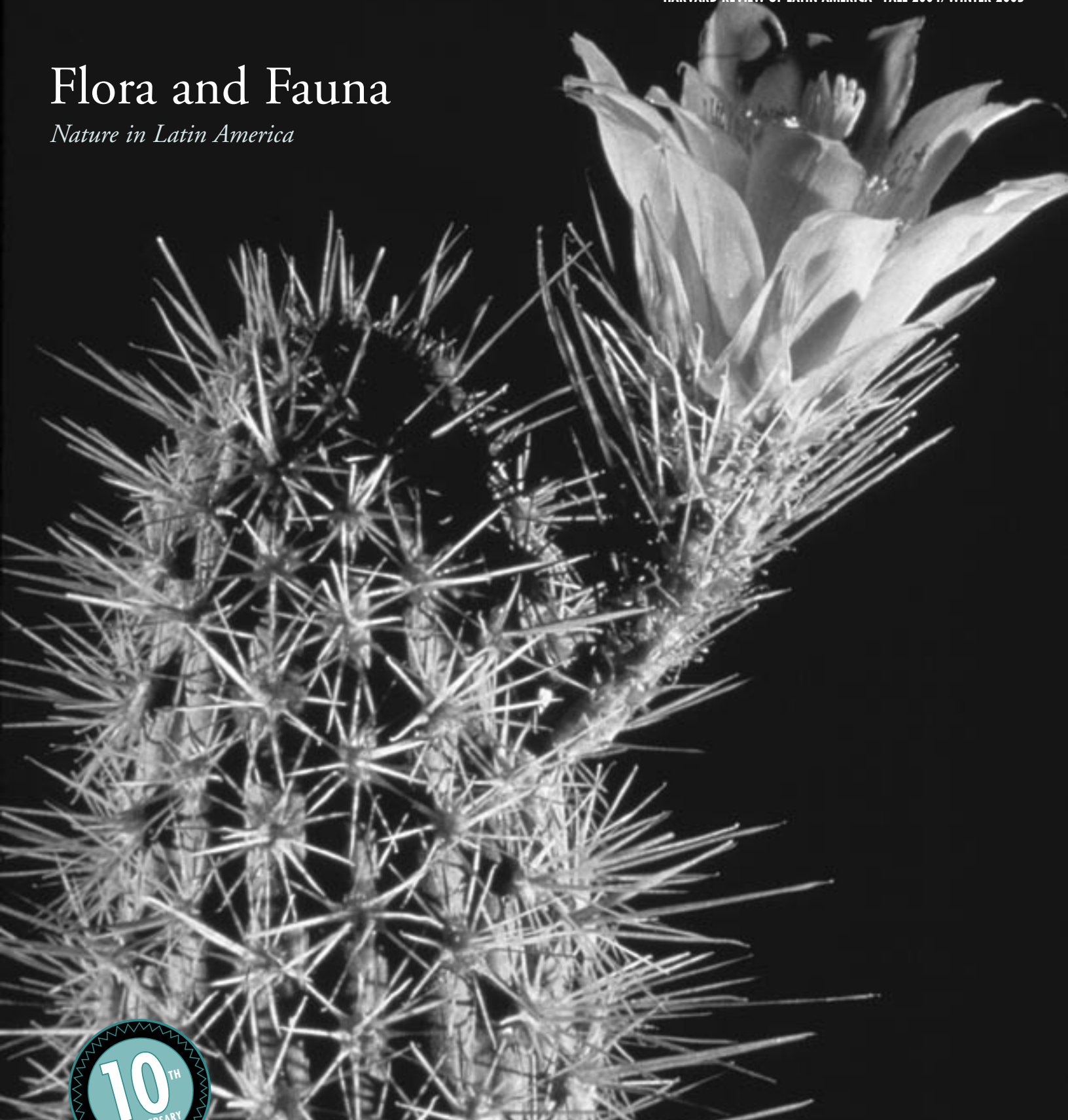


ReVista

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Flora and Fauna

Nature in Latin America



DAVID ROCKEFELLER CENTER FOR LATIN AMERICAN STUDIES, HARVARD UNIVERSITY



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Nature can be a window on the world. Brian Farrell and Julio Pantoja reflect on two opposite aspects of the cycle of nature: an Encyclopedia of Life and a reflection on death.

From Agronomics to International Relations

Building an Online Encyclopedia of Life in the Dominican Republic

BY BRIAN D. FARRELL

TWO STRANGE-LOOKING BLACK-AND-white butterflies found themselves swept up in nets one warm morning in March this year in the eastern Dominican Republic, far from chilly Cambridge. A group of Harvard undergraduates and their Dominican counterparts alongside Dominican and U.S. entomologists, including myself, made the capture in an overgrown field as part of a survey of insect species that we perform periodically on this Caribbean island. These specimens would soon prove to be remarkable discoveries—not just the very first records for the Dominican Republic, but also the very first documentation of this particular species, the lime or checkered swallowtail (known technically as *Papilio demoleus*) in the Western Hemisphere! The lime swallowtails of the Old World tropics are swift-flying butterflies whose caterpillars defoliate young lime trees, oranges and other citrus crops throughout southeast Asia, India and neighboring regions. They can completely strip the leaves from young nursery trees and cause many millions of dollars in damage annually. This species therefore poses a possibly significant threat to citrus industries in the Dominican Republic. The already

Students look over butterfly specimens collected in their fieldwork in the Dominican Republic.

broad and growing Old World distribution of the lime swallowtail also strongly suggests the possibility that it might flutter quickly and dangerously throughout the Caribbean to Florida and the rest of the Americas, potentially playing havoc with regional citrus crops.

Dominican entomologist Kelvin Guerrero acted quickly, e-mailing digital photos of the butterflies to colleague Andrei Sourakov in Florida. Within hours of the butterflies' capture, a reply was received by cellphone: a snap identification of these specimens as lime swallowtails. Later, the identification was confirmed by butterfly expert Rod Eastwood at Harvard's Museum of Comparative Zoology (MCZ) and John Rawlins at the Carnegie Museum of Natural History in Pittsburgh.

That first cell phone call to Guerrero rang in a gas station parking lot as we all waited while the field vehicles fueled up for the day's foray into the National Park, Parque del Este. Excited conversation led to formulation of the first report (to be published in the *American Entomologist* December 2004 issue). At day's end, we returned to our field laboratory base at the Punta Cana Center for Sustainable Tourism and Biodiversity (PCSB), supported by the non-profit organization Fundación Ecológico Punta

Cana (founded by Grupo Punta Cana, the developer of the community associated with the Punta Cana Hotel).

Some two dozen of us had crowded into the insect collection room at the Punta Cana lab earlier that same morning to learn techniques for collecting and preparing insect specimens from Dominican experts Guerrero, Denia Veloz and Litay Ramos.

Together with Dominican students, Harvard students learn that moths and beetles are attracted to ultraviolet blacklights at night; they learn to use specialized nets for collecting, and they even use a commercial orchard fogger that applies biodegradable insecticides to tree canopies, a technique that yields the first glimpses into canopy insect diversity anywhere in the Caribbean (including many species unknown to science).

Over the next seven days, the students would eagerly listen to Dominican and U.S. scientists discuss their entomological research in seminars, and would learn from Dominican students how to use the latest digital technology for capturing high resolution, computer-assisted images of insect specimens. These techniques, developed at the MCZ, are revolutionizing identification of economically and ecologically important insect species, as well as access to the valuable information that limits progress in

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biodiversity studies in Latin America and elsewhere.

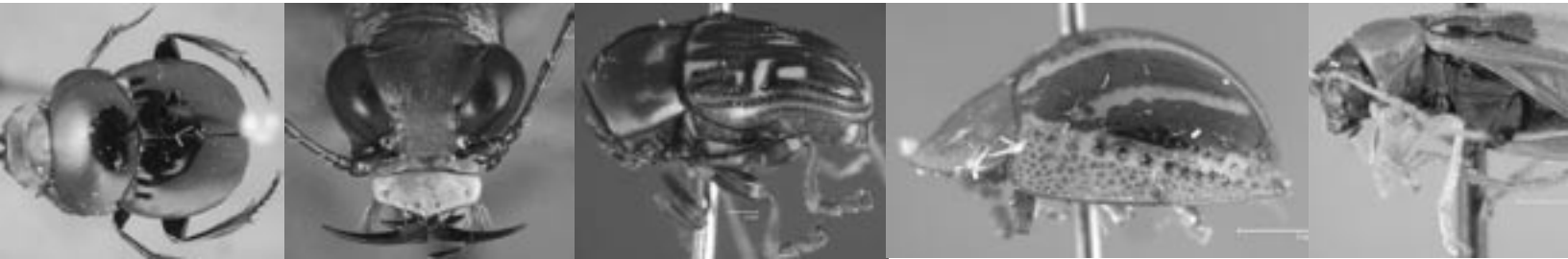
We were on hand to record this butterfly invasion of the New World because of the Harvard course OEB 156 (Tropical Insect Systematics) that brings undergraduate and graduate students to Latin America to learn field and lab techniques for documenting insects. Cambridge in the early spring, when the buds are barely open on the trees, has far fewer insect-yielding habitats than the tropical Dominican Republic. I relate these events to show how an exercise with educational and service components can spur discoveries of unexpected impact. In September 2004, acting on the strength of our report, the U. S. Department of Agriculture and its Dominican counterpart agency, the Departamento de Sanidad Vegetal de la Secretaría

founder Louis Agassiz with the important early Cuban biologist Don Felipe Poey y Eloy. However, I could not anticipate the effect of service learning opportunities on always-industrious Harvard students.

In the first weeks of class, armed with a bibliography provided by a Dominican colleague, the students rush to the MCZ's Ernst Mayr library and produce digital versions of the rare scientific articles, if any exist at all, for a given species in the often old, scarce journals—impossible to get in the very countries where their subjects occur. Such literature, especially combined with images of each species, is key to distinguishing species that could be invasive or endemic, known or unknown, important carriers of disease or innocuous look-alikes. We bring the cache of digitalized literature on a CD to our

of our educational programs by producing Spanish-language posters using the images in our database. A nascent poster series includes high-resolution photographs of butterflies and moths, dragonflies, ground beetles, leaf beetles and weevils, ants, palms, mountain plants, and plants in common families. All aim to provide the public with names and faces for familiar flora and fauna in the local environment, and all have the logos of the participating institutions and the URL for the website for further information: <<http://insects.oeb.harvard.edu/Caribbean>>. We hope to distribute these posters to elementary schools, beginning next year, and they form the core of a traveling exhibit beginning circulation this year in the Dominican Republic and New York.

The database and website we began



Closeups of beetles

de Estado de Agricultura flew experts in to document the establishment of the butterfly in the agricultural Cibao valley which produce an annual crop worth over one billion pesos. Hopefully, this early warning will curtail damage in the DR, slowing the spread to Florida, where the value of annual citrus production exceeds 1.6 billion dollars.

I initiated the course field trip in spring 2002 with support from philanthropist and renowned labor mediator attorney Theodore Kheel, who built the PCSB labs and the nearby Punta Cana Hotel. With my prior experience in similar courses in Mexico and Costa Rica, I wished to bring Harvard students to the field in a region that MCZ scientists had explored in decades past, resulting in remarkably strong museum collections of specimens and literature. In an academic world increasingly attuned to international affairs, the very strength of MCZ scholarship on the Caribbean brings both professional obligation and educational opportunity—to help repatriate the information gathered over 150 years that began with the correspondence of MCZ

Dominican colleagues, and make it available for use in the field station by students from Dominican and foreign universities. Harvard students have now digitalized some 600 scientific papers totaling over 15,000 pages now available to Caribbean researchers on our website for downloading.

However, it's not only researchers who are interested in bugs and plants. Elementary and high school students are fascinated as well. While only a few of these Dominican children may actually become biologists, all will be members of the community that determines the future of the environment. Dominican student access to computers and the Internet has increased under the administration of Dominican President Leonel Fernández, who was brought up in New York and attuned to the impact of the cyberworld on education. Under the Fernández administration, the Secretary of State of the Environment and the Subsecretary of Biodiversity and Protected Areas and the Subsecretary of Wildlife are supportive of science education, research and conservation, and work with us in our effort to broaden the impact

with a Harvard course now has been much expanded, thanks to support from DRCLAS and a grant from the National Science Foundation (NSF). With NSF support, I used a sabbatical year 2002-2003 in the Dominican Republic to bring my MCZ assistants to transmit their expertise in digital technology to students from the Universidad Autónoma de Santo Domingo (UASD) the oldest university in the Western Hemisphere, founded in 1538. Additional support from DRCLAS and the Fundación Ecológico Punta Cana permitted establishing three digital imaging centers, respectively, at the Jardín Botánico Nacional, PCSB and the Museo Nacional de Historia Natural (MNHN, later moved to the UASD when the MNHN closed due to infrastructure problems). At the Jardín, UASD biology majors Josue Henríquez and Arlen Marmolejo document insects economically important to agriculture, horticulture, and forestry as well as to human health (such as the different dengue- vs. malaria-vectoring mosquito species). Josue and Arlen digitize specimens from older insect collections, and are engaged in documenting endemic as well

as invasive insect species on the highly biodiverse grounds of the Jardín and in other protected areas of scientific interest.

Through the high entrance gates of the Jardín Botánico Nacional, the brick and fossil coral cobblestone drive expands into the broad low plain of a central plaza flanked by tree-lined slopes capped by pink-washed educational and administrative buildings. The cobble plaza, shaded by tall palms, envelopes several enormous rectangular pools with emerging lotus flowers and papyrus and swimming koi. The pools also host a dozen species of blue, red or green dragonflies that patrol the perimeters in search of mosquitoes and other flying prey. Nestled among spreading samana trees, high off to one side, are the offices of JBN Director Milciades Mejia. The plaza drops

tion (a special program produces a single, fully-in-focus image from the array of focal layers) and data entry for the database. This assembly line production is finished by noon, when the generator is turned off (there is no consistent electricity available in the DR these days) and the students move on to other tasks after lunch. Once a month, a CD of data and images is express mailed to us at Harvard for posting on the website.

Back at the MCZ, The website is maintained by Piotr Nasrecki, MCZ resident research associate. Nasrecki also designed the Filemaker Pro-based Mantis software that we use for the database. The MCZ also backs up the database with an Oracle server that connects all MCZ departments to the international network implemented by the Global Biodiversity Information Facility (GBIF).

vard professor documenting the ants of the Caribbean, and Smithsonian-based USDA scientists Steve Lingafelter, Alex Konstantinov and Norman Woodley (a former Wilson graduate student), plus Kelvin Guerrero, all of whom focus on plant-feeding beetles (my own specialty). Other contributors include my own graduate student Sebastian Vélez from Puerto Rico (at the MCZ) and graduate students in other American and Latin American universities.

An informal consortium has formed (the Consortium for Biodiversity of the Caribbean, or CBC) comprised of the New York Botanical Gardens, the Smithsonian Institution, United States Dept. of Agriculture, the Carnegie Museum of Natural History, the MCZ, Jardín Botánico Nacional, Museo de Historia Natural, Fundación Ecologico



off through a glade towards the herbarium buildings, leading to a blacktop drive winding through the Jardín. From high, grassy, central knolls studded with tall, skinny guanito fan palms the drive plunges down through the jungle of a riparian cañada, with tall rainforest trees draped with pendulous vines and harbor calling tree frogs and palmchats. Early morning walks here often produce a startled limpkin, meter-tall, long-billed snail hunters that are unusually diurnal in Hispaniola.

At the far end of a palm and tree filled grassy meadow, a long, low white stucco building holds the national plant collections, overseen by a plant scientist named Francisco Jimenez, and our imaging station. Here Arlen and Josue begin work in the cool of each morning alongside botanist colleagues and choose from drawers of insect specimens brought from the MNHN or from the field. The insects of the day are given tiny barcode labels, very much like insect-sized versions of those used in supermarkets, and all are photographed (with as many as 20 different layers of focus) with a digital camera attached to a Leica microscope. The photos are then taken to the computers for image produc-

tion. Wrobel and Nasrecki are now turning the insect and plant data into digital maps for use by the Dominican conservation community. Such maps are useful for decision-making as they convey information on the distributions of threatened species. When park boundaries take such species distributions into account, they preserve areas of maximal scientific importance.

This network of expertise we have formed between the Dominican Republic and the United States brings together information from biological specimens in historical and new collections, representing threatened habitats requiring documentation. To date, we have some 20,000 specimens representing some 5,000 species, or a quarter of the projected total of 6,000 plants and 15,000 insects. Together, these insect and plant species represent the vast majority of the species of visible life-forms on the island of Hispaniola, and are food for most of the rest. We anticipate a flood of new specimens from John Rawlins and his Carnegie Museum colleagues Chen Young and Bob Davidson, with whom we take inventory of the montane insects of Hispaniola, as well as by E. O. Wilson, a Har-

Punta Cana, and Fundación Moscoso Puello for the study of biodiversity of the Caribbean. This consortium has grown into an enterprise that includes hands-on opportunities for students from both countries. We hope to foster comparable efforts in Cuba, Puerto Rico, Jamaica and more distant countries, and are providing complete documentation of our experience, including an illustrated guide to databasing and imaging available for download on the website.

What started as a spring break field trip thus may have a more general impact on knowledge of biodiversity in the Caribbean. It seems fitting that a first step towards fulfilling E. O. Wilson's vision of a free, online encyclopedia of life, organizing biological information from all sources, should be taken on the island where the Americas began.

Brian D. Farrell is a Professor of Biology and Curator in Entomology at Harvard University. He is married to Irina Ferreras de la Maza from Santo Domingo. Together with their children Gabriela and Diego, they enjoy exploring the Dominican mountains and shore with members of a very large clan of cousins and close friends.