Human activities impacting global biodiversity through species extinction

Introduction

Human impacts on global biodiversity are threatening the survival of species. Already, within the short span of time that humanity, as we know it, has populated the Earth, ecosystems have been damaged or destroyed, often leading to species extinction. These impacts are being made continuously worse by the increasing population and the changing climate (Hoffman, 2022; UN, 2019).

This discussion will describe what biodiversity means and offer a brief review of biological, background and mass extinction. This will be followed by a more in-depth review of the five major human activities associated with species extinction occurring in global diversity; these are often referred to as overexploitation, exotic species introductions, habitat destruction, habitat fragmentation and pollution (AMNH, 2022).

Biodiversity

Biodiversity refers to the variety of all life on earth, including plants, animals and microorganisms (Australian Museum, 2020). “ Biodiversity is essential for the processes that support all life on Earth, including humans. Without a wide range of animals, plants and microorganisms, we cannot have healthy ecosystems (The Royal Society, 2022).

Biodiversity has four main components: species diversity containing both species richness and evenness; genetic diversity; ecosystem diversity with ecosystems referred to as biomes; and functional diversity, the ideal being those that offer the greatest stability to its members. (Miller & Spoolman, 2020, pp 72-73)

However, humanity is presently facilitating the extinction or extermination of species at a far greater rate than what has been experienced in much earlier epochs of the Earth’s history. But extinction, too, is multi-faceted.

Extinction

Extinction may be referred to as biological, background or mass extinction.

Biological extinction may be defined as: “The disappearance of all members of a species from the earth is extinction (Miller and Spoolman, 2020, p.176). This can occur as a natural process of evolution and is referred to as ***Background*** extinction. This is defined as a process with a “typically long-term, multi-generational loss of reproductive fitness (Wiens and Slaten, 2011).

However, the trajectory the planet appears to hold presently could lead to a sixth ***Mass*** extinction; the five earlier being attributed to the Ordovician-Silurian, Devonian, Permian, Triassic and Cretaceous (Begum, 2021). Although the advent of a sixth extinction is debated by some scientists (Lees, et al., 2020), there is a consensus by many that the present global extinction rate is now occurring and is at least 100 times greater than in previous eras (Lamkin and Miller, 2016).

It is with a high degree of certainty that degradation of the Earth’s biosphere via accelerated rates of extinction results from human activities (Kolbert, 2014; Cowie et al., 2022).

Human activities associated with species extinction

Habitat destruction & Habitat fragmentation

“Habitat destruction, degradation and fragmentation is the greatest threat to wild species and, in particular, in tropical areas “(Miller and Spoolman, 2020, p.181). The destruction caused by deforestation and overexploitation can appear self-explanatory, but habitat fragmentation is when large biodiverse localities are divided, creating smaller, less populated areas. This reduces easily accessible foraging and reproductive areas to assist in the regeneration of species. Typical and clear examples of this can be seen when driving through rural areas. Sub-divisions are constantly being built to provide housing for the increasing human population. This often requires considerable excavation, land clearing and infrastructure development for roads, homes and amenities that urbanity demands. These areas often degrade ecosystems and, if not producing complete destruction of once viable habitats, at best, would create less than optimal patches of

habitat, often termed habitat islands. This fragmentation can “divide populations of a species into increasingly isolated groups that are more vulnerable to predators, competitor species, diseases and catastrophic events such as storms and fires.” (ibid. 182). This is then edging closer to a species’ tolerance limits and can cause regional extinctions. And this concern is one of an increasing likelihood of realisation. Goncalves-Souza et al. (2020) aver that future extinctions:

Based on accumulated habitat loss expected until 2040, our model predicted 4209 extinctions of endemic terrestrial vertebrates, being ≈ 1895 amphibians (45% of the total of predictions), 855 birds (20.3%), 595 mammals (14.1%) and 865 reptiles (20.6%). (p.9)

Accelerating this toll of demise and as a related issue is that of overexploitation through unsustainable management of resources, in particular, forests and food sources.

Overexploitation

The massive depletions in fisheries, forestry and water resources can evidence this. The resultant effects are often referred to as an ecological footprint - a measure of how much human demands (consumption) relate to the resources capable of regeneration by the biosphere (Biodiversity, 2022).

Overfishing alone has created a 34% deficit in fish stocks beyond sustainable limits from 1974 to 2017, according to the UN’s 2020 State of World Fisheries and Aquaculture (SOFIA) report (p.13). It further highlights the data that 35 per cent of the global harvest is either lost or wasted every year (p. 15)

Deforestation. Each year, deforestation causes many plants, animals and insects to be extinct. Deforestation is performed to increase farmland for grazing and cropping, mining, drilling and urbanisation. The increasing number and size of wildfires can evidence further loss. This causes the loss of canopies protecting habitats from increasing temperatures, increases foraging effort, reduces breeding grounds, creates an imbalance in predator/prey relationships, affects global water cycles and affects the living areas of an estimated 250 million people dependent on forested areas for their subsistence (Nunez, 2020).

Tethered with this impact is the menace of invasive species that have fewer predators themselves, are possibly more adaptive to deteriorated conditions and can take advantage of local populations that are susceptible to their predation.

Exotic species introductions. Often referred to as invasive or alien, these species' translocation often has a strong negative effect on endemic habitats to which they are introduced. The International Union for Conservation of Nature avers that:

Invasive alien species (IAS) are animals, plants or other organisms that are introduced into places outside their natural range, negatively impacting native biodiversity, ecosystem services or human well-being. IAS is one of the biggest causes of biodiversity loss and species extinctions and is also a global threat to food security and livelihoods. (IUCN, 2021)

Many invasive species may not have to conform to the parameters for survival as in their originating habitats and may now find a lack of predation. As a result, they may overtake local species in their breeding ability and hence, create increased competition for food sources forcing endemic species to become stressed to the limits of their tolerance; or beyond it.

In Australia alone, the top ten worst invasive species have been listed by the National Environmental Science Programmes as follows below in Figure 1. :

Australia's 10 worst invasive species	
European rabbit	321
Phytophthora plant disease	236
Feral pig	149
Feral cat	123
Feral goat	116
European red fox	95
Lantana	95
Blackberry	47
Black rat	42
Feral cattle	39

Australia's top 10 invasive species and the number of Australian threatened species they affect.

"Cats are in fourth place affecting 123 threatened species. They have a particularly devastating effect on Australia's small to medium sized mammals, and also impact many threatened birds and reptiles.

Figure 1. Australia's ten worst invasive species. Taken from The Threatened Species Recovery Hub (2021) <https://www.nespthreatenedspecies.edu.au/news-and-media/media-releases/ australia-s-10-worst-invasive-species-study>

Pollution.

The most serious of pollutants are those emitted into the atmosphere due to industrial activity.

In gaseous form, the greenhouse gases of CO2, CH4, N2O and fluorinated gases contribute to a considerable quantity of the emissions affecting the atmosphere; 6,558 million metric tons of CO2 equivalent in 2019 (EPA, 2021). This exacerbates global warming and thus produces higher evaporation and precipitation rates creating regions that become susceptible to excessive drought and flooding (UCAR, 2022). This, in turn, makes many terrestrial ecosystems vulnerable to damage and destruction, impacting species' survivability.

Marine and freshwater environments are also greatly affected by chemical and oil spillages. Many news clippings and videos indicate the volume of plastics that also wash out to sea with disturbing visions of turtles, seabirds and other vertebrates being killed by ingestion, strangled by plastic drink retainers or drenched in oil and dying from poisoning or suffocation.

Conclusion

The extinction rate of biodiversity is considerably higher than has been estimated in all of the five mass extinctions the earth has experienced in past epochs. The present situation has been due not just to the background extinction that is part of the natural evolutionary cycle but the human impacts created by habitat loss, degradation and fragmentation, overexploitation, and changing ecosystems resulting from invasive species introduction and pollution. The question now remains as to whether humankind can reverse these trends before its own demise.

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