We've got your number: Tracing the source of invasive Japanese beetles

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A technique developed by Northern Arizona University researchers can help invasive pest managers make more informed decisions about how to control Japanese beetles and the extensive damage they cause.

Researchers led by Bruce Hungate, director of the Center for Ecosystem Science and Society, used the stable hydrogen isotope signature in body tissue of invasive Japanese beetles to model the source of origin and time since arrival of beetles trapped at Portland International Airport over the past decade.

The results, published in *PLOS ONE*, can help answer the question of whether a beetle detected in new territory is new or part of an established population in the area. New arrivals point to more control at the source; localized beetles point to more control at the destination.

"Knowing the timing of arrival of these invasive organisms can be really helpful in managing them, and the stable isotope gives us a very useful chemical clock," Hungate said. "It's a powerful addition to the tools we have to understand where these organisms are from and the dynamics of their movements."

Japanese beetles wreak havoc by feeding on over 300 plants, contributing to the billions of dollars per year in economic costs caused by invasive species. Japanese beetles are well established in the eastern United States. Control efforts at airports on both coasts aim to keep the beetles from spreading westward, with only partial success.

The study used isotopes as a sleuthing tool. One of the heavier isotopes of hydrogen, deuterium, is rare but stable, meaning it does not decay. The amount of this isotope—its signature—in local water sources varies from place to place, and has been found to match the signature in tissues of plants and animals consuming the local water.

Researchers found a close relationship between the stable hydrogen isotope signature in beetle tissue and local water from 71 sites around the country. Combined with the signatures of water at known sources of Japanese beetles in the East, these results provide a sort of "geographic fingerprint" to determine where the beetle is from.

To model time since arrival, researchers transplanted Eastern beetles to a Western environment and measured the signature change over time. Changes began after two weeks and the signature took about five weeks to equilibrate to the new environment. This offered a new clue: beetles trapped at points of entry to an area, like airports, are likely to be new arrivals if their signature is distinctly different from the signature in local water.

The transplant experiment also explored whether the signature from the hard, chitin-rich tissue of the beetle's wing covers changed more slowly than the signature in soft tissue, potentially preserving clues about the beetle's origin longer. They found that signatures did shift more slowly in hard tissue, adding it as another potential tool.

The resulting model pointed to the southeastern United States as the origin of beetles trapped at the Portland International Airport. And beetles trapped after 2011 appeared to have been more recent arrivals than beetles trapped in earlier years, suggesting that efforts to prevent beetles from establishing viable populations at the Portland International Airport seemed to be working.

Provided by Northern Arizona University