

Grupo del Oro, had just opened its first juicing plant, with vast, imposing machinery that, as Janzen would later describe it, "eats oranges, pees juice, and shits pulp." *Pulp* is the trade term for peels, seeds, and fiber, and Warren had to figure out some way to get rid of more than 300 tons of it each day. Standard procedure was to invest in a plant to turn the waste into cattle feed, but Del Oro hoped to avoid that. The small company had rigorously cultivated its environmental credentials, niche-marketing organic juice in the United States and Europe. A big, fossil fuel-fired feed producer didn't fit with that image, aside from the fact that it was sure to cost several million dollars.

As Janzen mulled it over, his thoughts turned, as usual, to the Area de Conservación Guanacaste (ACG), the enormous biodiversity reserve that had been his home and major project for the past fifteen years. Abruptly, a smile broke through his wild white beard and his hazel eyes lit up behind slightly crooked wire-rims. "I've got 235,000 species in the ACG," he told Warren. "Some of them are going to like to eat pulp."

That insight was the starting point for one of the strangest, most innovative, and ultimately most controversial business deals ever struck between a corporation and a wilderness. It yielded a contract, signed in August 1998, specifying several "services" to be rendered over a twenty-year period by the conservation area's biodiversity. They included water from the ACG's high, wet "cloud forests," natural pest control by local bugs, and the biodegradation of orange pulp. In return, Del Oro would hand over 3,445 acres of lightly logged forest lying between the ACG and the orchards, valued at \$480,000.

The juice firm agreed to pay for these benefits, most of which it had already been getting for free, for the sake of the most original and, for Del Oro, most valuable part of the contract: the disposal of pulp. As agreed, 1,000 truckloads per year of the orange waste would be trucked to the reserve and spread on strategically chosen pastures. There, they would be plowed through by stratiomyid and syrphid fly

Costa Rica: Paying Mother Nature to Multitask

"Partly by default, partly by design, all of nature is now in the process of being domesticated—of coming, or finding itself, under the (somewhat leaky) roof of civilization. Indeed, even the wild now depends on civilization for its survival. Nature's success stories from now on are probably going to look a lot more like the apple's than the panda's or white leopard's. If those last two species have a future, it will be because of human desire; strangely enough, their survival now depends on what amounts to a form of artificial selection. This is the world in which we, along with Earth's other creatures, now must make our uncharted way."

—Michael Pollan

DANIEL JANZEN, a University of Pennsylvania biologist who has made it his business to know everything about everything going on in Costa Rica's northwestern Guanacaste Province, was talking to Norman Warren, a local citrus firm manager, back in late 1995, when Warren happened to mention pulp. Warren's company,

larvae and then gradually devoured by thousands of species of fungi and bacteria, providing a benefit for which Del Oro would pay with its land, the equivalent of \$12 per truckload of pulp. This arrangement promised both to solve Warren's problem and to help Janzen's ACG.

An award-winning tropical scientist who combines Adam Davis' energy with David Brand's imagination and Ron Sims' deal-making savvy, Janzen had long been on the lookout for opportunities to raise money from Nature's labor to funnel back into conservation. His chief laboratory, to which he has devoted most of his career, is the ACG, yet he insists that the methods he has tested there could be models for much of the world. Janzen calls himself a tropical real estate developer; his specialty is coming up with different ways by which an ecosystem can make money to pay for its own preservation and maintenance.

He had come to Costa Rica thirty years earlier to study that country's wealth of biodiversity, specifically the animal-plant interactions that were his specialty. Yet he soon found his raw material vanishing before his eyes. Until the late 1980s, the small country, the size of West Virginia, had one of the world's highest deforestation rates. Oak forests were being demolished for charcoal, and fires were sweeping out of control across their razed remnants. Species were going locally extinct by the week, and the immensely complex webs of relations that make up healthy ecosystems were collapsing. Along the Pacific coast, only a few miserable patches were left of the magnificent dry tropical forest that five centuries earlier had reached from Mexico all the way to the Panama Canal.

That dry deciduous forest was nearly as rich in biodiversity as tropical rain forest, which has more successfully captured the public's imagination, but was even more endangered. The besieged forest's trees include the majestic, wide-canopied *guanacaste*, the province's namesake, and are home to such rare and charismatic creatures as jaguars, howler monkeys, scarlet macaws, toucans, and tapirs. When the Spaniards arrived, tropical dry forest occupied as much or more

of the lowlands as did rain forest, yet by the 1980s less than 2 percent of it was still relatively intact. Even so, by Janzen's calculations, about 120,000 species of insects, 60,000 species of fungi, and 9,000 species of plants were still clinging to the decimated wilderness within the ACG.

Janzen's scientific devotion is deep. He loves mice and moths and can talk for hours about caterpillars. In 1978, after two failed marriages—"nice, intelligent women, but they didn't like the Tropics"—he found a soul mate in biologist Winnie Hallwachs, seventeen years his junior, who shares, among other things, his fascination with warble flies (*Dermatobia hominis*), which lay their eggs on the undersides of mosquitoes. While the mosquitoes suck their victim's blood, the warble fly larvae hatch and burrow into the skin of their prey, seeking a comfortable way to spend their infancy. Hallwachs, who like Janzen has spent many years in the Tropics, estimates she has "reared" half a dozen of the flies in her ankles, wrists, and scalp. She once let a Cornell University camera team film a larva emerging from her arm, which, of course, for most people would be a rather upsetting process. But, as she explained, "For both Dan and me, there are certain kinds of curiosity that are really part of the wonder of life, and can way override the kind of reactions most people would have."

All the same, what Janzen witnessed in Costa Rica made it intolerable for him to remain in the role of someone who, as he said, "would study the flames while Rome burns." He felt as if he were watching people burn the Library of Congress during a fuel oil shortage. Orner by nature, he became more so. He did what few scientists do: he paused from his studies to, quite literally, fight the fires. Together with Hallwachs and a team of Costa Rican collaborators, he lobbied the government and raised the money to expand Guanacaste Province's tiny Santa Rosa National Park, then a barely surviving island amid the phantoms of the dry forests, into a 580-square-mile land and sea refuge from the pressures of the twenty-first century. The effort, eventually involving a full 2 percent of Costa Rica's land area, would in time become the world's largest tropical

restoration project and an inspiration for others seeking innovative ways to finance environmental rescue missions.

The initial pieces of the project included lowland dry forests, upland rain forests and cloud forests, and reefs, rivers, and beaches, all with some protection status. The remarkably ambitious plan was to combine them into one vast area by buying all the barren tracts of degraded pastureland that lay between them. Then the newly protected areas would be revived to their former richness as the forests gradually regenerated. In the lowland dry forests, the largest part of the ACG, that meant, first of all, controlling the fires. In this task, Janzen faced a stubborn enemy common to conservation efforts the world over: non-native pasture grasses, known in Costa Rica as *jaragua* and imported from Africa by ranchers in 1943. In more than half of the reserve, the *jaragua* fueled the fires, traditionally set by farmers and ranchers, that annually burned through the area. Janzen needed a way to kill the grasses and nourish the earth underneath. That's where the orange pulp came in. He realized it might just accomplish both tasks.

In 1996, he set up an experiment. He asked Del Oro to deposit 100 truckloads of pulp on a one-hectare plot of pasture a couple of miles downwind from a patch of forest. Within eighteen months, just as Janzen had hoped, the *jaragua* had been smothered, leaving behind dark, moist earth. Broad-leaved herbs and trees whose seeds had been blown in from the forest were already sprouting in abundance. Janzen was sure the pulp had degraded much more quickly than it might have in other landscapes because of the great variety of species in the ACG available to tackle the work.

Both he and Del Oro's managers were elated by the results. Janzen had obtained a new tool against the *jaragua* and the promise of a valuable new forest parcel, without having to draw on the ACG's beleaguered budget. For Del Oro, the arrangement meant not only avoiding a major new expense but also building up its environmental credentials, which were key to its financial survival. The small firm, with sales of just \$25 million per year, was competing with

giants from Florida and Brazil by using the minimum of agricultural chemicals and pitching its juice to the most environmentally conscious consumers. Its efforts had already won it the Rainforest Alliance's ECO-O.K. label, and Del Oro was the world's only citrus company certified as being in compliance with the environmental management criteria of the International Organization for Standardization (ISO), a prestigious voluntary association.

As Del Oro expected, the unique biodegradation scheme won applause from environmentalists. But soon afterward, a competing citrus company, TicoFruit, struck a fatal political blow. In noisy appeals to the government, press, and congress, TicoFruit said Del Oro's pulp disposal arrangement was sullyng a national park. The complaints led to an uproar that ended with the government canceling the project.

Janzen contended that TicoFruit's claim was groundless, arising from envy of Del Oro's novel competitive edge. "It just proves the worth of the services," he said with undiminished zeal in February 2001 during a bone-crunching two-day tour of the ACG in his Toyota four-by-four.

The comment typified the way Janzen looks at wilderness. His Costa Rica years have made him a fierce champion of the idea of wild places in effect paying for their own survival in societies that tend to think of them as costly luxuries. Use it or lose it, he argues. Use it, moreover, in as many ways as possible, as long as they aren't destructive. Most of the time, no one service of Nature pays enough to protect an entire ecosystem.

This notion of making wilderness work for a living repels other equally devout conservationists. "I would describe it as use it *and* lose it," says John Terborgh, codirector of the Center for Tropical Conservation at Duke University. Terborgh worries that, with the exception of ecotourism, many "sustainable" activities, such as selective timber harvests and cultivation of nontimber forest products, in fact do great damage. Among other risks, he says, they tend to attract more people to the new sources of income until the resource ends

up being overused and often completely destroyed. In his book *Requiem for Nature*, Terborgh describes a series of efforts to combine conservation and development in Southeast Asia, West Africa, and elsewhere that ended up only accelerating forest destruction. Condemning the "mirage of sustainable development," he argues instead for enforced protection of parks as the last bastion of biodiversity. He even suggests a full "internationalization of nature protection" under the auspices of the United Nations. "If peacekeeping has been widely accepted as an international function, why not nature keeping?" he asks.

But Janzen contends that Terborgh's complaints don't apply to his specific experiments in the ACG. And he holds fast to his utilitarian perspective. Humans are hard-wired to cultivate Nature, something we've done since the Pleistocene epoch, Janzen says, adding that in the future, "tropical wildlands and their biodiversity will survive in perpetuity only through their integration into human society." Not all of wilderness can be saved, he insists, only those parts that have specific value to people. He hates the word *park* because he thinks it restricts options. Instead, he has coined the word *gardenification*, implying, as he explains, "you invest in Nature, use it, think of it as having an owner and a future, as producing goods and services for the country, rather than as a frontier to exploit or destroy."

"Attempts to conserve biodiversity for its own sake just make local society mad," Janzen barked as the Toyota bumped furiously down a dirt road, in the brook-no-argument tones of his pre-Vietnam War U.S. Army Military Police years. Far ahead to the east, the 1,500-meter peaks of the Oroquieta and Cacao Volcanoes could be seen, wreathed in clouds and capped by dense forest. Janzen's hands flew around the steering wheel for emphasis. "We've got to get rid of the Smokey-the-Bear, guard-the-gold idea of a park," he said.

Janzen demonstrated his various proposed alternatives on that two-day guided exploration of the ACG, with stops along the way to tour Del Oro's factory and eat beans and rice at a new thatched-roof restaurant aimed at visiting ecotourists. By the year 2000, the con-

servation area had long been producing revenues, primarily through tourism. Some 50,000 travelers, most of them foreigners, were visiting each year, paying \$6 gate fees collected by the government. Besides that, Janzen estimated that visiting scientists, himself included, had recently been adding about \$600,000 per year to the local economy, some of it paid directly to the ACG in return for lodging and research facilities and some as salaries to resident research assistants.

These, of course, were obvious winners: gardenification's low-hanging fruit. Janzen had been involved in many more innovative plans, most prominently a 1991 "bioprospecting" contract, which he helped write, between the giant drug firm Merck & Company and the Instituto Nacional de Biodiversidad (INBio), which inventories Costa Rica's biological wealth. In the groundbreaking contract, Merck agreed to pay more than \$1 million over a two-year period for samples of chemical extracts from plants, animals, and microbes as well as royalties to INBio and the government if any new drug based on the samples were to prove commercially successful. The first materials came from the ACG, and the agreement with Merck has since been extended twice.

The commercial potential of Costa Rica's wealth of flora and fauna was becoming increasingly obvious in the years before the first Merck contract. Worldwide, at least forty-seven major drugs had come from rain-forest plant species, with an accumulated net worth of \$147 billion. "We don't have gold. We don't have petroleum. But we do have biodiversity—green gold," Roger Blanco, an early ACG official, told author William Allen, as recounted in *Green Phoenix*, his book about the early years of the ACG's development.

Following its contract with Merck, INBio made deals with several other foreign firms seeking new antibiotics, fragrances, and natural pesticides derived from tropical plants. The first glowing headlines about these contracts, in Costa Rica and elsewhere, raised expectations of instant wealth from developing countries' rain forests—expectations that still hadn't been met by the millennium's

end. But sobered enthusiasm for the concept persisted. In 1996, for instance, officials from Yellowstone National Park visited INBio and the ACG to learn from their experience. One year later, they announced that a San Diego corporation had agreed to pay for drugs or chemicals derived from the national park's resources, with revenues to help pay for conservation.

Pleased as he was by these developments, Janzen eventually grew frustrated by how few revenues from bioprospecting were directly funding conservation. "There is no big mystery in the technology," he has written of the art of bioprospecting. "The mystery lies in how to construct the income stream so that some portion of the prospecting profits are paid back to the wildland garden itself." Pointing at a cup of coffee one morning, he said, "I'll tell you what this is. It's the world's most popular rain-forest drug." Coffee, in fact, is the world's second-ranking commodity in monetary terms, right after petroleum. With trillions of cups of coffee brewed each year, Janzen claimed, "A one-cent tax on each cup worldwide would fund all of tropical conservation forever. Now, no one is going to succeed in imposing that tax . . . but if the bioprospecting contracts are written right, it'll be there for the next cup of coffee to come along."

Shortly after his experiments with bioprospecting, Janzen turned to another technique for marketing Nature's labor: the sale of carbon credits. The concept caught his imagination about the same time David Brand, in Australia, was working on the first carbon-rights legislation. In the early 1990s, he developed a plan to sell credits from Guanacaste's fledgling forests and aggressively courted General Public Utilities (GPU), an energy firm based in New Jersey that was among the first big U.S. companies to start acquiring carbon sequestration projects.

Dennis O'Regan, in charge of GPU's environmental auditing, said he met with Janzen in the fall of 1995 to review his proposal, which to his surprise turned out to be a multimillion-dollar project. "His price for a ton of carbon was very, very high," O'Regan said. "We were looking for a dollar a ton, while his estimates were on the

order of four. . . . Basically, he was appealing to our altruism to protect Costa Rican rain forest at a price four or five times what we were willing to pay." O'Regan praised Janzen's "creativity" but said, "I had a hard time getting \$100,000 out of my company. We basically told him no thanks."

Janzen countered that market prices for carbon by 2000 were between \$2.50 and \$6.50 per ton and that companies that bought in early gained valuable experience. But by 2001, he'd abandoned plans to try to sell Guanacaste's carbon credits. He'd decided that its water was a much more promising commodity and was working with officials from the Ministry of Environment and Energy on a plan to have the ACG start charging tens of thousands of local farmers for the water generation services provided by the cloud forests on its three volcanoes.

Cloud forests are full of interesting sounds—from buzzes, shrieks, and howls to soft peeps and melodious songs—but most of all the sound of constant dripping. Dark green leaves crowd the spaces between mossy trunks and stems in a confusion of shapes and sizes, but with one design feature in common: the drip tip. The leaves' enormous surface area condenses moisture out of the air and feeds it, via the drip tips, to the soft and spongy forest floor. In the ACG, cloud forests capture moisture as it blows inland from the ocean, storing and gradually releasing the water into the river system. The ACG's cloud forests make rivers flow abundantly through the hot, dry season and feed crop production far away in a vast, arid lowland region in the rain shadow of the volcanoes.⁴

Much of the prosperity of the lowland farming region owes to the unpaid services of the cloud forests. Janzen's plan would recycle part of the revenue stream flowing from agriculture back to its source. His plan was proceeding, even though it was sure to be unpopular locally. Water was still extremely cheap throughout Costa Rica at the turn of the millennium. Nonetheless, officials recognized that the ACG's water resources were bound to increase in value, particularly if global warming heated and dried the region. Janzen pre-

dicted that as the upland forest expanded, watersheds would be restored for eleven major rivers, creating a "water factory." He wanted to nail down a source of revenue for future factory maintenance. "The basic philosophy is no free goods, and protect the source," he said.

The more unconventional the strategy, the more Janzen liked it. At one point during the tour of the ACG, he braked his Toyota on a hilltop overlooking a small, green stand of new trees in a pasture. "These are gmelina," he announced. "They're fast-growing Southeast Asian plantation trees, and they provide most of the world's cardboard. They're anathema to most tropical conservationists because so often primary forests have been cleared to make way for them. Remember Ludwig?" He meant Daniel Ludwig, the U.S. shipping tycoon who'd bought a plot of Brazilian Amazon jungle larger than the state of Connecticut and deforested nearly 300,000 acres to plant gmelina and pine. Ludwig went bankrupt and sold out in 1982, but Janzen dreamed of success with a much smaller project. "The Nature Conservancy had a massive heart attack when I brought this up," he said, laughing, as he jumped down from the truck. "But then they saw the sense in it."

Janzen believed that gmelina could be a powerful tool in his effort to regenerate upland rain forest in the ACG. The tricks to restoring dry forest were comparatively simple: stop the fires and suppress the *jaragua* fueling them, and the natural process of succession to forest would immediately get under way, with wind and animals transporting seeds into the open pasture. Recovering the moist upland forest, on the other hand, posed more daunting obstacles. The seeds of most rain-forest trees are not dispersed by wind, and the ACG's moist uplands had few pasture-loving animals—like the lowland's magpie jays, coatis, and coyotes—to carry in seeds from the forest. Moreover, most young rain-forest trees can't survive in open pasture; they typically require shade to thrive. Topping it off, in order to survive, all the trees needed certain types of soil fungi to bind to their roots and supply them with nutrients. Although fun-

gal spores were blowing all over in the flat lowlands, the cloud-enshrouded mountainous uplands had lighter winds, making the chance fairly remote that both the seed of a rain-forest tree and a spore of its special fungal partner would arrive at the same spot at the same time.

The gmelina, as Janzen saw it, might kick-start the natural process of succession to rain forest, potentially helping to solve a major problem not just in the ACG but also potentially elsewhere in the Tropics. The trees were easy to establish in open pasture and would fairly quickly offer a canopy whose shade would kill the *jaragua* in as little as two years and let native rain-forest plants and their hidden partners gradually establish themselves and flourish. "I happened to walk by some plantation trees a few years ago and saw all this stuff growing underneath, and a lightbulb went off," he recalled. Subsequently, he flew to The Nature Conservancy's headquarters in Virginia to try to calm his conservationist colleagues with a briefing on the subject. Helped by a \$100,000 grant from the Michigan-based Wege Foundation, Janzen began in late 1999 planting gmelina on about 125 acres of pasture in the ACG. After as little as eight years, he said, he'd be able to sell the logs, depending on market prices, and kill the stumps with herbicides, leaving behind the start of a young rain forest. His results thus far were encouraging.

Although Janzen contends that his forest restoration and revenue models might easily be adapted to other places, his innovations in Costa Rica arise from a unique serendipity of politics, biology, and psychology. In few, if any, other parts of the world does the same combination exist: a country so eager to prove its environmental credentials, such a vast store of biodiversity to draw on, and so audacious, persistent, and well-connected a guest. Over time, Janzen's unorthodox approaches, aggressive ambition, and general lack of tact have alienated various government officials. Nonetheless, he has managed to wield extraordinarily enduring influence, especially considering his outsider status. "He's the hardest worker I know, and he's Costa Rica's biggest salesman," said former minister of environment

and energy Alvaro Umaña, a founding father of the nation's environmental policies.

As the century turned, Costa Rica was a global showcase of environmental leadership. It had started out with the advantage of holding 5 percent of the world's biodiversity on less than 0.04 percent of the world's land. The reason it had managed to maintain such lushness was the same reason many Costa Ricans see irony in their country's name—"rich coast." "Costa Rica's secret is that it has exceedingly crummy real estate," Janzen told us. "Tall slopes; not great soil; only about 9 percent of the land is arable. And above all, very little gold, and very few Indians to enslave. Nothing to interest the Spaniards, so they moved on."

Heavy European immigration didn't begin until the late 1800s, and the newcomers then were less rapacious than their sixteenth-century predecessors. The country has since been so blessed by peace and prosperity, compared with its war-ravaged neighbors, that it has become known as Latin America's Switzerland. No small part of this reputation is due to a tradition of relatively enlightened government policies, which included abolition of the military in the 1940s, provision of free and compulsory education to both boys and girls, and, in later decades, the establishment of environmental protection as a national priority. An announced national goal at the new millennium was to conserve a full 25 percent of the country as wildlands (compared with about 10 percent in the United States) within eleven declared "conservation areas."

In perhaps its greatest environmental success, Costa Rica has enacted an unusual environmental tax on fossil fuels, intended, among other things, to fund payments to landowners in selected areas who agree not to cut down their trees and to restore forest on land that has been cleared. The groundbreaking 1996 law allowing for those payments, *Ley Forestal No. 7575*, was set up to compensate thousands of property owners for "environmental services" provided each year by forests they maintain or reestablish on their land. The services include carbon sequestration, watershed protection, and bio-

diversity resources. Considering the depressed state of Costa Rica's cattle industry, the payments, of as much as \$20 per acre per year, have been high enough to be attractive. (The program nonetheless suffered some problems in its early years, including poor monitoring of participants and suspected spotty compliance. But by 2001, there was new hope of improvement as Costa Rica's government received a \$32 million loan from the World Bank and an \$8 million grant from the Global Environment Facility to increase the number of participants and ensure their legitimacy.)

With such efforts in mind, Costa Rica's officials have bragged that their nation is a world model for conservation. Umaña conceded that the country is still losing biodiversity, but he added, "We're clearly the closest in the world to turning the tide on that." That reputation has brought definite payoffs, particularly in the tourism industry, which in 1993 surpassed bananas as the country's leading revenue source. Thanks in large part to Costa Rica's popularity among Nature buffs, tourism by the year 2000 was the country's second largest source of income (after Intel's silicon-chip manufacturing), drawing 1 million tourists and approximately \$1 billion each year. At the same time, as "green development" became more fashionable among international banks and donors, Costa Rica's credentials attracted a healthy share of funding for development projects. Indeed, Janzen's colleagues have criticized him for having it too easy, saying his experiments couldn't have gotten past the blueprint stage anywhere else. Janzen counters that it was important to start where the innovations had the best chance of success, noting, "The Wright brothers didn't pick a blizzard in Minnesota in January to fly their first airplane."

Janzen grew up in Minneapolis, the son of a director of the U.S. Fish and Wildlife Service. At fourteen, his fascination with a butterfly exhibition at the public library decided the course of his future career; later, he went on a butterfly-gathering vacation through Mexico with his family in their Buick and grew addicted to Spanish and spicy food. He first came to Costa Rica in 1963 as a student in a traveling biology class financed by the National Science Foundation. He

was taken by the country's sheer amount of wilderness—at the time, half of it was still forested—its rich stores of species, and the warmth of its people.

The previous year, a chance encounter in Mexico had turned Janzen into an ecologist, eventually also launching his reputation as a world-class scientist. "I was walking down a trail in Veracruz and saw a beetle land on an acacia bush," he recalled. "An ant approached, and the beetle flew away. I looked closer and saw that there were ants all over the bush." He studied the situation further and eventually confirmed that the stinging ants were protecting the acacia, which provided their nectar and home, in a striking cooperation. It was one of a continuing set of insights that in 1984 won him a Crafoord Prize, the Nobel Prize of ecology and evolutionary biology. Janzen continued his scientific research in Costa Rica, eventually settling in Santa Rosa National Park. Spending half of each year teaching a double load at the University of Pennsylvania, he has also managed to produce hundreds of scholarly papers and immerse himself in a project, funded by the National Science Foundation, to identify all of the ACG's approximately 9,000 caterpillars of butterflies and large moths, as well as their food sources and parasites. (In 2001, after ten years of this labor, his collection, as posted by him on the Internet, numbered 2,500 species.)

Janzen kept up his prolific output even as he found himself increasingly caught up in more immediate issues of local sociology and politics. In early 1985, Alvaro Ugalde, a longtime acquaintance who had become director of Costa Rica's park services, asked him to report on the environmental effects of 1,500 gold miners who had invaded the rain forests of Corcovado National Park, in the southern part of the country. The government, in desperation, was at that time preparing a paramilitary operation to remove the prospectors. After one day in the park, Janzen found it easy to answer Ugalde's environmental impact question. Intensive placer mining and unrestrained squatting were trashing the rivers and forests. But he then took several days to study the miners themselves and discovered they were

not the impoverished career criminals he'd been told they were—many were middle-class; at least one was a corporate accountant. Furthermore, they fully believed they were legitimately making use of a "land with no owner" or, more precisely, no visible social presence. In the wake of Janzen's report, the government suspended its plans for force and instead set an unambiguous deadline for the miners to leave. This proved to be the solution: one year later, only 298 of them remained to be arrested and peacefully removed. And Janzen had more confirmation of his theory that wilderness had to have an owner and be useful in some way to people in order to ensure its own survival.

Another formative experience for Janzen came just a few months later, when he and Hallwachs were invited by Australia's government to spend several weeks in its sparsely populated but richly forested northwest region and give advice on how the country should make use of the area. They ended up recommending a combination of long-term, low-yield forestry, ecotourism, research, and conservation, realizing, as they did, that the same kind of package might prove to be the solution for the beleaguered Santa Rosa National Park. "We had never thought before about how to make Santa Rosa be 'used,' and 'have an owner,'" Janzen recalled. They returned to Pennsylvania, preoccupied by events in their adopted home. Costa Rica's economy was in the dumps, partly as a result of a global drop in coffee prices, and in the Guanacaste region the cattle trade, once a major source of income, was suffering. As the cattle were removed from pastures in and adjacent to the park, the *jaraguá* was growing higher and fire danger was increasing. Making matters worse, the park's administrative costs were rising, with no corresponding increase in its government budget.

In September 1985, Janzen and Hallwachs drew up an unsolicited plan for what they then called Guanacaste National Park. The basic idea was to create an area large enough for the long-term survival of local plant and animal species still clinging to life in Santa Rosa National Park and, as Janzen put it, "to absorb human activities."

Janzen hoped to do this by connecting the park with two others in a way that would allow animals to migrate during the dry season from the lowland dry forest to the upland rain forests and cloud forests to the east. This, he said, would be the only preserved inter-section between the two major land-based habitat types in Mesoamerica, if not in all the Neotropics. Early the next year, Oscar Arias Sánchez, whose fame as a peacemaker came to overshadow his extraordinary environmental achievements, took office as Costa Rica's president and rapidly approved the conservation plan—providing it wouldn't require any government funds. Janzen and Hallwachs became unpaid foster parents for the future ACG, which would ultimately extend over more than 279,000 acres of land and 101,000 acres of sea.

Working with Nature Conservancy employees and a team of Costa Rican collaborators, they raised more than \$17 million for the project. Besides buying land, the funds made the ACG the world's first fully endowed park. Rather than rely on annual appropriations, as had been usual practice, the conservation area's administrators could pay expenses out of \$1.4 million in annual interest from funds housed at a Costa Rican nongovernmental organization called the National Park Foundation. Together with as much as \$300,000 per year in income from Janzen's various schemes, that took care of most of the major bills from forest restoration, maintenance of ecotourism facilities, and salaries for 107 people, including caretakers, firefighters, teachers, guides, administrators, restoration staff members, and field researchers.

Creating the endowment was an adventure in itself. Most of the money came from a landmark debt-for-Nature swap in which Janzen, Umaña, and other Costa Rican leaders, aided by Salomon Brothers debt traders, leveraged a \$3.5 million donation from Sweden to buy \$24.5 million worth of Costa Rican commercial debt from around the world at huge discounts. Costa Rica's central bank then ended up paying 70 percent of the debt value, or nearly \$17 million, into the ACG account at the National Park Foundation, with

the understanding that the revenues generated would help pay for the conservation area. In a gesture of gratitude to the traders, who had worked without commission, Janzen later persuaded a friend, Ian Gauld, a taxonomist at The Natural History Museum in London (formerly The British Museum), to name several wasp species found in the park after them. *Eruga gutfreundi*, for instance, was named for John H. Gutfreund, then Salomon's chief executive officer. (One detail mitigated that honor: the wasp in question is a parasite that lays its eggs on the back of a "money spider," a species that some people believe brings good fortune.)

Purchasing land to expand the new conservation area took about five years. After protracted negotiations with more than 100 owners, Janzen, who had no formal title or authority for this task, arranged for the National Park Foundation to buy approximately 24,000 acres of low-grade ranchland. Fortuitously for the ACG, the decline in the cattle trade had decimated property values, and many owners were anxious to sell. Janzen negotiated prices as low as \$31 per acre for some plots.

(One parcel with a particularly complicated history cost rather more. South of the Santa Elena Mountains, surrounded by ACG land, was a 39,000-acre property formerly owned by Nicaraguan dictator Anastasio Somoza and then sold to a group of Americans in the 1970s. With the permission of Oscar Arias Sánchez' predecessor, President Luis Alberto Monge, Lieutenant Colonel Oliver North's operatives in 1986 had leased part of this property to build an airstrip to supply the U.S.-backed Contra rebels who were fighting Nicaragua's Sandinista government. But Arias Sánchez had other ideas, and soon after coming to power he closed the airstrip. Several years later, the government ended up having to negotiate with one of the property owners, a wealthy North Carolina textile manufacturer, to integrate it into the park. The case was finally settled in the year 2000, with Costa Rica paying the businessman \$410 per acre.)

In the midst of these deals, Janzen and his collaborators had started trying to restore the ACG's degraded lowland to dry forest,

using seeds from the existing forest fragments. It was a startlingly new idea in 1985, when many conservation groups were bombarding the public with the message that a forest, once gone, is gone forever. "I was told donors couldn't handle both messages," Janzen scoffed. He ignored the warning, finished raising his money, and set about tackling the fires that were raging in the area.

Blazes had been frequent during the dry months of January to June, often ignited by people burning their fields and pastures in a centuries-old land management technique. Janzen allotted one-fifth of the ACG's budget to fire control, recruiting and paying local residents as caretakers and firefighters. Eager employees came from the former colonies of squatters, many of whom had invested the money Janzen paid them for their land in homes in small communities near the ACG. "I told them: no fires. You figure it out, and if you can't do it, we'll hire someone else," Janzen said. He also brought in cows, which he called "biotic mowing machines," to reduce the fuel load from the tall *javagua*. He cultivated loyalty with paychecks and esprit de corps. "The biology of restricting fires became the sociology of having someone out watching for fires at 2:00 A.M. on Easter Sunday," he explained. He got funds for two fire lookout stations and two tractors with water tanks. By 2001, the ACG fire control program was putting out thirty to fifty fires per year, by Janzen's count.

Other ACG workers showed similar commitment to their jobs. Lucia Rios, a slender woman of thirty, bought her own house with savings from her salary after working for eight years as one of Janzen's parataxonomists, the assistants who help him gather specimens. It was a remarkable feat, considering that Rios was single and had only a sixth-grade education. But she clearly loved her work, and Janzen noted she had been the first to identify several caterpillar species. "We used to kill caterpillars before, on the farm," she said, smiling, "but now I think they're pretty."

Like many other investments in ecosystem assets, restoration of the ACG promised to yield some of its greatest benefits in the future, decades and even centuries away. Preoccupied with the project's

long-term security, Janzen has nurtured local loyalties with offers of not only well-paying employment and job training for adults but also "bioliteracy" courses for children. One of his first works as ACG foster parent was to design a curriculum that in 2001 was reaching all 2,500 children attending forty-two schools within some thirteen miles of the ACG. A full one-fifth of the ACG budget is devoted to the courses, including the salaries of eight teachers and the cost of two buses for field trips. "We'll take fourth-, fifth-, and sixth-graders out into the forest, put bandanas on their eyes, and have them identify ten sounds," he said. "Or we'll have them go out and find ten different fruits. It's natural history, not biology. When you're in the fourth grade, you don't need to know about environmental legislation. You need to know what frogs do when it rains."

Karin Viquez, the nine-year-old daughter of a local hotel owner, got the message. "We went to see the swamp, and saw crabs, and learned about the life of a turtle," she said, climbing off a pink scooter to talk. "We learned you have to take care of nature because in a few years, if we don't, there may not be any animals around."

At the end of the two-day tour, Janzen returned to the small, hardly converted storage building where he lives with Hallwachs for six months of the year. Its determined humility suggests one reason he has managed to wield such influence for so long in his adopted country. He owns no land himself, he says proudly, and decided against building his own house in the ACG so as not to provoke jealousy. He and Hallwachs live on about \$22,000 of his \$100,000 annual salary from the University of Pennsylvania, spending the rest on the ACG. Their home amounts to about 400 square feet, which Janzen said is shared with two species of bats and four species of rodents, besides the dozens of varieties of ants, moths, spiders, and mosquitoes claiming the space. Most of it is devoted to an office crammed with the detritus of their shared obsessions. Scattered across two desks was a blueprint for a field laboratory to study caterpillar guts, a receipt for tire repair, a glass bottle containing a broken crocodile egg, and a small jar of fingernail polish for gluing small

insects to pins. Old credentials from scientific conventions and a half-used pack of Mini-Stix hamster snacks for Espinita, their pet porcupine, were pinned to clotheslines drooping from the ceiling. A black umbrella hung upside down at the top of one of the lines to catch a leak. "It's peaceful. We like it," Janzen murmured in the dim lamplight.

Janzen, as a rule, spends as little time brooding over the past as he does arranging creature comforts at home. "I've got so many things going that if one project tanks, I just move on to another one," he said. Even so, in early 2001 he was still mourning the failed promise of one of his favorites: the Del Oro deal, in shatters by then for more than a year. It had gotten the most acclaim and seemed so particularly full of promise, so articulate an example of the innovative multitasking Janzen champions. And its demise had been so brutal.

"It exploded in our face" was the way Mike Baker, Norman Warren's successor, explained it. Baker called the deal's birth "ground-breaking if not totally unique. From all points of view—ethical, environmental, from every point but the commercial battlefield point of view—it was a great thing to do." Yet in the grueling controversy that followed the initial hopeful press conference, Del Oro had been forced to pay about \$100,000 in legal and public relations fees before it surrendered, withdrawing the contract in August 1999. At that point, the company replaced the biodegradation with a composting system, using the pulp on its own groves. The changeover cost \$500,000 to set up and was expected to cost another \$500,000 per year to operate.

Government environmental officials said they ultimately rejected ACG's disposal system because of a procedural problem: Costa Rica's Ministry of Natural Resources, Energy and Mines had failed to get the required approval of the comptroller general. But Alvaro Umaña, the former minister of environment and energy, agreed with Janzen that the real problem was rooted in commercial competition. "The science got lost in the noise," Umaña said. This version of events was disputed by TicoFruit's chief executive officer, Carlos Odio, who

alleged that competition wasn't an issue. He said he'd made his complaint because Del Oro's "dumping" of pulp risked spreading disease to the country's citrus groves if transported by birds and trucks. All the same, two U.S. citrus experts consulted for the purpose of this chapter called such a threat minimal.

Reflecting on his ups and downs with Costa Rican officials over the past few decades, Janzen suggested that the orange pulp conflict illustrated the profound changes that most developing countries' societies must make to allow conservation to endure. He suggested the deeper problem was that the Del Oro scheme, and the ACG's success as a model for local development, challenged Costa Rica's very system of power—which is why, he suspected, officials never came to his aid.

"This is not an undeveloped country. It's a matter of how it's developed, who gets the benefits," he said. "This is like East Germany. Everything's state-run. It's an extremely bureaucratized state, a very, very centralized system. We want to move it into a democratic system, with power moving out into the countryside. But if we say we ought to have democratization, there'll be some people who'll want to retain the structure they have, the one putting their kids through school. If you want to take that away, it's extremely disruptive."

Warning to his topic, Janzen went on to indicate that some government officials viewed him personally as a threat. "When you're just out in the woods as a biologist studying monkeys, you're not as aggressive to them and them to you," he said. "But if you start messing with the system, you get into lawsuits, murders, accidents, and mothers-in-law. It's called starting a peasant revolution. And what do they do to people who start peasant revolutions? They burn them at the stake."

In reality, Janzen seemed in little danger of being executed anytime soon. Rather, he was cheerfully looking forward to the swearing in of a new national administration in May 2002. He was hopeful that any of the candidates would be more supportive of environmental innovation, as, indeed, officials had been in the past.

He said he even held out hope that the pulp experiment might someday be revived.

On a baking afternoon, he took visitors to the site of "Modulo One," the first biodegradation experiment. Looking out from under his bush hat with fatherly pride, he pointed past a field of whispering, six-foot tall *jangua* to the small, dark patch of ground where five years earlier the pulp had started to restore the soil. To untutored eyes, it might not seem impressive. A single, tall, yellow-flowered *Cochlospermum* tree had staked out some ground, along with a few small shrub species. Yet Janzen was clearly envisioning the forest-to-be. "These seeds have been blown in by the wind. But there are thousands of other seeds, all in the guts of animals out there, in the magpie jays, woodpeckers, bats, and long-tailed grackles," he said. In a few years, or maybe decades, he expected, the dry-forest stalwarts would emerge: the *guanacaste*, the amber-producing *guapinol*, and the *chicle*, a source of chewing gum. Gradually, an image formed in the listener's mind of shady canopies full of whistling cicadas and jewel-colored birds above a forest floor rich with mammals and microbes. Never mind that it would take at least 200 years, perhaps 500, before the forest would truly resemble its untouched ancestors. Janzen had the determination, if not the life span, to wait.

As night fell, Janzen sat in a rocking chair on the terrace of a hotel near his home, watching orange-fronted parakeets, lovely green birds with long pointed tails, dart across the violet and orange sky. He was laying out his case that the best thing to do with one's life was to "choose a big lump of biodiversity" and defend it. Even though so many factors that had led to his triumphs in Costa Rica were unique, he insisted it was possible elsewhere in the Tropics to find creative ways to fund forest restoration and maintenance, and that in any case, it was urgent to try. "I've really wondered why no one else seems to be doing what Winnie and I are doing. People say there's only one Dan Janzen, but that's bullshit," he said. "Governments should start advertising. Like Guatemala. It could say, 'We have this area, the Petén, and we need help.' It could try to flush people out of the

woodwork, scientists looking for the most useful thing to do. It wouldn't be turning the area over to anyone: it would be a friendly partner. There are lots of big lumps that need help: consider Honduras, Mexico, Madagascar. . . ."

He looked out across the dry landscape, toward the darkening deep green forests clinging to the volcanoes looming far ahead. "Down the line, face it, you're going to have just a few lumps left in an ocean of Sacramento Valleys," Janzen said, referring to central California's flat, featureless agricultural region. "Those lumps need someone to invest in them and figure out how they can be loved by society around them. Those lumps need tender loving care."