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Board game helps Mexican coffee farmers grasp complex ecological interactions

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ANN ARBOR—A chess-like board game developed by University of Michigan researchers helps small-scale Mexican coffee farmers better understand the complex interactions between the insects and fungi that live on their plants—and how some of those creatures can help provide natural pest control.

Instead of queens, knights, bishops and pawns, the Azteca Chess board game uses tokens representing ants, ladybugs, wasps and flies living on a shade-coffee bush. The goal of the two-player game is for each player to capture the opponent's insect tokens.

The network of insects and fungi that live on these plants has the potential to aid in the control of the coffee-rust fungus, which has ravaged Latin American plantations for several years, according to University of Michigan ecologists Ivette Perfecto and John Vandermeer, who helped develop the board game. The game helps to drive home that point.

"Most of these farmers pay little attention to, or have little knowledge of, the behavior of the many small, inconspicuous organisms that may be key to the operation of autonomous pest control," said Perfecto, a professor at the U-M School of Natural Resources and Environment.

"Our goal is to help farmers to continuously update their management strategies based on a better understanding of the ecology of their farms, and we believe this board game helps us to facilitate that kind of learning."

Perfecto and Vandermeer, a professor in the U-M Department of Ecology and Evolutionary Biology, have operated research plots at an organic coffee farm in southern Chiapas, Mexico, for more than 20 years.

They have extensively researched the basic ecological interactions of a nine-species network found on Mexican coffee bushes. This ecological web includes tree-nesting Azteca ants, a sessile coffee-scale insect, ladybugs, parasitic wasps and parasitic flies.

In 2015, the U-M researchers held 14 workshops in Chiapas for more than 100 small-scale coffee farmers. The workshops included natural history lectures and Azteca Chess competitions, as well as quizzes to assess the value of the board game named for the tree-dwelling ants.

The quizzes revealed a statistically significant "gaming effect," showing that farmers who played the game were better able to recall the species interactions than farmers who attended lectures but did not play the game.

The researchers report their findings in a paper published online June 19 in the journal *Ecology and Society*. The paper's first author is Luís García Barrios of El Colegio de la Frontera Sur in Chiapas.



Mateo Verdugo- whom coincidentally lives in the small hamlet of "Azteca" on the slopes of the Tacaná Volcano- enjoys playing Azteca Chess

The Azteca Chess board displays 39 hexagonal section of a coffee bush. Various insects are re
The goal is for each player to capture the opponent's insect tokens.

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In real-world Mexican coffee plantations, Azteca ants protect tiny sap-sucking bugs called scale insects, which produce a sugary excretion called honeydew. Ladybugs and parasitic wasps try to consume the scale insects, but the ants stand guard in exchange for sips of honeydew.

Participants in the 2015 Chiapas workshops said they were amazed and amused when they learned of the insects' elaborate behaviors.

"There are so many little animals in our coffee farms that we prefer to ignore them," one farmer told the researchers. "I had no idea there was a chain and each animal has a function and they compete."

In addition, workshop participants said they were intrigued to learn that some of the tiny creatures can help them fight coffee rust. Farmers said they learned there are feasible actions they can take to promote this type of natural pest control, including tolerating Azteca ants and retaining the trees they use for nesting, tolerating scale insects, reducing the use of pesticides that kill beneficial organisms, and paying more attention to small creatures and their behaviors.

"You came today to awaken our belief that our coffee farms are not 100 percent lost" to the coffee rust fungus, one farmer said. "We have defenders, ants that are struggling for us. We are very rude with them, but starting today we are going to give ants a little bit of freedom. We won't mess with them, just let them be there."

The other co-author of the Ecology and Society paper is Juana Cruz-Morales of Universidad Autónoma de Chapingo, Campus Chiapas, Mexico. Workshops were supported by an NSF/OPUS grant 1144923 to I. Perfecto: Ecology and Complexity of the Coffee Farm, and by ECOSUR's special grant to L. García: Family Agriculture.



Dr. Ivette Perfecto and Dr. John Vandermeer inspecting organisms on coffee leaves at Sierra Madre de Chiapas

More information:

Paper: [The Azteca Chess experience: learning how to share concepts of ecological complexity with small coffee farmers](#)