

# **CHALLENGING OLD ASSUMPTIONS ABOUT AGRICULTURE: FINDING THE ECOLOGICAL BASES FOR NEW FORMS OF PRODUCTION**

John Vandermeer - Department of Biology  
Ivette Perfecto - School of Natural Resources & Environment

December 2, 1999

Presented At Fall 1999 Colloquium:  
Research in the Interest of the Public and the Environment  
Interdisciplinary Problems and Solutions at the University of Michigan

Sponsored by University of Michigan's:  
The Steering Committee on Environmental Issues and Research on Campus  
Office of the Vice President of Research  
The Erb Environmental Management Institute

VANDERMEER:

## **What is the environmental challenge you are addressing?**

The need to establish sustainable agricultural landscapes.

## **Please provide a brief history of your research on this subject.**

I began work in Nicaragua subsequent to Hurricane Joan in 1988. I have permanent plots in rainforest areas that I have been monitoring for the past 10 years. Recently I began a new project looking at the effects of agricultural type on post agricultural succession in eastern Nicaragua and Northern Guatemala.

## **What are some of the proposed solutions to this challenge or major research findings?**

That sociopolitical concerns are of paramount importance for the implementation of any technical solutions that may emerge.

## **What is your research agenda on this challenge for the future?**

We shall be continuing the monitoring program in the rain forest areas of Nicaragua and Guatemala. Additionally we shall initiate research on sustainable agricultural systems here in Michigan in the near future.

**Which people or groups are involved in this study (name and association)?**

Doug Boucher, Hood college

Inigo Granzow de la Cerda, Biology, Univ. of Michigan,

Ivette Perfecto, SNRE, U of M

Dan Griffith, Grad student, Biology U of M

Bruce Ferguson, grad student, U of M

Centro para Investigaciones y Documentacion de la Costa Atlantica (Nicaragua)

Javier Ruiz, UCA, Nicaragua

Gladys Luna, URACCAN, Nicaragua.

**What are the primary funding sources for this type of research?**

Currently we are supported by a grant from the National Science Foundation.

Please provide a list of key references that one could pursue if interested in this type of research

Agroecosystem complexity, productivity and sustainability (Anderson, Ong, and Vandermeer) in Swift, M. J. and J. S. I. Ingram (eds) Effects of Global Change on Multi-species Agroecosystems. GCTE Focus 3 office, Wallingford, UK (1996).

La recuperacion del bosque continua en la RAAS. (Vandermeer, Granzow de la Cerda, Perfecto). Wani, 20:38-45 (1996).

Theory of periodic disturbance and the preservation of species diversity: Evidence from the rain forest of Nicaragua subsequent to Hurricane Joan. (Vandermeer, Boucher, Perfecto, and Granzow) Biotropica 28:600-613 (1996).

The agroecosystem: A need for the conservation biologist's lens. (Vandermeer and Perfecto) Conservation Biology, 11:591-592 (1997).

Contrasting growth rate patterns in eighteen tree species from a post-hurricane forest in Nicaragua. (Vandermeer, Boucher, and Granzow) Biotropica 29:151-161 (1997).

Syndromes of production: an emergent property of simple agroecosystem dynamics. J. of Environmental Management. 51: 59-72 (1997).

Global change and Multi-species agroecosystems: Concepts and issues. (Vandermeer, van Noordwijk, Anderson, Ong, and Perfecto). Agric. Ecosystems and Environment, 67:1-22 (1998).

Maximizing crop yield in alley crops. Agroforestry Systems 40:199-206 (1998).

Acumulacion de especies siete anos despues del hurican juana en Nicaragua. (Granzow, Zamora, Boucher and Vandermeer,). *Biologia Tropical* 45:1409-1419 (1998).

Biodiversity and pest control in agroforestry systems. (Vandermeer and Perfecto) *Agroforestry Forum* 9:2-6 (1998).

The political ecology of deforestation in Central America. (Vandermeer and Perfecto) *Science as Culture* 7:519-555. (1998)

Growth rates of tree height six years after hurricane damage at four localities in eastern Nicaragua. (Vandermeer, Brenner, and Granzow), *Biotropica* 30:502-509 (1999).

**What are the potential opportunities for interdisciplinary research in this area, including that involving graduate students?**

Opportunities exist for economists, sociologists, natural resource managers, ecologists and others to join with this group. It is already a large group. Expeditions to Nicaragua are usually more than 30 researchers.

PERFECTO:

**What is the environmental challenge you are addressing?**

Most tropical forests are fragmented and much research attention has been given to questions related to the maintenance of biodiversity within these "islands" of forest. I argue that we need to approach this issue from a landscape perspective. This leads us to examine not just the forest fragments but also the agricultural matrix in which these fragments are embedded. Some tropical agroecosystems have a high floristic diversity and complex structure, which resemble that of forests. These agroecosystems help maintain biodiversity at the landscape level, decrease the probability of species extinction in the fragments by allowing the movement of individuals between fragments, and at the same time, represent an economic alternative for rural communities in the tropics.

**A brief history of the research on this subject.**

For the last ten years I have been documenting high levels of biodiversity in some tropical agroecosystems. Using the traditional shaded coffee system, I have documented levels of arthropod diversity comparable to those reported for tropical forests. In the 1980s development and international financial agencies stimulated the intensification of these diverse coffee plantations in order to increase production. The intensification consisted primarily on the elimination of shade trees from the plantations. We documented the loss of biodiversity concomitant with the intensification of coffee

plantations. More recently we began investigating the role that shaded plantations play in the conservation of biodiversity at a landscape level.

**What are some of the proposed solutions to this challenge or major research findings?**

Major research findings are that 1) traditional shaded coffee plantations contain extraordinarily high levels of biodiversity and that 2) the shaded plantations act as high-quality matrices that allow the establishment and movement of forest species. We also found that the more shade there is in a plantation, the higher the contribution to the preservation of biodiversity. But there is a dilemma: the more shade, the lower the production. Therefore, farmers will be inclined to reduce the level of shade to increase production. A possible solution to this problem is to provide a premium price for coffee that is grown under shade to compensate farmers for the loss in production. We are, therefore contributing to the establishment of criteria for the certification of "shaded coffee."

**What is your research agenda on this challenge for the future?**

In the future we plan to investigate the function of biodiversity in terms of pest regulation in the coffee plantations. The basic idea is that the higher the diversity of organisms in the plantation, the more control mechanisms there will be and the lower the possibility for a pest outbreak. This will also provide some incentive for farmers to maintain diverse shaded coffee plantations.

Which people or groups are involved in this study (name and association)?

Ivette Perfecto, SNRE, University of Michigan

John Vandermeer, Biology Department, University of Michigan

Russell Greenberg, Smithsonian Center for Migratory Birds

Guillermo Ibarra, Colegio de la Frontera Sur, Mexico

**What are the primary funding sources for this type of research?**

National Science Foundation

### **Key references that one could pursue if interested in this type of research**

Soto-Pinto, L., I. Perfecto, Castillo-Hernandez, J. and Caballero-Nieto, J. In Press. Shade effects on coffee production at the Northern Tzeltal zone of the State of Chiapas, Mexico. *Agriculture Ecosystems and Environment*.

Vandermeer, J., van Noordwijk, M., Anderson, J., Ong, C. and Perfecto, I. 1998. Global change and multi-species agroecosystems: concepts and issues. *Agriculture, Ecosystems and Environment*. 67: 1-22.

Perfecto, I., P. Hansen, J. Vandermeer, and V. Cartón. 1997. Arthropod diversity loss and the technification of a tropical agroecosystem. *Biodiversity and Conservation* 6: 935-945.

Vandermeer, J. and I. Perfecto. 1997. The agroecosystem: a need for the conservation biologist's lens. *Conservation Biology* 11: 1-3.

Perfecto, I., R. Rice, R. Greenberg, and M. Van der Voort. 1996. Shade coffee as refuge of biodiversity. *BioScience* 46: 589-608

Perfecto, I. and R. Snelling. 1995. Biodiversity and tropical ecosystem transformation: ant diversity in the coffee agroecosystem in Costa Rica. *Ecological Applications* 5: 1084-1097.

Perfecto, I. 1994. Foraging behavior as a determinant of asymmetric competitive interactions between two ant species in a tropical agroecosystem. *Oecologia* 98: 184-192.

### **What are the potential opportunities for interdisciplinary research in this area, including that involving graduate students?**

- Social and economic studies related to livelihood strategies of small coffee producers.
- Social studies on the involvement of organic coffee cooperatives in the shade coffee movement.
- Market studies examining the potential market for shade coffee.
- Biodiversity studies that evaluate existing coffee certification program.
- Landscape ecology studies that compare fragments of forests embedded in high and low quality matrices.
- Cost benefit analysis of high shade density and diversity in the coffee agroecosystem