Ecosystem management must consider human impact too

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Michigan Tech PhD student Azad Henareh uses remote sensing images and data to identify sudden forest loss in western Iran. The research approach and factors involved are similar to those discussed in the Oct. 14, 2011 issue of the journal Science.

For a long time, ecologists have believed—and others accepted—that when it comes to whether a land mass is covered with forests or grasslands, climate controls the show. They thought that the amount of rain, temperature and frequency of wildfires determine whether the ground will be covered with trees or grasses.

Maybe not, say two scientists writing in the Oct. 14, 2011, issue of the journal *Science*. In a review of their papers in a Perspectives article in the same issue of Science, Michigan Technological University researcher Audrey Mayer suggests that future studies also need to consider other factors—specifically, grazing patterns and human activities—when

planning for sustainable management of the world's forests and savannas or prairies. .

"Humans like to think everything is linear," says Mayer, an assistant professor of ecology and environmental policy with joint appointments in Michigan Tech's School of Forest Resources and Environmental Science and the College of Sciences and Arts Department of Social Science. "So we have assumed that if we want to restore a forest where there is now savanna, that we just need to plant some trees and the spaces between them will fill in with trees. Not so."

The grasses of savannas and prairies are highly flammable and promote their own spread through frequent fires, she explains. "Simply planting some saplings will mean that those saplings will die in the first fire that sweeps through. Far more effort and understanding is required to restore these ecosystems."

Mayer's graduate student, Azad Henareh Khalyani, is a co-author on the Perspectives article. He is studying similar dynamics in oak forests and savannas in Iran.

The papers they discuss are written by A. Carla Staver of Princeton University and colleagues, and Marina Hirota and colleagues of Wageningen University, The Netherlands. They found that forests, savannas and grasslands worldwide are maintained by the same three mechanisms: a strong feedback between vegetation and precipitation; a strong feedback between rainfall seasonality and grass; and a very strong feedback between grass and fire.

Both reports identify an unstable state at 50 to 60 percent tree cover; either trees take hold and promote their own growth hydrologically (and suppress fire), or grasses take hold and promote their expansion through fire, Mayer says. "This work has implications for the resilience of these

ecosystems in the Southern Hemisphere," she notes. "Large areas of savanna in Africa could shift to forest if fire and grazing are suppressed, and large areas of forest in South America could convert to savanna as climate change and local human impacts such as logging interact with rainfall seasonality and fire."

However, Staver and Hirota do not analyze several other important mechanisms, Mayer goes on to say. Large herbivores such as horses and antelope evolved in concert with savannas and grasslands, and their grazing in turn has an impact on the perpetuation of their feeding areas, she explains. "Topography—the surface features of a place—may also influence microclimates and thus, fire spread and vegetation. Finally, prehistoric and historic human activities had a sizable influence on the forests, savannas and grasslands that exist today."

Human activity will continue to influence the distribution and resilience of forests and savannas in a number of ways, Mayer and Henareh observe. "Fire suppression, grazing of domesticated animals, forest harvests, restoration efforts and contributions to climate change all have effects," they point out. "Future studies should examine the impacts of human activities on the natural feedback systems in forests and savannas in both hemispheres, to assist the development of better-informed management and restoration plans."

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