

Can Sustainable Management Save Tropical Forests?

Sustainability proves surprisingly problematic in the quest to reconcile conservation with the production of tropical timber

by Richard E. Rice, Raymond E. Gullison and John W. Reid

To those of us who have dedicated careers to conserving the biodiversity and natural splendor of the earth's woodlands, the ongoing destruction of tropical rain forest is a constant source of distress. These lush habitats shelter a rich array of flora and fauna, only a small fraction of which scientists have properly investigated. Yet deforestation in the tropics continues relentlessly and on a vast scale—driven, in part, by the widespread logging of highly prized tropical woods.

In an effort to reverse this tide, many conservationists have embraced the notion of carefully regulated timber production as a compromise between strict preservation and uncontrolled exploitation. Forest management is an attractive strategy because, in theory, it reconciles the economic interests of producers with the needs of conservation.

In practice, sustainable management requires both restraint in cutting trees and investment in replacing them by planting seedlings or by promoting the natural regeneration of harvested species.

Most conservationists view this formula as a pragmatic scheme for countries that can ill afford to forgo using their valuable timber. We, too, favored this strategy until recently, when we reluctantly concluded that most of the well-meaning efforts in this direction by environmental advocates, forest managers and in-

ternational aid agencies had a very slim chance for success. Although our concerns about the effectiveness of sustainable forestry have since mounted, our initial disillusionment sprang from our experiences trying to foster such practices in South America seven years ago.

A Disenchanted Forest

It was our interest in trying to preserve the Amazonian rain forests of Bolivia that brought two of us together for the first time in 1990, for a chance meeting at the bar of the sleepy Hotel El Dorado in downtown La Paz. Gullison had just arrived from Princeton University to conduct research on the ecology of mahogany (*Swietenia macrophylla* King), the most valuable species in the tropical Americas. Rice was about to re-

turn to Washington, D.C., after working with the Smithsonian Institution at the Beni Biosphere Reserve, located next to the Chimanes Permanent Timber Production Forest, a tract of half a million hectares in lowland Bolivia. In the mid-1980s the International Tropical Timber Organization selected the Chimanes Forest as a model site for sustainable management, and we were both eager to help that program advance.

Although our first exchange over beer in La Paz was brief, by the end of the conversation we had agreed to collaborate further. Within a year we secured funding for what eventually became a four-year study. At the outset, our intention was for Gullison to establish how best to manage mahogany production from an ecological standpoint and for Rice to develop the economic arguments

needed to convince timber companies to adopt policies based on these scientific findings.

As time passed, Gullison and his Bolivian field crew made steady progress in understanding the ecology of the forest. Mahogany seedlings, it turned out, grew and prospered only after sizable natural disturbances. In the Chimanes region, younger mahogany trees stood only near rivers where floods had recently swept the banks clear and buried competing vegetation under a thick blanket of sediment. Such disturbances in the past had created



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CENTURIES-OLD MAHOGANY log awaits cutting at a Bolivian sawmill. Logging of mahogany (*Swietenia macrophylla* King), one of the most valuable tropical woods, occurs in many parts of Central and South America, including Guatemala, Belize, Bolivia, Peru and Brazil.

widely dispersed pockets where seedlings could grow, eventually producing groups of trees of approximately uniform age and size. For the problem at hand, this aspect of the ecology of mahogany was quite alarming: it meant that uncontrolled logging would invariably obliterate the older stands, where nearly all trees would be of a marketable size.

Those worries were exacerbated by the realization that there would be little natural growth to replace harvested trees even if the loggers cut the forest sparingly. Mahogany seedlings (and those of certain other tropical tree species) cannot grow under the shady canopy of dense tropical forest. With natural regeneration unlikely to prove adequate, human intervention would be needed to maintain the mahogany indefinitely.

How could a helping hand be provided? In theory, loggers could create the proper conditions for new mahogany to grow by mimicking nature and clearing large openings in the forest. But the effort would be enormous, and judging from previous attempts elsewhere to do just that, costly periodic “thinnings” would be required to remove competing vegetation. Such efforts to sustain the production of mahogany could disturb so much forest that the overall conservation objectives would surely be compromised. Hence, winning the battle for mahogany might still lose the war to preserve biodiversity. Appreciation of this difficulty led us to question what exactly it was we were trying to achieve.

Money Matters

Just as Gullison was discovering the difficulties of regenerating mahogany, Rice was finding that timber companies working in the Chimanes Forest had no economic incentive to invest in sustainable management. This conclusion was not entirely surprising given global trends: less than one eighth of 1 percent of the world’s tropical production forests were operating on a sus-

LOGGED FORESTS can differ dramatically in the level of disturbance they experience. Loggers operating under strict regulations felled nearly all the trees at this locale on Vancouver Island in Canada (*top*), whereas their counterparts working with scant government oversight in southeastern Bolivia (*bottom*) downed only the tiny fraction of growth that contained commercially valuable timber.



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tained-yield basis as of the late 1980s.

Logging, as typically practiced in the tropics, rapidly harvests the most highly valued trees. The number of species extracted may be as low as one (where there is a specialty wood, such as mahogany) or as high as 80 to 90 (where there is demand for a wide variety). Logging companies generally show little concern for the condition of residual stands and make no investment in regeneration. This attitude emerges, in part, as a matter of simple economics. In deciding whether to restrict harvests, companies face a choice between cutting trees immediately and banking the profits or delaying the harvest and allowing the stand to grow in volume and value over time. Economics, it seems, dictates the decision.

In choosing the first option, a company would harvest its trees as quickly as possible, invest the proceeds and earn the going rate of return, which can be measured by real, or inflation-adjusted, interest rates. Because risks are considerable and capital is scarce, real interest rates in developing countries are often much higher than in industrial countries. For example, real interest rates on dollar-denominated accounts in Bolivia have averaged 17 percent in recent years, compared with 4 percent in the U.S. Similarly high rates of interest are common in most countries in Latin America. Thus, companies that rapidly harvest their assets can invest their profits immediately and generate continuing high rates of return.

The benefits of delaying harvests, in contrast, are small. From 1987 to 1994, real price increases for mahogany averaged 1 percent a year, whereas the average annual growth in volume of commercial-size mahogany trees is typically less than 4 percent. This combination of slow growth rates and modest price increases means that mahogany trees (as well as most other commercial tree species in the American tropics) rise in value annually by at most 4 to 5 percent—about the same as would be earned by a conservative investment in the U.S. and much less than competitive returns in Bolivia.

The value of the trees left to grow, moreover, could easily plummet if wind, fire or disease destroyed them or if in the future the government restricted logging. Therefore, choosing to leave mahogany growing amounts to a rather uncertain investment—one that would provide, at most, a rate of return that is

essentially the same as could be obtained by harvesting the trees and banking the profits safely. Like most other businesspeople, who are unwilling to make risky investments in developing countries unless offered considerably higher returns, loggers choose to cut their trees as quickly as they can.

After making a careful analysis of the economics of logging in the Chimanes region, we discovered that unrestricted logging is from two to five times more profitable than logging in a way that would ensure a continued supply of mahogany. From a purely financial perspective, then, the most rational approach to logging appears to be exactly what timber companies are doing—harvesting all the available mahogany first, avoiding investments in future harvests, and then moving on in sequence to all species that yield a positive net return. Adam Smith's invisible hand, it appears, reaches deep into the rain forest.

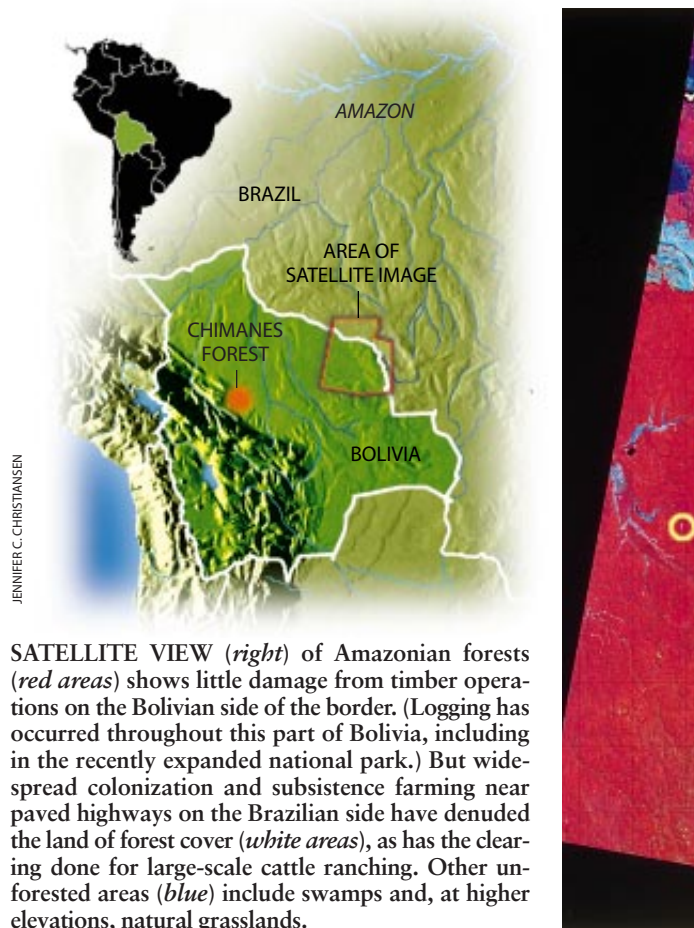
The incentives driving uncontrolled logging prove especially powerful in developing countries, where government regulation is, in general, quite weak. The national forest authority in Bolivia, for instance, receives annually less than 30 cents for each hectare of land it administers. (The U.S. Forest Service, in comparison, gets about \$44.) With such slim support, government regulators in Bolivia are hard-pressed to counterbalance the financial rewards of cutting all the valuable trees at once, and it is no wonder that few timber companies there invest any effort to help the targeted species regenerate.

The Value of Sustainability

After spending some time in the Chimanes region of Bolivia, we decided to investigate how severely logging there had injured the local environment. We quickly found that, although clearly unsustainable for mahogany, the physical effects of logging on the forest as a

whole have been relatively mild. Because only one or two mahogany trees grow in a typical 10-hectare plot, road building, felling and log removal disrupt less than 5 percent of the land. We estimate that current logging practice causes considerably less damage than some forms of sustainable management (which require more intensive harvests of a wider variety of species). Indeed, a more sustainable approach could well double the harm inflicted by logging.

Sustainability is, in fact, a poor guide



SATELLITE VIEW (*right*) of Amazonian forests (*red areas*) shows little damage from timber operations on the Bolivian side of the border. (Logging has occurred throughout this part of Bolivia, including in the recently expanded national park.) But widespread colonization and subsistence farming near paved highways on the Brazilian side have denuded the land of forest cover (*white areas*), as has the clearing done for large-scale cattle ranching. Other un-forested areas (*blue*) include swamps and, at higher elevations, natural grasslands.

to the environmental harm caused by timber operations. Logging that is unsustainable—that is, incapable of maintaining production of the desired species indefinitely—need not be highly damaging (although in some forests it is, especially where a wide range of species have commercial value). Likewise, sustainable logging does not necessarily guarantee a low environmental toll. Ideally, companies should manage forests in a way that is both sustainable for timber and minimally disturbing to the environment. But when forced to choose between unsustainable, low-impact logging and sustainable, high-impact logging, environ-

mentalists should make sure they pick the option that best meets their conservation objectives. If the maintenance of biodiversity is of paramount importance—as we believe it should be—a low-impact (albeit unsustainable) approach may be the preferable choice.

Yet the quest to sustain the yield of wood indefinitely has become a central theme in efforts to preserve tropical forests. And conservation-minded people have proposed several strategies to overcome the economic obstacles to sus-

as faster growth or a brighter price outlook—to suggest that investments in regenerating these species will be any more attractive than investments in regenerating currently targeted species. Larger markets for secondary species may only increase the number of trees that are harvested unsustainably.

A parallel argument can be made with regard to secondary, or value-added, processing. Such processing (of logs into furniture or plywood) is often said to have the dual advantages of allowing the use of a wider variety of species while providing a stronger economic incentive to manage forests sustainably. In fact, the promotion of value-added processing in many countries has actually reduced their overall earnings (because large subsidies are needed to attract the necessary investment) while greatly increasing both the pace and scale of forest destruction.

Arguments promoting secure land tenure suffer from a similar limitation. Environmental advocates point to the lack of long-term access to timber resources as a major cause of unsustainable management. The commonsense argument favoring tenure security is that, without it, timber companies will be reluctant to invest in future harvests. Yet ensuring that companies are, in principle, able to benefit from nurturing forest growth does nothing to provide the practical financial

incentives to foster such practices. More secure land tenure makes investments in regeneration possible for timber companies to consider; it does not, however, automatically make these investments economically worthwhile. In fact, rather than promoting investments in regeneration, more secure tenure may simply lower the risk of making larger investments in logging equipment, thus encouraging swifter liquidation of the resource.

This very issue brought Reid to our team in 1994. Rice had met Reid two years earlier in a torrential storm in the heart of the Petén, Guatemala's heavily

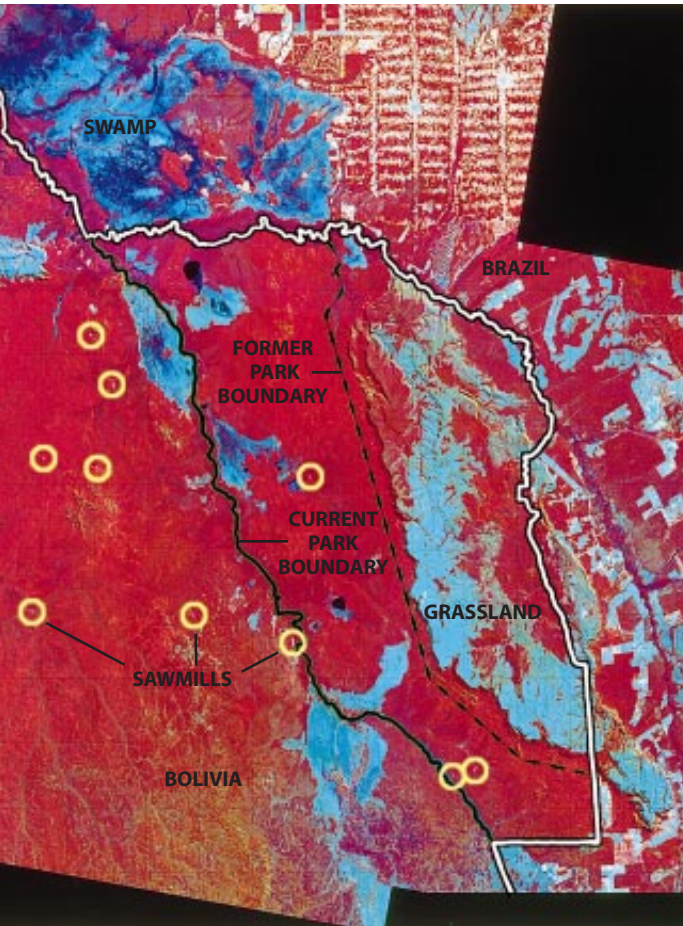
forested northern province. Logging there had been suspended by government decree, but Guatemala's policymakers were considering turning large tracts of forest over to companies under contracts that would have endured for 25 years.

We agreed that such lengthy tenure for loggers probably would not solve the problems of unsustainable logging and an expanding agricultural frontier. It could, we feared, hurt the thousands of people who roam these woods in search of chicle latex (a gum), ornamental palm leaves and allspice—all valuable products for export. So when local authorities drafted a proposal to allow timber interests long-term concessions in hopes of promoting sustainable management, Rice called Reid to ask whether he would like to examine that policy in detail. Six weeks later the Guatemalan government had our report, which demonstrated the hefty cut in profits that companies would have to absorb to manage these forests sustainably. As a result, the plan was shelved, although pressure remains to turn the forest over to the logging industry.

Certifiably Green

Many people concerned with the future of the rain forest view timber certification, or “green labeling,” as the prime means of providing the economic incentive needed to spur sustainable management. Such certification programs call for voluntary compliance with established environmental standards in exchange for higher prices or greater market access, or both. While experts debate whether certification actually leads to higher market prices, the more important question is whether the premiums consumers are willing to pay for certified products are sufficient to bring about the necessary changes. Our economic analysis of the Chimanes operations indicated that for valuable species such as mahogany, current patterns of unsustainable logging can be as much as five times as profitable as a more sustainable alternative. Yet consumers appear to be willing to spend, at most, 10 percent more for certified timber than the price they would pay for uncertified wood products. The gap is enormous.

Nevertheless, certification has the potential to be an important tool for forest conservation, as long as these efforts concentrate on low-cost modifications that are sure to reduce environmental



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tainable forest management. Their approaches, however, often fail to distinguish between the profitability of logging existing forests and the profitability of investing in regeneration. In the absence of strong governmental control, both must be financially attractive to succeed.

Efforts to increase the utilization of lesser known tree species provide an informative example. Some advocates of sustainable management contend that boosting market demand for lesser known species will make it worthwhile to maintain a production forest that otherwise might be converted to farmland or rangeland. Yet there is nothing—such

Vive la Différence

Why protect tropical forests? For one, because they harbor most of the planet's biodiversity, an umbrella term for the variety of ecosystems, species and genes present. Scientists estimate that tens of millions of species exist, but they have described between only 1.4 and 1.5 million of them. Half the species identified so far live in tropical forests, yet biologists suspect the proportion could reach 90 percent if a full tally were ever accomplished.

Some examples help to put the biological abundance of tropical forests in proper perspective. In one study, a single hectare of rain forest in Peru was found to house 300 tree species—almost half the number native to North America. In another assay, scientists counted more than 1,300 butterfly species and 600 bird species living within one five-square-kilometer patch of rain forest in Peru. (The entire U.S. claims 400 butterfly species and just over 700 bird species.) In the same Peruvian jungle, Harvard entomologist Edward O. Wilson uncovered 43 ant species in a single tree, which he pointed out was about the same number as exists in all of the British Isles.

Such diversity of plant and animal life is important to humans because it is essential for creating food, medicines and raw materials. Wild plants, for example, contain the genetic resources needed to breed crops for resistance to pests and disease. And about 120 clinically useful prescription drugs come from 95 species of plants, 39 of which grow in tropical forests. What is more, botanists believe that from 35,000 to 70,000 plant species (most drawn from tropical forests) provide traditional remedies throughout the world. Take away the places where such species live, and myriad medicines become lost forever.

One means to protect biodiversity is the Convention on International Trade in Endangered Species (CITES)—the 1973 treaty that helped to keep elephants and gorillas from becoming extinct. Bolivia, which is second only to Brazil in mahogany exports, recently asked the U.S. to join it in gaining protection for mahogany (*Swietenia macrophylla* King) under the CITES accord. The proposal seeks to include mahogany among the items in Appendix 2 of the treaty, which would require countries to monitor their exports to ensure that international trade does not threaten the species. (Appendix 1 of the CITES treaty includes those species that are already endangered and prohibits their export for international trade.)

The U.S. Fish and Wildlife Service agreed in January to request protective measures for mahogany during the next CITES meeting in June. Although the full implications of this proposal remain unclear, we hope this action will focus much needed attention on the question of how best to conserve biodiversity in tropical forests that are being logged. —R.E.R., R.E.G. and J.W.R.



damage (such as preventing loggers from hunting forest animals) rather than expensive changes that bring doubtful benefits. Although there is not yet broad consumer demand for certified wood, there does appear to be a growing niche that could be filled if the costs of being green are kept to a minimum. In the meantime, it would be best to avoid altering the economic incentives facing all logging operations, such as increasing tenure security or promoting lesser known species, simply to benefit the small number involved with certification. Without much broader acceptance of certification, such policies may only speed the degradation of tropical forests.

What to Do?

The management of tropical forests for sustainable timber production is unlikely to become a widespread phenomenon, at least in the near future. Contrary economic incentives, limited government control and a lack of local political support will consistently thwart the best efforts in that direction, particularly in developing countries. Environmentalists need to recognize this reality. Although we see no easy solutions, there are a few strategies that deserve greater attention.

One possibility is to provide timber companies with low-interest loans to fund regeneration and the protection of biodiversity. Logging that includes these activities is not sufficiently profitable at the high interest rates typical in developing countries, but it could become so if funded by cheaper capital, perhaps provided by development banks or conscientious investors.

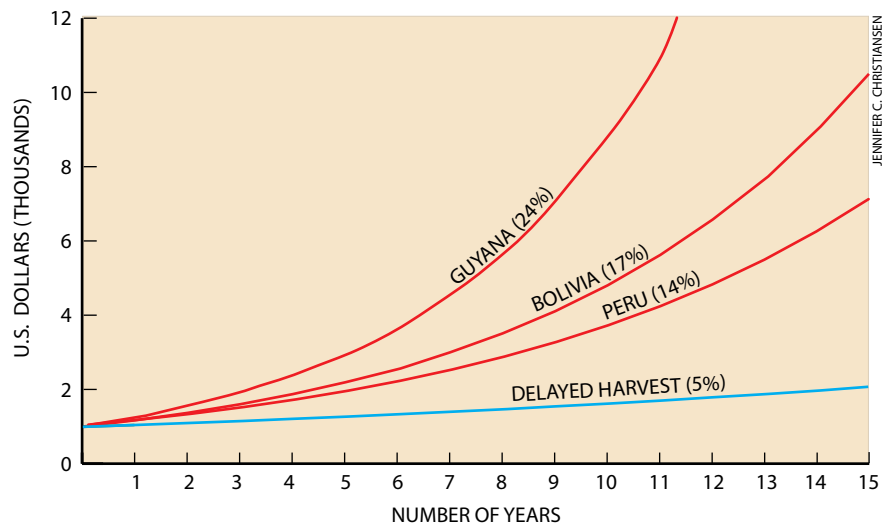
Another option is to promote the preservation of large forested areas within and around timber concessions. Such set-asides would be relatively inexpensive to monitor and could aid substantially in the conservation of biodiversity. Rather than just keeping forest cover, such protected areas could maintain forest that had nearly its full complement of species and old-growth structure. Ideally, these lands should be contiguous with,

MONITORED CREATURES already listed in Appendix 2 of the Convention on International Trade in Endangered Species include, among hundreds of others, (left, from top to bottom) orchids, poison-dart frogs, chameleons, hummingbirds, staghorn corals, Galápagos fur seals and American ginseng plants.

or near, other intact forest. To minimize the cost, we suggest focusing on commercially inoperable areas, such as places too steep to log or forests that have been lightly logged in the past.

Although such set-asides may be among the less economically productive areas under their control, timber companies are likely to resist any restrictions at all on their movements. In Bolivia the government is addressing this difficulty by offering loggers a financial reward for preservation. Under a law that has just been approved, the Bolivian government will collect a flat tax (of around \$1 per hectare a year) for logging privileges. Timber companies can, however, designate up to 30 percent of their concessions as off-limits to logging, and the lands thus specified will be exempt from taxation. This policy should encourage loggers to protect their commercially marginal lands, and it may soften their resistance to having other areas set aside for the protection of the environment.

Finally, in forests such as Chimanes, where uncontrolled logging is selective and settlement pressures are low, accepting some elements of the status quo may prove to be the best available option. As in many areas of the Bolivian lowlands, logging in Chimanes is almost certain to continue long after the mahogany has been exhausted. In fact, the current pattern of selective harvest of a large number of commercial species, one or two species at a time, is a process that in some areas could require decades to complete. The challenge facing conservationists under such circumstances is not so much to convince the timber companies to stay and log sustainably for the long run but rather to institute some form of protection for old-growth



FINANCIAL REWARDS that can be earned by harvesting trees worth US\$1,000 and investing the proceeds at the real interest rates available locally (red) outstrip the return attained by letting the trees grow in size and value before cutting them down (blue).

forests while the opportunity remains.

Environmentalists also need to remember that many threats to tropical forests would continue even if sustainable management were to become widely adopted. National agricultural policies, road development and colonization can each pose a far greater danger to tropical forests than unsustainable logging. Reducing the destruction caused by these forces could do much more for forest conservation than revamping current forestry practices.

Clearly, no single strategy will work indefinitely or for all forests. Our prescriptions (particularly for old-growth set-asides) might ultimately succumb to the same forces that now frustrate sustainable forest management. Over time, producers will have an ever greater incentive to enter currently uneconomic

areas. So, in the absence of determined government oversight, these alternatives, too, would fail just as surely as efforts to impose sustainable forestry. Our set-aside proposal differs, however, in that it delivers real and immediate environmental benefits by protecting old-growth forest. Furthermore, it relies on straightforward restrictions about where logging occurs rather than on complicated technical rules dictating how logging is to be done.

Although far from providing fully satisfying solutions, the measures we suggest may be the most realistic means to harmonize conservation with tropical timber extraction, until such time as political and economic change in the developing world brings a widespread demand for more effective protection of these majestic tropical forests. sa

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RICHARD E. RICE, RAYMOND E. GULLISON and JOHN W. REID came to study the problems of tropical forests from quite different perspectives. Rice obtained a bachelor's degree in economics at Grinnell College and went on to earn a master's in economics and, in 1983, a doctorate in natural resources from the University of Michigan. He is currently the senior director of the resource economics program at Conservation International in Washington, D.C. After graduating from the University of British Columbia with a degree in zoology, Gullison studied ecology and evolutionary biology at Princeton University, where he completed a Ph.D. in 1995. He now teaches at the Imperial College of Science, Technology and Medicine in London. Reid earned a master's degree in public policy at Harvard University before joining Conservation International in 1994. His work there focuses on natural resource economics and policy issues concerning conservation in the tropics.

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