A mathematical approach to protecting endangered plants

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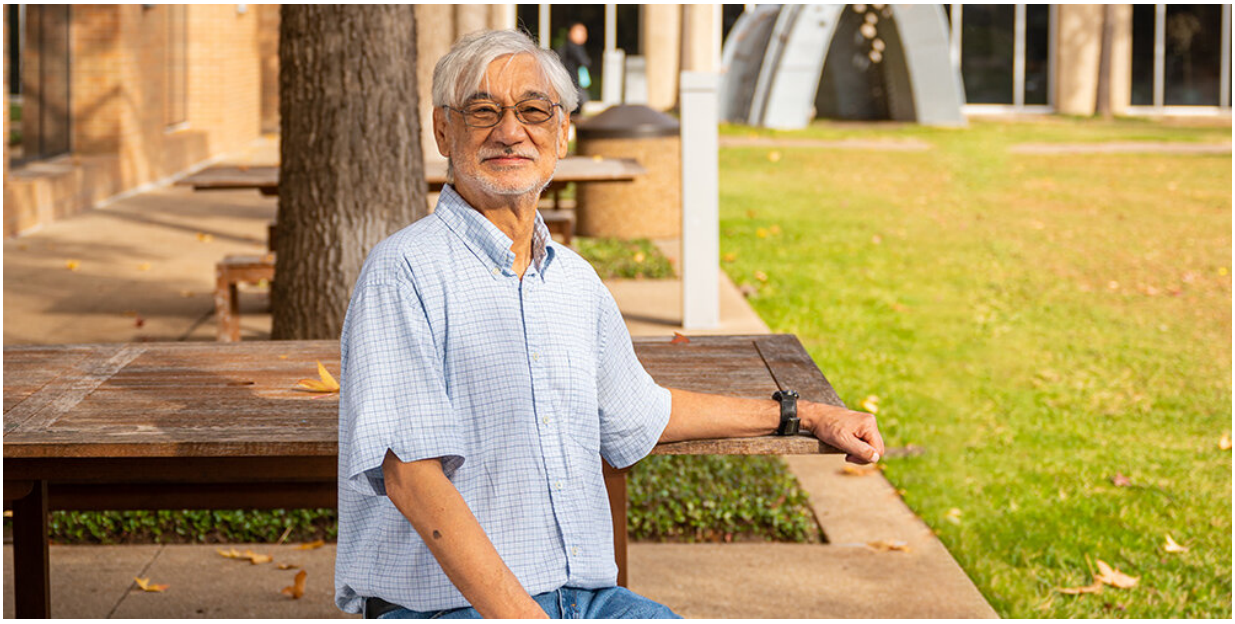

Professor Benito Chen-Charpentier. Credit: University of Texas at Arlington

In a new study published in the journal *Ecological Modelling,* a team of researchers led by Benito Chen-Charpentier, professor of mathematics at The University of Texas at Arlington, devises a mathematical model to calculate the minimum habitat size for endangered plant species.

Due to human activities and population growth, the rate of species extinction and ecosystem degradation is increasing worldwide.

Endangered plant species face challenges of habitat reduction caused by extreme weather, invasive species, infectious disease and human disturbances.

To assist in conservation efforts, Chen-Charpentier and colleagues developed and published a practical mathematical model to discover the minimum habitat area needed to sustain plant populations in fragmented landscapes.

"Mathematical modeling is an important tool to obtain insights into many aspects of ecosystem sustainability and management," said Chen-Charpentier, who is senior author of the study. "Mathematicians can do a lot to help ecologists and biologists solve today's most urgent problems in species conservation."

The study, "Modeling the persistence of plant populations in fragmented ecosystems," is among the first to provide practical answers to the key question of minimum or optimal habitat size to protect populations in fragmented ecosystems. Chen-Charpentier said most studies fail to address this central question, and scientists' understanding of and capacity to predict the effects and outcomes associated with fragmentation is still elusive.

Using data from the Biological Dynamics of Forest Fragments Project, one of the largest and longest data collection experiments to analyze the ecological impact of habitat fragmentation, the team developed an ordinary differential equation to determine the minimum patch size necessary to sustain populations of Heliconia acuminata, an Amazonian herb native to South America.

The researchers found a significant correlation between fragment area and growth rate, confirming that the herb's death rate responds more negatively to smaller habitat sizes. Further investigations are needed to

verify if these findings can be applied to other plant populations in fragmented systems.

Chen-Charpentier said the study's findings will not only help scientists, but could also aid architects and city planners looking to minimize environmental disturbances.

"When a city is developing a highway system, its planners may notice a plant population in the area that would not be able to survive the habitat reduction caused by construction," Chen-Charpentier said. "Now, they could use mathematical modeling to calculate the optimal habitat size and adjust their plans to support the local ecosystem."

More information: Maria C.A. Leite et al, Modeling the persistence of plant populations in fragmented ecosystems, *Ecological Modelling* (2021). DOI: 10.1016/j.ecolmodel.2021.109681

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