

Editorial

Earthworms as Invasive Species in Latin America — the 2nd Latin American Meeting on Oligochaeta (Earthworm) Ecology and Taxonomy

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"A fact is a simple statement that everyone believes. It is innocent, unless found guilty. A hypothesis is a novel suggestion that no one wants to believe. It is guilty, until found effective."—Edward Teller (1908-2003)

This special issue is based on scientific contributions presented at the 2nd Latin American Symposium of Earthworm Ecology and Taxonomy (ELAETAO, for its Spanish acronym) held in San Juan, Puerto Rico November 14-18, 2005. The first of these symposia was organized by George G. Brown and Klaus D. Sautter and held at Londrina, Brazil from December 1-3, 2003. The objective of the first symposium was to summarize the state of knowledge on the ecology, biodiversity and distribution of earthworms in Latin America and of their usefulness as bio-indicators in various natural and agricultural ecosystems. The present issue is focused on the ecology and taxonomy of earthworms in Latin America, with the general theme of "Earthworms as invasive species." Symposium participants evaluated the knowledge of earthworm ecology and taxonomy in Latin America with particular emphasis on the relative importance of exotic vs. native earthworms and their effects on ecosystem processes and services. The symposium included 39 invited and contributed talks and posters, two workshops, and a demonstration on vermi-composting techniques. A one-day taxonomy course taught by Samuel James immediately followed the 2nd ELAETAO (Fig. 1).

Workshops at the symposium dealt with the following topics: possibilities of cross-site studies and/or experiments, potential

synthesis efforts, and proposal writing and prospective funding agencies in Latin America. An unprecedented result from the various workshop deliberations was a Memorandum of Understanding (MOU) which was signed by fifteen of the participants from eleven countries agreeing to "work actively towards setting important research directions for earthworm ecology and taxonomy in the Americas and to define a research agenda that would include dissemination of results and new knowledge" (Fig. 2). Furthermore, the MOU states that "this knowledge would be widely distributed and accessible to fellow researchers and land managers for better understanding and use of soil ecological principles and for soil and biological conservation". These goals are not trivial as language barriers and financial support often limit the dissemination of scientific knowledge in many Latin American countries.

The publication of this special issue of the Caribbean Journal of Science (CJS) furthers those goals stated in the MOU and adds to recent literature synthesizing earthworm invasions in Canada, the United States, Europe and Australia. Recently, Paul F. Hendrix edited a Special Issue of the journal Biological Invasions on this topic (September 2006). In Latin America (as in temperate North America), the invasions of exotic earthworms can be generally



FIG. 1. Participants to the taxonomy course of the 2nd Latin-American Symposium of Earthworm Ecology and Taxonomy held in San Juan, Puerto Rico. 1) María de los Angeles Sánchez-Rosa, 2) Xiaoming Zou, 3) Yaniria Sánchez-de León, 4) Maria Stella Zerbino, 4) Grizelle González, 6) Yolmar B. Ríos, 7) Sandra C. Tapia-Coral, 8) Malena Sarlo, 9) Sonia Borges, 10) Esperanza Huerta Lwanga, 11) Samuel W. James, 12) Catalina C. Mischis, 13) Beto Pashanasi, 14) Tawainga Katsvairo, 15) Ching-Yu Huang, 16) George G. Brown, 17) Gabriella Jorge, 18) Paul H. Hendrix, 19) Christina M. Murphy. Not in the picture: Alexander Feijoo-Martínez, and Bruce A. Snyder.

explained by the historical dispersal of humans and commerce. Most recently, advances in communication technology (e.g., internet access) have facilitated the sale and export of exotic earthworms internationally via e-commerce. Thus, the transport of living goods over the long history of *mestizaje* (mixture of foreign cultures), combined now with ready availability of earthworm-associated commodities (e.g., horticultural or vermi-composting materials) add to the challenges that scientists and managers must face in pursuit of the study of the ecology and taxonomy of earthworms in Latin American countries. Although not all countries in Latin America are covered here, this collection of papers reflects the state of our knowledge of native and exotic earthworms in this part of the world.

About sixty percent of these papers explore a wide range of issues dealing with the diversity, community structure, and distribution of earthworms in Latin America. Richardson et al. explore the biogeography of epigeic worms in bromeliads of Dominica and Puerto Rico. They report that earthworms in Dominica occurred in more than 90% of the plants and made up a large portion of the total invertebrate biomass, whereas in Puerto Rico earthworms were less abundant. Mischis and Herrera review the distribution of exotic earth-

worms in Argentina and confirm that during the last five decades, growers who cultivate earthworms for vermiculture are responsible for the introduction of *Eisenia andrei* and *E. fetida* into this country, as they imported cocoons and individuals from the USA. On the other hand, Zerbino et al. explore the potential use of earthworms as biological indicators in the development of sustainable ecosystems. Grosso et al., Feijoo et al., Zou et al., Sánchez et al., and Huerta et al. provide evidence of a large incidence of exotic earthworm species in agroecosystems of Uruguay, Colombia, Puerto Rico, Costa Rica and Mexico, respectively. Yet interestingly, there are also reports of native earthworms thriving under intensive management, as observed in an inundated rice field in Uruguay (Grosso et al.), in degraded pastures and row crops in Brazil (Nunes et al.), dominating more than 70% of the total density of earthworms in sugarcane and banana fields in Mexico (Huerta et al.), or present in combination with exotic worms in a Colombian pasture above 2000 m (Feijoo et al.). Nevertheless, results from Zou et al. support the findings from other studies that converting tropical forests to pasture lead to the reduction of particular functional groups of earthworms in these soils. In this regard Huang et al. propose that biotic factors, such as competitive exclusion of native earthworms by

MEMORANDUM OF UNDERSTANDING

among the
Participants of the Second Latin American Meeting on the Ecology and Taxonomy of Earthworms,
San Juan, Puerto Rico, November 14-18, 2005

This **MEMORANDUM OF UNDERSTANDING** is hereby entered into by and between the participants of the Second Latin American Meeting on the Ecology and Taxonomy of Earthworms (ELAETAO).

A. PURPOSE: To work actively towards setting important research directions for earthworm ecology and taxonomy in the Americas and to define a research agenda including dissemination of results and new knowledge generated by the participants. This knowledge will be widely distributed and accessible to fellow researchers and land managers for better understanding and use of soil ecological principles, and for soil and biological conservation.

B. STATEMENT OF MUTUAL BENEFIT AND INTERESTS:

The Participants of the Second Latin American Meeting on the Ecology and Taxonomy of Earthworms (hereafter: Participants) have a mutual interest in the generation of new knowledge on earthworm ecology and taxonomy, on their interactions with the environment and other biota and their impacts on soils, biological diversity, and human well-being, such that economic systems that promote sustainability and economic viability of diverse native and agricultural ecosystems and other land uses are supported.

Accomplishment of the stated goals and agenda is to the benefit and interest of the Participants. The following research and educational goals are important to earthworm ecology and taxonomy in the Americas:

1. Understand, quantify and predict the role of earthworms in the development of sustainable agriculture and in the functioning of agricultural and natural ecosystems and their services.
2. Understand, quantify and predict the possible consequences of earthworm invasions.
3. Survey earthworm biodiversity and expand the taxonomic knowledge of earthworms.
4. Facilitate participatory and interdisciplinary research including various stakeholders.

In order to complete these goals the Participants shall:

1. Meet regularly to generate an environment for discussion and information exchange.
2. Promote standardization of methodologies, networks and collaborative research projects.
3. Promote this agenda to a wider audience of peers, scientific societies, agencies, land managers and the general public.
4. Be mutually supportive in terms of student development, research accomplishments, and dissemination of new knowledge.

C. IT IS MUTUALLY AGREED AND UNDERSTOOD BY ALL PARTIES THAT:

- 1) **MODIFICATION.** Modifications within the scope of the instrument shall be made by consensus of the future Participants of ELAETAO, by the issuance of a written modification prior to any changes being performed.
- 2) **PARTICIPATION IN SIMILAR ACTIVITIES.** This instrument in no way restricts the Participants from engaging in similar activities with other public or private agencies, organizations, or individuals. The participants are not obligated to fund any activities herein described.
- 3) **COMMENCEMENT.** The instrument is executed as of the date of the last signature.

THE PARTIES HERETO have executed this instrument:

Date: November 16, 2005

FIG. 2. The Memorandum of Understanding signed by fifteen of the participants of the 2nd Latin-American Symposium of Earthworm Ecology and Taxonomy (ELAETAO) held in San Juan, Puerto Rico during November 14-18, 2005.

exotic earthworms, may have substantially retard their re-colonization and/or cause the disappearance of native earthworm populations in disturbed areas. Lugo et al. and Borges et al. report the coexistence of native and exotic earthworms in disturbed forests under secondary plant succession.

Some of the papers in this special issue investigate the ecology of native and exotic earthworms, particularly as they influence ecosystem processes and services. For example, using mesocosms in the Peruvian Amazon, Tapia et al. show that *Pontoscolex corethrurus* can increase soil nitrogen mineralization. But as Brown et al. well point out, little is known of the effects of most exotic earthworm species on plants, soil properties and processes, or on other native species and conversely, as Sarlo's study shows, native tree species can favor earthworm biomass over other tree species. New tools using fluorescent markers for carrying out mark-release-recapture studies (e.g., González et al.) could enhance comparative studies that would help us understand the biology, demography, selective feeding strategies, and resource competition dynamics of native and exotic earthworms.

I believe the information contained in this special issue will be valuable as we consider management and policy options to earthworm invasions and introductions in Latin American countries and elsewhere. I also hope this wealth of information can motivate a new generation of studies focused on the unraveling of the mechanisms, effects and implications of invasive

species in terrestrial belowground ecosystems. Indeed, these are exciting times to study the patterns, mechanisms, and consequences of earthworms as invasive species in the Americas!

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