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postnote

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Impacts of deforestation and forest degradation on apex predators of the Brazilian Amazon

Photos adapted from *Pexels* and *Pixabay* using *Canva*

Background

Biodiversity is a measure of the variety of life in a habitat, including the number of different species and their relative population sizes. Biodiverse habitats provide **valuable services**, such as carbon storage and clean water. Biodiversity losses create **unstable** ecosystems (biological communities) that are more vulnerable to future disturbances. In the Brazilian Amazon, frequent land-use changes are depleting biodiversity.

Deforestation is the process whereby forests are converted to non-forest land-uses, such as logging, mining, and agriculture[5]. Conversely, **forest degradation** refers to a reduction in the capacity of a forest to provide natures services. The primary causes of degradation are the fragmentation of forests into disconnected patches, logging, fires, and extreme droughts - which are exacerbated by human-induced climate change[6].

Importance of apex predators

Apex predators are species at the top of the food chain and are often classed as **keystone species**[9], meaning that they are vital for regulating stable prey populations. They tend to be **flagship species** for conservation due to their large size and easy recognisability, which drives public interest in conservation. However, apex predators are vulnerable to the reductions in prey availability caused by habitat degradation and deforestation[9].

Overview:

- The Brazilian Amazon is primarily deforested for logging, mining and agriculture
- Forest degradation is primarily caused by habitat fragmentation, logging, fires and droughts - which are exacerbated by human-induced climate change
- Deforestation and forest degradation deplete biodiversity and hinder important natural processes like carbon storage
- Destruction of the rainforest negatively impacts apex predators which destabilises the food web
- Indigenous territories are some of the most successful areas for rainforest protection
- Effective governance can improve the state of tropical rainforests, but policy frameworks need refining

Policy Context

Since 2020, UK law has prohibited companies from using products grown on land that was illegally deforested, encouraging supply chain scrutiny[4]. COP26 saw 110 countries (including the UK and Brazil) committing to ending deforestation and forest degradation by 2030. Previously, COP15 implemented global agreements to halt and reverse biodiversity loss by 2030.

More recently, in 2023, the UK signed a partnership with Brazil during COP28 to aid their clean energy transition and help them reduce industrial emissions[4]. The UK also committed an additional £35m to protecting the Amazon rainforest on top of the £80m already pledged.

Rate of change

From 2004 to 2012, the deforestation rate of Brazil decreased by 84%. However, from 2012 to 2020, the rate more than doubled and caused a 44% increase in fire occurrences[2]. In this period, wildfires adversely affected ~80% of Amazon's threatened species[3].

Forest degradation affects ~38% of the Brazilian Amazon, an area 9% larger than deforestation affects[6, 7]. Lowest estimates of the resulting carbon and biodiversity losses caused by degradation match that caused by deforestation.

Carbon emissions

The Amazon rainforest plays a vital role in the global climate system by removing large quantities

of carbon dioxide[8]. Therefore, destruction of the Amazon rainforest has major consequences for global warming. Restoring forests can lower overall carbon emissions by 37%, but current deforestation rates contribute 11% to global carbon emissions[4].

The Amazon directly supports 330 million people and ~420 indigenous communities[8]. Indigenous territories (IT's) and Protected Natural Areas have the lowest emissions of the Amazon[5], and IT's protect almost one-third of stored carbon in the Brazilian Amazon. Despite making up just 5% of the global population, indigenous people are involved in the protection of ~80% of global biodiversity[4].

Giant otters

Although laws have restricted otter hunting and allowed populations to begin recovering[10], the species is still classed as Endangered by the IUCN and faces threats from deforestation and forest degradation caused by the gold mining industry.

Giant otters prefer habitats with an abundance of fish, low banks, and good vegetation coverage[10]. Deforestation clears vegetation so reduces habitable areas. Furthermore, gold mining often involves the use of liquid mercury, which contaminates water sources[1]. Mercury enters fish and produces strong neurotoxins (chemicals which damage the nervous system). These chemicals build up in the otters when they eat the fish. Areas with higher mercury pollution have fewer giant otters[1].

Jaguars

The IUCN classes Jaguars as Near Threatened. They generally avoid non-forested areas so are vulnerable to the impacts of deforestation. Between 2016 and 2019, almost 1,500 jaguars were displaced or killed in the Brazilian Amazon due to deforestation, a reduction of almost 2% of their population[8].

Jaguars not only protect the biodiversity of the habitat, but they are also tracked by conservationists to plan management strategies. For example, jaguars have large home ranges and their movements encourage prey species to move around, so tracking of jaguars is used to predict the movements of other species and to identify suitable locations for conservation efforts[12].

Harpy eagles

The Harpy eagle is the aerial apex predator of the Amazon and is classed as Vulnerable to Extinction by the IUCN. They rely on forest-dwelling prey and cannot switch to open-habitat prey[9]. Feeding rates decrease with forest loss, and areas where more than 70% of trees are deforested cannot support nests (**Figure 1.**). Additionally, areas where over half of the forest is cut down cannot support baby eagles into adulthood. This results in starvation. Therefore, fragmented forest patches caused by deforestation are a major threat to this species.

Figure 1. Impact of Amazonian deforestation and forest degradation on apex predators and the food chain (Inspired by Pires *et al*. 2023)[11]

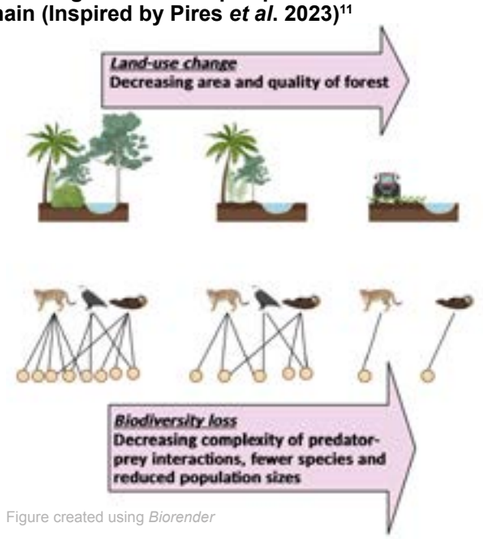

Figure created using *Biorender*

Solutions

Two main issues face Amazonian apex predators: (1) unprotected habitat is rapidly deforested, degraded, and polluted, and (2) protected areas face illegal destruction due to a lack of legal enforcement.

Tackling these issues requires help from stakeholders, including monitoring of disturbances and refining policy frameworks such as REDD+, in which financial incentives are given for successful reductions to emissions and deforestation.

Research also suggests that indigenous territories are effective for conserving biodiversity and protecting carbon stores in tropical forests[5]. In line with the UK's involvement in *the United Nations Declaration on the Rights of Indigenous Peoples*, recognising the rights and lands of indigenous communities is already a goal of the UK. Protecting indigenous lands can therefore simultaneously protect the rainforest.

Endnotes

1 Barocas *et al*. 2023, *Science of the Total Environment*, DOI: 10.1016/j.scitotenv.2023.164024
2 Butt *et al*. 2022, *Earth's Future*, DOI: 10.1029/2022EF003048
3 Feng *et al*. 2021, *Nature*, DOI: 10.1038/s41586-021-03876-7
4 House of Commons Environmental Audit Committee, The UK's contribution to tackling global deforestation, Fourth report of session 2023-24
5 Kruid *et al*. 2021, *Frontiers in Forests and Global Change*, DOI: 10.3389/ffgc.2021.645282
6 Lapola *et al*. 2023, *Science*, DOI: 10.1126/science.abp8622
7 Matricardi *et al*. 2020, *Science*, DOI: 10.1126/science.abb3021
8 Menezes *et al*. 2021, *Conservation Science and Practice*, DOI: 10.1111/csp2.477
9 Miranda *et al*. 2021, *Scientific Reports*, DOI: 10.1038/s41598-021-92372-z
10 Pimenta *et al*. 2018, *Biological Conservation*, DOI: 10.1016/j.biocon.2018.06.015
11 Pires *et al*. 2023, *Current Biology*, DOI: 10.1016/j.cub.2022.11.066
12 Thornton *et al*. 2015, *Ecological Applications*, DOI: 10.1890/15-0602