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COSTA RICAN PARKS: A RESEARCHER'S VIEW

A park whose flora and fauna are unknown and uncataloged can be compared to an excellent library whose books have no titles, no authors, and no call numbers. This is one of the primary reasons why Winnie Hallwachs, a graduate student from Cornell University, and I have been surveying the moths of Costa Rica for the past four years. We estimate that there are some 9,000 moth species in the country, most of them occurring in the national parks and similar permanent reserves—the locations of nearly all of our 23 intensive survey sites.

The moth fauna of these areas is formidably large. By way of illustration, all of North America above Mexico supports about 70 species of the moth family Saturniidae, which includes such large and colorful creatures as cecropia, polyphemus, and luna moths. But, even though Costa Rica is roughly the size of West Virginia, our latest census shows that *its parks* harbor a minimum of 98 species of Saturniidae. Any particular lowland park alone hosts a breeding population of 30 to 45 species, which means that a few hundred square kilometers of Costa Rica's lowlands support as many species of these moths as does all of the United States east of the Mississippi. Meanwhile, members of the family Sphingidae—the sphinx and hawk moths, which use their long tongues to drink nectar from flower blossoms—number 115 species throughout North America north of Mexico; but 130 occur in Costa Rica. In Santa Rosa National Park alone, 108 square kilometers of lowland dry forest harbor about 145 species of the family Notodontidae, while *all* of North America has only 136 species.

By the end of our project—30 years from now—we shall have placed moth specimens from Costa Rica's parks in the major collections of the world and organized, at the Museo Nacional in San José, the *only* identified reference collection yet created for the moths of an entire tropical country. In addition, we shall have published field guides to each of the moth families for Santa Rosa National Park (in Spanish) and for the country as a whole.

All of this taxonomic and geographic referencing will mean that moth caterpillars—the most significant group of leaf-eaters in tropical forests—may for the first time receive the ecological attention they deserve. Moreover, the Costa Rican specimens and the diverse habitats represented by the country's national parks will be internationally useful to the study of tropical moth taxonomy and ecology. We anticipate that this research will also serve as a model and impetus for similar studies of other species-rich groups of Costa Rican organisms.

But why do we personally want to see that the moth fauna of Costa Rican parks is named and identifiable? The bane of tropical researchers is to behold an interesting biological phenomenon involving undescribed, unknown species. One has no reference point, no words to record the organisms that have been observed and no means of relating those observations to the observations of others. Because I am documenting the impact of Santa Rosa's caterpillars on the lives of the park's 680 species of broad-leafed plants, I must be able to identify all of the area's moth species. In addition, I am studying how the traits of the plants influence the caterpillars.

The first step in my research is to discover what species of caterpillars occur and in what numbers. I scrutinize every limb and every bit of foliage. Since green caterpillars are not easily seen on green leaves by daylight, I search for them at night with a flashlight. By artificial light, the insect reflects a shade of green that is different from the green reflected by the leaf. Moths are attracted for observation—and to obtain eggs—by the lights we hang in the forest; and by hanging cages that contain virgin female moths, we can census the males that come to mate—by marking, releasing and re-

capturing them. I also release young caterpillars that have been raised in captivity into the forest (different numbers per tree) to see how many leaves they eat before maturing or being taken by a predator. At the same time, I note how the trees respond to having their foliage eaten.

Numerous questions arise. With so many available plant species, why does a particular caterpillar species feed on only one or a few species of plants? Is it because the uneaten plants grow in the wrong microclimate, contain defensive chemicals that render them inedible, or are too easily gleaned of caterpillars by predators? The answers are different for each species of caterpillar and for each potential host plant.

For example, many saturniid moth caterpillars that feed on a variety of plant species at Santa Rosa are the best protected against vertebrate predators. These hemileucine saturniids have stinging spines —equipment that makes it less necessary for them to conceal themselves visually from predators. They can feed on many more tree species than can caterpillars whose protection depends on camouflage.

The chemistry of host plants also helps determine what foliage different caterpillars eat. Members of certain tropical plant families contain very toxic substances in their leaves. (The caffeine in your coffee is an example of such an ingredient, as are cocaine and nicotine.) Although saturniid caterpillars are relatively indiscriminating in the flora they consume, they are seldom observed eating the poisonous plants at Santa Rosa. The diet of sphingid caterpillars, on the other hand, is composed almost entirely of these toxic plants. We can only conclude that the creatures are very competent at detoxifying or somehow avoiding the poisonous substances.

While pursuing these studies, we live seven months of the year only a few tens of meters away from our work, unless an army ant colony cleans out the house or a boa catches a rat in the ceiling. Santa Rosa's park guards and administrators sleep at the gates, fight the fires, ride hard under the hot sun to deter poachers, and sit for hours in town fretting over legal battles with neighboring landowners. These people safeguard the park and make it possible for us to count beetles, scrutinize caterpillars, and examine tapir dung in peace.

We do, however, share with park officials in introducing Santa Rosa to visiting university students, such as those who come from the Organization for Tropical Studies, the University of Pennsylvania, Sweden's Uppsala University, and The University of Costa Rica. Because we are familiar with the park's biota (and have described it in scientific journals, at conferences, and in general biology books), we can offer visitors a portrait of the area that is richer in detail than one they would view at a different, lesser-known tropical site. We can point out, for example, that a certain guapinol tree is 450 years old because we have eight years' worth of growth records for it. We can explain that agoutis—the rabbit-sized rodents that Winnie Hallwachs is studying—may carry and deposit the guapinol's seeds as far as 100 meters from the tree because we have tracked and watched the animals. We can write captions for the park's dioramas. We can even tell students that there are more than 2,500 caterpillar species in Santa Rosa, and, should a catastrophe strike the park, at least a quarter of these insects will be eventually extirpated from the country as its dry forests are converted to rice fields, cotton patches, and cattle pastures.

Biologists at Santa Rosa cannot serve simultaneously as researchers, park naturalists, and interpretive guides. But the flow of information from researchers to park personnel—and then to park visitors—is undoubtedly the largest local benefit we offer to Santa Rosa. Moreover, we show that it *is* possible to live where you work, even if it's in a forest 250 kilometers from San José. Here we are learning how a fragment of the tropics still functions.

The use of parks and reserves by researchers has made these areas more visible and has increased their importance to those who pay for their continued existence through labor, taxes, and lottery tickets—the people of Costa Rica themselves. Biological researchers and conservationists are greatly in debt to Costa Ricans for their farsightedness in supporting their park system.

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PRESERVE RECEIVES INTERNATIONAL RECOGNITION

The Conservancy's Northern California Coast Range Preserve, a spectacular 4,000-acre wilderness in Mendocino County, has been named an "international biosphere reserve" by the United Nations' Man and the Biosphere Programme. The designation has been given to only 262 natural areas in the world, 40 of them in the United States. The Conservancy's Konza Prairie in Kansas and its Virginia Coast Reserve received the same recognition in 1979.