

The Link Between Environmental Change and Invasive Species

December 2024

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Quick Facts

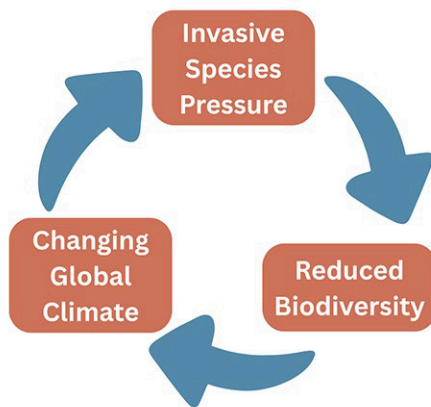


Fig. 1. Cycle of

invasive species and climate change.

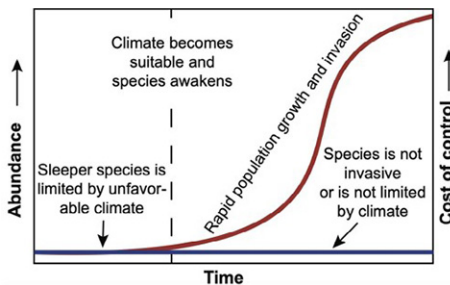


Fig. 2. Climate

change creates conditions suitable for invasive species to thrive. Bobryk, 2024

- Climate change and invasive species are interconnected threats impacting biodiversity and ecosystem stability.
- Warming temperatures enable invasive species to expand into new areas and outcompete native species.
- Extreme weather and fire events create disturbances that invasive species exploit due to their adaptability and rapid reproduction.
- Climate change can weaken biological control efforts against invasive species.

Climate change and invasive species represent two pressing environmental challenges facing our planet (Fig. 1). Each poses a threat to global biodiversity and ecosystem stability, and together, they amplify each other's impacts. As global temperatures rise and ecosystems are disrupted, new conditions are created that allow invasive species to spread more easily, establish themselves in new areas, and outcompete native species (Ma & Ma, 2022).

How Climate Change Facilitates Invasions

Range Expansion

As global temperatures rise, many species are shifting their geographic range to higher latitudes or elevations (Lenoir & Svenning, 2014). This shift opens ecological niches that invasive species, known for their adaptability and rapid reproduction, often exploit (Fig 2). In contrast, some native species may be less mobile or less able to cope with the rapid pace of change, making them more vulnerable to competition by invasive species (Early & Sax, 2014). Once established in these regions, invasive species can displace native organisms, leading to biodiversity loss and ecosystem disruption (Sanders et al., 2003).

This phenomenon is already happening in Utah and beyond. In Utah, the sycamore scale, originating in southern California, has shifted its range northward over the last few decades into northern Utah. In the eastern U.S., the potential spread of emerald ash borer (EAB) also illustrates this dynamic. Currently, colder winter temperatures provide a natural barrier to the spread of EAB. A team of researchers recently developed a model to predict the spread of EAB in response to climate change. The model projected that areas across North America where native ash species occur are at significant risk of EAB presence within the next 20 years (Barker et al., 2023). This risk is due not only to warming temperatures enabling EAB to survive in previously unsuitable regions but also to heat stress impacting EAB in areas where it is already established.

Stress Tolerance



Fig. 3. Spongy moth larvae killed by the introduced fungus, *Entomophaga maimaiga*. Steven Katovich, bugwood.org.

Invasive organisms are often more resilient to drought, heat, salinity, and pollution than native species. As climate stressors become more intense, this resilience allows invasive species to continue expanding into degraded or marginal habitats where native species may struggle to survive.

These extreme climate conditions also impact how invasives are controlled. A prime example is the spongy moth, an invasive insect accidentally introduced to the U.S. over a century ago. It continues to cause millions of dollars in damage annually (Morin & Liebhold, 2015). Scientists introduced *Entomophaga maimaiga*, a specialist fungal pathogen highly effective at reducing spongy moth populations in cool, moist environments (Fig 3). This biological control method has proven successful in the past, but as climate change leads to hotter and drier conditions, the fungus's ability to suppress the moth is expected to decline (Liu et al., 2025). This will likely result in rising spongy moth populations, leading to increased economic losses and greater environmental damage.

Climate-Related Disturbances

In addition to a warming climate, the world is seeing increases in the frequency and severity of weather and fire events. These events can create sudden disturbances in ecosystems, such as habitat destruction, altered resource availability, or reductions in native species populations. Invasive species are often well-adapted to exploit such disturbances due to their biological characteristics, including broad environmental tolerances, high reproductive rates, rapid growth, and opportunistic dispersal strategies. Because of this, invasive species often colonize newly available niches or weakened ecosystems before native species have a chance to

reestablish after an extreme weather event (Parmesan et al., 2000).

Phenological Shifts

Shifts in seasonal patterns also play a role. Earlier springs and longer growing seasons can create mismatches between native species and their environment. In its native European range, spongy moth lays its eggs on red and black oaks. If the eggs hatch too long after bud break, larvae are likely to die of starvation unless alternate host plants are available (Ward & Masters, 2007). There is already evidence that earlier phenological events, such as earlier flowering, are linked to climate change (Fitter & Fitter, 2002). This mismatch between native species and their environment will create ecological opportunities for invasive species to establish themselves and displace the native species.

What Can We Do?

Detect invasive species early and track them using tools like satellite imaging, eDNA analysis, and predictive models.

Educate and engage the public through citizen science and reporting platforms.

Prevent introduction by enforcing biosecurity measures to stop invasive species from spreading via trade, travel, and ballast water.

Promote biodiversity and restore native habitats to enhance ecosystem resistance to invasion.

The issue of invasive species should be integrated into climate policy and biodiversity conservation efforts, ensuring that strategies address both immediate and long-term drivers of ecosystem change. A combined approach that tackles both climate change and biological invasions is essential to protect our global ecosystems.

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