European forest plants are migrating westwards: Research suggests nitrogen is the main cause

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The common wood sorrel (Oxalis acetosella) migrates westwards at a speed of around 5 kilometers per year and northwards at around 0.1 kilometers per year. The main driver is nitrogen deposition. Credit: Petr Harant

New research reveals nitrogen pollution, and to a lesser extent climate change, unexpectedly as the key driver behind surprising westward shifts in the distribution of plants.

A study published in *Science* has uncovered that many European forest plant species are moving towards the west due to high nitrogen deposition levels, defying the common belief that climate change is the primary cause of species moving northward. This finding reshapes our understanding of how environmental factors, and in particular nitrogen pollution, influence biodiversity.

While it is widely assumed that rising temperatures are pushing many species toward cooler, northern areas, this research shows that westward movements are 2.6 times more likely than northward shifts. The primary driver? High levels of nitrogen deposition from atmospheric pollution, which allows a rapid spread of nitrogen-tolerating plant species from mainly Eastern Europe.

The establishment of these highly competitive species in areas with high nitrogen deposition rates often comes at the expense of the more specialized plant species.

The results highlight that future biodiversity patterns are driven by complex interactions among multiple environmental changes, and not due to the exclusive effects of climate change alone. Understanding these complex interactions is critical for land managers and policymakers to protect biodiversity and ecosystem functioning.

Key findings include:

- European forest plants shift their distributions at an average velocity of 3.56 kilometers per year.
- 39% of the plant species shift westward. Northward shifts are

only observed for 15% of the species.

- Nitrogen pollution, rather than climate change, is surprisingly, the main factor behind westward distribution shifts in European forest plants.
- The study analyzed the shifts in the distribution area of 266 forest plant species across Europe over several decades, with the first measurements being taken in the year 1933 at some locations.
- Several of Europe's most emblematic forests were included in this study, such as the primeval forest Białowieża in Poland.

More information: Pieter Sanczuk, Unexpected westward range shifts in European forest plants links to nitrogen deposition, *Science* (2024). DOI: 10.1126/science.ado0878.
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