hold the most species; **small, remote** ones the fewest

isolation drives evolution

island species often become **specialists**, which makes them vulnerable to **invasive species**

zones of stress

at the edges of a species' tolerance range, where individuals survive but do not thrive or reproduce well

over geological time

climate has shifted for many reasons, and sea level has risen and fallen with the amount of glacial ice

Anthropogenic activity disrupts ecosystem services at a **real economic and ecological cost** – losing pollinators forces farmers to pay for pollination.

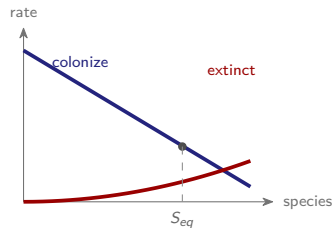


Island biogeography

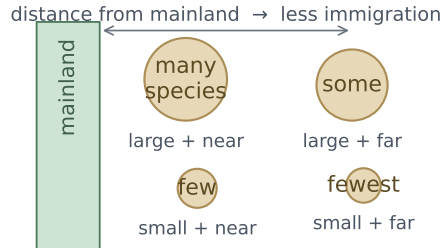
Island species number is a balance of two rates:

- **colonization** – new arrivals
- **extinction** – species dying out

Richest islands are **large & near**; isolation breeds **endemic species** found nowhere else.



Larger and nearer islands hold more species



larger area $\uparrow$ species · nearer mainland $\uparrow$ immigration ·
equilibrium richness

Larger and nearer islands hold more species, balancing immigration against extinction

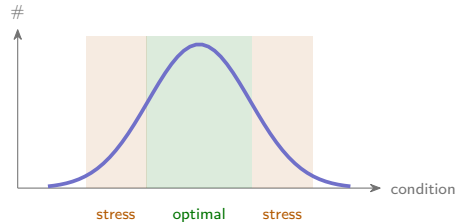


Ecological tolerance

Every species survives only within a **range of tolerance** :

- **optimal range** in the middle
- a **zone of stress** on each side
- limits beyond which it dies

A population's range is wider than one organism's – individuals vary.





Disruptions and adaptation

Disruptions: periodic, episodic (wildfire), random. Adaptation by natural selection: structural, physiological, behavioral.

When the environment changes, selection can favour a different trait.



Episodic disruption: wildfire resets succession

Natural disruption comes on three schedules

periodic

regular cycles – seasons, tides

episodic

occasional and irregular – fires, floods, volcanic eruptions

random

no pattern at all – a meteor strike

A single natural event can rival or exceed a human-made one, and over geological time the climate and sea level have shifted for reasons that had nothing to do with us.

Adaptations

An **adaptation** is an inherited trait that improves survival and reproduction in an environment.

Adaptations arise through **natural selection** – incremental genetic change accumulating over generations, not within a single lifetime.



Ecological succession

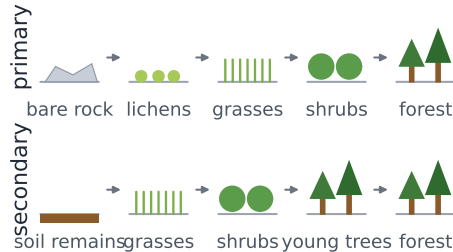
Life returns in a predictable order:
pioneer → climax.

Primary starts on bare rock;
secondary keeps the soil – far
faster.



Pioneer lichen on bare rock

Primary succession builds from bare rock; secondary



primary: bare substrate (no soil) · secondary: soil remains ⇒
faster recovery

Primary succession builds from bare rock; secondary succession regrows from surviving soil

Succession runs from bare rock to a climax community

pioneer species

first arrivals on bare rock – **lichens** and mosses, which break rock down into the first soil

primary succession

starts with **no soil at all** (new lava, retreating glacier) – very slow

secondary succession

follows a disturbance that **leaves the soil intact** – after a fire or abandoned farmland – so it is much faster

climax community

the stable end community for that climate, until the next disturbance

The single discriminator between the two kinds is **soil**. If soil survived the disturbance, it is secondary.

Introduction to Biodiversity



ecosystem
diversity



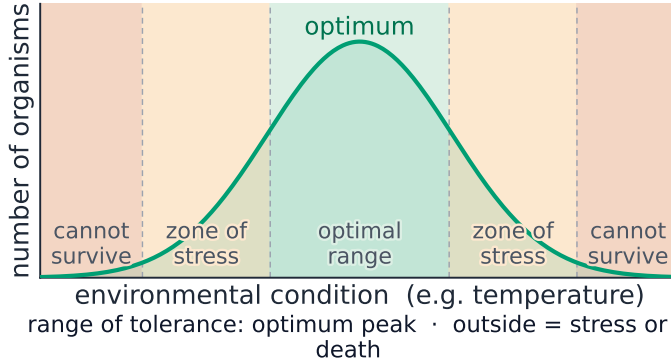
species
diversity



genetic diversity
(within a species)

Biodiversity has three levels: genetic, species, and habitat

Ecological Tolerance, continued



Within its optimal range a species thrives; toward the limits it is stressed, then cannot survive

Exam tips

- Describe biodiversity at three levels: **genetic, species, and habitat**, and link higher diversity to greater **resilience**.
- **Specialist** species (narrow needs) are more vulnerable than **generalists** when a habitat changes.
- Distinguish **primary** succession (bare rock, no soil, slow) from **secondary** (soil intact, faster).
- Explain a **keystone species** (outsized effect) and an **indicator species** (signals ecosystem health).
- Name the four **ecosystem services** (provisioning, regulating, cultural, supporting) with examples.



Worked example – species diversity

Wood A has 100 birds of 1 species; Wood B has 100 birds evenly split across 4 species. Compare their diversity.

- **Richness** = number of species: A has 1, B has 4.
- **Evenness** = how equally individuals are spread: B is perfectly even.
- B wins on **both** $\Rightarrow$ **B is far more diverse**.
- Higher diversity $\Rightarrow$ more **resilience**: if one species fails, others fill its role.

Diversity = **richness** + **evenness**. A monoculture has richness 1 and no evenness – which is exactly why a single pest can destroy a whole crop.

Unit 2 – key takeaways

1

Biodiversity

genetic/species/habitat; richness
× evenness

2

Services

provisioning, regulating, cultural,
supporting

3

Islands & tolerance

large+near hold most; optimal vs
stress zones

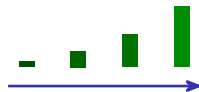
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Succession

primary (bare rock) vs secondary;
pioneer to climax

Check yourself

- 1 Name the two numbers that together give species diversity.
- 2 Which island holds more species: large-near or small-far?
- 3 What is a species found nowhere else called?
- 4 Which succession keeps the soil and so is faster?



Answers 1. richness and evenness 2. large-and-near 3. endemic 4. secondary succession