# 39.1 Stability and change

Name: _____ Class: _____ Date: _____ **Total: 26 marks**

**KEY WORDS** keystone species • tipping point • eutrophication • biomagnification • sustainable • succession

## Objective

Build the skills to answer exam questions on **stability and change** in ecosystems: tipping points, keystone species, sustainable use, eutrophication, biomagnification, plastics and restoration.

**You must be able to:**

- explain what makes an ecosystem stable, and how deforestation can pass a tipping point
- explain sustainable harvesting and sustainable agriculture
- explain eutrophication and biomagnification, and the harm caused by plastics
- describe how mesocosms are set up and how rewilding restores ecosystems
- explain primary and secondary succession, climax communities and arrested succession

## 1 Key knowledge and worked examples

### ■ Stability and change

A **stable ecosystem** keeps its structure over long periods. It needs a supply of energy, recycling of nutrients, high **biodiversity** and climate within suitable limits. A **keystone species** has a large effect for its numbers (sea otters keep sea urchins in check, so kelp forests survive).

**Tipping point:** a small further change causes a large, lasting shift. If enough of the **Amazon rainforest** is cleared, less water is recycled by transpiration, rainfall falls, and the forest may turn to savanna.

**Mesocosms** are small, closed or open model ecosystems (a sealed jar or a fenced plot) used to test how factors affect stability.

**Sustainable harvesting** takes no more than the population can replace (fishing quotas, minimum net mesh size). **Agriculture** can cause soil erosion, leaching of fertilizer, and a large carbon footprint.

**Eutrophication:** fertilizer runs into water → **algal bloom** → algae die → **bacteria**



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**decompose** them and use up **oxygen** → fish die. **Biomagnification:** a persistent pollutant (DDT, mercury) is not broken down or excreted, so its concentration **increases at each trophic level**. **Plastics:** macroplastics trap or choke animals; microplastics are eaten and pass along food chains.

**Restoration: rewilding** brings back species, such as wolves in Yellowstone, and lets natural processes recover.

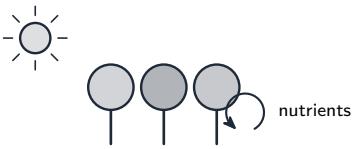
**HL: succession** is the gradual change of a community over time. **Primary succession** starts on bare rock with no soil (pioneer lichens and mosses make soil); **secondary succession** starts where soil remains (after fire or farming). Biomass, soil depth, diversity and food-web complexity increase until a **climax community** forms. **Arrested succession** happens when a factor such as grazing or fire stops it (grassland kept by sheep).

**Worked example.** DDT in water 0.00005 ppm, in fish-eating birds 25 ppm: $\frac{25}{0.00005} = \mathbf{500\,000}$ times higher.

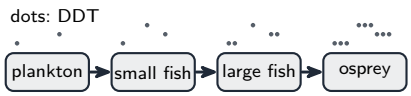
**Answer shapes:** cause → change in one factor → effect on organisms → effect on the whole ecosystem.

## 2 Practice

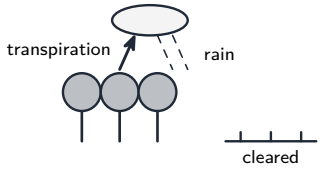
**2.1** State two conditions needed for an ecosystem to be stable. [2]




**2.2** Explain why the concentration of DDT is highest in top predators. [3]



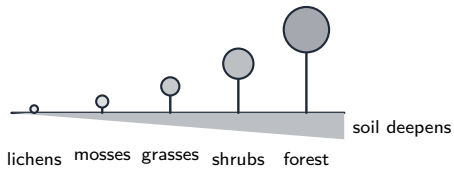

**2.3** Explain why deforestation of part of the Amazon could cause the rest of the forest to change to savanna. [3]



**2.4** Distinguish between primary and secondary succession. [3]



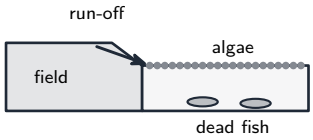

**2.5** Outline the changes that happen during primary succession. [3]




## 3 Exam-style questions

**3.1** The diagram shows a lake next to a field where fertilizer is used.

(a) Explain how fertilizer run-off causes the death of fish. [4]




(b) Suggest two ways a farmer could reduce run-off into the lake. [2]



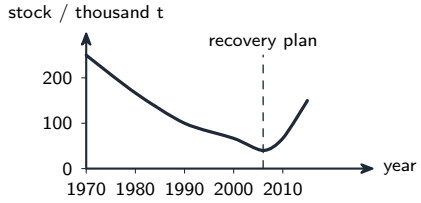
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**3.2** The graph shows the spawning stock (adult fish that breed) of North Sea cod. The data are simplified.

(a) State the spawning stock in 2006. [1]

(b) Explain why the stock fell between 1970 and 2006. [2]

(c) Suggest how quotas and larger net mesh sizes helped the stock recover. [3]






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## Solutions

Marking: **M1** a correct method, **A1** the correct answer, **B1** an independent mark.

Each answer shows the steps, then the **result**.

**2.1**

any two: a supply of energy; recycling of nutrients; high biodiversity / genetic diversity; climate within suitable limits

**2.2**

DDT is not broken down or excreted, so it is stored in tissues; each consumer eats many organisms from the level below; so DDT builds up and is most concentrated at the top of the food chain: biomagnification

**2.3**

trees release much of the water vapour that forms rain, by transpiration; after clearing, less water is recycled, so rainfall falls; past a tipping point, the remaining trees cannot survive the drier conditions and grassland/savanna replaces them

**2.4**

primary succession starts on bare ground with no soil, e.g. new volcanic rock; secondary succession starts where soil is already present, e.g. after a fire; secondary succession is faster, because soil, seeds and nutrients remain

**2.5**

pioneer species such as lichens break down rock and start soil formation; deeper soil holds more water and nutrients, so larger plants can grow; biomass, biodiversity and food-web complexity increase until a climax community forms

**3.1**

(a) nitrates/phosphates cause rapid growth of algae (algal bloom); algae block light and plants below die; bacteria decompose the dead algae and plants, using up dissolved oxygen; fish die from lack of oxygen

(b) any two: use less fertilizer / apply only when crops need it; do not spread before heavy rain; leave a buffer strip of plants by the lake; use organic manure that releases nutrients slowly

**3.2**

(a) 40 thousand tonnes

(b) fish were caught faster than they could reproduce (overfishing); young fish were caught before they bred, so fewer new fish joined the stock

(c) quotas limit the number of fish caught; larger mesh lets young fish escape; so more fish survive to breed and the population grows



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