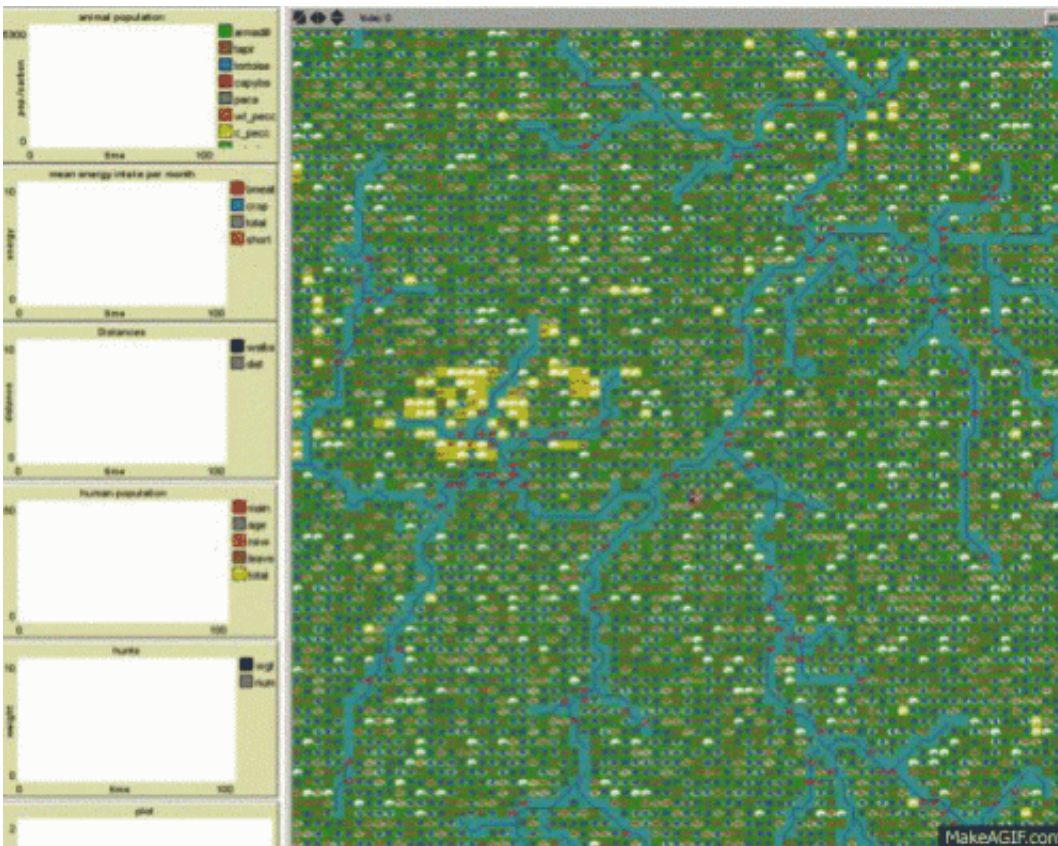


Scientists develop computer model to examine fate of indigenous peoples

June 16 2014, by Bjorn Carey



A computer model simulates the expansion of cultivated areas to reach a stable state. Color of the cell represents type of land cover: green, forest; yellow, grassland; blue, water; pink, cultivated land. Credit: Iwamura et al.

(Phys.org) —Modern culture and technology have infiltrated all but the very most isolated places on Earth, changing forever how the people in

those areas interact with both themselves and the outside world. Stanford scientists have developed a computer model to understand how outside influences can affect the sustainability of indigenous people in the Amazon.

Roughly 45 percent of the planet's terrain remains covered by natural vegetation – the rest has been developed as cities or agriculture, or is ice – and about half of that land is controlled by indigenous peoples. These spaces store huge quantities of carbon – thus keeping it out of the atmosphere – and provide habitats for most of the world's biodiversity of animals and plants.

Most indigenous peoples now have frequent contact with other cultures and have experienced improved health care and Western-style education, said Jose Fragoso, a senior scientist in the Department of Biology at Stanford and co-author of the new [model](#). "These societal changes can affect how much [natural vegetation](#) occurs by changing how much farming people do," Fragoso said. "Or if they need to hunt more, that can change the number of animals on their lands."

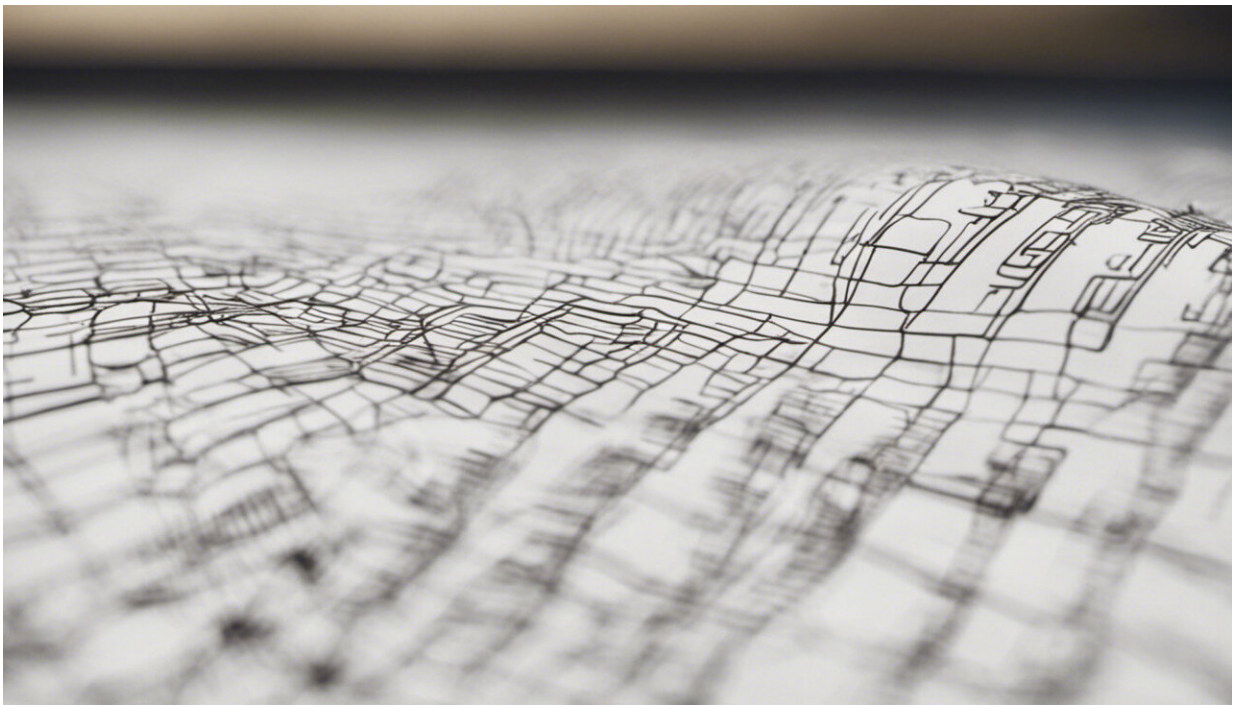
Now, Fragoso has partnered with Eric Lambin, a professor of environmental Earth system science (EESS) and a senior fellow at the Stanford Woods Institute for the Environment, and Takuya Iwamura, a postdoctoral scholar in the departments of Biology and EESS, to develop a computational tool for simulating how these types of land-use changes affect the sustainability of these areas.

The work, which was also co-authored by Jeffrey Lutz of the U.S. State Department and Kirsten Silviu, currently of the Gordon and Betty Moore Foundation, is detailed in the journal *Environmental Modelling & Software*.

Counting calories

The scientists devised a model based on the relationships between various ecological factors that affect indigenous communities, such as the rate of deforestation, changes in the diversity of vegetation, agricultural output, hunting practices, and the abundance and diversity of the 10 most-hunted species.

They then projected how changes in these parameters could increase or decrease a community's growth rate. Population growth was limited by the caloric demand of humans, and how much nutrition the land and animals could reasonably supply.



Credit: AI-generated image ([disclaimer](#))

"This makes it more of a universal model, because all people need

calories," Fragoso said. "They must meet their daily caloric requirement. If they farm more to do that, then they hunt less, or vice versa. But that drives the system and causes all the changes to occur."

To test the model, the scientists entered historical population data for two villages in the Amazon that Fragoso has been closely involved with for several years.

"We developed the model that captures complex interactions between people and environment. To examine how the model works compared with field data, we started with an undisturbed village, and ran the model for 100 years to project how that village and area would grow and change," Iwamura said. "The population increases as animal population and vegetation cover reduce, but at some point it stabilizes, and that number closely matches what we see in the field."

The model revealed that in an environmental system dominated by hunting and some cultivation, the forest and biodiversity of the system can balance with the livelihoods of [indigenous people](#) if the human population stays within a relatively narrow sustainable range.

"Once indigenous populations move outside that space, the land use rapidly shifts to another state characterized by a much lower forest cover, with negative impacts on both biodiversity and carbon stocks in the vegetation," Lambin said.

Changing future behavior

Fragoso suggests collaborating with governments, institutions and agencies to apply the model. Many such entities are already interested in this model, or one like it, to help institute policy and management regarding indigenous lands.

"Few such areas may still remain in the modern world, but preserving that cultural diversity is very important," Lambin said. "The model helps us to understand under what conditions these traditional, indigenous systems can be sustained."

They also hope to expand the model's scope to examine how activity on the outskirts of an indigenous land can affect sustainability. For example, Brazil has become the largest soybean producer in the world, in part because farmers have converted forests into farmlands that run right to the edge of indigenous areas. Similar development is occurring with hydroelectric dams and roads.

"What happens to those people and sustainability of a system when you develop right up to the edge?" Fragoso said. "This model could eventually allow us to make these sorts of projections."

The scientists caution that the model can't currently answer all questions. The initial version only considered the relationships between humans and animals and the forest, but educational, behavioral and policy factors also play a critical role in guiding the [sustainability](#) of these areas.

"As other models, this is based on our assumptions and doesn't tell you every single thing," Iwamura said. "But it simplifies reality on certain aspects, and it can be useful to tease out some really complex realities, and helps to identify the important mechanism which causes societal and ecological changes."

Future versions could incorporate these other external factors. In the case of education, the scientists are hopeful that they can guide communities toward sustainable decisions by showing them how the location of a farm and how often they crop it could affect the surrounding vegetation and animal populations years down the road.

More information: Takuya Iwamura, Eric F. Lambin, Kirsten M. Silvius, Jeffrey B. Lutzar, José M.V. Fragoso, "Agent-based modeling of hunting and subsistence agriculture on indigenous lands: Understanding interactions between social and ecological systems," *Environmental Modelling & Software*, Volume 58, August 2014, Pages 109-127, ISSN 1364-8152, [dx.doi.org/10.1016/j.envsoft.2014.03.008](https://doi.org/10.1016/j.envsoft.2014.03.008).

Provided by Stanford University

Citation: Scientists develop computer model to examine fate of indigenous peoples (2014, June 16) retrieved 3 July 2024 from <https://phys.org/news/2014-06-scientists-fate-indigenous-peoples.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.