Scientists watch water fleas take over new territory

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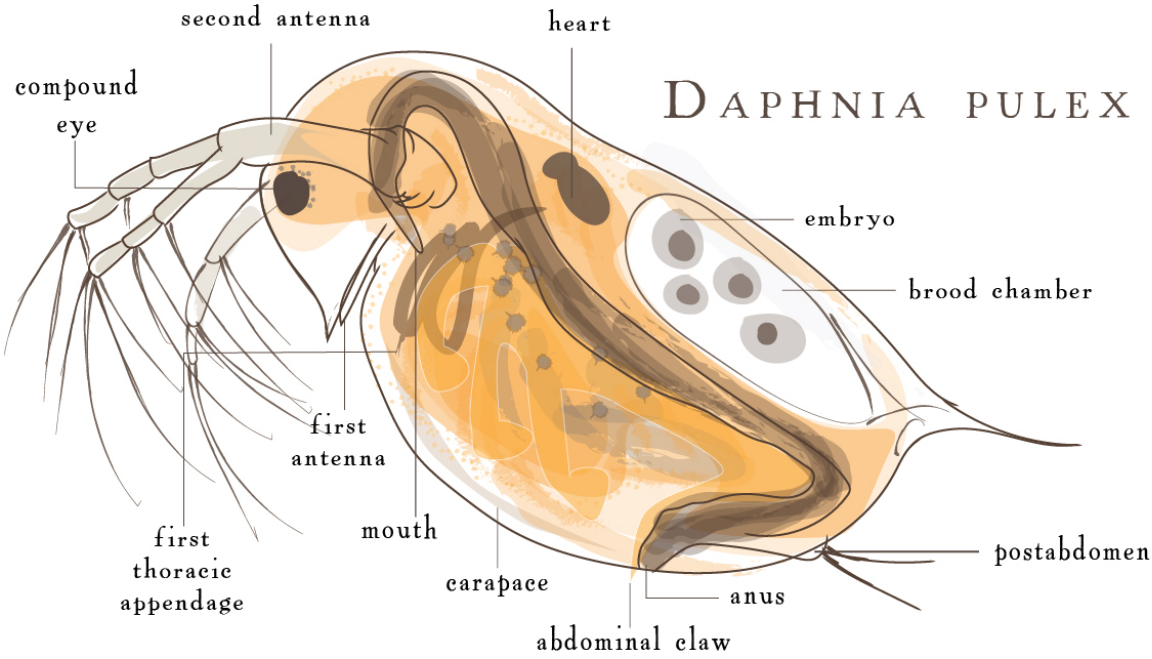


Daphnia pulex has conquered the world, one pond at a time. Credit: Julie McMahon

Look into any nutrient-rich pond almost anywhere in the world and you will find *Daphnia pulex*, a tiny crustacean (also called a water flea) that is

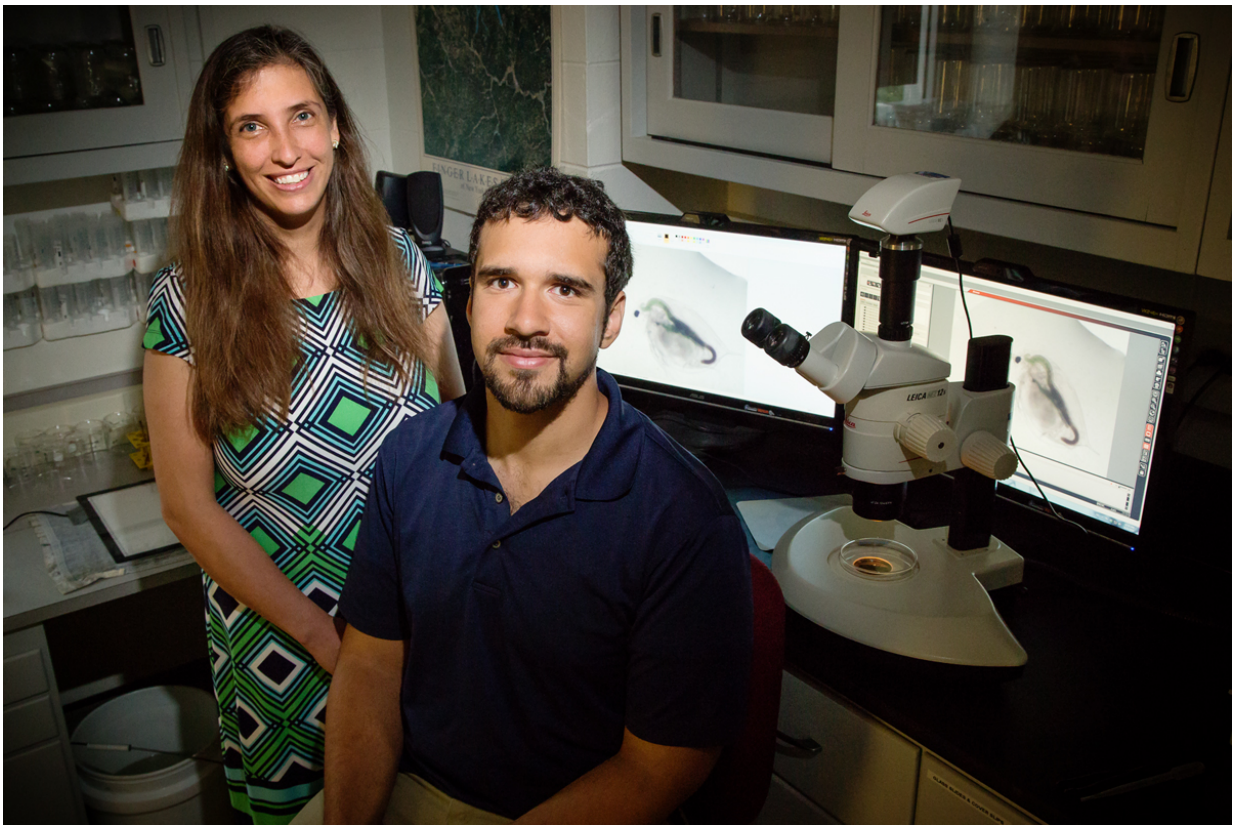
a source of food for fish and fascination for scientists. A new study, reported in the journal *Molecular Ecology*, offers insights into this creature's ability to disperse and its remarkable success in the wild.

Part of the water flea's resilience involves a survival strategy it shares with many other zooplankton. When its watery habitat dries up, a water flea embryo can persist in a dormant state until - if it's lucky - the pond refills or the embryo hitches a ride on an insect or amphibian or is carried by the wind to a wetter locale. Studies have shown that water flea embryos can survive in this dormant state for decades or even centuries.

The new research focused on obligately asexual varieties of *D. pulex*, which reproduce only by cloning themselves.

The researchers wanted to see the process by which *D. pulex* colonize and, in some cases, dominate, new territory in nature. To do so, they stocked dozens of new, human-made ponds in a forest in upstate New York with *D. pulex* clones. The ponds were created as part of an effort to restore wetlands habitat for endangered frogs.

"We are trying to understand the factors controlling biodiversity," said University of Illinois animal biology professor Carla Cáceres, who led the study with graduate student Christopher Holmes. "With these new ponds, we realized we could watch the patterns as they develop across the landscape."



University of Illinois animal biology professor Carla Cáceres and graduate student Christopher Holmes led a study of *Daphnia pulex*, an aquatic crustacean, to gain insight into the ecology of ponds. Credit: L. Brian Stauffer

Since water fleas share their habitat with mosquitoes, some of which carry diseases that can afflict humans and other wildlife, understanding how these natural ecosystems work can benefit those hoping to contain the spread of such diseases, Cáceres said. Like mosquito larvae, water fleas eat algae and other microbes in the water, and so can be seen as competitors with mosquitoes for a pond's food resources.

Water fleas make ideal subjects for the study of aquatic ecosystems because they're small, prolific and occupy an important niche in a pond's food chain, Cáceres said. Deciphering the dispersal patterns of even a

single species can be tricky, however, Holmes said.

"The challenging thing about studying *Daphnia* is that, even though they are very good at dispersing, you may find a clone in one pond and not find it in another five meters away," he said. "Two ponds may be close together and yet the varieties of *Daphnia* occupying each may be very different."

Other studies have looked at different species or genetic variants of *D. pulex* in nature, Holmes said. But many take only a snapshot of what is living in a particular site at a given time point, then try to explain how these patterns came to be, he said.

"Studies that examine these patterns over time are much more informative for addressing these ecological questions," he said.

The researchers stocked newly created ponds in upstate New York with *Daphnia pulex* clones, tracking the creatures for three years to understand the factors that contribute to their success. Credit: Christopher Holmes

In the new study, the team stocked 27 (of 38) new ponds with *D. pulex* clones drawn from other ponds in the same environment. The researchers then tracked the creatures for three years. Thirteen ponds were each stocked with one of six single clones, while 14 ponds got all six clones. Each stocked pond received a total of 750 individual water fleas. The remaining ponds were not stocked.

The team sampled each of the 38 ponds every two weeks from May to August in 2011 and 2012, extracting water fleas, taking them back to the lab and using genetic tests to classify genetic variants. The researchers also sampled each pond once in 2013 and in 2014.

The team found that higher *D. pulex* biodiversity at the time the ponds were created enhanced the likelihood that at least one of the clones would survive in that pond over time and even dominate that pond.

"The theory is that whoever gets to a new habitat first can establish these numerical advantages, monopolize these habitats or grow and prevent immigration by other individuals," Holmes said. "Our findings add to the evidence that higher genetic diversity enhances these 'priority effects.'"

More information: Christopher J. Holmes et al, Initial genetic diversity enhances population establishment and alters genetic structuring of a newly establishedmetapopulation, *Molecular Ecology* (2016). DOI: 10.1111/mec.13672

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