Protecting ecosystems, pollution remediation goals of research at UH

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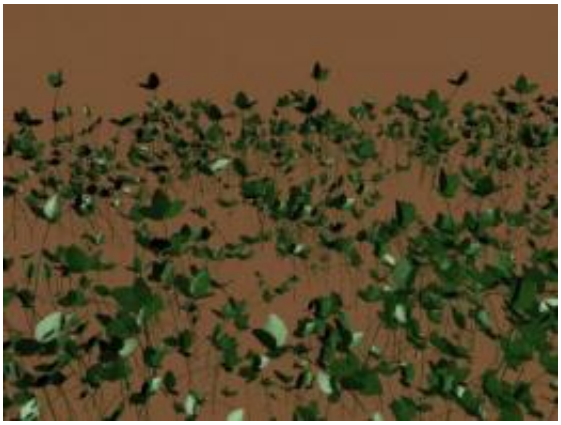

This rendering of the guerrilla trifolium (clover) used in 3-D animation of the virtual prairie project is based on professor Marc Garbey's computer data generated for this project at the University of Houston. Credit: Jose Baez

Cleaning up pollution, protecting soil from erosion and maintaining species-rich ecosystems are some of the goals of a computational ecology project by a University of Houston (UH) scientist and his team. Published recently in a top journal, the work sheds light on a new method to speed up research in the ecology of plants.

Marc Garbey, a professor of computer science and mathematics at UH, and his fellow researchers describe these findings in a paper titled "Large scale parameter study of an individual-based model of clonal plant with volunteer computing," appearing in a recent issue of

Ecological Modelling. The journal covers the use of mathematical models and systems analysis in ecological processes and sustainable resource management.

"Most plant communities outside of forests are dominated by clonal plants, which are basically genetic clones of one another," Garbey said. "These plants are able to colonize space by vegetative reproduction, and the clonal plant communities such as grasslands are of tremendous importance to humanity."

Underscoring their importance, Garbey says that prairies are used for raising cattle and may support biodiversity, as well as play an important role in regulating carbon emissions. These ecological functions will be increasingly important in the future framework of global change. Ecologists wish to better understand how clonal plant arrangements may have an effect on these functions. That's where Garbey's talents as a computational scientist come in.

Pictured here is the clonal plant community developed in France to exactly match the simulation conditions from professor Marc Garbey's work at the University of Houston. Credit: Marc Garbey

His team's research looks at the interactions between plants and their dynamics, using a "virtual prairie" that involves trying to understand clonal strategies in complex ecological systems. His main collaborator is his daughter, Cendrine Mony, an assistant professor in ecology at the University of Rennes in France, and they published their first paper together on this topic five years ago. While Mony and her collaborators provide expertise in the ecology of plants, Garbey's group provides capabilities in computational science.

"We grow plants virtually, mimicking nature to try to get the fundamental mechanism of how a community changes in time and space, by comparing our computer simulation with a special series of live experiments done in France," Garbey said. "Once the model works, we manipulate the plant growth in our computers simulating a series of 'bad' scenarios, such as lack of water and nutrients, intensive grazing or mowing and adding virtual pollution. Our computer simulations dramatically increase our capability to test various scenarios or ideas."

Using this method, the researchers would ultimately be able to design the ideal prairies by combining the right species that would offer a variety of ecological benefits. Among these benefits are creating prairies able to clean up nitrate pollution so that it does not go back into the water system, providing stability where vulnerable species can coexist and preventing erosion by repairing the ground.

In addition to the various field experiments, a crucial element in this research is the thousands of volunteers around the world who donate time and space on their computers. To carry out these time- and space-intensive computer simulations efficiently, Garbey and his collaborators relied on their virtual prairie program's more than 10,000 volunteers in 90 countries. This is an arrangement where people volunteer to provide computing resources on their personal PCs for information processing, problem solving and storage of the researchers' work. The virtual prairie

project extensively uses the open-source software computing platform of David Anderson, a professor in the University of California, Berkeley's space sciences laboratory and adjunct professor in the computer science department at UH.

Beyond the help that it provides Garbey's project, benefits of volunteer computing include encouraging public interest in science and providing the public with a voice in determining the directions of scientific research. While volunteers are typically members of the general public who own Internet-connected PCs, organizations such as schools and businesses also may volunteer the use of their computers.

"Ecology of plants is important for us, as well as the next generation, and large-scale computer simulation with virtual prairies is going to change the way we do research and drive experiments," Garbey said. "It is a wonderful concept to engage volunteers all around the world in this new kind of science and also may be used to improve other types of ecosystems in the future."

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