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Another cheer for biodiversity

Dramatic proof of the value of biodiversity has been reported, says S.Ananthanarayanan.

The uses of biodiversity are widely documented. That different species would draw nutrients from and replenish the soil more evenly has been accepted and has been verified in field trials. The other benefit is that while predators prevent species from growing unchecked, species also feed on each others' predators, or come in the way of their prosperity and keep predators in check. There is also general evidence that biodiversity can lead to resistance against the spread of disease. .

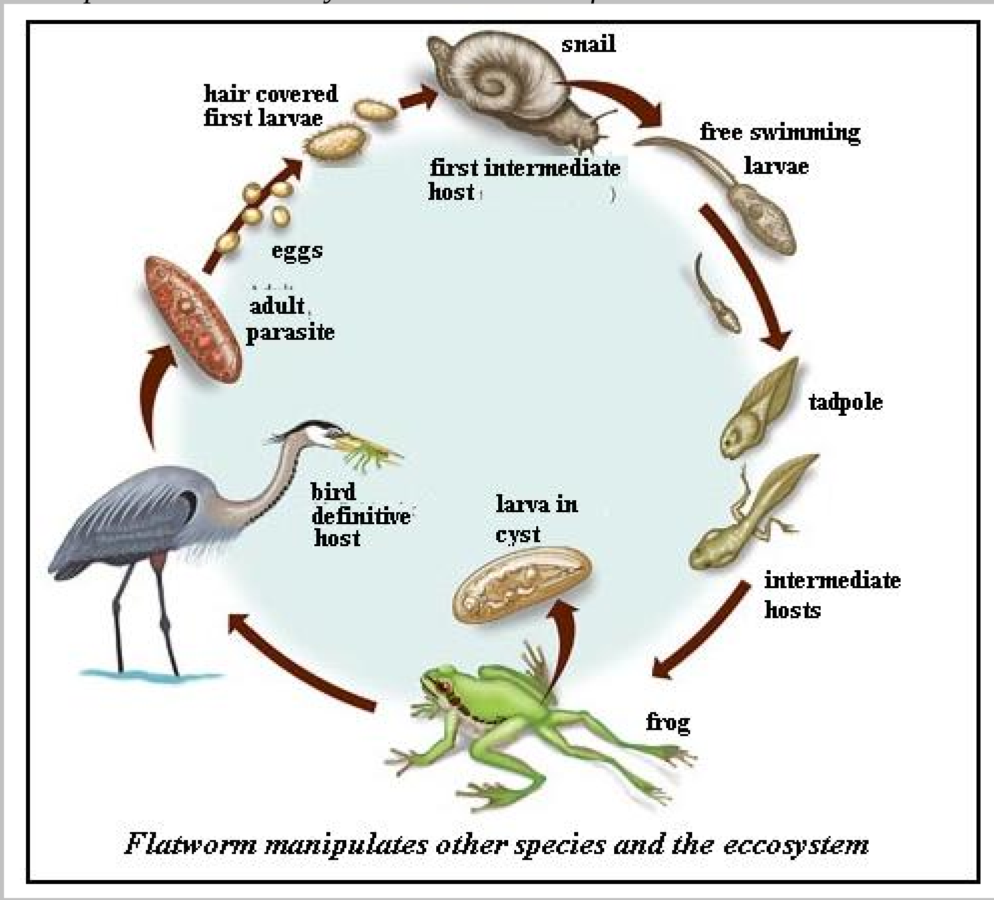
Pieter T. J. Johnson, Daniel L. Preston, Jason T. Hoverman and Katherine L. D. Richgels, of the University of Colorado and Purdue University, USA report in the journal, ***Nature*** a close look at this last feature – of biodiversity controlling the effect of a single pathogen on a specific class of target animals. With help of ample field data and experiments where different conditions were varied, they have demonstrated that diversity of species that could harbour a virulent flatworm species that causes disease in frogs actually brought down the ability of the parasite to prosper.

Flatworm and frogs

The story starts with Prof ***Pieter Johnson at University of Colorado*** learning that frogs were growing from tadpoles with deformities, sometimes a whole 25%, even 50% of frogs, in ponds in many parts of the US. Just what was causing such large scale deformities and what were the implications became

questions that demanded answers Prof Johnson teamed up with colleague ***Kevin B Lunde*** and after extensive survey of affected frogs and their environment, and laboratory work, they identified the cause as infection by a flat, worm-like parasite, ***Ribeiroia ondatrae***. The first hosts for these flatworms are freshwater snails that abound in ponds. "*Each night each of these snails can produce thousands, sometimes tens of thousands of these microscopic parasites,*" says Prof Johnson. When the parasites swim out and find tadpoles, they enter at the places where the tadpole limbs are about to grow and they form a cyst. The result is a deformed frog, with no limb or a twisted limb. And these frogs are easy catch for predator birds, which get infected themselves. The birds then spread parasite eggs through their faeces and infect more snails in the pond or in far-flung ponds.

"*Its humbling,*" Prof Johnson says, "*that this tiny, microscopic worm can manipulate all these other species and an ecosystem to is own benefit*."



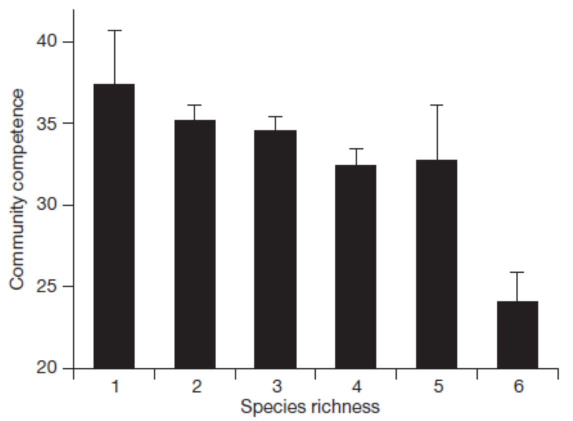
While flatworms are the reason for the deformities, the present study looks into what could be the ecological changes that make for this rise in the virulence of the flatworm parasite. The study notes that recent studies have linked biodiversity changes to shifts in disease risk of humans and animals. Many pathogens, like the flatworm in the present case, affect a number of species, and not all the species are equally effective as vectors or carriers forward, of the pathogen. There is, in fact, a distribution of vectors and there has been established, over time, a balance of organism population. Now, if there comes about a change, where the poor carriers of the pathogen start disappearing, the result will be a rise in virulence, or reduction of virulence if poor carriers begin to dominate. That the composition of the species in an ecosystem would influence the effects and drivers of changes in biodiversity has just started being recognized. And the present case, where there was a distribution of ponds and locations, with different conditions, offered an opportunity to study the effect of biodiversity on transmission of the pathogen, and then to simulate varying conditions in the lab.

Pond system survey

Johnson and colleagues noted that pond systems are well suited for this study, as they provide comparable assemblies of concerned species and allow comparisons with assemblies that differ gradually in the number of species which support the pathogen. Over three years, the team sampled the composition of supporting amphibians in 345 pond systems over a large region in California and over 24,000 instances of malformation of hosts were assessed. The ability of different species to support the pathogen were worked out and experiments were conducted to see if having more species together led systematically to the group of species being less supportive of the pathogen. The study also accounted for the roles played by different agents, such as the fresh water snails and huge data was collected of the levels of infection of snails and then to assess the effect of diversity of hosts on the effectiveness of the snail intermediates.

It was found that in naturally occurring systems, like in the case of the ponds, the most ***competent***, which is to say, the ***most pathogen-supporting*** species of amphibians, were also the most common species, and the fraction of this more competent component fell as the diversity of species increased, that is, when the numbers of less competent species increased. When the data of the competence of the different host species was integrated with the relative abundance of the species, it was seen that there was a 35.7% decrease in the combined competence of the different species that were present, as one passed from the least diverse to the most diverse distribution.

But when it came to the effectiveness of transmission from snails to hosts, it was found that diversity, or the richness of species in a population strongly moderated transmission – the level of transmission was just a sixth in the high diversity case, as compared to the level in low diversity. These results were confirmed in laboratory simulation, where increasing species richness from one species to three species reduced transmission by 64% . It is interesting that this reduction was not only because introducing more species reduces the density of the most competent species. As a test, when the density of the ***Pacific tree frog or the Pacific Chorus frog***, ***P.regilla***, the most competent amphibian, was kept unchanged with the addition of more species, there was still a 28% reduction in overall competence. In outdoor artificial arrangements to mimic real condition, the infections in P.regilla decreased by 50% between the least diverse state, of one species, to the diverse state of 4 species.



There were six main species in the ponds. When all six are present, the combined competence drops from about 37 to 24, a drop of 35.7%


Pacific tree frog or Pacific Chorus frog

“Our results lend mechanistic insight into how host diversity can reduce disease risk……………. In light of mounting evidence that higher biodiversity can buffer against pathogen exposure in human, wildlife and plant disease systems, preserving functional diversity—including both genetic diversity and community richness—has the potential to offer a novel, cost-effective approach to disease management,” the authors of the paper say.