Madagascar Tames the Bohemian of Biology

After a career that makes him sound like a biological Indiana Jones, Steve Goodman may have settled down, but he is still fighting to save this island's unique wildlife

ANKARAFANTSIKA NATIONAL PARK, MADAGASCAR—Steve Goodman shambles to the top of the hillock where the camp breakfast boils over a fire. "I have a fever," he mutters between ragged breaths. Just yesterday he was marching through the forest with what seemed like superhuman fitness, striding through the brush and tangle as if it weren't there. After a night writhing and mumbling deliriously in his tent, Goodman's physical transformation is alarming. Now his 6-foot, 8-inch (203-centimeter) frame lies crumpled on a reed mat—pale, trembling, and soaked with sweat—just waiting the fever out. For the first time on this field trip into the northern forests of Madagascar, worry crosses the face of the stoic camp cook Ledada Razafindravao, a friend who has followed Goodman into the remotest parts of his island country. "Steve never complains," says Achille Raselimanana, a herpetologist with the conservation group WWF, as he opens a medical kit. "So it's serious. Probably malaria."

It's true that Goodman hasn't complained despite, in the past week, being stung in 10 places by wasps, bitten on the thumb by a tenrec—a mouse-sized mammal—and having parasite-laden bats crawl into his shirt and up his pant legs. "These are the occupational hazards," says Goodman, a biologist who makes Madagascar his home while holding a staff position with the Field Museum in Chicago.

With self-effacing humor, Goodman describes himself as "a typical American biologist: graying beard, pony tail, sandals, et cetera." But his colleagues consider him anything but typical. "He has done more to investigate the fauna of Madagascar than any living person," says Anne Yoder, a biologist at Yale University who has done research in Madagascar for nearly 20 years herself. That's not bad for someone who got his Ph.D. just 3 years ago. Goodman is driven by a sense of urgency to make "a lasting contribution" in a country whose remaining habitats—home to one of the world's most diverse and unique biotas—he has watched dwindle and degrade all around him. "The clock is ticking," he says.

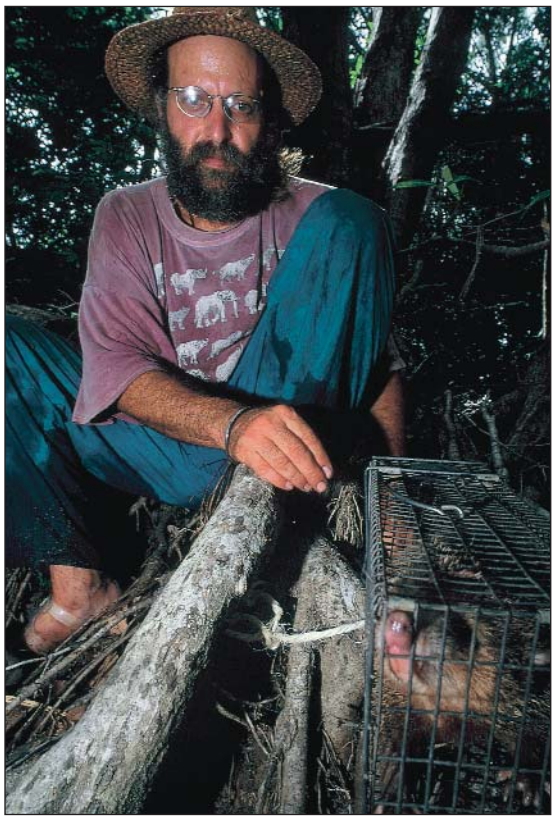
The reluctant biologist

The course of Goodman's life would have been difficult to predict for those who knew him as a rebellious teenager in Michigan. His interest in science during those years was limited to do-it-yourself rocketry—a hobby that resulted in the accidental torching of a neighbor's garage. At 14 he declared himself "uncomfortable" sleeping with a roof over his head and began spending nights in a sleeping bag outside, even during winters that dropped to an eyebrow-frosting –35°C. "I was a weird kid," admits Goodman, who is more domesticated now, although he still prefers the outdoors. He did have an obvious talent for sculpture, so his exasperated parents shipped him off to Interlochen Arts Academy, a remote upstate boarding school.

Goodman's sculpture earned him a medal from U.S. President Jimmy Carter, but soon another passion took over. What had begun as a study of birds to capture their movement in sculpture became an interest in their behavior and ecology. Following a gut feeling, Goodman turned his back on a promising artistic career and in 1980 enrolled at the University of Michigan, Anne Arbor, to study biology.

From the start, Goodman followed his own path, skipping half of his required undergraduate classes and instead studying birds in the field. "Steve has never been a conventional academic," explains Larry Heaney, curator of mammals at the Field Museum who taught at the University of Michigan when Goodman was there. "He has only ever pursued what interests him." Even as an undergrad, he was crossing into other fields, for example with his study of animal mummies recovered from ancient Egyptian tombs.

"I never wanted to do a Ph.D.," says Goodman, but after graduation he signed up for one anyway because the University of Michigan offered him some financial support. "Goodman was a complete bohemian," recalls Heaney. "He lived very cheaply, spending most nights sleeping on friends' floors." Nevertheless, after several years Goodman was as productive as most faculty members twice his age. He was spending months at a time in North Africa doing field research funded by the American Museum of Natural History and the National Geographic Society, he had published 23 papers on topics ranging from evolution and ecology to art history and anthropology, and he had co-written a scholarly book on the role of birds in ancient Egyptian culture. But the graduate administration eventually rumbled that Goodman was doing little work on his thesis and forced him to make a choice: knuckle down, or quit the program. Goodman cut the ties and went his own way as an independent researcher.



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Scholar in the bush. Steve Goodman feels at home in the remotest forests of Madagascar.

Thus began a career that would seem nightmarish to most scientists. Never keeping an address for long nor, indeed, staying in one country for long, Goodman lived precariously from grant to grant, free to roam the world.

One of Goodman's greatest assets in his travels is that he is "exceptionally capable of picking up and instantly using" languages, says Peter Meininger, an ornithologist at the National Institute for

Coastal and Marine Management in the Netherlands. While in Egypt researching a definitive book on ornithology in North Africa, he taught himself Arabic and Bishareen, a Bedouin language, adding German so he could read the field notes of a long-dead German ornithologist. He learned Urdu and Balochi while traveling through Pakistan, as well as publishing a set of ethnobotanical papers that helped settle a long-standing question about the transmission of culture in the region. Today Goodman is fluent in French and Malagasy, the two languages spoken in Madagascar, and his list of publications runs into the hundreds.

But after escaping the jungle, Goodman started coughing up a mixture of blood and worms. Luckily, he received medicine through the mail in time to prevent a nematode infestation of his lungs from killing him. This was one of several lucky escapes Goodman has had. In the Philippines, he was comatose and within a few hours of death from scrub typhus before being carried to a hospital. In Sudan, he was ambushed by murderous bandits, but he scared them off with a few shots from his pistol.

On the edge. The unique organisms of Madagascar, such as lemurs, could be gone within decades due to habitat loss.

A Biological Bible for Madagascar

Aside from holding the occasional megaconference or sequencing a genome, biologists rarely join forces to do something big. But biologists Steve Goodman of the Field Museum in Chicago and Jonathan Benstead of the Marine Biological Laboratory in Woods Hole, Massachusetts, are about to pull off a collective feat: They have persuaded nearly everyone with a scientific stake in the island of Madagascar—nearly 300 scientists with expertise spanning paleobotany to bat phylogeny—to collaborate on a single book, to be published by the University of Chicago Press in January. At nearly 1800 pages, *The Natural History of Madagascar* is a scientific milestone and by far the largest synthesis of tropical biology research ever. The authors have a strong incentive to team up: to save their workplace.

An estimated one in 31 plant species and one in 36 vertebrate species exist solely in Madagascar's unique habitats, but they could be gone within decades. "A book *can* make a difference," says Benstead, who along with Goodman is contributing chapters and editing the tome. A similar book about half its size proved to be a huge boon to Costa Rica in 1983. Like Madagascar now, Costa Rica in the 1980s had one of the highest rates of deforestation. The publication of *Costa Rican Natural History* provided a catalyst for research and ecotourism, says Benstead, and today the country is a model for tropical conservation. To make Madagascar's biological bible flush with color photography as well as affordable to students and tourists, charitable subsidies have poured in from the Field Museum, WWF, science funder Schlinger Foundation, and even QMM, a Canadian mining company.

But another unique aspect of the book, says Goodman, is revealed by its table of contents: There are nearly 70 Malagasy authors. "For decades these national biologists have been in the shadows of their foreign colleagues," but their work now speaks for itself. This shift of scientific expertise shows that "we have reached a new era," says Goodman, in which the biological riches of the developing world can be studied and protected by those who live there rather than by foreigners. **–J.B.**

But Goodman's greatest advantage in the field is that "he just works incredibly efficiently under the worst conditions," says Brian Fisher, an entomologist at the California Academy of Sciences. In the face of blistering heat, a lack of potable water, or endless treks through muddy jungle, Goodman "always gets the job done." Fisher recalls wading through stagnant water deep in the forests of Gabon with Goodman, "completely covered in biting tsetse flies." Their native guides had run off with their supplies, so they were forced to hunt for food. Nonetheless, the trip was "very productive, scientifically"; they identified several animal species new to science and one of the largest pythons ever recorded, which they were then forced to eat.

"I've been extremely lucky," says Goodman. "But I'm not in it for the thrills. I don't seek out danger in the field."

At 46, Goodman seems to have settled down at last. He bought a house in Madagascar in 2000 with his wife Asmina, a Malagasy model and fashion designer, and the arrival of a baby boy last year has made him more risk-conscious. He also finally got his Ph.D. in 2000. Because the University of Antananarivo in Madagascar, where he supervises graduate students, technically requires Goodman to hold a higher degree, he flew off to Germany for "a few weeks" to get a Ph.D. at the University of Hamburg based on his recent work.

He even has a steady job now, which signals "the end of bohemianism," says Goodman. His position at the Field Museum is one of a kind. "He has absolutely no administrative duties," says Heaney, who was instrumental in bringing Goodman onboard. "We just pay Steve to do whatever research he wants and continue being productive. No other field biologist in the world is better for the job."

At home in a naturalist's wonderland

It's late afternoon and Goodman is still running a fever. Nonetheless, he's putting in a full day's work in the camp's "lab," a spot of shade behind a hanging reed mat where a selection of the animals caught in traps are measured, photographed, and dissected.

"Different parts of each specimen go all over the world," says Goodman as he delicately turns a tiny tenrec inside out. The eyes, for example, go to Frankfurt, Germany, for a study of the development of vision systems. Cornell University's Weill Medical College gets the testicles to investigate the evolution of mammalian gonads. Parasites and blood samples go to the Pasteur Institute in Paris for research on the diseases coevolving with Madagascar's animals. Goodman's work "sustains projects in disciplines as diverse as ecology and phylogeny, physiology and neuroscience," says Yoder.

Madagascar deserves such attention, says Goodman, because it is one of the best places to study certain evolutionary processes, such as adaptive radiation, the sudden blossoming of new species that made Darwin's finches on the Galápagos Islands famous. Since

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breaking away from the Indian subcontinent some 88 million years ago, the isolated, France-sized landmass has produced oddities such as the 7-centimeter-long Madagascan hissing cockroach and the lemurs, our big-eyed primate cousins. But the scale and breadth of Madagascar's radiations and their significance to evolutionary biology have become apparent only over the past 5 to 10 years of research, says Goodman. This is in no small part due to Goodman's own research on the phylogeny and distribution of Madagascar's biota. "Steve's genius lies in the combination of his abilities in the field along with his ability to synthesize and communicate," says Fisher.

In spite of all this biological wealth, Madagascar has remained poorly studied due to political turmoil and creaking infrastructure. Since the Malagasy people forced out their French colonizers in 1960, the country has lurched from dictatorship to dictatorship. Westerners have often been ejected from the country, and when they have been allowed in, field biologists have always had to grapple with the very sparse network of passable roads. Many biological hot spots are still a 100-kilometer walk from any road.

Tenacious researchers like Goodman have opened up to the world the treasures hiding on the island. Since first settling here in 1989, Goodman has himself identified dozens of species new to science, and the biologists he has trained or brought into the field have added hundreds more. When it comes to the challenging terrain of Madagascar, says Fisher, "you can plunk your finger down anywhere on the map, and Steve is the guy who can make it in there and get the data."

In recent years, liberalization and international aid have made it easier for biologists to study Madagascar in depth. But their work has revealed a bleak picture. Most of Madagascar's species are huddled together in the 10% of the original forest cover that's still intact. These pockets of natural forest are now dying a slow death by degradation and fragmentation. Madagascar's dense biodiversity, combined with looming ecological disaster, has made it the top priority in the eyes of many conservation biologists. Madagascar is home to what biologists call "charismatic megafauna," such as the lemurs, which have helped conservation initiatives attract hundreds of millions of dollars over the past 3 decades. But much of this money has disappeared into the country's inefficient bureaucracy.

Another problem is that biologists have tended not to include Malagasy scientists in their projects, although their involvement is required for any lasting conservation. Goodman's inclusive work ethic has helped reverse this trend, says Robert Dewar, an ecologist and conservation biologist at the University of Connecticut, Storrs. "No one has done as much to train Malagasy biologists as Steve." Working with WWF-Madagascar, Goodman created the Ecological Training Program (ETP) in 1993, which is the first of its kind and is now being replicated elsewhere in Africa. More than 30 Malagasy field biologists have gone through the ETP, including Raselimanana, who is now the chief biodiversity scientist for WWF-Madagascar. Goodman still directs the program, spending about 6 months of the year in the forests. Starting next month, he is taking the only substantial break from the field in years, but not for a vacation. He is putting the finishing touches on a book that he hopes will change the fate of Madagascar (see sidebar).

Back at camp, night has fallen and Goodman is telling a joke in Malagasy, French, and English so no one is left out. He looks a little healthier. "I come down with a fever once a month or so," he says nonchalantly, due to the malaria and other parasites he carries for life. Would he trade it all in for a comfy teaching job in the States? "Not a chance." At long last, Goodman feels at home.

—JOHN BOHANNON

John Bohannon is a writer based in Paris.

Meiotic Drive

Bickering Genes Shape Evolution

Not all genes follow the rules of inheritance; now researchers are discovering how organisms adapt to the troublemakers

Reproduction is supposed to be an equal opportunity event. Consider humans: In developing sperm, the sex chromosomes sort 50:50 such that half the sperm carry the male-defining Y chromosome and the rest sport an X. Only the randomness of fertilization leads to families of nine girls and no boys, for example. The same supposedly holds true for the rest of the genome.

But in humans, flies, mice, and perhaps many other organisms, guerrilla warfare within the genome sometimes pits one element against another. This often takes on the appearance of a battle between the sexes, but it is really a fight between genes. In this struggle, typically one or more of the X chromosome's genes strike out against the Y's genes. Genes on other chromosomes also can get caught up in this struggle, causing an escalating arms race.

Researchers have caught glimpses of these so-called intragenomic conflicts ever since the 1920s. They dubbed the phenomenon "meiotic drive." But only in the past decade have they come to appreciate just how devious and pervasive the aggressive genes—called drivers—are, and how dogged the counterattacks can be. This interplay "may markedly affect the evolution of the whole genome," says Catherine Montchamp-Moreau, an evolutionary biologist at CNRS, the French basic research agency, in Gif-Sur-Yvette. As such, the work is leading evolutionary biologists to see patterns in what once was considered a fluke of nature.

Genes usually work together. Their survival depends on their collective ability to make an individual run fast, eat well, reproduce efficiently, and ward off infections. Still, as biologists are increasingly coming to realize, not all versions—called alleles—of each gene are alike. Some appear to look out for themselves. Somehow, they are more adept at passing copies of themselves on, sometimes even crowding other alleles out. It's a game of

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Emblem of excellence. Female stalk-eyed flies judge males (*above*) by the length of their stalks, which reveal whether the male carries selfish genes.