

Declines in insect numbers are largely driven by losses of more abundant species, find researchers

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Monarch butterflies (*Danaus plexippus*) are an example of a species with formerly high local abundances that has declined in number. Credit: T. Hill

Researchers at iDiv looked at long-term trends of land-based insects, such as beetles, moths, and grasshoppers, and found that decreases in the number of the formerly most common species have contributed most to local insect declines. Common or abundant insect species are those species that are locally found in the highest numbers, but which species these are differ among locations. The study's findings, [published](#) in *Nature*, challenge the idea that changes in insect biodiversity result from rarer species disappearing.

The study follows the recent sounding of alarm bells about [insect loss](#), as researchers note dramatic declines in the total number of insects in many parts of the world. However, little is known about the general trends among locally rare and [abundant species](#) over long periods.

"It was obvious this needed exploring," says Roel van Klink, lead author of the study and senior scientist at iDiv and MLU. "We had to know whether observations about declines in total abundances of insects differed among common and [rare species](#), and how this translated into changes in the overall insect diversity."

More common species are losing out

Van Klink and colleagues set out to better understand trends in insect numbers by diving into past studies. They compiled a database on insect communities using data collected over periods between nine and 64 years from 106 studies. For example, one Dutch study on ground beetles

was started in 1959 and continues today.

With this updated database, the researchers confirmed that despite variation among the data, on the whole, land-based insects from these long-term surveys are declining by 1.5% each year. To better understand this pattern, they compared the trends of species in different abundance categories and found that species that were the most abundant at the start of the time series showed the strongest average decline—around 8% annually—while rarer species declined less.

Importantly, the losses of previously dominant species were not compensated for by rises in other species, which has far-reaching implications: Abundant species are a [staple food](#) for birds and other insect-eating animals, making them essential for ecosystems.

"Food webs must already be rewiring substantially in response to the decline of the most [common species](#)," explains van Klink. "These species are super important for all kinds of other organisms and for the overall functioning of the ecosystem."



Insect populations with the steepest abundance declines included beneficial insect species, such as predatory beetles (*Poecilus versicolor*). Credit: F. Vassen

Winners and losers

The analysis clearly shows that the formerly abundant species are consistently losing the most individuals compared to the less abundant insect species. However, less abundant and rare species are also taking losses, driving declines in local species numbers. The study found a modest decrease in the overall number of species of just under 0.3% annually. This decline indicates that in addition to significant losses of common species, some rare species are going locally extinct.

Coming out on top are new arrivals who managed to successfully establish themselves. Most of these new arrivals stay locally rare and replace other formerly rare insects, but occasionally they become very abundant. The invasive Asian Ladybeetle (*Harmonia axyridis*), which is now common throughout Europe, the Americas and South Africa, is one such example.

According to the paper's authors, further research is necessary to determine the underlying causes of these trends. Although this study did not explicitly investigate possible causes, the declines are likely linked to recent human-related impacts, such as climate change and urbanization, which are considered major drivers of biodiversity loss.

"Insects seem to be taking a heavier hit than many other species as humans continue to dominate the planet," explains Professor Jonathan Chase, senior author of the study and professor at iDiv and MLU. "Other studies, including those our team has worked on, have not found such diversity declines at local scales from many other groups of animals and plants."

While the study's results are striking, these trends are strongly biased to data on insect communities in Europe and North America. As such, they should not be interpreted as a global phenomenon. Chase adds, "The patterns we observed might be a best-case scenario for quantifying the real impact of people on insects," referring to what scientists have called the lifeboat effect.

"These declines were observed in long-term data from areas that have remained largely intact, sort of like a lifeboat, rather than in areas where massive conversion of natural areas into human-dominated landscapes has occurred, such as malls and parking lots."

More information: Roel van Klink, Disproportionate declines of

formerly abundant species underlie insect loss, *Nature* (2023). [DOI: 10.1038/s41586-023-06861-4](https://doi.org/10.1038/s41586-023-06861-4).
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