When natural disaster strikes, can insects and other invertebrates recover?

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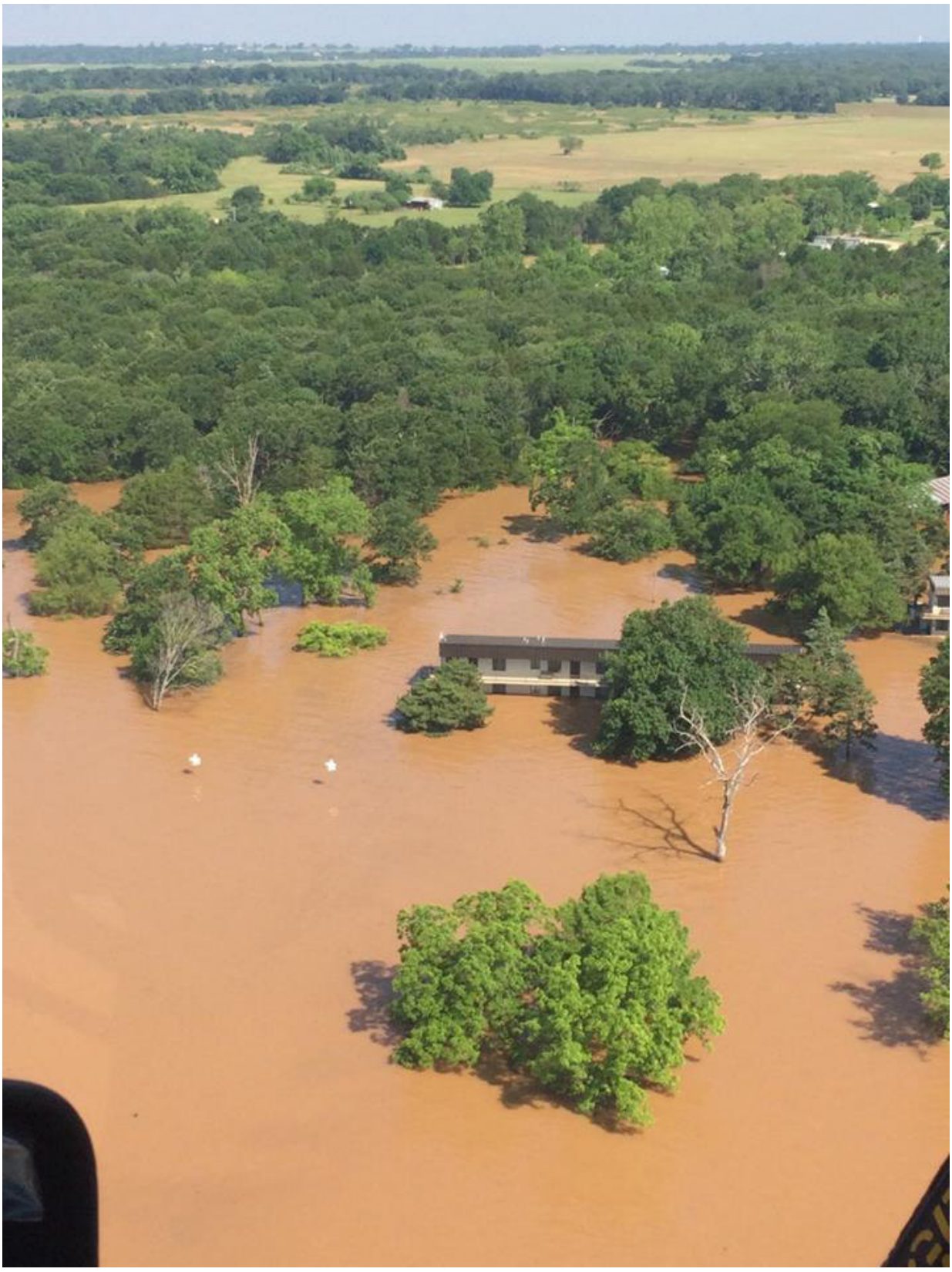

The University of Oklahoma Biological Station near Lake Texoma on the state's southern border found itself in the middle of a once-in-a-century flood in June 2015. Three months earlier, researchers there had sampled the insect and invertebrate community in the area, and later sampling found a 93 percent decrease in abundance, a 60 percent decrease in species presence, and a 64 percent decrease in biomass among insects and other invertebrates nine months post-flood. Credit: Jeff Thrasher

After a 100-year flood struck south central Oklahoma in 2015, a study of the insects, arthropods, and other invertebrates in the area revealed striking declines of most invertebrates in the local ecosystem, a result that researchers say illustrates the hidden impacts of natural disasters.

Researchers at the University of Oklahoma and Cameron University compared the invertebrate community before and after the flood and found a 93 percent decrease in abundance, a 60 percent decrease in species presence, and a 64 percent decrease in biomass among insects and other invertebrates nine months post-flood. They also found the differences between above-ground and below-ground invertebrates to be largely erased. Only those creatures well-adapted to recolonizing a disturbed environment were quick to return.

"I will never forget picking up the traps, and it just seemed like every trap had one cricket and one spider," says Karl A. Roeder, a doctoral student at the University of Oklahoma (OU) and lead researcher on the study. "The area had transitioned from a diverse insect community to a large expanse of crickets and spiders. We were pretty surprised at how similar everything was."

Roeder and colleagues Diane V. Roeder, Ph.D., assistant professor of biology at Cameron University, and Michael Kaspari, Ph.D., presidential professor of biology at OU, report their findings in a new research

article published March 15 in the journal *Environmental Entomology*.

When natural disasters such as floods, fires, or hurricanes strike, we are understandably concerned about their human impact. But these events also cause significant disturbance to natural ecosystems. How—and if—those natural communities recover is not fully understood, even as the occurrence and severity of natural disasters is increasing.

"As these weather events can perturb natural communities in very dramatic ways, it will be important to understand which organisms are likely to persist or at least able to recolonize areas quickly," Karl Roeder says. "If such species are unable to perform functions of the displaced individuals—such as soil cycling, decomposition, or pollination—ecosystems may have trouble returning to their previous states."

From a scientific perspective, Roeder and colleagues were in the right place at the right time. The area near OU's Biological Station on Lake Texoma, along the state's southern border with Texas, was scheduled for a controlled burn, and so they sampled the community of insects and other invertebrates (such as spiders, millipedes, and snails) in March 2015, with plans to repeat the sampling and compare findings after the burn. But, instead, record rainfalls struck in June, and the lake rose nearly 30 feet, flooding the surrounding area. Afterward, the team carried forth with resampling three, six, and nine months later to learn about the impact of the flood.

They found that, of the seven taxonomic classes measured, "most decreased or were completely absent after a June spent underwater." For example, only three of the 14 ant species found pre-flood were present afterward (one of which was the invasive red imported fire ant, Solenopsis invicta). And isopods and millipedes, which play key roles in decomposition and nutrient cycling, had not yet returned nine months

after the flood. Changes like these can have ripple effects across an ecosystem.

"We noticed a large amount of dead vegetation at our site. Yet detritivores like millipedes and isopods that normally break down decomposing vegetation were largely gone," Karl Roeder says. "Instead, we recorded an increase in large-bodied groups like field crickets, spiders, and beetles. This change may have important consequences for the survival of amphibians, mammals, and reptiles, which opportunistically prey upon these larger invertebrate groups, or for birds as they fuel up for migration. Conversely, as there are now fewer invertebrates overall, groups that cannot reliably capture highly mobile invertebrates may be negatively impacted."

Roeder says the study raises important questions about how invertebrate communities change after major disturbance events, how those communities re-assemble, and whether certain species are better able to recover, and why. The big question, though: Will the community of insects and other invertebrates ever return to its original composition—and, if so, how long will that take?

"The importance of field stations for long-term ecological research programs should not be underestimated," Karl Roeder says. "While our study is rather short term, programs like the National Ecological Observatory Network or the Long-Term Ecological Research Network should provide invaluable data for monitoring the impact of and recovery from severe weather events at longer time scales."

More information: Karl A Roeder et al, Disturbance Mediates Homogenization of Above and Belowground Invertebrate Communities, *Environmental Entomology* (2018). DOI: 10.1093/ee/nvy022