Natural Partners

How people in Latin America are forging a new relationship with their natural environment

Roger Hamilton

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Produced by the IDB Office of External Relations

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Cataloging in Publication data provided by the
Inter American Development Bank
Felipe Herrera Library

Hamilton, Roger.

Natural partners : how people in Latin America are forging a new relationship with their natural environment / Roger Hamilton.

p.cm
Includes bibliographical references.
ISBN: 1597820482

1. Environmental protection—Citizen participation. 2. Environmental protection—Latin America. 3. Environmental degradation—Latin America. I. Inter-American Development Bank. II. Title.

TD171.7 .H265 2007
363.70525 H265—dc22

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Introduction

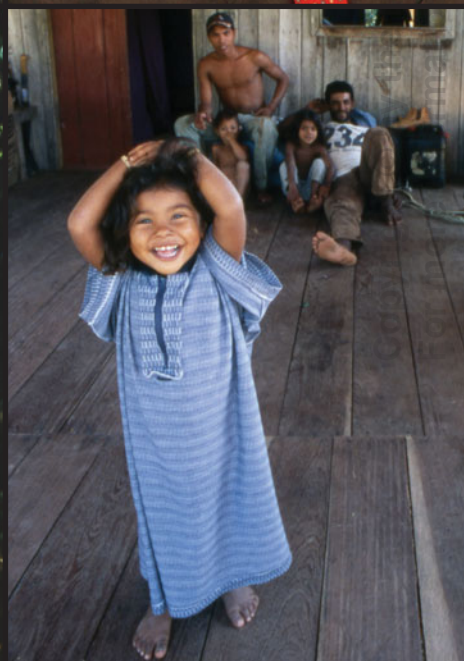
All of the projects in these pages received funding from the Inter-American Development Bank. But they are not IDB projects. Rather, they belong to the people, communities, organizations and governments on whom their success ultimately depends. The true protagonists of development are people who are willing to work hard and take risks to turn dreams into reality.

These are stories about people learning to live in their environment, a theme as old as humanity itself. But though the subjects are timeless, the people of the region are bringing to them a spirit of innovation that is often invisible and unacknowledged in remote capital cities and in headquarters of development institutions. Only by actually going there—to far-off forests, small farms and humble communities—is it possible to meet these people.

They will tell about new approaches they are taking to protect the rainforest, reduce erosion, conserve marine life, create protected areas, and ensure a better future for themselves and their families. They will also tell how they are learning to sit down with former adversaries and work toward common goals. Some will admit that their toughest job was to open up their own minds to change.

It is the IDB's privilege and mission to support these people's steps into the unknown. And it truly is the unknown, for none of these stories have—or will ever have—an end.

Alfredo Barnechea
Office of External Relations
Inter-American Development Bank



People of the forest

In the western Amazon, a group of idealists is protecting the rainforest in a way that makes sound economic sense

One evening 19 years ago, Chico Mendes walked down the wooden steps of his little house in Xapuri, in Brazil's state of Acre, and into his backyard. He didn't see the gunman hiding behind a shrub.

Today, people from around the world visit Xapuri to honor the man who has become an icon of the struggle to protect the rainforest and the people who live and work in it. But while they mourn his death, they also celebrate his legacy. The story of this former rubber tapper has become a legend that is inspiring people to forge a new relationship with their natural environment.

The spiritual heart of Xapuri is the house where Chico Mendes lived and died. There's not much to see—the bed where the fallen leader was laid after he was shot, the shirt he wore that night, other personal items and household effects. But visitors feel they are in a very special place, almost a shrine. Across the street the Chico Mendes Foundation displays artifacts and honors that Mendes accumulated during his life and after.

Much has changed in Xapuri since that day in 1988. Back then, the state of Acre was pretty much the end of the line, one of the most remote and lawless corners of the Brazilian Amazon. Today, visitors heading for Xapuri travel on a paved highway called the Road to the Pacific that in a couple of years will link the heart of the continent with the ocean ports of neighboring Peru. Instead of an isolated backwater, Acre will soon be an economic and international fulcrum point, with a population of 30 million people within a radius of 750 kilometers.

Now even the road from the main highway to Xapuri is paved, as will be a feeder road to Chico Mendes' birthplace, the community of Cachoeira. But even before the dump trucks and graders arrived, crews had planted

The Amazon is home not only to great biological riches, but also to people of many cultures and ways of life.

rubber trees that will eventually grow into a leafy arcade for passing motorists. The new "Rubber Road" will be a tribute to Mendes and the people whose rights he had fought to protect.

What happened in this little community nearly two decades ago has changed how people throughout Acre think about their natural environment and what it means to their lives. Before, with the exception of indigenous people and rubber tappers, most people saw the forest as an obstacle to progress. But today, Acre's governor and a committed group of state officials, business people, community leaders and activists have coalesced around a grand vision to create a state whose economy and culture are defined and sustained by the forest.

It is a new concept, and state officials needed a new word to describe it. They explained that the Portuguese word *cidadania*, or "citizenship," has its roots in the city, the *cidade*. But Acre's roots, they believe, are in the forest. Whether *Acreanos* live in the city, in rural settlements, ranches, or far from the nearest road, their dominant economic and cultural reality is the forest, or in Potuguese, the *floresta*. So they invented a new word to describe the ideal to which the state's citizens aspire: *florestania*. At the same time, the state government adopted a tree as its symbol.

Acre Governor Jorge Viana credits Chico Mendes as the inspiration for *florestania*. The main avenue leading into the state capital of Rio Branco bears Mendes' name. City people can get a taste of the forest at the nearby Chico Mendes Ecological Park. Facing the capitol building, in the Park of the Forest People, rural workers have their pictures taken with a life-size bronze statue of their fallen hero.

Viana, a forester by training, makes it clear that *florestania* is not some mantra of misty-eyed nature lovers. Its proponents are hard-nosed politicians, successful entrepreneurs, veteran environmentalists, and ordinary people who must put food on the table and send their children to school. They are idealists, but not ideologues. Their methods are pragmatic and based on the conviction that their state's most precious resource is its natural forest.

In fact, traditional environmentalists would be very uncomfortable with some of the basic precepts of *florestania*, such as cutting trees, creating forest product industries, and promoting some forms of cattle ranching.

Most of all, they would find it hard to understand how a project to pave a major highway could have anything to do with saving the forest. When state officials approached the Inter-American Development Bank (IDB) for a loan to finance part of the project, the Bank initially balked. "The IDB said, 'if you build the road, you will destroy the forest'," recalled Gilberto Siqueira, the state government's planning secretary.

The IDB had it mostly right. New roads attract settlers and speculators. The forest gives way to slash-and-burn agriculture and eventually pastures. Secondary and tertiary roads extend the destruction deeper and deeper. In the end, the only vestige that remains of the former forest are Brazil nut trees, which are protected by law. But even these are soon reduced to mere skeletal re-

The Acre state government calls itself the "government of the forest."

Only a short walk from the state capitol building, a bronze statue of Chico Mendes affirms Acre's roots in the forest and the legacy of its most famous citizen.

mains, victims of the destruction of their ecosystem and repeated burning.

But this will not happen in Acre, vowed Planning Secretary Siqueira. "We said to them [the IDB officials] that the only way to make forest management viable is by creating reliable transportation infrastructure. We said, 'If we build the road the forest will remain standing because our economy is the forest'." The IDB responded by approving a loan for the project. Part of the funds would help finance the road, but a substantial portion would also pay for measures to create new state parks, systems for monitoring their use and enforcing regulations.

In the end, Acre's grand experiment, and the IDB's investment in it, may have repercussions far beyond the state's borders. Viana, Siqueira and officials from the other Acre agencies responsible for carrying out the IDB-funded program receive a steady stream of visitors from other Amazonian states and beyond. Governor Viana lobbies his political counterparts in neighboring countries to protect their forests before they build new roads.

Hearing *florestania* described is one thing. The best way to learn how Acre is turning its vision into reality is to take a journey across the state, from the increasingly graceful capital of Rio Branco, past cattle ranches, state forests, privately owned forests, Indian reserves, and communities of small-scale farmers and forest dwellers, and finally arriving in the river port city of Cruzeiro do Sul. Along the way one meets many people with stories to tell. All of them are participants in *florestania*.

Could environmentalists learn to love this road?

An asphalt strip through the Amazon is intended to anchor an economy based on a gentler, more sophisticated way to use the rainforest

For the people of Brazil's Amazonian state of Acre, BR-364 is much more than a highway. It is also a central protagonist in a narrative born in violence and martyrdom, woven in myth and legend, and now leading toward a future of new ideas that could help preserve the Amazon rainforest for future generations.

Like most Amazonian roads, BR-364 is a two-lane filament in an immense and fast-changing region. Where it has been paved, the surface is occasionally cracked and crumbled, the victim of heavy rains and an underlying soil that was meant to support trees, not asphalt. Like most roads in this area, it is also bordered by cattle pasture. "First roads, then deforestation, then cattle or soybeans," say the environmentalists.

It looks like yet another assault on the forest, but many areas along BR-364 have already been protected as state parks staffed with tough park guards.

In fact, this chain of events has been the iron law of change in much of the Amazon. But in Acre, things might turn out differently. The reasons trace back to the birth of BR-364 in the 1980s, when the World Bank helped to finance what was formerly a dirt track leading to Porto Velho, capital of the state of Rondônia. The new all-weather route sparked a land rush that remains one of the darkest chapters of deforestation in the Amazon. From Porto Velho the paving continued into the neighboring state of Acre to its capital of Rio Branco, this time with financing from the Inter-American Development Bank (IDB).

What happened next would reverberate throughout the Amazon and around the world. The agreement for the IDB-financed portion of the road stipulated that the Bra-

zilian government would carry out a series of measures to reduce the project's impact on the environment and traditional communities. But several years into the project, local and international activist groups protested that the government was failing to follow through on the agreement. Chico Mendes, former rubber tapper turned union leader, became an international spokesman for the groups that were protesting the highway. The situation grew tense. The government and the military had no interest in talking with Mendes and his rubber tappers, nor with Indian communities, settlers or environmentalists.

It could have ended very badly. But ultimately, in a historic meeting in May 1988, the IDB helped to broker an agreement to create an environmental protection plan. Its centerpiece would be the nearly one-million-hectare Chico Mendes Extractivist Reserve, the first time a large piece of natural forest was set aside for people to practice traditional methods of harvesting products to make their living.

Now, nearly two decades later, BR-364 is again on the move. From Rio Branco west to the river port town of Cruzeiro do Sul, highway crews are turning the former track of red earth into black asphalt to create what will be the state's geographic and economic backbone. Up to now, rain has made the road largely impassable during the rainy season. When the project is completed, the road will be usable throughout the year.

Once more, the IDB is a key player. With a $64.8 million loan approved in 2002, the Bank is helping to finance a set of projects to conserve and manage natural resources, develop industries to add value to these resources, and pave a 70-kilometer segment of BR-364.

And as before, the story of BR-364 is being watched throughout the Amazon and beyond. Former friends and colleagues of Chico Mendes now occupy the statehouse, and they have rallied private businesses, Indian leaders, extractivist communities and civil society organizations to create a new future for Acre based on managing the natural forest. Their goal is to turn on its head the long-time paradigm of the tropical forest as an obstacle to economic development. They believe that the rainforest, even with its high number of species and the complexity of their interactions, can play a central role in a modern economy. For traditional environmentalists, as well as their timber industry opponents, this is a radical idea.

The highway BR-364 (in red) forms the spine for the state of Acre.

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All roads in Acre lead to Rio Branco. But they begin in the forest, and that was the destination one morning for a delegation of state officials. Leading them was Gilberto Siqueira, planning secretary for the state government and right-hand man for its charismatic governor, Jorge Viana. On the door of Siqueira's vehicle was the state symbol, a tree. Siqueira went down a checklist of Acre's accomplishments during the seven years that Viana has been governor.

"Before this city was one big favela," said Siqueira. He showed a picture of the state capitol as it was, its paint grey and peeling, its windows bristling with dilapidated air conditioning units. Now this same building stands gleaming white in a serene setting of trees and well-tended gardens. Its doors are open to the public, and a ground floor museum tells the story of Acre's brief period of independence from Bolivia in 1899–1900, before the *Acreanos* decided to become a part of Brazil. (The state flag, like that of Texas, which shares a similar history, displays a lone star.) The building's stately rooms showcase locally produced furniture crafted of lustrous native wood.

The improvements are more than cosmetic. The current administration is credited with balancing the state's accounts, imposing rigorous financial management, and subsequently attracting a flood of investment and credit, including the IDB loan. Public security and education have also improved, thanks largely to significant increases in public spending.

Acre's economy has been growing at an annual rate of nearly 7 percent. Its annual 5 percent population increase includes an influx of engineers, lawyers and other professionals, according to Siqueira. Acre's potable water coverage now stands at 95 percent, up from 31 percent seven years ago. Lest any of these achievements go unnoticed, the state's sophisticated communications operation includes a satellite TV system that beams news to even the most isolated communities.

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Siqueira was not on his way to just any forest. The 66,168-hectare Antimary State Forest has won national and international recognition as a model for how to sustainably harvest timber and other natural products in an intact tropical forest ecosystem that includes people.

"Our grand aim is to show that the standing forest, managed sustainably, generates profits, wealth and jobs, in the forest itself as well as in the cities," said Marcus Alexandre Médici Aguiar, 28-year-old executive secretary in the state's Planning Secretariat. Forestry is already Acre's number one industry, he said. He and the other state officials insist that over the long term, one hectare of forest will produce four times more than one hectare of agricultural land or livestock pasture. They are determined to prove it.

Like other proponents of forest management, including Chico Mendes himself, Aguiar advocates a people-centered approach. They would agree with Gifford Pinchot, the

Acre Planning Secretary Siqueira points to a metal tag nailed into a tree trunk that identifies it as a certified product of a sustainably managed forest.

Rainforest protagonist

Local people first saw the new reserve as a threat

Genaro Santos da Cruz's legs can no longer carry him along his rubber trails in the rainforest in Brazil's western Amazonian state of Acre. But his eyes sparkle with youthful energy as he tells about his part in a grand experiment for saving this place he calls home.

Cruz began to walk the rubber trails when he was eight years old. His first job was to follow his father, carrying the bucket filled with the milky sap that oozed from the herringbone cuts in the trees' trunks and into little tin pots. Three years later he began walking the trails himself.

This was many years before there was any talk of turning this forest into a reserve. It was also long before Chico Mendes, before even the military dictatorship. But it still was a time of change, when the question of who controlled the land was often settled by threats and violence. Cruz always kept one eye over his shoulder as he raised a family, walked his rubber trails, grew crops and raised a few cattle.

Then word reached him that the government was going to make "his" land part of a forest reserve. "I had no idea what they were talking about," he recalled. "The idea of a reserve made no sense to us."

Rumors began circulating. "The people were saying, 'The government wants us to get out and leave the land just to the animals and the trees'," Cruz recalled. "They were afraid. They said, 'We have lived here for so many years. We were born here, our children were raised here, and now this'."

But the fears proved unfounded. The people living in the forest were allowed to remain, and they received official confirmation of their rights to continue to use their land, although not property titles.

Cruz: "This is a place where we can live peacefully."

"Our great-grandchildren will still be able to live here," said Cruz. "We don't have to be afraid. This is a place where we can live peacefully, hunting a little, collecting Brazil nuts. For me it is good."

The reserve is just one change that has come to this forest area. Another is on the horizon. In just a couple of years, the dirt road to the state capital of Rio Branco will be paved. Cruz is optimistic. Since his land is located within the reserve, the settlers and speculators that new roads often attract cannot threaten his traditional way of life nor those of his neighbors. Also, he says that the road will lower the cost of trucking his products to market and make it easier for him to visit his four children, who moved to the city to attend university.

For his part, Cruz intends to continue living in the forest, along with a son who decided that he, too, will follow in his father's footsteps and walk his family's rubber trails.

Machines in the garden

Technicians and entrepreneurs add critical value to the natural forest

A tree has just been felled in a rainforest. If the log is merely sent down the river to be processed elsewhere it will do practically nothing for the local economy. "If we export tree trunks, we are exporting our wealth and creating jobs elsewhere," said a state official in Brazil's western Amazonian state of Acre.

Acre's state government has decided that its campaign to prove the long-term economic value of the natural forest will ultimately be won in the marketplace. So on the outskirts of Acre's capital of Rio Branco, the government has created an industrial park consisting of 12 large factory shells that private firms are equipping to produce furniture, flooring and other wood products. The state gives each firm $68,000 for start-up operations in addition to tax breaks and other incentives.

The firms are also receiving strategic support from the Acre Technology Foundation, or FUNTAC after its initials in Portuguese. In FUNTAC's design center guests can try out sleek furniture with European-inspired designs, crafted from certified wood produced by Acre's managed forests. The foundation also provides the firms with facilities for drying wood and sharpening tools, offers classes for workers and makes available marketing services.

The goal is quality. For example, wood for flooring must have exactly 8 percent moisture content. If it doesn't the floor will buckle after it is installed and the company—and Acre's certified wood—will get a bad reputation.

FUNTAC was founded by Acre's current Planning Secretary, Gilberto Siqueira.

Skilled artisans add value to Acre's natural forests.

When he moved to Acre 20 years ago, Siqueira saw that the technology-related policies coming out of the capital of Brasília had little relevance for Acre. So he got together with a group of fellow engineers, and with support from the University of São Paulo, they created FUNTAC. Over the years, his group got to know the local rubber tappers. "We became good friends with Chico Mendes and we began to see what we could do together," he recalled.

Acre was a very different place then. "We [at FUNTAC] had some hard times," he recalled. "The government considered us a bunch of crazy people, even a bunch of communists." But by wedding technology to the forest they pioneered what would become the state government's drive to create an economy based on sustainably harvested wood products.

"These were the basic ingredients: our innovation and its integration with the forest, technology and traditional communities," said Siqueira.

early 20th century founder of the United States Forest Service, who maintained that forests should provide the "most good for the most people." In their view, the only realistic way to save the Amazon rainforest is summed up in a slogan on a locally produced tee shirt: "A managed forest is a protected forest."

Well-managed forests retain their diversity of plants and animals.

But total protection still has its place in Acre when the aim is to safeguard biologically critical or highly sensitive areas. Protected natural areas make up more than 45 percent of the state of Acre. Of this, 32 percent consists of conservation units, either under total protection or designated for sustainable use, and 13 percent are Indian lands.

Managing the forest is only the first step to long-term protection. The forest cannot produce the economic returns that will be needed to justify its survival if logs are merely cut here and processed elsewhere. Acre officials insist that value must be added to these same logs in local factories and workshops. In fact, the Acre government forbids shipping wood out of the state without at least primary processing. The goal is to ensure local processing and manufacturing of products ranging from the familiar—furniture and flooring—to the exotic—essential oils and organic condoms.

While Acre officials preach forest management with evangelical fervor, they keep open minds. For example, Aguiar was unapologetic about the cattle ranches that flank BR-364. To begin with, he said, only 10 percent of the state is presently deforested, and the deforestation rate is dropping. The view from the highway is deceiving, because nearly all of the cleared land lies close to the road. In fact, beyond the pastures the eye could nearly always make out the silhouette of the distant tree line. And as for the ranches, Aguiar believes that cattle raising has a place in Acre, but not the way it is carried out now. Instead of running low numbers of animals on large expanses of degraded, unproductive pasture, ranchers must raise more cattle on less land, said Aguiar.

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Turning off BR-364, a dirt road wound through a landscape of pastures and fields interspersed with patches of forest. Clouds of butterflies lifted off the packed earth as the vehicle approached. Finally the forest closed around the road, and signs announced Antimary State Forest.

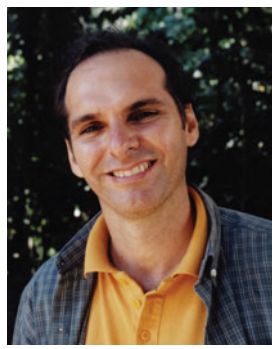
Antimary was Brazil's first public forest—twice, in fact. The same land was declared a reserve in 1911, and then was promptly forgotten. When the decree creating Antimary was signed 80 years later, researchers discovered that history in fact does repeat itself.

João César Dotto, a 42-year-old civil engineer and São Paulo native, welcomed the visitors with a lunch and lectures. Dotto heads the Acre Technology Foundation, or FUNTAC, after its name in Portuguese. His quasi-state organization is charged with developing and testing local products. The fact that it also manages a natural forest is significant. Normally, forest management is the job of an environmental or agricultural agency. But in Acre, the goal is to derive the maximum economic good from the forest's resources. More than mere wood, a tree is a raw material that technology can transform into products of much greater value.

Dotto explained that it takes real finesse to manage a tropical rainforest, where each hectare may contain hundreds of tree species

but only a few individuals of each. The traditional forester would throw up his hands in frustration, unable or unwilling to deal with such a variety of species, each with different physical characteristics, industrial uses and markets. Like agriculturalists down through the ages, their natural inclination is to replace troublesomely complex and inscrutable ecosystems with something more manageable.

In Antimary, just two or three trees per hectare are cut annually on a rotating schedule that roughly mimics the number of trees that would be removed under natural conditions. Some 4,000 hectares of forest have been exploited and certified since 2003. An additional 2,000 hectares would be exploited in 2006.



Dotto puts technology at the service of conservation.

Altogether, some 6 million hectares of Acre's forests have management potential. This includes 1.5 million hectares of state forest, 2.7 million hectares of community-owned forest, and 1.8 million hectares owned by private individuals or companies. State forests will be expanded in 2007 by an additional 600,000 hectares. Investment in the state forest system in 2008 is projected to total $4.8 million, which includes management, infrastructure and certification activities. Outside of Antimary, the bulk of certified wood comes from one private landholding and five community-owned forests. Other timber presently being cut in Acre is not yet certified.

Some 12,000 hectares of forest land in Acre are currently being managed by communities. Of this, 1,088 hectares in 10 separate projects were included in 2005 as part of the Community Forest Management Program, another state government initiative. The total community forest area under management was expected to increase sharply in 2006 to 250,000 hectares, of which 25,000 hectares will be exploited.

The state is also starting to reforest worn-out pastureland. A new tree nursery on the outskirts of Rio Branco will produce 4 million seedlings annually, enough to reforest 2,000 hectares. It sounds impressive, but Dotto insisted that this is just a pilot project. "We need 10 nurseries of this size," he said. The nursery is being financed in part by the National Environmental Fund, a recipient of IDB financing. It will be managed by a private firm, which will sell the seedlings to large landowners. Small farmers will get their seedlings without charge. Beyond the benefits of reforestation and the creation of new jobs in Rio Branco, the nurseries buy seeds collected by people living in the forest, thus giving them a new source of income.

In addition to reestablishing natural forests, Dotto says that Acre also needs a minimum of 200,000 hectares of tree plantations to support a cellulose and paper plant.

"So you can see that Acre has a very strong forestry vocation," said Dotto. "The agricultural frontier will stop at Acre's borders."

But a forest-based economy does not happen overnight. The forest grows and regenerates at its own pace. It takes time to create industries and find markets. The business world is not used to investment horizons of 30 or 40 years, particularly in a region with a history of economic and political instability. In the meantime, people need jobs and incomes, making cattle and other short-term sources of livelihood an economic necessity. Dotto maintained that livestock are perfectly compatible with his state's forest future so long as the animals are raised in intensive systems on land that had already been deforested.

"Increasing cattle production in a smaller area relieves pressure on the forest," he said.

But in the last analysis, the choice between managed forestry and cattle—or soybeans or any other crop, for that matter—will be made by the marketplace. "This is a free economy," said Dotto. Cattle are already an economic reality in the Amazon, and they produce predictable profits over the short term. "People have to eat," he said. Then there are soybeans, that second archenemy of forest conservationists. Dotto admitted "there's a very big risk" that soy could get a foothold in Acre. But that would be a big mistake, he said, because soybean cultivation would undermine efforts to make the best use of the state's most valuable resource, which is its forests.

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The moment of truth in forest management happens when the tree hits the ground. Dotto led the way down a forest path to show how it is done in Antimary. He introduced a burly man, a big chain saw casually dangling from his hand. The man yanked on the cord, and the saw jumped to life. He set the bar against the trunk, and carefully sculpted the base of the tree to direct its fall where it would do the least damage to the surrounding forest. The tree groaned and crashed downhill, taking vines and saplings along with it.

The man wielding the chain saw was one of the 380 people who continue to live in the forest. Here was another key part of Acre's vision: Rather than exclude people from the forest, FUNTAC considers human inhabitants as much a part of Antimary as the trees themselves. They are partners in a common enterprise. FUNTAC shows its sincerity by providing each of the 109 families in the forest with a modest but sturdy new house. In addition, they each get a document granting them rights over some 300–400 hectares of forestland, which roughly corresponds to the area served by the trails they had established to tap rubber trees. While the document gives them rights, it is not a title that would enable the families to sell the land.

Each family decides how to exploit its area of forest. Some refuse to cut trees at all,

A chain saw operator cuts trees according to a management plan carefully designed to leave the forest intact.

but most do, happy to have a new source of income. However, money is not everything. For example, families often opt to leave a particular tree standing because it produces fruit that attracts animals they hunt for food. Indeed, maintaining the forest's diversity of species is an aim shared by the families and the reserve managers. In all, some 42 tree species are harvested, not just the three or four most valuable species, which is the usual practice. In this way, the forest maintains its natural composition.

All of the people participate in forest operations in one way or another. Some get training in tree identification and management techniques. Others learn to operate chain saws (Dotto claims that some of the best chain saw operators in Acre live in Antimary). Still more take courses in harvesting other forest products, such as oils, seeds for sale to nurseries, and the fruit of the Açaí palm, which is made into a drink reputedly high in iron. "Better technology and quality will help the people increase the value of their products," said Dotto. FUNTAC has helped to start a cooperative where the people can sell their products. Before they used a barter system to get supplies, usually on disadvantageous terms.

"Our aim is multiple use," said Dotto, "not just wood production." He says that families are much better off now than before. Today they earn on average $7,500 annually, which he claims is 10 times more than they would get from raising cattle or crops.

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But creating a forest-based economy requires more than vision, good technology, and an able work force. It even takes more than political will, which Acre now has in abundance. It also demands institutional and political stability with a time horizon that corresponds to the long-term rhythms of the forest itself. What can the proponents of a forest-based economy do to ensure that pro-forest policies don't fall victim to shifts in the political winds?

Ultimately, the most compelling case for maintaining the current policies will be their unequivocal success: Acre must prove that managed forests can turn profits. In the interim, a group of independent organizations will help to insulate the forest from shortsighted political meddling. They include Acre's Forest Councils, which are made up of state and municipal officials, community members and representatives of civil society. Other institutions also have a long-term stake in forest management, such as Brazil's environmental protection agency, local universities, and the Amazon Work Group (Grupo de Trabalho Amazônico), which brings together more than 600 nongovernmental organizations in Brazil's nine Amazonian states. Joci Aguiar, the latter group's regional coordinator, says that such organizations can help provide continuity to programs that might not necessarily be a priority for the next administration. "Civil society remains, the unions remain, the associations keep working, the cooperatives remain," she said. "They will insist on preserving the gains made. No citizen of Acre wants to return to the past."

Acre will change profoundly in the coming years. Some of these changes will inevitably be caused by completion of the Road to the Pacific and BR-364. Dotto echoes the prevailing view in Acre that the new roads should not be seen as a threat, but as an opportunity. "The roads frighten some people," he said. "But if roads are well planned, with measures to protect the environment and local communities, they can be a great benefit."

Contraception goes organic

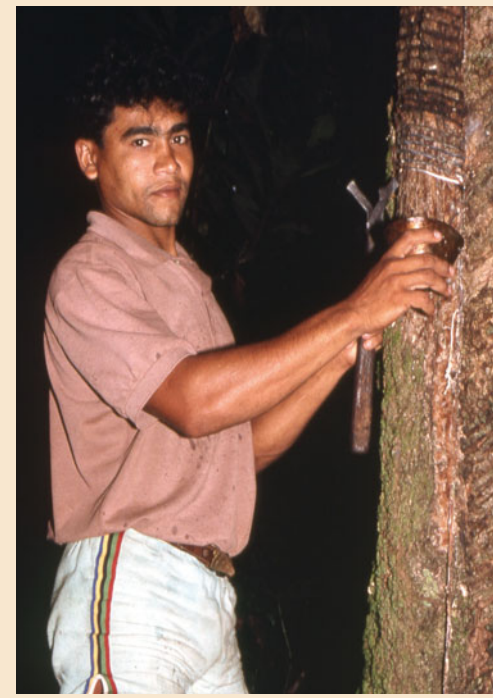
New product from the natural forest

People making the pilgrimage to the house of Chico Mendes in the town of Xapuri, in Brazil's state of Acre, may notice a large factory on the main highway. The proximity of these two buildings is not coincidental.

Chico Mendes fought to protect the rights of people who harvest the natural products of the forest. His dream lives on in the nearly one-million-hectare Chico Mendes Extractive Reserve, which was created as part of a project financed by the Inter-American Development Bank in the 1980s. The principal product extracted from the forest is latex, harvested by 350 local rubber tappers.

The new factory is using the latex to make condoms, 100 million of them annually. Acre's state government set up the factory for eventual management by a private firm.

But these are not just any condoms. First, they are the only condoms produced by a Brazilian company (the others sold in the country are made by international companies). But more than that, the Xapuri factory produces the world's first organic condoms. Other condoms are made from latex produced by industrial rubber tree plantations in Southeast Asia at low cost made possible by chemical pesticides, herbicides and other agrochemicals. But in Xapuri, latex collected in the natural forest is as pure as nature herself.



Rubber tappers gather latex the old way but earn more from new markets for innovative products.

State officials are hopeful that the condoms' all-natural cachet will win them a ready market among quality- and eco-minded consumers. Good sales will put money in the pockets of the rubber tappers, who will be less inclined to abandon their "rubber trails," as many are now doing, and move to the city.

Among the challenges in using latex from the natural forest is that the raw material must arrive at the plant in a liquid state. Normally, rubber tappers pour the liquid latex into a mold and let it congeal to a solid block, which can then be transported to the buyer at their leisure. For this reason, only families living relatively close to the plant qualify as suppliers.

Natural product: A big cachet is their origin in the Amazon rainforest.

It takes more than bulldozers to build this road

Acre's aim is to build a "green highway" in a land of red earth

There are roads, and there is BR-364, the highway that forms the spine of Brazil's western Amazonian state of Acre.

First, it is a road with a turbulent and troubling history. It was born during Brazil's military dictatorship, a time when decisions about massive projects were made in the capital of Brasília with little or no regard to their impact on local people or the environment.

The World Bank financed the first leg of BR-364, up through the state of Rondônia to its capital of Porto Velho. The Inter-American Development Bank helped finance the segment to Rio Branco, capital of the neighboring state of Acre. Along the way, and through the ensuing years, the road project caused massive deforestation, disruption of traditional communities, and violence, most notably the murder of forest activist Chico Mendes.

Then the road's history took a new route. After a dispute with the Brazilian government, the IDB brokered an agreement with competing groups—rubber tappers, government officials, Indians, the military—on how the funds from a $10 million environmental program should be spent. Among other things, the program created the country's first extractive reserves, a category of protected areas that allowed residents to remain rather than excluded them.

Now the IDB is helping to finance the paving of 70 kilometers of the stretch of BR-364 between the town of Tarauacá and Acre's eastern river port city of Cruzeiro do Sul. When this segment is completed it will make year-round transport a reality across three watersheds. This is the same troubled road. But the

A bulldozer gives traction to a grader in the slippery soil of Brazil's western Amazon, in the state of Acre.

IDB and the Acre state government are determined not to repeat the mistakes of the past.

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Fernando Moutinho was the man charged with coordinating the construction project for the state government's highway department. It was up to him to ensure that the final 120 km of paving needed to link the two cities be completed by the deadline of December 2006.

Moutinho stood on a rise where he could view the ballet of heavy machinery—the steam shovels loading red earth into trucks, the bulldozers giving forward traction to the graders, the 4x4s of supervisory personnel buzzing about the sculpted contours of red earth. The site was alive with men and machinery, to which was added the normal flow of cars, trucks and buses.

Although all highway engineers must deal with peculiarities of geology, topography and logistics, BR-364 is in a class by itself. Moutinho offered a few examples:

- There is no stone in the area to create the roadbed.
- There is no sand available locally for making concrete.
- The clay soil is very elastic, capable of expanding and contracting 37 percent of its volume; it must be removed.
- The path of the road cuts perpendicular to the network of rivers and streams, requiring the construction of many bridges.
- Bridges must deal with wildly fluctuating river levels, from near trickles in the dry season, when only 50 millimeters of rain might fall in July, to the rainy season, when 300 millimeters of rain in March can cause flooding that would nearly put entire bridges under water. On top of that, rivers here frequently change their courses.

Fernando Moutinho is the man in charge of the complex road building job—and more.

Transport logistics further complicate matters. Moutinho's crews use rocks, sand and steel that have been shipped over thousands of kilometers of rivers and highways. Cement barged from Manaus must travel 3,252 kilometers. Lime must be trucked 1,552 kilometers to Belém, and from there, 4,654 kilometers to Cruzeiro do Sul.

Even the road's past comes back to haunt the engineers. When the original dirt route was opened by the military in the 1970s, crews used logs to firm up soft spots. Now these same logs, often buried out of sight, must be found and removed. Otherwise they will rot and the pavement will cave in.

Another challenge is reducing the road's social and environmental impacts. All too often, roads are planned and built to meet short-term political and economic dictates. Their broader consequences have mostly been ignored.

But in the case of BR-364, paving is only part of the project. "The government says that the construction of a road is not an end in itself," says Moutinho, "but a means to an end that involves respecting watercourses, archeological areas and the forest." Since the current state government began building roads in 2000, its highway department has contracted environmental specialists to identify problems and come up with solutions. It may complicate Moutinho's job, but that's the price for building roads in the Amazon.

"Many times people destroy the environment out of

ignorance," he said. "Now we have a new consciousness, we do more studies, we use better materials," he said. "When we have to clear an area, we replant it later."

Building a "green highway" was not something Moutinho learned in engineering school. But he had to master the art nevertheless. "It is something we do because today we have a government that is very interested in protecting the forest and the people who live in it," he said. "This has now become the way we work. We do it automatically."

State officials believe in the road, and believe in doing it right.

Still, Moutinho knows full well that most environmentalists will continue to view a highway as a principal agent of rainforest destruction, that causes a predictable and unstoppable chain of events leading to settlement and deforestation. "Why do the conservationists say this?" continued Moutinho. "It's precisely because governments that previously built roads didn't take the trouble to say, 'No we're not going to cut down the forest. We're not going to destroy. We're going to conserve.' This is the job of the government."

Lawbreakers call him 'Sir'

A tree poacher operating in a protected area in Brazil's state of Acre would not like to look up from his chain saw and meet the gaze of Corporal José Carlos Alves Das Chagas. The imposing stance, the immaculate uniform and the semiautomatic pistol in its shiny black holster send a clear message: This man means business.

Chagas heads the six-person squadron of military police charged with enforcing the law in a cluster of state forests around a new highway, BR-364. He has a big job. First of all, it's a big area. It is also the scene of rapid change, brought on in part by the road's paving. Ordinarily, a new road will open the floodgates to settlers and speculators, who will set off the familiar cycle of deforestation and degradation. But hopes are that the creation of the state forests—and Chagas' squadron of law enforcers—will prevent this from happening here.


It takes a tough man to protect a fragile ecosystem.

In reality, Chagas said that the road will actually help him carry out his job by enabling his men to respond more quickly. But he took pains to point out that he is not merely a policeman. Chagas has been enforcing the law in Acre for 22 years. "I'm doing this job because I want to," he said. "We depend on the forest for clean air, for water. If we destroy the forest, we destroy everything."

New pathways for rubber tappers

Local people learn the complex business of forest management

Although Francisca Nazaré de Oliveira has lived in the rainforest of western Brazil all her life, she never imagined that someday she would be in the forestry business.

Nor did 100 other families in the São Luís do Remanso extractive reserve. They are descendents of people who for generations made their living mainly by tapping rubber trees and gathering other natural products such as Brazil nuts, as well as hunting and fishing. The rainforest has been their supermarket, their pharmacy, their lives.

It sounds romantic, but it's not. The fact is, a rubber tapper lives a meager life. Options are few and hard times are always waiting around the corner. To make ends meet, families would sometimes cut trees illegally or clear forest margins to plant crops or pasture.

Then change came to São Luís. In 2000, experts from a nongovernmental organization called the Center for Amazonian Workers (CTA after its name in Portuguese) met with the forest dwellers and described a plan in which they could cut trees and sell them, earning them income, but leaving the forest intact. The people were interested but it sounded new and complicated. They knew nothing about making forest inventories, creating maps, designing cutting schedules, calculating income and costs and profits, planning capital investments and dealing with government regulations. Moreover, the CTA insisted that they would manage their forests as a community venture, not as individual families. Could they learn to make joint decisions and put long-term communal interests ahead of short-term personal profits?

According to Bruzzi, the ballpoint pen is as mighty as the chain saw when the aim is sustainable forestry.

Despite their initial reticence, community-based forest management seemed to be São Luís' destiny. First, the very existence of their extractive reserve was owed to Chico Mendes, the revered defender of the rights of forest people. By giving their reserve a more solid economic foundation, they would be honoring their legendary hero.

The forest itself provided another argument for adopting the new plan. While it boasts the impressive species diversity characteristic of tropical rainforests—more than 350 tree species alone—it is particularly rich in valuable mahogany and Spanish cedar. So they could harvest the large number of species needed to help maintain the existing biological diversity, but a higher than normal percentage of the timber would command top prices.

Some 30 families in São Luís do Remanso eventually agreed to participate in the program

in various ways. Of these families, 10 are directly engaged in managed forestry. The others collect and sell other forest products, such as oil from the copaiba tree and seeds for selling to tree nurseries. Others produce handicrafts. Throughout, the CTA has provided technical assistance, including help to create the community organization that oversees the management plan.

The CTA's work in São Luís do Remanso is being financed with the help of a $750,000 grant from the Inter-American Development Bank through a fund that the IDB manages on behalf of the government of Japan. The CTA is carrying out the program in collaboration with the Acre Technological Foundation, a quasi-governmental organization.

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CTA forest engineer Pedro Bruzzi met Oliveira to inspect a section of her forest. She carried a rolled-up map, stained and discolored from its intimate contact with the tropical environment. Its grid pattern marked the locations of her trees and a key identified the species, size and estimated commercial value of each one. Every so often they stopped before a tree and discussed its physical characteristics and potential value.

"At first the people were afraid of forest management," Oliveira recalled. It took nearly two years of meeting with the CTA experts before they agreed to take part.

In any given year, harvests are carried out in an area of 50 hectares located within a management area. Under the system used in São Luís, the management area is formed by five family owned forest parcels. At any given time, two groups of families exploit 50 hectares each, for a total of 100 hectares. This area is large enough to allow skidders and trucks to do their job efficiently and with minimum collateral damage to the nontarget trees and bushes.

Women gather seeds in the forest and transform them into what they have dubbed "Amazonian biojewelry."

Under the management plan, only a given number of families harvest trees each year. These families receive the larger share of the income from the trees' sale, although all families receive some returns. Such a system would appear destined to create disputes. But disagreements are minimized by making decisions out in the open. "We bring the numbers to the community, provide orientation, and we all discuss how to divide the profits," said Bruzzi. "The community members make the final decisions." Over a 20-year harvest cycle all families will receive benefits proportionate to the labor they invested and the amount of timber harvested from their land.

One of the most difficult challenges in forest management is resisting the temptation to cash in on short-term gains in a future filled with uncertainties. The local people know full well that government policies change or that sources of outside funding could dry up. But Bruzzi is not worried. There will always be a demand for wood, he says. He puts his faith in the eternal self-interest of the marketplace.

The São Luís do Remanso forest has been logged in three successive years, with varying results. But problems are to be expected in what is in many respects a pioneering venture. Tropical rainforest management has bedeviled experts for many years, and the additional factor of community decision making only adds to the complexity.

The 2004 harvest fell far short of expectations because of delays in building roads and making clearings for stockpiling logs. As a result, each family received only about $435. The forest not exploited in 2004 was added to the 2005 quota, making a total of 200 hectares, with harvesting taking place on 150 hectares. The total yield was 1,100 cubic meters of logs, which included high-value hardwoods and lower value "white" woods that would be used for plywood. The "white" wood was bought by a local company for a total of $26,000. This amount, added to funds from the IDB contribution, covered working capital for 2005, leaving a preliminary profit of $260 per participating family. Another local company will purchase the hardwood for $87 per cubic meter. After subtracting marketing and processing costs, the hardwood will yield an expected $2,174 per family. The association will use part of the profits for working capital as well as to create funds to pay for education and health projects and training courses.

Meanwhile, the newly minted entrepreneurs of São Luís do Remanso continue their traditional activities, such as rubber tapping, but also adding new ones, such as selling syrup from medicinal plants at a local products fair and collecting seeds from native species to sell to nurseries that use them to grow seedlings to reforest degraded areas. They have also started making necklaces and bracelets from seeds, dubbed "Amazonian Biojewelry."

"We don't earn much, but it's enough to live on," said Oliveira.

The forest business

The CTA's Pedro Bruzzi doesn't believe in handouts

Q: *How do you justify the amount of outside support and government subsidies it has taken to get the São Luís do Remanso project up and running?*

A: Forestry is a new activity here. We had to construct roads. We had to spend money for training and buy chain saws, safety equipment, and tools for fieldwork, such as compasses and maps. We had to hire specialists to help develop the forest management plan.

In a market economy, private firms normally make these kinds of investments, although subsidies and other incentives are often used to give innovative businesses a start and promote activities that are in the public good. Once we have established a chain of production, the business will be very profitable.

Q: *You insist that the private sector and not CTA must ultimately provide the technical services needed for community forestry. Why?*

A: Because private sector involvement means that forest management is profitable and does not have to depend on other sectors in society for its existence. It also means that forest management will survive future political administrations that might not be as supportive as the present one.

Also it is essential for communities to develop partnerships with private firms, such as sawmills, where local people can learn such things as how to measure a tree trunk, how it's cut and how the sawn timber is measured.

‘Manage your forest or lose money’

Private landowners join the movement to build a forest-based future

Adelaide de Fátima G. de Oliveira has the firm handshake and the loquacity of an urban entrepreneur, which she is. But she was having no problems leading a group along a forest in the gathering darkness. Her visitors, some in city shoes, stumbled along behind.

She owns this forest, she explained, all 7,700 hectares of it, and a sawmill besides. She is also the president of a group of entrepreneurs called Assimanejo whose members believe that they can both earn a living and protect the environment by managing the natural forest and producing wood products. They are protagonists in a new vision being pioneered here in Brazil’s Amazonian state of Acre. Called *florestania*, the idea is to turn the natural rainforest into the foundation for the state’s economy.

Oliveira wants to save Acre’s rainforest with industry and enterprise.

The 20 Assimanejo members and other private businesses are crucial to making *florestania* work. No matter the dreams of state officials and their civil society allies, a forest-based economy can only become a reality if it succeeds in the rough-and-tumble world of the marketplace. It will be up to entrepreneurs such as Oliveira to prove the oft-repeated contention by *florestania* proponents that the natural forest can out-produce any other agricultural use by a factor of four to one.

Assimanejo receives support from the state government, the Inter-American Development Bank, the World Wildlife Fund and other groups. Just the week before, a group called the Forestry Services Council had granted certification for the wood harvested from Oliveira’s land, affirming that her management methods will ensure the forest’s long-term survival.

Hers is the first privately owned forest in Acre that produces certified wood. She brings people here for training and to see for themselves how logging operations can be carried out with minimal disturbance to the forest. “People have to see to believe,” she said.

In particular, Oliveira was proud that the 16 species of trees being cut on her land include mahogany, an icon of the neotropical plant world. Throughout the Americas, mahogany has been the target of loggers, some operating within the law, but many more exemplifying the predatory practices that have helped to inflict nearly 500 years of forest destruction on this continent.

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Oliveira’s destination that evening turned out to be a spectacularly big mahogany tree, a true queen of the forest. Oliveira looked admiringly up into its darkened crown. Lumber cut from a tree this size could fetch $70,000, she estimated. But she would never cut her forest queen, because it is a special tree. Besides, its massive trunk was probably hollow or rotten inside. The ideal commercial trunk diameter for a mahogany tree is 80–100 centimeters. Her forest has an average of 1.6 such mahogany trees per hectare.

This majestic tree will live on many more years, to eventually die a natural death. In the meantime it will produce seeds that will en-

sure new generations of mahogany trees. It will also anchor the 100 hectares Oliveira has set aside as a special reserve where university students can carry out research projects.

With good management, Oliveira believes that Acre will not repeat the mistakes made in neighboring states, where mahogany trees have been practically wiped out. "We have to be very careful," she said.

Oliveira readily acknowledges the responsibility that private landowners must bear for a great deal of the destruction that has taken place in the Amazon. "Landowners want their money now," she said. But she maintains that this shortsighted mentality is starting to change, at least in Acre. "People are seeing that we will have no place to go if our forests disappear," she said. They are also starting to understand the importance of the forest as a source of crucial services, such as water supply. "Landowners are seeing that if they continue to do things the old way," she said, "they are going to leave a poor future for their children and grandchildren."

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But in the end, Oliveira is a businesswoman, and her forest is part of her business. "If the forest produces profits, it will remain standing," she said. "If it doesn't, it will be cut."

Well, not exactly, Oliveira admitted. According to Brazilian law, landowners in the Amazon are required to leave 80 percent of their holdings in natural forest. "But if they don't manage their forest for wood production," she said, "they are losing money."

Oliveira's group insists on a close link between forest and industry, even requiring that Assimanejo members must own both forestland and some kind of industrial plant for processing wood. Oliveira's sawmill supplies lumber to a São Paulo furniture manufacturer. "Without the forest there is no industry," she said, "and without an industry, there is no entrepreneur."

Forest owners harvest many kinds of trees—not just the most valuable ones—to maintain biodiversity.

According to Oliveira, local people also stand to benefit from forest management. She estimates that her logging operations will eventually provide jobs to some 200 local people. Many of them have received training in a center she established. Families also participate in vaccination and literacy campaigns paid by her firm. She regards the local people as partners in forest management, but she sees them in human terms as well. For example, she believes that they should be partially exempt from the rule requiring Amazonian landowners to leave 80 percent of the land in natural forest. "A family that owns 10 hectares cannot support a family with four or five children by growing crops on only two hectares," she said.

‘We are winning, the forest is winning’

Still in blue jeans, Jorge Viana had just returned from a visit to an Indian village in Brazil’s Amazonian state of Acre. As the state’s two-term governor (he was elected first in 1998 and then reelected in 2002 with 64 percent of the vote), he had made many other such visits in the past. Here he talks about his government’s innovative approach for protecting the rainforest.

Q: *You call your administration the “Government of the Forest.” Were did this idea come from?*

A: It came from the forest itself. Before entering government we worked in the Acre Technology Foundation (FUNTAC) in the mid-1980s, where we came in direct contact with social movements in Acre led by Chico Mendes and indigenous people. The discussion was how to substitute cutting down the forest by taking another approach. Our technical staff at FUNTAC began to develop a proposal for multiple use of the forest, just as Chico Mendes was consolidating a model based on extractive reserves that would give the rubber tappers a means for survival. At that time, these discussions were still far removed from the government policies, both at the state and national levels.

But these ideas were so positive, so strong, and so rooted in the forest that they eventually formed the basis for our government. These ideas won the election, and they were the initial step in creating the Government of the Forest.

Governor Viana gets a ceremonial welcome on one of his frequent forays into his state’s interior to visit constituents. “[The forest] gives me strength,” he says.

Q: *Would you say, then, that your government's philosophy had its roots in the life and lessons of Chico Mendes?*

A: It was an attempt to achieve part of the dreams of Chico Mendes. I say part of his dreams, because he was killed in 1988. If he were with us today, as a great visionary, he would certainly have other dreams.

We have a great responsibility because we are not merely attempting to carry out a government program. We are also working to achieve sustainable development. But even more, we are attempting to make dreams happen. This is a much greater responsibility.

We see very clearly that the best way to defend the forest is to recreate a dependent relationship between the people who live in the Amazon and the forest, as was the case 100 years ago. The best means to defend the forest is to make sustainable economic use of the different products that the forest offers us.

Q: *How long do you think it will take to realize this dream?*

A: I think it's already happening. We are living in a historic era, but we don't realize it. In the next three, four or five years, we will pretty much have consolidated our major economic goals. I have no doubt about this. In addition, our efforts are supported by the gains Brazil is making in law enforcement and monitoring and control of deforestation [such as the rule that landowners must leave 80 percent of their forest undisturbed].

When we started we were a group of dreamers. But not anymore.

Q: *What support have you received from outside of Acre?*

A: For more than 10 years we had wanted to be a partner of the IDB. When I was mayor [of the capital of Rio Branco], and later along with Marina Silva [Minister of the Environment in the Lula administration, and originally from Acre], we made the first trips to Washington to negotiate this program of sustainable development.

We also had the support of [former Brazil president] Fernando Henrique [Cardoso] and we also carried out a program of financing with the BNDS [Brazil's national development bank], and received funding from the federal government.

Q: *How can you help ensure that your vision will survive future state governments?*

A: We want to move our program outside of the government and into the hands of the private sector. If the economic activities are sustainable, they will continue after people now in government leave office.

I can see clearly that when the people understand that the forest is a business, Acre will be the number one, or number two or number three forest producer in the world. In other economic activities, we will be number 20.

Q: *Do you think that what is happening here in Acre will have an impact elsewhere in Brazil?*

A: I believe that the Amazonian forest will have business allies as strong as those that currently back the agribusiness sector. I think that there will be two great forces in Brazil's economy: agribusiness, which should grow even more to become a great producer of meat and soybeans for the world, and certified wood products from sustainably managed forests.

Several other Amazonian states are already following our lead, such as Amazonas and Pará. Look at it this way. Acre is situated at the head of rivers that form and flow through 5,000 kilometers of the Amazon basin to the Atlantic. If something bad happens here, it is carried down these rivers. If something good happens here, it also goes down the rivers. I believe that our message of hope and confidence is flowing down the rivers throughout Amazonia. The message is

that the numbers we are beginning to generate here in Acre are showing that the natural forest is good business, and that deforestation is bad business.

Q: *What has been the importance of the role of effective government in carrying out this vision?*
A: Without false modesty, I must say that good government has been very important. We have been in office for seven years, and we are doing what we said we would do. Again speaking honestly, I believe that all of the problems of the Amazon—not just of Acre—have been the fruit of bad policies carried out by governments and financed by governments. We are showing that the government does not always have to do the wrong things. It can do the right things as well.

Our government in Acre is trying to be a pioneer. We have to build the road and we have to have infrastructure. We have to provide technical support for forestry. We have to make education our top priority. We have to have a health program for the people living in the forest that is different than that for the rest of the population. We have to have a communications program that reaches people living in the forest. We have to find innovative means of financing our projects. All of these initiatives are the responsibility of the state. They are not an expense, but an investment.

Q: *Most conservationists and scientists are pessimistic about the pace of deforestation and loss of biodiversity in the Amazon. Do you share their pessimism?*
A: I understand their point of view. Their job is to alert us to dangers. But there is nothing inevitable about the continued destruction of the Amazon forest. Throughout the entire world, and right here in Brazil, there is a cry to protect the forest. No government can resist this pressure.

We cannot accept the present rate of deforestation. We are deforesting the Amazon at a rate of 2.5 million hectares annually. Over the years we have planted only 5 million hectares. Every two years, we deforest the equivalent of all that we have planted in the past. For the Amazon, 2.5 million hectares may not seem like a lot, but it equals the size of many entire countries.

But one thing is clear: this coming year [2006] the deforestation rate is going to drop, and the next year it will drop even more. There is still a great deal of suffering ahead, but things are improving.

Q: *Many traditional conservationists would oppose much of what Acre is doing to build a forest-based economy: building a road, cutting trees, creating forest-based industries. What would you tell them?*
A: It is good that they are resolute in their views, that they want to conserve the forest and identify areas for permanent protection. But my problem is that this can be done on only part of our territory. You can't turn everything into a nature preserve. What do you do with private land, other areas? And this is where the Acre model is making a contribution.

The nature preserves are being expanded, and this is an important victory. But the real victory must take place in the economic arena, in real life. We have to make the forest a good business, because if the forest generates profits, everyone will want to protect it. It's like the goose with the golden egg.

For many years, people have called the forest a problem. "Cut it down to use the soil." We believe the opposite—"Don't cut the forest, use the forest."

Q: *A major highway, the Road to the Pacific, will pass through Acre. How will this infrastructure development affect the state's efforts to protect its forests?*

A: First, I think that all highways in the Amazon are problems. They bring the risk of deforestation if they are planned and built as they traditionally have been in Brazil. Here in Acre we're trying to do something new. The highway that the IDB is financing here [BR-364] is being done in the reverse of the normal order. Construction is going from Cruzeiro do Sul [an outlying city] to Rio Branco [the capital], not the other way around. We are organizing the communities around a government plan to control deforestation and create state forests along the highway.

I fought hard to make the Road to the Pacific a reality. I also have met with Peru's president, foreign minister and environmental minister to urge them to strengthen their environmental legislation. We have to be stricter in the area of influence of this road, or we will pay a big price. It could generate a new economic geography here in this region, and we here in Acre and the government of Brazil are working with the Peruvian government to help them carry out a major investment plan to protect their forests and their traditional communities. If this is not done, the highway will be a problem.

Q: *Is what we're seeing today in Acre the New Amazon?*

A: No. What we are creating here is a strategy that links the need for economic development with the conservation of the forest. We are not establishing a new relationship between man and nature, but between the economy and the sustainability of the forest.

Q: *Then in fact there is something new.*

A: Well, yes. We are leaving a very concrete legacy for Chico Mendes, 19 years after his death. Chico Mendes is winning even though he is dead. We are winning. The forest is winning.

Q: *You just returned from a trip into the interior of the state. How do you personally feel about the rainforest?*

A: I love it. It gives me strength. I love walking in the forest, traveling along the rivers, staying with the Indians. When I can, I am always in the forest, as deep in the forest as possible. The forest strengthens the body and the soul. It fulfills many human needs that cannot be met anyplace else.

In many parts of the Amazon, everything and everybody—including Governor Viana and his hosts—travels by river.

New ideas from faraway places

Can a chain saw help sculpt a new approach for protecting the rainforest?

New ideas sometimes come from unlikely places. The airplane was developed in a garage in a small city in Ohio. The science of genetics was born at a monastery in Moravia.

Today, in a remote corner of the Amazon, a group of government officials and their allies believe they are answering a question that has vexed scientists and conservationists for many years: how to protect the Amazon rainforest while creating a better life for local people.

They are idealists, but not ideologues. In many cases, their ideas challenge traditional environmental assumptions. They don't recoil at the image of a man in the rainforest wielding a chain saw. They don't believe that roads inevitably lead to environmental destruction. They don't necessarily see cattle as the bête noire of forest conservation. They promote industry, not at the expense of forests, but as a way to add value to natural ecosystems and their productions.

It looks like the middle of nowhere, but this humble dwelling lies within sight of a new road and a new vision for protecting the Amazon forest.

These new Amazonians are government officials, community leaders and private entrepreneurs in Brazil's western state of Acre. They are committed to saving the rainforest and its people. But they also know the gritty reality of the place where they live. Many of them are veterans of the social and environmental turmoil that claimed the life of Chico Mendes, famed forest activist. They have seen the dramatic changes the Amazon has undergone and know that more change is on the way: new infrastructure, new crop technologies and growing overseas appetites for raw materials that the Amazon can produce.

The region faces tough, seemingly unsolvable problems, but these people are determined to meet them head on. Their aim is to prove that they can build a solid local economy

based on resources harvested from the natural forest. This falls short of the total protection many rainforest advocates demand. But then, the Amazon was never a nature preserve. And does anyone have a better idea?

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Latin America can be a land of tough environmental realities. In many instances, these realities produce tragic outcomes for ecosystems and the people who depend on them. But sometimes, problems that would appear insurmountable in developed countries have inspired people in Latin America to find new approaches for protecting their natural environment. In nearly all cases, their innovations address the perennial question of how to reconcile the needs of people with nature's capacity to meet them.

So in the Galápagos, after centuries of depredation, former antagonists are forging a plan to conserve marine resources. In Guatemala, a government agency and private groups are helping local farmers to boost their production in order to reduce the likelihood that they will invade national parks. In Nicaragua, a government agency has contracted local private associations to work with farmers to plant trees and conserve soil. On Brazil's northeast coast, a marine biologist is helping local officials to protect the coral reefs. In Honduras, a mayor proudly shows off his mountaintop "ecological park" where his constituents learn the value of the natural forest as a provider of ecosystem services.

In each case, the objective is to help local people form a partnership with their natural environment. In most cases, success depends on persuasion. Even when laws exist to protect the environment, governments lack the money and institutions to enforce them. In developed countries, such as the United States, well-funded public agencies are charged with protecting natural areas, although few are aware that these same areas were originally established by forcibly removing local people, creating a legacy of bitterness and resentment.

Latin America is attempting to forge a new relationship between man and nature that in many cases includes the history, heritage and views of local people. It has not been easy, but the experience gained so far constitutes the region's major contribution to the practice of natural resource management and biodiversity conservation.

This innovative approach to conservation requires one caveat. In most cases, the process of dialogue has been led by dedicated individuals and groups working in the absence of strong public institutions. While admirable, these efforts are by their nature ephemeral. Effective, well-established and well-funded government institutions, working closely together with their civil society counterparts, must make the changes permanent.

But there are exceptions, and one of them is Brazil's state of Acre. There, the government is spearheading the process of change and innovation, working closely with a rich network of civil society and community organizations. They have accomplished a great deal in just a few years. Their example should be studied carefully in other developing countries and beyond.

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Alexander von Humboldt, who was right about so many things, perhaps would not be surprised at what is happening in Acre. "There [in the Amazon basin]," he said, "sooner or later, the civilization of the world will be found."

Man and nature on the Galápagos

Beleaguered and beloved, a tiny archipelago gets critical support

They are the cradle of evolutionary theory, one of the earth's natural crown jewels, the dream destination of every ecotourist. But they are also the scene of bitter, at times violent, disputes that threaten some remarkable but increasingly beleaguered species and ecosystems.

The Galápagos Islands, a tiny archipelago 1,000 kilometers off the coast of Ecuador, are a microcosm of paradoxes facing efforts to conserve biological diversity worldwide. Never have the islands gotten more attention and support than they are getting now. Yet never has this help been more critical.

For the Galápagos, this status is something new. For most of their recorded history, practically from the time of their discovery in 1535 by a Spanish bishop, the islands have been regarded as a ship's larder at worst, a cabinet of curiosities at best. Typical of the islands' marauders were the crews of whaling ships that carried off thousands of giant tortoises to stock their ships' larders. Wealthy European and American collectors insisted on having at least one example of each species, and often subspecies. Boatloads of scientists collected thousands of bird skins that they would later examine for minute differences in size and plumage. Meanwhile, the islands' delicate ecosystems were repeatedly devastated by exotic plants and animals, introduced either accidentally or on purpose, that wiped out some native species and put fragile ecosystems in jeopardy.

During these former times, the Galápagos were considered a curiosity at best, a godforsaken eyesore at worst. When a Spanish sea captain called them "Enchanted Islands," he wasn't describing a tropical island paradise. Quite the contrary. Desperate for water, he repeatedly attempted to reach the islands, but each time was foiled by slack winds and treacherous tides. Frustrated, he decried the islands' "apparent fleetingness and unreality."

A romantic vision of peace and harmony between man and nature brightens a wall outside an elementary school in the Galápagos' main town of Puerto Ayora.

A group of cruise ship tourists stops at a souvenir stand en route to the wildlife exhibits at the Charles Darwin Research Station. Although some 100,000 tourists will visit the Galápagos this year, few will spend much time—or money—on the islands themselves.

When he eventually did gain landfall, his crew found no water. He returned to the mainland, defeated.

Later visitors were just as unappreciative. The captain who brought Charles Darwin to the Galápagos found the islands no more than "black, dismal-looking heaps of broken lava." In the opinion of the great Darwin himself, "Nothing can be less inviting." The writer Herman Melville, who could describe the dismemberment of a whale with clinical enthusiasm, called the Galápagos a "dark, doleful, dreary" place, where the "chief sound of life here is a hiss" produced by reptiles.

Then finally, the islands began to get their due. Eccentric foreigners were drawn to them by their rugged beauty. Many remained, some to cause memorable scandals, such as a self-titled baroness from Germany who engaged in a mysterious love triangle and subsequently disappeared.

Just as artists made the Grand Canyon grand and poets made mountains sublime, it was the scientists who made the Galápagos a window on nature's grand design. Research being carried out on the islands continues to add crucial new details to our understanding of life and how it evolves.

As the islands gained fame, increasing numbers of foreign visitors came to see for themselves. Their numbers rose from 7,500 in 1974, to 32,600 in 1987, 92,000 in 1993, and an estimated more than 100,000 the year following. The visitors add an estimated $150 million to the country's economy. Some be-

As ubiquitous as they are unique, marine iguanas are found on the Galápagos and nowhere else in the world.

The islands were formed by volcanic activity.

lieve that the islands' present tourism infrastructure could handle a total of 160,000 visitors, although others regard such numbers as a rosy dream.

The islands have also attracted growing numbers of mainland Ecuadorians seeking jobs in the fishing and tourism industries. For a time the islands' population grew at an explosive 6.7 percent annual rate. In 1962, the population stood at 4,000. Today, even with new restrictions on immigration, it stands at 19,000.

In this dynamic but trouble-filled scenario, the Galápagos Environmental Management Program, financed with the help of a $10.4 million loan from the Inter-American Development Bank, has taken the lead in forging teams of colleagues out of people who formerly scarcely spoke with each other. Together, they are deciding how to share resources and conserve the islands' biodiversity. Just as Darwin found empirical evidence here for his theories on natural selection in birds and tortoises, a modern-day student of social Darwinism can observe the unfolding of a participatory process in meeting rooms, town halls, fishermen's association headquarters, tour agencies and research centers, where the people of the islands are determining their own future.

There is still resentment and anger, but also a newfound cooperation, which, as Darwin himself believed, is as much a part of the real world as is conflict.

A seal ignores a party of tourists arriving at a secluded Galápagos beach. While most animals mirror the islands' somber hues, there are exceptions (below).

Cooperation or competition?

Formerly antagonistic interest groups are starting to set aside their differences and work to protect the shrine of evolutionary theory

Tourists in the Galápagos are overwhelmed by what appears to be nature's Peaceful Kingdom. They stroll through colonies of nesting seabirds, get eyeball-to-eyeball with fearsome-looking sea iguanas, and share their table scraps with tiny finches. The creatures on this cluster of volcanic outcroppings live in seeming harmony, situated in their environments by an all-knowing hand.

But the Galápagos' most famous visitor, Charles Darwin, saw things quite differently. Inspired by his observations on these islands, he developed a theory of natural selection based in competition and conflict.

Part of an archway commemorating Charles Darwin shows the famous scientist in the midst of the finches that helped inspire his theory of natural selection many years after he visited the Galápagos.

Competition and conflict are not limited to the islands' flora and fauna. Cloistered in their tour boats, most visitors are not aware that the people of the Galápagos are engaged in a struggle over the islands' resources that would have been perfectly understandable to the early social theorists who took Darwin's theories and applied them to human society.

How can these competing interest groups replace conflict with cooperation? How can biological diversity be preserved while at the same time improve the lives of the islands' people? The answers emerging in the Galápagos will have enormous significance—practical as well as symbolic—in efforts to protect endangered species and threatened ecosystems in other parts of the planet. And so, long famed as a laboratory for studying the dynamics of nature, the Galápagos have also become a key test case in biodiversity conser-

vation. If it can't be done in the Galápagos, then where?

While the islands themselves are relatively well protected, the marine reserve created in 1998 remains a focus of controversy. The islands' 700-plus fishermen insist on their right to earn a decent living, which depends on their harvests of two high-value species: lobsters and sea cucumbers.

While lobsters need no further introduction, the same cannot be said of sea cucumbers, at least in the non-Asian world. These slug-shaped echinoderms hold a revered place in Chinese cuisine. Dried, reconstituted and used in soup, they are considered effective remedies for a varied assortment of complaints, including kidney disorders, weakness, constipation and impotence. Demand is insatiable, particularly as rising incomes in Asian countries put such exotica within the reach of burgeoning numbers of a new middle class. On the Galápagos, sea cucumbers can earn fishermen as much as $23 per kilo, compared to a mere $2–$3 per kilo for fish. Lobsters, though not quite as lucrative as sea cucumbers, are also snapped up by export companies.

Both lobsters and sea cucumbers are being harvested to the point of near extinction around the Galápagos. Alex Hearn, marine biologist at the Charles Darwin Research Station, in Puerto Ayora, does the numbers: On one site off the island of Fernandina, researchers in the year 2000 tallied 167 sea cucumbers per 100 square meters. The next year, the count dropped to 100, the year following to 47. "We recommended that they shut down fishing on this island, but they didn't," said Hearn. "Now we're down to nine individuals per 100 square meters," he said. "That's scary." Beyond the issue of man's right to drive fellow creatures to extinction, this lowly animal plays an essential, though still incompletely understood, role in the marine ecosystem by aerating and recycling sediment, much like earthworms in the soil.

Hearn and others at the world-renowned Darwin station laboriously collect and analyze such data. But in many cases, the fishermen find the studies, with their numbers and equations, too complex to understand. They dismiss them as biased or inaccurate. Their first priority is not science, or even resource management, but earning a living. So they demand longer fishing seasons for these species, and permission to use more effective techniques, such as long lines with multiple hooks to catch finfish.

Biologist Hearn worries that sea cucumbers may disappear altogether from the islands' marine fauna.

When the fishermen's demands for longer seasons and more generous quotas are denied, the result can be explosive. In periodic strikes, the Galápagos fishermen—albeit a distinct minority of them—effectively shut down life on the islands. In some instances they have even taken scientists hostage and threatened to kill rare giant tortoises. Not only do these acts sour relations among the islands' 19,000 people, but they also make headlines around the world. Ecuador can ill afford to have its major tourist attraction, a source of crucial foreign exchange, perceived as unsafe for tourists and inhospitable to the preservation of unique biological riches.

Something had to be done, and the Ecuadorian government took groundbreaking action in 1998 when it passed the Special Law of the Galápagos. In addition to creating the marine reserve, the new law banned mainland fishermen from entering the reserve, put sharp restrictions on burgeoning migration to the islands, and set up an interlocking system of institutions under the Ministry of the

Environment that would oversee management of the marine reserve. The Inter-Agency Reserve Management Authority, made up of representatives from the central government as well as Galápagos interest groups, would vote its decisions. This body would receive guidance from a Participatory Reserve Management Board, made up of marine reserve users that includes representatives of the fisheries and tourism sectors, the scientific community, and the Galápagos National Park. In this more collegial group, decisions would be made through consensus.

The next major move came two years later when the IDB approved a loan to fund the Galápagos Environmental Management Program. Its aim would be to protect the islands' natural heritage, on which its tourism industry is based, while improving living conditions for local residents.

The conceptual core of the IDB program would be participatory management: The different interest groups themselves would meet together, discuss together, argue together, and forge a management plan for the marine reserve. In addition, IDB funds would be used to purchase patrol boats and other equipment needed to monitor and enforce the new laws, carry out research to guide management decisions, create environmental education programs, and prevent further introduction of invasive species to the islands. Other funds would be used to strengthen the ability of key institutions, such as the environment ministry, the Galápagos National Park and the local municipalities, to discharge their responsibilities over the long term. Sanitation projects would be carried out in the islands' three population centers.

Sea cucumbers come in all hues. This green specimen could pass as a large clump of algae.

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It was early July, and rumors were circulating of an impending fishermen's strike over the closure of the sea cucumber fishery. People were nervous. Then IDB president Enrique V. Iglesias was due to inaugurate a new quarantine center the following week and Bank staff in Quito and Washington were wondering if the visit should be canceled.

One person who was not nervous was Jorge Meza, who directed the Galápagos Environmental Management Program from his headquarters on the campus of the Galápagos National Park. If the fishermen were to strike again, and if Iglesias had to cancel his visit, would this mean that the program was failing? Meza smiled. "By no means," he said.

Meza knows the problems intimately, and keeps them in perspective. He saw seven Galápagos National Park directors come and go in one year, in 2003. He has lived through the strikes. He is an astute observer of how the complicated political life of the islands achieves a whole new level of complexity when it gets entwined with the politics in the capital of Quito. But he is confident that his program will ultimately succeed in creating a working—if not amicable—community among the various interest groups on the islands. There will be strikes, and more strikes, and continued instability, but the program is forging an institutional framework to provide the continuity needed to weather the inevitable storms. "Protests too are a part of the process," said Meza.

The environmental management program could have opted for a less participatory approach for protecting the marine reserve. For example, it would have been more efficient in the short term to hire outside consultants to draw up the management plan. But then the local people would not have had a personal stake in its provisions, and when the money ran out and the consultants returned to the mainland, the conflicts could have resumed. For this reason, Meza cautions against trying to push the decision-making process too fast. "We must take care not to trample the natural dynamics of the people's social evolution," he said. "The members of our Participatory Management Committee are learning to talk to each other and make decisions, and to arrive at a consensus," he said. "We must be patient."

Meza regards conflict as part of the dialogue.

Meza cited as an example a strike carried out earlier that year, not by the fishermen this time, but by the Galápagos National Park guards. They were protesting the removal of the park's director, a respected biologist and Galápagos native, and his replacement with a person who the guards considered less likely to enforce fishing regulations. The upshot was that the IDB, the United States Agency for International Development and the United Nations Development Programme appointed a team of consultants that would interview representatives of the different sectors in the Galápagos, including local authorities and park staff. They would then draw up a profile for the position of park director and map out a new selection process, which the Ecuadorian minister of the environment would use to appoint a new director.

Members of the local management committee, such as Eliécer Cruz, agree that, despite occasional lapses, participatory decision making is working. Cruz is a former longtime director of the Galápagos National Park and now heads the World Wildlife Fund (WWF) program on the islands. His group coordinates the activities of the nine nongovernmental groups on the islands. He called the new participatory model a "major success," offering as evidence a framework management plan that was hammered out by consensus over the course of 82 meetings.

Another success has been an agreement to expand the marine reserve, now the world's second largest, and to prohibit industrial-scale fishing within it. Participants decided what activities can be carried out in the eastern portion of the reserve, although there was still heated disagreement over the details. "This management model is truly innovative, a pioneer for many areas in South America, particularly in its use of consensus for reaching agreements," said Cruz.

One of the strengths of the participatory board—and at the same time one of its weaknesses—is that decisions must be made by consensus. "Normally, out of five stakeholders, four are in agreement," said Fernando Ortiz, who heads the park's marine resources unit. The holdout will inevitably be the representative of the fishermen. "The fishermen see the board as a bunch of conservationists who are not really interested in compromising with them," says Ortiz. "So they feel cornered, and then they go out and riot. This is the way it's been for years."

Part of the problem is that the fishermen feel isolated, ignored and demeaned. Less educated, less well off, less articulate and outnumbered, they take the only avenue they feel is open to them. For this reason, Javier Arano, producer of the park's television program *Reserva Viva* (Living Reserve), does what

he can to close the perceived gap in status by taking special care how he portrays fishermen on his broadcasts. "What we want to do is to show the fishermen at the same level as the tourism leaders and conservationists." he said. "We want to dispel the image that the fishermen are always either on strike or are playing cards at their wharf at Pelican Bay," he said. When TV crews from the mainland film fishermen in their hammocks in the afternoon, he said, they fail to explain to viewers that these same fishermen started work at four in the morning. "I will not interview a conservationist at his desk, and then a fishermen lying in a hammock," said Arano.

At meetings of the Participatory Management Committee, the fisherman representative is often the odd man out. This was clear the previous day, in a meeting room at the Galápagos National Park headquarters in Puerto Ayora. There, Eduardo Abudeye, president of the fishing cooperative on the island of Isabela, struggled to hold his own against a table of park officials, representatives of conservation groups, the head of a tourism association, and scientists. They were starting the job of fine-tuning the marine reserve management plan. Where could fishermen fish? Where could tourists land to see the seabird rookeries or swim with the sea lions? Where could dive boats anchor? These were touchy, territorial questions, and it was clear that Abudeye was very concerned about protecting the rights of his constituents.

Danulat loves science, but is less fond of negotiating with local leaders.

Later, in his office in Puerto Villamil, on the island of Isabela, Abudeye hammered home many of the points he had made in the meeting. When other participants called for stricter quotas, his response was, "We need some other way to earn a living." When they talked about patrols to keep an eye on the fishermen, he said, "We do our own patrols." When they insisted on the need to protect nature, he said, "First we have to protect people, so that the people can protect nature."

Eduardo Abudeye, president of a fishermen's cooperative, vigorously defends his constituency's interests.

All of this is frustrating to some members of the panel, notably the scientists. Eva Danulat, a German biologist who heads marine research at the Charles Darwin Foundation, led an ambitious project to produce the first compendium of marine biodiversity in the Galápagos. This highly detailed baseline study, thick with information about life cycles of nearly every creature found in the marine reserve as well as the human context in which they live, was compiled in just two years.

How does she like participating in meetings where she has to deal with representatives of the fisheries sector, such as Abudeye? "I'm a scientist," she said. "The language of diplomacy is not mine. I am impatient, and I want to deal with issues directly." She has learned that she must be cautious in what she says, for example, not speculating about the possibility of higher fishing quotas, which could raise expectations. "It is our responsibility to be very careful in what we say. In the fisherman's mind, we have not always kept our word."

Still, there are enough common interests to keep all parties coming back to the table. For example, although the fishermen continue to butt heads with the other user groups,

they are pleased with the prohibition against industrial fishing in the marine reserve. They knew that on the very day of the committee meeting, three rusty commercial fishing boats from the mainland that had been caught fishing in the reserve were sitting at the coast guard dock. Their captains were scheduled to appear before a judge.

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Despite the undeniable problems, participatory management is working. At the start of discussions on coastal zoning, the conservation sector wanted 100 percent of the reserve to be protected, the fishermen wanted to be able to fish anywhere they pleased, and tourism companies wanted to bring their clients anyplace they chose. Everyone was "tremendously opposed," said the WWF's Cruz. "It took a lot of effort to bring these people together." In the end, the board members got on a boat and traveled around the islands to see for themselves the sites in question. In this way, the fishermen came away with a better understanding of why prime spawning areas had to be placed off limits to fishing entirely to maintain stocks and ensure a future for their livelihoods.

Of course there have been failures. For example, the management plan called for a five-year fisheries calendar in which certain indicators would have to be met to be able to open or close a fishery. This past year, indicators showed a sharp decline in the sea cucumber population. The participative board could not reach a consensus to close the fishery, so the issue went to the Inter-Agency Reserve Management Authority. Once again, what should have been a scientifically based management issue turned political, and ultimately violent.

Cruz sees in the continuing problems not evidence of failure but of the need to continue the process. "We have to overcome the political problems, help the fishermen get more education and improve their lives," he said. "They are not bad people, they are not devils. They have a right to earn a living and eat, and we have to find ways to both protect the islands and improve their lives."

Three men and a boat

Will they catch enough fish to cover the cost of gasoline?

Fishermen on the Galápagos don't like to be told that they are the problem. They admit that some species in these biologically rich waters are disappearing. But how much is their fault? And what do conservationists and marine biologists know about fishing, let alone the struggles of being a fisherman?

Only reluctantly did Captain Jaime Asencio, of Puerto Ayora on Santa Cruz island, agree to let a visitor join his crew for a day on the water. "Be at the fishermen's dock at Pelican Bay on Sunday morning, at 6 a.m. sharp," he said unsmilingly.

His crew members were already there when Asencio arrived with an armful of supplies. They boarded his nine-meter *fibra*, a sturdy fishing boat made of fiberglass. Their first job was to wrestle seven big plastic drums on board, each containing 17 gallons of gasoline. Then Asencio tested his twin Yamaha outboards. He advanced the throttle to engage the props and steered around the moored boats. He didn't talk much, except to give orders.

He rounded a breakwater made of black lava and looked out at the gray water beyond. "The sea is angry," he said, zipping his waterproof jacket over his waterproof bib overalls. He turned north toward a towering rock islet far in the distance. There he hoped to catch albacore tuna and a sleek, mackerel-like fish called wahoo. He would need to land at least 300 kilos of fish just to cover the cost of the gasoline his motors would consume.

The sun had burned off the mist by the time he arrived at the island's sheer rock cliffs.

Captain Asencio (center) keeps his eye out for flocks of birds that indicate fish schools working below.

The *fibra* tossed in the squirrelly currents. All around, gulls and terns were wheeling and plunging into the water, picking up scraps of baitfish that a school of predatory fish had left in their wake. Then, one of Asencio's trolling rods bent in an arch. He set the drag on his big #50 Penn International reel and used its powerful set of gears to winch the fish in quickly. It was an albacore tuna, about an arm's length, glistening blue and iridescent in the sun. The crew member gaffed it and subdued it with a club before tossing it into the icebox. Asencio swung the boat around to make another pass, but the school had sounded.

By mid afternoon Asencio had picked up a few more fish, but it was clear that the twin outboards were draining the gasoline containers much faster than his crew was filling the fish chest. On one pass, a fish made off with one of his lures, a hand-painted Swedish import worth $25. Asencio decided that his only hope for making some money on this trip would be to spend the night bottom fishing for *pargo*, or barred snapper, a tasty fish that he hoped would command a good price.

The crew reeled in the lines and Asencio headed to shore to drop off his visitor. He wasn't very talkative. Maybe it was the bad fishing. Or maybe he suspected that his visitor was a conservationist, and the less said the better. But finally, responding to persistent questioning, he started to open up. He insisted that the Galápagos fishermen are merely doing what they know to put food on their table, clothes on their families' backs, and send their children to school. They need help, he said, not brickbats. For example, if the long-promised fish processing plant would finally go into operation, they could freeze their catch when prices were low and sell when the market improved.

Asencio knew about the Participatory Reserve Management Board, the group charged with drawing up a plan to protect resources within the newly minted marine reserve that encompassed the islands' waters. He heard that it was discussing alternative ways for fishermen to earn a living, such as working as tourist guides or park guards. He said he would serve as a guard while he was out fishing, "if they pay me." He is also interested in new capture techniques that would enable him to fish on the open ocean.

One option he doesn't consider is going on strike to protest catch restrictions. "Strikes don't achieve anything," he said. "We just want to work. When we can't work, people see us at the fishermen's dock on Pelican Bay, lying in our hammocks or playing cards, and they say, 'look at the lazy fishermen'."

Asencio considers himself a conservationist, and believes the data showing that certain species are in trouble. But he insists that "there's enough here for everyone, if we share it."

An albacore tuna gets an assist to the fish box.

Operation search and destroy

Inspectors battle ecological imperialism at airports and docks

It was an innocent mistake, and the tourist was clearly embarrassed. Before flying to the Galápagos, she had passed through Colombia, where a relative had given her a bag of fruit called feijoa. Now that same bag was in the hands of Lourdes Acosta, uniformed inspector of the System for Inspection and Quarantine of the Galápagos (SICGAL).

The tourist had just arrived at the airport on the tiny island of Baltra, the islands' main port of entry. She and her flight mates were clearly excited to be on these famed islands. They had paid the $100 fee to enter the Galápagos National Park, and were now watching as Acosta and the other inspectors went through their luggage. The inspectors' job was to look for any plant or animal that could conceivably get out into the wild. Such uninvited guests, arriving in a suitcase, a cargo hold, even on the sole of a shoe, are considered the greatest threat to the archipelago's famed ecosystems and its unique flora and fauna because of the potential of some of them to out-compete and replace native species.

In all likelihood feijoa trees would probably not have gained a roothold in the islands, but one never knows. This plant belongs to the same botanical family as the guava, a small tree esteemed throughout much of tropical America, for its fruit, which is turned into a flavorful, vitamin-rich jam. When introduced to the Galápagos, however, the guava proved to be too much of a good thing, and today these low-lying trees occupy more than 40,000 hectares of land on four islands. Farmers hate them because they invade pastures and fields. And conservationists are alarmed to see dense guava forests replacing three unique highland vegetation zones in Galápagos National Park.

Inspector Acosta intercepted a bag of forbidden fruit, saving the islands from a potential new pest.

Acosta wrote up a report on the feijoa incident and sealed the bag, wrapping it round and round with meters of tough plastic tape. The fruit, along with other confiscated products, would be incinerated.

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After centuries of nearly unrestricted immigration of alien plants and animals, Acosta and her coworkers are now putting the squeeze on newly arriving organisms whose spread could further jeopardize the Galápagos' biological integrity. The program is part of a new quarantine system that began operations in 1999 as part of the Galápagos Environmental Management Plan.

Although still in a learning curve, the SICGAL team has succeeded in blocking the entry of some potentially dangerous biologi-

cal invaders, including an aggressive species of grass, an insect that is currently destroying mangroves on the mainland, and a fruit fly that could have damaged the islands' mango trees (themselves alien species, but of an earlier vintage). Inspectors have also intercepted a number of larger animals that could have gained a foothold here, such as crabs, mollusks, and even a hapless rabbit.

SICGAL is also carrying out training programs and community education, as well as establishing new inspection offices in airports and docks and a headquarters building in the town of Puerto Ayora, on Santa Cruz island. The new building, whose volcanic rock construction helps it to blend with the natural landscape, was inaugurated by then IDB president Enrique V. Iglesias.

Tourists generally accept the increased security measures with understanding and good humor, says Franklin Falconi, who heads the Ecuadorian Agricultural Health Service Operations on the Galápagos, which includes SICGAL. Most are seasoned travelers who have endured countless airport searches by steely-eyed officials looking for bombs, knives, and weapons of mass destruction. They don't get upset at having to give up a bag of fruit.

The inspectors' job is not limited to the airports. They also poke around in the cargo holds of boats, and not just in containers of fruits and vegetables. According to Falconi, even a box of books will invite their scrutiny, because it could contain cockroaches. Nor are inspections limited to items arriving from the mainland. The SICGAL inspectors keep an eye on shipments between islands as well.

Former IDB president Enrique V. Iglesias inaugurates a new inspection and quarantine station on Santa Cruz.

When inspectors find a prohibited item they do not fine its owner. According to Falconi, the nonpunitive approach helps to reduce bad feelings and resistance.

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Ironically, the Galápagos' scientific value is largely owed to the relatively recent arrival of the ancestors to all plant and animal species that currently inhabit the islands. Hitching a ride on logs or floating mats of vegetation, these evolutionary pioneers from the mainland adapted to their new environment and went on to evolve into varieties and eventually new species altogether. Charles Darwin's astute theorizing on how this happened has contributed enormously to our understanding of how evolution works.

But it was the arrival of humans in 1535 that sparked a veritable avalanche of newcomers. In the centuries after the landing of a Spanish bishop and his crew, the pace of ecological imperialism acquired new orders of magnitude. Later settlers brought with them a complete agricultural kit of plants and animals, not to mention unintended stowaways, from snakes to microbes. Many of these invader species pushed out endemic populations, in some cases to the point of extinction. And today, fishermen—also recent arrivals—are locking horns with conservationists over efforts to control overfishing of the sea cucumber and other marine species in the Galápagos waters. Never the tidy little laboratory of evolutionary change of popular imagination, the Galápagos' ecosystems today face increasingly rapid change and disruptions.

Heading the most-wanted list of invasive species is the smart, nimble, adaptable

goat. Originally introduced for food, these voracious animals have stripped whole mountainsides of vegetation, leaving the islands' emblematic tortoises without food or shade. On the island of Baltra, goats, along with airport construction, resulted in the demise of a subspecies of land iguana that occasionally reached five feet in length. Over the past three decades, the Galápagos National Park, with the support of the Darwin Research Station, has eliminated goats from five islands. On Isabela Island, the largest of the Galápagos and home of the archipelago's largest number of endemic species, an original herd of goats estimated at 150,000 on the island's north lobe has been reduced dramatically through air patrols and sharpshooters using scoped .223 rifles.

Although it is expensive to prevent new species from arriving on the islands, it costs far more to attempt to control or eradicate them after they have become established. For example, about $1 million from the IDB's sustainable development loan was used to strengthen measures at airports and docks to keep out new arrivals. Meanwhile, a grant of $7 million from the Global Environment Facility (GEF) is being used to eradicate goats.

Also high on the Galápagos search and destroy list are feral pigs that eat tortoise eggs and young. Rats eat tortoise eggs too, and have killed every hatchling on Pinzón for the past century, reducing the island's tortoise subspecies to a geriatric-age population. Cats wreak havoc among bird and iguana populations. In the late 1970s, wild dogs on Santa Cruz Island killed more than 500 iguanas in a single attack.

The ani, a large black bird appreciated on the mainland for its appetite for ticks on cattle, preys on the nestlings of Darwin's finches. Meanwhile, these same finches feed on the fruit of introduced and rapidly spreading blackberry bushes, in the process broadcasting its seeds in their droppings.

At the micro end of the faunal spectrum, aphids, wasps and fire ants have spread far and fast. The cottony cushion scale, which first appeared on San Cristóbal in 1982, is attacking native plants on 10 different islands. Hundreds of new species arrive each year. Most do no harm, but any one has the potential of being the serious pest of the future.

Falconi is proud of the success of the fledgling inspection system. Noting that invasive species are still less of a problem on the Galápagos than on the mainland, Falconi says, "We want to keep it that way."

"Judas" goats help to betray the location of their feral equivalents, aiding in the eradication campaign.

Something fishy

A confiscated bag of shark fins proves that laws can work

A man in a camouflage uniform carrying a heavy plastic bag shouldered his way through a line of tourists at the airport on the island of Baltra, the main point of entry for the Galápagos.

Franklin Falconi, Galápagos coordinator for Ecuador's agricultural health services, poked the bag with his finger. "Shark fins," he said. They had been cut from animals that were probably still alive and flopping on the deck of the fishing boat. The rest of the carcasses—some 98 percent of the fish—was thrown back into the sea. The practice is condemned around the world by conservationists and animal rights advocates for its cruelty and wastefulness and is outlawed in many places.

But one person's contraband is another person's soup. The fins, dried and cleaned, are a source of collagen fibers. Although the fibers have little flavor or nutritional value, they are the essential ingredient in a brew that is sold in Asian restaurants for as much as $100 per bowl.

The practice of shark "finning" is strictly prohibited in the Galápagos Marine Reserve that was established around the Galápagos in 1998. Even so, many fishermen cannot resist the high prices they are offered by middlemen.

The guard carrying the bag of fins was a member of the Environmental Unit of the National Police. The fins were confiscated from one of three mainland-based boats apprehended in the reserve during a routine patrol. The patrols are being stepped up with the help of boats and equipment purchased as a part of an IDB-financed environmental management plan for the marine reserve.

A bag of shark fins will be used as evidence against a boat captain caught fishing in the marine reserve.

Down at the dock, the offending boats were tied up in a row, their crews out of sight down below. The officer in charge at the guard station confirmed that the captains had been taken to Puerto Ayora to appear before the local judge to plead their case. Clearly, they were operating within the marine reserve. But were they actually fishing there? And had the shark fins been taken from reserve waters or from elsewhere? This was for the judge to decide.

While the bag of fins made a sorry spectacle, it was evidence that the laws designed to protect the marine reserve can work. Some of the regulations are controversial. But others, such as the ban on fishing boats not based in the Galápagos, are popular with local residents, who see them as essential to reducing pressure on marine resources and putting the islands' fisheries on a sustainable basis.

New trails for tourists

Local people will be more interested in protecting the islands' natural attractions if more tourist dollars come their way

Far in the distance, past the lava flows and across the pastel blue of Elizabeth Bay, a sleek cruise ship lay at anchor. A group of tourists, just visible through a pair of binoculars, fanned out along the shore. They may have been visiting a colony of nesting sea birds or observing marine iguanas, or maybe just looking about, wonderstruck to be walking in the footsteps of Charles Darwin.

A Galápagos cruise is an adventure of a lifetime. But while tourism on the Galápagos contributes $150 million to the country's economy annually, only 20 percent of that actually goes into the pockets of people on the islands themselves. As such, many local people are not impressed by arguments for conserving the islands' famous natural attractions on which the tourism industry depends.

"At present, *Galapagueños* receive limited benefits from conservation," says Steven Stone, IDB environment specialist in the Bank's Quito office. "Therefore, there is limited demand for conservation in the Galápagos."

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Most Galápagos tourists don't get much closer to community members than the tee shirt vendors they pass on their walk to the Charles Darwin Research Station. As a rule, tourism on the islands is carefully scripted. After arriving at the airport on the tiny island of Baltra, tourists hop a bus and then catch a ferry to the next-door island of Santa Cruz. Another bus takes them to the town of Puerto Ayora, where they get a quick look at a city park featuring Jurassic-size sculptures of Galápagos

A thin line of tourists on Isabela Island's Sierra Negra Volcano provides an accent to the landscape's stark beauty. Few see this "other" Galápagos.

wildlife before heading out to their cruise ships. From then on, nearly everything they need—guides, food, entertainment—comes out of the ship's storeroom. And most of that comes from the mainland, even the fish they eat for dinner. Few tourists venture out on their own and book a room at a local hotel. Fewer still strike a deal with a local guide to sample sights off the beaten path.

How to give community residents a greater economic stake in tourism is an important agenda item in meetings of the Galápagos Participatory Reserve Management Board, a group made up of local interest groups that is drawing up an environmental management plan for the Galápagos Marine Reserve. Represented are scientists, park officials, fishermen, conservationists, and tourism entrepreneurs. Each sees conservation differently, but all agree that making tourism an integral part of the local economy will help give *Galapagueños* a real reason to help preserve the islands' natural heritage.

One way to benefit local residents from tourism is to get more tourists to use community-based services, such as guides, tour agencies, boat operators, etc. Equally important is linking the local productive economy to the existing large-scale tourism sector as a supplier of goods, the objective of a program financed by the IDB's Multilateral Investment Fund (MIF). In the program, fishing and agricultural cooperatives are learning to improve the quality of their products to meet the standards demanded by the big tourism operators as well as how to market their products to them.

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Pablo Gordillo is convinced that tourists who visit his fishing community of Puerto Villamil (pop. 2,000) will not be disappointed. "We have flamingos ten minutes from my office, we have great places for diving, we have volcanoes, we have wetlands," said Gordillo, who

Most visitors to the Galápagos see the islands as passengers on cruise ships. Few travel on their own.

is the town's mayor. "We have attractions that most visitors hardly ever see."

But he knows that attractions on their own are no guarantee that tourists will come. "The touring firms say that they don't visit Isabela because our transportation is bad, or because our restaurants don't give good service or that we don't have other facilities," he said. "So let's sit down with the tour companies and with the Galápagos National Park, and have them tell us what we have to do. We will do our part. But then [the tour companies] have to do their part and send tourists."

He believes that tourism will help to ease pressure on marine resources. "Today, the farmer comes down from his fields, the student leaves school, and they all go fishing, because that's the only option they have," he said. "Without a doubt, well-managed, responsible tourism is a way out of the problems and conflicts we have today."

Gordillo acknowledges that local governments such as his must take the lead in making Puerto Villamil more tourist-friendly by providing such basics as decent roads, clean water, reliable electricity, and sanitary services. Improvements are already underway in Puerto Villamil, and the mayor himself was inspecting construction sites where workers were

Isabela Island's flamingos pose as living lawn ornaments in the middle of Puerto Villamil.

building a new sewerage system. It was one of a series of municipal works being carried out in Galápagos' three main towns with support from the sustainable development program. In addition, municipal staff are being trained to improve financial management and their ability to carry out public works projects.

Puerto Villamil's private sector also needs assurance that tourists will come before it can invest in hotels and restaurants. So far, the big touring companies have not shown much interest in Puerto Villamil as a destination, Gordillo said. This worries him: "If they are not interested in coming here, then the *Galapagueños* will conclude that tourism is not a realistic alternative, and everyone will go fishing. There will be more trouble, more strikes, more bad publicity, and this will come back and hurt the tourism sector. "People and conservation would be very good allies if conservation involves the people in the benefits that tourism generates," he concluded.

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Just as Gordillo promised, the flamingos were on view a short drive from his office, happily feeding in shallow ponds bordered by houses. At the wheel was Oscar Mauricio Carvajal Mora, a park ranger stationed on Isabela, who would show his visitor a sampling of his islands' attractions.

Carvajal continued down the seaside road and into the national park, past opuntia cactus, volcanic caves and secluded beaches. He turned in at the tortoise breeding station. There, in concrete enclosures, hundreds of the islands' famed but threatened reptiles live under the solicitous care of park personnel, safe from rats, pigs and other introduced animals. After they have grown big enough to fend for themselves, the tortoises are released onto private farms as a kind of halfway house. Eventually they will be released into the wild.

Leaving the breeding station, he passed a series of trails marked with signs and legends that described the various coastal ecological zones. To anyone familiar with United States National Parks, the signs looked as if they could have been designed by a Park Service employee—which they were.

Dusk was beginning to fall when Carvajal reached the end of the road. He stopped

Mayor Gordillo checks on the progress of his town's sewerage system, being built with tourists in mind.

Despite the menacing visage, the famous Galápagos tortoises are peaceful and vulnerable.

before a towering wall built of blocks of lava rock. This was the famous Wall of Tears, part of a 1940s penal colony built by the prisoners themselves. Carvajal recounted stories of the cruelty of the guards, the attempted escapes and a failed rebellion.

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Beyond birds, lizards, and even its colorful historical past, tourists will soon be able to choose among new attractions that will not only draw more visitors, but also provide opportunities for local people.

Fernando Ortiz believes that sport diving has a great future on the Galápagos. "Divers stay in local hotels, eat in restaurants, spend money in the communities," said Ortiz, who heads the islands' 25-member Tourism Council and serves on the Galápagos Participatory Reserve Management Board. Sport fishing would also draw more visitors.

Ortiz also hopes that the islands' fishermen, at least some of them, could earn their livelihoods from these new activities. But it won't be easy to turn fishermen into tour guides. For one thing, it will cost them a great deal to upgrade or replace their boats to meet the expectations of a demanding clientele. Where will a poor fisherman find the $60,000 needed to buy a new boat, motor and equipment, asks Eduardo Abudeye, president of the Isabela Fishermen's Cooperative.

Jorge Meza, who heads the IDB-funded environmental management program, agrees that special lines of credit would have to be offered to fishermen to help them gear up to enter the tourism sector. But in addition, fishermen would have to be trained in the delicate art of guiding tourists, with all their demands, quirks and expectations. How many fishermen have the requisite people skills, the necessary tact and diplomacy, let alone the discipline just to show up on time? "It would be very naive to think that we're going to employ all of these fishermen in the tourism sector," he said. "So we have to accept the fact that most fishermen will continue being fishermen," he said. As such, the program must not lose sight of the need to help them get the equipment, training, and institutional support they need to fish better and on a more sustainable basis, he added.

"In the end," said Ortiz, "the people who live here have two options: fishing or tourism." While the management plan may help to make fishing sustainable, fisheries resources will always remain limited. "Tourism," concluded Ortiz, "is the future of development here in the Galápagos."

View from a volcano

Tourists who venture off the beaten path will take away memories while leaving money in the pockets of local people

"It's a special race of horse," guide Richard Vokes said without a hint of irony.

He explained that the small and bony mount he was steadying for his client descended from horses that escaped from English pirates in the 17th century. Vokes also warned that these horses have a peculiar jerky gait, a fact that would become palpable on the ride up to the rim of the Sierra Negra Volcano, on the island of Isabela, the Galápagos' largest.

The day had begun bouncing along in a pick-up truck, past overgrown farms and patches of woodland. As the truck climbed higher, the fog sweeping in from the south grew denser, producing a kind of precipitation just short of rain. Around a bend the fog parted to reveal a herd of horses, their wranglers strapping on saddles and bridles. The visitor sloshed through the mud and manure and dubiously mounted the small creature that Vokes was steadying for him.

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As he led the way up the volcano, Vokes proved to be an expert in the area's ecology and geology as well as a colorful figure in his own right. He loves working as a guide, which he does about three times a week. He also relished telling of his adventures as a member of the Park Service's goat extermination crews and of his solo forays into the brush to hunt feral pigs, armed only with a knife and wearing football padding on his legs for protection against the enraged animals' tusks.

Galápagos guide Vokes points out features in the volcano's mist-shrouded caldera, one of the world's largest. The islands were formed by volcanic activity.

The son of what he described as a hippie from Philadelphia and an Asuar Indian woman from the city of Cuenca, Vokes early on concluded that learning English would be his ticket to the future. He got a dictionary and immersed himself in English-language television. At the Darwin Research Station, on the island of Santa Cruz, he learned about the islands' natural history. As he grew up, his father, a tattooed blues musician nicknamed Gringo Jack, would disappear from his life, only to reappear later. Vokes sells CDs of his father's group, called the Iguanamen, to help defray his father's medical expenses.

The daisy-like Scalesia appears in many Galápagos habitats and guises.

One of just a few guides on Isabela, Vokes is an example of how local tourism can put money in the pockets of local people. In this case, the tourist took away unforgettable memories, but also left something important behind: $40 for the owner of the pickup that took him to the end of the road, $10 for the owner of the horse, and $50, plus a generous tip, for the guide himself.

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Now the little horses were skirting the volcano's rim. The caldera, reputed to be the second largest in the world, was alternately obscured and revealed as clouds swept over the south edge of the rim and poured down the slope to the floor below. Vokes named some of the native plants, mostly low-lying shrubs.

He also pointed out broad expanses of guava trees, so thick it would take a machete to hack one's way through them. These were introduced by early settlers who hoped to turn their fruit into a cash crop. But the trees would not stay confined to their orchards, and now the guava has become a major threat to the islands' native plants and animals.

Vokes and his client continued along the volcano's rim, eating guava fruit and spitting out the seeds, probably abetting their further dispersal. Abruptly, the cold mist gave way to a bright blue sky and searing heat. They had entered a "rain shadow." In a pattern repeated throughout the Galápagos, the winds push air up the south side of the volcano, where they drop their moisture, leaving the north side a scorching desert.

The horses headed for the shade of a soap tree, whose sap the early settlers used for washing clothes. From here on, said Vokes, they would have to go by foot, because the sharp volcanic rock would cut through the horses' unshod hooves just as he predicted it would destroy his client's running shoes.

The landscape turned into a panorama of lava flows, cascades and caves. Deep shafts lined with moss and ferns disappeared into the rock like missile silos. Everything that molten lava can do, it did here.

On the return trip, Vokes suggested that next day he and his client could go snorkeling with hammerhead sharks. Not a bad way to get away from it all.

Vast lava fields, practically devoid of plants, provide palpable evidence of the islands' fiery origins.

Fishermen demand respect

Conservation is fine, but putting food on the table comes first

One of the world's preeminent biologists has speculated that people have a natural affinity for living things. The biologist, Edward O. Wilson, calls this affinity "biophilia."

But for the fishermen of the Galápagos Islands, biophilia takes second place to more practical concerns, such as making ends meet. They are no different from poor people anywhere, for whom the esoteric notion of protecting nature runs headlong into the need to extract a living from whatever natural resources lie at hand.

For Galápagos fishermen, making a decent living means harvesting high-value but increasingly scarce species, such as the sea cucumber. When conservationists claim that these species are already overharvested and urge drastic catch reductions or prohibitions, the fishermen protest. At least among the more militant, the resentment periodically boils over into strikes and even acts of violence.

A representative of the fisheries sector sits on the Galápagos Participatory Reserve Management Board, which is charged with drawing up a management plan for the islands' marine reserve. The other members are scientists, park managers, and leaders of conservation and tourism groups. These conservationist-minded members of the Galápagos community inhabit a different world than that of their fisherman colleague. Highly educated, politically connected, well traveled, articulate, and often backed by big, powerful institutions, expressions of biophilia come more naturally to them. At coffee breaks they speak languages the fisherman does not understand. They pass around reports full of mathematical formulas.

Galápagos fishermen's cooperative President Abudeye defends his members' rights to earn a living from the sea. He also points a finger at the tourism industry.

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Eduardo Abudeye, president of the 200-member Fishermen's Cooperative on Isabela Island, represents the fisheries sector on the participatory board. His mandate is to defend the interests of people who have been vilified not only in conservationist circles, but even in the international press. He feels beleaguered and besieged, convinced that the deck is stacked against him.

Abudeye is angry. Being constantly on the defensive at the negotiating table is bad enough. But there is more. He recounted a visit by a team of European journalists. "They invited a group of fishermen for a beer, and then they all went down to the dock to take photos. Everyone was happy. Then two months later a copy of their publication arrived. The headline over the photo read, 'Ecological terrorists'."

It hurts to have a bad image. But in the end, Abudeye said, "You don't eat an image, you eat from your work." His real problem is what he considers lack of power, particularly compared with what he describes as the "men in white suits" who control the large-scale tourism sector. Unlike the fishermen, they have the economic and political clout to get what they want. And he resents this. "There are scientific studies that show that tourist cruise boats do the most damage in the marine reserve," he said. "But nobody wants to talk about this."

He also charges that some cruise boats take their customers sport diving, an activity presently prohibited in the marine reserve. "So where is respect for the law?" he asks. In contrast, when an individual fisherman is caught illegally harvesting sea cucumbers, "all of us are denounced."

He concluded, "The day that representatives of the fisheries and the tourism sectors sit at a negotiating table, and discuss what are the best options to protect the Galápagos marine reserve, without either side having an advantage over the other, that is the day when our problems will end."

A heroic portrayal of a Galápagos fisherman belies the true status of the men who harvest these waters.

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And what about Edward O. Wilson's biophilia? Clearly, Abudeye has other things to think about than reverence for nature. But always the optimist, Wilson would probably point out that the fishermen spend their lives in personal contact with nature, and that their success depends on knowledge that cannot be acquired from books and in meeting rooms. If at some point their understanding of nature also assures them a secure living, a genuine conservation ethic may well emerge. Don't confuse means with ends, argues Wilson. "For what purpose," he writes, "did human potential evolve?"

Modern enigmas in the land of the ancient Mayas

Can Guatemala's fast-changing department of Petén expand economic opportunities while protecting its natural and cultural heritage?

Things are often not what they seem in Guatemala's northern department of Petén. Consider the little herd of cattle owned by Carlos Humberto Portillo, a grizzled farmer with a twinkle in his eye.

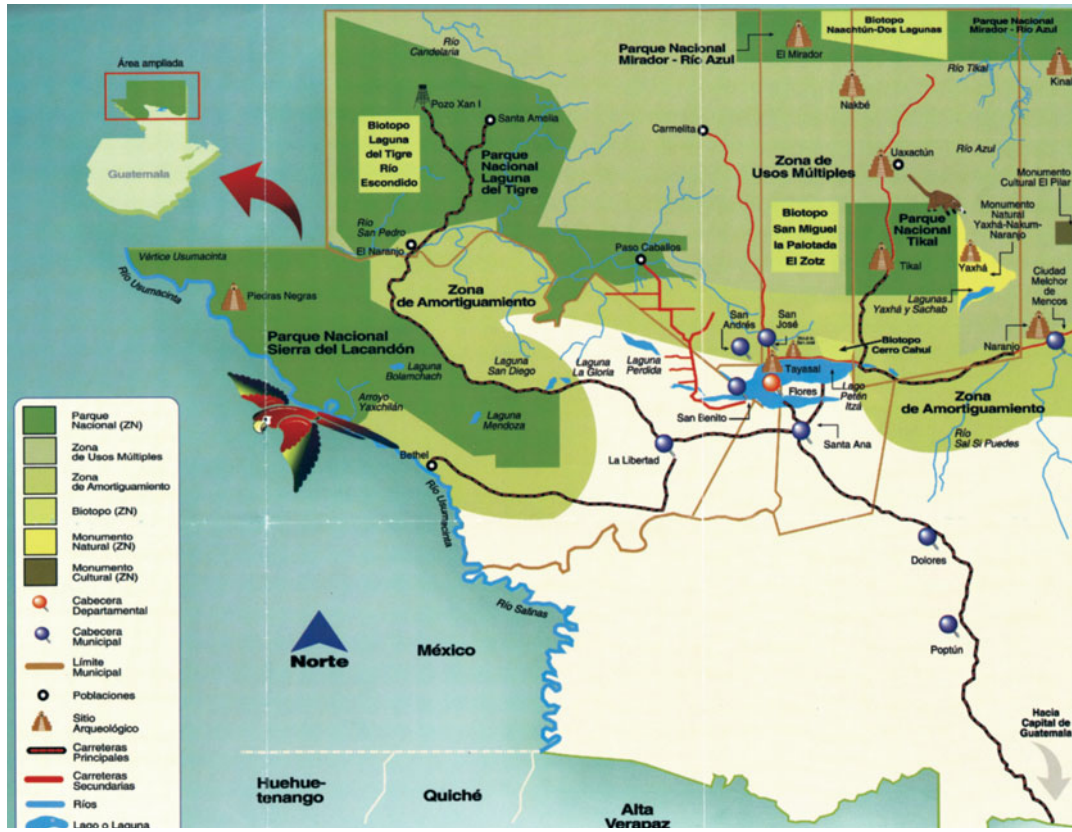
Leaning on a fence post, Portillo described what sounded like the typical small farm anywhere in Latin America. Along with his cattle, he raises some corn and beans, the staple crops in these parts. A little pond and a patch of forest complete the pastoral landscape.

But there is something unusual about Portillo's farm: It is one of many located within the boundaries of the Sierra del Lacandón National Park, a forest preserve. And where is the forest? Portillo gestured toward some distant hills. "A long way away," he said.

Sierra del Lacandón is one of a smorgasbord of parks, buffer zones, archeological sites, multiple-use areas and other categories of protected land in northern Petén. Many are part of the 15,553-square-kilometer Maya Biosphere Reserve. They all appear on a map prepared by Guatemala's National Council for Protected Areas (CONAP, after its initials in Spanish). Each category of land use appears in a different color, and sprinkled throughout are little triangles, which represent some of the thousands of Mayan ruins.

But like the Sierra del Lacandón Park itself, the CONAP map cannot be taken at face value. Most maps attempt to show how things are. This map is an expression of how things should be. Many of the protected areas shown so confidently are in reality scenes of struggles among competing interests—established residents, new settlers, tourism operators, conservationists, even archeologists. The map may look reassuringly definitive on the wall of a

Farmer Portillo raises cattle in a national park—with no apologies. He is also proud of the monkeys in his forest.



A map of Guatemala's department of Petén is both more and less than the colored areas would indicate.

government office. But in the field, where the situation is fluid and the future uncertain, the colors often run together and sometimes disappear entirely.

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Another way to get an idea of what is happening in Petén is to take in the view from the top of Temple 216 in the vast Mayan ceremonial center of Yaxhá.

From the temple's limestone aerie you can look out over a lake surrounded by an unbroken canopy of trees punctuated by the tips of other temples, gleaming white in the harsh sun. Far off rises a plume of smoke where a farmer is clearing a field for planting.

The view from the summit of Temple 216 reveals both the grandeur of the ancient Mayan civilization and the challenges confronting the area's present-day inhabitants.

By 900 AD, Yaxhá's more than 500 structures and networks of streets and plazas had been abandoned. Most experts believe that the people themselves simply moved elsewhere, where their descendents continue living today. But what happened to this extraordinary civilization, with its elaborate cities, fortifications, roads, art, ceremonies, and complex social and political systems? Although still a subject of debate, the consensus is that the ancient Mayas fell

victims to a combination of factors, including deforestation and increased erosion, leading to reduced food supplies, cycles of warfare among competing rulers, and eventual collapse of a complex and remarkable civilization.

In short, it appears that the ultimate cause for the Mayan collapse was a series of bad environmental management decisions. In today's Petén, increasing numbers of settlers in search of land and livelihood could set off yet another cycle of deforestation and natural resource degradation.

Perhaps 1,200 years ago, some geographically inclined Mayan intellectual saw what was coming and tried to warn his rulers. But certainly today, many are sounding the alarm about the dangers confronting Petén, and many are taking action.

The biggest and best funded of these initiatives to protect Petén is headquartered in a little cluster of buildings on a dusty road bordering Lake Petén Itzá. Here, members of a special unit in Guatemala's Ministry of Agriculture are moving forward on a series of interrelated projects to both improve living standards and safeguard the region's resources and biological diversity. Called the Petén Sustainable Development Program, the initiative is being financed with the help of $19.8 million in loans from the Inter-American Development Bank.

The program's four components were chosen to slow down the process of environmental degradation and reversing damage already done. They are:

- Legalization of land tenure for some 4,500 families.
- Protection and restoration of archeological sites and promotion of tourism.
- Promotion of small agricultural and forestry projects.
- Strengthening public institutions, including Petén's municipalities and grassroots organizations.

Cofiño tries to balance the necessary with the possible.

Heading the sustainable development program is Eduardo Cofiño. A cosmopolitan businessman and long-time resident of Petén, he appreciates how the department's problems stem from a volatile mix of geographical and historical factors. Principle among them is demographics.

Until not many years ago, he explained, Petén was a vast, virtually empty wilderness of scattered villages and homesteads. Representing one-third of the country's territory, the department still has a population of only 390,000, compared with 12.5 million in the remainder of the country. So for land-hungry settlers from the densely populated highlands, Petén seems like an "empty" frontier. Adding to this impression, the 1996 peace accords ending Guatemala's 36-year civil conflict promised ex-combatants land where they could lay down their arms and pick up a plow. Many came here.

"Petén has been the safety valve that has prevented a real social revolution of all against all in the rest of the country," said Cofiño. As a result, he said, the department's population has been growing at a rate of more than 9.9 percent, versus 2.9 percent for Guatemala as a whole.

About one-third of Petén's population is indigenous, primarily Kekchi, originally from the department of Alta Verapaz. Their former homeland is admirably suited for growing corn, an annual crop. But not so in Petén, where soil and climate call for permanent crops that protect the soil year-round.

What is more, said Cofiño, even people who consider themselves to be original Petén

Economic refugees from elsewhere in Guatemala come to Petén in search of land and hope for the future.

residents, or *peteneros*, often have grandfathers or great-grandfathers who came from Belize, or Mexico, or southern Guatemala. "It's not an area where people have lived for many generations and who love their land and know how to work it," said Cofiño. "Petén is populated by adventurers—and I am one of them," said this capital city transplant. "It's a very difficult department to work in."

Reducing migration into Petén would help to solve many of the department's problems. So would education. "People have to learn why it is folly to continue to have large families," said Cofiño, "and also how to limit the number of births."

The rapid influx of newcomers is not only putting pressure on the land, but on local authorities as well. "The main problem in Petén is the lack of strong government institutions," said Cofiño. Neither the local municipalities nor the departmental government can provide basic services and enforce the law to the extent required. Weak law enforcement, particularly in remote areas, has resulted in virtual no-man's lands. Parts of Petén's protected areas have been used as staging grounds for trafficking in narcotics, arms, illegal aliens and archeological treasures. Even agricultural products, such as cattle and corn, move across borders unregulated and untaxed in a kind of de facto free trade zone.

Local nongovernmental organizations, acting as the sustainable development program's co-executing agencies, are teaching farmers alternative techniques and new crops that will both conserve the land and improve earnings. The strategy is to create economic opportunities in the southern part of the department that will induce people to stay there and not move north where they would threaten the remaining forests and archeological sites. "This is the theory," said Cofiño.

One such activity is cattle raising, ordinarily considered the scourge of the natural environment. Cofiño claims that any production system that protects the ground with perennial plants is worth promoting. "Cattle raising by itself is not bad; it all depends on how it is done," he said. The same holds for forestry: It depends on how it is done. If local people find that they can make good money by leaving a forest intact and harvesting only a few trees per hectare on a rotating basis, they will resist the natural inclination of farmers to turn it into cropland. Similarly, honey production gives economic value to flowering plants in abandoned lands and nearby forests for an additional source of income.

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While the sustainable development program increases economic opportunities in southern Petén, it also is laying the groundwork to increase tourism in the protected areas in the north by restoring archeological sites and building basic infrastructure for visitors.

Tourism is Guatemala's number one earner of foreign exchange, and Petén's famed temple city of Tikal attracts more than 120,000 visitors annually. But most of them see no more of Petén than this one site. There are so many more places to visit, says Cofiño. Petén has more than 380 archeological sites in addition to some 60 outstanding natural sites rec-

ognized by the World Tourism Organization. "There are few places in the world that have so many things to see in such a small area," said Cofiño. "You could visit a site every day of the year and never go to the same one twice." More attractions would give visitors an incentive to spend more time in the area, staying in local hotels, eating in local restaurants, using local guides, transport services and other businesses.

The striking differences between the two archeological centerpieces of the Petén Sustainable Development Program illustrate the variety of attractions awaiting future tourists. Yaxhá, a relatively short drive from the departmental capital of Flores and close to famed Tikal, is a vast complex of structures set in the middle of a luxuriant forest with a lake as a backdrop. More isolated Aguateca sits on a bluff overlooking a river. It is believed to have served as a fortress that took defensive advantage of a spectacular geological fault. In both sites, architects and archeologists are working to restore structures with an accuracy and respect for ancient techniques that is setting new standards in the field.

How long does it take to stabilize a highly fluid, even tumultuous region such as Petén to the point where protecting natural areas and sustainable agriculture are realistic possibilities? Certainly not four years, which is the official lifespan of an IDB-financed project, said Cofiño. The Petén project was now in its seventh year, and he was neither apologetic nor concerned. He blamed neither the program's original design nor the government for the delays. "We are doing something very new," he said. "The only mistake was to think the program could be implemented in four years, which was not possible."

Art with a machete

The plants looked elegant even in their natural state, their lanceolate leaves rustling in the afternoon breeze. But they lacked some finishing touches demanded by their ultimate Dutch purchasers, namely a clearly defined "trunk." So the farmers complied by delicately trimming off the plants' lower leaves.

The field where they were growing, in Guatemala's northern department of Petén, would ordinarily be used for corn or beans. These traditional staples are harvested annually, and every year the farmers burn the fields to prepare the land for the next crop, a practice that quickly wears out the soil. In contrast, these ponytail palms (*Beaucarnea guatemalensis*) are grown and harvested over a longer time period. As such, their cultivation is easier on the soil. Their sale also yields more profits.

An El Arbolito farmer sculpts a ponytail palm.

The ornamental plant project is being carried out by the Centro Maya Association, a private nongovernmental organization that works with the Petén Sustainable Development Program. A large-scale grower has already promised that he will buy all the plants that the farmers can produce.

Eco-friendly cattle raising?

A national park's checklist of resident mammals normally does not include cattle, but there are exceptions in Guatemala's department of Petén

Lean and weathered, hats in place, the farmers gathered under the trees in front of a humble ranch house. A dog wandered through their ranks, sniffing, and a male turkey strutted for the hens, who ignored him.

The farmers were discussing the first results of an intensive system for raising cattle. Widely practiced elsewhere, it is being introduced here as a way to earn more from their land and at the same time protect the environment.

It looked like a scene from anywhere in Latin America. But this was Petén, Guatemala's northernmost department, a land of controversy and contradictions. There was more to this scene than was immediately apparent.

Farmers tell technical experts how they are faring in their first experience with intensive cattle raising. Their aim is to boost profits and conserve soil.

The fact is, the road running past the farmhouse where the men had gathered marked the boundary between the Sierra del Lacandón National Park and a buffer zone established to protect the park. Some of the farmers had their land and cattle operations on one side of the road—in the buffer zone—and some on the other side—squarely in the park.

The idea of people living in parks is out of the question in many countries, such as the United States. But it is accepted in many places in Latin America, where people already living in newly declared protected areas remain to continue their traditional practices, collecting

forest products, such as rubber, chicle, spices, medicinal plants and other products, as well as hunting and fishing. But cattle ranching? Throughout the tropics, the expansion of cattle raising is a major cause of deforestation and loss of biodiversity.

In some places, protected areas are invaded by land-hungry farmers who view the "empty" forests as an invitation to expand the agricultural frontier. But such is not the case with this group of farmers. They were already established before the park boundaries were drawn up. In addition, according to some experts, cattle raising does not necessarily have to be the bane of biodiversity. It can be done in a way that protects soil and water resources. Unlike annual crops such as corn and beans that are grown on bare earth that is exposed to harsh sun and pounding rain, pasture consists of perennial plants that cover and protect the soil and interlace it with their root systems.

Maybe not such an environmental scourge after all, according to some.

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The farmers were meeting with their technical advisor, a representative of the Defenders of Nature Foundation. This nongovernmental group, one of six co-executing agencies that work with the Petén Sustainable Development Program, taught the farmers the basics of intensive animal husbandry. In this system, the rancher fences in four pastures of a half hectare each. He puts up to six cows in the first pasture, and when they finish the grass there, he moves them to the second, and so on. In the dry season, when the grass goes dormant, the animals are fattened for sale on a mixture of chopped hay, grain and molasses.

Each of the 29 participating cooperative members receives a $1,866 loan to purchase pasture seed, barbed wire and medicines, plus four steers for eventual sale and one cow for breeding. The animals gain about one pound daily on pasture, and four pounds daily on the concentrated feed. In eight months, they double their weight and reach the marketable size of 1,000 pounds. The rancher sells them for about $2,600, earning a profit of some $800.

The new system is more efficient than putting the cattle in large fenced areas, where the animals tend to spend a lot of time walking around the perimeter, trampling the soil and losing weight. In addition to raising the farmers' incomes, the program has the broader aim of increasing production on land now under cultivation as a way of stemming the need to colonize presently forested areas.

Farmer Carlos Humberto Portillo led a tour of his property, which is in the national park. He showed off his cows and also his live fence posts, which were sprouting with leaves that Portillo will use as forage. Portillo culls the fence posts from his two hectares of forested land. He receives the equivalent of about $660 annually per hectare from the government to leave this forest standing. He also gets something else from his miniforest: contact with nature.

He proudly told his visitors that he has six howler monkeys on his land as well as some spider monkeys. "These animals live like us," he said. "We get enjoyment from seeing them, not eating them."

Sweet profits from wildflowers

If bees like natural areas, then so do their keepers

The hike to the cluster of beehives led through what appeared to be abandoned land, a tangle of brush and small trees, many armed with sharp spines. But to the property's owner, Mauro Hernández Flores, if his bees liked it this way, so did he. As he explained, this vegetative potpourri, a mix of many different species that bloom throughout the year, ensure a continual source of nectar for the residents of his 35 hives.

Chopping a pathway with his machete, Hernández Flores led his visitors to a small tree with bunches of yellow flowers. The tecomasuche bush (*Cochlospermum vitifolium*) was a particular favorite with the bees, he said. The honey produced from its flowers had an especially delicate fragrance.

He extolled the benefits of beekeeping. "To be honest, I like it better than farming," said Hernández Flores. "I clear a little plot of land where I keep my hives that earn me the equivalent of about $660 a year," he said. "This is the same that I would make if I cleared six or seven hectares to raise corn and beans." He also values the conservation benefits. While the bees are producing honey, the plants that feed them protect the soil. His land is far from being a natural forest, but it is much more environmentally friendly than a cornfield.

Hernández Flores would like to have 160 hives, as his father did. Then he could devote himself exclusively to beekeeping and would not have to clear and burn any land. "There

In a clearing surrounded by seeming wasteland, bees produce income for local farmers in Guatemala's department of Petén. Their honey can be sold as organic.

would be food for my bees, so that my bees could give food to me."

The mention of his father led Hernández Flores to share a little of his personal history, which sounded tragically familiar in this land of former turmoil and violence. When he was 11 years old, his father and two older brothers were killed in the civil conflict, and he and his mother had to struggle to make ends meet. Now, he is carrying on part of his father's legacy.

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Hernández Flores' visitors that day included Esteban Hernández, president of one of the 11 branches of the 108-member Northern Guatemalan Beekeepers' Association. The association sells supplies and equipment to the members and purchases their honey. Another visitor was the project coordinator for the nongovernmental organization Mesoamerican Cooperation for Development and Peace, one of six co-executing agencies that carry out projects for the Petén Sustainable Development Program.

Nearing the hives, the members of the group slipped into their white long-sleeved shirts and pants, tied at the ankles. Their head nets would protect their faces. Hernández, a veteran of 20 years of beekeeping, stuffed grass and leaves in his smoker and lit it. He tested the bellows until enough smoke was puffing out of the nozzle to keep the agitated bees at bay.

"Petén is perfect for honey production," Hernández said. First, the local farmers use no pesticides, so all the honey can be marketed as organic. Also, the large remaining natural areas produce flowers year-round. Finally, no sugar cane is grown in the area, so there is no danger that the bees will suck its juice, which would give their honey the taste of ordinary cane syrup.

Hernández has visited Mexico, Honduras and Chile to study apiculture. The sustainable development program was helping him develop his skills still further, teaching him how to make better hives and reduce the threat of diseases. He was optimistic on another score. Even as he and other association members increase their production, the market for honey continues to be strong, with the price for producers six times more now than it had been just a few years previously. He invests the equivalent of about $260 a year in frames, boxes, fencing, and other materials, and receives the equivalent of about $530 annually in honey sales. Like other beekeepers, he also grows corn and beans. But honey gives him a better return in terms of time and money invested.

Although Hernández's protective gloves were worn and full of holes, he nonchalantly reached into the hives to remove the trays. He brushed off the bees, which formed an angry cloud around the human trespassers, and showed how to distinguish the combs that contained honey from those with pollen and bee larvae. He took a fancy knife out of an elaborately decorated sheath and cut off thick, dripping hunks of honeycomb, some of which contained larvae and pollen. The men assembled in another little clearing a short distance away to eat the honeycomb in a ritual of spitting the chewed wax on the ground and praising the power of the pollen to restore virility.

Back at the association's Palestina office, Hernández gave his guests soda bottles filled with honey. "I'm fascinated by the bees' life cycle," he said. He is also happy to be earning a living in a way that helps, not harms, the environment.

Cutting trees to save a forest

A pioneering experiment in community forestry management

The man planted his foot into the hillside and laid the bar of his snarling chain saw on the trunk of a mahogany tree. He first cut a wedge on the downhill side of the tree to direct the trunk's fall. Then he moved to the opposite side to deliver the coup de grâce. Sawdust wet with sap and lubricating oil flew off the chain's teeth, stinging the man's face and bare arms. The tree shuddered and began to topple. The man yanked the bar out of the cut and jumped back as the tree, draped with vines, bromeliads and who knows how many other kinds of plants and animals, crashed to the earth, taking with it some smaller trees. The tree shifted a bit, and then lay still.

As the man trimmed the limbs from the trunk, Sergio Gómez, the logging contractor hired by the El Arbolito forest cooperative, made a mental calculation of the trunk's increasing value as it would move up the market chain. First, the cooperative would get about $175. After his company's sawmill cut it into boards, it would be worth about $300. In Europe, where the boards would probably be sliced into veneer for fancy furniture and paneling, the wood would be worth some $1,000.

Cutting down trees isn't normally regarded as the best way to save a tropical forest. But it depends on how the cutting is done and where. The forest parcel in this case is located in the western corner of Guatemala's northern department of Petén. At 4,516 hectares, it is considered large in this heavily deforested region. Despite the cutting of 280 trees this year, the forest remains functionally intact. The goal is to keep it that way by ensuring that its owners receive enough income from logging to convince them to preserve it. The cooperative is taking its first steps toward this ambitious goal as part of the Petén Sustainable Development Program.

A mahogany tree is sacrificed to help give value to the forest that will ensure its long-term survival.

Much of the forestland that once stretched unbroken from one end of Petén to the other is gone. Timber cutting began here in earnest during the decades-long civil conflict, particularly in 1980–1982. At that time, the violence was such that many local residents fled to Mexico. Private timber interests moved in and cut mahogany and Spanish cedar, the most valuable species, and processed them at their two sawmills. The loggers operated with impunity by paying a "tax" to rebel forces then in control of the area. After the conflict ended, cutting continued and forests were converted into pasture. In some cases, fires set to clear brush and regenerate grass got out of control

and burned down neighboring forests. Other fires were intentionally set to flush out pacas, a large, tasty rodent.

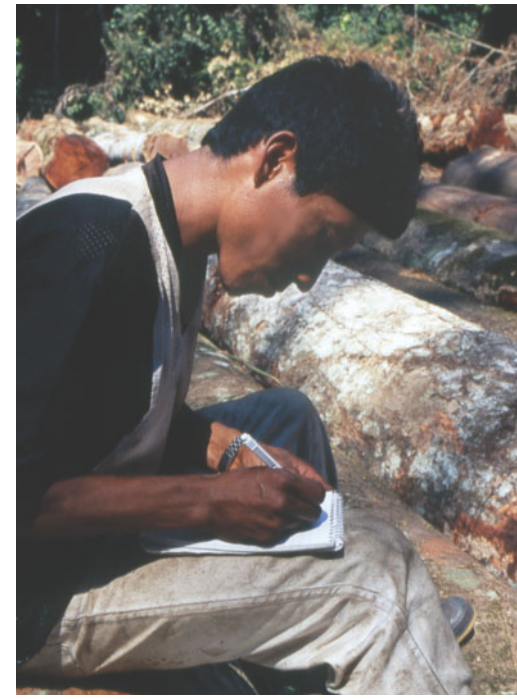
So this is no ordinary forest. It is a survivor, thanks to the reprieve it received when cooperative members signed an agreement with the government to manage it in return for a 20-year lease. According to the plan, instead of "creaming" the forest of its most valuable trees, 21 species would be cut, some for fine lumber, some for plywood, and others for paper or other products. The cutting would be done on a rotating basis that would maintain the forest's biological diversity. The cooperative members would plant new trees in the clearings created when the trees are felled. They would receive technical support from the Centro Maya Association, a nongovernmental organization.

Managing a tropical forest, with its myriad of species, is a notoriously difficult undertaking under the best of circumstances. The problems multiply when management is carried out by a community where individual interests don't always coincide with the long-term goals of the group. Sure enough, many El Arbolito cooperative members decided that they didn't like joint management and would prefer to take direct charge of forest parcels assigned to them. Part of the reason for the discontent was the poor returns from the previous year's cutting. The problem was neither the forest nor the management plan. Instead, there were delays in processing government paperwork with the result that many logs still lay in the forest when the rainy season began. The rains made the road impassable to trucks, and many logs rotted. In the end, each cooperative member received only about $135. "The people are very demoralized," said Cooperative President Edwin Atilio López.

Edwin Castro Castellanos, Centro Maya Association's forest technician, was discouraged, but by no means ready to admit defeat. He said he knows of cases where small, privately owned forests have been successfully managed. But he admitted that for an individual small farmer with a growing family and no options, the temptation to convert trees into quick cash could prove irresistible.

"If it were up to me I would fight with cape and sword to defend the forest," he said. "But we have to deal with politics and other matters beyond our control."

He took some comfort in the knowledge that things were much worse in former years when illegal logging was in full swing. "At least now we provide incentives to conserve forests." Does he believe that the forest will still be standing 50 years from now? "That is the vision that we have," he said.



Cooperative president Edwin López keeps track of the logs the timber company harvests from its forest.

Dealing with doubting farmers

New methods raise eyebrows, but also boost profits

Poor farmers tend to stick with what they know. When an outsider with a degree in agronomy comes knocking with ideas about new crops and techniques, they will politely accept the pamphlets and brochures. But the truth is, their minds are on more immediate problems, like the weather, the price for beans, or a sick cow. With a family to support on a few hectares of marginal land, they are in no mood to venture into the unknown.

In Guatemala's northern department of Petén, farmers are particularly loath to gamble on novelty. Survivors of 36 years of armed conflict, many have migrated to Petén from someplace else, bringing with them few resources beyond their own determination to persevere.

"These are people who don't want to know anything about anything," said Omar Samayoa, technical director for the Petén Sustainable Development Program. "They cannot visualize a better future." Samayoa has the tough job of finding ways to convince the farmers that it is in their best interest to change the way they work the land, and not just for their own sake, but for the future of Petén.

Despite their skepticism, farmers in fact can earn more from their land than they do from their traditional corn and beans. In addition, the new farming methods, using permanent rather than annual crops, also protect the soil and prevent erosion. Samayoa believes

A farmer loads bulging sacks of beans that he hopes will command a decent price in the market. Beyond growing corn and beans, he has few options.

that with better technology, Petén's farmers could produce as much as they are producing now on only 10 percent of the land they are currently using. Once the new methods are proven successful, the farmers will opt to stay where they are and not move elsewhere to drive the agricultural frontier ever deeper into the forest.

Samayoa says that good people can make a success out of even a bad project.

"We have to wake them up so that they can realize that change is possible," said Samayoa, who oversees five technicians who work with the six nongovernmental organizations that act as co-executing agencies for the program.

Despite Petén's problems, Samayoa says that many farmers already are proving that they can produce "fabulous results" by making simple changes that require little investment. "We're seeing farmers who started from zero, but who are now succeeding. The secret is motivating them."

The new techniques are designed to jumpstart the process of change. For example, the farmers participating in intensive cattle raising will be building up their herds, and sales of heifers will give them a cushion of capital. Then they will be in a position to invest in permanent crops, such as black pepper and fruit trees, that protect the soil. "If we had first urged the farmers to raise permanent crops, they would have said no, because they didn't have the financial means to think beyond putting in another crop of corn and beans," said Samayoa. It's only logical. "The farmer must first take care of his basic needs, and then he can consider something different."

Economic security is one thing. But in a rough-and-ready region such as Petén, farmers also worry about the safety of their families and possessions. "Some people are afraid to invest in cattle because they worry that the animals could be stolen," said Samayoa. "These are very basic things that outsiders don't always think about."

Sometimes farmers simply refuse to change. "I have seen very good projects fail because the people were not up to the task," he said, "and I have seen bad projects succeed because the people were very good."

The Petén Sustainable Development Program began with 36 projects, of which five were cancelled, mainly because the participating farmers could not work as a group. For example, in one cattle project, the farmers started to sell their animals individually and before the prescribed time, thus preventing the group from meeting its goals.

Although similar programs in other areas often enlist the collaboration of local municipalities, this is not the case with the Petén program. "The mayors have their own priorities, such as roads and potable water, which have more political value than introducing new agricultural techniques," said Samayoa. Furthermore, he added, "they may be tempted to skew the program toward objectives that don't fit in with our priorities."

At the same time, he feels that municipalities could be important agents in change by helping to attract funding. Also, giving local governments a stake in the program would help to ensure that the changes persist after the program comes to an end.

A new life for ancient stones

The Mayas left intriguing puzzles for scholars… and a tourist attraction

Aracely Avendaño gesticulated as she strode among the pyramids and plazas at the vast temple site of Yaxhá, in Guatemala's department of Petén. In particular, she was excited about new archeological findings that are adding flesh and blood to the mute edifices of limestone and mortar.

But archeology, she said, is only part of the story. The other part is how the buildings themselves were constructed. She wants people to know Yaxhá as not just an archeological site, but as an architectural site as well.

Herself an architect, Avendaño heads a multidisciplinary team of archeological and restoration specialists who work for the Guatemalan firm Keit Sei. Their job is to simultaneously uncover the mysteries that lie under the limestone edifices and restore the buildings with an attention to detail that the ancient Mayas themselves would have recognized and appreciated.

The broader purpose of Avendaño's work—and the rationale for spending millions of dollars on research and restoration—is to turn Yaxhá into a major tourism site that will produce revenue and jobs for this impoverished region of northern Guatemala. To this end, another Guatemalan firm is constructing tourism infrastructure at Yaxhá that includes visitor centers, restrooms, docks, and even staircases that allow visitors to climb some of the more precipitous temples. The work is being carried out as part of the Petén Sustainable Development Program, which is being financed with the help of an Inter-American Development Bank loan.

Newly reclaimed temples at Yaxhá sit in a forest setting that teams with life. Hundreds of sites throughout Petén remain covered by earth and vegetation.

Tourism is Guatemala's number one earner of foreign exchange. The famed temple site of Tikal, located near Yaxhá, presently receives some 120,000 visitors annually. But the numbers look more impressive than they are. The tourists typically fly out of Guatemala City or Antigua in the morning, see Tikal, and return in the afternoon. They see no other archeological sites and only catch tantelizing glimpses of Petén's forests, teeming with life.

Avendaño believes in paying respect to the ancient Mayan architects.

The strategy behind restoring Yaxhá and other important sites is to give visitors a reason to spend several days in Petén, going from one attraction to another, staying at local hotels and eating in local restaurants.

Yaxhá's rebirth will do something else: help protect one of Central America's most outstanding natural forests. For many visitors, one of most memorable parts of a visit to Petén is seeing temples in a tropical forest setting. Where else can you stand on top of an ancient pyramid and gaze down at troupes of monkeys and flocks of noisy parrots? Just as Africa has its elephants and giraffes to draw tourists and rally conservation support, Petén has equally charismatic archeological sites. "We must market nature along with monuments," Avendaño says.

Yaxhá is a site of superlatives for many reasons, including two pyramid complexes, nine acropolises, and a total of more than 500 structures.

As Avendaño followed broad Mayan roads leading from one temple complex to another, she described the groundbreaking approach her team is bringing to the practice of site restoration. Traditionally, archeologists come in and painstakingly remove millennia of dirt and stones to expose bits of bone, beads, pottery, or anything else that can cast light on the lives of the people that lived there. But in most cases they give only passing attention to the structure in which they were digging. While they may contract architects to map the site's topography, they generally do not keep careful records of how each building was put together. After they have extracted the information they sought, they cover up the openings they had made, and leave. Perhaps many years later, others would come along, usually at the behest of a government agency, to reconstruct the building. But by then the clues that would enable them to faithfully reconstruct the original would have been lost. In the worst cases, local people would use the site as a quarry for building material. The result: Even if the structure looked credible in outward appearance, its true design would often be lost forever.

Sandoval insists that his masonry crews make lime mortar the ancient Mayan way.

But at Yaxhá, the chief archeologist, who is usually the undisputed star of the digging site, is coequal with the chief architect, Víctor Sandoval. As the archeologists go about their work, Sandoval's crew takes careful notes and measurements that they will later use to restore the structure to as close to its original condition as possible.

What is happening at Yaxhá represents a kind of peaceful revolution in the world of scholarship. There were some grumblings at first, Avendaño said, even among the archeologists in her own firm. "It was a little hard

for them," she said. But the IDB liked the concept, and gave its blessing.

The results are clearly evident. Sandoval ran his hand along the face of a newly cut limestone block. His people use the same materials and construction techniques that the Mayas used —at least most of the time. The stone comes from the original Mayan quarries. But his crews use modern diamond tooth saws to cut the blocks, for two reasons. First, laboriously chipping away at the blocks with pieces of flint would be ridiculously time-consuming. But also, the different appearance of a newly cut stone will clearly show visitors what is original and what is not.

Newly built flights of stairs twist and bend up the sides of temples.

They take particular care to duplicate the ancient mortar used to hold the blocks together. Modern cement-based mortar cures too hard to integrate successfully with the existing materials. If the physical characteristics of the materials in a given structure are different, changes in temperature can cause out-of-synch movements that can jeopardize the building's structural integrity. So at Yaxhá, part of the job of the masonry crews is to make lime mortar by burning limestone in wood-fueled ovens.

The Mayas made prodigious quantities of lime, both for mortar and also for plastering gleaming white surfaces on the temples. They had to burn legions of trees to produce this lime. The result was massive deforestation, which caused erosion, impoverished the soil and reduced agricultural productivity. Wars over increasingly scarce food resources may have led to the demise of the Mayan civilization.

One problem in restoring Yaxhá is the porosity of the local limestone and the inexorable deterioration of the original stone used in the restoration. So after considerable laboratory experimentation, the Keit Sei restoration team developed a unique formula for extending the limestone's lifespan. Shunning modern chemicals, they found that a simple mixture of water, lime and a natural polymer extracted from the seed of a native tree, when injected into the stones, produces a chemical reaction that could make them last an additional 500–1,000 years, according to Keit Sei's Avendaño.

Preference for local solutions is a hallmark of Keit Sei. "We're giving jobs to Guatemalans and at the same time showing that Guatemala has qualified people at every level to do this kind of work," said Avendaño. In a field where professional jealousies can be pointed and public, the work at Yaxhá has met with expressions of support from foreign experts. Within Guatemala, Keit Sei has had to answer to local criticism, but that has had more to do with politics than science and engineering, she said.

Local workers, who are among the more than 140 persons on the site, also benefit from work at Yaxhá. Most of them come from the nearby community of La Máquina. In the future, many of them will work as park employees or start their own businesses to provide food, lodging, tour guides, transportation, and other services for tourists.

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The Yaxhá restoration work is creating an attraction designed not only to draw tourists, but also to ensure their safety. For example, few visitors can resist the temptation to scale the tallest pyramid on the site. But after just a few steps, they discover that the Mayas de-

signed their temples more for rock climbers than for the average out-of-shape foreign visitor, particularly when the structure's face is worn and crumbly. Moreover, every ascent wears a little more of the original stone.

The solution at Yaxhá is to build stairways. Although arguably attractive from an architectural standpoint, stairways are clearly not what the Mayas intended. The decision to build them came only after a debate both inside and outside of Avendaño's firm. Once tourists get safely to the summit, they face another potential danger: they could slip and topple over the edge. Should the park be responsible for protecting visitors by installing railings? That question is still being debated, according to Avendaño.

While they might sneer at the stairways and railings, the Mayas would probably be delighted with the new restrooms. Built along traditional lines, the structures are fitted with roofs of woven palm thatch. According to the construction chief, the fronds are cut during the full moon to ensure that the roof will last 10 years. Ignoring this dictate would result in a roof that would rot in five years. The influence of the moon is common knowledge, he said, and doesn't require further explanation.

Palm thatch roofs made the traditional way turn humble restrooms into Mayan period pieces.

Finally, future tourists will have the luxury of a paved road all the way to the site. At present, a four-wheel drive vehicle is a good idea in the dry season and a necessity when the rain starts to fall. Some conservationists are critical of these access roads, claiming that they make it easier for settlers to come in and establish themselves on protected areas, as has happened in other parts of Petén. But many local residents support the roads. They point out that the paved road to nearby Tikal has not led to settlement attempts. The reason is simple: If a truck appears on the road loaded with families and their personal possessions, the guards will simply turn them away. The Yaxhá site will have similar protection. "A highway without security measures means death to the forest," says Eduardo Cofiño, head of the Petén Sustainable Development Program.

Yaxhá still has few visitors—20,000 in 2004—which is not surprising considering that just a few years ago most of the site consisted of tree-covered mounds. But soon, this place, once the proud city of kings and priests, will receive tourists by the busloads. In the meantime, Yaxhá, whose construction may have been partly responsible for the destruction of the forest and ultimately of the Mayan civilization, will be a part of the solution for the forest's preservation.

After 1,200 years, another invasion

Local people will respect an archeological park if they benefit from it

Even as archeologist Takeshi Inomata unravels events surrounding the fiery capitulation of a Mayan city to invaders 1,200 years ago, present-day Mayan descendents are threatening to invade the park in which the ancient site is located.

Local people have entered the park several times in recent years to cut wood, hunt and make clearings in which they plant corn and beans. Now some of the group's leaders are vowing to establish a permanent settlement within the park's borders.

An archeology apprentice meticulously records the placement of stone blocks for later reconstruction. He said he doesn't expect to make a major discovery. "But if I do," he confided, "then, fantastic."

Is this any way to run a park? The problem is not unique to Guatemala. All over Latin America, many parks exist in name only. Such is the case here in Guatemala's northern department of Petén, whose population is largely made up of migrants from elsewhere in the country in search of land and a better life. They are poor, they need to make a living and they have few options. The concept of an archeological park means nothing to them.

Inomata, an associate professor of anthropology at the University of Arizona, is interested in both the ancient and contemporary invasions. In his 15 years at this site, called Aguateca, he has uncovered a wealth of information about the daily lives of ancient Mayas as well as tantalizing glimpses of the city's fall

at the beginning of the ninth century in which the local defenders fled, leaving their belongings behind. His work has been featured in the National Geographic magazine and in books and academic journals.

The present-day invasion is both more mundane and more complex than the previous one, and this piques Inomata's interest as a social scientist and a person interested in the lives of ordinary people, ancient or modern.

Inomata says that his work at Aguateca can yield jobs as well as knowledge.

First, he doesn't believe that the problem of the settlers is merely a matter of law enforcement. "These are really poor people," he said. "You can't just tell them that they cannot move into an area, that they cannot deforest. The economic temptation is just too great. Our job is to find ways for them to benefit economically from this protected area."

Second, Inomata believes that instead of being part of the problem, local people can be part of the solution. This is also the view of the Petén Sustainable Development Program, which is financing much of Inomata's work as well as the restoration of the ancient monuments and the construction of tourism infrastructure that will help to draw visitors and boost the local economy. Elsewhere in the department, the Petén program is helping to investigate and restore a second outstanding Mayan site. It is also helping local farmers to increase production on existing crop and pasture land as a way to forestall further expansion of the agricultural frontier into the still relatively pristine Maya Biosphere Reserve further north.

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Getting to Aguateca is part of the adventure. You board a boat in the town of Sayaxché, on the Río de la Pasión, where ferries carry on a lively business taking vehicles to the other side. (The local municipality does not want a bridge, because it gets a cut of the ferry fares—15 quetzales for a car, 20 for a pickup, and 30 for a large truck.) The boat snakes up the river, past women doing their laundry while keeping an eye on their children splashing playfully nearby. White egrets stand motionless waiting for an unsuspecting fish, as do men and women wielding long cane rods sticking out of the brushy riverbank.

An hour later the boat pulls up at a makeshift dock at the base of a steep hill. At the top of a steep set of stairs, you find yourself in a sprawling encampment. It is lunchtime, and the communal tables are filled with staff and students, a mix of Guatemalans and foreigners. Outside the central area are rustic cabins, tents, and a trail leading to the archeological site. Two students from California are washing pottery sherds and sucking on lollipops.

In the midst of all this activity is Inomata, serene, relaxed, looking no older than many of the students. He talked about the complexity of life in present-day Petén and how the region has become a safety valve for the country, where people from overcrowded regions come

Washing potsherds can be fun when you're doing it with a friend. Both foreigners and locals work on the site.

in search of land and opportunity. It's a fluid situation, where man and nature have yet to arrive at a truce and where the government's authority is still too tentative to broker a stable future for both the people and the forest environment.

Inomata believes that his work at Aguateca has more than academic importance. By learning what happened here, he is making the site come alive for tourists, on which the country depends for a large share of its foreign exchange. In particular, he believes that Aguateca can spark a local tourism industry that will give desperately needed economic opportunities to nearby residents.

According to Inomata, tourism depends on education as much as on attractions. And he doesn't just mean training for unschooled locals. "We ourselves have to learn to think like cultural anthropologists," he said. "We must work to understand local people, learn how their society works, how they think, what their economic goals are. We have to learn how they perceive an archeological site, and what would make them want to respect it and not destroy it. Only then can we start to design projects that will benefit them."

Once local people have a personal stake in the site they will protect it and persuade their neighbors to do the same. Inomata knows that people in small communities can be as fractious and political as in any big city. In the case of Aguateca, some of the laborers on the archeological site live in the same villages as the people planning to invade the protected area.

Unlike many scientists, Inomata happily opens the doors of his ivory tower to local people. He wants them to come and see what he and his team are doing. Some of his workers, who have been with him for many years, have learned quite a bit about archeological fieldwork and the story of Aguateca, and they are eager to know more. "When they learn how Aguateca can be important to their lives, they themselves will protect it," he said.

Guatemalan archeologist Erick Ponciano, Aguateca's co-director, has helped some of Aguateca's laborers organize a tourism cooperative in a nearby community. At first, these workers could see no further than their picks and shovels, said Ponciano. But over time they developed a curiosity and appreciation for the explanatory power of the site and the lives of the "ancients," as they call their ancestors. "They are surprised at what the ancients achieved in ceramics, sculpture, architecture," he said. Most importantly, the workers and other community members now see that, with the right training, organization, financing, and stable policies, this budding tourist site will create opportunities for themselves as guides, cooks, guards, maintenance workers, and in other jobs.

Ponciano helps local people get into the tourism business.

The tourism cooperative members will never be able to compete with the big outside operators and their package tours. But they can offer something that the tour operators cannot. They will invite visitors to stay in their village and experience a taste of the indigenous Kekchi culture. Guides from the community, descendents of the ancient Mayas, will conduct tours of Aguateca. Of course this will all require a good deal of training. For now, Ponciano is offering classes in archeology right in the encampment. Community members also will learn cooking and other skills.

It is easy to be skeptical on hearing about yet another plan for community-based tourism. Typically, outside "experts" come to a

A group of young Guatemalans enjoy a day of learning about their country's mysterious but glorious past.

village and tell residents that they have great cultural or natural attractions, and that all they have to do is get some training, build a few bungalows, and the tourists will come. In many cases, even if such a project gets off the ground, it will likely come crashing back to earth before long, leaving a legacy of cynicism and mistrust. Expectations were too rosy, the training was too meager, the infrastructure was subpar, and the marketing was nonexistent. The end will usually be precipitated in the midst of a dispute about money management or some other issue that pits community members against each other.

Ponciano appreciates the problems. He knows that the success of the tourism project will depend on outside support and guidance. But equally important, he said, is a stable business climate, which in this case is an archeological site that is well-managed, well-maintained and well-financed as part of a national policy. "Imagine an Aguateca with restored structures and tourism services," said Ponciano, "and how this will change everyone's vision of the future."

But in the meantime, what can be done about the immediate problem of the settlers who are threatening to invade the park? Both Inomata and Ponciano are concerned not just about these threats, but also of the general problem of deforestation and changes in the local environment. Human societies are both agents and products of such changes, which makes environmental history a constantly recurring theme of archeology and social science in general. The subject is particularly interesting because the present process of forest destruction mimicks in part the changes that led to the fall of the Mayan civilization.

Some of these changes can be seen even at the relatively pristine Aguateca site. Inomata's wife Daniela Triadan said she is spotting more and more howler monkeys, and they are venturing closer to the encampment. A good sign? No, said Triadan. The probable reason is that their habitat elsewhere is shrinking.

Deforestation in the park also encourages further lawlessness. Inomata says that the people who cut trees illegally are often the same ones who plunder archeological sites and smuggle artifacts. More law enforcement will help, but tourism will address the more fundamental problems by creating new economic opportunities. "If we don't benefit the communities, the forests are going to disappear," said Ponciano.

"Restoring the past to build a better future." Archeologists say the site and local people will mutually benefit.

For the time being, the government must shoulder the responsibility for dealing with the would-be settlers. This frequently frustrating task falls on Guatemala's National Council for Protected Areas (CONAP, after its initials in Spanish). "The first thing we have to do is try to prevent these things from happening," said Francisco Castañeda, CONAP technical director who works out of the council's

headquarters in the town of Santa Elena, near Petén's departmental capital.

In the case of Aguateca, the immediate plan was to get the leaders of the threatened invasion to sit down with officials from CONAP, members of a specialized police unit for protected areas, and local municipal officials, and try to hammer out an agreement. If that failed, CONAP would have to defer to the national police or the military and hope for the best. In the end, he said, very few cases are followed up and resolved. Part of the reason is that the government is loath to risk violence in a country where 36 years of civil conflict are still fresh in people's minds. Also, government authority is simply spread too thinly to be effective in an area as large as Petén. Finally, the people themselves—officials as well as common citizens—must have an understanding of local realities that goes deeper than laws and regulations. "We have a great deal of poverty here," said Castañeda, "and people use the protected areas to try to solve it."

Petén Governor Manuel Barquín agrees. "We cannot afford an armed confrontation," he said. "We can't subject children to this kind of situation. Violence is not going to achieve anything." However, as the representative of the central government, he is charged with upholding the law. "Those people are threatening to commit an illegal act," he said. "If negotiations don't succeed, we will have to use force."

Masons occasionally experience a bad "mix," when the mortar doesn't cure properly. These workers had to dismantle previously restored walls and try again.

Back in Aguateca, archeologist Inomata takes a long view of the sweep of environmental history. "Human beings have always interacted with natural systems," he said. So when we talk about preserving a forest, we do not mean an area that has never felt the hand of man. "The question," Inomata said, "is what kind of interaction should we have? This is an important subject for archeology, and archeology can provide lessons for us living here at the present time."

How can parks get the protection they need?

How can a government agency and a conservation group work together to safeguard a priceless natural and cultural heritage?

In a spectacular piece of archeological sleuthing, scientists determined that an ancient Mayan site called La Corona was the source of a large number of artifacts that flooded the antiquities market 40 years ago. Back then, looters could carry off priceless archeological treasures with impunity. Even if government authorities knew what was going on, they would have been in no position to stop it.

Since then, things have improved, at least somewhat. La Corona is today located in Guatemala's Laguna del Tigre National Park, one of several protected areas that together make up the Maya Biosphere Reserve. This vast swath of forest in the country's northern department of Petén is famed not only for its diversity of flora and fauna, but also for thousands of Mayan archeological sites.

Spirited members of Guatemala's environmental police head off to Laguna del Tigre National Park to show lawbreakers that the government means business. Their presence is already making a difference.

But how protected is it? "Still not 100 percent, not even close," said Francisco Castañeda, technical director of Guatemala's National Council for Protected Areas (CONAP, after its name in Spanish), which oversees most of the country's protected areas, including Laguna del Tigre.

What can be done to ensure the region's future protection? Javier Márquez, Petén director of Defensores de la Naturaleza, Guatemala's premier conservation group, says much

depends on finding ways for local people to benefit from Petén's parks and other reserves.

In many cases, government agencies and conservation groups are uneasy bedfellows at best. But in Petén, CONAP and Defensores de la Naturaleza pursue similar objectives and even share in the administration of some protected areas.

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Castañeda works in a cavernous building whose wooden walls are painted green. The color, he said, doesn't reflect its present conservationist mission but merely its former incarnation as a hospital.

Until fairly recently the government had practically abandoned the Maya Biosphere Reserve area, treating it almost as a no-man's-land, according to Castañeda. The biggest trouble spot was the Laguna del Tigre Park, which was less a refuge for flora and fauna than for a variety of illegal operations, including seven landing strips used by drug traffickers and well-established smuggling rings specializing in Mayan artifacts and illegal aliens. Adding to the chaos was the steady encroachment into the park by groups of settlers seeking "empty" land on which to plant corn and beans.

At the urging of civil society groups, the Guatemalan Congress approved a national emergency decree and allocated 5 million quetzales (around $700,000) in 2004 and 3 million more the next year to strengthen law enforcement in the park. The result was some 40 arrests, the elimination of several illegal landing strips, and more involvement with local communities.

"We're still not in total control of the situation," admitted Castañeda, "but we're getting there." CONAP cannot do it all alone, Castañeda hastens to add: "Our people are not armed, so it is very difficult for us to apprehend violators." When problems escalate beyond the talking stage, CONAP must call in the Nature Protection Service, the National Police or the military.

Another problem for CONAP is what to do about human settlements within park boundaries. Unlike in the United States and a handful of other countries, people live in many national parks and other protected areas in Latin America. In some cases it is too difficult or politically inexpedient to remove them. In others, the people and their way of life are considered compatible with the aims of biodiversity protection. In Petén, the reality is that park boundaries were sometimes drawn up with little information or interest in whether people lived in the area or not.

It has become an article of faith within the conservation community that local people must help decide how to manage a protected area so that it both remains intact and continues to provide them with a living. But working with local people can be frustrating. At the Defensores de la Naturaleza offices, a short walk from CONAP headquarters, Márquez recounted his group's experiences as co-manager of the Sierra del Lacandón National Park, which is located to the southwest of Laguna del Tigre. In 2001–2002, he said, a group of seven families entered the park, and legal proceedings got underway to have them removed. Today, not only are the original seven families still there, but they have been joined by some 97 more.

Farmers burn both to clear underbrush from previously planted land or to create new settlements in currently forested areas.

"It is an unarmed conflict," said Márquez. If a judge orders the people evicted, the

executive authority is loath to follow through, fearing a violent confrontation in which other groups might come to the defense of the settlers. Moreover, savvy politicians know that associating themselves with the execution of such an order will probably cost them votes in the next election. "We have about 10 removal orders," said Márquez, "but the judiciary is not empowered to carry them out. Their execution is in the hands of the executive, and this is our biggest problem."

Despite his frustration, Márquez does not regard the settlers as villains, but as victims. They invade protected areas because it is the only option they have to earn a better living. "All they know is to plant corn and beans," said Márquez, "and so they clear new land to grow crops." The result: "The agricultural frontier moves forward once again."

Márquez wants to give farmers new options by teaching them more productive ways of using the land. That way, they will have less incentive to cut, burn and plant in the forest reserves. Before, 90 percent of his group's budget was used to finance protection and enforcement in the Sierra del Lacandón Park. Now they mostly work with the communities and forge agreements on managing the land. In one project that he concedes might raise eyebrows in traditional conservation circles, Márquez's group is helping farmers to raise cattle more efficiently. The project is part of the IDB-financed Petén Sustainable Development Program, which is backing other private organizations to help farmers adopt new productive activities.

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How sustainable will these efforts prove to be over time? Márquez conceded that his group's activities might not afford much protection to the Maya Biosphere Reserve in the long term if Petén's population quadruples by 2013, as has been projected. That scenario would see

CONAP's Castañeda leads a tour of a lot filled with illegally harvested wood and the trucks used to haul it.

Márquez sympathizes with illegal settlers who merely want to make a living.

Petén's population rise from the present 400,000 to one million in 2007, and to two million in 2013. "All these new people will be demanding land," he said. "Some people say that all we are doing is slowing down the destruction of protected areas."

Given this climate of rapid change and uncertainty, the IDB is laying the groundwork in a second program in Petén to focus specifically on the Maya Biosphere Reserve. This new initiative will consolidate the system of protected areas by strengthening local governments and community groups, promote ecoturism as well as archeological tourism, strengthen social services, and diversify pro-

ductive activities, including managed forestry in addition to the extraction of nonwood forest products.

The new program will give added momentum to efforts for protecting these irreplaceable treasures. Ultimately, the answer must lie with the people who live in Petén, the *peteneros*. Will their voices be heard when crucial decisions are taken on land use? Will Petén's protected area enhance, rather than reduce, their ability to improve their lives? Can the region's organized groups evolve into a constituency for protected areas that will help them to maintain a steady course even in the face of shifting political winds?

An organized and determined local citizenry is essential for the region's long-term prospects. But it cannot substitute for the essential role that only government can play in creating an environment for democratic decision making, reconciling the various interest groups, and enforcing the law. Environmental protection ultimately depends on strong and efficient public institutions.

A technician with an environmental NGO sits down with farmers to discuss how to boost their production and reduce pressure on protected areas.

"This is not a question of policies and laws, but of political will," said CONAP's Castañeda. "As technicians we will propose solutions, but in the end, the decisions will be made at the political level."

Man in the middle

Petén's governor says voters must assume responsibility for ensuring that good policies survive changing political administrations

Manuel Barquín has problems common to all governors. But Petén presents some special challenges. For example, the department accounts for one-third of the country's land area but only 2 percent of its population. It contains more than 80 percent of Guatemala's protected areas. Population growth, at 9.9 percent per year, is the highest in the nation. Petén also has the least government presence of any Guatemalan department. Here Barquín talks about the problems of governing in an environment of rapid social and economic change.

Q: *Petén is famous for its protected areas, both for their natural heritage and their world-class archeological sites. How would you characterize the status of efforts to protect these areas from deforestation, burning and invasions by settlers?*

A: In the past 12 years more than the equivalent of $40 million have been invested in the Maya Biosphere Reserve, and conditions today are worse than before. The problem has been individual agendas, in which each sector pursues its own goals. We need to replace individual agendas with inter-

Barquín says that conservation yields economic returns from tourism and managed forests.

institutional agendas in which all groups join together to make decisions, including how to best invest the support we receive from our friends overseas.

Q: *A large portion of the land in Petén is protected in one way or another. Is this an obstacle to development or an opportunity?*
A: If the protected areas are well-administered, we will eventually be able to trade carbon credits, as Costa Rica does. Also, the natural and cultural sites constitute a major tourism potential that will benefit local people. Perhaps the best example of economic benefits we have from protected areas is community management of forest concessions. We have some 1,000 persons involved in concessions that are protecting forests while at the same time generating economic benefits from the sale of wood and other products.

Q: *These benefits all depend on long-term management. For example, managing a natural forest requires a time frame of at least 20 years. Yet political administrations change, and along with them, policies and personnel. What can be done to create a stable policy environment that can convince skeptics to make long-term investments?*
A: I think that the people themselves will provide a large measure of the continuity required by long-term management. The job of the government is to design policies with the collaboration of local people so that these policies represent a consensus among the different groups. Although the government changes, local institutions and interest groups remain.

Q: *What can be done at the level of the governor's office to strengthen democratic and participatory institutions here in Petén?*
A: My job is to represent the president of the republic here in Petén, and to convey the seriousness with which the administration regards the problems in the department. I am a facilitator, a coordinator. My principal interlocutor in Petén is the Development Council, which represents all of the interest groups in the department. [The IDB has] brought us this vehicle [a sustainable development program]. Now it is up to us to organize ourselves and move forward.

We have an important mandate to instill confidence in those who are providing assistance to Petén and to develop our own self-confidence. By fighting corruption, by fighting impunity, we will show our own people and people from other countries that we can manage these resources responsibly. Above all, we have to achieve zero corruption, which has hurt us most of all.

A butterfly in a land of iron

In the midst of mountain-moving machines and a real estate boom, conservationists work to save a rare butterfly and its habitat

It seemed like a dangerous place for a rare butterfly. Just out of sight of its forest sanctuary, mammoth steam shovels were devouring a mountain that had the bad luck to be made mostly of iron, as many are near Belo Horizonte, capital of Brazil's state of Minas Gerais. At the same time, the butterfly's little valley refuge is filling up with vacation homes and condos, turning butterfly habitat to human habitations.

The mining company is the third biggest in the world, and the encroaching metropolitan area is Brazil's third biggest city. As for the butterfly, it's only average size, and not even very pretty.

Yet *Parides burchellanus* is irresistible in its own way. It is not only very rare, but for 40 years it was presumed to have gone extinct. The last specimen had been sighted in 1965 along the Maranhão River near the Brazilian capital. Intensive searches in other likely habitats revealed no other *P. burchellanus* colonies. But during the butterfly's "dark ages," several specimens found their way into private collections. A foremost Brazilian butterfly taxonomist confirmed their identity and learned where they have been captured. So he and a colleague went to take a look. In just three days in January 2002, they spotted more than 50 "extinct" butterflies. *P. burchellanus* was back on the list of the living.

But the future of this delicate creature is far from guaranteed. Its fate hinges on the action of people, not just scientists and conservationists, but ordinary citizens who must come to the realization that they and the butterfly have a vital common interest. Both depend on clean springs and free-flowing streams—for the butterfly as its irreplaceable habitat, and for the people as a crucial source of drinking

Biologist Pimenta checks to see if this specimen carries a tiny tag that will help provide crucial information on its distribution. Such population data are essential for making decisions about how to save this butterfly from extinction—for the second time.

water. If the springs start to dry up or streams become choked with silt, both would lose.

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When headlines announce that some long-lost creature has been rediscovered, it usually turns out that its refuge was a very remote place, such as the depths of the Indian Ocean where the primitive coelacanth fish was found, or the hardwood swamps of the state of Arkansas, where true believers still hold out hope for the ivory-billed woodpecker.

But *P. burchellanus* was hiding under the noses of millions of people in the little valley community of Casa Branca, about a half hour's drive from Brazil's third-largest city of Belo Horizonte. Far from a nature preserve, Casa Branca is a fast-growing town of weekend homes, construction sites and "land for sale" signs. Restaurants and other businesses cater to urban refugees.

The community is changing fast, as biologist Ivan Pimenta found to his dismay on a visit to a stream where he had seen the *P. burchellanus* many times before. When he pulled up to the bridge, he found that a new fence blocked access to the stream. Even worse, the property owner had cleared the forest undergrowth right down to the water's edge. The cleared plants almost certainly included the one species of vine on which *P. burchellanus* caterpillars depend for food. Pimenta did an end run around the fence and followed the shoreline upstream. But he found no butterflies. He would try somewhere else.

At the second bridge, Pimenta's luck changed. Almost immediately, a dark butterfly emerged from the forest shadows. Pimenta went into action, attracting the attention of some little monkeys, who scampered along a telephone line to get a better view. A truck with a loudspeaker passed nearby, announcing that a circus was coming to town.

Pimenta swung his collecting net overhand before him, and then underhand behind him, in a series of moves resembling an exotic dance. Butterflies don't fly a straight, predictable course, but flit from here to there, like a thought. Pursuers of butterflies have no choice but to mimic their whimsical trajectories.

Pimenta stumbled down the road embankment and into the underbrush where he made his catch. It was indeed a *P. burchellanus*, and Pimenta grasped it between his three middle fingers to inspect the pink spots on the trailing edges of its wings. After taking some photos he let it go, and the butterfly continued its journey down the stream.

Pimenta, a researcher at the Belo Horizonte Zoo and Botanical Foundation, is heading a program to secure this butterfly's future. The program is being partly financed with the help of a $31,753 grant from Brazil's National Environment Fund. The fund has underwritten some 1,000 projects throughout the country, in many cases with the help of a total of $46 million in financing from the Inter-American Development Bank.

The availability of this nondescript vine is one key to saving the *P. burchellanus* butterfly from extinction.

In their project, Pimenta and a group of consultants will fill in the blank spaces in *P. burchellanus*' natural history, particularly its range and population size. Already, Pimenta and his collaborators are tagging butterflies in three locations. Each captured specimen gets a number. On the basis of data from recaptures, they will develop a clearer idea of the size of the population, the survival

P. burchellanus **caterpillars change color and form as they mature and grow larger.**

The caterpillar develops into a pupa to prepare for its final, glorious, stage of life.

The adult *P. burchellanus*' subdued coloration reflects the mystery surrounding its brush with oblivion.

rate of individuals, their space requirements, reproductive and feeding behavior, and effects of predation, among other things.

The scientists will also establish a captive breeding program and work with local landowners to preserve the butterfly's habitat. The support of local people is essential because the entire known range of *P. burchellanus* is on private land, as is likely to be the case with any future discoveries of new populations.

Throughout, the intriguing question is, why Casa Branca? Why, of all the fragments of its historical range, did the butterfly choose this unlikely place to take refuge? "This is the mystery," said Pimenta. "This is the big question we are trying to answer."

As Pimenta resumed his streamside vigil, he described the *P. burchellanus*' tenuous existence. First, like many insect species, it goes through dramatic physical changes during its life cycle. The adults lay their eggs on a leaf, and after the emerging caterpillars grow to maturity, they develop into pupae, finally metamorphosing into adults to begin the cycle once again.

The caterpillars of many butterflies are picky eaters, adapted to feed on just one or a few kinds of leaves. The *P. burchellanus,* too, practices an extreme form of vegetarianism in which they only eat the leaves of one species of vine, the *Aristolochia chamissonis*. This vine is similarly fussy, growing only on the banks of healthy, free-flowing streams, with rocky bottoms free of sediment. It cannot tolerate streams that are silted up by erosion or where the forest has been removed. For this reason, *P. burchellanus* cannot exist apart from a natural stream environment.

Already, Casa Branca residents, as well as the local mining company, have pledged their support to protect the butterfly. It will take information, education, and in some cases, strong legal and government action. If *P. burchellanus* disappears again, it could be the last time. Pimenta is determined that this will not happen.

Iron mining with a silver lining

Good neighbor relations include measures to protect local plants and animals

On some hilltops in the state of Minas Gerais, near the city of Belo Horizonte, you can pick up a rock that seems so heavy in proportion to its size that it feels as if some extragravitational force were tugging it back to earth.

The rocks are iron ore, not surprising in a state whose name translates into General Mines. Much of the ore extracted here is so pure that it needs little refining before being exported to steel plants around the world.

It's hard not to admire this humble yet remarkable rock on which civilization depends. It is also difficult not to be impressed by the sheer hubris of the mining operations themselves, in which men and machines literally recreate the earth's topography, sculpting hills and obliterating mountains.

Yet all of this comes at a price, a fact that Francisco Couto well knows. His job is to ensure that the giant firm Brazil Mining United (MBR, after its name in Portuguese), complies with Brazilian environmental law.

As he drove a company pickup past a series of checkpoints, he told how MBR has changed since its founding 40 years ago. Back then, he said, neither citizens nor companies cared about the environment. Environmental legislation was weak or nonexistent. But in the 1980s, with the birth of Brazil's environmental movement, this laissez-faire attitude changed. Today, the 60 staff members making up MBR's environmental unit are responsible for meeting legal norms governing environmental monitoring, water quality, noise, oil

Uneasy neighbors: An iron mine coexists with a meadow of flowers on one side and a housing development on the other. The mining company is a veteran in the art of getting along, as it vows to do with a rare butterfly.

pollution, waste treatment and restoring vegetation on closed mine sites.

Couto now stood on the top of a hill overlooking a vast mining operation. Below, men and machines were creating an extraterrestrial landscape. He spoke proudly of his company and of what he described as its commitment to protecting the environment.

Couto: Iron mining is an extractive industry, but it is no longer predatory as in former times.

"Yes, the objective of our company is to mine iron, and we are an extractivist industry," he said. "But we are no longer a predatory industry."

He went further: "We don't just comply with the law. We go beyond what the law requires." In a sense, MBR does not have a choice. Unlike mining operations that are located in sparsely populated areas, such as in the Amazon, MBR moves its mountains in one of the most densely populated parts of the country, in many places practically in people's backyards. "Here, we have to maintain very strict controls," he said. "Our operations are monitored very frequently and very rigorously. If we didn't have good relations with the community, we couldn't continue to operate mines," he said. "There would be so many protests and restrictions."

MBR must work hard to be a good neighbor. Even little things count, such as washing dirty ore-laden trucks before they leave the mine site. At midday, mine operations stop so that people living nearby can enjoy lunch in peace. At night, the annoying "beep...beep... beep" alarm that warns that heavy machinery is in use is replaced by lights. The company plants fast-growing trees such as eucalyptus and pine as noise barriers.

The company also tries to maintain good relations with the natural world, Couto said. Company crews plant abandoned mine sites with native species, a challenge considering the great variety of different plants that make up local ecosystems.

And how about butterflies? Jangada Creek flows from MBR's Jangada mine site and through the community of Casa Branca, possibly the last refuge for a very rare butterfly previously thought to have gone extinct. The company is planning to deepen the mine, which could affect local watercourses, including the critical stream vegetation on which the butterfly depends.

Couto wanted to know if this particular butterfly had been found along Jangada Creek. Not yet, he was told (although it would be discovered there the very next day). If it was found on MBR land, Couto said, he was confident that mining operations would not pose a threat. For one thing, he said, the mine's operations and the butterfly have apparently coexisted for many years. In addition, he said, MBR has a good record in getting tracts of its land designated as private nature preserves, and was planning to do so here as well.

"Big mining companies own a great deal of land, only part of which can be mined," he said. The reason is simply that the ore occurs at the tops of the mountains, not in the forested lower elevations. "As incredible as it may sound, the mining industry has been a major force in nature preservation."

As for *P. burchellanus*, Couto said MBR would protect the butterfly if its mining operations were found to be a threat to its existence. "We would study how to protect it, and if necessary, either relocate it or take measures to protect the same species in other areas," he said.

Science in the rough

The way to learn if a rare butterfly lives on Jangada Creek is to go there

The two butterfly experts were worried. A nearby mine was planning to expand, and that could affect the flow of streams running through the town of Casa Branca, in Brazil's state of Minas Gerais. It would not only mean possibly less water for the town residents, but also increased siltation that could jeopardize the future of an extremely rare butterfly.

Most squarely in the line of fire was Jangada Creek. Did the endangered butterfly, *Parides burchellanus,* live along this stream? Nobody knew. Was the stream already being affected by mining operations? They resolved to find out.

They tossed their collecting nets over a barbed wire fence and gingerly squeezed through the prickly strands. Then they followed a winding path down the forested hillside until it reached the creek. Ivan Pimenta, researcher at the Belo Horizonte Zoo and head of a new program to study and protect this endangered species, elected to wait for the butterflies—if any—to come to him. Keeping him company was Lucas Machado de Sales, local doctor and tourist lodge owner. The other butterfly expert, Fernando Campos, together with a visitor, would follow the creek as it climbed up into the forest.

The two headed off. Where the stream was shallow, they waded. When the water got too deep, or where passage was blocked by fallen trees and logjams, they pushed their way through the underbrush on the banks.

Campos kept his eye out for the telltale flicker of dark wings with pink spots. Whenever he found the vine *Aristolochia chamissonis*, the caterpillars' only food, he checked out the underside of its leaves for the larvae. He

Campos looks for caterpillars on leaves of the vine that holds the key to a rare butterfly's survival.

commented that the stream itself appeared to be healthy, its clean rock bottom providing the vines with the conditions they needed to anchor their roots. "You have to be a botanist to work with butterflies," he said.

He found no caterpillars. Nor did he find *P. burchellanus* eggs, which was not surprising. He explained that this butterfly lays its egg cluster on different plants a few meters away from the stream. In this way, he said, cannibalistic caterpillars munching on *A. chamissonis* leaves will not happen upon eggs and tiny larvae and eat them as well.

Campos surmised that the vines he was finding had grown from seeds from a stand of the plants further upstream. Above this, the vines would be absent, because their seeds are disbursed by the downstream flow of the stream. No vines, no *P. burchellanus*, he said, surmising that this was perhaps one factor in this species' seemingly uneven and erratic historic distribution in what would ordinarily be suitable habitat.

Actually, nobody knows for sure why this butterfly nearly disappeared. Campos has some theories and looks forward to testing them as part of a program being carried out by the Belo Horizonte Zoo with financing from Brazil's National Environmental Fund. The causes will most certainly be a mix of factors, including the coevolution of the butterfly and the *A. chamissonis* vine, geological and climate changes and human intervention. "This is going to be a very good experience," he said, "a model for how to get the data needed to develop management plans for other endangered species."

Campos demonstrates the proper way to hold a butterfly.

Wet, muddy and scratched by thorns, Campos finally called off the search. But he still found things to delight in. Every so often a neon blue morpho butterfly would fly past. "Look, what a marvel!" Campos would exclaim. He added that morphos sometimes eat fermented fruit and become intoxicated.

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Campos, who works as a technician at the Brazilian energy company Petrobras, began studying biology on his own 15 years ago. He focused his attention on butterflies because they are relatively easy subjects for a budding nature photographer. His interest grew into a passion and his growing expertise earned him a respected place in local scientific circles. He made small butterfly gardens, and then was instrumental in the construction of a 24-square-meter structure at the Belo Horizonte Zoo, one of Brazil's three large butterfly gardens. Its spacious interior teems with fluttering wings and often groups of excited schoolchildren.

Now, at age 42, Campos is studying biology at the university. "It's a way to broaden my knowledge," he said. "I've become too much of a butterfly specialist." He expects to have his doctorate in 12 years, and is looking forward to teaching as well as doing fieldwork and research.

Campos may be a fanatic about butterflies, but he is not an environmental ideologue. Of course he is worried that the mine's planned expansion could put the butterfly in danger. But he is not against mining. "For us, mining is extremely important economically," he said. "I believe it is possible to extract ore and also protect the environment at a reasonable cost." And is the mining company capable of doing the protection? "I have no doubt of it," he said. "The mine and the butterfly can live side by side," he said.

He loves the *P. burchellanus* because it is rare, and the morpho because it is beautiful. "Each butterfly has its mysteries," he said. Butterflies have long been revered as symbols of renovation, hope, fragility and beauty. Their image frequently appears on cosmetics and jewelry, even tattoos. Does Campos have a butterfly tattoo? "Yes, on my heart," he replied.

"I love to watch all butterflies," he said, on the return walk to the spot where he left his companions. "But even more, I love to watch people who are charmed by watching butterflies."

Now approaching the spot where the group had split, he called out to his companions: "See anything?" In fact they had. Without moving three meters from their resting spot they observed a *P. burchellanus* following the stream course down the hillside and toward the town. It would be one more little piece of empirical data to fill in a very large scientific puzzle.

Entomology 101

Local people want to know more about their celebrity butterfly

Lucas Machado de Sales had heard about the endangered *Parides burchellanus* butterfly only the previous month. "I was surprised to hear that it lived here in Casa Branca, and I'm still surprised," he said.

Sales' white hair and ready smile gave him the air of a family doctor, which he is. "I have a certain amount of influence here," said this resident of a little valley near the Brazilian state capital of Belo Horizonte. In his house an entire wall was lined with bottles of *cachaça* (a local sugar cane liquor), dusty and unopened, tokens of gratitude from his many patients. "People believe what I say," he said.

Would he be willing to speak to the landowner down the road who had cleared plants and bushes to a stream bank, eliminating critical butterfly habitat? Yes, he said. Would he lobby local officials for protection measures? "Definitely," he declared.

Sales' trim physique speaks to his other persona. He is transforming his bucolic property into a tourist retreat, but one with a mission. Its prime attraction is an arboreal "beltway" of ropes and trees on which physically fit visitors can make a 360° tour of his property without ever touching the ground. He hopes that they will occasionally pause from their exertions, observe the birds and the plants, and reflect.

But his little patch of Eden is under siege. Casa Branca is turning into a community of weekend houses, "a community without an identity," he lamented. Natural areas are giving way to residences, and residents are clearing their land, right down to the banks of the streams. A second threat lies just four kilometers over the next mountain: the Jangada

Butterfly expert Fernando Campos holds the attention of local residents with a talk on butterfly ecology and what they can do to save a threatened species.

mine. Sales believes that the plan to expand the mine by deepening its pit could lower the water table and dry up local springs and streams.

"When I saw this butterfly for the first time," said Sales, "I thought, 'this creature could bring this community together. It could become a flagship species for defending the environment'." African game parks have their elephants, Yellowstone Park has its bison and grizzly bears, Brazil's Pantanal has its jaguar, and Casa Branca has a butterfly. "There are a lot of green areas around Belo Horizonte," he said, "but only one with an endangered butterfly."

Sales will use his influence to defend an endangered butterfly.

It's a butterfly with rigorous environmental standards. It demands a regular stream flow of clean water. So do the local residents, said Sales, and this gives them a common interest in ensuring that any mine expansion does not disrupt the local hydrologic regime. At a recent public meeting, Sales cited the precarious status of *P. burchellanus* in his petition to halt plans for the mine expansion. Authorities put the licensing process for the mine's expansion on hold pending studies that would give a more accurate picture of its effect on the water table. In the meantime, Sales mapped Casa Branca's small springs and calculated their volume, a vital piece of empirical data he might need to counter the mining company's own information.

Sales had just returned from a *P. burchellanus*-hunting expedition with Ivan Pimenta, researcher at the Belo Horizonte Zoo and head of a new program to protect the butterfly, and Fernando Campos, self-taught butterfly expert. Now they joined several groups of tourists in Sales' open-air bar and restaurant, whose centerpiece was a highly polished copper still for making *cachaça*. A brilliantly azure morpho butterfly alit on a glass of *caipirinha*, Brazil's national drink, and would not leave. Some of the tourists overheard what Sales was saying about the *P. burchellanus*, and soon the conversation turned from soccer and the weather to butterfly ecology.

Sales said he learned that caterpillars are very particular about what leaves they eat. But one of the weekend guests insisted, "I see caterpillars eating everything." Biologist Pimenta stepped in: "Take a closer look," he said, and added that caterpillars that dine on toxic plants become toxic themselves, to protect themselves from predators. "This is really all new to me," exclaimed another guest.

Taking advantage of the moment, Campos now turned his chair to face his "students" and launched into a full-scale ecology lecture. Butterflies are not just a work of nature's art, he said. Their caterpillars help to control plants that would otherwise out-compete other plants and reduce biological diversity, he explained. The guests were proving to be attentive students. "So if there were no butterflies," one remarked, "nature would become unbalanced." The others nodded in agreement.

"Butterflies seem so fragile that we assume they're not important," Campos continued. "But if there is a change in the environment, we learn it first from the butterflies."

Wonderful life in a harsh landscape

Land set aside to protect water also safeguards an unusual ecosystem

The 4,000-hectare Serra do Rola Moça State Park, south of the Brazilian city of Belo Horizonte, is not a place of spectacular beauty. It offers no impressive peaks, breathtaking canyons or profusions of animals and flowers. Just rolling hills of seemingly poor land.

But what it lacks in spectacular vistas, Rola Moça makes up for in strategic importance. An island of relatively pristine nature in an expanding sea of urbanization, it was established in 1994 to protect water supplies for a growing population. It is no coincidence that the park's manager, Paulo Emílio Guimarães, works for the local water company. Part of his job is to protect the value of his company's concession to exploit the water and distribute it to surrounding urban areas.

The park also gives local people—including some 5,000 students a year—a chance to experience one of the world's truly unusual ecosystems, the *canga*. The park's 225 plant species include pineapple-like bromeliads, orchids (a favorite with plant smugglers), and thick-leaved succulents. The lucky visitor might catch a glimpse of one or two deer species, monkeys, or the elusive bush dog.

In order to survive, these tough plants and animals have had to adapt to the region's geological realities. The fields are full of rock outcroppings and fragments lie strewn about. These are not pretty rocks in the usual sense. Colored black to dark cinnamon brown, they lie twisted and layered in sometimes grotesque shapes. But pick up a piece, and the reason for this place's special qualities becomes clear: the rock is startlingly heavy because it is nearly pure iron.

Brilliant blooms add to nature's palette on the iron-dominated *canga* landscape.

Guimarães' job is to protect water by preserving nature.

The park perhaps has yet another possible attraction. It could be part of the tiny, fragmented range of the recently rediscovered butterfly *Parides burchellanus*. Yasmine Antonini, an ecologist with the environmental group Biodiversitas, thinks she saw one. It will be up to a new program carried out by researchers from the Belo Horizonte Zoo to make a definitive determination that would confirm this addition to the creature's tiny known range.

Antonini would be delighted to add an endangered species to her list of park fauna. She is developing a management plan for the

park, and the butterfly would be well protected here, she said. Both Biodiversitas and the park itself work very closely with university researchers as well as with leaders from nongovernmental organizations and local communities. "This gives us a special level of support and credibility," she said.

But protected areas are seldom free of threats, and Rola Moça is no exception. Some of the threats are common to many protected areas near urban centers, such as feral cats and dogs that compete with wild animals and introduce diseases. In addition, Rola Moça's ferrous-dominated geology has put it in the sights of a mining company. The company wants to extract ore from a portion of the park, and feels a certain justification in making this demand. It formerly owned the land on which the park sits, and was never indemnified when the state took it over. The mining company further maintains that mining operations here would not threaten either the quantity or the quality of the 400,000 liters per second of water produced by the park's six springs. In fact, the iron deposits in this region are unusual for their absence of sulfur, which in other mining operations commonly leaches out during extractive operations and acidifies watercourses for many years to come.

Guimarães is determined to keep the park as intact as possible. "It would be a real shame if the company were able to exploit land that is now under protection," he said. "All of the communities around the park are very aware of environmental issues, and they put a lot of pressure to protect this area," he said. They are mostly interested in the park's practical benefits, and less so in its role as a natural sanctuary. "The water is a more important factor for conservation than preservation of nature," said Guimarães, "because the benefits are immediate. People are more interested in having water than in seeing animals."

Tough little shrubs make the *canga* their home. Altogether, the Serra do Rola Moça State Park is home to 225 plant species, belonging to 71 families.

Many *canga* plants live here and nowhere else.

From elephants to butterflies

Zoo-goers also learn to appreciate the nature in their own backyard

More than 1 million people every year visit the Belo Horizonte Zoo and Botanical Foundation on the outskirts of this Brazilian state capital where they enjoy its graceful gardens and exhibits of animals and plants.

But Director Carlyle Mendes Coelho insists that his institution has a more serious mission than rest and recreation. In particular, he is proud of the zoo's role as a living classroom, where exhibits of native plants and 215 species of animals help local people better appreciate the nature in their own backyard.

"We have a strategic opportunity to shape perceptions about nature and about conservation," Coelho says, claiming that more people worldwide go to zoos than to the movies.

But zoos must not get overzealous in pursuing their serious mission. After all, zoos are supposed to entertain. "If we tell children or adults, 'come to the zoo and learn,' they won't come," he said. "So we tell them, 'come and have fun,' and while they're enjoying themselves, we teach and they learn."

What would a zoo be without elephants and other faunal superstars to pull in the crowds? But in Belo Horizonte, not all the zoo's charismatic creatures hail from exotic lands. The prime example is the maned wolf, *Chrysocyon brachyurus*, native to central and southeastern Brazil, Paraguay, eastern Bolivia, and northern Argentina. This elusive creature—not the elephants—is the zoo's most emblematic resident.

Every major zoo must have its crowd-drawing elephants. But in Belo Horizonte, visitors are equally impressed by rare native wolves and an exciting excursion into the world of butterflies.

An inhabitant of open forest, savanna, and marshland, the maned wolf has nearly no natural enemies. Nevertheless, its survival is in jeopardy because the wide, uninterrupted spaces it needs are being cut up and fragmented by human activities. The zoo is spearheading a program to protect the animal in relatively undisturbed areas near Belo Horizonte.

Several wolves live in a semiwild state in forest patches on zoo land. But few visitors see these shy canines, least of all groups of noisy schoolchildren. The wolves mostly remain hidden, except to zoo researchers. Each evening, notebooks in hand, they follow a short path to the edge of the forest. There, in the middle of a clearing they set out an assortment of food items, a kind of offering to the god of endangered species, and then hunker down in a little wooden blind. They sound a whistle, and a short time later something moves behind the wall of slender trees. Emboldened, the wolf advances toward his "prey," looking from side to side, half walking and half dancing on its long legs. He eats, keeping his eye on the blind, and then slips away.

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Another major draw at the zoo is its butterfly garden, only one of three large ones in all of Brazil. Here visitors step into a world of brightly hued, delicately patterned creatures, feeding at colorful flowers or even alighting on their shoulders.

Here too, education is part of the fun. For example, visitors learn that the heart of the butterfly garden is not the butterflies themselves, but the zoo's botanical garden, which provides the plants on which the butterfly caterpillars feed. "If we didn't have a botanical garden, we couldn't have a butterfly garden," says Ivan Pimenta, zoo researcher and head of a new research project to study and protect a rare and endangered butterfly species native to a small valley near Belo Horizonte.

Visitors stroll through the zoo's butterfly garden.

Coelho : More people go to zoos than to the cinema.

Zoo Director Coelho is currently planning an ambitious new project to build an aquarium that will display the fish and other creatures of the São Francisco River. Rising in the state of Minas Gerais, the São Francisco, the continent's fourth largest river system and the longest river wholly in Brazil, has been tamed by a series of dams that are interrupting the seasonal migrations of many of its fish species. The aquarium, which is presently in search of funding, will show how the river environment once was and—in the eyes of conservationists—should be.

While he strives to make the zoo a leader in environmental education, Coelho worries that knowledge will not necessarily translate into action. "Here in Brazil," he said, "we still lack something that I see when I visit zoos and parks in the United States. This something is the answer to the question, 'What can the public do to help protect nature?' We don't have opportunities for people to really help," he said. "We need more spirit of volunteerism, both among individuals and enterprises."

Pathways to survival for a tiny primate

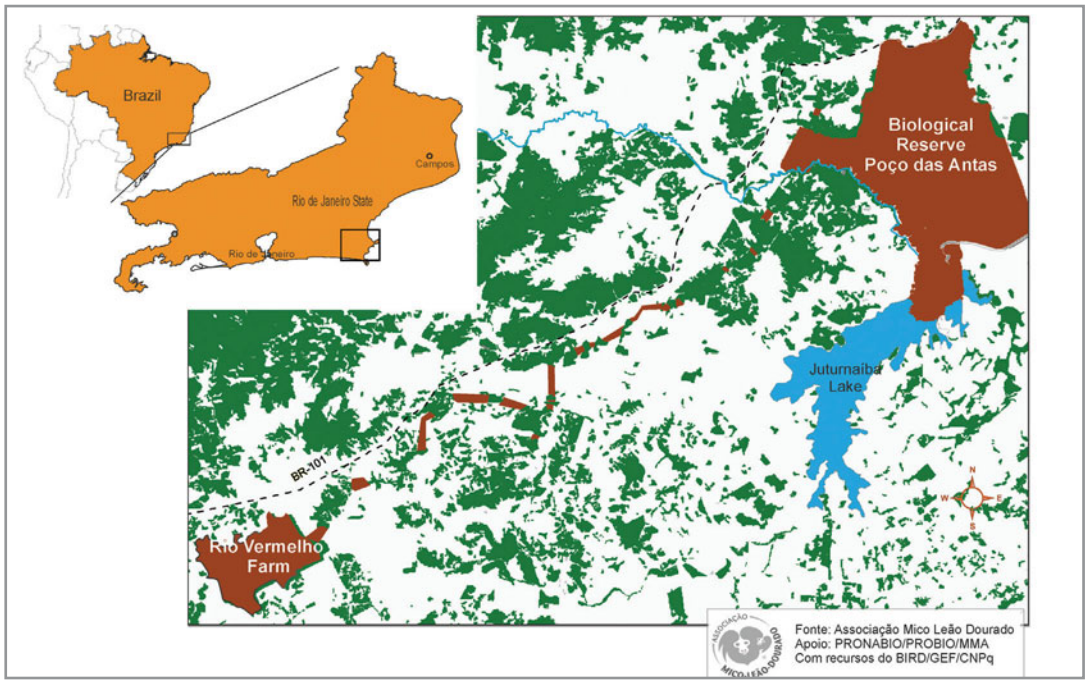
The diminished world of the golden lion tamarin gets a little bigger

Imagine a world where all the people live on small islands, many of them no more than a beach and a few palm trees. Lacking seagoing craft, they cannot get from one island to another to trade, to socialize, to seek mates, or to flee in case conditions get desperate on their own speck of land.

This is a pretty fair description of the plight of one of our fellow primates, the golden lion tamarin (*Leontopithecus rosalia*). This tiny monkey, dazzling in its golden fur and pouffy mane, is one of the most endangered species on earth. Its islands are fragments of forest in a sea of pastures, croplands and ever-expanding population centers east of the city of Rio de Janeiro.

A mother and her baby: Will the next generation of tamarins grow up in a bigger, more secure habitat?

Five centuries ago, things were quite different for the tamarin. It and three closely related species lived in a part of the great Atlantic Forest that stretched 2,800 kilometers from Brazil's southernmost state of Rio Grande do Sul to the state of Rio Grande do Norte. As Brazil grew, the forest was transformed into the agricultural, industrial and urban heart of a new nation. Its biological diversity, rivaling the better-known Amazon, was buffeted by advancing waves of sugar cane fields, cattle pastures, coffee plantations, and vast cities. Today, only 7 percent of the original



The tamarin's survival depends on stitching together forest fragments to create a large breeding population.

Atlantic Forest remains, much of it in forlorn fragments fringed by dead and fallen trees.

The forest loss is particularly pronounced in the tamarin's Rio de Janeiro homeland, where only about 2 percent of the original forest remains.

In Rio de Janeiro and in other rapidly changing areas around the world, many species are coming under growing pressure as people increasingly alter their habitat. The problem of species extinction is a very serious one, not only for charismatic species such as the tamarins, but also for myriad other forms of life. Species are currently disappearing at a rate estimated at from 50 to 500 times the historic rate, according to the recently released Millennium Ecosystem Assessment. The consequences of such a massive die-off, on a scale that has occurred only five times before in the history of the earth, are not known.

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The major threat to the tamarin's survival is low numbers and how groups are distributed among the surviving forest fragments. Members of small, closely related bands living in isolation have no opportunity to find mates in more distantly related groups. The result is an impoverished gene pool and a greater risk of hereditable defects and disease. Even with absolute protection, a species can pass a genetic point of no return and disappear for good. It almost happened with the tamarin. In 1969, the animal's total population in the wild dipped to a low of 200 individuals, distributed in isolated groups.

Even in the two relatively large reserves dedicated to protecting the tamarin, the animals are vulnerable to inbreeding as well as predation and environmental change. Catastrophe can come without warning, such as when a fire consumed a good part of the 6,300-hectare Poço das Antas Biological Reserve in 1989, destroying the food sources and hiding places on which the tamarins depended.

A serious threat to the tamarins is predation. In a healthy ecosystem, predators are

crucial for maintaining healthy prey populations. But there are too few tamarins, and their habitat is too degraded to permit the loss of many members. In more than one instance, researchers tracking tamarins with radio telemetry have found their transmitters were sending signals from inside boa constrictors. In another case, a scientist filmed a boa consuming a female with its baby, all while being attacked by two males. (The snake won.) In another case, a female tamarin was observed killing and partially eating another tamarin's baby, the in the process providing an illustration of why it is unwise to look for ethical lessons in nature. Tamarins that stray from their forest habitat are particularly vulnerable. A short hike across a pasture to reach a neighboring patch of forest could end in a fatal encounter with a neighborhood dog.

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Researchers believe that saving the tamarin will depend on increasing its population by 2025 to 2,000 individuals organized as a freely evolving population on 25,000 interconnected and protected hectares of forest. They have set these goals by plugging current knowledge about the tamarin into a conservation tool called the Population and Habitat Viability Assessment. At present, a total of 1,200 tamarins live on 17,000 hectares of forest. Most of the other 480 live in zoos worldwide, many of them donated by Brazil's environmental protection agency.

The most feasible way to achieve these goals is to plant forest corridors to link the bits and pieces of remaining forest fragments, in this way making them available to the tamarins to expand their range. The corridors are analogous to the roads and waterways that enable human societies to create large, interdependent economic and political units. For tamarins, these corridors will create what biologists call a "metapopulation." Members of a metapopulation can roam freely over a wide geographical area to find suitable mates, exploit supplementary food supplies, and make their escape in case disaster should strike their own forest fragments.

Building these vital forest corridors depends entirely on the cooperation of ranchers and small farmers for the simple reason that they own the land needed for planting the trees. They also own the forest fragments where tamarins have been successfully reintroduced since 1984 from captive populations.

A locally based association is working to save this endangered primate from extinction.

How can local landowners be persuaded to donate land for the corridors? This is part of the job of the Golden Lion Tamarin Association, one of the country's most respected conservation groups. Founded in 1992, it builds on work carried out since the 1960s that led to the creation of the Poço das Antas Biological Reserve, the country's first protected area.

Unlike many struggling conservation groups in Latin America, the association has succeeded in attracting funding from around the world. In Brazil, major financial support comes from the Environment Ministry's National Environmental Fund. The fund has underwritten some 1,000 projects throughout the country, in many cases with the help of a total of $46 million in financing from the Inter-American Development Bank.

Over its short lifespan, the association has become an international hotspot for conserva-

tion biology, drawing researchers from Brazil and around the world seeking to study the tamarins and their ecosystem. A list of the scientific papers these researchers have produced filled more than 10 pages in a recent association annual report.

As a scientific organization, the association holds a special distinction. In few other places in the developing world can researchers find such a stable institution for monitoring a species' interaction with its habitat. Moreover, the tamarins are used to people, so the presence of researchers with clipboards does not alter their behavior. The association's most valuable scientific asset is the long period of time during which the studies have been carried out. Researchers have followed many of the same individuals from birth to death. Such longitudinal studies are critical in a field where genetics plays an important role. Researchers know who the fathers and mothers are of nearly all of the animals, detailed data rarely encountered in the world of conservation biology.

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In the association's early years, researchers found that their scientific expertise did not prepare them for the tough job of getting cooperation from skeptical landowners. Scientists are trained to ask questions, conceptualize experiments, handle data, draw conclusions, and write papers. Few are eager to leave their laboratories or field experiments to lobby local people on conservation issues.

But the association's staff made it their business to learn about the local people, just as they have had to learn about tamarins. What are their problems? What are their needs? What could the people gain, both psychologically and economically, by allowing the association to introduce tamarins and plant forest corridors on their land?

The association has made considerable progress. "We have here the first case in the world where the wild population of an endangered primate has increased," said Denise Marçal Rambaldi, the association's general secretary. "But it took nearly 30 years to make this happen." The 2003 edition of the Red List of Threatened Species maintained by the International Union for Conservation of Nature had downgraded the tamarin's status from "critically endangered" to merely "endangered."

The project to plant forest corridors builds on a solid foundation of knowledge of the tamarin's habitat requirements, forest dynamics and land use surrounding the frag-

Biologist Rodrigues uses radio telemetry like an electronic leash to keep track of her research subjects such as the monkey (below) outfitted with a transmitter.

ments. These data were gained the hard way—by countless hours of observation in the field over a period of many years.

Biologist Susie Rodrigues, a doctoral candidate whose work is partially funded by a local municipality, spends a good deal of her time in the forest tracking down and observing the tamarins. One day, she and Paula Procópio de Oliveira, the association's technical director and coordinator of the project being funded by the National Environmental Fund, set out to find a group of tamarins known to inhabit an area in the União Biological Reserve, the region's other large protected area. Some of these animals have been fitted with radio telemetry devices that make it possible to track their movements.

Rodrigues stepped out of her 4x4 and held aloft what looked like a television antenna. Over her shoulder hung a receiver that would pick up signals from a group of tamarins that she knew were in the dense forest further down the hillside. She and Oliveira ducked along a pathway that tunneled through a dense understory of trees and vines. Every so often, Rodrigues held her antenna aloft. They were getting closer, she told Oliveira.

Suddenly the forest came alive with a rustling of leaves and a swaying of branches. The tiny monkeys hurled themselves from tree to tree, en route to a feeding spot. Just meters away, one tamarin with a radio transmitter strapped around its neck landed on a limb with a gentle thud (tamarins only weigh about half a kilogram). It glanced at the intruders and moved on.

Rodrigues has identified 1,300 trees that produce food on which the tamarins depend. She has marked many of these with plastic ribbons. She explained that the monkeys not only need an abundance of fruit-producing trees, but also trees of many different species to ensure that at least some are producing at any given time during the year. Other foods they favor include nectar produced by bromeliads, insects, amphibians, and tree sap. In some cases they use their long, slender fingers to probe into cracks and crevasses, a behavioral trait called micromanipula.

Best appreciated in the shadowy fastness of its native habitat, the little animal's luminous beauty helps to explain its attraction to humans. Although conservation biologists avoid referring to animals as cute (at least in public), the tamarin's eye appeal is a definite plus for conservation efforts. Whatever advantage this animal's appearance has conferred in its evolutionary history, it clearly gives them an important handicap in the race for survival in a human-dominated world. People like them, therefore their survival matters.

Just as some regions are identified in the public mind with a distinctive culture, landscape or cuisine, this corner of Rio de Janeiro state has become synonymous in many minds with the golden lion tamarin. At the association headquarters, researchers wear tee shirts with a tamarin logo. The fiberglass booth of a public telephone is shaped like a giant tamarin. The public reserve that surrounds the association headquarters, which is managed by the environmental protection agency Ibama, receives some 6,000 visitors annually, among them local schoolchildren. Interest in the tamarins' well-being can even transcend political boundaries. For example, one municipality paid for half of the cost of remodeling the association's headquarters, even though the facility is located in a neighboring municipality. Local governments recognize the tamarin's value as a draw for tourists.

It's a lot of responsibility for one animal. But small and endangered though they may be, the tamarins and their human allies are proving that environmental degradation can be reversed and that an impoverished biological diversity need not be the inevitable fate of an increasingly human-dominated world.

Monkeys vs. people?

Conservation can be a win-win proposition for nature and people

Brazil's Golden Lion Tamarin Association exists to achieve one objective—bring a little monkey back from the brink of extinction.

Even in wealthy countries, people working to save endangered species frequently must respond to criticism that protecting nature often comes at the cost of people's livelihoods. In countries with serious and pervasive poverty, how can conservationists justify spending hundreds of thousands of dollars to save one animal while millions of people desperately need help?

Denise Marçal Rambaldi, the association's general secretary, based in Silva Jardim, in Brazil's eastern Rio de Janeiro state, gives a short answer and a long answer.

First, she says that Rio de Janeiro state has at least 700 organizations that help needy youth. But her association is the only group working to save the golden lion tamarin. Her annual budget of around $400,000, which comes from a large number of local, national and international sources, is "infinitely smaller" than the money being spent to help disadvantaged people. Moreover, she said, "our funding sources are completely different from theirs. We're not competing for resources with these other organizations."

But more importantly, her association's efforts to save the tamarin are helping to address the problem of rural poverty. Many of the slums that ring the region's big cities are populated by families that migrated from rural areas in search of better opportunities. "These people were, in effect, expelled from the land," she said, because the big, unproductive farms cannot provide them with work. The answer is not less conservation, she said, but rather more conservation, which will improve agricultural productivity and expand economic opportunities for all. "We must improve people's understanding of the connection between a healthy environment and their own well-being," said Rambaldi.

Rambaldi says that saving the monkey will indirectly help people's lives by improving the farm environment.

The association itself employs some 30 local community members. Through its work in reforestation and soil conservation, it is also helping small farmers to increase their production. Other association staff are showing local people how to earn additional income with handicrafts and other activities.

Finally, in protecting the tamarins, the association is safeguarding the region's main tourism resource. Both the monkeys and their protectors have put an otherwise unremarkable part of Rio de Janeiro state on tourism itineraries, thus creating new sources of income.

"So I think that we are making a pretty substantial investment in this region's welfare," said Rambaldi.

More options for poor farmers

Conservationists and small farmers first had to get to know each other

The 106 families in the farming settlement of Cambucaes, east of Rio de Janeiro, Brazil, mainly worry about making ends meet, not about the fate of a little monkey, no matter how cute or close to extinction.

Yet today, many of these same families have become protagonists in a plan to save the golden lion tamarin, one of the world's most endangered species. In so doing, they have joined forces with two neighboring groups with whom they formerly had practically nothing in common.

A bundle of stakes will mark the spots for trees that will form a new forest corridor on the land of a small farmer. A local conservation association supplies the expertise and the seedlings, as well as the labor to do the work. The farmer provides the land.

The people in the first group are the scientists and conservationists with the Golden Lion Tamarin Association. They are based in a large nature reserve that the settlement residents would probably be eager to use for hunting and cutting firewood, if they could.

The second group consists of the region's big landowners, mostly wealthy professionals and government officials who live in Rio. The Cambucaes settlement itself was carved out of one of these large ranches as part of a takeover operation carried out by Brazil's landless movement.

These odd bedfellows have coalesced around a conservation mission that, while far from being won, is showing how local people with radically different interests and points of view can be mobilized in the cause of pro-

tecting a valuable natural heritage. All three groups are doing their part to stitch together a safety net of forest fragments with corridors of trees. The tamarins need these corridors to travel from one area to another, where they can meet, mate, and create a viable gene pool that will ensure the health and reproductive success of future generations.

Seven years ago, the Cambucaes settlement was identified as a missing link in the chain of forest fragments and corridors. The association's job was to convince the farmers to allow a part of their land to be used to create corridors.

Things got off to a bad start. Part of the problem was the association's inexperience in dealing with small farmers. "We only knew about tamarins," said Paula Procópio de Oliveira, the association's technical director. And the local people? "At first they didn't understand what we were doing," she said. "When they did learn, they wanted to know why we were spending so much money on monkeys when so many people are suffering from hunger." Also, by their nature, farmers are conservative and reluctant to try something new. Moreover, many settlement residents had previously worked in sugar cane processing plants or came from urban areas, and so had no farm experience. On top of everything, many were convinced that the association was planning to take their land from them. The settlement split into two groups, one favoring cooperation and the other opposed.

Clearly, the Golden Lion Tamarin Association had to try a new approach if it was to win the small farmers' hearts and gain access to their land. "We could see that you can't go into a community and say, 'do this, don't do that,' without offering something in return," said Oliveira.

So the association's staff started to talk with the Cambucaes farmers. They learned how the farmers had to struggle to eke out a living on poor, unproductive land. The association concluded that it could help them boost their land's productivity while at the same time provide habitat for the tamarin.

A banner marks the 12th anniversary of the takeover of a large ranch by landless settlers.

Their efforts paid off. Today, the association's Rosan Fernandes spends a good part of his time helping to establish forest corridors on the land of Cambucaes farmers. As he explained, a forest corridor is a kind of agroforest in which native trees, fruit trees and crops are grown together. While humankind has practiced variations on the agroforestry theme since the dawn of agriculture, growing mixtures of plants has become obsolete in the age of industrial, monocultural farming, except where traditional agriculturalists cling to the old ways.Today, however, agroforestry is being rediscovered as a way to increase production by conserving soil and water resources while providing habitat for plant and animal species.

Fernandes had an afternoon appointment at a 14-hectare farm owned by a woman he identified as Dona Leda. But first he stopped at the tree nursery in Cambucaes that the association helped to establish by providing the farmers with seeds and technical advice. The association also buys the seedlings, plants them, and makes sure that the fledgling forests would be properly maintained.

Fernandes was greeted by Benedito Lessa, who proudly named the different plants in his beds of seedlings. "In the past, all the people here knew was to cut the brush, burn it, and plant," Lessa said. But farmers are learning to take a smarter, longer-term view of their relationship to the land. "When you plant a fruit tree, you don't harvest tomorrow," he said. "We have to make a compromise between the present and the future." It will take three or four years for the fruit trees to begin producing. In the meantime, farmers earn income from annual crops such as cassava, corn, and vegetables.

Fernandes loaded a bundle of stakes into the back of his pickup truck and headed off to the farm of Dona Leda. He explained that her corridor, which would extend some 510 meters and measure between 35 and 50 meters wide, would abut a small road. On the other side was the start of a corridor that had already been established on the property of a large landowner. The tamarins will be able to cross the road because the trees selected for either side will develop large interlocking crowns.

Dona Leda's corridor will occupy more than 10 percent of her farm. This would be an unreasonably large chunk of land if its only aim were to help tamarins. But in a few years she will be earning money from fruit and eucalyptus trees (for wood production), pineapple, coffee, and other crops, all planted together with native trees. Meanwhile, the miniforest will be protecting her water sources.

Like many small farmers, Dona Leda began as a skeptic. Fernandes sympathized with her initial hesitation. "Investing a large portion of her land in a new technique could be very risky." But Fernandes reminded her that most of her land was in poor shape—eroded, stripped of its topsoil and incapable of supporting more than a few cows. He is convinced that Dona Leda made a wise decision. "Agroforestry will really increase her production," he said.

Eusemiro Silva, a third member of the tree planting team, was already reaping the benefits of agroforestry. He claimed that his pineapples, grown together with native trees, produce better than pineapples planted by themselves because the neighboring trees help the ground retain moisture. "It's not theory," Silva said. "It actually works."

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By making frequent visits, talking with the farmers and keeping their promises, the association has gained credibility in settlements such as Cambucaes. In so doing, it has stepped into a role that would normally be claimed by government extension agents. But the agents only come to the settlements "when the association brings them here," said nursery man Lessa. Likewise the environmental protection agency Ibama sometimes invites farmers to attend a workshop, "but only when there is a problem," he said. The local municipalities provide some support from their limited budgets. But in the end, practically the only technical assistance the farmers receive is provided by the association.

The association serves local people in other ways as well. It is working with women's groups to establish handicraft businesses. It even occasionally mediates when a settlement has a problem with the Brazilian land reform agency or a local municipality.

But while the association and its collaborators have made a great deal of progress in very few years, a secure future for the tamarin is still far from assured, said Oliveira. "People continue hunting and cutting down the forest. The fragments keep shrinking. And there are still a lot of charcoal ovens," she continued. "We are dealing with a dual reality."

Status symbols for the wealthy

'Mico mystique' is one reason why big landowners are helping a tiny primate

Rosan Fernandes remembers his first contacts with the big landowners in the eastern part of Rio de Janeiro state.

He would tell the rancher that the golden lion tamarins, called *micos* by the local people, are in danger of extinction. Then he would patiently explain that these monkeys could only be saved if the rancher would allow the association to plant forest corridors on his land to connect fragments of the animals' remaining forest habitat. The trees would be good for the rancher as well as for the monkeys because they would reduce erosion, improve soil fertility, and protect water supplies. It would not cost the rancher anything. The trees would be bought and planted by the Golden Lion Tamarin Association, the conservation group where he works as an agroforestry specialist.

As Fernandes recalled, the typical rancher's reaction would be "something like, 'Here is a group of conservationists that want to use some of my land to help a creature that you can't even eat'." In the end, Fernandes said, "They would remark, 'your work sounds very interesting, but count me out for now'."

But over time, attitudes started to change and many ranchers, who traditionally play the role of the conservationist's archenemies, have become among the tamarin's staunchest allies. Today, at least 30 of these *fazendeiros* have agreed to allow the association to introduce tamarins in their forests, or to plant forest corridors, or both.

A mosaic of forest fragments, pastures and eroded hillsides is all that is left of much of the Atlantic Forest, which once rivaled the mighty Amazon. Here, the endangered golden lion tamarin struggles for existence.

The corridors typically measure 50 meters wide and sometimes hundreds of meters long, with fences on either side to protect the young trees from hungry cattle. While the land used is crucial for the tamarin, it is generally negligible for the rancher—typically less than a hectare in total. "If it was a bigger area," said tamarin association general secretary Denise Marçal Rambaldi, "[the ranchers] would probably not be so agreeable."

The key to saving the tamarin is habitat, which is largely in the hands of the *fazendeiros*, although some strategically situated land is owned by smallholders as well. The association has determined that the tamarin's survival as a wild species can only be assured if the animal's population is increased from the present 1,200 animals on 17,000 hectares of land to 2,000 animals on 25,000 hectares in what was the *mico*'s historic range.

"We never thought we would get such cooperation," said Rambaldi. As she explained, the rancher's interest in saving the tamarin is motivated by a mixture of personal interest and pragmatism. Many of them are "gentlemen farmers," professionals or government officials who live in Rio de Janeiro during the week and visit their farms on weekends to pay their workers and relax. For them, being a landowner is a pastime and a source of pride. They love to be able to tell their friends that their property has animals that are featured on the Discovery Channel and appear on the cover of National Geographic. "Tamarins are a kind of status symbol," said Rambaldi.

The landowner gets another intangible but valuable asset by participating in the program: credentials as a conservationist that are displayed to all in the form of the yellow and green plaque that the association places at the ranch's main entrance. "They want to be regarded as benefactors of society," Rambaldi said. This is heightened by an element of friendly rivalry. "Landowners are always checking out what their neighbors are doing," she added. "If a neighbor has a plaque, they want one as well."

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Some ranchers have more serious reasons for cooperating with the association. An ever-present concern among large landowners in many areas of Brazil is the possibility of a takeover by landless settlers. *Sem Terra* (Without Land), an established national movement complete with administrators, computers and lawyers, is constantly on the lookout for large landholdings with shaky property titles or evidence of unproductive land management. After such a property is identified, a group of prospective settlers may set up camp and wait—sometimes for years—for the legal process to turn in their favor. But if a rancher is using his land to serve what Rambaldi calls a "noble use," in this case, as a refuge for an endangered species, the threat of a takeover is considerably less, she said.

Ranchers also know that trees safeguard their soil and water resources. So when they maintain their forest fragments or plant forest corridors, they are doing their land a favor. In Brazil, the importance of forests and natural areas as a land management tool is recognized by law. The government requires property owners to leave a certain percentage of their land in its natural state as a "legal reserve." The percentage varies depending on the region—from a high of 80 percent in the Amazon to 20 percent in the densely populated Atlantic Forest, which includes the state of Rio de Janeiro.

Many properties fall short of this requirement, making their owners subject to potential penalties. But the mere fact of the law's existence indicates that the land—even private land—is recognized as a public good. This stance contrasts with that of other countries. In the United States, for example, landowners

Severe land erosion might inspire an artist, but it gives nightmares to ranchers. A solution is to plant trees.

have almost free rein over how their properties are managed, reflecting a strong historical and cultural bias that favors the rights of private ownership. Laws requiring landowners to leave a certain amount of their land forested would "never happen" in the United States, according to noted U.S. environmental historian Donald Worster.

But regardless of the law, the mere fact that tamarins live in a particular forest provides a compelling reason to save it. "We've never had a case where a landowner told us to remove the *micos*," Rambaldi said.

Joining the save-the-tamarin movement also gives the landowner a measure of protection from trespassers. Normally, local people would slip into the big estates to steal wood, cut palm hearts, catch fish or hunt. But they will think twice when they observe the comings and goings of association technicians, whom they often mistake for officials from Ibama, the Brazilian environmental protection agency. Or the locals conclude that the association is at least working in close partnership with Ibama and will report any illicit activities observed. Whatever the reason, ranch administrators say that they spend less time chasing out trespassers once the association's green and yellow sign goes up at their property entrance.

Finally, landowners can take advantage of another feature of Brazilian land-use laws to both protect tamarins and their ecosystems, and at the same time get important benefits from the government. In 1990, Brazil created the Private Natural Heritage Reserve system, in which a landowner can request the government to declare the natural area on his property protected in perpetuity. In return, the area is completely exempt from the rural territorial tax and the landowner gets preferential treatment from official credit-granting institutions. These RPPNs (after their name in Portuguese) have become valuable pieces of the habitat puzzle being assembled to save the tamarin. The municipality of Silva Jardim, in the heart of tamarin country, has 11 RPPNs, the most of any municipality in the country. Rio de Janeiro has 44 RPPNs, putting it in fourth place among Brazil's states.

Whether the big landowners in this corner of Rio de Janeiro have become conservationists out of conviction or self-interest, they have made common cause with saving the golden lion tamarin. Without their support, the fight couldn't possibly be won.

The message of a little monkey

If it escapes extinction, the world will be more habitable for the rest of us

Like the tubes that keep an intensive care patient alive, corridors of trees planted in the farm country east of Rio de Janeiro are linking together forest fragments in an effort to save a little monkey from extinction.

The monkey is the golden lion tamarin, one of the most endangered species on earth and an icon of the conservation movement. The tamarins will travel these corridors to visit patches of forest in search of food and safety, and most importantly, to find mates that may help to expand the population's dwindling gene pool. It may not be pristine nature, but it will have to do.

This exercise in ecosystem engineering is the work of a conservation group called the Golden Lion Tamarin Association. The association has negotiated with ranchers and small farmers to plant forest corridors on their land. So far the program has been a success, but anything could happen. For example, a landowner could decide to cut down his forest corridor, thus severing the tamarins' life support system and sending the little monkey once more hurtling toward the black hole of extinction. Again, negotiation and compromise is not an ideal way to save a species, but it's the only option.

In Rio de Janeiro and across the globe, natural ecosystems are being altered and simplified to serve burgeoning human demands. When farms and cities replace forests and grasslands, the changes are clear and dramatic. But less visible perturbances, such as global warming, also threaten to disrupt ecosystems. Does it matter?

A plastic primate sends a call to save endangered species and the ecosystems on which life depends.

It does indeed matter, according to some 1,360 scientists and other experts from around the world who produced the Millennium Ecosystem Assessment (MA). Unlike studies that merely document environmental problems, this groundbreaking report shows how the destruction of natural ecosystems is jeopardizing the environment's ability to provide the services on which people depend.

Most people, particularly city dwellers who have little contact with nature, assume that the soil, water, climate regulation, pollination and the many other so-called environmental services will always be there to meet human needs. Most economists don't even include environmental services in calculations of a country's current economic activity. As a result, according to the MA authors, "a country could cut its forests and deplete its fisheries, and this would only show as a positive gain." They cite Ecuador, Trinidad and Tobago and Venezuela as examples of countries that have

posted positive growth in net wealth, yet show a net loss when depletion of their natural resources is factored in.

The MA, which was coordinated by the United Nations Environment Programme, has a good deal to say about prospects for the success of another U.N. initiative, the Millennium Development Goals (MDG). In the MDG project, countries have pledged to reduce poverty by setting goals for themselves in eight key areas.

According to the authors of the MA, these goals cannot be met if ecosystems can no longer provide environmental services. Four of the eight MDG target areas are particularly at risk. They are: *hunger*, because agriculture is sensitive to climate change, soil degradation and water scarcity; *disease*, since alterations in ecosystems encourage some of the most serious infectious diseases; *child mortality*, which closely reflects levels of nutrition and disease; and *poverty*, which affects all of the above. For many societies, the future is already here. Many countries with the highest levels of poverty are precisely those whose ecosystems are in the worst shape. According to the MA, a six-fold increase in global domestic product projected for 2050 will make it even harder for countries to meet MDG targets—even if population growth levels off, as expected.

The authors of the ecosystem assessment do not call for a radical overhaul of national and global institutions. But they insist that many institutions will have to change how they manage resources in the public domain. They also call for stronger regulatory and accountability systems, elimination of perverse economic incentives, and more participation in decision making by marginalized groups such as the poor, women and indigenous communities. They call corruption a "major obstacle" to effective ecosystem management.

Among the many evidences of ecosystem decline, the most poignant is the extinction of a species. Losing the golden lion tamarin would amount to erasing a part of our earth's natural treasure as surely as destroying a painting by Picasso or a Beethoven symphony would constitute acts of cultural vandalism. Still more, when a species disappears, it means that the earth has become just a little less habitable, and not just for plants and animals, but also for humankind.

According to conservative estimates, species have been going extinct over the past century from 50 to 500 times the so-called "background" extinction rate that has prevailed throughout the earth's history. The present rate may be much higher. Most of the world's species are still unknown to science, or are very rare, so their disappearance can easily go unrecorded.

Paula Procópio de Oliveira, the technical director of Brazil's Golden Lion Tamarin Association, has dedicated her professional career to saving this monkey. Many others around the world are also working to conserve ecosystems, protect habitats and save other species.

When asked if she thought that her efforts to bring back the tamarin would ultimately succeed, Oliveira gave a simple but unsettling answer.

"Sometimes yes," she said, "and sometimes no."

A constellation of conservation organizations, Brazilian as well as international, has come to the aid of the golden lion tamarin. These are just a few.

Disease threat turns farmers into conservationists

They worry that peripatetic pathogens will cross from wild animals to their domestic animals, and maybe even to themselves

Farmer Cícero Joaquim Sebastião put a headlock on his cow, stopping its backward lunge. With his free hand he grabbed the animal's nostrils with a pair of iron pincers. That settled the contest of wills, and veterinarian Cássio Roberto Peterka was able to sink his syringe into a vein in the cow's neck. He drew a blood sample and emptied it into a test tube.

It wasn't the kind of pastoral scene that inspires poets. But neither was it a routine visit of a veterinarian in the Pontal do Paranapanema, a ranching region in the far western corner of Brazil's São Paulo State.

A veterinarian in western São Paulo state convinces a cow that a blood sample is for her own good.

Peterka is both a veterinarian and a practitioner of conservation medicine. A member of the Institute for Ecological Research (IPÊ, after its initials in Portuguese), he is interested not only in the health of Sebastião's cattle, but also of the creatures living in the nearby forests. A relatively new field, conservation medicine links together three disciplines that generally have little to do with each other: conservation biology, veterinary medicine and human medicine. As Pe-

terka would explain, many disease pathogens freely pass among populations of wild and domesticated animals, as well as to people.

Paranapanema is the classic example of an area where disturbance and deforestation have created an ideal setup for disease transmission. The 247,000-hectare triangle of land was declared a nature reserve back in 1942 to protect a prime piece of the fast-disappearing Atlantic Forest. But this idealistic plan could not resist the designs of land-hungry farmers, who around 1945 invaded the reserve together with their domesticated animals, plants, and microbes. They converted much of the forest into pasture in a process that continues today throughout Latin America.

Today, Paranapanema is largely a land of low-intensity cattle ranching on large holdings. Some of the ranches contain fragments of the original forest, some 21,000 hectares in all. In the 1990s a new wave of colonists invaded the region. Landless families organized by the Brazilian Land Reform Movement succeeded in taking over some of the large holdings and dividing them into settlements of small farms. Sebastião lives in one of these settlements.

Peterka wants to help farmers and also protect wild animals.

The only remaining vestige of the original Paranapanema reserve is the 36,500-hectare Morro do Diabo State Park. Its centerpiece is a flat-topped hill (the *morro*), visible for kilometers, around which a fairly intact ecosystem provides refuge to large mammals such as wild pigs, cats and tapirs, as well as many smaller creatures.

An extrovert with a ready smile, Peterka thoroughly understands the needs of the local farmers. But he is also a committed conservationist and he mourns the disappearance of the forests and worries about the tenuous existence of the remaining wild animals.

A flat-topped hill marks the last stronghold for Paranapanema's original plants and animals.

"Today there is no way of talking about conservation without including the people that live in the area," he said. "Our job is to teach them to be conservationists as well."

Peterka's work is being financed with the help of a $90,000 grant from Brazil's National Environmental Fund (FNMA, after its initials in Portuguese) provided to the IPÊ, one of the country's premiere conservation organizations, headquartered outside of São Paulo. The IPÊ project is one of some 2,000 nationwide that the FNMA has financed with the help of IDB loans totaling $46 million.

The Paranapanema study aims to determine how the process of forest fragmentation relates to the incidence of diseases in two species of wild pig and three species of wild cats, as well as in domestic animals and man. Most of the work is carried out in the area bordering the Morro do Diabo Park. Peterka's findings will help protect the wild pigs and cats from disease. Monitoring the status of these "sentinel species" will also enable biologists to better gauge the health of the ecosystem in general and anticipate future threats.

Disease poses a bigger danger to wild populations than to domestic animals, if only

Tree seedlings from a community nursery will be planted by farmers to create habitat and protect the soil.

because wild animals cannot be kept under constant observation and given treatment, said Peterka. Epidemics in wild animal populations, often unobserved and unrecorded, could be causing long-term problems by reducing fertility and recruitment of the young, resulting in a steady decline in the population. As far as Paranapanema is concerned, this is the hypothesis. "This is what we think is happening, but nothing is proven so far," said Peterka. Solid answers could take five to eight years to emerge, or even longer.

Back at the farm, Sebastião told Peterka that he had chosen these 19 cattle for testing because they were sick during the dry season and now were suspiciously scrawny. The laboratory will test the blood samples for brucellosis and leptospirosis, two highly transmissible diseases that debilitate cattle and other domesticated and wild animals. These same diseases also infect humans. Peterka predicted that the samples will probably prove negative. The poor condition of the cows, he said, was probably due to their simply not getting enough to eat.

In fact, Sebastião has 54 cattle on his 18 hectares of land, which is a lot, considering the sorry state of his pasture. He depends on them for meat, milk and hides. In addition, he grows corn and cassava, as well as trees, both fast-growing eucalyptus for wood and native seedlings he received from IPÊ's reforestation project.

Peterka visits all of the farms in the area of the park, testing horses, dogs, cats, pigs and other domestic animals as well as cattle. Many farmers are convinced that their cattle have brucellosis, but tests so far have come out positive for only one animal. Leptospirosis, however, is widespread, particularly in horses.

It was fitting that Peterka started his day on a farm, since the diseases that have invaded the natural areas were originally introduced by domesticated stock. Now he would go to a large forested area on a private ranch and try to capture wild pigs for testing. On the way, he stopped at the farming community of Teodoro Sampaio to buy bags of salt and grain to bait the animals.

Peterka described the precarious status of the region's large mammals and how their welfare reflected the overall health of Paranapanema's remaining forests and their inhabitants.While both of the wild pig species appear similar, they have very different habits, he said. The white-lipped peccary (*Tayassu pecari*) travels in bands that can exceed 200 animals. They often go great distances to find food supplies, making them highly vulnerable to local extinction where only patches of forest remain. The collared peccary (*Tayassu tajacu*) rarely travels in groups exceeding 20 individuals. Both have a major impact on the forest's ecology, rooting through the upper layer of soil and dispersing seeds that pass through their digestive tract.

The wild pigs share diseases with domesticated animals as well as with man. For example, IPÊ research so far has determined the presence of leptospirosis in 25 percent of domestic animals tested (including cows, dogs, pigs, horses and sheep) and 78 percent of wild peccaries analyzed, a finding that researchers consider worrisome. Elsewhere in Latin America, entire herds of peccaries have been reported decimated by such diseases.

If wild pigs start to disappear, the cats that prey on them will have to find other sources of food, which would likely be domesticated animals. This additional contact would further encourage disease transmission as well as farmers' ire over the loss of their animals.

All three of the wild cat species—the jaguar (*Panthera onca*), the puma (*Puma concolor*) and the ocelot (*Leopardus pardalis*)—are on the endangered list maintained by the International Union for the Conservation of Nature. As large predators, they play a key role in the ecosystem by regulating numbers of herbivores. In so doing they determine to a great extent the composition of other plants and animals. Their elimination in nearly all cases causes a ripple effect resulting in a loss of species diversity.

A classic illustration of the effects of the loss of large predators was documented at the Smithsonian Institution's research station on Panama's Barro Colorado Island, which was created when a forest was flooded to create a lake to supply water to the Panama Canal. Biologist Edward O. Wilson describes what happened: First, jaguars and pumas abandoned the island, which allowed herbivores to multiply 10 fold. The herbivores overexploited the large seeds, reducing the numbers of trees that produced them. Meanwhile, trees that produced small seeds flourished, as did smaller animals that fed on the seeds and their suite of predators. And so it went, the changes eventually affecting even the species composition of bacteria and fungi populations. Similar scenarios have been observed in many other locations. One study carried out in Venezuela found that the disappearance of jaguars from newly created islands caused numbers of tree species to drop from 225 to 27.

Data from a captured peccary will be used to help prevent diseases that can decimate wild pig herds.

According to Peterka the three Paranapanema cat species are particularly susceptible to feline leukaemia virus and feline immunodeficiency virus, which could affect domestic cats that live around the Morro do Diabo Park. Although most domestic cats in the area are malnourished and plagued with ticks and fleas, a sample of 20 cats turned up negative for lentivirus antibodies and the feline leukaemia virus antigen.

Peterka now arrived at the forest where he hoped to capture wild pigs. He slung the heavy bags of feed over his shoulder and followed a path to a clearing containing a rustic wooden enclosure. He dumped the bait inside and set the trap door. He and his visitors settled down on the damp earth, with their backs against trees, and began their vigil. But after several hours without even a rustling in the

underbrush, Peterka concluded that this was not a lucky day.

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Just as the Pontal do Paranapanema is a thoroughly manmade landscape, the IPÊ must work closely with both large- and small-scale farmers in order to achieve its conservation goals. The more local people understand about mechanisms of disease transmission and prevention, the better able they will be to safeguard their own animals—and their wild counterparts.

In addition to making "house" calls at farms such as Sabastião's, the IPÊ organizes workshops where groups of farmers are briefed by experts from the governmental sanitary and epidemiological services and other agencies. In addition to health-related subjects, speakers teach the farmers soil conservation techniques, reforestation, pasture improvement and the use of alternative feed for cattle. In this way, the IPÊ shows the people that it is interested in their welfare and not just in saving wild animals. "We've never gone to a farm where the farmer refused to let us test his cattle," said Peterka. "They are always cooperative."

This pragmatic approach is starting to change attitudes and practices. For example, after milking a cow, local people customarily leave a little raw milk in a dish for the dogs. But farmers are starting to abandon this traditional practice after learning that a cow infected with brucellosis could pass the disease on to the family pet. In one settlement, farmers have stopped using the nearby forest as a convenient place to dispose of farm animals that have died from disease because they learned that this could spread pathogens to wild animals.

The farmers are also learning to appreciate the workings of nature, both for its own sake and as a matter of self-interest, said Peterka. Interestingly, the small farmers care more about conservation than the more educated, more sophisticated big landowners. The reason, he said, is that the large landowners often live in the big cities and come to their ranches only a few times a year.

Sebastião, for example, readily acknowledged the importance of forests in maintaining his water supplies. Even more, he said, forests make it possible for "our children to grow up knowing about wild animals." He reported that wild cats occasionally frequent his farm. "I saw tracks just last week," he boasted. Although the cats occasionally make off with an occasional dog, a pig, or some chickens, he accepts the losses.

But while Sebastião collaborates with the conservationists, helping to trap wild pigs and adopting many of their views, he remains loyal to his culture, family and neighbors. This can cause dilemmas when newly aquired ideas about conservation conflict with traditional practices. For example, a perennial flash point between conservationists and local people is illegal, unregulated hunting. Farmers by day, poachers by night, local people armed with shotguns can pose a serious threat to the survival of large mammals. Do Sebastião's neighbors hunt in the reserve? He gave the following elliptical reply: "I've never seen them hunt, so I don't know if they do. If I said they hunted, then it would be a lie. But it could be that they hunt." Has he himself ever eaten wild game? "People say it's tasty," he said. "But all I know is that beef is good. I love a nice fat steak. My freezer is full of beef."

Local populations may hinder or help in conservation efforts. But they cannot be ignored. "In the reality in which we work, if people don't have a decent standard of living, and don't have at least some understanding of conservation, we will not make any progress," said Peterka. "It doesn't do any good to try to preserve a park if the people don't want it."

Brazil's other rainforest

Still brimming with biological diversity, the Atlantic Forest needs allies

Everyone knows the Amazon, a land of superlatives, of romance and controversy. But few people outside of Brazil and the conservation community think much about the continent's other great repository of plant and animal diversity, the Atlantic Forest.

The reason is simple: Most of the Atlantic Forest is gone. It once stretched 2,800 kilometers from Brazil's southernmost state of Rio Grande do Sul to the state of Rio Grande do Norte. But of the forest's original 1.3 million square kilometers, only about 7 percent remains today in fragments totaling some 99,900 square kilometers. Coincidentally, some 70 percent of Brazil's population lives in the area the Atlantic Forest once occupied.

The forests of Guaraqueçaba, in Paraná state, retain their splendor and much of their biological diversity despite their close proximity to major urban centers.

As the forest has gone, so have many of its species, in many cases quietly and without official notice, victims of habitat loss and fragmentation. Conservationists working to preserve the forest's remnants bemoan its lack of celebrity status. "The majority of international donors are more interested in the Amazon than the Atlantic Forest," said Denise Marçal Rambaldi, general secretary of the Golden Lion Tamarin Association, in the state of Rio de Janeiro. "They think that the 7 percent of the forest that remains is sufficient to conserve its biodiversity, but we know that's not true."

The Atlantic Forest continues to shrink. Rambaldi showed satellite photos from 1986 in which deforested land appeared as red dots, as in a mild case of chicken pox. A current photo of the same area looked like a virulent rash.

The conservationist and the sheep rancher

In the high Andean redoubt of the endangered condor, the meeting had the potential for being a classic confrontation

Gustavo Mosquera threaded his way out of the traffic of downtown Quito, Ecuador, and headed southeast, toward the cold, wind-swept slopes of the Antisana Volcano.

The technical director of a conservation group called the Antisana Foundation, Mosquera had an appointment with José Delgado, a sheep rancher whose family owns an immense swath of the land around the volcano's flanks. It looked like a recipe for a classic confrontation: the bearded environmentalist vs. the landowner who doesn't want anyone telling him how to run his business. Or alternatively it could be one of those rare instances where two potentially opposing viewpoints find common ground.

On the slopes of Ecuador's Antisana Volcano, Mosquera and Delgado discuss how to protect an environment critical to many species, including the rare condor.

As Mosquera passed through the city suburbs and then a succession of villages, he described the biological and human importance of the seemingly bleak high altitude environment. Called the *páramo,* this ecosystem of grasslands, 4,000 meters above sea level, supports a remarkable community of plants and animals, many found nowhere else.

The *páramo* also supplies the water on which a large part of Quito's population depends. Meltwater from the glaciers on Antisana, combined with precipitation, seep through the matted vegetation to feed brooks, streams and finally rivers. In 1996, engineers from

Quito's autonomous public company, known as EMAAP-Q, built a reservoir to store part of this runoff in a water supply project that was financed with the help of a $136 million loan from the Inter-American Development Bank. A pipeline from the reservoir transports water at a rate of 1.5 cubic meters per second to some 320,000 residents in Quito's southern district.

Most city dwellers are not aware of this and other environmental benefits they receive from the *páramo*. "When you ask a *Quiteño* where water comes from, he will say, 'from a faucet'," said Mosquera. Indeed, a park in downtown Quito features an enormous sculpture of a faucet suspended in space. Out of this disembodied piece of plumbing flows a copious stream of water that has no apparent origin. Few residents realize that the real origin of their water lies in the mountains, far beyond the park.

A project to extract this amount of water could have had disastrous consequences for *páramo* ecosystems around Antisana. But early on in the planning stages, EMAAP-Q resolved to reduce to the minimum the impact that this pipeline and reservoir would cause. It would not repeat the experience of many large infrastructure projects, where environmental management only comes as an afterthought.

The real message of this surrealistic spigot in a Quito park lies in the mountains beyond: they are the real water source.

The water company needed environmental expertise and it turned to the Antisana Foundation, a group established in 1991 with funding from USAID, The Nature Conservancy, and the governments of Switzerland, Great Britain and the Netherlands.

Little rivulets seeping through the matted *páramo* vegetation supply water to millions of people in Ecuador's capital of Quito.

As work on the water project proceeded, the foundation successfully lobbied the government to create the 120,000-hectare Antisana Ecological Reserve. Ultimately, the government contracted the foundation to manage the reserve to protect both Antisana's water resources and its endangered species and ecosystems.

The foundation was well qualified for the job, not just for its environmental expertise, but also because of its experience in working with people. About half of the reserve's area is land owned by the Delgado family. Outside of the reserve, land critical to the ecosystem is also privately owned.

"Big ranchers, small farmer cooperatives, indigenous communities—we work with them all," Mosquera said. "In a sense, property owners are providing a free service, and not just for the people of Quito, but for humanity, by protecting plants and animals."

Driving further up the mountain, Mosquera passed a mass of volcanic lava that had filled a valley and solidified during one of Antisana's eruptions, the last of which occurred in 1802. The air grew damper and colder.

The road skirted a series of cliffs on the far side of a small valley where some of the area's remaining condors roost. Three Andean ibises passed overhead and alighted near the road, offering a good view of their white breasts and graceful, decurved bills. The *páramo* is home to a unique avian fauna that attracts binocular-toting tourists, said Mosquera. His foundation is helping private landowners to design tourism facilities that will help them attract more tourists as a way to generate income with a low environmental impact.

The main job of the foundation's six technicians and three extension workers is to help property owners carry out conservation practices that will not threaten their bottom line, and in some cases, even increase profits. For example, by improving their pastures, ranchers can raise the same number of animals on less land. Then they can put their steep, easily eroded slopes off-limits to grazing and allow the natural plant cover to reestablish itself.

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The foundation operates more like a soil and conservation agency than a green advocacy group. In fact, Mosquera emphatically distanced himself and his group from what he considered to be radical and ideologically motivated environmental groups. "If you take an extremist stance, the landowners simply say, 'get off of my property'," said Mosquera. "Conservation is a matter of respect, and this includes respect for private property."

In Mosquera's view, man is a part of nature. "We are a conservation organization, but we do conservation with people," he said. "You can't ask people to abandon agricultural systems they have operated for 80 years." Nor can legitimate demands for development be ignored. "If we have to build a road to help people, then let's build it," said Mosquera. "But let's build it right!"

This pragmatic point of view does not ignore the need to grant full protection to particularly sensitive or biologically significant areas. But even in these cases, it's people who make the decision to protect nature, based on their values and self-interests. "It all comes down to the kind of world in which people want to live," said Mosquera.

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While Mosquera believes that conservation must serve people's needs, people have the responsibility to use nature more wisely. In particular, he believes that Quito should draw its water from streams and rivers closer to the city, and not from the distant and fragile *páramo*. But the city must resort to these far-off "primary" sources because 60 percent of the water flow of the closer sources has been co-opted by irrigation or has been polluted. "When we say we must get our water from the *páramo*, we are conceding failure," he said. "If we had taken the proper measures 20 years ago, we would not have to use primary sources today."

The issue of tapping Antisana's water is, of course, a fait accompli. Now there is talk about building a second pipeline from a neighboring watershed to serve Quito. While Mosquera is very protective of the *páramo*, he is not necessarily opposed to these plans. "We're not fighting progress," he said. But he asks, "Is it really necessary? Once we stop wasting irrigation water and polluting streams, we can consider a new pipeline."

Every few miles, as the road neared the Delgado ranch, Mosquera would stop his vehicle before a red-and-white barrier. Presently, someone would emerge from a little building to study Mosquera's travel permit and then ceremoniously raise the gate. This road is the only access to the reserve, making the job of managing people much simpler than in protected areas served by several roads.

At a final gate, Mosquera got out to embrace Andrés Ordonec, an older man wearing a puffy ski jacket with an Antisana Reserve insignia. Years ago he had worked for the father of rancher Delgado, and was now a respected keeper of the region's environmental memory. In the old days, he said, it was common to see 50 condors around a dead cow.

Mosquera continued up the road, over a rise, and then into a small valley with a cluster of modest buildings. Delgado was there, waiting for him. They entered the simple ranch house and walked down the hallway, past faded photos, stuffed animal heads and skins and a mummified condor wing. In a sunlit room they settled into big armchairs and sipped tea made from a wild *páramo* plant.

They discussed an upcoming meeting where Delgado and other landowners would review a management plan to reduce erosion, restore vegetation, and promote new productive activities such as agroforestry, aquaculture, organic farming, and tourism.

Delgado fully acknowledged that his sheep damaged the *páramo*. "Many years ago there were very few eroded areas here, but over time they have increased," he said. So six years ago he told his herders to keep the animals off the most fragile slopes. He conceded that it will take 20 years for the vegetation cover to regenerate completely. "But the important thing is to take the first step," he said.

As Mosquera hoped, Delgado was enthusiastic about nature tourism as a way to maintain his ranch's earnings while reducing his herd of sheep. Mosquera politely offered his foundation's help. Then he returned to the issue of the sheep. Their numbers would have to be cut, he said.

Driving back down the volcano, Mosquera reflected on his conversation. "In the end the decision is Delgado's. Ultimately, he does what's in his best interest. But frankly, if he's thinking of tourism, tourists don't like to see sheep."

Seemingly bleak, the high Andean landscape offers adventuresome ecotourists the opportunity to see rare birds and a profusion of delicate flowers.

A living from sheep, a life with nature

A rancher takes up the conservation cause... with some caveats

The aftermath of a mountain lion attack on a flock of sheep is not a pretty sight. Sometimes 50 or 60, or even 100 dead and maimed animals may lie strewn across the pasture. So why do sheep rancher José Delgado's eyes sparkle when he talks about mountain lions?

The reason is that Delgado is proud to have these predators on his sprawling ranch, along with his spectacled bears and even his resident population of wolves. Fortunately, mountain lion attacks are quite rare, having occurred only five or six times during the 65 years that the Delgado family has ranched these wide open expanses of *páramo* surrounding the Antisana Volcano, about two hours' drive from Ecuador's capital of Quito. For the most part, the lions stick to their natural prey.

If Delgado can coexist with mountain lions, it's hardly surprising that he can also work with the Antisana Foundation, a private conservation group charged with managing the 120,000-hectare Antisana Ecological Reserve, part of which encompasses his land. The reserve was established in 1993 to preserve the area's biodiversity and protect a vital source of water for Quito. Delgado is a founding member of the foundation.

Belying the stereotype of the large landowner who regards conservationists as natural enemies, Delgado wants to preserve the valuable and fragile ecosystems under his stewardship. "We landowners want to conserve nature," he said, seated in a worn leather armchair in his rustic ranch house. He appreciates the work of the foundation and its pragmatic approach to environmental management. "We speak the same language," he said.

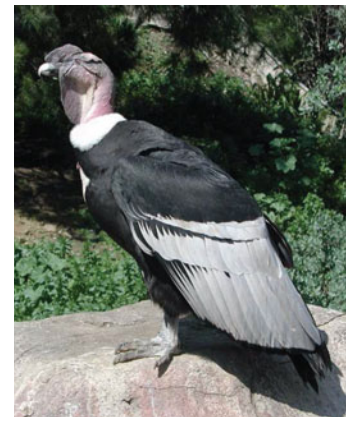
Rancher Delgado is looking for ways to cut his herd of sharp-hoofed sheep to help reduce erosion.

Delgado has already reduced his flocks from 30,000 to 9,000 animals, and is prepared to cut back even more to prevent erosion that the sheep cause by stripping and trampling vegetation on the steep hillsides. For the past six years he has kept sheep off certain areas to allow the land to regenerate. But as a businessman, he cannot allow conservation to jeopardize his economic interests. "If the foundation tells me I have to get rid of all of my sheep, then we will have a conflict," he said. "Conservation cannot become a financial burden for the ranch or for my family."

Delgado's strategy for further reducing his flocks consists of finding other ways in which his land can turn a profit. Tourism is one way, and he presently hosts groups of tourists—mainly bird watchers—that visit the hacienda for the day, eat lunch, and return to Quito. He

is working with the Antisana Foundation to plan a simple lodge where tourists can spend the night. "Foreign visitors don't expect luxury," he said. "They don't even mind if it's cold or rainy."

Another alternative could be raising llamas for meat. Unlike sheep, these Andean natives don't have hooves, so they are gentler on erosion-prone land. He already has a herd of llamas, which he is monitoring to see how fast the animals reproduce and how long it takes them to grow to marketable size.



Delgado counts about 15 condors on is land. When a sheep dies of natural causes, he has it set out for the winged scavengers, much like a suburban homeowner and his birdfeeder.

But Delgado's conservation ethics have their limits. One is what he calls the illegal use of his land without compensation. The 60,000 hectares of land owned by the Delgado family that was declared part of the Antisana Ecological Reserve is subject to stringent use restrictions. The government originally intended to expropriate this land and indemnify its owners, but it never came up with the funds. "This is not right," said Delgado.

He also insists that nature must occasionally take a back seat to meeting human needs. While conceding that some particularly sensitive or biologically rich areas need 100 percent protection, elsewhere nature must cede priority. He cited what he called the "unrealistic" position of environmentalists who insisted that a pipeline slated to cut through a natural area be rerouted at a much higher cost. "Nature is sufficiently wise to recover from whatever damage the construction would cause," he said. Such was the case with the dam and pipeline built in the last decade in an IDB-financed project to supply water to Quito. "I am very interested in nature," he said. "But you cannot say no to this kind of project." As it turned out, the project caused minimum environmental damage, "thanks to the Antisana Foundation," he said.

"We have to recognize that man is part of nature," Delgado said.

Laws of man and nature

Local governments and citizens in Honduras act to protect the fragile environment on which their economy rests

Alton Cooper's youthful face hardened when he got the call that a swath of trees along the road to Pumpkin Hill had been cut. And on top of that, a pile of posts—probably from the same trees—had been deposited right on the main street of Utila Town.

"We have very strict ordinances about cutting trees," said the 33-year-old mayor of Utila, a tiny island off the coast of Honduras. "If a law was broken, there will be fines."

Even as Cooper was speaking, the head of the municipality's environmental unit, Shelby McNab, was heading for the local TV studio to broadcast a call for anyone with information to come forward. The appeal worked. The next morning, the post-cutting perpetrator was knocking on McNab's door. He was a local business owner who intended to use the wood to shore up the supports for a new workshop. He said he didn't realize he needed a permit to cut the posts, because the trees came from land that had previously been cleared, entitling the property owner to the permission he needed. The outcome: Red faces, apologies, handshakes and a promise from the business owner that he would get his permit on Monday. "You have to be alert," said McNab in the brogue-inflected English he shares with many other long-time island residents of Scottish or English origin. "You have to get out there, not sit in an office."

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On Utila, with its 2,000 inhabitants, environmental problems can still be sorted out one-on-one, among friends and neighbors. But this easy-going lifestyle is starting to unravel. Changes are coming to this and the other two large members of Honduras' Bay Islands archipelago, Roatán and Guanaja. Sometimes called the "Galápagos of the Caribbean" for their stunning coral reefs and fragile terres-

A diver explores the fantastic underworld of a coral reef. For reasons as diverse as global warming and carelessly dropped anchors, coral is dying worldwide.

trial ecosystems, the Bay Islands are feeling increasing pressure from a growing population that demands ever more land, water and other resources.

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Lying 50 kilometers north of the Honduran mainland, the Bay Islands have an ecological and economic importance that far outweighs their size. Anchoring the southern terminus of the Mesoamerican Barrier Reef System, the world's second largest barrier reef, the archipelago's waters are remarkable for their abundance and diversity of marine species. Visitors from around the world come to dive in its pristine coral gardens to view shoals of fish, marine turtles, and maybe even a whale shark. They also come to see the terrestrial species that inhabit the islands' mangrove swamps, pine forests and other ecosystems.

The Bay Islands account for about one-third of Honduras' tourism visits. In addition to the 50,000 visitors drawn by diving and sport fishing each year, cruise ships now unload some 60,000 day visitors. Total annual

Bicycles and dogs rule on Utila Town's main street.

The Bay Islands mark the southern terminus of the Mesoamerican Barrier Reef, the world's second biggest.

tourism receipts are estimated at some $55 million. Commercial fishing, including the earnings of the islands' 800 small-scale fishing families, generates $10 million in income. Real estate sales account for another $11 million per year.

With credentials like these it's no wonder that the Bay Islands have attracted the support of the international community, in particular the Inter-American Development Bank. With loans totaling over $31 million, the IDB is helping to finance an ambitious program that will help island residents like Cooper and McNab to protect their island's natural heritage and its people's way of life. Additional support has come from a $1.8 million grant from the government of Taiwan and $2.5 million from the Global Environment Facility.

The Bay Islands Environmental Management Program (PMAIB, after its name in Spanish) is forging a long-term plan to help the archipelago's four municipalities protect the islands' natural resources and ensure economic opportunities for their people. A comprehensive database on environmental conditions is already giving planners information they need to solve the perennial problem of scarce water as well as to find the best way to dispose of sewage and solid waste. Computerized land surveys, or *cadastres*, are giving municipalities crucial tools for managing land use and raising tax revenues. PMAIB's ultimate

goal is to create a self-sustaining set of institutions for protecting the islands and adjacent waters and the livelihoods of its people.

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Either directly or indirectly, much of the islands' economy depends on the health of the coral reefs. Throughout the world, coral is dying, and that around the Bay Islands is no exception. Spot checks around the islands turn up areas of coral that have turned bleached and lifeless. Global warming is thought to be part of the problem. But a large share of the blame lies closer at hand. Deforestation on the islands has caused erosion on land, resulting in the discharge of sediment into nearshore waters that suffocates these tiny organisms. Dredging produces more sediment, as does the destruction of mangroves and sea grass pastures, which act as natural filters. Pollution is another enemy of coral reefs, and one of PMAIB's major priorities has been to pinpoint areas for urgent action.

Although PMAIB can show what must be done, it will ultimately rest on local governments to do it. The need for strong local action might seem self-evident. But the fact is that in Latin America, decisions about environmental protection and natural resource management have traditionally been made by officials in distant capital cities. In most cases, mayors have been appointed by their national parties and not elected by the local people. Furthermore, local governments are perennially strapped for the money and managerial and technical expertise needed to plan and carry out projects. This is now changing in many countries, where the movement toward governmental decentralization is finally putting local citizens and their elected representatives in the driver's seat.

Utila remains as laid back as the vernacular art that depicts it.

On the Bay Islands, local representatives hold more than half of the seats on PMAIB's decision making body, the Executive Commission for Sustainable Tourism. Chaired by the minister of tourism, the commission was created to forge consensus and manage conflicts among the principal interest groups. The 13 commission members include the four mayors, representatives of the private sector and the goverment of the Bay Islands department.

The mayors declare themselves up to the task of self government. "We're capable of administering," said Roatán's Jerry Hines. "We've come a long way. Five years ago this municipality did not even own a dump truck. We were run down and broke. Now we have money to pay our bills and do our job." In the past, said Hines, "technicians came from Tegucigalpa [the Honduran capital], did their job, and then left, taking their experience with them. Today, we have people who can deal with the problems."

But not in every case. On Utila, Mayor Cooper has used the power of his office to enact tough environmental ordinances. But he worries about the lack of trained people to carry them out. "I have to admit that a lot of plans handed over to municipalities are just too complex," he said. "For example, we got a computer program to help us monitor our aquifers, and we got the equipment to do the testing. We trained a couple of people to do the work, but then they left the island."

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The major question facing the Bay Islands is what to do about the huge influx of new residents. The archipelago's population actually doubled during the program's first seven years. "Poor people on the mainland hear about the rich foreign tourists, the good jobs, the dollars, and they say, 'I'm going to the islands'," said PMAIB Director José Flores, a forest economist, who works out of a two-story building in Roatán. "When they get here they find only more poverty. But they stay here anyway, because they don't want to return home as failures."

Mayors Cooper and Hines want limits set on migration to the islands. But they concede that it will be tough for the government to tell citizens that they cannot live where they wish in their own country. For his part, Flores calls migration restrictions "urgent." One approach, he said, would be to declare all the islands a protected area and set strict standards on new development, which could eventually curtail migration. He pointed out that similar measures have been adopted by Ecuador's Galápagos Islands and by Colombia's San Andrés.

If the government succeeds in passing special laws for the islands, much of the job of making them work will fall to the sustainable tourism commission. "The commission will be the first filter of approval and acceptance for things like making different standards on the islands than for the mainland," said Flores.

The tourism boom and the economic opportunities it creates are fueling the islands' population surge. In addition to diving, the Bay Islands have become a port of call for cruise ships that unload hundreds of tourists at a time for a day of sun, sand and shopping, creating a veritable economic windfall for taxi drivers, restaurants, refreshment stands, handicraft shops and owners of private beach facilities. But this kind of "success" could lead the Bay Islands down the mega-resort road taken by other Caribbean islands, where mass tourism has overwhelmed reefs, mangroves, and peace and tranquility.

"What would happen if land owners were allowed to put hotels all along the coasts?" asked Antonio Woods, president of the Bay Islands Conservation Association on the island of Utila. He predicts that boat owners would demand that channels be dredged through the coral. Oil discharges from boats would poison marine life. Tourists annoyed by sand fleas would demand spraying with pesticides. The serious water problem would only get worse. Uncontrolled use of wells is already causing salt water to seep into the aquifers.

Nearly everyone on the Bay Islands professes to be an environmentalist. Developers claim that a better future lies with better development. Naturalists urge protection of natural areas. Dive operators want healthy reefs for their clients. Fishermen want more fish. All will have to get used to more restrictions and stricter rules and it will be up to local officials to gain their acceptance and enforce them. As Bay Islanders continue to insist, their tiny archipelago is still a sanctuary, an idyllic spot from which to gaze out at the world's problems. They are determined to keep it that way.

Whose land is this?

Land owners, local governments and the environment all need accurate property surveys

The main job of environmental planners is to reconcile the competing demands of people and nature. Where do the plants, the animals, the people live? How do they interact? What are the trends and what do they mean for the future?

One of the first orders of business for the Bay Islands Environmental Management Program (PMAIB) was to carry out a land survey, or *cadastre*, of all of the 10,700 properties on the 260 km^2 of land on the islands of Roatán, Guanaja and Utila.

In Honduras and much of the rest of Latin America, uncertainties about land ownership encourage people to put short-term gains ahead of long-term goals. Formerly in the Bay Islands, records of land ownership consisted of hand-drawn lines on maps that were stored in old file cabinets. "The public land records were totally disorganized," said José Flores, PMAIB director. "Local governments had little idea of who owned what." A person wishing to purchase a parcel of land might find himself dealing with three or four presumed owners. "Nobody was going to make a long-term investment with that kind of insecurity," said Flores. "And environmental protection is a long-term investment."

But in the Bay Islands today, a couple of keystrokes can bring up a detailed map of any neighborhood, beach, hilltop, or mangrove swamp. The images include accurate property lines along with information on the property owners. Property ownership is transparent and secure. "Rest assured that if someone buys a piece of land on the islands, there is no owner other than the person listed in the survey," said Flores.

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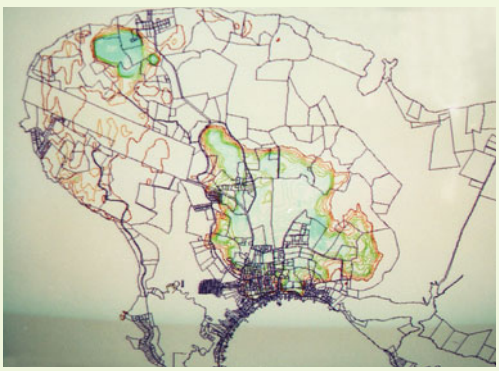
The effects of the land survey have rippled out into the economic life of the islands. One beneficiary has been the real estate industry. "It's just been amazing," said T. J. Lynch, a Canadian transplant who works for RE/MAX, the international real estate franchise. "It's created confidence in the buying sector we've never had before. It used to be that an attorney had to research three different land registries, going back many years. Now we can actually register land transactions online."

The property survey also has given local government a powerful environmental management tool. In an instant, officials know whom to contact when they need to carry out projects to control erosion or protect watersheds and habitat for plants and animals.

Finally, the survey is proving a financial boon to the municipalities by enabling them the ability to identify taxpayers. By including more property owners in the tax base, governments have greatly increased revenues needed to carry out environmental projects and provide public services.



With a few keystrokes, a municipal employee can see who owns what. This map shows the eastern end of Utila, including the town and Pumkin Hill.

A green mayor

A young elected official puts local environmentalists on the municipal staff

Alton Cooper, 33, hunched over a computer in his modest office on the second floor of the municipal building.

"I'd say we have 22 hours before it strikes," he said, holding up the digital display of his pocket calculator. Tropical storm Claudette was churning into a full-blown hurricane, and it was headed toward the tiny island of Utila, off the north coast of Honduras. A lot of residents were worried, but particularly Cooper, because he was the mayor.

As it turned out, the storm missed the island, sparing Cooper a major environmental headache. But he deals on a daily basis with smaller and much more persistent ones. Utila is not only vulnerable to hurricanes, but also to collisions between a fragile environment and a growing population.

A tranquil isle of sandy beaches and one lone hill, Utila is experiencing growing pains whose remedies will tax the ingenuity and political will of its people.

Utila's Cooper says he has the autonomy he needs to protect the environment.

Cooper and other elected mayors in Latin America are benefiting from reforms that have given them new authority and resources. "I have a great deal of autonomy to do my job," says Cooper, resisting the temptation of many mayors to blame their woes on central government red tape. Cooper has used his autonomy to take an activist approach to solving environmental problems.

For one thing, rather than merely consult with the local environmental group, the Bay

Islands Conservation Association (BICA), Cooper named the group's executive director to head the municipal environmental unit. It was an inspired move. "We're doing fantastically," exclaims environmental unit chief Shelby McNab. "We finally have a mayor who works with us."

Such enthusiasm is understandable. One of Cooper's first official acts was to declare all of the waters around the island an environmental reserve where spear and net fishing would be prohibited. But he quickly found that autonomy from the central government did not mean freedom to do as he pleased. Local fishermen protested that when high winds prevented them from venturing offshore the new rules prohibited them from pursuing their livelihood inshore. So restrictions were lifted in the area where most of the small fishermen live.

Cooper and McNab next set out to protect the reefs from physical damage. Cooper, who himself is the owner of a dive shop, knows firsthand the destruction caused when boats drop their anchors on coral reefs. If the reefs die, his business and the island's economy would be ruined. So BICA and the municipality ringed the island with 72 buoys to which dive boats must moor. Money to pay for the buoys and the patrols is raised with the help of 11 dive shops on the island that levy surcharges on their customers. "Without these funds, our marine reserve project would be dead in the water," says Cooper. "Our reefs are looking really good and healthy."

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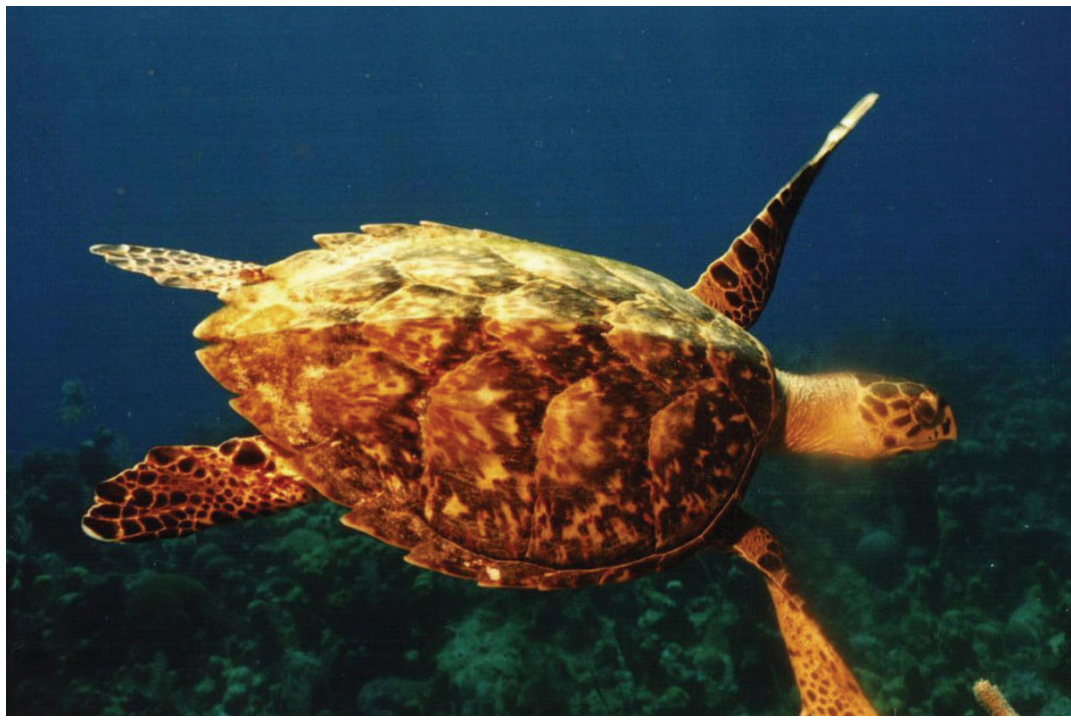
The municipality also put BICA in charge of a prime nesting area for sea turtles called the Turtle Harbor Marine Reserve. Traditionally, islanders only cared about turtles as sources of meat and eggs. "We want to show people that they can make more money by taking tourists to see the nesting area rather than by stripping it of resources," McNab says. He and his BICA colleagues enforce many other municipal environmental ordinances as well. If he gets word that somebody has been dredging or cutting down trees, McNab takes a council member and the chief of police to the scene. "This doesn't happen often now," says Cooper, "but at the beginning it did."

McNab would like to see the islands themselves patrolled with the same thoroughness as the surrounding marine area. But merely knowing that regulations will be enforced ensures compliance. "It used to be that the second day after a mainlander arrived, he would go into the woods and come out with 40 iguanas to sell in the market," he said. We know there's still some hunting going on, but anyone who gets caught will get a fine."

Cooper and McNab still have time to make a difference. The island's population is still small. People still know and care about each other, and about their environment.

McNab, his staff and volunteers, help to manage the island's protected areas and monitor compliance with the municipality's new environmental rules.



On the turtle's trail

Endangered species build public support to protect fragile ecosystems

The tracks headed up the sand and into the thick underbrush. "It must have been a hawksbill," said Alejandro Gallo, explaining that the loggerhead, the other principal turtle species in the Bay Islands, generally makes its nest on the beach itself.

The tracks led through a tangle of bushes to a patch of suspiciously disturbed sand. Pronouncing it to be an intact nest, Gallo retraced his steps to the water's edge, scuffing away the turtle's footprints as he went. It's illegal to take turtle eggs, he explained, but some casual passerby, seeing the tracks, might be tempted to follow them and raid the nest.

Graceful in the water, the hawksbill turtle must lumber onto land to dig a nest and lay its eggs. Protecting these eggs from human and four-footed predators is a challenge for island conservationists.

Gallo believes that turtles and people can coexist.

Gallo, conservationist, youth leader, and former Mr. Honduras, was on a patrol around the island of Utila, off Honduras' north coast. As head of the turtle conservation program of the Bay Islands Conservation Association (BICA), he comes often to this swath of beach, a favored nesting area that is protected by municipal ordinance and managed by BICA.

Gallo returned to the skiff, which was piloted by BICA President Antonio Woods. They turned back out to sea, crossing over

flats covered with sea grass and past the breakers that mark the edge of the world's second largest barrier reef.

"This reef doesn't just belong to the islanders, or to Honduras, but to the whole world," said Woods. Although he applauded the local municipality for passing an ordinance to give the reef at least some measure of protection, only Honduran law would ensure its long-term survival, he said.

Nearing the western end of the island Gallo spotted a small plastic container bobbing in the waves. He suspected it was attached to an illegal lobster trap. He hauled the line attached to it, only to have it break just as the trap came into view.

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In contrast to the surrounding waters, the islands host a relatively low number of species, in part due to their small land areas and the laws of biogeography. Only 13 km long and 4 km wide and 80 percent consisting of mangrove swamp, Utila nevertheless contains areas of intact natural forests and several endemic animals. One is the Utila iguana (*Ctenosaura bakeri*), a large—and some would add tasty—reptile considered to be endangered.

A short walk from the center of Utila Town takes a visitor to the Iguana Station where a tiny staff and a group of volunteers run an island-wide program of environmental education, captive breeding and research. Station Director Karsten Gees and a volunteer were weighing and measuring juvenile iguanas to get data needed to make decisions on protection measures. He said that a municipal ban on hunting reduced a major threat to the iguana population, but critical habitat continues to be destroyed.

The iguanas live in mangrove swamps, which are protected. But the females lay their eggs on beaches, which mostly remain unprotected. Gees would like to buy some beachfront property for an iguana reserve, but his data first must provide some critical information. How much land will do the job? Are some areas more suitable than others? How well can iguanas tolerate disturbances, such as passing cars?

Gees applauded the Utila mayor's eagerness to pass ordinances to protect sensitive terrestrial and marine areas. "But what about the next mayor?" he asked. Perrmanent safeguards depend on firm action by the central government, he said.

A major step forward in habitat protection was the creation of three marine and three terrestrial protected areas and the development of management plans by the Bay Islands Environmental Management Program. An additional six areas would receive a basic level of management. Altogether, 21,000 hectares of coral reefs, coastal lagoons and mangrove swamps, and 5,280 hectares of inland forests, will be protected. Management activities will be financed by a Bay Islands Conservation and Protected Areas Fee charged to tourists. Surveys indicate that visitors would be willing to pay $10 if they were assured that the money would be used for conservation purposes. Whether visitors or residents, conservation on Utila has many allies.

Utila's iguanas measure up as a charismatic species that rallies public support to protect habitat.

It takes strong action to ensure island tranquility

The Caribbean pioneers in coastal zone management—and just in time

The people of the Caribbean are never very far from the realities imposed by their geography. Small is indeed beautiful, and the allure of these islands draws tourists from across the world. But small can also mean cheek-to-jowl competition for scarce space and resources, both among people and between them and natural ecosystems.

On a small island, whatever happens matters. Pump too much fresh water from aquifers, and salt water begins to take its place. Allow too much contamination or sediments to flow into the sea, and the coral reefs begin to die. Damage the reefs, and expose the beaches to disastrous erosion. The litany of cause and effect goes on.

In Barbados, for example, the people have learned to their dismay that their seemingly tranquil beaches are actually a battleground, a constantly shifting interface where waves discharge their energy and in the process move sand down the coastline and out to sea. Ordinarily, replenishment balances the effects of erosion. But on this islands' north coast in the 1990s, beaches were receding at a rate of 1.5 meters per decade.

The very tourist industry that depends utterly on the beaches has been a major culprit in their disappearance. For years, hotel owners have built structures into the water to trap migrating sand in front of their properties, but in the process impoverishing their neighbors' beaches further down the littoral conveyor belt.

The most serious cause of erosion has been the loss of offshore coral reefs, nature's own seawalls. The coral has increasingly fallen victim to pollution that promotes the growth of algae that smothers the coral organisms and blocks the sunlight they need to grow.

Oblivious to tourists, reseachers track powerful forces in a seemingly tranquil setting.

"The reefs are critical for maintaining coastal equilibrium," said Leonard Nurse, who has managed the island's Coastal Conservation Project Unit. "Only healthy reefs can provide this free environmental service."

The country's response was to develop a coastal zone management plan, financed with the help of the Inter-American Development Bank. This new initiative, the first of its kind in the Caribbean, combined research with a program for strengthening institutions charged

with developing and managing the legal and regulatory changes needed to carry out the plan. An IDB loan for $17 million is now financing a program to restore coastal habitats, increase public assess to the coast, and further strengthen critical institutions needed to ensure that the changes are permanent.

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The economy of the Bahamas also depends heavily on tourism. But the very proliferation of hotels and other guest facilities that help to provide jobs for many of the islands' 320,000 citizens could eventually destroy the beauty and tranquility the visitors seek. Among the problems are major dredging and consequent sedimentation, destruction of critical mangrove wetlands, erosion of beaches, and even traffic congestion. Added to this is the islands' vulnerability to rising sea levels from global warming as well as hurricanes.

As in other Caribbean nations, the Bahamas must create a strong group of institutions that are capable of giving pemanent protection to its coastal environment. With the help of a $3.84 million loan from the Inter-American Development Bank, the country is now putting into place a long-range process for preparing an Integrated Coastal Zone Management Master Plan. With the participation of the islands' people, the different units of government and the private sector, the plan is expected to mature into a permanent entity for coordinating all issues related to coastal zone management in the Bahamas.

Trees full of big scarlet birds help give Trinidad a special place in the world of ecotourism.

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Environmental management in the Caribbean does not consist only of solving difficult problems, but also of celebrating nature's gifts. On the island of Trinidad, residents as well as visitors make a daily pilgrimage to Caroni Lagoon National Park and Bird Sanctuary to witness a remarkable sight.

"It is awesome to see thousands of birds transforming these beautiful green mangroves into live Christmas trees," said Winston Nanan, self-taught ornithologist and guide. "I never get tired of it."

This is the famed scarlet ibis, a big bird with a long decurved beak that roosts each evening in clumps of mangroves. Besides the ibis, more than 160 species of birds, as well as otters, marine opossums, mongoose, boas, caimans, raccoons, anteaters and many other animal species, make this 5,611-hectare park their home.

Nanan's father and a group of his hunting friends persuaded the government to declare the swamp a bird sanctuary in 1948. Since then, it has grown in popularity, and will continue to do with as a result of new tourism infrastructure built as part of a $1.2 million IDB loan. The facilities include a visitor center with a 50-seat auditorium, an observation tower, a boardwalk into the mangroves, and a viewing platform near an ibis roosting area.

"This project should win the favor of the most passionate of our environmentalists," Trinidad and Tobago's prime minister, Basdeo Panday, said at the center's dedication.

Scientists work to win over fishermen

Both groups applaud as life returns to protected areas on Brazil's Coral Coast

Mauro Maida pulled off his facemask and brushed the hair from his face. "Let's dive here and see what we find when we dig into the bottom," he said, pointing down at what looked like hard-packed coral sand.

A couple of hours of exploring the reef off the coast of Tamandaré, in Brazil's northeast state of Pernambuco, clearly showed what happens when you completely close an area to fishing and diving. Outside of the 400-hectare protected area much of the coral was dead and broken. The occasional fish fled at the first sight of human intruders. But the protected area was a different world. Although the reef was not ready for prime-time nature shows, fish were abundant. On all sides, schools swam in synchrony while lone foragers scoured the multihued coral for bits of food. "It's in much better shape than other reefs along the coast," said Maida.

But even though life was returning here, the coastline as a whole remains threatened, the result of complex interactions between man and nature dating back many years, even centuries. This was the point Maida wanted to make as he replaced his facemask and regulator and headed back down.

It turned out that the sand that covered the sea floor was only a thin veneer that masked a stratum of arm-coating muck laced with bits of semidecayed organic matter. How did it get there? Maida explained that for more than 400 years, European colonists have been cutting the Atlantic Forest that once stretched 2,800 kilometers along Brazil's coast. As the forest disappeared, the rain washed soil and terrestrial detritus down the unprotected hillsides and into streams and rivers. Reaching the ocean, currents carried the sediment along the coast where it suffocated coral and left its telltale contribution to the geological profile.

With a show of optimism, a Coral Coast fisherman heads off to pit his wits against a marine environment that is increasingly stingy with its bounty.

Sedimentation is only one of many assaults on the Coral Coast, a 120-kilometer stretch of coral reefs, open water and mangrove swamps between Tamandaré and the town of Paripueria in the neighboring state of Alagoas. Unless something is done, the reefs could soon lose not only their biological importance but also their economic value to the local population.

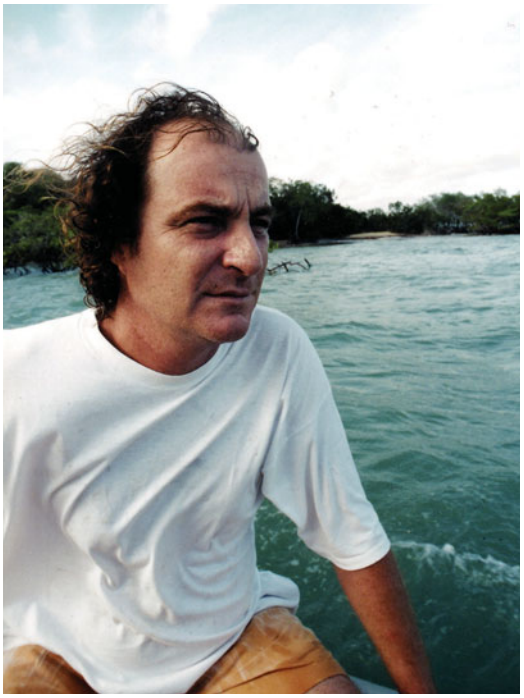
This is the challenge facing Maida, a marine ecologist who heads the Integrated Coastal Management Initiative, a program that is already being held up as a model for how to resolve conflicts in the often contentious environment arena. Maida's partner in conservation as well as in marriage is Beatrice Padovani Ferreira, a marine biologist. They and their staff are learning about the local marine ecosystem and are using their knowledge to help forge a partnership with local people to produce real and lasting change.

More and more, scientists such as Maida and Padovani are stepping out of their research sanctums to work at the interface between conservation and local politics. Both Maida and Padovani completed their PhDs in 1993, came to Tamandaré to work on smaller projects, and then went on to manage the Coastal Management Initiative. They got to know the local fishermen, their concerns, their aspirations for a better life, and the rivalries among different groups. They learned to work with politicians, businessmen and leaders of community organizations. It was not easy, but in the end, Maida and Padovani earned the respect and affection of their neighbors.

The problems they found in Tamandaré are a microcosm of a global crisis in marine resource conservation caused by uncontrolled development and overfishing. From finger-pointing debates at international conferences to heated exchanges in community meeting halls, people around the world argue who is to blame for the increasing scarcity of once plentiful resources and how to divvy up what's left. Although science can supply knowledge and management tools to focus the debate, final decisions are often based on politics and economic self-interest, not research data.

In Brazil's states of Pernambuco and Alagoas, local leaders took a different approach. They recognized that they had a problem and looked to science to provide the information they needed to take control of their own future. They and other residents could see that change was coming to this once relatively pristine area. New roads were bringing in large numbers of new residents and a large-scale regional tourism project was expected to add an estimated 3,000 new hotel rooms to the coastline. Local people welcomed the new economic opportunities these changes would create. But they also feared that without strong action, the Coral Coast would suffer the same fate as so many other sensitive coastal areas: rising land prices, contaminated beaches and near shore waters, growing scarcity of fresh water for drinking and household use, and disappearing marine life.

Fish were already growing scarce on the Coral Coast. A major culprit, according to the head of the local fishermen's group, Carlos Roberto Albuquerque, is what he calls predatory fishing techniques. For example, many fishermen use nets made out of nylon monofilament, which is practically indestructable and nonbiogradable. When these nets break loose,



Marine ecologist Maida works with local people to reverse the destruction of the Coral Coast reefs.

which frequently happens, they continue catching marine life, a phenomenon called "ghost fishing." Speargun fishing is another problem. Outsiders with boatloads of diving equipment muscle in on local hook-and-line fishermen. The latter don't put up much resistance, said Albuquerque, because the intruders are often armed and the local people are not. Lobster stocks are also getting wiped out, the victim of a vast fleet of lobster boats, only one-third of which have licenses, according to Padovani.

The mangroves present some particularly thorny issues. Invaluable ecologically as the nursery for many fish that go on to reach adulthood on the reefs or offshore waters, the mangroves are primarily exploited by women and poor people. The problem is how to restrict fishing in these easily accessible areas without causing additional hardship to those most in need.

Another problem is contraband, not the usual guns or drugs, but coral. In one case, authorities intercepted a shipment of three tons of contraband local coral destined for Miami. But by the time it arrived back at its original home most of the coral organisms had died. Coral also suffers damage when it becomes entangled in fishermen's nets and breaks off.

But shrimp farming poses the greatest long-term threat to the local marine environment. Across the globe, industrialized production of this crustacean has turned a former luxury into a commodity targeted at the mass market. But cheap shrimp on the table costs the environment dearly. In many cases, shrimp are raised in large ponds carved out of the ecologically critical mangrove swamps. The loss of the mangroves, plus pollution from the farming operations themselves, degrades not only the inshore environment but also reduces fish stocks offshore. So far, efforts to establish shrimp farms along this stretch of Brazil's coast have been stalled. But Maida and Padovani worry that the battle is not over.

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Armed with a dossier of such problems, the area's 13 municipalities together with local organizations successfully petitioned the government to add their stretch of coast to the country's list of protected areas. And so in 1997, the Coral Coast Marine Protected Area was created. Embracing a total of 413,563 hectares, the new MPA extends from 33 meters above the high tide mark to the edge of the continental shelf. It is the largest marine conservation area in Brazil.

Declaring the area protected was only the first step. Next a management plan had to be created based on solid scientific data as well as input from local stakeholders. With a $2.1 million grant from the Inter-American Development Bank, the Federal University of Pernambuco, the Center for Research and Fisheries Extension and the Aquatic Mammals Foundation, in collaboration with other Brazilian agencies, initiated pilot management experiments that would lead to eventual protection measures.

Once the management plan has been completed, the challenge will be to get it off the shelf and into the hands of local decision makers. Maida and Padovani say that their aim is to create a flexible management process that will remain relevant in the years to come. "I don't think there will ever be a point when we will say, 'Well, the plan is finished'," said Padovani.

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Management decisions must be based on accurate, comprehensive data. Maida's field workers systematically collect information from fishermen on fishing techniques and catch levels. In addition, his scientific team has also pieced together a detailed picture of local marine ecology to make it possible to gauge the effects of different harvesting regimes on the commercially valuable species,

for example, taking juvenile fish from the mangrove swamps. Other research is showing how best to restore degraded reefs back to health. Maida has released coral spawn that he predicts will produce renewed reefs in as little as five years. If they take hold and grow as he expects, it will be the first successful example of reef restoration in Brazil.

The research is paying off. One of the first successes in the planning process was the creation of the Tamandaré protected area, which is expected to serve as a model for other municipalities. Although poachers still occasionally slip into the reserve under the cover of darkness, the payback from the restrictions—no fishing, no taking ornamental fish, bans on scuba diving and other practices—have been dramatic and convincing. After just six years of protection, numbers of seriously depleted fish species had increased 13 times. Numbers of octopus and lobsters had increased fourfold. Some species that had scarcely been seen in these waters for many years have returned. Although some fishermen are demanding access to this restored bounty, most are happy that they are now catching more fish in areas outside the reserve's boundaries.

How will these gains become permanent? According to Maida, it will all depend on local support, to a great extent from the newly created Marine Environmental Defense Councils, one for Tamandaré and the other for a neighboring municipality. The councils serve as a point of contact between civil society organizations—the Coastal Reef Institute, fishermen's groups, tourism associations, the church, labor unions and foundations—and local municipalities and national agencies. They are the key to continuity, said Maida. A coastal management plan that enjoys a strong institutional base of

A researcher introduces a fisherman to the mysteries of otoliths, the tiny bones in fishes' ears that record the animal's age as well as environmental conditions it had encountered.

support will be able to weather the changing politics and policies that are sure to come.

The councils already are already flexing their muscle. For example, shoreline development used to simply happen, with little or no consideration given to its cumulative and long-term effects. Today, these issues are subjected to close scrutiny in open, transparent debates among council members. Throughout the debates and deliberations, Maida and Padovani offer their data and their expertise, but leave decision making to the local people. Council members also agree that any development that will have large-scale environmental impacts, such as shrimp farming and polluting industries, should be prohibited. Similarly, hook-and-line and net fishermen are unanimous that spear fishing should be prohibited.

Debate will become more spirited as the council takes on issues that directly affect local people. One would be fishing in the mangrove swamps. Another would be a proposal by tourism interests to ban commercial fishing altogether in order to make the reefs more attractive to paying sport divers.

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In an ideal world, local people should be able to defend their own interests without the need for outside resources and expertise. "They are completely competent," Padovani said. "Nobody has to speak on their behalf." But this is true only in the context of their own community. The problems arise, she says, when local people have to operate in the "modern world." They don't have telephones, computers or fax machines. Some local mayors are illiterate. Some of their treasurers cannot sign a check. As a result, Padovani and Maida help out where they can, from providing simple logistical support to opening politicians' doors, all with the aim of making local participation more effective.

"In a way, we assume the role of the government, helping the people to make their voices heard," Padovani said. But it hasn't been easy, her husband added. "We never thought that [dealing with local communities] would be so much work, that there would be so many meetings, so much to learn about the law."

Occasionally they even have to help resolve problems that arise between different governmental institutions. In one case, the national land settlement agency put a new colony for rural workers in a forested area that provided Tamandaré's water supply, thus violating regulations established by Brazil's environmental protection agency. After two years of discussion at the local level and negotiation with the government, the settlers were moved elsewhere.

Maida and Padovani handle the role of community organizers extremely well. But they came to Tamandaré as scientists, and scientists they remain. Asked if she enjoys the rough and tumble of local politics, Padovani frankly answered, "No. I want to do research. When I started here, the only contact I wanted with the fishermen was their help in getting data. I never thought I would be part of a participatory process." Then she paused and thought again. "But if I didn't do it [the local politics] I would be frustrated," she said, "because nothing that we could do as scientists would be worth anything. I would be doing research, but for what?"

A specter of shrimp

Flying high above a South American coastline, a traveler (business class) might turn away from his shrimp cocktail and look down on a strange landscape consisting of rectangular ponds stretching as far as the eye could see. He might learn that these are shrimp farms, boon to the producers, bane to conservationists, with the environmentally conscious consumer stuck in the middle.

Could industrial shrimp farming alter the topography, not to mention the biology, of the protected Coral Coast of northeastern Brazil? For the moment it seems unlikely. Local interests have asked the country's environmental protection agency to deny licenses to potential growers. But the shimp lobby has by no means given up. In the nearby state of Ceará, shrimp farms have already replaced most of the mangrove swamps. According to Carlos Roberto Albuquerque, who heads a local Coral Coast fishermen's association, if the same were to happen here, his members would be among the first to suffer. In particular, he was worried about reports that disease had broken out in the Ceará farms that could spread to wild stocks. Moreover, non-native species used to stock the farms have reportedly escaped—as could be predicted—raising the possibility that they could get a foohold in local waters and outcompete the native species.

Farm-raised shrimp generate income for investors, but often to the detriment of the mangrove swamps and the small-scale fishermen.

An impressive array of Coral Coast institutions oppose shrimp farming, according to Mauro Maida, marine ecologist and head of a program to develop a marine management plan to protect the environment and improve local living standards. Among these groups are the local marine environmental councils, which are made up of representatives from a wide variety of local groups, municipal governments, the state university, and the Public Ministry, the federal agency that protects citizen's rights.

Maida urged other organizations—including international agencies—to also take a stand on the issue. Banning shrimp farming in the Coral Coast would make good geoindustial sense by helping to prevent its march southward. "We should have one stretch of coast without shrimp farming," said Maida.

Endangered mangrove wetlands harbor a wealth of marine life, including commercially valuable species.

Leaf cutter ants bring their spoils underground to create fungus gardens on which they depend for food.

Epilogue

Throughout Latin America and the Caribbean, untold millions of species are busy rearranging their environments to improve their chances for survival and perpetuation. They live in dangerous worlds, where conflict and catastrophe rule the day and disaster can strike at any moment. Yet they and their ecosystems adapt and, for the most part, persevere.

Of course mankind has altered its environment the most, by far. Scientists are warning that many of these alterations will have serious consequences. The public is beginning to listen. We are coming to understand the degree to which we are putting ourselves at risk, along with the millions of other species with whom we share this earth.

Scientists are also helping to illuminate the historical record, teaching lessons that may challenge some of our cherished assumptions. Consider the notion of the virgin forest, epitomized by the Amazon. How virgin really is it? According to growing evidence, vast swaths of the pre-1492 Amazon were under cultivation and supported a population numbering into the millions. It turned into a "wilderness" only after European-introduced diseases decimated its inhabitants. Much of what we regard today as pristine might more accurately be described as a feral garden. Does knowing this diminish our responsibility for protecting this most remarkable assemblage of life on earth? Not at all. It simply demonstrates, once again, that few places have not felt the hand of man. We have the ultimate power to destroy or to conserve.

These articles are dedicated to the many people of Latin America and the Caribbean who are acting on these lessons. They are working to reverse the damage already done and to build a more environmentally sound future. Always, their actions are guided by the full recognition that man is, and always will be, a part of nature.

Further Information

Many organizations referred to in these pages maintain websites that provide valuable background information as well as updates on current activities.

Chapter 1: A new Amazon

Government of the State of Acre
http://www.ac.gov.br
Chico Mendes Foundation
http://www.chicomendes.org
Antimary State Forest
http://www.ac.gov.br/m_amb/antimary.htm
Chico Mendes Extractive Reserve
http://www.ibama.gov.br/resex/cmendes/cmendes.htm
Center for Amazonian Workers (CTA) - Website under construction
http://www.cta-acre.org

Chapter 2: Enchanted islands

Charles Darwin Foundation
http://www.darwinfoundation.org
Ecuador's Ministry of Environment
http://www.ambiente.gov.ec
Inspection and Quarantine System for the Galápagos Islands (SICGAL)
http://www.darwinfoundation.org/terrest/entomology/advice.html

Chapter 3: Petén and paradox

Guatemala's National Council for Protected Areas (CONAP)
http://conap.online.fr
Petén Sustainable Development Program
http://www.iadb.org/EXR/doc97/apr/gu973e1.htm
Centro Maya Association
http://www.guate.net/centromaya/organizacion.htm
The Nature Defenders Foundation
http://www.defensores.org.gt
Guatemala's Ministry of Environment and Natural Resources
http://www.marn.gob.gt/remodelmarn/index.htm

Chapter 4: Species on the edge

Brazil's National Environment Fund (FNMA)
http://www.mma.gov.br/index.php?ido=conteudo.monta&idEstrutura=1
Belo Horizonte Zoo
http://portal1.pbh.gov.br/pbh/index.html?id_nivel_home=70&id_conteudo_home=null&em_construcao_home=N&id_servico_home=4245&ver_servico=&guia=
Conservation International
http://www.biodiversityhotspots.org/xp/Hotspots/hotspots_by_region
Golden Lion Tamarin Association
http://www.micoleao.org.br
Ecosystem Profile: Atlantic Forest (Conservation International)
http://www.cepf.net/xp/cepf/where_we_work/atlantic_forest/full_strategy.xml
National Environment Fund
http://www.mma.gov.br/port/fnma/index.cfm
Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (IBAMA)
http://www.ibama.gov.br
Millennium Ecosystem Assessment (MA)
http://www.millenniumassessment.org//en/Products.Synthesis.aspx
U.N. Millennium Development Goals (MDG)
http://www.un.org/millenniumgoals
Brazil's Institute for Biological Research (IPÊ)
http://www.ipe.org.br/ing/index_home.asp
19th Annual Meeting of the Society for Conservation Biology – Brazil
http://www.conbio.org/Activities/Meetings/2005
SOS Mata Atlântica,
a Brazilian organization dedicated to protecting the Atlantic Forest
http://www.sosmatatlantica.org.br
Antisana Foundation
http://www.antisana.org
Quito's Empresa Metropolitana de Alcantarillado y Agua Potable (EMAAP-Q)
http://www.emaapq.com.ec

Chapter 5: The coastal zone

Basic information on the Bay Islands Environmental Management Program
http://www.islasdelabahia.org
Efforts to protect Utila's threatened iguanas
http://www.utila-iguana.de/
Projeto Recifes Costeiros
http://www.recifescosteiros.org.br

Several books of interest

There is a large and growing literature on the role of people in nature. Much consists of articles in academic journals or technical papers produced by organizations such as the IDB. Excellent books also examine subjects and ideas raised in these pages, from both current and historical perspectives. An eclectic sampling follows.

Andrew Revkin, *The Burning Season: The Murder of Chico Mendes and the Fight for the Amazon Rain Forest*, Houghton Mifflin Company, Boston, 1990.

Edward J. Larson, *Evolution's Workshop: God and Science on the Galápagos Islands.* Basic Books, New York, 2001.

Richard B. Primack, David Bray, Hugo A. Galletti, Ismael Ponciano, eds., *Timber, Tourists and Temples: Conservation and Development in the Maya Forest of Belize, Guatemala, and Mexico*. Island Press, Washington, D.C., 1998.

Leticia Merino Pérez, *Conservación o deterioro: el impacto de las políticas públicas en las instituciones comunitarias y en los usos de los bosques en México*. Instituto Nacional de Ecología, Mexico D.F., 2004.

Antonio Carlos Diegues, *O Mito Moderno da Natureza Intocada*. Editora Hucitec Ltda., São Paulo, 4th edn. 2002.

Edward O. Wilson, *The Future of Life*. Alfred A. Knopf, New York, 2002.

About the author

Roger Hamilton is editor of IDBAmérica, the magazine of the Inter-American Development Bank. A graduate of Amherst College and Columbia University, he has written extensively on conservation and national resource management at the IDB and previously for other publications including The New York Times, The Washington Post and National Geographic magazine.

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Printing
Juan A. Rodríguez, Williams Lea Corporate Information Solutions

Photographs
Roger Hamilton, except for the following:

Government of the State of Acre, p. 2 (Governor Viana)
Government of the State of Acre, p. 24 (Governor Viana in ceremonial welcome)
Government of the State of Acre, p. 27 (Governor Viana traveling by boat)
Alex Hern, p. 36 (sea cucumber)
Steven Stone, p. 43 (ribbon-cutting)
Fernando Campos, p. 85 (caterpillar, pupa and burchellanus)
Fundação Zoo-Botânica, BH, p. 95 (butterfly garden)
Juan Pratiginestos, p. 96 (golden lion tamarin and its baby)
Institute for Ecological Research - IPÊ, p. 113 (captured peccary)
Barrie & Claire's RV Adventures, p. 121 (condor)
Robert J. Deal Jr., p. 122 (diver)
PMAIB, p. 130 (sea turtle)
David Mangurian, p. 132 (beach photo)
Norbert Wu, p. 133 (tree with ibises)

ENVIRONMENT

How can a burly man swinging a chain saw be a friend of the forest? What is a herd of cattle doing in a national park? Can protests by angry fishermen lead to a consensus for protecting marine resources?

People in Latin America and the Caribbean are creating a new paradigm in the relationship between people and nature. Whether out of choice or necessity, they no longer accept unquestioningly the model of "untouched nature" handed to them by their neighbors to the north. They act on the recognition that people are a part of nature.

Natural Partners takes the reader to places of outstanding biological value that face a difficult, uncertain future. Most of the people who live in these places—peasant farmers and rubber tappers, fishermen, local officials, conservationists and business leaders—want change. But they also want to pass on to their children a rich and healthy natural environment. Their vision is idealistic but their methods are pragmatic.

These essays originally appeared in IDBAmérica, the online magazine of the Inter-American Development Bank.

IDBAMÉRICA

News about people and ideas that are reshaping Latin America and the Caribbean

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