



The devastating impact of humans on biodiversity

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Humans are having a highly detrimental impact on biodiversity worldwide. Not only are the numbers of species declining, but the composition of species communities is also changing. This is shown by a study by Eawag and the University of Zurich published in the scientific journal “Nature”. It is one of the largest studies ever conducted on this topic.

Biological diversity is under threat. More and more plant and animal species are disappearing worldwide. Humans are responsible for this. Until now, however, there has been no synthesis of the severity of human interventions in nature and whether the effects can be found everywhere in the world and in all groups of organisms. This is because most of the studies conducted to date have only looked at individual aspects. They either examined changes in species diversity over time or were limited to a single location or to specific human impacts. Based on those studies, it is difficult to generalise about the effects and impacts of humans on biodiversity.

In order to close these research gaps, a team from the aquatic research institute Eawag and the University of Zurich has now conducted a synthesis study that is second to none. The researchers compiled data from around 2,100 studies that compared biodiversity at almost 50,000 sites affected by humans with almost 50,000 reference sites that were unaffected. The studies cover terrestrial, freshwater and marine habitats around the world, and all groups of organisms, from microbes and fungi to plants and invertebrates, fish, birds and mammals. “It is one of the largest syntheses of the effects of humans on biodiversity ever conducted worldwide,” says Florian Altermatt, Professor of Aquatic Ecology at the University of Zurich and head of a research group at Eawag.

The numbers of species are clearly declining

The findings of the study, which has just been published in the journal “Nature”, are unequivocal and leave no doubt as to the devastating impact humans are having on biodiversity worldwide. “We have analysed the effect of the five main human impacts on biodiversity: habitat changes, direct exploitation such as hunting or fishing, climate change, pollution and invasive species,” says François Keck, a postdoctoral researcher in Altermatt’s research group and the lead author of the study. “Our findings show that all five factors have a strong impact on biodiversity worldwide, in all groups of organisms and all ecosystems.”

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On average, the number of species at impacted sites was almost twenty percent lower than at unaffected sites. Particularly severe species losses across all biogeographic regions are found in vertebrates such as reptiles, amphibians and mammals. Their populations are usually much smaller than those of the invertebrates; this increases the probability of extinction.



Alongside agricultural intensification, urbanisation is one of the biggest global drivers of land use change with an impact on biodiversity. This often leads to a major shift in species composition (Photo: Florian Altermatt, Eawag).

Species communities are shifting

However, the effects go far beyond the loss of species. “It’s not just the numbers of species that are declining,” says François Keck. “Human pressure is also changing the composition of species communities.” The species composition at a location is a second key aspect of biodiversity, in addition to the pure number of species. In high mountain regions, for example, specialised plants are at risk of being displaced by species from lower altitudes due to climate warming. In some circumstances, the number of species at a particular location remains the same; nevertheless, biodiversity and its ecosystem functions are affected if, for example, a plant species disappears that has particularly good root systems for protecting the soil from erosion. The greatest shifts in the species communities are found among tiny microbes and fungi. “This could be because these organisms have short life cycles and high dispersion rates and therefore respond more quickly,” says François Keck.

According to the study, environmental pollution and habitat changes have a particularly negative impact on the number of species and the composition of species communities. That is not surprising, says Florian Altermatt. Habitat changes are often very drastic, for example, when humans cut down a forest or level a meadow. Pollution, whether accidental, as in the case of an oil tanker accident, or deliberate, as in the case of spraying pesticides, introduces new substances into a habitat that destroy or weaken organisms living there. The findings do not mean that climate change is less problematic for biodiversity in comparison, says Altermatt. "However, it is likely that the full extent of its impact cannot yet be verified today."

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Florian Altermatt, Professor of Aquatic Ecology

The findings are a cause for alarm

The third key aspect of biodiversity that the research team investigated was the homogeneity, or how similar species communities are at different sites. For example, large-scale, intensive agriculture leads to landscapes becoming more homogeneous, and the species communities they contain more similar. In this regard, the effects were mixed: some studies show a very strong tendency towards homogenisation, while in others, species communities tended to become more diverse, especially at the local level.

However, the researchers doubt that the latter is a good sign. They speculate that increasing dissimilarities could also be a temporary effect in severely impacted habitats. "The human influence that we find is sometimes so strong that there are even signs that could indicate a complete collapse of the species communities," says Florian Altermatt.

According to the authors, the study shows, on the one hand, that changes in biodiversity should not be based solely on changes in the numbers of species. On the other hand, the findings are alarming due to their distinctness and global validity. They can also serve as benchmarks for future biodiversity research and conservation efforts. "Our findings provide clear indications as to which human influences are having the greatest impact on biodiversity," says François Keck. "This also shows what goals need to be set if these trends are to be reversed."

Cover picture: According to the study, environmental pollution, such as from the spraying of pesticides, and habitat changes have a particularly negative impact on the number of species and the composition of species communities (Photo: Adobe Stock).

Original publication

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