Letter writers debate the merits of "sustainable forest management" in the tropics and the role the "private sector" should play in rain forest "conservation strategy." And care is urged in preparing "review articles" in the "genome sequencing era."

Logging On in the Rain Forests

In their policy commentary "Logging and tropical forest conservation (*Science*'s Compass, 19 June, p. 1899), Ian A. Bowles *et al.* take a position against lifting the World Bank's ban on investing in the logging of primary tropical rain forests (*1*), and they criticize the usefulness of sustainable forest management (SFM) as a conservation practice. We agree that the World Bank's ban should not be changed soon, and we agree that tropical forest conservation is of prime importance to preserving the world's biodiversity and the ecosystem services that it provides. Our view of the present and near future development trajectories in tropical rain forests suggests, however, that it is unreasonable to rely exclusively on protected areas for the future needs of biodiversity conservation and that SFM can be one viable and conservation-friendly option to complement an overall conservation strategy.

CONSERVATION INTERNATIONAL

Rain forest loggers atop stump

First, under the proposals of Bowles *et al.*, vast areas would be needed to conserve much of the world's biodiversity—in some cases, orders of magnitude more than already set aside. Even the 10% objective of protected land by the year 2000 (*2*) would be insufficient to protect the majority of species in the natural habitats [see "Conservation targets: Do they help?" by M. E. Soulé and M. A. Sanjayan (*Science*'s Compass, 27 Mar., p. 2060)]. Also, it is no secret that effective protection of reserves in tropical countries is rarely achieved because of lack of enforcement and of human and financial resources. In Brazil, for example, the central Amazonian conservation corridor, one of several proposed for Brazil (*3*), has a major federal highway cutting right through it that was upgraded and fully paved just last year. More paper parks and reserves will not solve the conservation problem of tropical forests.

Second, rapid changes are occurring in many tropical regions that demand immediate, sound, and viable conservation alternatives to avoid more outright destruction. In the Amazon basin, many elements have been converging in the last several years, creating a possibly explosive situation. New roads are appearing, old-world stocks of tropical hardwood timber are dwindling, there is a rapid influx of migrants to the city of Manaus, employment opportunities in urban centers are decreasing, and national and international investments in land and infrastructure for timber extraction have dramatically increased (*4*). The stage is set for the Amazon basin to become the new center for tropical timber extraction. The absence of sustainable development models will lead to the same uncontrolled destruction that we all wish to avoid. Past "selective logging" of mahogany, for example, has not led to the extraction of only one or two trees per acre (as suggested by Bowles *et al.*), but to the removal of entire regional forest cover, as in the southern part of the state of Para in Brazil.

Finally, although SFM is obviously more detrimental to forests than outright preservation, it is the best-known model of forest management in existence today (*5*). For example, operating costs (per area) of SFM are lower than conventional harvesting, and profits can be higher (*6*). Also, since it began only 4 years ago, the Forest Stewardship Council has labeled more than 6.3 million hectares of native and plantation forests as sustainable, a much larger area than that shown in the illustration in the commentary (p. 1899). Moreover, one of the criteria of forest certification requires that 10% of any management unit be set aside for conservation, a measure that would help attain the World Bank and World Wildlife Fund (WWF) goals. Finally, SFM should not be equated with timber production alone. SFM includes nontimber forest products. A blanket opposition to investments in SFM also means that the potential to sustainably harvest many of the other nontimber forest products would not be investigated.

The bottom line is that timber companies do not need loans to clear-cut areas and sell valuable tropical timber, and they will continue to do so unless alternative management strategies are implemented to complement preservation (*7*).

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Bowles *et al.* miss the forest for the trees. In pitting protection against sustainable forest management, they treat these two options as conflicting alternatives when, in fact, they are essential complements.

No one would argue that SFM is a substitute for protection. But reliance on protection as a stand-alone strategy for forest conservation does not account for the reality that degraded forests outside park boundaries have a direct effect on those inside—eroding ecological integrity, altering rainfall patterns, and, as was graphically illustrated by this year's wildfires in Latin America and Asia, threatening their very existence.

A tropical forest with roads is eight times more likely to fall to wildfires than a tropical forest without roads. The strategy of Bowles *et al.* would require an extensive road network. As such, conventional

logging is far from benign, even if only a few trees are removed.

The thesis of the commentary—that SFM does more harm than good in tropical forests—rests, moreover, on a skewed concept of what SFM actually entails. No respectable proponent of SFM would equate it solely with sustained yield. Currently accepted definitions, such as the Earth Summit Forest Principles and their subsequent "criteria and indicators" (*1*), attempt to balance various ecological, economic, and social factors. Indeed, certification under the Forest Stewardship Council (FSC) calls for the "protection of representative samples of ecosystems" and "the establishment of conservation zones" to ensure the continued integrity of the forests subjected to harvesting (*1*, FSC Principle 6, Criteria 6.2 and 6.4). We know from an increasing number of studies across the tropics that by applying such practices we can reduce the devastating environmental impacts of conventional logging by up to 50% while improving the bottom line by 20%.

Bowles *et al.* are correct that the complete preservation of biodiversity is not possible in the context of industrial logging. The purpose of SFM, however, is not to serve as an alternative to protection, but to rationalize timber harvesting and reduce the negative impacts of rampant logging common throughout the tropics. Protection is better from an environmentally purist point of view, but in view of the fact that less than 8% of the world's forests are currently protected (many of them ineffectually), it is unrealistic to expect that enough forest land can be put under protection to avoid massive species extinction.

The solution, WWF believes, lies in using protection and SFM in tandem by creating more protected areas and surrounding them with buffer zones where management activities minimize negative impacts. If forest conservation is to succeed, it is urgent that we expand our scope beyond parks by working to improve ecological practices in the great majority of forests that lie outside them. For this second, but no less critical imperative, certified SFM is without question the most promising initiative to date.

There is, finally, a damned-if-you-do–damned-if-you-don't logic to the authors' criticism of SFM. On the one hand, they dismiss the concept because only a tiny percentage of the world's tropical forests are currently well managed. On the other, they criticize the World Bank for committing to increase that percentage several fold over the next several years. Even those who remember the Bank's flawed environmental record under previous administrations should welcome World Bank President James Wolfensohn's historic commitment (*2*) to support this vital component of tropical forest conservation.

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Bowles *et al.* correctly emphasize the multidecadal and multinational efforts to curb the loss of tropical forests. They raise some important issues about biodiversity conservation and sustainable use of tropical forests. Unfortunately, their focus on the limited progress toward sustainable forest management leads to an incorrect conclusion that tropical forest use and conservation are incompatible.

In their critique of sustainable forest management initiatives, they do not discuss the much greater cause of tropical deforestation from conversion to nonforest land uses. Many of us who have worked for tropical forest conservation recognize that unless economically viable uses of tropical forests are developed, most unprotected tropical forests are doomed to conversion. In forest-rich countries such as those sharing the Amazon and Congo basins, officially designated conservation areas (for example, national parks and equivalent reserves) cover only a small fraction of the remaining tropical forests. Therefore, improved and enlightened uses of these unprotected forests—whether by local communities for nontimber products or by commercial logging companies—may lessen or minimize the loss of biodiversity and ecosystem services when one compares that loss with the alternative of forest conversion to agriculture.

Bowles *et al.* do not mention several initiatives now under way—for example, Bolfor (Bolivia), Iwokrama (Guyana), Portico (Costa Rica), and Rio Bravo (Belize)—that are demonstrating that SFM can be compatible with conservation. It takes enlightened leadership and strong commitment to conservation principles for ecologically responsible tropical forestry to succeed. If unprotected tropical forests are to survive well into the next century, the private sector must play a far greater role than it is at present in promoting sustainable uses of these globally important resources. The World Bank and other bilateral and multilateral donors can and should play catalytic roles in promoting the sustainable use of unprotected tropical forests.

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Response

The letters contain two general messages: first, relying on protection as a conservation strategy in tropical forests is naive and ineffective, and second, SFM is a proven and economically viable conservation strategy—and, indeed, is more profitable than conventional logging. The authors offer little compelling evidence to support either of these positions.

With regard to the first message, protected areas have and should continue to be the cornerstone of any sensible conservation strategy (*1*). If conservationists agree on this, then why would any of us want to set up the argument as "parks are important, but they are rarely effective, so we have to focus on other strategies"? This seems a risky message to be broadcasting. Indeed, in regions like the Atlantic Forest of Brazil, protected areas are often all that is left in terms of intact, functioning ecosystems. The message that parks don't work is not only unhelpful and generally untrue, it is also unsubstantiated in the letters. In our commentary, we simply note that protection *is* a proven strategy and, further, that conservationists should be vigilant that our experiments with SFM do not become co-opted and used to argue for new investments in destructive logging.

With regard to the second message, Cabarle, for example, states that "an increasing number of [unnamed] studies across the tropics" show that adopting sustainable logging practices can raise profits by 20%. This assertion conflicts with our own experience and with the published literature that we have seen (*2*). If SFM is 20% more profitable, one might reasonably ask why more profit-maximizing private operators have not adopted it as a sensible business decision.

Elsewhere, Cabarle criticizes us for a proposal we do not make. After correctly drawing a general link between forest disturbance, roads, and the risk of wildfires, he incorrectly concludes that we advocate "an extensive road network." On the contrary, a central theme of our article is the need for more strict protection, fewer roads, and less logging—both in terms of geographic extent and the duration of timber extraction in a given forested area.

Hartshorn, while not disputing the substance of our presentation on SFM, simply asserts that SFM is necessary and important for conservation. We agree with his premise that unless economically viable uses of tropical forests are developed, most unprotected tropical forests are doomed to be converted to other uses. The logical response to this problem, however, is to put more forests under strict protection, not to focus more attention on a strategy (SFM) whose main shortcoming is a lack of economic viability. Hartshorn also states that we do not acknowledge several SFM successes, yet the examples he cites do more to bolster our perspective than his.

Work conducted under the Bolfor project in Bolivia forms the basis of Rice *et al.*'s criticisms of SFM (*2*). Bolfor has spent close to $20 million and has one subsidized certified logging operation to its credit that, to our knowledge, has not yet made a profit (*3*). The Nature Conservancy, in contrast, recently protected a large tract of lightly logged forest nearby in Bolivia for a fraction of this investment (*4*).

The Iwokrama project in Guyana does not currently include any commercial logging (*5*). The timber industry in Guyana is shrinking, and private operators in forests

near Iwokrama are reportedly considering abandoning their substantial investments (*6*). If the Iwokrama project does begin logging, it will do so in a forest that the private sector would not log voluntarily for economic reasons. Such an outcome would draw into question whether this conservation project is minimizing environmental impacts or creating them.

The Portico operation in Costa Rica is at present certified as sustainable. Yet the market benefits of this certification are not clear. In a study by the Sustainable Forestry Working Group (*7*), Portico's Executive Director stated that "he had no clear evidence from retail customers that they would pay more for a door simply because the wood used to make it was certified. He believed that customers still made their buying decisions largely based on the price-to-quality ratio." Given the company's experience to date, they reportedly see "no current need for expanding [their] certification."

With regard to the Rio Bravo project in Belize, we are not aware of any study that characterizes this project as a successful business enterprise based on SFM. To the contrary, reports indicate that it continues to struggle financially (*8*).

Finally, Hartshorn does not cite the one example on which he himself has written: the Yanesha Forestry Cooperatives Project in the Palcazu Valley, Peru. The timber management component of this project is now defunct (*9*), but for years it was hailed as a prime example of how SFM can and should be implemented (*10*). Hartshorn's letter—and indeed, all three letters—echo the convoluted logic that has permeated this debate. While conceding that protected areas are the best prescription for biodiversity conservation, they argue that these same parks don't work and, therefore, we need SFM. But, as we mention above, parks are generally all that remains in the most heavily degraded tropical forests, and SFM has so far done little to preserve these ecosystems.

Returning to the central argument of our article, Gascon *et al.* agree that the World Bank should not return to making investments in logging primary tropical forests. The other two letters are silent about this, but supporters of a change in the World Bank policy seem to argue that SFM in tropical forests is such a proven success that all it needs now is additional World Bank investment. This view ignores nearly 20 years of history, including the World Bank's own previous investment in a wide range of large and unsuccessful schemes to promote SFM. Indeed, despite years of effort and massive public expenditures, virtually no natural tropical forests are managed sustainably. It is because of this record of past achievement—and the evidence that it is unlikely to change any time soon—that we see no reason for the World Bank to alter its current policy.

In sum, we feel that it would be a risky strategy for the World Bank to use SFM as the basis for changing its prohibition against logging investments in tropical forests. Until better options arise, conservationists (and the World Bank) should recall the lessons of the past and support outright protection and other proven strategies for biodiversity and forest conservation in the tropics.

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Errors in Genome Reviews

It is becoming clear (*1*) that the advent of the genome sequencing era is accompanied by the propagation of erroneous functional annotations in an increasing number of cases. The sudden availability of an enormous amount of information has raised the probability that review articles may contain erroneous annotations. It often appears that the transfer of functional assignments either from (i) annotations or (ii) additional sequence information are not carefully checked in the reviews that follow.

As an example of the first case, the assignment for the *Methanoccus jannaschii* ORF MJ1228, originally correctly characterized as the archaeal eIF-5A (*2*), was subsequently miscopied as eIF-5 in two more recent reviews (*3*, *4*). An eIF-5 homolog has not been found in Archaea thus far (*5*).

As an example of the second case, the tentative annotations of certain archaeal ORFs as eIF-2B alpha and delta (*2*), the best available predictions at that time, have proliferated in a review that followed (*4*), without reference to more recent literature. With new sequence information (*6*), it has been possible to show that these archaeal ORFs belong to a different subfamily named aIF-2B I and II (*7*).

These annotation errors engender ill-derived conclusions. The authors who are writing reviews based on genomic data should use extreme caution copying the information and should confirm the results they intend to cite.

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