EMERGENT ECOLOGIES

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CHAPTER TEN

POSSIBLE FUTURES

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Leaving the fringe-toed foam frogs behind in Costa Rica's lowlands, I traveled to the highland community of Monteverde, where I continued studying emergent ecological assemblages involving a multiplicity of agents—capital, cattle, rhizomorphic grasses, earthworms, and convivial tree species. English-speaking farmers and scientists helped transform Monte Verde, a two-word place name (Green Mountain) into Monteverde, a singular destination for tourists.[1] The region was settled in 1951 by peace activists, a group of Quakers seeking refuge from U.S. militarism, who became cheese makers and dairy farmers. Expatriate biologists followed in the 1970s—studying the ecology of cloud forests in lands surrounding the Quakers' pastures.[2] By the 1990s, Monteverde had become an international tourism mecca. "On a good day," according to the Lonely Planet guidebook, "Monteverde is a place where you can be inspired about the possibility of a world in which organic farming and alternative energy sources are the norm. On a bad day, Monteverde can feel like Disneyland in Birkenstocks and a zip-line harness."[3]

Many critical accounts of tourism and conservation in this popular destination have been published. Martha Honey, a veteran reporter who helped expose covert CIA operations and the Iran-Contra affair in the 1980s, found "a mixture of hype and experimentation, superficiality and creativity" in Monteverde when she visited in the 1990s. "Industry promises before international forums and 'green' imaging in slick brochures were juxtaposed, out in the field, with grassroots struggles around national parks and nature tourism by some of the world's poorest and most marginalized peoples."[4] Monteverde is "a watershed, a space of recreation, a space of adventure, an exhibit hall for environmental education, a laboratory, a refuge of spiritual inspiration," and, above all, "a tourism spectacle," in the words of Luis Vivanco, a cultural anthropologist.[5]

FIGURE 10.1. The resplendent quetzal (*Pharomachrus mocinno*), an iconic emblem of conservation initiatives in Costa Rica. Photograph by Dominic Sherony.

One animal in particular, the resplendent quetzal—"a migratory bird with colorful plumage and mythical connotations"—is key to the spectacular relations of Monteverde. Like other spectacles described by Guy Debord, these birds are often viewed with "false consciousness"—illusions about the political and economic relationships that sustain their existence and their ecological communities. Quetzals "mediate social relationships between consumers and producers in a tourism economy," according to Vivanco. Images of quetzals are produced by Costa Rican farmers, hospitality industry staff, tour guides, and local conservationists, who are in a subordinate relationship to consumers: visiting tourists, scientists, and documentary crews. At their most spectacular, quetzals are seen as existing outside "the highly specific socioeconomic conditions that created the possibility of their viewing."[6]

The quetzal was a flagship species, a charismatic animal whose image was used in a marketing campaign in the 1980s to raise hundreds of thousands of dollars for outsiders to purchase land in the Monteverde region. Dozens of subsistence farming families, with homesteads on desired plots of land, were induced to move. Some relocated to other farmlands, while others embraced opportunities emerging with the new economy of tourism. As resplendent quetzals and English-speaking tourist guides flourished, others struggled to survive in the shadows of the

spectacle.[7] Hunting was outlawed in the protected areas of Monteverde, as was the gathering of forest plants—like hearts of palm, wild avocados, and timber trees. Wild cats—pumas, jaguars, and ocelots—preyed on the farmers' livestock as they proliferated in this emergent ecosystem.

One woman, whose family willingly sold their homestead to conservationists in the 1980s, moved to town and found employment as a maid in one of the many hotels that sprang up in the region. She befriended me in 2008, after we met via her husband, a day laborer who sometimes cleared trails in the Monteverde Preserve. Steady wages, proximity to family and friends, and an affable boss meant that she was generally upbeat about her position in the new economy. She was the stable breadwinner of the family. But when we passed each other on the street one day, she furtively confided in me: "My nose started bleeding at work today. I think that it is the cleaning products they make me use." Emergent economic opportunities have thus exposed Costa Rican families to new vulnerabilities, new precarious modes of existence.

Biologists from the United States who have become Monteverde residents told me (off the record) that life on earth was in an increasingly precarious position. Pointing to anthropogenic changes in environments at local and global scales, resident ecologists talked about troubling signs. Despite the best efforts of conservationists, endangered species were disappearing from protected reserves, seemingly like rivets being popped out of an airplane wing. In the 1980s the resplendent quetzal often appeared alongside another charismatic animal, the golden toad of Costa Rica, on posters for the Save the Rainforest campaign.[8] This charismatic frog was confined to a tiny environmental world: a strip of high-elevation elfin forest that measured eight kilometers long and only half a kilometer wide at the center of the Monteverde Cloud Forest Reserve. Living within an underground tunnel system between the roots of cloud forest trees for most of the year, it only emerged for five to ten days early in the wet season to breed. Shortly after the ecotourists began arriving by the thousands, the golden toad went extinct.[9]

"The disappearance of the golden toad has coincided with the phenomenal growth of tourism," writes Martha Honey. "The history of the golden toad and that of ecotourism are intertwined, and some speculate that an ecotourist (or perhaps a scientist) may have carried into Monteverde's rain forest an alien organism that caused a plague among the reserve's toad population. If true, it is ironic, since Monteverde scientists and residents have consciously used conservation grants and ecotourism profits to protect the habitat of the golden toad and other exotic, endangered

FIGURE 10.2. Milk cartons and junk mail, featuring missing amphibians in the place of missing children, were created by ecoartist Ruth Wallen in 1996 as part of a digital installation called *If Frogs Sicken and Die, What Will Happen to the Princes?* The carton featured the golden toad of Monteverde, Costa Rica, an animal now presumed extinct. Image courtesy of Ruth Wallen.

species."[10] Martha Honey's essay, "In Search of the Golden Toad," was published in 1999, just months before Joyce Longcore described and named *Batrachochytrium dendrobatidis*, the frog-killing chytrid fungus. While ecotourists may have unwittingly brought chytrid zoospores to Monteverde, and conservationists may have ironically hastened the doom of one of the very animals they were trying to protect, this particular extinction story also contains elements of a broader tragic plot about uncaring human masses. It must be told against the backdrop of global climate change.[11]

An El Niño / Southern Oscillation event hit Central America in 1986–87, resulting in abnormally low rainfall in Monteverde. Marty Crump, a herpetologist who was studying the tadpoles of the golden toad, wrote in May 1987, "This has not been a good year for the toads with respect to recruiting new individuals into the population. During April nine of the ten pools where I found eggs had dried up completely before the eggs had even hatched, and all the hatchlings from the tenth pool dried up later. From May's breeding bout, half the pools containing eggs dried up before the tadpoles were a week old, and only twenty-nine tadpoles survive in the remaining pools."[12] A local Costa Rican naturalist, Eladio Cruz, saw

some golden toads shortly after Crump made these observations. This species has never been seen since and is now presumed to be extinct. This particular extinction event in the recent past fueled feelings of anxiety and dread about the near future. Over drinks one night at Moon Shiva, a tourist bar that has since closed, one young biologist with a PhD from Princeton told me, "Articles about the golden toad have been published in all of the top journals—like *Nature* and *Science*. As people advance their academic careers, and raise funds to create nature reserves, there are forces at work beyond our control. To me it is clear the world is ending, so we might as well go out with a bang—drinking and partying!"

HOPE ON THE MARGINS

As credentialed biologists from prestigious universities intimated their apocalyptic dreams and hedonistic desires, I found Costa Rican thinkers and tinkerers who were doing practical and imaginative labor to keep concrete hopes alive. Milton Brenes, the coordinator of a reforestation program at the bilingual Monteverde Cloud Forest School, is working against general feelings of anxiety about the environment to create a shared future with a multispecies community he loves. Milton is a short, mustached man with a seemingly endless reserve of energy and enthusiasm. He is a farmer, an organic intellectual, and a bricoleur. On eleven hectares of derelict pasture in the highlands of Costa Rica, Milton is re-creating a forest in collaboration with a multitude of plants, animals, and students. In parallel, the Cloud Forest School, a private K–11 institution, is endeavoring to generate a community of English-speaking environmentalists to care for the rejuvenating landscape.[13] Skilled at working with emergent opportunities and shifting contingencies, Milton guides a labor force of children and volunteers—ranging in age from preschool to their early thirties. Paying careful attention to their interests has enabled Milton to bring diverse actors together in a common project. Casting my lot with Milton, I joined this initiative as a volunteer who helped plant trees and as a participant observer of reforestation in action.

"Hope for the future," Milton told me in Spanish, "lies in the conservation of diversity." At first blush, this sound bite might sound like a simple repetition of environmental platitudes. Careful attention to Milton's rhetoric and practice reveals instead a clever way of speaking in terms a transnational audience can hear.[14] Hope here is emerging within a contact zone shaped by transnational regimes for regulating life, by elite North American visions of Nature, and by predictions of multiple

catastrophes on future horizons. Diversity here is a product of cultural hybridity, *mestizaje*, where a diversity of uses in indigenous traditions, a diversity of articulations with market economies, and a diversity of taxonomic forms all matter.[15] Using the language of hope and diversity helps Milton direct the impulses of short-term foreign staff and volunteers like myself, drawing us into the living architecture of regenerating cloud forest trees. Amid major ecological and economic transformations, he has aligned the interests of heterogeneous life forms, enfolding us together in an assemblage of multiplicities. An ecosystem is emerging, a riotous collection of strangers, which has begun to exceed Milton's own vision. Entrepreneurial plants, worms, and other animals are generating their own multispecies communities.[16]

Rather than focusing his efforts on preserving rare forms of life, Milton has cultivated alliances with robust trees that are helping him generate convivial assemblages. "We are producing twelve different tree species in our reforestation program," Milton says. "This will ensure that our students and tourists can have the opportunity to see important parts of the local fauna." *Inga punctata*, which is a hearty and fast-growing plant often found along roadsides and in abandoned farmlands, is one of Milton's favorite plants. "*Ingas* produce food for monkeys," Milton continues. "We want to attract monkeys to our school since they are dynamic, they are fun, since they are a species that the tourists like." The leguminous fruits of these trees, which are tasty food for capuchin monkeys, also attract parakeets, squirrels, large rodents called agoutis, and relatives of raccoons called coatis. Known as ice cream beans in English, or *guaba* in Spanish, the sweet-white pulp in *Inga* seed pods is a prized recess snack for children at the Monteverde Cloud Forest School. *Inga* flowers are also of interest to a diversity of beetles, butterflies, wasps, flies, hummingbirds, and bats.[17]

Fast-growing *Inga* saplings are quick to send out a spreading crown and shade out cosmopolitan grasses in the abandoned pasturelands. These leguminous plants fix nitrogen in the soil, creating conditions for the flourishing of other trees. *Ingas* can also summon animal familiars to their defense. All *Inga* species in Costa Rica have extrafloral nectaries, which enlist ants like *Ectatomma* as well as wasps and flies into multispecies ensembles (see chapter 2, figure 2.4).[18] In coffee and cacao plantations, *Inga* trees are planted to support an "ant mosaic" that helps protect crop plants from herbivory.[19] Milton plants *Inga* saplings at the Monteverde Cloud Forest School to help build a convivial world, tooth and nail, in concert with others.[20]

FIGURE 10.3. Milton Brenes's center for tinkering and thinking with plants was the greenhouse, a small structure with orchids, ferns, and bromeliads twining around each other and dripping from the ceiling. Here seeds were germinated, seedlings were nurtured, and rescued epiphytes were nursed back to life. Plantlets thrived on the floor, benches, and tables. Photograph by Eben Kirksey.

Conservation textbooks suggest planting tree species with attractive fruits to "encourage seed dispersal to the site via frugivores" (fruit-eating animals).[21] Each visit from a bird, an agouti, a monkey, or a bat to fruit trees brings the possibility of new plants sprouting from seeds in poop left behind. Pushing past textbook approaches to reforestation, Milton works to recruit allies—humans from disparate social worlds and multiple other species—to build an expanding network. In other words, he is always trying to multiply his forces with a multitude of entrepreneurial agents, seeking to generate an ever-expanding project of interessement, of enlistment.

"We started the reforestation project in the year 2000 and in total we have planted 13,630 trees," Milton told me. Kindergarteners and preschoolers put in a few important tree species in the first year. When Milton introduced me to the project in 2008, just eight years after starting, scores of trees were already towering over his head. By leveraging the interests of animals from a range of locations, by drawing allies into the generative processes of pollination, seed dispersal, and propagation, the *Ingas* were already helping create a multispecies community. Assimilating others into themselves, destroying this otherness while drawing sustenance, these plants began weaving insects, rodents, primates, and

birds into emergent ecologies on the school grounds.[22] Another convivial tree, hollow heart (*Acnistus arborenscens*, Solanaceae), was already attracting a wide variety of insect pollinators. Wasps, flies, butterflies, and beetles were being drawn in by a rare fragrant compound called orcinol dimethyl ether, which was almost undetectable to my own human nose. The corky bark of the hollow heart trees also proved to be an ideal substrate for growing epiphytes, plants that grow on the branches of other plants (*epi-*, upon; *-phyte*, plant). After just eight years, one hollow heart tree at the Cloud Forest School was full of orchids (*Pleurothallis* sp.), bromeliads, mosses, lichens, piper plants (*Peperomia* sp.), and melastomes.[23] Students were snacking on the tasty fruits, which are also attractive food for bats and over forty species of birds.[24]

Milton's reforestation program, and other educational initiatives at the Monteverde Cloud Forest School, have been chronically underfunded. The Nature Conservancy initially loaned the school $189,862 to purchase the pasture land in 1992 from a wealthy Costa Rican family.[25] After charging the cash-strapped school 8 percent annual interest on this loan for several years, the Nature Conservancy demanded a payment of $270,000 by a June 2000 deadline.[26] Administrators met this deadline, at the eleventh hour, but have been struggling ever since. A fund-raising campaign in 2008 sought to raise the wage of the Costa Rican and U.S. expatriate teachers—who were being paid less than $3.50 an hour—and to provide more scholarships to students, who were over 90 percent Costa Rican. As a result of the school's fragile finances, Milton was running the reforestation program on a shoestring. Despite day-to-day difficulties, the lack of foreign funding was liberating in a sense. Disinterest from the Cloud Forest School Foundation—a 501(c)(3) based in Sewanee, Tennessee—meant that Milton had the freedom to implement his own vision of reforestation while being attentive to local needs and interests. Milton was not working outside the machinations of global capital, but was cultivating diversity at the margins.

Milton's understanding of diversity had been shaped by his earlier work on projects with the Monteverde Conservation League.[27] Rather than focusing on biodiversity protection concerns of biologists, the Monteverde Conservation League was oriented to "the needs, interests, and perspectives of rural communities and small-scale dairy and coffee farmers."[28] Initially, exotic species such as casuarina (*Casuarina equisetifolia*) and cypress (*Cupressus lusitanica*) were planted because they were fast growing, known to foresters, and on a Costa Rican government list of trees approved for financial incentives. As thousands of ecotourists be-

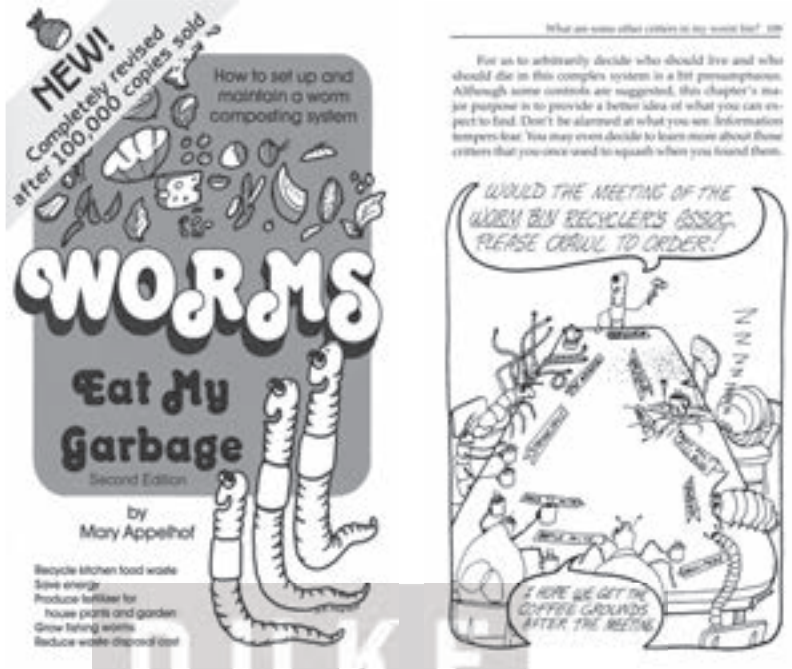
gan arriving in the 1980s, intent on seeing spectacular quetzals, toucans, and monkeys, economic opportunities emerged in ecosystems forested with local trees. The Monteverde Conservation League shifted their focus from exotic trees to native plants amid pressure from farmers who understood local plants as "more ecological, more productive, and more useful," according to Milton. By the early 1990s, Milton and the other League personnel were growing forty-nine species—six kinds of exotic trees and forty-three natives.

Working with resources that were ready at hand, the Monteverde Conservation League had developed simple reforestation methods. Milton used similar methods at the Cloud Forest School. Periodically he led the youngest students into the forest where they collected seeds from under *patrónes*, large "patron" trees that provided stock for the project. The seeds were brought back to a greenhouse where they were soaked in water for twenty-four hours—to kill insect larvae, eggs, and worms—before being laid to rest on three different beds for germination. One bed had leaf litter from the forest, one had decaying wood, and a third had soil. "Seeds of some plant species won't germinate if they are covered by soil," Milton told me. "Many trees in the primary forest need the specific moisture levels found in leaf litter or decaying wood to germinate." Once plants were big enough to leave the germination beds, they were housed in reused milk and juice cartons—collected, washed, cut to the proper specifications, and packed full of soil. Using found objects and organisms—gleanings from the detritus of industrial food production and the litter of leaves in the forest—Milton was re-creating an ecosystem.

THE RHIZOSPHERE

Despite pressure from some influential local biologists to use only native organisms, Milton brought a multitude of undocumented aliens, laborers rumored to be from California, to help with his reforestation project.[29] These workers were earthworms with a talent for converting food waste, the lunch leftovers of the teachers and schoolchildren, into a nutritious microbial assemblage that fed plant roots. Paul Sataltan, a Peruvian biologist, first brought the ancestors of these worms to the Monteverde region in 1997 from a technological institute in the lowlands of Costa Rica. Originally the worms were imported for different work: to deal with the waste, the fruit pulp, left over from the processing of coffee beans at the Café Monteverde Cooperative. Given as gifts to neighbors, conserva-

FIGURES 10.4 AND 10.5. Planting trees at the Monteverde Cloud Forest School in 2008. When I returned to the same site in 2014, a young forest, with an intact canopy, had reemerged in the barren ground. Photographs by Eben Kirksey.



FIGURES 10.6 AND 10.7. The convivial community of the worm bin comes to order with little help from humans. Cartoon courtesy of Mary Appelhof and Mary Frances Fenton.

tion institutions, and farmers, these earthworms came to populate local compost bins throughout the region.[30]

Members of an alien species thus began serving as surrogates for native plants in the regenerating cloud forest.[31] Milton started using worms to literally reassemble the forest from the ground up. Each tree seedling was planted in a small hole with a shovel full of material from the worm bin. Heavy grazing by cattle had compacted the lands inherited by the Cloud Forest School, turning the soil into a dense and distorted mass with reduced porosity and permeability.[32] Soil is usually a dynamic, living entity. The forest rhizosphere, the zone of soil around plant roots, is usually teeming with bacteria, microfauna, and symbiotic fungi. These companions are fed with nutrients by the roots and, in turn, they help the plants flourish.[33] Parts of the school's soil had turned into an impoverished desert, with few plant companion species.[34] Karen Masters, who laid plans for the Monteverde school's reforestation program in 1998

shortly after finishing her PhD in biology, told me, "This spot was windswept. The ground was like concrete."

Compost helped enliven this soil. Millions of microorganisms and thousands of small burrowing animals were present in the material generated by Milton's composting system. Worm castings usually contain fairly low amounts of nutrients. Yet plants grown in this chemically poor material still often have higher yields than those grown with high concentrations of commercial fertilizers.[35] Symbiotic organisms found in compost promote growth by increasing the bioavailability of nutrients to plants. Soil organisms can also play a defining role in the emergence of novel ecosystems by hindering, rather than helping, plant growth. Mature soils contain pathogens that limit growth of dominant trees while indirectly helping rare plants. Homogenous stands of plants, clusters of individuals that are all the same kind, often attract swarms of nematode worms, insect larvae, and deadly microbes that feed on roots. Attacks on abundant plant species thus create opportunities for others to emerge.[36]

Convivial communities in the rhizosphere, unruly assemblages that foster life for some and hasten the death of others, can do their work in the world with little help from humans.[37] Worm compost bins require little care. Shade them from the sun, keep the compost moist, periodically add more food scraps, and worms will work their magic. "C" for Compost, in the 2005 edition of the *Encyclopedia of Soils in the Environment*, describes the mystery surrounding these multispecies interactions in dry prose: "Compost can have a range of positive effects on soils, microbial communities, and plants. The complexity of these interactions and the diversity of compost types and behaviors pose continuing challenges for both scientific understanding and practical management."[38] Creatures lurking in the cosmos beyond the narrow purview of our understanding are thus exploring possible political articulations among themselves, exploring modes of coexistence in common worlds that are largely imperceptible to humans.[39]

Worms Eat My Garbage, a book I found in a local Monteverde library, contains a cartoon by Mary Frances Fenton that illustrates a Worm Bin Recycler's Association that has crawled into cosmopolitical association of its own accord. Here beetle mites, mold mites, millipedes, sowbugs, springtails, roly-poly pill bugs, mold, bacteria, and pot worms have come together in an assembly that is being called together by the red worm (*Eisenia fetida*). According to *Worms Eat My Garbage*, "Your worm bin is not a monoculture, but a diverse community of micro and macro-organisms that are inter-

dependent. No one species can possibly overtake all the other species present. They serve as food for each other, they clean up each other's debris, they convert materials to forms that others can utilize, and they control each other's populations. For us to arbitrarily decide who should live and who should die in this complex system is a bit presumptuous."[40]

THANATOS AND EROS

While the compost bins of worms were treated with laissez-faire policies, where benign neglect and disinterest allowed a multitude of beings to flourish in the soil, the work of reforestation above ground demanded more careful attention to matters of life and death. Since the Monteverde Cloud Forest School became a conservation easement, strict rules from Costa Rica's environmental ministry theoretically governed the management of killing and fostering life on the school grounds. But, in actual practice, local environmental ministry staff were up to their ears in other issues and rarely had time to visit. Milton was given a mandate by the state to determine which organisms should be cultivated and which should be killed on the school grounds. Milton became the benevolent *oikonomos* (the head of the estate) with the power to determine which plants deserved protection and which might be stripped of the right to life.[41]

Heroes and villains in this project of reforestation did not exist in any absolute sense, but were judged on the basis of situated, contingent action and effect.[42] As Milton began to care for an emergent forest, he began making high-stakes, and potentially arbitrary, distinctions between species he considered the enemy and species he regarded as allies.[43] Deborah Bird Rose argues that "death and continuity are core aspects of the integrity of life." Caring for others involves watching out for their interests, defending against outsiders or interlopers. Rose calls for us to embrace the necessary labor of killing in a way that affirms and sustains multispecies connections.[44] Milton applied similar norms about death and life to the plant communities under his watchful eye. Singling out enemies that were disrupting diverse connections, Milton worked to kill some plants in a way that twisted death back into life.[45]

East African star grass (*Cynodon nlemfuensis*) became the number one enemy of the Cloud Forest School's reforestation program. Like jaragua grass, which was introduced to lowland pastures of Costa Rica, this plant has long been a companion of cattle in Central America's highlands. Introduced to the region in the 1970s as a plague of spittlebugs and froghoppers attacked the fields of local dairy farmers, star grass was once

loved by many people in Monteverde. Star grass was less nutritious and less palatable for livestock than other grasses but became the preferred plant because of its resistance to insects. The same fortitude that made dairy farmers love this grass led Milton to hate it. Unlike the California red worms, allied aliens that were helping him build new worlds, he judged that star grass had become irredeemably destructive. Abandoned fields inherited by the Cloud Forest School were overgrown by tall and dense stands of star grass that shaded out other plants. Attempts to chop down these thickets with machetes or motorized weed whackers were frustrated as this tenacious plant quickly resprouted.

Star grass has deep roots, rather than rhizomes. It can spread vertically, as well as horizontally, with long stolons, runners that weave among the branches of emergent trees, weighing them down and blocking the sunlight.[46] While Milton's trees struggled to form links with a multitude of beings in the world, the star grass was more autonomous. This plant had a limited sense of self. An unrelenting commitment to self-preservation and self-propagation once made star grass an ideal companion of cattle as well as capitalist patterns of production and consumption.[47] These same properties made it the enemy of reforestation. Levinas has written of beings for whom "interest takes dramatic form in egoisms struggling against one another." For such beings, "*esse* is *interesse*; essence is interest."[48] Combating this vegetal egoism, Milton formed alliances with entrepreneurial plants with more convivial approaches to interessement.

While star grass had egoistic struggles with spittlebugs, froghoppers, and other insect herbivores, fast-growing *Inga* saplings began shading them out with their spreading crowns while summoning a diversity of insects to their aid. Surprises emerging within the abandoned pasture also prompted Milton to develop new tactics and strategies. An aster bush, known only as *monte* (a word meaning "mountain, backwoods, wilds, bushy scrub, or weed"), grew of its own accord within the tangled mats of star grass. Monte bushes began carpeting the land with light blue flowers and thousands of tiny seeds.

Milton began leaving the patches of land with *Monte* alone, watching as this native bush began to gradually displace the African grass. Vegetative dynamics among monte bushes and star grass were eventually overshadowed by trees he planted nearby as well as saplings spontaneously growing within. Costa Rican fiddlewood trees, *Citharexylum costaricensis*, began emerging within the fray. Likely arriving in the pasture from seeds distributed by birds pooping on the wing, the fiddlewood seedlings began secreting nectar from glands on their underside, summoning ants and

FIGURE 10.8. A bush called monte spontaneously emerged within the abandoned pastures and helped Milton rein in the wild roots of star grass. Photograph by Eben Kirksey.

other helpful insects to their defense. Quickly growing and producing flowers, they attracted small moths at night and stingless bees during the day. With fruits eaten by more than twenty species of birds, including toucans and turkeys, the fiddlewood trees helped open up opportunities to a multitude of others.[49] Responding to historical contingency, Milton was welcoming some emergences and squelching others. Always on the lookout for new talented or useful species, he was improvising at the intersection of multiple social worlds and ecological communities.

COMPETING VISIONS OF NATURE

When I returned to the Monteverde Cloud Forest School in February 2014, Milton brought me to places where I had helped plant trees and pull out weedy grasses. Exposed sections of the school grounds, once choked with star grass and underbrush, had become covered by a shady forest canopy. Milton pointed out the trees that were starting to overshadow the classrooms. There were *dama* (*Citharexylum costaricense*) as well as *Lorito* (*Cojoba costaricensis*), both which were producing fruit for migratory birds and squirrels. Nearby students were snacking on the fruits of a

FIGURE 10.9. A tree locally known as Maria (*Conostegia xalapensis*) is commonly found along roadsides and in abandoned pastures in Monteverde. The small dark fruits are favored by a diversity of birds as well as schoolchildren. These two students of the Cloud Forest School were enjoying a snack of Maria fruits from a branch given to them by Milton. Photograph by Eben Kirksey.

large *Conostegia xalapensis* tree, a member of the melastome plant family. Other children showed me their favorite tree, *mocos de mono*, or monkey boogers (*Saurauia montana*). The small lobed fruits of this tree contain a tasty sweet slime. "But don't eat too many monkey boogers," one boy warned me in English. "It makes your tongue and throat all tingly."

We were sitting in a park that Milton had created, on a bench he had built with help from students. "This park is a place where students and volunteers like you can come back to see the results of your efforts," he said. Signs labeling the principal tree species in his reforestation program gave the park an orderly feel. Milton said that he had been meticulously caring for this space, establishing well-defined trails, keeping the area free from weeds and human trash. This was clearly a space for people, for learning about trees and their uses. "Over here we have the *chancho blanco* (*Beilschmiedia costaricensis*)," Milton said, "which is desirable for hunters because its seeds are food for some mammals, like the paca (*Agouti paca*) and the wild pig. The chancho blanco is also good for lumber." The park was also becoming a site for encounters with Monteverde's charismatic wildlife. Howler monkeys had been visiting the school. As we talked, a toucan flew overhead and the metallic honk of a bellbird sounded in the distance.

While Milton showed me the trees he had planted with diverse local uses, he also talked about preparing students to engage with economic opportunities that had emerged with ecotourism in Monteverde. A few students, like Milton's own son Johnathan, had managed to use their education at the Cloud Forest School to pursue university education abroad. But most graduates were finding employment locally in the tourism sector—as taxi drivers, hotel receptionists, waitresses, bartenders, and guides. With wealthy tourists whizzing through treetops in zip-line harnesses on land immediately adjacent to the school grounds, students were indirectly learning uneasy lessons about social inequality as they studied natural history in the emergent ecosystem outside their classrooms.

Some expatriates living in Monteverde—biologists and conservationists from the United States—were critical of Milton's reforestation efforts, claiming that he was not doing enough to enhance the lifeways of certain charismatic species. These critics pointed me to the research of George Powell, who had been conducting radiotelemetry studies of resplendent quetzal migrations in the region. Powell was part of the team that petitioned the Nature Conservancy to help buy the land in 1992, writing that this site was "very important to the conservation of the quetzals because it is situated adjacent to the Monteverde Preserve, but at a lower elevation which is heavily utilized by migrating quetzals." Forest fragments near the farm had more than fifteen species of wild avocado trees, in the Lauraceae family, "all the important ones for quetzals." Powell concluded that the lands that were eventually acquired by the Cloud Forest School could "provide a bridge for migrating quetzals and a critical source of food in this altitudinal zone."[50] Critics claimed that Milton was not doing enough to help the quetzal and other birds. They charged that he was not planting enough wild avocados.

When he began the reforestation program in the year 2000, Milton planted many Lauraceae seedlings. But many of these fragile plants died. "The only way most wild avocados can advance is with help from other planted trees that are faster in their growth," he told me. Milton has had success in planting only one kind of wild avocado, *Ocotea whitei*, which is known in Spanish as *ira rosa*. In 2008, Deborah Hamilton, a U.S. national who has devoted much of her adult life to the study and conservation of the three-wattled bellbird in Monteverde, told me that *Ocotea whitei* is a "trash tree." According to Deborah, another species in the same genus, *O. monteverdensis*, is an endemic tree that is "preferred by everybody," namely toucans, bellbirds, thrushes, and quetzals. On

FIGURES 10.10 AND 10.11. The Cloud Forest School is located next door to Monteverde Canopy Tour, which was started in 1994 when the tops of forest trees were suddenly opened up to the paying public. A headline attraction is the Tarzan Swing, a harnessed free fall at the end of a long metal cable. Participants are also given the opportunity to climb up entangled fig roots, rope ladders, and guide wires. Photographs by Eben Kirksey.

one occasion, Deborah saw some eight quetzals sitting on a single tree. When *O. monteverdensis* is planted in combination with *O. floribunda*, it becomes a "super quetzal and bellbird tree," she added. These two *Ocotea* species fruit every other year, providing a good seasonal source of fruit that draws the same individual birds back to the same place. Deborah was running a tree nursery where she was nurturing *O. monteverdensis* saplings. In addition to producing trees with fruit for her favorite birds, she told me, her nursery was aiming to match the natural abundance of tree species in forests.[51]

Key questions should be asked of all reforestation projects: "What counts as nature, for whom, at what costs?"[52] The community of expatriate conservationists and biologists in Monteverde is deeply divided with respect to answers. Alan Masters, a biologist who served as the president of the Cloud Forest School Board for eleven years, is critical of reforestation programs that favor charismatic megafauna. "People only think that a plant is good if it feeds something like a bat, a bird, or another animal," Alan told me. "Why make a giant zoo?" he asked. "No one is planting trees for millipedes." While interviewing Alan Masters, I brought up Bruno Latour's proposal for manufacturing new speech prosthetics, for bringing new nonhuman voices into the domain of human representations. I said that our knowledge about plants and animals is constrained by university institutions and the history of particular disciplinary traditions. Alan picked up on some of Latour's arguments right away, rhetorically asking, "How much is the critter like you? How well is it studied? By virtue of design or neglect, who are we doing favors?"

Pulling a book off his shelf, *Costa Rican Natural History* by Daniel Janzen, Alan told me that he had been reading it against the grain. The milk tree, a lowland species that grows to a towering height of fifty meters, has a variety of uses (thus the scientific name, *Brosimum utile*). The sap, a white latex fluid, is drinkable, and the sweet pulpy fruits are edible. The wood is useful in construction, and the thick bark made for a warm and flexible blanket for Amerindian groups. The milk tree is the most abundant canopy tree on well-drained slopes and ridges in Corcovado, a peninsula in southern Costa Rica that is regarded by conservationists as the most pristine region in the country.[53] When Sir Frances Drake visited the region in the sixteenth century, he saw a wilderness, according to Alan, rather than a place with a high density of useful trees. Pointing me to other sites in Central America, Alan said that even after some two thousand years of regeneration following the collapse of the Mayan empire, the forest still shows signs of human presence. There are still higher

densities of trees with big juicy fruits and edible seeds near Mayan ruins, when compared with forests farther from these settlements.[54]

Bringing our conversation back to reforestation at the Monteverde Cloud Forest School, Alan asked, "If Milton is planting twelve species that favor particular birds and mammals, what is this doing to ecological dynamics? How will decisions taken today play out over the next two thousand years?" Advocating for a disinterested approach to reforestation, kindred to the laissez-faire policy that allows the Worm Bin Recycler's Association to crawl to order on its own, Alan Masters told me that reforestation projects should be focused on creating spaces for nonhumans. Rather than creating a utopia for bird enthusiasts, or for tourists who want to see monkeys, he thinks we should also focus conservation efforts on mushrooms and bacteria. Alan would like to see more places left alone to see what might emerge. "Reforestation isn't an inherently natural process," he said upon reflection. "With ecosystems there are unpredictable outcomes," he added. "There are emergent properties that we can't anticipate."

After hearing the concerns of Alan Masters and Deborah Hamilton, I went back to Milton and invited him to respond. Walking with me around the school grounds, he recounted his work with emergent properties of plant communities, the experimental interventions he made against the backdrop of unpredictable outcomes. He showed me places where the helpful aster, monte, was still present, entangled in a life-and-death struggle with star grass. He asked me to take a second look at places for humans that had become focal sites of his attention and care (*cuidado*), and other spaces that he was regarding with benign neglect (*descuidado*). In the orderly park, where Milton had established well-defined trails and clearly labeled trees, he was caring for plants with roles in Costa Rican communities. Many of these trees were valuable as lumber or had fruits and nuts that were attractive to pigs, agoutis, and other animals favored by local hunters. Relationships between students and plants useful in mestizo farming traditions were being cultivated here, in an outdoor classroom. Encounters with insects, birds, and bats—all creatures with critical roles in the reemerging forest ecosystem—were also being facilitated in this carefully managed space. In this park, Milton was enacting an ethics of care based on sustained relationships.[55]

Caring for other spaces with benign neglect also enabled Milton to decenter his social world, allowing other forms of life to flourish outside of utilitarian calculations. While cultivating sustained relationships with some plants and allied animals, Milton tactfully kept his distance from

others—like the worms in his compost bins and monte, the blue aster. With competing needs and interests intersecting in this regenerating forest—those of small-scale farmers, local hunters, capricious visitors, foreign donors, tourism promoters, and biological scientists—this place exemplified the "contaminated diversity" described by Anna Tsing. "Contaminated diversity is everywhere," writes Tsing. "For better or worse, it is what we have. . . . Diversity continues to emerge, even in ruins." Milton was fostering a diversity of links to economic systems and overlapping ecological communities. Working in the aftermath of environmental destruction, with the detritus of industrial food production, with weedy plants and alien helpers, he was generating lively possibilities.[56]

SURVEYING DIVERSITY

Eladio Cruz, a renowned Costa Rican naturalist, worked with me in February 2014 to conduct a biodiversity survey on the grounds of the Monteverde Cloud Forest School. He also helped me better understand how each plant species we encountered had a diversity of articulations and entanglements in social and biological worlds. Meeting at Eladio's house, at the base of a steep hill leading up to the school, we chatted about how local dairy pastures were gradually being reclaimed by trees, even in the absence of active reforestation programs. A light rainy mist, what Costa Ricans call *pelo de gato* (cat hair), was falling all around us as we climbed the hill. We stopped to look at a tall *Inga* tree and a cluster of mature Maria trees (*Conostegia xalapensis*) growing along the roadside on their own accord. As we entered the school's land, as we began photographing and identifying trees, we bumped into Eladio's son, José Andreas, a high school junior. Walking past the areas frequented by students, we ventured onto a steep hill, into a stand of trees I had helped plant in 2008, just six years before (see figure 10.4). Underfoot was much leaf litter and some plastic litter. Overhead was a canopy formed by lanky *Inga punctata*, guayaba, and ira rosa (*Ocotea whitei*) trees. But Eladio and I were not counting or identifying those species that had been planted as part of the reforestation project. We were instead searching for emergent seedlings and saplings that had germinated on their own.

Star grass was still covering some parts of the hill in an impenetrable tangle. Other parts of the hill had an open understory, with the blue aster, monte, growing sparsely, close to the ground. Eladio identified most plants by sight, occasionally crumpling a leaf to see if it had a distinct odor, or turning it over to see if it had spines or hairs. Rolling the syllables

gently off his tongue, Eladio patiently waited for me to scribble in my notebook, recording Latin words and plant families that invoked distant lands and long-dead botanists: *Montanoa guatemalensis* (Asteraceae), *Diospyros hartmanniana* (Ebenaceae), *Sideroxylon puertoricensis* (Sapotaceae), *Beilschmiedia brenesii* (Lauraceae). Repeating variations of familiar stories, Eladio told me about the animals attracted to particular plants: "This one has small seeds distributed by doves and the blue-crowned motmot. That plant bears the favorite fruits of bats. This tree is useful for timber and attracts wild pigs, squirrels, and agoutis."

Walking to the other side of the school, toward the park Milton had created, we passed by a fragment of old-growth forest and by some of the very first trees planted at the school. Two "super bellbird" seedlings, *Ocotea monteverdensis* and *O. floribunda*, were growing spontaneously near a "trash tree" seedling, *O. whitei*, the plant derided by Deborah Hamilton for having substandard fruit. As Eladio identified another plant in the same genus, an *Ocotea tenera* sapling, he brought out a magnifying glass to show me some miniscule domicia, "small houses," on the underside of the leaf. We could see tiny arthropods—perhaps mites or small beetles—scurrying around, but they were too small for us to identify.

Eladio was pointing to surprises beyond the scope of Milton's vision, wild emergences involving multiple species that had come into being amid the play of diverse market economies, pedagogical initiatives, and scientific enterprises. Oblique powers and opposing forces were at work in these multispecies worlds. Allies in Milton's reforestation project—convivial trees attracting animals involved in pollination, seed dispersal, and plant protection—had multiplied their forces to the point where their existence was no longer contingent on humans, worms, or other surrogates. Enfolding each other into an emergent ecosystem, they had brought a multitude into being. Not counting the twelve tree species that had been actively planted, Eladio identified a total of thirty-eight tree species emerging within the reforestation project.[57] These species had not figured directly into Milton's vision for the forest; they were the unexpected figures of hope he had expected, textbook examples of seed dispersal at work.

DISASTER AND OPPORTUNITY

Eladio and I took a break after our biodiversity survey, to eat a picnic lunch on a bench in the manicured park that Milton had created. As we were talking, Eladio sprang up. A tree had caught his eye from across the

other side of the park. Bright-red fruits were hanging down in conspicuous clusters from the branches of a bitterbush (*Picramnia antidesma*), a shrub that he had never seen up at this altitude. This central part of the Monteverde Cloud Forest School lands sits at about 1,500 meters, and Eladio had seen this plant previously only in the nearby San Luis valley at an elevation of about 1,100 meters.[58] Milton lives in San Luis, and we later learned that he had brought its seeds up to the school in a modest attempt to prepare for climate change.

Working under Milton's direction in 2008, I had helped plant lowland trees on the school grounds that had diverse articulations to market economies, uses in mestizo traditions, and possible futures in techno-scientific dreams. Costa Rica's national energy and telecommunications company, ICE, donated seedlings of valuable timber species—cigar-box cedar (*Cedrela odorata*), cocobolo (*Dalbergia retusa*, Fabaceae), and false

FIGURE 10.12. This wild avocado tree species, *Ocotea tenera*, will attract spectacular birds—like the resplendent quetzal and the three-wattled bellbird—with its fruit if it survives to adulthood. The leaves of this tree, even at the sapling stage, have tiny domicia—small houses—where arthropods can live. Photograph by Eben Kirksey.

FIGURE 10.13. Milton planted bitterbush (*Picramnia antidesma*), a common shrub found throughout the lowlands of Central America and the Caribbean, in Monteverde's regenerating cloud forest to test the boundaries of its range amid changing environmental conditions. The bark of this bush "has been given with success as an alternative in constitutional affections, connected with syphilis and yaws, and as a tonic in debility of the digestive organs, and in intermittent fever," according to James Macfadyen's *The Flora of Jamaica*, published in 1837. Photograph by Eben Kirksey.

savanna oak (*Tabebuia rosea*, Bignoniaceae)—to the Monteverde Cloud Forest School. The company was planting fifteen thousand trees in the region to protect their hydroelectric projects from erosion. One of the three ICE trees, the cocobolo, has fine wood used in furniture and jewelry. It is currently listed as "vulnerable" on the IUCN Red List of Endangered Species. Wood of the other two trees, the cigar-box cedar and the false savanna oak, is often used by Costa Ricans for building houses. Milton later told us that all of the cocobolos, the cigar-box cedars, and the false savanna oaks we had planted in 2008 had died within the first year. Bitterbush was the only lowland plant that Eladio and I found growing at the Monteverde Cloud Forest School during our 2014 survey.

Many expatriate biologists in Monteverde fear that attempts to prepare for climate change may backfire. Human actions often trigger unexpected outcomes. Introducing lowland species to the highlands, according to local critics, might hasten the demise of members of local flora and

fauna that are struggling to survive. Milton disagrees. Rather than seeing broken ecosystems, with species being popped out like rivets in an airplane wing, he is helping fasten an emergent community in place—testing out new living rivets all the time, to see if they might fit. By his reckoning, planting lowland trees in Monteverde will ensure that a forest will still be standing even if local trees die from heat stress.

William Haber, who has been studying the ecology of Monteverde's cloud forest since 1973, is not worried that reforestation projects like Milton's somehow violate the natural order (as many expatriate critics imply). "To me it doesn't make too much difference if you just let it regenerate," Haber told me, "or if you plant things that you like for a specific reason because you have a goal in mind." Haber arguably knows more about the distribution and diversity of Monteverde's trees than anyone else alive today. "The Plants of Monteverde," the results of Haber's collaboration with the Missouri Botanical Garden and the Electronic Field Guide Project at the University of Boston, currently serves as the definitive reference for anyone conducting ecological research in the region.[59] Pointing me to the local paleontological record in Monteverde, Haber related his bleak visions of a future when a geological cataclysm will eclipse all local human agency and action.

Haber situates local ecologies within a long regional history of volcanic disasters. Ash, pumice, and cinders from Arenal Volcano have periodically destroyed the forests of Monteverde, with eruptions taking place about every five hundred years.[60] "The last big ash layer, the last major explosion, was about a thousand years ago," Haber told me. "We are about due for another big one." These prehistoric disasters likely had dramatic impacts on the forests of Monteverde. "I presume a lot of it was killed and then it was recolonized," Haber said. "So sometimes when you think you are in primary forest, it is actually still a regenerating forest." A major volcanic eruption at Arenal would certainly kill much of the local flora and fauna of Monteverde and also disrupt long-term conservation agendas. But against the backdrop of this potentially bleak future, amid the immanent possibility of an apocalyptic ending, there are still signs of hope.

Volcanic ash fields are fertile grounds for nourishing emergent ecological assemblages or agricultural initiatives. A team of archaeologists has found that the village lifestyle of indigenous groups "was remarkably stable and resilient in spite of the effects of at least nine prehistoric explosive eruptions of Arenal Volcano." By comparison, other prehistoric sites near volcanoes—in Mesoamerica, the Andes, and Middle America—had much more dramatic disruptions following eruptions. In contrast to these

FIGURE 10.14. Evidence of past volcanic disasters is clearly visible in sections of the soil that have been cut away during the construction of roads in Monteverde. Photograph by Eben Kirksey.

other sites, which showed evidence of political stratification, economic centralization, and reliance on commodities transported great distances, the prehistoric villages in the shadows of Arenal were sparsely populated and avoided reliance on irrigation systems, storage facilities, and large-scale construction. Archaeologists attribute the "striking stability" of prehistoric societies in the greater Monteverde region to "a diversified adaptation within the environment." Wild food sources—fish from a nearby lake, game animals from the forest, fruit trees, root crops, wild seeds, and berries—were supplemented with agriculture focused on corn and other seed crops.[61] In other words, practices of gardening in ruins have a deeply rooted local history.[62]

Looking past many potential catastrophes looming on future horizons—predicted extinction events, possible volcanic eruptions, and reports of economic disaster in distant lands—Milton sees the possibility of fresh order-forming associations amid order-destroying disasters. Milton has seeded a forest that will endure many different possible futures. By paying careful attention to the interests of entrepreneurial agents, he has brought a swarming multitude to life.[63] Rather than envisioning a postapocalyptic utopia, where humans have abruptly left the scene, Mil-

ton imagines a shared future with plants and animals he loves.[64] Instead of holding loved ones in a tight, uncomfortable embrace, he has tried to keep a polite distance—experimenting with forms of care and generative practices of disinterest. Dismissing the immediate relevance of apocalyptic predictions, and people who are waiting for the arrival of messianic figures, Milton has grounded modest hopes by gardening in twentieth-century ruins. His visions of the future are full of happiness. Living with the hap of what happens, multiple species are flourishing as they navigate the contingency of a world managed with tactful oversight.[65]