Smithsonian Institution News

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Researchers Ask If Plant Neighbors Are Relatives To Predict Disease

Disease is an invisible hand, shaping plant communities across the globe and determining the outcomes of environmental change, weed invasions and agriculture and forestry management strategies. Whether or not a disease devastates a plant community depends on how related the plant species are and on how many individual plants of each species are present, according to research from the Smithsonian Tropical Research Institute (STRI). The results were published in Nature April 23.

"Just as certain families get hit harder during flu season, some plant species are more vulnerable to disease than others," said Ingrid Parker, research associate at the Smithsonian Tropical Research Institute and professor at the University of California, Santa Cruz. "In the past, people have mostly looked at the relationship between a single plant species and a single pathogen. We study the spread of plant diseases in whole communities by figuring out which plants in an area are related and estimating the number of individuals of each species and the level of infection for each. This lets us predict the impacts of disease at the community level for the first time."

The team, led by Parker and Greg Gilbert, also a research associate at STRI and professor at University of California, Santa Cruz, is hot on the trail of an elusive holy grail, the explanation for the incredible diversity of life in the tropics. A patch of plants in Ecuador, Peru or Panama may have 10 times the number of species as the same-sized patch in the U.S. or Germany.

"The leading theory for the origin and maintenance of tropical biodiversity suggests that disease hits the most common plant species the hardest, giving rarer species an advantage," Gilbert said. "But a lot of pathogens affect more than one species. Disease outbreaks are likely to affect neighboring species, too, especially close relatives. To make good models of how disease moves through plant communities, you have to know how closely the plants are related as well as how many of them there are."

Parker, Gilbert and their students measured the amount of leaf area showing disease symptoms on 43 different species in a coastal grassland in California and also determined how closely the plant species were related. Finally, they developed a model relating how susceptible each species is to fungal diseases.

They also set up a huge experiment in California, planting species in the same plant families but from other parts of the world. Some of them were closely related to locally common disease host plants and some more distantly related. Their prediction that close relatives would be more susceptible to local diseases panned out.

"We did these experiments in California, in part because people want to predict what happens when invasive weedy plants are introduced here," Gilbert said. "Our next question is whether the same rules apply to the way disease shapes other plant communities, like the much more species-rich tropical forests on Barro Colorado Island in Panama where we've done a lot of our work in the past. If they do, then we're getting pretty close to discovering general rules to predict the ecological and evolutionary forces that shape plant communities everywhere."

With researchers from North Carolina State University, the team created a model based on the U.S. Department of Agriculture's data base of fungal pathogens and their host plants, which links the degree to which plants are related to their disease susceptibility. By considering how plants in a community are related, researchers will gain a much better understanding of why crop introductions sometimes fail in areas where wild relatives are sources of damaging diseases and how invasive weeds gain a foothold in areas where there are no diseases to control their spread.

Funds for this project came from the U.S. National Science Foundation and the U.S. Department of Agriculture.

The Smithsonian Tropical Research Institute, headquartered in Panama City, Panama, is a part of the Smithsonian Institution. The institute furthers the understanding of tropical nature and its importance to human welfare, trains students to conduct research in the tropics and promotes conservation by

increasing public awareness of the beauty and importance of tropical ecosystems. Website: www.stri.si.edu.

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