

Exercise walk-through

20.4.1

Conservation: why species are lost, and how forests, fish and species are saved

IGCSE Biology

You must be able to

- describe a **sustainable resource** 可持续资源 as one produced as rapidly as it is removed, so that it does not run out
- explain how forests are conserved using education, protected areas, **quotas** 配额 and replanting
- explain how fish stocks are conserved using education, **closed seasons** 休渔期, protected areas, controlled net types and **mesh size** 网目尺寸, quotas and **monitoring** 监测
- explain why organisms become endangered or extinct: climate change, habitat destruction, hunting, overharvesting, pollution and introduced species
- describe how endangered species are conserved: monitoring and protecting species and habitats, education, captive breeding programmes and **seed banks** 种子库

You must be able to

- describe the use of **artificial insemination** 人工授精 and **in vitro fertilisation** 体外受精 in captive breeding
- describe the reasons for conservation: maintaining **biodiversity** 生物多样性, reducing extinction, protecting vulnerable **ecosystems** 生态系统, and maintaining ecosystem functions
- explain the risks to a species whose population falls, reducing its **genetic variation** 遗传变异

1

The method

Method — Sustainable means the rate, not the amount

*A **sustainable resource** is one that is **produced as rapidly as it is removed**, so that it does not run out.*

- It is a statement about **two rates** being equal. “A resource we can use for a long time” is not the definition and does not earn the mark.
- The two examples the syllabus uses are **forests** and **fish stocks**. Both are living, so both can replace themselves – if we take no more than they replace.

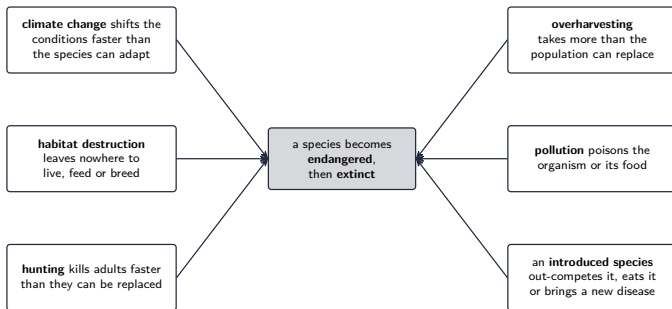
Method — Why a species is lost

Naming the cause is half a mark's work. Say **how** it reduces the number of organisms:

- **climate change** – conditions change faster than the species can adapt, so its habitat becomes unsuitable;
- **habitat destruction** – nowhere to live, feed or breed; often from clearing forest for farming or building;
- **hunting** – adults are killed faster than they can be replaced;
- **overharvesting** – more is taken than the population can replace;
- **pollution** – poisons the organism, or kills what it eats;
- **introduced species** – out-competes the native species for food or space, eats it, or brings a disease it has no resistance to.

Method — Why a species is lost

Naming the cause is half a mark's work.



Naming the cause is half the answer. The other half is *how* it reduces the number of organisms – which is the sentence inside each box.

Method — Conserving a forest and conserving a fish stock

measure	forests	fish stocks	what it actually does
education	✓	✓	people understand why the resource matters and accept the rules
protected areas	✓	✓	a region where no felling or fishing is allowed, so the population there can breed and spread out
quotas	✓	✓	a limit on how much may be taken, so removal does not exceed replacement
replanting	✓	—	a new tree is planted for each one felled, so the forest replaces itself
closed seasons	—	✓	no fishing during the breeding season , so the fish can reproduce undisturbed
net type and mesh size	—	✓	a larger mesh lets young fish escape , so they survive to breed
monitoring	✓	✓	counting the population, so the quotas can be changed if it is still falling

- Every one of these works by making the **rate of removal** no greater than the **rate of replacement**. Tie your answer to that and it is rarely wrong.

Method — Conserving a species itself

method	what it is
monitoring and protecting species and habitats	counting the population and making its habitat a protected area
education	so that local people support the programme rather than hunting the species
captive breeding programmes	breeding the species in zoos or reserves, then releasing individuals into the wild
seed banks	storing seeds of many varieties in cool dry conditions, so a plant species can be grown again even if it is lost from the wild

Method — Conserving a species itself

Artificial insemination (AI) places sperm from a chosen male into a female without the two animals meeting, so animals in **different zoos** can be bred together. **In vitro fertilisation (IVF)** fertilises an egg **outside the body** and places the embryo into a female. Both let a programme choose which individuals breed, which keeps as much genetic variation as possible in a very small population.

Why we bother – the four reasons the syllabus lists: maintaining or increasing **biodiversity**; reducing **extinction**; protecting **vulnerable ecosystems**; and maintaining **ecosystem functions**, which means nutrient cycling and the resources we get from nature – food, **drugs** 药物, fuel and **genes** for crop breeding.

Method — Why a small population is still in danger

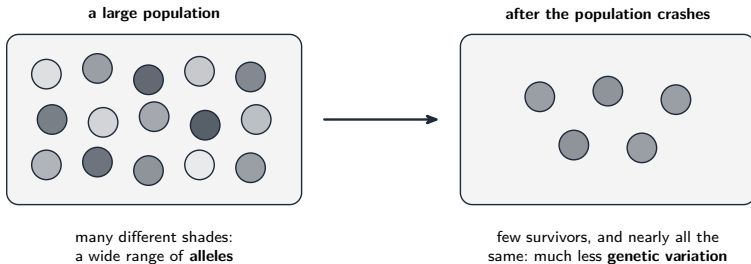
When a population falls, most of its **alleles** are lost with the individuals that carried them.

*With little genetic variation, the species is far less likely to contain an individual that survives a new **disease** or a change in the environment, so a single event can wipe out the whole population.*

- That is the reason protecting the last few individuals is not enough on its own, and why breeding programmes work hard to avoid breeding close relatives.

Method — Why a small population is still in danger

When a population falls, most of its alleles are lost with the individuals that carried them.



With little variation, the species is far less likely to contain an individual that can survive a new **disease** or a change in the environment, so the whole population is at risk from one event.

2

Practice

Practice 2.1 ■ 2 marks

Explain why a forest managed by replanting can be described as a sustainable resource.

Solution 2.1

Method: Conserving a forest and conserving a fish stock — p.8

Worked steps

- a tree is planted for every tree that is felled, so the forest **replaces** what is taken (B1)
- the rate at which wood is **produced** then equals the rate at which it is **removed**, so the resource does not run out (B1)

Practice 2.2 ■ 3 marks

State **three** reasons why a species may become endangered.

Solution 2.2

Worked steps

- any **three** of: **climate change**; **habitat destruction**; **hunting**; **overharvesting**; **pollution**; an **introduced species** B1 B1 B1

Practice 2.3 ■ 2 marks

Describe **two** ways in which a forest can be conserved.

Solution 2.3

Worked steps

- any **two** of: **replanting** a tree for each one felled; setting up **protected areas** where felling is banned; setting **quotas** on how much timber may be taken; **education**, so that people accept and support the rules **B1** **B1**

Practice 2.4 ■ 3 marks

Describe **three** ways in which fish stocks can be conserved.

Solution 2.4

Worked steps

- any **three** of: **quotas** on the mass of fish landed; a **closed season** during breeding; **protected areas** where no fishing is allowed; a **larger mesh size**, or controlled net types; **monitoring** the stock; **education** B1 B1 B1

Practice 2.5 ■ 2 marks

State what a seed bank is, and explain why one is kept.

Solution 2.5

Worked steps

- a seed bank stores **seeds** of many different varieties in cool, dry conditions **B1**
- so that a plant species can be grown again even if it is lost from the wild, which also preserves its **genetic variation** **B1**

Practice 2.6 ■ 3 marks

Explain why a species with a very small population is still at risk, even when it is fully protected.

Solution 2.6

Method: Conserving a species itself — p.9

Worked steps

- a small population contains only a **small number of alleles**, because most were lost with the individuals that carried them (B1)
- so there is little **genetic variation** in the population (B1)
- the species is then unlikely to contain an individual that survives a **new disease** or a change in the environment, so one event could kill them all (B1)

3

Exam-style

Exam-style 3.1 ■ 1 mark

Which method conserves a fish stock by letting young fish escape from the nets?

- A** a quota on the mass of fish landed
- B** a closed season during the breeding period
- C** an increase in the mesh size of the nets
- D** a protected area where no fishing is allowed

Solution 3.1

Method: Conserving a forest and conserving a fish stock — p.8

- A a quota on the mass of fish landed
- B a closed season during the breeding period
- C an increase in the mesh size of the nets
- D a protected area where no fishing is allowed



Worked steps

C

- a larger mesh lets the **young, smaller fish pass through** the net, so they survive to breed **B1**
- **A, B and D** all conserve the stock, but none of them works by letting young fish escape from a net

Exam-style 3.2 ■ 6 marks

Only 60 individuals of a rare antelope remain, and all of them live in zoos. The zoos run a captive breeding programme.

Exam-style 3.2 (a) ■ 2 marks

Describe what is meant by a captive breeding programme.

Solution 3.2 (a)

Method: Conserving a species itself — p.9

Worked steps

- the species is **bred in captivity**, in zoos or reserves, where it is protected from hunting and from predators **B1**
- individuals are later **released into the wild** to rebuild the wild population **B1**

Exam-style 3.2 (b) ■ 2 marks

Explain how artificial insemination and in vitro fertilisation help such a programme.

Solution 3.2 (b)

Worked steps

- **artificial insemination** places sperm from a chosen male into a female without the animals meeting, so animals in **different zoos** can be bred together **B1**
- **in vitro fertilisation** fertilises the egg **outside the body** and the embryo is placed into a female; both let the programme choose which individuals breed, keeping as much genetic variation as possible **B1**

Exam-style 3.2 (c) ■ 2 marks

Explain one problem that the very small population creates for the programme.

Solution 3.2 (c)

Worked steps

- with only 60 individuals there is very little **genetic variation**, and close relatives must often be bred together **B1**
- so the offspring are all similar, and the species remains vulnerable to a single disease or change in conditions **B1**

Exam-style 3.3 ■ 11 marks

The cod caught in one fishing area fell from 250 000 tonnes in 1970 to 30 000 tonnes in 2000. The government then introduced quotas, a closed season, a larger mesh size and a protected area.

Exam-style 3.3 (a) ■ 2 marks

Explain how overharvesting caused the catch to fall.

Solution 3.3 (a)

Method: Conserving a forest and conserving a fish stock — p.8

Worked steps

- the fish were caught **faster than they could reproduce** and be replaced **B1**
- so fewer adults were left to breed each year, and the population fell further, giving a smaller catch **B1**

Exam-style 3.3 (b) ■ 2 marks

Explain how a quota helps the stock to recover.

Solution 3.3 (b)

Worked steps

- a quota **limits the mass of fish** that may be landed **B1**
- so removal no longer exceeds replacement, and enough adults are left to breed and rebuild the population **B1**

Exam-style 3.3 (c) ■ 2 marks

Explain how increasing the mesh size of the nets helps the stock to recover.

Solution 3.3 (c)

Worked steps

- a larger mesh lets the **young fish escape** through the net **B1**
- so they survive to reach breeding age and reproduce, instead of being caught first **B1**

Exam-style 3.3 (d) ■ 2 marks

Explain how a closed season helps the stock to recover.

Solution 3.3 (d)

Worked steps

- no fishing is allowed during the **breeding season** **B1**
- so the adults can reproduce undisturbed and their young survive, which increases the number of fish in the next generation **B1**

Exam-style 3.3 (e) ■ 2 marks

Give **two** reasons for conserving this fish stock, other than keeping the fishing industry going.

Solution 3.3 (e)

Worked steps

- any **two** of: maintaining or increasing **biodiversity**; reducing the risk of **extinction**; protecting a **vulnerable ecosystem**; maintaining **ecosystem functions** such as nutrient cycling; keeping a source of food, drugs or **genes** for the future **B1** **B1**

Exam-style 3.3 (f) ■ 1 mark

Explain why the government also needs to monitor the stock.

Solution 3.3 (f)

Worked steps

- so that the government can see whether the stock is recovering, and **change the quotas** if it is not **B1**