Ecosystems change long before species are lost

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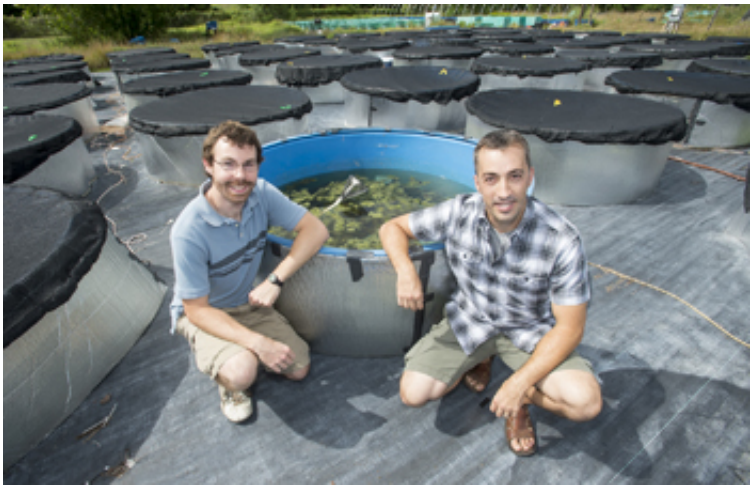

Graduate student Nick Rasmussen, left, and Professor Volker Rudolf visit ponds on the campus of Rice University where they created dozens of distinct communities to study the effects of manipulations in populations of two apex predators, dragonflies and diving beetles. Credit: Tommy LaVergne

(Phys.org) —Communities in nature are likely to be a lot more sensitive to change than previously thought, according to a new study at Rice University.

The study, which appears this week in *Nature Communications*, shows that scientists concerned about human influence on the biosphere need to take a deeper look at how altering the dynamics of a population—for example, by removing large members of a species through

overfishing—can have measurable consequences, said Rice ecologist Volker Rudolf.

"Natural communities are increasingly altered through human impact, and ecologists have long strived to determine how these changes influence communities," Rudolf said. He noted the disappearance of a species is the most extreme but not the only cause of biodiversity loss.

"That's the last thing that happens after you mess up the entire ecosystem for a long period of time," he said. By then, changes forced upon the structure of a population—such as the ratio of young to old in a species—have already been felt up and down the food chain.

Rudolf suspected species play various roles and their effects on the environment change as they progress through their life cycles, to the degree that altering these life "stages" within a species could have a significant impact. He and Rice graduate student Nick Rasmussen made a considerable effort to prove it.

Rice University researchers studied 35,000 creatures pulled from dozens of

miniature environments to gauge the effects of changes within populations of dragonflies and diving beetles on their environments. The results, they said, show that changes to an ecosystem appear long before a species disappears entirely. Credit: Rudolf Lab/Rice University

For the painstaking experiments that started in 2009, Rudolf, Rasmussen and their colleagues chose dragonflies and water-diving beetles to represent species that have major impact on their respective communities—in this case, fishless ponds—and then created dozens of miniature environments to analyze that impact. Manipulating the presence of different developmental stages within a predator species in each pond helped the researchers determine that such changes did alter the dynamics of complex ecosystems in a measurable way.

"Other than being the largest and most voracious predators in these communities, they're totally different," Rudolf said of the apex predators. "We figured if we saw any generalities across these two species, then there's something to our theory."

They found that altering which classes of size were present in a population also altered the structure of the entire community and ultimately how the whole ecosystem functioned. Also important, Rudolf said, was that changing the structure of populations sometimes had bigger effects on the ecosystem than changing the predator species.

The results, he said, "challenge classical assumptions and studies that say we can make predictions by assuming that all individuals of a species are the same. You don't expect a toddler to do the same thing as a grownup, and the same is the case for animals."

The study could also explain why such human activities as size-selective

harvesting can alter the structure of entire food webs in some ocean systems, even when no species had gone extinct and the total biomass of the targeted fish remained the same, he said.

"While these changes would be hard to predict by the classical approach, our results suggests such changes are expected when human activities alter the population structure of keystone species in an ecosystem," Rudolf said. "Thus, natural ecosystems are likely to be much more fragile then we previously thought."

More information: www.nature.com/ncomms/2013/130 … full/ncomms3318.html

Provided by Rice University