A visionary's plan to preserve the world's species—by counting them.

THE WORLDACCORDING TO DAN JANZEN

By ROBERT LANGRETH

Like air billowing from an open oven, the bone-dry trade winds assualt Dan Janzen as he climbs a ladder to the veiwing platform. Reaching the plateau, the balding, 50ish ecologist helps pull his two visitors to the top, then sweeps his arm toward the unobstructed vista of pristine tropical forest in Costa Rica's Guanacaste Conservation Area.

"You can see the whole park from here," he shouts above the wind's roar. In front of Janzen, brown and yellow hills erratically descend to the shimmering Pacific a few miles away. Behind him, the thick landscape becomes greener as it rises inland toward rain-soaked territory that terminates in two

cloud-covered volcanoes in the distance.

The Guanacaste Conservation Area embraces almost all of Costa Rica's climatic zones in just a few hundred square miles, making it one of the most densely concentrated centers of biological diversity in Latin America. "There are probably more species of animals and plants between us and that cloud bank than in all of the United States," he says, gesturing at the volcanoes with one hand while holding down his shirt with the other. "Yet no one has ever surveyed exactly what's out there."

That's exactly what Dan Janzen wants to do. A brilliant, eccentric University of Pennsylvania researcher and part-time Costa Rica resident, Janzen is probably the boldest thinker in a growing movement to catalog the world's biodiversity. Over the last several years, he's helped establish Costa Rica's National Biodiversity Institute (INBio), a world-renowned center that has become a model for other countries' fledgling efforts to inventory their wildlife.

Janzen wants to initiate a project that would greatly intense INBio's current surveying efforts. Dubbed an All-Taxa Biodiversity Inventory (ATBI), it is a detailed survey that would bring specialists from around the world to Costa Rica's Guanacaste Conservation Area for five years. Their goal: to catalog *all* the species in the park, from the largest monkey to the most minuscule viruses. Once the ATBI survey is finished, the award-winning ecologist plans to convince other researchers to perform ATBIs around the world.

In the small-time world of organismal biology, Janzen's grandiose goals are unprecedented. Never before have scientists attempted to count all the species on any plot of land, not to mention a 427-square-mile national park. Even Janzen's supporters wonder if the ecologist can pull it off. But if he does, says the Missouri Botanical Garden's director, Peter Raven, one of the top U.S. experts on biodiversity, "everyone would use the results."

Janzen's proposal comes at a critical juncture in understanding biodiversity, as scientists begin to realize how little they know about the world's organisms—and how disastrous that ignorance may be. Currently, scientists have described a mere 1.4 million species—most of them insects—out of the estimated ten million to 100 million species of plants and animals believed to reside on our planet.

Making the issue especially urgent: Many species may disappear in a few years. Experts such as Harvard's Edward O. Wilson believe that as many as 10 percent of the world's species become extinct each decade from tropical deforestation.

In the United States—with a stable population and large open areas—it's easy to dismiss the predictions of mass extinctions as environmentalist propaganda. But the drive through the Costa Rican countryside on the way to visit Janzen eliminates any doubt that rain forests are really vanishing.

Everywhere, forests in this West-Virginia-size country are being recklessly plowed away to create ranches, farms, or resorts. Near a beach resort named Jaco, a wide strip of fresh asphalt runs from the beach, past several vacant fields, then suddenly ends. A few miles away, a "national park" stands like a tiny island, giving way abruptly to fields on every side.

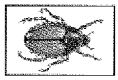
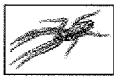
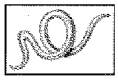
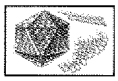
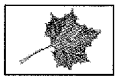
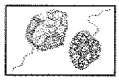
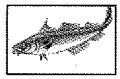
But from the viewing tower in the Guanacaste Conservation Area, untouched tropical wildwoods flourish. We descend the ladder and follow Janzen to his home, a shack with a corrugated metal roof and cinder block walls. A few yards away, a cluster of log buildings form the park headquarters. It feels like thousands of miles from the nearest road.

A family of white-faced monkeys frolics in a big tree a few yards away. Every few seconds, amazingly bright birds flash by in stark contrast to the tangled masses of dull brown and yellow trees and vines. It is January, the dry season, and no rain is expected.

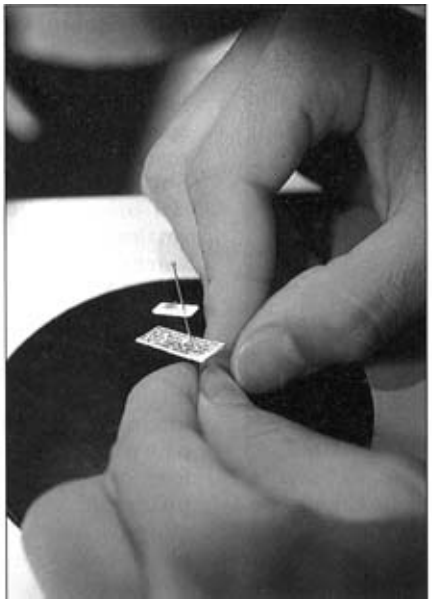
Janzen sports what seems to be the customary dry-season outfit in this country—wrinkled beige trousers, sandals, no shirt. For a man who spends half his time in the tropics, he is remarkably pale. His close-cropped gray hair, blown by the wind, sticks up in random directions. Janzen doesn't seem to care.

From his front porch, Janzen explains why comprehensive ATBI surveys form

HOW MANY SPECIES ARE OUT THERE?

	Type	Known	Undiscovered
	**Insects**	950,000	8 to 100 million
	**Algae**	40,000	200,000 to 10 million
	**Bacteria**	4,000	400,000 to 3 million
	**Fungi**	70,000	1 to 1.5 million
	**Spiders, mites**	75,000	750,000 to 1 million
	**Roundworms**	15,000	500,000 to 1 million
	**Viruses**	5,000	perhaps 500,000
	**Plants**	250,000	300,000 to 500,000
	**Mollusks**	70,000	200,000
	**Protozoan**	40,000	100,000 to 200,000
	**Crustaceans**	40,000	150,000
	**Vertebrates**	45,000	50,000

AN IN-DEPTH LOOK AT THE CATALOGING PROCESS



Cataloging insects—or any other type of organism—begins by trapping them. INBio's parataxonomists snare different insects with a variety of creative traps, such as this contraption (left) that's raised by a rope and pulley to treetop level. Specimens in hand (above), parataxonomists sort through the results in their cabins, discarding ones that obviously aren't interesting.

Curious or unknown specimens are sent to INBio headquarters near Costa Rica's capital, where workers pin bar-code labels on them (left) for easier reference. INBio experts may spend a year or more consulting specialists around the world to classify an obscure sample. Once classified, new species are stored in boxes in INBio's large specimen library (above).

an essential first step in his grand, if loosely conceived, plan. The world's species, he says, represent a biological treasure trove for humanity, yielding genes for genetic engineering, biochemicals for pharmaceuticals, and bacteria for waste bioremediation. The treasure source must be cataloged and organized, like a library waiting to be explored, Janzen says. "An ATBI is like taking this library, figuring out where the books are, getting call numbers, computerizing the abstracts, and beginning to read them," he explains, leaning against a table next to a box of dead roaches. "You can't use the tropical forest unless you've done that first."

Already, smaller-scale efforts have uncovered plants that have provided health-care breakthroughs. Vinblastine, a substance discovered in the rosy periwinkle of Madagascar, has increased childhood leukemia survival rates ninefold since its introduction. A potential AIDS drug, now in early stages of testing at the National Cancer Institute, comes from a forest vine native to Cameroon. Seemingly ordinary plants such as these, along with millions of unknown organisms containing a variety of chemicals, cover the planet and have yet to be studied in the lab.

Janzen is pragmatic and doesn't promote scouring the entire surface of the earth. "If scientists performed ATBI surveys in ten or 12 carefully chosen locations, you'd cover maybe 40 to 50 percent of the world's biodiversity," Janzen estimates. If the survey were coordinated with national biodiversity surveys that are springing up in many countries, he adds, that figure might be even higher.

The scheme is ambitious, but it would cost much less than the $75 billion that biologists, in a recent proposal called Systematic 2000, recommend spending on a systematic survey of the entire planet. Janzen estimates each ATBI would run between $80 million and $100 million, totaling about $1 billion to hit most of the locations. And since it would rely on trained locals, dubbed "parataxonomists," to do most of the field collecting, it wouldn't require hordes of new Ph.D.s. This is a critical factor, since third-world countries frequently lack trained scientists.

During the conversation, a half-dozen young, enthusiastic parataxonomists approach Janzen. They treat him like a mentor and father. They're clearly his priority; the ecologist interrupts our discussion to answer their questions in nasal, high-pitched Spanish.

Between interruptions, Janzen ticks off a list of possible sites for ATBI surveys: "Mexico's Lacandon region, north Australia, the eastern Amazon region, and the Cape Province of South Africa...." The United States, he says, wouldn't rate an ATBI. It's not because the United States is overdeveloped, he explains, but because the tropics contain a much greater variety of wildlife.

If variety of wildlife is the criterion, Janzen's own home might rate an AT-

FOLLOWING INBIO'S FOOTSTEPS?

The United States, like Costa Rica, now has its own national biodiversity institute. Last November, at the request of Interior Secretary Bruce Babbitt, Congress quietly voted to establish a new federal agency charged with inventorying, mapping, and monitoring America's biological resources.

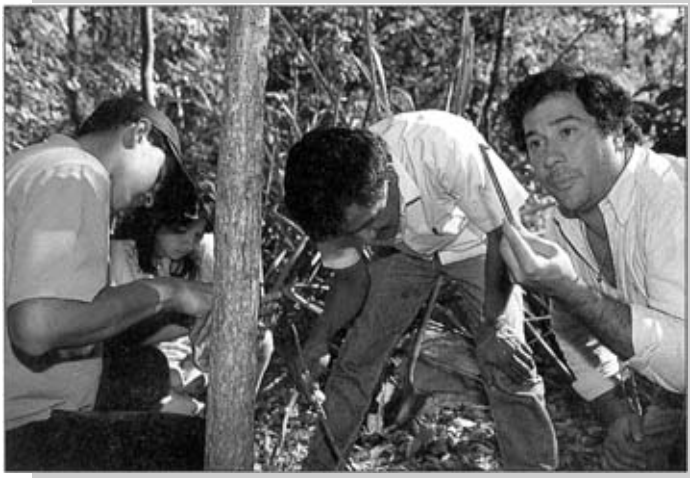
The nascent National Biological Survey has a budget of around $180 million and will be staffed by 1,800 research scientists reassigned from other divisions of the Interior- Department. It won't concentrate on identifying new organisms, because most U.S. species are already known. Instead, it will study how to restore or maintain various biodiverse "hot spots," such as Florida's Everglades, the Pacific Northwest's old-growth-forest, Hawaii's rain forests, or Southern coastal wetlands. Another goal is to establish a national clearinghouse of information on biodiversity, probably at the Smithsonian National Museum of Natural History in Washington.

In creating the agency, Babbitt cited the "need to avoid economic and environmental train wrecks we see scattered across the country." He hopes the survey will detect declining species or ecosystems before they become endangered, when it is still possible to save them without drastic action.

Because of budget limitations, however, the NBS will have to start new research gradually. It will also have to withstand attacks from conservatives, who complain that biological surveyors may trespass on private lands.

"Right now the Survey is a noun," another government agency, says Peter Jutro, an Environmental Protection Agency scientist who helped set up NBS. "Over the next few years, we hope to make it a verb."—R. L.

THE NEW PROSPECTORS



"Every insect I collect probably contains 2,500 new chemicals," says Merck's Costa Rican drug prospector, Felipe Chavarría-Diaz (right).

Prompted by limited success at concocting new drugs in the laboratory, pharmaceutical companies are now returning to nature—the original source of medicines—for new leads.

In the last three years, five major drug companies have announced plans to search for natural drugs in seven tropical countries. The most recent effort: a $2.5 million collaboration between the National Institutes of Health and several drug companies to prospect for medicinal gold in South America, Africa, and Asia.

But the collaboration between American drug conglomerate Merck and Costa Rica's INBio agency represents the most prominent example of how both parties can benefit. Merck pays INBio more than $1 million for rain forest samples gathered by INBio. Most of the money goes to conservation projects within Costa Rica. This contract, first signed in 1991, has been hailed by environmentalists as a model for sustainable use of tropical forests.

Insect and plant specimens collected at Guanacaste are frozen and transported on a former ice cream truck to INBio headquarters in San Jose, Costa Rica. There, technicians grind each sample into a fine dust that is mixed with various chemical solvents to extract biologically active substances. The tea-like extracts are dried to yield powders. These powders are flown to Merck headquarters in New Jersey where they are distributed to Merck labs around the world to be tested for anti-disease activity. If an extract powder seems promising, scientists try to isolate the specific molecule responsible for the activity. Only after several years of focused testing might a new medicine be ready for human trials.

A Merck spokesman will only say that the company has "no substantive results" so far. But the company's actions speak volumes: This year, it renewed and expanded its contract with INBio. Moreover, Merck has requested that INBio locate additional samples of one species of caterpillar—a hint that the company may be onto something.—R. L.

BI survey. Tangles of cobwebs adorn the ceiling. Tiny balls of crushed leaves lie scattered across the floor. Mysterious clumps of brown organic matter line the wall tops. "Those are wasp nests," he proclaims, sounding like a proud homeowner discussing his art collection. "There's at least a thousand of them in here."

In a back room, I discover a family of 12 bats hanging under a table. What might be a bed is nearly hidden under stacks of bags containing dead insect specimens. Four or five species of mice (ironically, the ecologist doesn't keep track), and at least that many species of cockroaches call this hut their home. "I'd bring in the rattlesnake if it weren't poisonous," Janzen intones, wistfully.

Everything that the animals might get into—kitchen utensils, prepackaged food, even a computer cable—is stored in sealed plastic bags hanging from a clothes line strung up across the front room. Dozens more plastic bags holding insect samples hang over the front porch. "This is no thing," Janzen's wife, Winnie Hallwachs, deadpans from behind a cluttered desk. "When we're active, the room is full of bags."

It is here, on his home turf, that Janzen proposes to launch the first ATBI survey. Not just because of the diversity of wildlife, Janzen explains, but because of the diversity of habitats the Guanacaste park embraces. "Right here," Janzen says, "we're in the middle of something even rarer than rain forest: a dry forest." He points to the mostly bare trees in front of his porch. "It's like a desert now, although if you came back during the rainy season you wouldn't believe it was the same place."

"Those cloud-covered volcanoes that we saw from the tower," he continues, "that's *classical* rain forest. The climate there is influenced by the Caribbean, not the Pacific, and it rains there all year. It's only 20 miles away, but the flora and fauna are totally different."

The next morning, as Janzen busies himself with training sessions, a photographer and I climb into a four-wheel-drive vehicle to visit the rain forest. Eventually, we arrive at the ranger station in a small clearing. We park and trek into the forest.

Thirty feet in, the clearing has vanished. We are lost in a sea of green and brown, interrupted only by occasional glimmers of sunlight piercing the forest canopy. Every inch of every tree trunk is covered with moss, cobwebs, and parasitic plants shooting out at odd angles. These smaller organisms are layered with still smaller organisms, from beetles to red-brown fungus. Life heaped on top of life.

Then the magnitude of Janzen's project hits me. There are thousands, probably tens of thousands, of species within 20 feet of where I'm standing, and Janzen wants to catalog everything within *20 miles!* It suddenly seems a crazy, impossible task.

Similar thoughts have crossed the mind of Peter Raven at the Missouri Botanical Garden. "I support Janzen's concept fully," Raven says, choosing his words carefully. "But I'm worried that it could become a bottomless pit." Since no one knows how many organisms live on a given piece of real estate, Raven explains, ATBI surveys might turn out to take longer and be far more difficult than expected. They could end up monopolizing scientific resources that could better be used elsewhere.

If his past accomplishments are any indication, Raven may be underestimating Dan Janzen. Janzen, by all accounts, is one of those rare scientists who combines both extraordinary energy and vision with a practical knack—and sometimes unique tactics—for getting things done.

Early in his career, the ecologist became famous for his creative problem-solving. Once, for instance, he wanted to ascertain whether seeds were capable of germinating after being eaten and excreted by animals. Lacking animal subjects, he performed the experiment by swallowing the seeds himself. (They germinated.)

He also began keeping animals around the house to gain insights into their behavior. In this way, he solved a long-standing riddle concerning the male paca, a dog-size tropical rodent. It had been long known that when a male paca is courting a mate, it will stand up on its hind legs for a brief instant. But the purpose of this behavior mystified researchers. Then the paca that slept under Janzen's bed—obviously lonely and confused—decided to court...

[*Continued on page 112*]

Dan Janzen

[*Continued from page 82*]

Janzen. When the rodent reared up on its back legs, there was no mistaking the warm splash of urine that hit the ecologist in the face. The paca was marking Janzen as his mate.

It wasn't until he won a Crafoord prize in 1984—the closest thing in biology to a Nobel Prize—that Janzen turned his energies to conservation. During the trip to Sweden to receive the prize, a reporter cornered him and demanded to how what he was doing to protect the tropical rain forests. The blunt-spoken researcher retorted that a scientist's job was to study the rain forest; it was the environmentalists' task to save it. However, Janzen promised that if the reporter came up with a large chunk of money, he'd put it to good use in Costa Rica. He never expected to hear from her again.

But she did call back, and that phone call was the first of a series of events that led to Janzen's first heretical conservation proposal, the Guanacaste project, in 1986. The idea was to extend the Guanacaste Conservation Area by buying back ranch land adjacent to the reserve and regrowing the rain forest—something environmentalist dogma decreed impossible. Janzen says that, when he first presented the concept to American scientists, "people thought I had completely flipped." But today, next to the Pan American highway and several miles from Janzen's hut, forest is reclaiming former pasture.

Janzen's success at garnering international support for the Guanacaste project made him gradually realize that a bigger, countrywide conservation project was necessary. A MacArthur Foundation "genius" award also gave him extra money. At the same time, Costa Rican conservationists and researchers were becoming increasingly dissatisfied with the lack of concrete results from Costa Rica's fragmented National Park program. Putting their minds together, Costa Rican plant virologist Rodrigo Gamez and Janzen established Costa Rica's INBio agency. The centerpiece of the agency's efforts are biodiversity inventories of Costa Rica's national park holdings. The results are put to practical use, such as prospecting for natural drugs and enhancing public awareness.

When INBio was first proposed, its success seemed dubious. Nothing like it had ever been done before. But today, five years after the first class of parataxonomists graduated from Janzen's intensive six-month training course, INBio is thriving. The agency has negotiated an unprecedented agreement with Merck in which the

Dan Janzen

[*Continued from page 112*]

drug company pays an up-front fee to INBio for access to plants and insects containing potential disease-killing chemicals. Merck's money funds much of INBio's bustling inventory, which sends thousands of samples every month to processing labs near San Jose, Costa Rica's capital [see "The New Prospectors"].

Within Costa Rica, INBio's high-profile research has helped make preserving biodiversity "part of the national scene," Janzen says. INBio's efforts have become so popular that when Janzen published a volume on the natural history of Costa Rica, the first printing sold out in three months. Scalpers were soon hawking copies at inflated prices on the streets.

Outside the country, the INBio agency has become a template for other countries bent on counting their wildlife, says Harvard's Edward O. Wilson. Already three countries-Kenya, Mexico, and Indonesia-have created their own versions of INBio, and almost a dozen more nations have sent emissaries to Costa Rica to study the INBio process. Janzen predicts that "virtually every country in the world will eventually end up with one."

What INBio is not doing-and what Janzen's proposed ATBI surveys would do-is quickly count Costa Rica's biodiversity. INBio's surveying efforts uncover about 300 new species each year. This sounds like a lot until one considers that Costa Rica hosts hundreds of thousands of unknown species. Janzen's accelerated, detailed ATBI survey would tally as many organisms in five years as INBio's smaller-scale efforts could in several decades.

Janzen wants to initiate the world's first ATBI survey in 1997 at Guanacaste. First, though, he must sell the idea to international funding agencies. Early the next morning, Janzen prepares for a big meeting in San Jose before returning to the United States to petition government funding agencies.

He's nagged by critics who accuse him of scientific empire-building. "Don't compare me to a general leading his troops into the field," he says. "I'm trying to get rid of that analogy."

Janzen—who wears his emotions on his sleeve—is in a hurry to finish the interview so he can start packing.

But he finds time to describe the logistics of an ATBI survey, between mouthfuls of brown gruel spooned from a plastic bowl. First, Janzen, Gamez, and other INBio officials will examine high-resolution NASA aerial photographs of the park and use these images to divide the area into parcels corresponding to different habitats. With a battlefield mapped, Janzen and

his colleagues will train an extra-large class of Costa Ricans to do most of the fieldwork, guided by taxonomic specialists from around the world.

The hardest part is not cataloging the mammals and large plants, which are relatively well known, but uncovering and counting the vastly more numerous and less understood smaller creatures such as insects, mites, and fungi. Researchers will have to set up thousands of different kinds of insect traps, for example, and then painstakingly differentiate among many thousands—perhaps millions—of sometimes identical-looking bugs. The surveyors will even catch and dissect a few wild cats to count the dozens of parasites and viruses inside them.

Ultimately, Janzen envisions a network of ATBIs and other national biodiversity surveying efforts pooling their results to create a worldwide biodiversity database on the Internet. Such a database would be a vast improvement over the current system of scattered specimen collections pigeonholed in the dim recesses of museums.

Janzen's fondest dream is to take the knowledge gained from surveys and put it to practical use around the world. Drug prospecting is one obvious example, but Janzen has other ideas as well.

In particular, he imagines popularizing the knowledge garnered from ATBI surveys in Costa Rica or elsewhere by creating a new kind of ecotourism, one where rangers would explain the life-styles of a national park's wildlife. "Everyone goes to the zoo or park and sees a parrot, but nobody there explains to you what a parrot *does*," he says. "No one ever explains that parrots have marriages, have divorces and affairs, and are even bigamous. Or that teenage parrots talk in a different tone of voice to their parents than to each other. That they live almost 40 years. I mean, they're practically *human*."

His earlier haste forgotten, the ecologist is now excited. We could build a bed-and-breakfast here, and a small library" where guests would read or watch movies about the park. "You could be in New York, get bored, and hop on a plane," he says. Tour hours later, you'd walk off the plane into another world."

Janzen, one realizes, has a great bargain to sell: healthy tropical forests, stimulated local economies, and a host of substances that could enhance humanity. In his first career as a research scientist, he discovered the wonders of tropical wildlife for himself. Now Janzen hopes to bring them to the rest of the world. PS