Edexcel GCSE Biology

Your notes

Human Influences on the Environment

Contents

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Fish Farming

Benefits of fish farming

- Most fish are still caught in the wild (i.e. in the open ocean or in freshwater rivers and lakes)
- However, **overfishing** has lead to dramatic **declines** in many fish populations
- **Fish farms** are ways of **raising large numbers of fish** in a **small space** to provide **food (protein) for humans**
- Fish are bred in large tanks or cages to **minimise energy losses** and **maximise yield**

Methods to maximise yield in fish farms

- Within fish farms, large numbers of fish are kept in freshwater or seawater enclosures and are carefully monitored and controlled in different ways (many of which are not possible with wild-caught fish)
  - **Selective breeding** ensures high quality, fast-growing fish
  - **Interspecific predation** is **prevented** using nets and cages
  - **Intraspecific predation** is **limited** by grouping fish according to their age and size
  - **Water quality** is carefully controlled by monitoring pH and temperature as well as removing fish waste or dead fish
  - **Diet is controlled** by feeding high protein fish pellets regularly to ensure rapid growth
  - **Diseases and pests** are prevented using antibiotics and pesticides or biological controls

The effect of fish farms on biodiversity

- Fish farms, whilst reducing the pressure of overfishing of wild fish, can have a negative impact on biodiversity in several ways
  - **Predators** may be attracted to the fish farms and may get caught in nets trying to reach the fish
  - **Diseases** can spread quickly in fish farms due to the enclosed space and number of individuals in close proximity. Diseases can also spread in the water to other species outside of the fish farm
  - If any caged fish were to escape, they can cause issues with the **native species** nearby (i.e. those that live in the area naturally)
  - **Eutrophication** can occur

Fish Farming Methods Table

Method	Explanation
Maintenance of water quality	Water is filtered to **remove waste and harmful bacteria** to prevent diseases. Water is also cleaned to **maintain high levels of oxygen** for aerobic respiration
Control of intraspecific predation	**Intraspecific predation**: predation within the same species Fishes are **separated by size and age** so they don't eat each other or fight
Control of interspecific predation	**Interspecific predation**: predation between different species Different species of fishes **are separated by fences, nets and tanks** to prevent fighting
Control of disease	**Antibiotics are given to fish to prevent disease** which might otherwise spread quickly due to their close confinement, increasing the chances of survival. They are also kept in small numbers to minimise the spread of diseases
Removal of waste products	Water can be **filtered to remove waste products** such as faeces and sewage. Fences, nets and tanks are cleaned or location of fish can be changed to ensure clean water
Quality and frequency of feeding	Fish are **fed food that is high in nutrients** to ensure fast growth. They are **fed frequently but in small amounts** so they do not overeat or start eating each other
Use of selective breeding	Fish are separated by gender so that selective breeding can be used by farmers to only **allow fish with desired characteristics to reproduce.** This ensures that the stock of fish is fast growing as these genes get passed on much more frequently

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Non-Indigenous Species

- An **indigenous species** is one which is **native** to a particular area

- Introducing a non-indigenous species into an area can have **negative affects** on the native species
- Introduction may be **purposeful** (for example, as a biological control) or it might be **accidental** (for example, if an organism escapes captivity)
- Negative effects occur due to **competition, impacts on the food chain and disease**
- This results in a **decrease in the biodiversity** of the habitat


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Competition

- The **non-indigenous species** may compete with native species for **food, water or space**
- This could result in one or more indigenous species being **outcompeted** and possibly being **eradicated**
  - For example, the red squirrel is a native species of squirrel in the UK that has declined in numbers drastically due to the introduction of the North American grey squirrel
  - The grey squirrel not only carry the deadly parapox virus, which is fatal to red squirrels, but they also directly compete with red squirrels for food and nesting sites

Impacts on the food chain

- A new species in the food chain would disrupt the balance as it would provide a new **food source** or a **new predator**
- This would impact the populations of the other organisms in the food web
  - For example, the Cane toad is a species of poisonous toad that was introduced into Australia as a biological control to help combat an infestation of beetles, which were destroying sugar cane.
  - The toads then went on to infiltrate the local food webs, poisoning predators that ate them, which had a knock-on effect on other species in the food web

Disease

- New species may bring with them new diseases which may be **deadly** to indigenous species
- This can have minimal impact but can also be devastating for whole populations, either by total eradication or via long term effects to the health of the species
  - For example, Chalara Ash dieback (a fungus that grows on ash trees), which was brought over through imports of ash trees from Asia, is set to wipe out up to 80% of indigenous Ash in the UK

Eutrophication

- Runoff of fertiliser from farmland enters the water and causes **increased growth of algae** and water plants

- The resulting 'algal bloom' **blocks sunlight** so water plants on the bottom start to die, as does the algae when competition for nutrients becomes too intense
- As water plants and algae die in greater numbers, **decomposing bacteria increase in number** and **use up the dissolved oxygen** whilst respiring aerobically
- As a result there is less oxygen dissolved in water, so **aquatic organisms such as fish and insects may be unable to survive**
- This results in a **decrease in biodiversity** for the habitat


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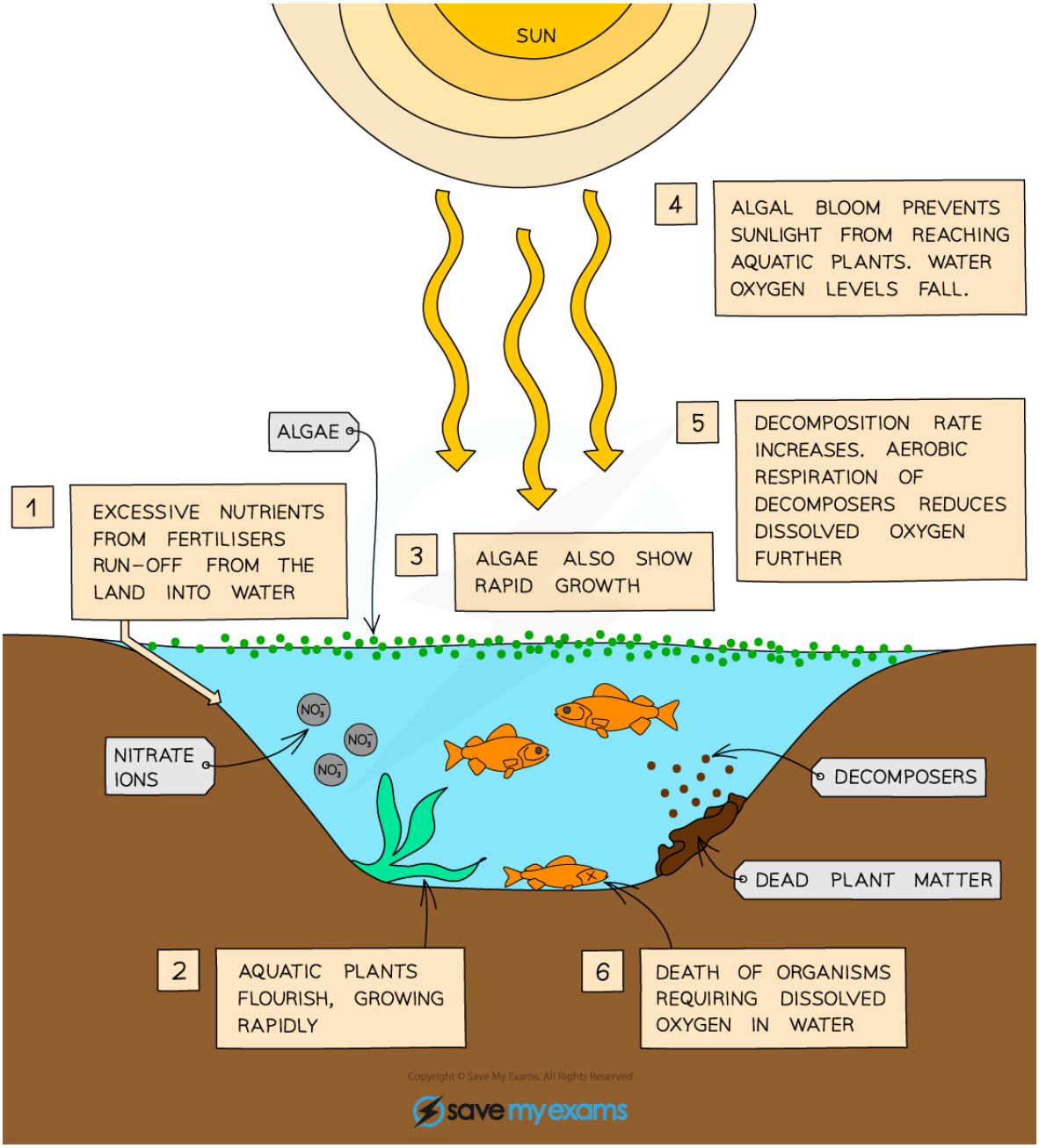

Eutrophication can reduce biodiversity in polluted water bodies

Assessing Pollution

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Indicator Species

Higher tier only

- It is possible to use the **presence** or **absence** of particular organisms as an indicator of **pollution**
  - For example, some organisms are **particularly sensitive** to certain changes in their environment
  - This means they can be studied in order to determine the **effect of human activities** on a particular **habitat** or **ecosystem**
  - These organisms are known as **indicator species**
- Indicator species can be used to determine the level of:
  - **Water** pollution
  - **Air** pollution

Water pollution

- One form of water pollution occurs when **raw sewage** or **fertilisers** (both containing **nitrates**) are released into a body of water, such as a stream or pond
  - This causes **microorganisms** in the water to **increase in number**
  - As these microorganisms **respire**, they **use up the oxygen** in the water
- Some invertebrate species, such as **stonefly larvae** and **freshwater shrimps**, are **highly sensitive** to the **concentration of dissolved oxygen** in the water they are living in
  - This makes them good indicator species for water pollution
  - For example, the **presence** of stonefly larvae in a stream or river indicates that the water is **not polluted** (i.e. it is **clean** and has **high oxygen levels**)
- On the other hand, some other invertebrate species are **adapted to live in polluted environments**
  - This also makes them good indicator species for water pollution
  - For example, the presence of **blood worms** and **sludgeworms** in a body of water indicates a **very high level of water pollution**

Air pollution

- **Lichen** (that grow on **trees** and **buildings**) can be used as an indicator species for air pollution

- This is due to the fact that lichens are **highly sensitive to sulfur dioxide concentrations** in their environment
  - Sulfur dioxide is one of the air pollutants released from **car exhausts** and **power stations** (i.e. during the combustion of fossil fuels)
- The **abundance** (number) and **type** of lichen species growing at a particular location can be monitored to determine **how clean the air is**
  - For example, a **high abundance** of lichen indicates **clean air**
  - In particular, a high abundance of **bushy lichen** indicates **very clean air** (as these lichens need cleaner air than **crusty lichen**)
- Another indicator species for air pollution is **blackspot fungus**, which grows on **rose leaves**
- Like lichen, it is also sensitive to sulphur dioxide concentrations and **its presence indicates clean air**

Potential disadvantages of using indicator species

- Although using indicator species is a fairly **simple** and **cost-effective** method of determining whether a habitat is polluted or not, it has some **drawbacks**
  - For example, it **can't give accurate numerical (quantitative) figures** for exactly **how much** pollution is present
  - In addition, the **presence** or **absence** of indicator species can also be **affected by factors other than pollution** (e.g. the presence of predators or disease)
- If more detailed information on pollution levels is required, **non-living indicators can be used instead**. For example:
  - **Dissolved oxygen meters** and **chemical tests** can be used to very accurately determine the concentration of **dissolved oxygen in the water** and can be used to show **changes** in levels of water pollution **over time**
  - **Electronic meters** and **laboratory tests** can be used to very accurately determine the concentration of **sulfur dioxide in the air** and can be used to show **changes** in levels of air pollution **over time**


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Benefits of Maintaining Biodiversity

- The **interactions** between organisms in an ecosystem mean that organisms, populations or whole species may **depend** on one another
- Due to this **interdependence,** maintaining biodiversity is key in maintaining the stability of the ecosystem and avoiding disruption which could lead to the **loss of species**
- The loss of one species would have knock-on effects that would impact other species within the ecosystem (including humans). For example:
  - **Human food supply** - some farming methods threaten certain populations which could have future implications for the availability of that species for the human food supply e.g. the effect of overfishing on fish stocks
  - **Medicines** - some medicines are extracted from plants, these same plants may be at risk of extinction due to human activities such as deforestation
  - **Jobs** - conservation efforts and ecotourism provide jobs to support local populations
  - **Cultural aspects** - many cultures have traditions and symbols which come from nature, these cultural symbols may be threatened by loss of biodiversity
  - **Ecotourism** - human interest in rare or exotic species provides cope for tourism to admire such species. Although it requires careful control, also provides economic support for future conservation efforts
  - **Climate change** - peatlands and wetlands store lots of carbon so preventing disruption to these areas is of great importance in trying to reduce the amount of carbon released back into the atmosphere as carbon dioxide

Reasons for Maintaining Biodiversity Table

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Reason	Explanation
Moral and Ethical	Humans have a responsibility to reduce their impact on the planet and other species
Ecological	Biodiversity increases the stability of ecosystems
Environmental	Organisms provide essential environmental services (water cycle, nutrient cycle and absorption of carbon dioxide)
Economic	A range of organisms contribute to medicine, ecotourism, science and technology
Aesthetic	Humans take pleasure from the visual effects of biodiversity
Agricultural	Genetically diverse wild species can rescue crops from catastrophes

Conservation

- The future of the human species on Earth relies on us maintaining a good level of biodiversity
- The increasing human population and the activities of humans (including **waste production**, **peat bog destruction**, **deforestation** and our contributions to **global warming**) are causing a **reduction** in global and ecosystem-level biodiversity
- These activities are considered as **negative** human interactions with ecosystems
- There are, however, ways in which humans can interact **positively** with ecosystems

Conservation of species

- Working directly with the species under threat can help to support that species to allow it to recover

- Methods might include:
  - **Protected areas or conservation areas** - these are areas that are not allowed to be interfered with, for example, no building work is allowed
  - **Breeding programs** - selective breeding of organisms, often in zoo's, to support an increase in population numbers
  - **Seed banks** - seeds of plants species can be collected and stored for many years under the right conditions to future proof the species


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Reforestation

- A conscious effort has been made in recent years to try and counteract the negative impact of **deforestation**
  - Trees provide important **habitats** for many species and also help to maintain the **global carbon balance** by removing **carbon dioxide** from the atmosphere for photosynthesis
  - Replanting large areas of forest land with a variety of tree species helps to rebuild the **biodiversity** of the cleared areas

Methods to Protect Biodiversity Table

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Method	Impact on biodiversity
Breeding programmes for endangered species	• Breeding programmes have been set up to save endangered species from extinction. • Endangered species are bred in captivity. • Individuals can then be released back into their native habitats to help support or in some cases re-establish endangered wild populations.
Protection and regeneration of rare habitats	• Protection of vulnerable habitats such as rainforests, mangroves, heathland and coral reefs helps to preserve the biodiversity within them and stabilise these ecosystems.
Reintroduction of field margins and hedgerows in agricultural areas where farmers grow only one type of crop	• A single crop-type (known as monocultures) can only support a low level of biodiversity. • Hedgerows, as well as the wild flowers and grasses that grow when field margins are created, support a high level of biodiversity.
Reduction of deforestation and carbon dioxide emissions by some governments	• Deforestation results in habitat destruction and increased carbon dioxide in the atmosphere. • Reducing deforestation and carbon emissions will reduce the rate of current global warming, which is threatening habitats and biodiversity.
Recycling resources rather than dumping waste in landfill	• Reduces the amount of waste produced and the amount of space required for landfill sites, reducing habitat destruction. • Reduces the rate we are using up natural resources, reducing habitat-destroying activities such as quarrying and mining.

- There are many conflicting pressures on maintaining biodiversity. Some examples include:
- **The cost of programmes:**
  - Protecting biodiversity can be very **expensive**

- Eg. the land used for field margins could be used by farmers to grow crops and sell them – governments sometimes pay farmers a **subsidy** to make up for the lost money
- It costs money to check that programmes designed to maintain biodiversity are actually being followed

- **Protecting food security:**
  - Land that is **protected** to maintain biodiversity could instead be used for **farming** – this can cause **conflict** in areas where there are food shortages
  - Sometimes organisms seen as a **threat** by farmers (eg. locusts and wolves) are killed to protect crops and livestock – this can negatively affect food chains / biodiversity and can cause **conflict** when species that are **already under threat** due to hunting or habitat loss are involved (eg. lions in parts of Africa)
- **The development of society:**
  - Increasing amounts of land are required to **sustain the increasing human population**
  - Eg. land required for new **housing developments** or for new **agricultural land** in developing countries
  - This high demand means that land with **undisturbed habitats** and high biodiversity is **increasingly being used** for development


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