FIELD PROJECT

Threats of Biodiversity

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INTRODUCTION

Before the industrial revolution, ecology was characterized by stability. Within each habitat, ecosystems had been assembled by long-term evolutionary processes where predators and prey, collaborators and competitors, from microbes to mammals co-existed within complex, inter-connected webs.

Change in biodiversity – the mix of plants, animals, fungi and microscopic organisms living within each habitat – occurred but was largely driven by long-term processes happening over centuries to millennia.

Human activity, such as burning fossil fuels and industrialized farming, have combined to dramatically impact the planet's biomes and ecosystems. Climate change, deforestation, and pollution have destroyed or damaged habitats, changed where species live and eliminated species at a speed and scale comparable to major extinction events of the past.

Humanity relies on the earth's natural systems to regulate the environment and maintain a habitable planet. Terrestrial and marine ecosystems help regulate the earth's surface temperature by absorbing greenhouse gases and changing the humidity and reflectance of land, and provide products vital for survival such as clean water, food, fuel, fibre, medicines, and shelter.

This field project explains how human activity threatens biodiversity, and what actions are needed to address its global decline.

What are threats to biodiversity?

Threats to biodiversity include the burning of fossil fuels and clearing forests and other wild lands for industrialized agriculture. More direct human interventions such as poaching and hunting can also have a serious effect.

Within each ecosystem, the interconnected nature of species' interactions means even the elimination of a single species, whether an apex predator, a pollinating insect, or a plant can have cascading effects, causing ripple effects which reconfigure the entire ecosystem in ways that are unpredictable and with unexpected consequences.

A famous example is the impact that removal and reintroduction of wolves had in Yellowstone in the US. The US government sought to exterminate wolves in the late 19th and early 20th century, seeing them as a dangerous threat to people and livestock. But with the wolves gone, deer populations exploded, grazing out the vegetation in Yellowstone and rapidly diminishing tree growth. The lack of trees in turn reduced beaver populations, meaning less dams were built, affecting the flooding patterns of Yellowstone's rivers.

A project to reintroduce wolves has helped stabilize Yellowstone as, to reduce the risk of being eaten, deer now avoid certain areas of the park allowing them to regenerate, and willow and cottonwood trees have returned.

This in turn restored bird populations and beaver colonies. Regenerating river forest also stabilized riverbanks and reduced soil erosion, meaning rivers were more fixed in their courses and flooded in more predictable ways.

The Yellowstone example illustrates how human interventions can dramatically reduce the diversity of species and even change the landscape in ways that are unpredictable and undesirable. These cascading effects are crucial in understanding why threats to biodiversity threaten humanity too.

Climate change threats to biodiversity

Climate change is altering what parts of the planet can accommodate each species as where each species lives is determined by climate either directly – through their ability to cope with heat or cold, dry, or wet conditions – or indirectly through change in the availability of food.

As the world's climate changes, the 'envelope' of suitable climate for each species tends to move towards the planet's poles. But species respond differently to this change as some can track it quickly and move as the climate changes, but others – with limited dispersal ability – may not track the climate envelope in real time.

As certain species depart ecosystems, seeking cooler climates or spreading into newly warmed areas, animals and plants they interact with changes, meaning the climate change fundamentally 'rewires' historical ecosystems.

Animals and plants, pests and diseases may 'escape' from their own natural enemies so climate change can lead to outbreaks of new, invasive species or pests – such as locusts – or contribute to diseases jumping to new hosts, including from animals to humans.

A warming world is causing ice and snow to melt and raising sea levels, leading to increased flooding and erosion of vital coastal ecosystems. Increasing global temperatures also raises the probability of fires and drought that destroy natural habitats such as forests and rivers, threatening the survival of more species and driving more climate change.

Wild areas such as forests and peat lands are vital carbon sinks, absorbing carbon dioxide from the atmosphere but, as warming increases and more wild areas are destroyed, more carbon dioxide enters the atmosphere and warming accelerates even more, threatening more destruction of biodiversity.

This creates a vicious circle of heating leading to destruction leading to more heating and more destruction.

Habitat loss

Industrialized farming methods have seen the cultivation of single crops, known as ‘monoculture’, and the rearing of livestock on a massive scale. This has been, and still is, justified as essential to feeding the expanding human population and delivering more affordable and safer food supplies.

But industrialized agriculture has enormous impact on biodiversity and human health. Instead of wild animals, a small number of farmed animal species – mainly cows and pigs – now dominate. Together they account for 60 per cent of all mammal species by mass, compared to four per cent for wild mammals and 36 per cent for humans. Farmed chickens now account for 57 per cent of all bird species by mass, whereas wild birds make up 29 per cent of the total.

Wild areas of the planet are being continually cleared to accommodate expanding demand for land to host livestock and for the crops to feed them. This is highly destructive to global biodiversity, reducing wild areas, carving up the territories of large predators, ecologically re-wiring ecosystems, and creating cascading effects.

Pesticides are used on a vast scale to protect crops, wiping out insect populations. When it rains, fertilizers run off the ground and contaminate rivers, impacting the ecology in multiple ways. Nutrient-rich rivers become dominated by fast-growing bacteria and algae, crowding out other wildlife and reducing the oxygen available in the water, creating ‘dead zones’.

Bee populations of all kinds have been declining worldwide due to the use of pesticides in intensive farming and climate change, but they are vital to delivering successful yields of crops, especially nutrient-rich fruit and vegetables.

Mass livestock cultivation and the clearing of wild areas to support it also increases the likelihood of humans becoming exposed to new and dangerous pathogens, which can leap from to new host species and then via livestock and ‘bushmeat’ to people. One theory for the origin of COVID-19 is that it spread from bats via pangolins to people via a ‘wet’ market in China.

Threats to marine biodiversity

Marine ecosystems are as vulnerable to the effects of climate change, pollution, and monoculture as those on land. Climate change is causing the oceans to warm, and carbon dioxide dissolves in sea water, increasing its acidity.

This reduces the ability of small organisms at the base of the marine food chain, such as diatoms, to build their skeletons. Acidification and warming are threatening corals across the tropics. Changing currents are altering fish migratory patterns, disrupting habitats, and surfacing new nutrients from the sea floor, causing bacteria to become more common and spread into new areas.

Human agriculture also affects marine biodiversity. Nitrogen and phosphorous nutrients from farms and other source drains into the Gulf of Mexico through the Mississippi river and its tributaries, causing vast algae blooms which choke off oxygen and create a dead zone where minimal ocean life exists.

These changes threaten people as well as animals. Dead zones, acidification, and behavioural change caused by climate change and pollution threaten the ocean food chain and affect coastal dwellers' ability to feed themselves.

Future threats to biodiversity and pathways to their prevention

The world is making some progress towards preserving biodiversity. The conference of the parties on biodiversity (COP15) agreed to a new Global Biodiversity Framework with a vision to live in harmony with nature by 2050. That provides a strategic plan for a collective effort among nations to affect transformative change.

The framework is built around four big goals:

- Maintain the genetic diversity of species and protect and restore ecosystems.
- Restore biodiversity in a way that works for people.
- Ensure the benefits of biodiversity are shared equitably at a local level, and local knowledge about preserving biodiversity is maintained.
- Mobilize the funding to achieve the Global Biodiversity Framework.

Biodiversity is now much better understood as a crisis equal to climate change by governments around the world. Crucially businesses also increasingly understand that biodiversity loss threatens their own futures.

However, there are serious obstacles to realizing the framework. Some governments and industries have enormous investments in current agriculture, timber, and fishery practices and are reluctant to address the need for change, as it is seen as expensive or threatening to their future.

The framework calls for a huge reduction in subsidies which encourage the use of pesticides and fertilizers, threatening vested interests. Additionally, ‘nature-positive farming’ may make food less available and more expensive in a world where food insecurity is already a big issue.

Reduce emissions

The world must rapidly phase out the use of fossil fuels to reduce the amount of carbon dioxide being pumped into the atmosphere and limit the effects of climate change. Biodiversity must be understood as a vital element in efforts to combat climate change.

Threats to biodiversity directly contribute to climate change and, without protecting biodiversity, a habitable climate cannot be preserved.

Reform agriculture

The world must take steps towards becoming less reliant on large scale monoculture and make better use of agroecology – sustainable farming which reduces emissions, works with nature, and empowers farming at a local level.

Super-intensive farming methods produce cheap food but a food system which is highly inefficient, with enormous amounts thrown away, people over-consuming calories and under-consuming nutrients, and one-third of crops being grown to feed livestock instead of people. Meat demand continues to grow, resulting in more deforestation, more pollution, and more threats to human health.

Improve diets

A new approach to agriculture cannot rely only on changed farming practice – society also needs to change. Better diets in the developed world, featuring a smaller amount of meat and more fruit and vegetables, not only reduces the impact of the meat industry on nature but delivers healthier populations. Currently developed populations require 9-11,000 calories per day with most production being fed to livestock to allow plentiful supply of animal-sourced foods.

Fundamentally, all threats to biodiversity are related to humanity's drive for economic growth built on increased consumption – of food, energy, and natural resources. To preserve the natural world, governments need to integrate biodiversity considerations across all sectors.

The causes of biodiversity loss are complicated and interconnected and due to local and global factors. It is going to take a huge international effort to slow and stop the rate of extinction and to protect, restore, and regenerate wild areas in appropriate and effective ways.