

Stability and change

Give evidence that ecosystems can be stable.

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Four requirements for ecosystem stability

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Tipping point

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Why does the Amazon need a large area of forest?

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Percentage change formula

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Mesocosm

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Keystone species

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Condition for sustainable harvesting

Supply of energy, recycling of nutrients, genetic diversity, climatic variables within tolerance levels.

Some have persisted for tens of millions of years, e.g. rainforest in the Daintree region of Australia and the Namib Desert (arid for at least 55 million years).

Transpiration generates water vapour, causing cooling, air flows and rainfall inland. The minimum area needed is uncertain.

A critical threshold beyond which a small change causes a large, often irreversible, shift to a different state.

A small experimental ecosystem used as a model; best in sealed glass vessels so matter cannot enter or leave but energy can.

$$(\text{final} - \text{original}) \div \text{original} \times 100.$$

The rate of harvesting is lower than the rate of replacement.

A species with a disproportionate impact on community structure; removing it risks ecosystem collapse, e.g. sea otters in kelp forests.

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How is the sustainability of cod fishing assessed?

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Factors affecting sustainability of agriculture

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Biochemical oxygen demand (BOD)

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Why do fish die in eutrophication?

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Which fertilizers cause eutrophication by leaching?

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Biomagnification

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Effect of DDT on birds of prey

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Mercury biomagnification

Soil erosion, leaching of nutrients, supply of fertilizers and other inputs, pollution by agrochemicals, carbon footprint.

Stock assessments of breeding adults from catches and surveys; age structure of the catch; quotas and mesh sizes set accordingly.

Dead algae and plants are decomposed by aerobic bacteria; BOD rises, dissolved oxygen falls.

Oxygen used by microorganisms in a water sample over a set time to break down organic matter.

Increase in concentration of a toxin in the tissues of consumers at each higher trophic level.

Nitrogen (nitrate) and phosphate fertilizers.

From coal burning and mining; bacteria make methylmercury; highest in large predatory fish such as tuna; damages the nervous system.

Thin eggshells that broke, so populations of ospreys and peregrine falcons crashed.

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Why are plastics persistent?

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Macroplastic vs microplastic effects

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Three methods of rewilding

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Hinewai Reserve

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Causes of ecological succession

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Five changes during primary succession

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Role of marram grass in sand dune succession

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Cyclical succession example

Macroplastic: entanglement and swallowing (blocked guts). Microplastic (under 5 mm): eaten by plankton and filter feeders, passes along food chains.

They are non-biodegradable: decomposers lack enzymes to break them down.

Former farmland in New Zealand where, with grazing removed and minimal interference, native forest regenerates through gorse.

Reintroduce apex predators and keystone species; reconnect habitats over large areas; minimise human impact.

Increases in plant size, primary production, species diversity, food web complexity and nutrient cycling.

Changes in the abiotic environment (e.g. new land) and biotic factors (organisms forming soil, shading, adding nitrogen).

Heather heathland: pioneer, building, mature and degenerate phases repeat instead of one fixed climax.

Grows up through new sand and stabilises dunes, allowing soil to form for later species.

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Arrested succession

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Climax community

The relatively stable community that succession tends to reach under given environmental conditions.

Human influences stop the climax community developing, e.g. grazing by farm livestock, drainage of wetlands.