# Qualia

## Biodiversity may protect against spread of disease

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Biodiversity matters when it comes to susceptibility to disease. A recent study shows a richer assortment of amphibians in a pond means more protection against the spread of a parasite that causes limb deformities. The findings support the long-held theory that biodiversity in an ecosystem dampens the spread of pathogens, and may also apply to diseases that affect humans.

Over the past decade, scientists have reported negative correlations between host biodiversity and disease risk. For instance, more species of mammal in an area may limit the prevalence of Lyme disease, while a greater number of bird species may curb the spread of West Nile virus.

The theory behind these observations is known as the dilution effect, which predicts that a greater variety of host species will actually hamper the spread of a pathogen. This is because when there is greater diversity, hosts that are more susceptible to infection will become diluted in the population by more resistant hosts over time.

But testing this theory experimentally was nearly impossible in complex ecosystems, largely because of the huge number of animals that would have to be sampled and the vast size of the ecosystems over which those animals roamed. Without experimental data, scientists could not say if higher host biodiversity directly caused a drop in disease or if two factors were correlated but did not have a causal relationship.

The authors of this study, published February 13 in *Nature*, overcame these hurdles by focusing on smaller, easier-to-sample ecosystems. The researchers, led by Pieter Johnson of the University of Colorado, Boulder, sampled over 24,000 amphibians in 345 ponds in California over a three-year period. In each pond, they documented the number of different amphibian species and the number of animals infected with *Ribeiroia ondatrae*, a parasitic flatworm that completes part of its life cycle in the tadpoles of various frog, newt, and salamander species. Infected amphibians are easy to spot because the parasite causes limb malformations, including missing, misshapen, or extra sets of hind legs. (These deformities don't usually harm the host, but they do make it more likely to be caught and eaten by a bird — which is exactly what the parasite needs. It completes the next step in its life cycle within the bird's digestive tract).

The results of this extensive sampling showed that ponds with six amphibian species had a 78% reduction in *Ribeiroia* transmission compared to ponds with only one amphibian species.

While compelling, these field data still couldn't address the question of causality, so Johnson and his colleagues bolstered their observations with laboratory tests and controlled ecosystem studies. They measured how prone each amphibian species is to infection in the lab, and then created pond replicas using large plastic tubs stocked with different combinations of amphibians

and a controlled number of parasites. The experiments confirmed their field observations: greater biodiversity actually caused a decrease in infected animals.

One reason why the dilution effect occurs is probably related to how ecosystems become colonized with wildlife. Johnson and his colleagues found that the first amphibian species to settle down in a pond tend to be the most susceptible to infection and the later species tend to be more resistant. In the California ponds they sampled, the researchers noticed that when a pond had just one amphibian species, it was almost always the Pacific chorus frog. These frogs reproduce quickly and are often the first amphibian colonizers in wetland habitats, but they're also prone to infections. One of the last amphibians to join a pond was the California tiger salamander, which was also one of the species most resistant to the parasites.

This tendency of less diverse communities consisting of species that are more vulnerable to disease infection is likely not unique to these California ponds. The first species to colonize a habitat usually has the ability to reproduce rapidly and spread across ecosystems quickly, but these advantages come at the expense of their resistance to disease.

This comprehensive pond study is probably a good model for more complex ecosystems and disease processes. It also provides another argument for preserving biodiversity — diversity itself actually helps reduce disease.

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