Climate change forces major vegetation shifts

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This map shows locations of 15 cases of observed biome shifts due to climate change. Credit: Map by Patrick Gonzalez, et al.

(PhysOrg.com) -- Vegetation around the world is on the move, and climate change is the culprit, according to a new analysis of global vegetation shifts led by a University of California, Berkeley, ecologist in collaboration with researchers from the U.S. Department of Agriculture Forest Service.

n a paper published today (June 4) in the journal *Global Ecology and Biogeography*, researchers present evidence that over the past century, vegetation has been gradually moving toward the poles and up mountain slopes, where temperatures are cooler, as well as toward the equator, where rainfall is greater.

Moreover, an estimated one-tenth to one-half of the land mass on Earth

will be highly vulnerable to climate-related vegetation shifts by the end of this century, depending upon how effectively humans are able to curb greenhouse gas emissions, according to the study.

The results came from a meta-analysis of hundreds of field studies and a spatial analysis of observed 20th century climate and projected 21st century vegetation.

The meta-analysis identified field studies that examined long-term vegetation shifts in which climate, rather than impacts from local human activity such as deforestation, was the dominant influence. The researchers found 15 cases of biome shifts since the 18th century that are attributable to changes in temperature and precipitation.

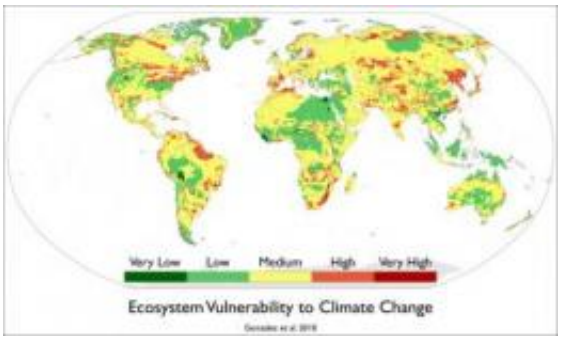
"This is the first global view of observed biome shifts due to climate change," said the study's lead author Patrick Gonzalez, a visiting scholar at the Center for Forestry at UC Berkeley's College of Natural Resources. "It's not just a case of one or two plant species moving to another area. To change the biome of an ecosystem, a whole suite of plants must change."

The researchers calculated that from 1901 to 2002, mean temperatures significantly increased on 76 percent of global land, with the greatest warming in boreal, or subarctic, regions. The most substantial biome shifts occurred where temperature or precipitation changed by one-half to two standard deviations from 20th century mean values.

Some examples of biome shifts that occurred include woodlands giving way to grasslands in the African Sahel, and shrublands encroaching onto tundra in the Arctic.

"The dieback of trees and shrubs in the Sahel leaves less wood for houses and cooking, while the contraction of Arctic tundra reduces

habitat for caribou and other wildlife," said Gonzalez, who has served as a lead author on reports of the Intergovernmental Panel on Climate Change (IPCC). "Globally, vegetation shifts are disrupting ecosystems, reducing habitat for endangered species and altering the forests that supply water and other services to many people."



Researchers identify areas of vulnerability to biome shifts, based upon observations of changes from the 20th century and projections of changes in the 21st century. Credit: Map by Patrick Gonzalez, et al

To identify the areas most vulnerable to future vegetation shifts, the researchers combined statistical analyses of observed climate data from the 20th century with models of vegetation change in the 21st century.

Based upon nine different combinations of IPCC greenhouse gas emissions scenarios and climate models, the researchers divided the world's land into five classes — from very high to very low — of vulnerability to biome shifts.

"Scientists had not quantified this risk before," said Gonzalez. "We developed a simple classification system that natural resource management agencies can use to identify regions in greatest need of attention and planning. We have worked with the U.S.D.A. Forest

Service and the U.S. Fish and Wildlife Service to explore the application of our results to adaptation of natural resource management."

Gonzalez said that because of limited resources, it may be prudent to focus on protecting areas of greater resilience to ecological changes so that they can serve as refuges for plants and animals. "It is also useful to identify places of higher vulnerability, because agencies will need to consider adaptation measures for vulnerable ecosystems," he said. "Some shifts in vegetation could increase fuel for wildfires, for example, so prescribed burning may be necessary to reduce the risk of catastrophic fires."

"Approximately one billion people now live in areas that are highly to very highly vulnerable to future vegetation shifts," said Gonzalez. "Ecosystems provide important services to people, so we must reduce the emissions that cause climate change, then adapt to major changes that might occur."

Provided by University of California - Berkeley

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