

Biodiversity Integrity: State, Future and Consequences

Abstract

This report looks at the state of biodiversity on Earth. It provides a brief summary of the findings from the Schumacher Institute's July 1st workshop on Biodiversity and research. It presents readers with biodiversity's current state, future trends and consequences for the world and the city of Bristol in particular. The key finding is that as biodiversity loss worsens under growing human pressure, the world faces a more uncertain, less resilient future. Bristol and the local population may experience greater insecurities and lower welfare in economic, social and cultural life.



Figure 1: DPSIR Diagram showing the relationships and interactions between the factors influencing biodiversity status. Curved arrows (on the circle) indicate causal relationships, and straight arrows indicate lines of influence. As seen here human pressure is the fundamental driving force of biodiversity loss, with major consequences for human societies. Proper policy responses can however mitigate this pressure and improve future scenarios.

1. Introduction

Biodiversity refers to the diversity of life forms in all ecosystems on Earth. It has great importance for the Earth's systemic stability and human wellbeing, providing vital ecosystem services for human societies. This report looks at its current state, its future trends and the potential consequences for Bristol and the wider world. It finds that global biodiversity is under increasing pressure from human activities, and continued biodiversity loss can significantly affect future welfare and security. Effective actions are urgently required to mitigate the potential negative impacts.

2. State

Biodiversity on Earth is currently in a state of rapid decline and loss, driven primarily by excessive human pressure on the environment. Human activities are driving the Earth System towards its limits, with several boundaries already crossed. All the main components of biodiversity are experiencing unprecedented rates of decline. Major drivers of biodiversity loss show few signs of improvement, and present efforts are not enough for effective conservation.

- **Human societies are using the Earth towards or beyond its limits.** Biosphere damage and biogeochemical flows (phosphorous (P) and nitrogen (N) loading) have already exceeded their safe boundaries. Off-limit usage of the Earth System risks driving it into a new, much less hospitable state for human development.
- **A majority of species are facing decline or extinction.** Currently, between 10 % to 50% of well-studied species are threatened with extinction, and the extinction rate is around 100 times higher than in fossil records. Decline in population and range is widespread among the majority of species.
- **Genetic diversity is in decline globally.** In particular, selective breeding has caused substantial loss of genetic diversity in many animal and plant species. Loss of genetic diversity reduces the resilience and recovery potential of endangered species.
- **Ecosystems are substantively transformed and degraded.** For the 14 global biomes, 9 have been converted to croplands by 20% to 50%. Around 20% of seagrass and mangrove habitat are lost, and 40% of coral reefs are destroyed or degraded. Changes are most rapid in developing countries, but in some cases the conversion rates are slowing globally.
- **Human pressure is the fundamental driving force of biodiversity loss.** In particular, growth in global population and consumption leads to increasing pressure on ecosystems and biodiversity. Global population has doubled in the last forty years, and global economic activity has increased nearly sevenfold. Advances in science and technology allow more efficient forms of resource use, but also new means of exploiting natural resources.
- **Habitat change, climate change, pollution, overexploitation, and invasive species and diseases are the main pressures driving the losses.** Habitat change, especially conversion to cropland, is currently the biggest factor for species decline: 24% of the Earth's surface has been converted to cultivated systems. Anthropogenic climate change is increasingly affecting many ecosystems, with disruptive impact on the distribution, abundance, behaviour and health of species. Pollution, particularly P and N loading, encourages freshwater eutrophication and threatens dependent species and ecosystems. Overexploitation poses a major threat to many marine and terrestrial species, with 75% of the world's commercial marine fisheries over or fully exploited. Introduction of invasive alien species and diseases risks decline or extinction of native species, and is responsible for 42% of native species decline in the US. These factors are either keeping steady or increasing in intensity, suggesting continued or heightened pressure on biodiversity.
- **Current conservation efforts are far from enough.** Only 2.2% of the world's oceans are protected, roughly 80% of its land area is not formally protected, and less than 10% of known species have

had their conservation status assessed. Lack of effective cooperation among international agreements and institutions also constraints the utility of existing measures.

3. Future

Most analysts predict continued biodiversity loss towards the middle and end of this century. Under current trends, major threats to biodiversity will continue or increase in intensity, more species will be lost, and ecosystems will suffer further degradation. Absent genuine improvements in consumption pattern and environmental management, the Earth System will become much less hospitable for human habitation.

- **Human pressure will become greater, causing further biodiversity loss.** By 2050 global population will grow to 8.1 to 9.6 billion, and global economic activity will increase by three to six times. These will bring much greater consumption pressure on the environment, causing another 10% loss in global biodiversity.
- **Species decline and extinction will continue, and will likely become faster.** The future extinction rate is projected to be over ten times higher than the current rate. Species more sensitive to environmental change, such as amphibians, pollinators and top predators, are expected to have the largest decline. Regions under greater human pressure, like Africa, will lose more biodiversity. Man-made speciation is unlikely to compensate for the rapid loss.
- **Ecosystems will be further degraded by human activities.** In particular, urbanisation and agricultural intensification are to cause rapid ecosystems degradation. Deforestation, massive water withdrawals and industrial fishing will increasingly affect terrestrial, freshwater and marine ecosystems, respectively. Rapidly developing regions like South Asia and sub-Saharan Africa face the worst changes.
- **Major threats to biodiversity will continue driving the losses.** For example, by 2050, another 10-17% of the species present in 1970 will be lost to habitat change. The combined effect of habitat change, climate change, and nutrient loading could lead to 13-19% of vascular plant diversity lost. Invasive species are expected to have greater impact as global transport grows strongly.
- **Climate change will increasingly become the dominant driver of biodiversity loss.** Global temperature will rise by about 2.0-3.5° Celsius towards the end of the century. As a result of global warming, extreme weather events will become more frequent, species highly sensitive to temperature change will be more threatened, and coastal ecosystems are to be increasingly threatened by rising sea levels. The Amazon forests can be turned into less species-rich savannahs by increased droughts, and polar warming can lead to decline of many cold-climate species and ecosystems.
- **The Earth System will become much less hospitable for human development.** Continued destabilisation of the Earth system may drive it into a new systemic state with drastically worse conditions for human societies. Improved environmental management and sustainable consumption can substantially reduce this possibility.

4. Consequences

Biodiversity loss, both present and future, have major consequences for human wellbeing. Large scale impacts include degradation of ecosystem services (economic and non-economic ones alike), loss of ecosystem resilience, loss of future options, and exacerbation of inequalities and insecurities. Specifically for Bristol, biodiversity loss could trigger a comprehensive degradation of material and cultural life for local people.

- **Biodiversity loss can lead to the degradation of ecosystem services vital to human wellbeing.** Ecosystems provide many important services for human development, both in terms of material needs (economic) and cultural benefits (non-economic). There is established evidence that as ecosystems become degraded, they provide fewer services with lower qualities, which negatively affects human welfare and development.
- **It represents a loss of consumption sources.** Human societies are dependent on the Earth's many economic resources for their consumption needs, from food production to industrial materials. Loss of biodiversity means the consequent loss of such sources. For instance, a fall in pollinator species will lead to a reduction in crop yields and overall agricultural productivity.
- **It also means a loss of cultural benefits.** Biodiversity constitutes an important source of spiritual, aesthetic and epistemic benefits for many individuals and communities, and its loss means the loss of these services for them. Indigenous knowledge will be particularly affected by rapid changes in local species.
- **It will lead to losses in ecosystem resilience and future options for human development.** As key species and habitats suffer decline and loss, ecosystems become increasingly vulnerable to sudden shocks (like extreme weather incidents) and are more prone to collapse. And as the Earth system continues to be destabilised by human activities, such shocks will be more frequent, further reducing ecosystem resilience. A rapidly deteriorating environment also constraints future freedoms of choice for mankind, forcing them to prioritise resilience building over higher developmental objectives.
- **Global insecurities and inequalities will be exacerbated.** A more hostile Earth System with less ecosystem services increases the risks for human livelihood, particularly for food, water and energy securities. In addition, as the aforementioned changes hit the poor and disadvantaged disproportionately, global (and often regional) inequalities will rise as well.

Potential negative impacts for Bristol and local population include:

- **Threats to local agriculture:** In particular, the local crops and honey industries face growing challenges from the ongoing decline in pollinators;
- **Degradation of cultural life:** The daily 'disappearance' of nature considerably affects local people's aesthetic and spiritual life;
- **Increasing environmental shocks:** Ecosystem damages in its hinterland increases risks of extreme weather events, especially droughts and floods, for the urban area;
- **Long-term, indirect effects:** Shortage in food supply and other ecosystem products (such as timber or fuels) can arise due to global environmental degradation. The former may even lead to social unrests, indicating greater insecurity for local residents.

5. Conclusion

The Earth's biodiversity is an invaluable asset for human societies. However it is being rapidly lost by the latter's unsustainable activities. With its projected continuation (in cases acceleration) in the foreseeable future, unless urgent and effective measures are to be taken, human beings will suffer from increasingly negative consequences of biodiversity loss, and the entire Earth System will become less humanly inhabitable. Possible future actions should focus on three key aspects: the conservation and restoration of existing biodiversity and ecosystems; the improved management and more sustainable consumption of the environment; and increased understanding of the natural world. An integrated approach combining these aspects and backed by effective international coordination will hopefully see an improved future for global biodiversity and human development.

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