to challenge yourself...

WORLD

Wildlife Conservation Past, present and future















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Section I: INTRODUCTION

BIODIVERSITY

What is biodiversity, how is it threatened and why should we care?

What is biodiversity?

A survey asked the UK public what they thought "biodiversity" was. The most frequent answer was "Some kind of washing powder"! To be fair, the correct answer to this question is not as simple as you might think.

https://www.bbc.co.uk/news/science-

environment-11546289

The Convention on Biological Diversity (CBD), an international agreement adopted at the Earth Summit, in Rio de Janeiro, in 1992, defined biodiversity or biological diversity as:

"...the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems"

https://www.cbd.int/doc/legal/cbd-en.pdf

Therefore, biodiversity can be measured at different scales and can be used to describe different parts of the natural world, including habitat, organism and genetic diversity.

See the useful link section for even more information.

However, generally the term biodiversity is used to describe the number of species in a given area. This is the definition we will be focussing on.

What causes biodiversity loss?

Humans have a huge impact on the natural world and have caused levels of biodiversity around the globe to decline. We have done this in several different ways, with four of the key drivers of biodiversity loss often being referred to as 'Diamond's evil quartet', named after Jared Diamond, the ecologist who first proposed them. However, many additional factors and variations on the 'evil quartet' have also been suggested with some arguing that this evil quartet should now be expanded to include six key drivers.

Follow the links below to learn more about the causes of biodiversity loss.

This first source describes three of Diamond's evil quartet:

http://darwin200.christs.cam.ac.uk/node/21

The second link lists all four of Diamond's evil quartet and describes two additional factors, creating an evil sextet:

https://conservationbytes.com/2011/05/18/ the-evil-sextet/#more-5704_

This final link gives a slight variation on Diamond's four main drivers:

<u>http://www.unesco.org/new/en/media-</u> <u>services/single-view/news/edward_o_wilson_</u> <u>the_loss_of_biodiversity_is_a_tragedy/</u>

See the useful links section for even more information.

Of all the proposed contributing factors, the main driver of biodiversity loss worldwide is the conversion of natural habitats to agriculture (farmland). Researchers at the University Museum of Zoology are studying the effects of this change, both here in the United Kingdom and abroad in Southeast Asia.

Around Cambridge the most dramatic expansion in agriculture happened hundreds of years ago. This included large-scale drainage of wetland (called fenland), causing dramatic declines in species of plants and animals that relied on this habitat. In Southeast Asia, conversion of natural habitats to agriculture is still occurring at a rapid rate. Take a look at the two case studies included in this pack to learn more about habitat conversion and its impact on biodiversity both in the past and today.

Let's get started!

Using the information above and the two case studies in this pack can you list five key factors that contribute to biodiversity loss?

You can also search online to find real world examples for each factor. The World Wildlife Fund for Nature's website is a good place to start:

http://wwf.panda.org/our_work/wildlife/ problems/

Section II: CASE STUDY 1



HABITAT CHANGE OF THE PAST Local habitat in the UK

Local habitat in the UK

Fenland once covered vast areas across Southeast England. However, this habitat has suffered steep declines over the past 500 years and it is estimated that up to 99% of fenlands in the UK have been drained to make room for agriculture.

Fenlands are made up of diverse habitats, from open water to reedbeds, damp grass and woodlands. They support a wide range of species, many of which are specialists, with insects like the Swallowtail and Large Copper butterflies and birds like the Bittern and Bearded tit surviving in no other environment.

Follow the links below to find out more about the historical wild fens of the UK:

https://www.greatfen.org.uk/wildlife

and the history of habitat conversion as the fens have been converted to farmland:

http://www.greatfen.org.uk/heritage/drained-fens

Studying the impacts of past habitat change

Museum collections enable us to look into the past.

Leonard Jenyns was an important naturalist of the 19th century who lived in Cambridgeshire for much of his life, making observations and collecting a huge number of specimens from the local area. A lot of this material is now stored at the University Museum of Zoology, Cambridge and provides a fascinating snapshot of Cambridgeshire's wildlife from 200 years ago.

His collection allows us to study the dramatic changes that have taken place in the Cambridgeshire countryside over the past 200 years. By comparing Jenyns' records (1820-1849) with information on present-day species, we can see how species have changed. Let's do this for two species of wetland (fenland) specialists:

Swallowtail Butterfly Papilio machaon



- Jenyns' notebook entry from 1829: "Found in the greatest plenty, thro'out the Fens between Ely & Cambridge".

- Today: these beautiful butterflies no longer live in Cambridgeshire, but they can be found in Norfolk, where there are still large areas of the wetland habitat that the Swallowtail butterflies rely on. Large Copper Butterfly Lycaena dispar



- Jenyns' notebook entry from 1829: "not uncommon in Cambridgeshire".

- Today: sadly this species is now extinct in the UK and attempts to bring the Large Copper back to surviving wetlands have so far failed.

These entries and more like them make it clear that most wetland species have declined or disappeared since Jenyns' time.

Follow the link below to learn more about Leonard Jenyns and the Jenyns Research Project being carried out at the University Museum of Zoology, Cambridge:

https://www.museum.zoo.cam.ac.uk/jenyns/ jenyns-project

Today local conservation organisations are working to recreate wetland habitat in Cambridgeshire. This will help to protect remaining species and allow others to be reintroduced. Click below to learn more about the conservation of fenland species in the local area:

http://www.greatfen.org.uk/about/introduction

https://www.nationaltrust.org.uk/wicken-fennature-reserve/features/wicken-fen-vision

Using the information from this case study and the links provided answer the following questions:

1.How can we study past habitat change and its impact over time?

2.What is being done to conserve remaining species and potentially reverse losses in areas that have lost their past biodiversity? You can use the fens as an example.

Section III: CASE STUDY 2

HABITAT CHANGE TODA

Habitat change in Southeast Asia

Habitat change in Southest Asia

Tropical forests are among the most threatened habitats on Earth. These remarkable ecosystems support an extremely high number of species but are being felled at a rapid rate to make way for agriculture. Southeast Asia has experienced some of the highest levels of forest loss in the tropics, with less than half of the original forest cover now remaining. For example between 1990 and 2010, forest cover in the region declined by over 13%.

This rapid reduction has resulted in a sharp decline in biodiversity, with more extinctions predicted in the future. For example, Singapore has already lost over 95% of its forest cover and at least 881 of the 3196 species that had previously been recorded from the country.

Follow the links below to learn more about current threats to biodiversity in Southeast Asia: https://doi.org/10.1002/ecs2.1624

https://news.mongabay.com/2009/10/forests-versusoil-palm-plantations-in-sumatra/

Reducing the impact of agriculture on biodiversity

Researchers at the University of Cambridge Department of Zoology are working to understand the full impact of converting tropical forest to agricultural land and how losses of biodiversity can be reduced. Most forest species cannot survive within agricultural sites, which means that conserving large tracts of rainforest is the only way to protect much of the extraordinary biodiversity of these areas. However, some species do survive in disturbed habitats and can be important for the functioning of agricultural systems, by pollinating crops, helping leaf litter decomposition and nutrient cycling, or eating pest species.

Managing agricultural habitats for these beneficial species is important, as it can reduce the need for pesticides and the impact of existing agricultural areas on the environment. The natural processes species carry out can also give them a monetary value, which can be a powerful argument when trying to convince agricultural industries that they should care about biodiversity. Furthermore, as the human population grows and agricultural areas continue to expand, it is vital that species are supported within them. With the correct management, oil palm plantations can maintain relatively high levels of biodiversity, whilst improving important ecosystem processes that support crop production. Follow the links below to learn more about research taking place at the University of Cambridge Department of Zoology, which investigates methods of managing for oil palm plantations for increased biodiversity:

https://www.zoo.cam.ac.uk/research/groups/ insect-ecology/ongoing-projects

http://oilpalmbiodiversity.com/

Using information from the case studies and the links provided, answer the following questions:

1) What parallels can you see between habitat change of the past and present?

2) What can be done to increase crop production but also maintain biodiversity in modern agricultural areas?



A stream in an established oil palm plantation, Riau, Indonesia

Section IV:

IMPORTANCE OF BIODIVERSITY AND ITS CONSERVATION

Importance of biodiversity and its conservation

An understanding of both past and present habitat change can help to conserve biodiversity. For example, a record of the wetland species found in Cambridgeshire in the past can be used to inform ongoing conservation efforts to restore wetland areas today. Understanding factors responsible for current losses of species in Southeast Asia can also be used to inform modern agricultural management and make practices less damaging to the environment.

Why should we care?

What are the consequences of losing biodiversity?

Ethical reasoning for preserving other living organisms and pleasure in knowing they exist can be powerful arguments for conservation. However, in terms of convincing otherwise uninterested parties, economic reasoning and evidence for improved human wellbeing can also be very useful (such as with the Southeast Asia case study). Follow the links below to find out more about what biodiversity does for us and why it is so important.

These links talk about ecosystem services and putting a real monetary value on the natural processes species carry out:

http://www.globalissues.org/article/170/why-isbiodiversity-important-who-cares

Ecotourism, where people travel and pay money specifically to view parts the natural world:

https://www.nature.org/greenliving/what-isecotourism.xml

and the benefits of biodiversity for mental health, linking to how it forms an important part of our culture:

https://theconversation.com/is-conservingbiodiversity-the-key-to-good-mental-health-26667

The final link below gives an overview of the different types of value we can place on biodiversity. Look for 'Box 1', which describes the monetary value of ecosystem services, how species have to exist regardless of their use to humans, and the value humans place on knowing species exist, even if no money is gained from them.

https://www.sciencedirect.com/science/article/pii/ S0169534716000501?via%3Dihub

See the useful links section for even more information.

Using the information in this pack and the links provided here, answer the following question:

Why should we care about conserving biodiversity? [500 words]





USEFUL LINKS

Useful links

The National Trust's website gives a good overview of what biodiversity is and information on how you can interact with it in your local area.

https://www.nationaltrust.org.uk/features/what-isbiodiversity

The link gives some good descriptions of biodiversity as well as describing how you can try to measure it and how levels of biodiversity change across the planet. The sections on patterns of biodiversity across the globe are followed by descriptions of different types of ecosystem services and how services supported by species carry out beneficial natural processes.

https://www.greenfacts.org/en/biodiversity/I-3/1define-biodiversity.htm

The journal 'Nature' investigates the problem of trying to support as much biodiversity as possible, when land and money to do so is limited. It discusses targeting biodiversity hotspots (areas with exceptionally high levels of biodiversity) to try and protect as many species as possible. It also includes a map (Figure 1), which shows the location of these hotspots across the globe.

https://www.nature.com/articles/35002501

The first section of the article below from Nature is the most useful. It describes what conservation biology is and gives more information on Diamond's evil quartet, which are four of the main drivers of biodiversity loss worldwide. The later sections discuss some of the statistical tools used in conservation biology and what the future may hold for this science.

https://www.nature.com/scitable/knowledge/library/ conservation-biology-16089256

This article from the Guardian gives lots more information on many aspects of biodiversity. These include: what biodiversity is; why it is important to protect it; the services biodiversity can provide; its monetary value; the particular importance of insects; why biodiversity is declining and what can be done to protect it.

https://www.theguardian.com/news/2018/mar/12/ what-is-biodiversity-and-why-does-it-matter-to-us The World Health Organisation's website gives an interesting overview of how the loss of biodiversity can negatively impact humans. The article describes direct impacts on food and medicine supplies but also more complex interactions between biodiversity, the spread of diseases and climate change.

http://www.who.int/globalchange/ ecosystems/biodiversity/en/



A collection of magpie moths at the Museum of Zoology, Cambridge.

S GLOSSARY OF TERMS

Glossary of terms

Ecosystem: A community of interacting organisms (plants and animals) and their physical environment (soil, temperature, humidity etc.).

Organism: An individual living thing. For example: a single plant, animal or fungus.

Species: A group of organisms sharing common characteristics that are capable of mating with one another to produce fertile offspring.

Habitat: The area or environment in which a species normally lives.

Impact: a noticeable effect, influence or change. For example, if someone describes the 'impact' of humans on the natural world they would be describing how humans have changed it.

Loss: The reduction or extinction of species. A reduction could mean a reduced population size or reduced size of the area lived in by the species.

Population: A group of organisms of one species that live in the same place at the same time.

Pest species: A species that has a negative impact on humans, for example by destroying their crops and reducing available food.

Crop: A plant grown on a large scale for human use, such as for food.

Natural process: A process existing in or produced by nature, rather than by the action of human beings. For example, pollination of flowers by insects.

Ecosystem services: the benefits provided by healthy ecosystems that contribute to improving human life. These include resources we use for food and shelter, natural processes such as insects pollinating crops and improved wellbeing from spending time in nature.