Lasting Impact

Johnson State College Students Learn Tropical Ecology Through Experience

Gustav W. Verderber

On a coconut palm, no more than 20 meters from where we stood, a howler monkey lounged on a giant palm frond and stared at us. Standing next to me, Dr. Cyrus McQueen, associate professor of biology at Johnson State College in northern Vermont, trained his binoculars on the monkey as I focused my 500 mm telephoto lens. The 15 students enrolled in his tropical ecology course crowded around us and whispered superlatives to one another. Soon, other monkeys appeared from their hiding places in adjacent trees until the entire troop of seven howlers, including a tiny wide-eyed infant in mother’s arms, scrutinized us as intently as we did them.

Dr. McQueen and his students came to Costa Rica to gain first-hand experience in the natural history of the rain forest and other tropical environments. Because I am an adjunct professor of biology at the college, I wanted to explore the tropics for myself. Moreover, I was interested in the students’ reactions as they learned about one of the most unique environments on Earth from the best of all teachers—the rain forest itself.

The monkeys, likely having seen humans before, turned away after a few minutes and moved off into the jungle. Our students, however, were moved by their first encounter with primates in their natural habitat.

We continued along the trail through Cahuita National Park in southeast Costa Rica and I asked them how they felt about what they had just experienced.

“It was a real personal experience,” said Ben. “I mean, there I am staring at my ancestors like some prodigal son returning home after millions of years. There was something about the way they looked at us... almost as if they knew we were related.”

“What do you think they’d say if they knew what we’ve done to the Earth since we came down from the trees?” asked Linda. There was a round of murmured affirmation and then silence.

Two weeks before the encounter with the monkeys, our band of 17 expeditioners arrived in San Jose. We spent a day and a half there practicing how to order meals and exchange the local currency before we rented a van and drove north to the private tropical forest preserve called Monteverde.

Much of the rural landscape we drove through consisted of brown, barren hills where the tropical forest had been clear-cut to make room for cattle and crops, mainly coffee and sugar cane. Occasionally, we encountered a stretch of forest, invariably a national park, where a lush green canopy still blanketed the land and glimpses of green iguanas perched on grey, lichen-covered trunks could be snatched from the passing scenery. Yet, all the land outside of these natural refuges either was denuded or subjugated by farmers. In spite of the literature they had been given prior to the trip and the vivid images in textbooks that describe the extent of the environmental degradation in the tropics, the students were shocked by what they saw. Their comments reflected a genuine sense of personal loss.

After four hours we turned off the Pan American Highway onto a grueling series of dirt switchbacks that climbed 35 kilometers to the Monteverde preserve perched 1500 meters high in the Costa Rican highlands. It was dark by the time we filed into the pension Flor Mar, stiff, grimy and exhausted from the day’s 95 degree Fahrenheit temperature. After everyone claimed a bunk in the dormitory, we gathered in the dining area for dinner—an excellent stir-fry served family style by our friendly Costa Rican hosts.

We continued practicing our Spanish over dinner. Cyrus had asked his students to avoid rude attempts to communicate with the Costa Ricans merely by speaking English loudly and slowly. In fact, he incorporated short lessons in Spanish into his weekly classes prior to the trip. Our awkward efforts at expressing ourselves in the native language were rewarded with warmth and understanding by the Costa Ricans. Occasionally, we would be given an on-the-spot Spanish lesson: When two of our students wanted to buy fruit from a street vendor in San Jose, they were not given their slices of pineapple and bananas until they learned to ask for them in Spanish: “Quiero piña y platano, por favor.”
Most of our dinner talk, however, was about what each of us looked forward to seeing in the cloud forest, the major tropical forest type at Monteverde. Monkeys and sloths topped most everyone’s list. Toucans also were in high favor. I held out for leaf cutter ants and everyone knew very well what Cyrus wanted to find most: Sphagnum.

Cyrus is one of four leading authorities on Sphagnum moss—the moss that, when dried, is called peat and that gives peat bogs their waterbed-like character. Cyrus has described several new species of Sphagnum and is the author of A Field Guide to the Peat Mosses of Boreal North America published by University Press of New England. Cyrus’ ulterior motive for coming to Costa Rica was to continue his ongoing quest for yet-to-be-described species of Sphagnum as well as to determine the number of different species that grow here. Incredibly, by the end of our relatively short expedition, none of us was disappointed; each of us saw a favorite denizen of the tropics.

The food restored our energy, and the cool evening breeze coming through the open windows of the dining hall refreshed us. There was also dinner music; an entertaining serenade of chirping, trilling and buzzing charged the group with excitement and curiosity about the musicians. Occasionally, a startling “toot” was interjected into the noisy percussion like a solitary woodwind out of time with the rest of the orchestra.

I could not restrain my curiosity until the next day. After dinner, I ventured out with my camera and strobe light to discover some of Costa Rica’s “nightlife.” Keith Conger asked to come along and I told him he was more than welcome. In fact, if no one volunteered to accompany me, I most likely would have changed my mind.

A few meters down the dusty road that brought us to Monteverde, Keith and I found a narrow trail leading into the forest and we decided to follow it. I led the way through a dark opening in the vegetation into what reminded me of the inside of the cathedral in San Jose, with its high-vaulted ceiling and great stone columns. Massive, grey trunks rose up around us and disappeared into the darkness overhead; the canopy was barely within reach of our flashlights. Below, underbrush was sparse and it was easy to walk, but just as easy to lose the trail.

Everywhere we pointed it, the flashlight’s beam revealed life. A giant camel cricket clung to the trunk...
of a tree, an oversized katydid hung upside down from the leaf of a low bush, and a centipede as long and thick as a new pencil crawled across our path. Most conspicuous were the ants. Endless processions of these ubiquitous insects criss-crossed the trail and paraded up and down the trunks of the giant trees in tenuous dark lines, over whatever lay in their path. (Should you carelessly stop in the path of one of these processions you likely will have several hundred ants swarming up your legs before you can focus your binoculars or lens on whatever it was that caught your attention.)

We moved along carefully, checking the ground for ants and the overhanging branches for snakes before taking each step. Now and again I pointed the flashlight back along the trail to assure us that we still knew the way out. We hadn’t advanced more than 50 meters along the trail before we decided it would not be prudent to venture any further.

As we turned around, I noticed two tiny eyes reflecting the flashlight beam from beside a fallen tree just off the path. “A mouse,” I suspected out loud as we approached the log. When we were still several paces from them, we discovered that the eyes belonged not to a rodent, not even to a mammal, but to a spider! “They’re like a pair of headlights!” remarked Keith. We had only a glimpse of the spider’s bulbous abdomen and its long, spindly legs before it retreated underneath the log.

While we debated which one of us would coax the spider back out to get another look at it, I traced the horizontal trunk with the flashlight beam. “Leafcutter ants!” I suddenly shouted. Startled, Keith jumped back toward the trail. I apologized and reassured him that we were in no danger. When he came up beside me again I pointed to a single-file line of ants which stretched back along the entire length of the tree—some 15 meters—then ran down one of the unearthed roots, crossed the leaf litter and continued on into the darkness. The procession disappeared into a small opening at the apex of a mound the size of a groundhog burrow which was banked against the side of the fallen trunk just shy of my left boot.

Each pale brown ant was about one centimeter long. Approximately a third of the ants carried the cutting of a leaf slightly smaller than a dime in a position similar to that of a sail when the boom is parallel to the keel of the boat. Although I was anxious to discover where the ants were doing their harvesting, we decided not to follow the procession past the base of the trunk as it would lead us dangerously astray of our own trail.

I was elated with our discovery. Keith held the flashlight steady on the procession while I exposed several rolls of film. Between frames, I explained to him that the ants harvested the leaf cuttings in order to grow fungi on them. It is the fungi that they “garden” on the cuttings underground which the ants use as a food source, not the cuttings themselves.

“That was amazing!” exclaimed Keith as we stepped back out of the dark forest onto the road. The first quarter moon had risen so we switched off our flashlights and allowed our night vision to take over. “I’ve never seen anything like that in all my life,” he continued. High praise, I thought to myself, for something so common as an ant.

Later, back at the pension, as he was telling the others what he had seen, Keith remembered something he had learned in general zoology—that an ant is strong enough, in terms of its body mass, to carry a load analogous to a man climbing a vertical wall with a piano in his mouth. He astounded his fellow classmates with the analogy and excited them with his description of what he had seen that evening. In fact, the following morning, many of the students arose early and accompanied Keith and me into the forest to see the ants who were still marching along the fallen log with their bounty of leaf scraps.

Keith had been genuinely affected by what he saw that evening in Monteverde. His enthusiasm, and many similar events throughout the trip underscored, once again, the fact that the more real the learning situation, the more personal the learning experience becomes and the more powerful and lasting its impact. Also, first-hand experience has its own inertia—personal knowledge is contagious and the learner soon becomes the instructor.

During their time in Costa Rica, Cyrus’ students were treated to a smorgasbord of biological, earth and environmental science including mammalogy, entomology, marine biology, geology and resource management. They also experienced a good deal of social studies and geography along the way.

As the trip progressed from ecosystem to ecosystem (we explored all of the tropical life zones described by Holdridge in 1967), Cyrus and I became little more than knowledgeable tour guides. Having discussed what the ecology students would encounter in Costa Rica in lectures prior to the trip, Cyrus simply introduced them to their surroundings and let them explore for themselves. They needed no encouragement (only, on occasion, a few words of caution to remind them of the natural hazards).

Learning reactions—students relating their discoveries to one another, posing pertinent, insightful questions about various aspects of the ecosystem, stimulating one another to think about interrelationships between the biotic and abiotic components of the ecosystem—soon consumed the group. That Cyrus and I were unable to answer many of the students’ questions didn’t bother the students (nor us, for that matter) or cost us any of their respect. Indeed, one of Cyrus’ goals was to impress the
students with how little is known about tropical ecosystems. [William W. Nichols (1987) cites Lewis Thomas in affirming the value of the unknown and the pleasure of "bafflement" in teaching.] I was moved as I listened to students apply basics of biology, ecology, botany and zoology, and employ inductive and deductive reasoning to form hypotheses and make inferences. These moments were the most exhilarating experiences I have had as a biology instructor.

In addition, all students were given special topics to investigate, ranging from science to the history and politics of Costa Rica. Moreover, several of the students conducted original research.

Ken Grant, a senior, analyzed lead levels in Sphagnum and found that plants lining the Pan American highway contained twice as much lead as plants in remote areas, such as the summit of Chirripo, the highest peak in Costa Rica (3700 meters). Ken associates the high contamination of Sphagnum along the highway with the continued use of leaded fuel. To gather data atop Chirripo, Ken, Cyrus and two other students climbed the mountain in 90 degree heat and camped two nights on the summit in freezing rain and hail.

Another student, John Wolfe, compared the water chemistry of Sphagnum habitats at various elevations, the first such study done in Central America. He is presently comparing his data to those collected by Cyrus in similar peatlands in the Andes of South America. Both Ken and John have submitted their research for publication and, so far, John's manuscript has been accepted.

Other students visited museums and historical sites to learn about the Costa Rican culture, health care centers to learn about the state of health care in the country, and farms and markets to study farming practices and learn about local natural and herbal medicines. An interest in journalism motivated one student, Amy Bently, to publish an article about her experiences in the local paper. The approach, in all cases, was discovery-oriented with an emphasis on procuring data.

From the cloud forest at Monteverde, we went on to explore active volcanoes, bogs, coral reefs, and the tropical rain and alpine forests. When we looked up at the forest canopy, white-faced monkeys and sloths returned our gazes while lizards, crabs and armies of insects scurried across the ground. We saw giant moss-covered trees that dangled woody vines like the strings of a puppet; every square inch of bark was occupied by hundreds of smaller plants. Take a tree, cover it in moss, liverworts and fungi until no more bark is visible, then plant epiphytes (plants that live on other plants) and ferns in every fork and on all its horizontal surfaces. Finally, wrap, entangle and wind the tree in an assortment of leafy vines until it is
difficult to distinguish the tree’s own foliage. Now that’s species packing! No picture or text could substitute for the three-dimensional reality of students examining and attempting to identify even a fraction of the various plant families growing on top of one another in a tropical forest.

And on Cerro del Muerte (The Mountain of Death), Cyrus found what he was looking for—a new species of Sphagnum. This brings the total number of additional species of Sphagnum that Cyrus has discovered in Costa Rica to 15, two of which he described and named. Before he began combing this country for Sphagnum there were only 11 species known to exist here. Now Costa Rica claims a total of 26 Sphagnum species, including species from North and South America and a few indigenous species. (The mix of species from north and south is common to nearly all groups of plants and animals in this crossroads between the two hemispheres.)

We also discovered what made the “toot” that was one of the most prominent sounds of the cloud forest at Monteverde. Perched high in the crown of an oak, we spotted a bird the size of a crow silhouetted against the bright sky. Its outstanding feature, besides its pervasive call, was the thick, fleshy strands that dangled from its head as though it just had a plate of spaghetti dumped on it. We watched the bird, called a Bell Bird (*Procnias tricarunculata*), issue its clear, single-tone call while we debated the adaptive function that stringy headdress might provide.

Education is about learning to live on this planet. Therefore, a full and proper education cannot take place entirely within the relative isolation of a high school, college or university campus. Students must be exposed to life in order to learn how to live. While there is currently much pressure on educators to reduce the cost of educating their students, vital, first-hand experience should not become an expendable component of any secondary or post-secondary curriculum.

Environmental educators, in fact, all educators, whenever they can, must strive to involve students personally with their subject. Nichols (1987) also speaks of fostering in students intimacy with the world around them. We say that we do, yet most secondary and post-secondary education is still much too estranged from the out-of-classroom experience of most students to have any genuine impact on their perspectives. Textbooks and lectures must become supplements to field experience, to daily, real-life, first-hand learning adventures.

For Cyrus’ students, the exposure to an unfamiliar and exotic environment as well as to a foreign culture and the opportunity to participate in a scientific mission was a unique and valuable learning adventure. The experience inspired one student to change her major to biology and five students to take Spanish, a true reflection of the interdisciplinary value of the course. Keith Conger, the student who ventured into the cloud forest with me our first evening at Monteverde, now uses a discovery-oriented approach to teach native Eskimo children in Alaska about nature.

The cost of offering a field course such as Cyrus’ is more than offset by the amount of experience the students gain.* Our days in Costa Rica were so full that by suppertime, the morning of a day seemed like two weeks in the past. It was as though time had expanded several orders of magnitude in order to accommodate a whole semester’s worth of experience in two weeks.

Over dinner in San Jose, the night before our departure from Costa Rica, the students reminisced and tried to single out their most outstanding impressions of the trip. Yet, it seemed that all of their mental images competed with one another. In the tropics, everything competes for space and for a biologist’s attention. Here also, the stuff of textbooks is three-dimensional and stares down at you from a giant palm frond or marches past you in endless procession. Biology itself becomes the instructor and concepts like evolution become part of the student’s realm of personal experience. And that, as a student put it best, is a “totally awesome experience!”

**References**


*Cost/student (in 1991; tuition for a three-credit course not included) was $700 for a two-week trip. This included roundtrip airfare, lodging and van transport. In addition, students spent about $20/day on meals and miscellaneous bus transportation.*