Seeing The Forest And The Trees

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With human emissions of carbon dioxide on the rise, there is growing interest in maintaining the Earth's natural mechanisms that absorb and store carbon.

A new study released last week in the on-line edition of the journal Science suggests that tree diversity in tropical forests plays a crucial role in determining how much carbon these natural storehouses are able to hold, as well as their ability to provide other crucial ecosystem services such as preventing erosion.

The study was led by Daniel Bunker and Shahid Naeem from the Department of Ecology, Evolution and Environmental Biology at Columbia University and Fabrice DeClerck from the Earth Institute at Columbia University.

They simulated variations in forest diversity that resulted from a range of different extinction scenarios: those governed by biological characteristics such as low growth rate or limited growing range, those resulting from human activities such as selective logging, and those arising from environmental changes such as widespread drought.

As a result of the simulations, they found that the types of trees remaining after each scenario played out had a large and widely varying effect on the amount of carbon a forest would be able to store.

"Carbon sequestration is just one of the many services that tropical forests provide," said DeClerck. "The more ecosystem functions you

look at, the more important diversity becomes."

The study was based on data from the 120-acre Forest Dynamics Plot, a tropical forest on Barro Colorado Island in the Panama Canal run by the Smithsonian Tropical Research Institute that has been surveyed every five years since 1985.

Previous studies have found that nearly half of the estimated 52 billion tons of carbon stored in the Earth's biomass is found in tropical forests. By simulating different extinction scenarios and analyzing the resulting mix of tree species, the team was able to determine how much carbon the forest was able to hold.

They found, for example, that converting tropical forests to less-diverse tree plantations containing only species with high wood density such as teak resulted in a 75 percent increase in the forest's carbon-storage capacity--so long as the trees are not harvested.

By contrast, selectively logging trees with high wood density was found to reduce carbon storage by as much as 70 percent. Other scenarios, such as disease outbreaks that result in a selective loss of large or slow-growing trees, also produced a marked decline in the forest's ability to sequester carbon.

Moreover, the study concludes that forest diversity provides a measure of "biological insurance" that prevents large swings in carbon sequestration or any other service a healthy forest provides such as soil stability or fruit production that might arise from a single extinction scenario.

"In general, we found that when you have more species, things are more predictable," said Bunker, who was lead author on the study. "It's like having a diversified investment portfolio. Having many different types

of trees lowers overall variability of a forest's ability to provide crucial services."