

Invasive wasp tests nature's strengths and weaknesses

June 16 2022



Sirex noctilio, also known as the Sirex woodwasp. Credit: Flora Krivak-Tetley

A wasp that has already caused major damage in the Southern

Hemisphere could spread throughout North America, although nature's defenses are currently keeping the insect under control, according to a Dartmouth study.

The research on *Sirex noctilio*, also known as the Sirex woodwasp, estimates that the species has the potential to reproduce at rates 2-3-times higher in North America than in its native range in Europe, Asia and North Africa. While the wasp's impacts have been limited so far, it could pose a threat under the right conditions as it spreads throughout its newly adopted continent.

The research demonstrates how local ecosystems can use their biological defenses to deter attack from [invasive species](#), but it also highlights nature's potential breaking point when confronted with environmental change.

"Understanding why invasive species are destructive in some places and not in others gives us the tools to respond to them quickly," said Flora Krivak-Tetley, a postdoctoral researcher at Dartmouth and first author of the paper. "The Sirex woodwasp is perfect for exploring this question because its impacts on forests vary in different parts of the world."

Unlike yellow jackets and other common wasps, Sirex woodwasps eat wood rather than fruit and meat. The insect injects a fungus and a dose of venom into trees to weaken and even kill them. They also place their eggs in the trees, where the larvae hatch and feed on wood that is pre-digested by the fungi.

"These wasps are cool, and a bit different than wasps many of us are familiar with," said Krivak-Tetley, who conducted the research as a Ph.D. candidate at Dartmouth. "The larvae tunnel through tree trunks, mature inside the wood, and emerge as adults. They don't sting people, they sting trees."

The Sirex woodwasp is considered to be a minor tree-eating scavenger in its native range. In those areas, it is kept in check by [natural enemies](#) and the limited availability of suitable pine trees to serve as hosts.

However, the insect can kill large numbers of trees and be expensive to manage in non-native areas. In New Zealand, Australia, Chile, Argentina, and other countries in the Southern Hemisphere—a region where the wasp has no natural enemies—the invasive is responsible for major attacks against stands of pine trees that were imported for commercial plantations.



Sirex noctilio, also known as the Sirex woodwasp, in the larval stage. Credit: Matthew Ayres

Unlike other invasive insects that may be limited in range by sensitivity to temperature and other climatic conditions, Sirex woodwasps are not restricted by temperature extremes within their range. They are only

constrained by the presence of predators, competitors and the availability of host pines.

"This wasp will continue to expand its distribution in North America" said Matthew Ayres, professor of biological studies at Dartmouth and senior researcher on the study. "It can apparently tolerate the climate anywhere that pine trees occur."

The insect's invasiveness is compounded in pine forests that are overstocked and water stressed. Sirex woodwasps are also difficult to monitor, which makes them harder to control.

The wasp was first detected in North America in 2004. It is believed to have entered the continent inside wood packaging material used in shipping at a cargo port on Lake Ontario in upstate New York. Since first being introduced, the Sirex woodwasp has migrated throughout the northeastern United States and parts of Quebec and Ontario in Canada.

"Non-native species arrive from distant lands all of the time," said Ayres. "Sirex woodwasps arriving from Europe found forests that resembled their homeland, but that also included many of the same natural enemies—from nematodes to woodpeckers."

The Dartmouth study, published in *NeoBiota*, assessed the impacts of life history traits, host resistance and species interactions of the Sirex woodwasp in the Northeast U.S. and compared the data to information on species' activities from within the native range in Galicia, Spain.

According to the research in New York, Pennsylvania and Vermont, the woodwasp has the potential to be over 150% more productive in the areas studied in the US than in Spain. As a result, there is increased potential for rapid population growth and localized outbreaks of the wasp in North America than in the insect's native range. While a single

female *Sirex* woodwasp in Spain has the potential to generate about 10 offspring over five subsequent generations, in North America each female could potentially produce 1,000 offspring.

According to the team, the higher reproduction rates in the Northeast are driven, in part, by a different relationship with a parasitic worm that sterilizes wasp eggs in its native range but not in the North America zones that were studied. Females in North America also tend to be larger and have more eggs than in the native range.



Sirex noctilio, also known as the *Sirex* woodwasp. Credit: Matthew Ayres

Although the wasp was found to reproduce more successfully in North

America, most of the offspring observed in the study emerged from only 13% of the trees sampled, indicating that a large majority of the trees attacked by the woodwasp in North America produced no adult insects.

While more productive in North America, the research indicates that the Northeast of the United States is resistant to *Sirex* woodwasps because of the relative scarcity of host pine trees and the existence of natural enemies such as parasitic wasps.

"When we first observed the *Sirex* woodwasp in North America, we said 'oh no, we better brace ourselves for this,' " said, Krivak-Tetley. "We are not sure how it will go in other parts of the continent but, for the moment, nature has rallied to its own defense against this woodwasp."

The research team expects the population to expand south into the U.S. "wood basket" states—from North Carolina to East Texas—that contain large expanses of valuable, fast-growing pine forests. The U.S. West, with pines already at risk from drought, fire and beetles, could also be susceptible to the invasive species. The wildcard is whether natural competitors and predators will keep them in check, or if the larger resource base will allow them to spread.

"This wasp will continue to spread throughout North America and can be expected to eventually show up everywhere there are pine trees," said Ayres. "The good fortune we've enjoyed so far with the *Sirex* woodwasp could change if the insect reaches areas with higher resource availability and fewer natural enemies."

In follow up to the study, the research team hopes to compare the ways in which the woodwasp populations grow in the north and south to better understand the conditions that lead to impactful invasions. They will also combine data on stand-level susceptibility, species-specific susceptibility, and availability of pine tree hosts to conduct detailed risk

assessments for the U.S. South and West.

"This is not a bad news invasive story yet, it's more of a warning that we need to act on," said Krivak-Tetley. "Knowing how these wasps behave before they spread can help guide future management decisions."

More information: Flora E. Krivak-Tetley et al, Demography of an invading forest insect reunited with hosts and parasitoids from its native range, *NeoBiota* (2022). [DOI: 10.3897/neobiota.72.75392](https://doi.org/10.3897/neobiota.72.75392)

Provided by Dartmouth College

Citation: Invasive wasp tests nature's strengths and weaknesses (2022, June 16) retrieved 26 April 2024 from <https://phys.org/news/2022-06-invasive-wasp-nature-strengths-weaknesses.html>

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