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# Will concern for biodiversity spell doom to tropical forest management?

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**Abstract**

Arguments against active tropical forest management are analyzed in light of available data and new research that shows tropical forests to be more resilient after disturbances than previously thought. Tropical forest management involves a diverse array of human activity embedded in a complex social and natural environment. Within this milieu, forest structure and composition adjust to change and reflect the human and natural economy of regions. Critics of active forest management overestimate problems and underestimate human capacity to solve them. They isolate parts of a complex issue, i.e. the biodiversity component of tropical forest management, to generalize about the negatives of logging. This view of the tropics is consistent with past treatment of tropical issues by those that evaluate the situation from a non-tropical perspective. The literature reveals that conservation of biodiversity can be compatible with measured use of tropical forests. However, the conservation of biodiversity could be hurt should society not approach the tropical forestry issue holistically and act on misinformation. Active forest management is the means towards the goal of conservation and the best available way to simultaneously address human needs and conservation of biodiversity. 

*Keywords:* Biodiversity; Tropical forests; Conservation; Logging; Mahogany; Protected areas

> 'The best hope for conserving the biodiversity of tropical forests is to develop economically viable land uses that require large areas of relatively natural forest cover. Strict reserves are essential for conservation, but they usually are too few or too small to contain the necessary elements of a tropical forest ecosystem, and their integrity may depend on being surrounded by zones of compatible economic land uses' (Brokaw et al., 1998, p. 225).

'What is it that very few people have seen, but which many people have defined, that in practice barely exists, or that doesn't exist at all (according to some people), but which, if ITTO (International Tropical Timber Organization), TTF

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(Tropical Timber Foundation), and WWF (World Wildlife Fund) have their way, will become one of the dominant forms of land use in the tropics by the year 2000? Attributed to Synnott by Johns' (1997, p. 13).

'Definition is of paramount importance because 'sustainable yield' management for timber can have devastating impacts on the structure and composition of natural forests and their biodiversity' (Bowles et al., 1998a, p. 1899).

## 1. Introduction

The above quotes summarize the arguments of an ongoing debate in the pages of *Science* (vols. 280 and 281) regarding the conservation of tropical forests. The impetus for the debate was an announcement by the World Bank of its intention to review a 1991 policy that precluded the Bank from investing in forestry activities that in the 1980s were believed to cause tropical deforestation. The debate is misdirected in that it addresses tropical forest management as if forestry activities were the main cause of tropical deforestation. In fact, the deforestation of tropical forest lands is driven by complex socioeconomic forces of which forestry activities represent a minor component (Kaimowitz and Angelsen, 1998).

However, whether forestry activities are or are not the main causes of tropical deforestation is not the focus of the referred pages of *Science*. What is at issue is if tropical forests can be managed in a way compatible with the conservation of biodiversity. The argument is clouded further by the labeling of active forest management as 'sustainable forest management', 'natural forest management' (Frumhoff and Losos, 1998), 'sustainable harvest' (Struhsaker, 1998), or 'sustainable yield management.' These terms mean different things to different people and are not formalized in a standard package of field prescriptions (see the second quote before the Introduction). Therefore, everyone is free to advance opinions without consideration for rigor in the comparisons.

The debate involves some who argue that tropical forests cannot be managed sustainably and that the best alternative for the conservation of biodiversity is to increase the size of protected areas (see the third quote before the Introduction). A contrasting point of view recognizes the problems of tropical forest management and the importance of protected areas, but advocates forest use and active management as the most realistic alternative to the conservation of biodiversity (see the first quote before the Introduction). At the center of debate are three items: active forest management, conservation of biodiversity, and the role of logging.

The alleged incompatibility between logging (used by many as a surrogate for active forest management) and conservation of biodiversity is one reason given against the attainment of sustainability in the tropics. Another reason against achieving forest sustainability is based on the economics of forest management. Forest management appears not to be cost effective given the economic environment in many tropical countries. Apparently, active tropical forest management is not construed to be an acceptable practice in the tropical biome.

In this article I review the arguments that are used by both sides of the debate and check their consistency with the ecological literature and recent research on forest resilience. I conclude that tropical forest conservation, while presenting daunting challenges, is compatible with forest use and maintaining biodiversity. However, forests cannot be expected to remain unchanged even as their products and services are extracted for human benefit.

## 2. The case against sustainable forest management

Bowles et al. (1998a,b) expressed strong opinions against the notion that investing in sustainable forest management would lead to forest conservation in the tropics. They used four lines of argument to support their point of view.

1. After two decades and hundreds of millions of dollars of investment in the tropics, there is little to show for the effort; few if any

examples of successful forest management are available.
2. Economic environment in many tropical countries is not favorable to forest management because it motivates the quick depletion of timber supplies as opposed to stimulating their management. Profits are higher without, active forest management. Moreover, tropical countries lack the institutional capacity and the political will to counter the strong financial incentives for exploitation. The analysis in support of this position appears in Rice et al. (1997).
3. Active management has devastating effect on biodiversity (see the third quote before the introduction).
4. The lack of effectiveness of management as a conservation strategy. Bowles et al. (1998a) also opposed diversifying the markets for tropical trees, logging of tropical forest, and active forest management.

Of the four arguments against forest management in Bowles et al. (1998a,b), the first two deal with economics and the last two with ecology. My focus is on the two ecological arguments, but will first briefly comment on the economic arguments.

## 3. Analysis of the case against tropical forest management

### *3.1. Economic arguments*

The first argument is factually correct, but Bowles et al. (1998a) report 328 207 hectares as the area of tropical forests under management. This is a gross underestimate. Wadsworth (1997) reported that in tropical America alone, 21.9 million ha of tropical forests were under some form of management in 1980. By 1990, the area of tropical tree plantations alone exceeded 40 million hectares which, when added to protected areas and forests under other kinds of management, double the area of the USDA Forest Service National Forest System. This is not a small feat given the complexity of tropical forests (over half of the world's biodiversity), their huge area (half of the world's forests), the low investment in trying to understand these ecosystems [very few scientists study tropical forests (Yantko and Golley, 1977)], and the dire condition of institutions and economies in tropical countries.

This first argument of Bowles et al. (1998a) can be used just as effectively in support of forest management as against it. The millions of dollars spent in trying to reverse the situation need to be considered in relation to the short time over which these investments have been made (two decades according to Bowles et al. (1998a), the long-term nature of forestry operations (harvesting cycles $> 80$ years), the large number of countries involved (76 countries), and the effectiveness of the delivery of those investments. One could argue that it is too early to evaluate results from the investments; or that when the money is spread over such a large area and the time it takes a forest to develop, the investment is not as large as it appears over the short-term.

The observation that the capitalist economic system favors rapid liquidation of the forest as opposed to managing it (argument 2), appears to be a reality of the economics of harvesting natural resources in general, and not just of the harvesting of tropical forests. Many have argued that market economics do not value the free services and intrinsic value of natural resources until it is too late, i.e. when the resource becomes scarce and perhaps incapable of recovery (Odum, 1973, 1996; Costanza, 1991). Fisheries, timber, water, minerals, and other natural resources are usually depleted by market forces until government control and regulation limit their exploitation. This is why Bowles et al. (1998a) add to their economic argument a critique of the institutions and governments of tropical countries. The problem of market behavior is not unique to the tropical biome. What appears to be different is the socioeconomic and political environment in the tropics. However, there is no reason to assume that tropical countries are somehow incapable of taking action to solve their socioeconomic and political problems.

The economic arguments of Bowles et al. (1998a,b) exaggerate the condition of the management situation in the tropics, underestimate

the capacity of tropical countries to solve their problems, unfairly portray their socioeconomic situation, and oversimplify the context in which tropical forest management needs to occur. I believe that these arguments require a broader discussion with the participation of professionals with intimate knowledge of tropical countries.

### 3.2. Ecological arguments

The first ecological argument of Bowles et al. (1998a) is based on Bawa and Seidler (1998) who reviewed the effects of natural forest management (NFM) on tropical biodiversity. After examining the evidence, they stated:

> 'We conclude that emphasis on NFM to conserve biodiversity is not supported by the available evidence...' (p. 47),

and

> 'Significant uncertainties remain about the effects on biodiversity of any level of exploitation of primary tropical forest' (p. 52).

Given the apparent ambivalence in the conclusions, one must evaluate the evidence presented in Bawa and Seidler (1998) to reach an independent conclusion.

The ecological evidence summarized by Bawa and Seidler (1998) contains observations for different groups of organisms whose density, presence, or diversity have been compared in logged and unlogged sites. There is no clear pattern of differences in logged compared to unlogged stands. Studies show that changes due to logging occur in populations, but they do not show a consistent pattern that could be construed as harmful to populations because their numbers after logging increase, decrease or remain unchanged. Bawa and Seidler (1998) comment that the interpretation of these data is made difficult due to the variety of research methods, logging methods, synergy between logging and other natural or anthropogenic disturbances, and the need to evaluate logging effects after at least three logging cycles, i.e. in the long-term as opposed to the short-term.

Bawa and Seidler (1998) report short-term data and few if any results from long-term observations are presented. Given this uncertainty in the data, I cannot find the basis on which Bawa and Seidler (1998) or anyone else can conclude that logging and the conservation of biodiversity are incompatible. However, Bowles et al. (1998a) add the adjective *devastating* (see the third quote before the Introduction) to the effects of logging on biodiversity reported by Bawa and Seidler (1998). The 'devastating' effects of logging on structure, species composition, and biodiversity of tropical forests is apparent at the small scale for a short-time after the event. Forest structure, composition, and biodiversity, however, soon recover as discussed next.

Bawa and Seidler (1998) is not the only available review on the effects of logging on tropical biodiversity. Johns (1997) recently published a book on the subject that was not quoted in Bawa and Seidler (1998) but in which long-term data are reviewed. Johns (1997) observed that logging changes the environment in a stand because it opens the canopy, changes the microclimate, compacts the soil, and removes biomass and nutrients. The effects on the biota and on the regeneration of the stand depend on how much material was removed from the forest and the measures taken to reduce incidental damage. Felling and skidding cause the greatest loss of trees and delayed mortality. In general, logging rarely acts to eliminate species but can change the relative abundance of species. Responses of animal and plant populations are species-specific and depend on the kinds of changes to stands. Long-term changes after logging are difficult to detect because natural heterogeneity of tropical forests mask any effects induced by logging. In comparison to many natural disturbances, logging effects are 'subtle'. In sites where damage by logging is deemed significant, management intervention can mitigate effects. Johns (1997) dedicates a chapter to the types of active management available for mitigating any effects of logging.

The comprehensive analysis of Johns (1997) led him to conclude (p. 189) that

> 'The potential value of production forest has been underestimated. Until comparatively recently it has been con-

sidered of little value for biodiversity conservation. In fact, no species has yet become extinct as a direct result of tropical forestry operations. As pressures on preserved areas grow, foresters may hold the key to the conservation of tropical biodiversity.'

Cannon et al. (1998) found high species diversity in commercially logged areas in Borneo. In some cases, values were higher than in undisturbed primary forests. They concluded (p. 1366):

'These findings warrant reassessment of the conservation potential of large tracts of commercially logged tropical rainforest.'

Johns et al. (1996) compared planned and unplanned logging operations in eastern Amazonia and found that the levels of damage decreased and the profits increased with planning. Veríssimo et al. (1998) advocated zoning of forest lands as a step towards sustainability, effective forest use, and conservation of biodiversity. All these results underscore the importance of active management with regards to the conservation of biodiversity, mitigating negative effects on biodiversity when they occur, and improving the efficiency of resource use.

The second ecological argument of Bowles et al. (1998a,b) was based on the big-leaf mahogany (*Swietenia macrophylla*) case study from Bolivia used as an example of why sustainable forest management does not work in the tropics. The argument is based on the work of Howard et al. (1996) and Gullison et al. (1996), and the critique of sustainable forest management of Rice et al. (1997).

From the descriptions in Gullison et al. (1996), Howard et al. (1996), and Rice et al. (1997), the problem with big-leaf mahogany is that concessionaires were not supervised by the Bolivian government and profit is maximized by only building roads to extract the most valuable big-leaf mahogany trees. Because these trees are widely spaced, the effects on the forest are small (mostly due to road construction), and big-leaf mahogany trees fail to regenerate inside the residual forest canopy. The species regenerates well on roadsides and other areas heavily impacted by logging. As stated earlier, the extraction of big-leaf mahogany is not detrimental to the biodiversity of the forest. Gullison and Hardner (1993) found that typical big-leaf mahogany logging impacted only 4.4% of the logged stand. However, they report on a modeling exercise that showed that even this low level of impact could be reduced further through better road design and location.

It is difficult to equate this scheme of selective forest extraction to sustainable forest management, particularly when no effort is exerted to assure a future crop. Assuring the regeneration of desired species in logged big-leaf mahogany stands requires active management and as far as one can tell from these narratives, there is no effort by anyone to plant big-leaf mahogany nor to manage the forest in any way to promote the regeneration of big-leaf mahogany or any other forest species. Not even in the temperate zone would many commercially preferred tree species regenerate after harvest without active management. In fact, logging can be used as a silvicultural tool for regenerating desired species. Similarly, nowhere in the world would one expect species composition to remain unchanged after harvesting a stand. Yet, those who appear to care about tropical forests somehow apply a different standard to this biome. They expect the forest to be exploited and abandoned, and somehow show no change in structure or species composition. If the forest changes in any way, sustainable or natural forest management is to blame, the forest is deemed fragile (Nilsson and Grelsson, 1995), and calls for reduced forest use and increased protection ensue.

## 4. Protected areas as the alternatives to active management

The alternative to tropical forest management problems according to Bowles et al. (1998a,b) and Rice et al. (1997) is to increase investment in protection itself. This includes: (1) new protected areas in biologically important sites; (2) more investment in existing parks and reserves; and (3) creative mechanisms like corridors to link pro-

tected areas, or incentives to logging companies to fund forest regeneration and the protection of biodiversity.

No one has expressed disagreement with the importance of protected areas and the need for investments in protection and creative conservation mechanisms [Brokaw et al., 1998 (see the first quote before Section 1), Hartshorn, 1996, 1998; Cabarle, 1998; Chazdon, 1998; Gascon et al., 1998]. However, there is strong opposition among the authors just cited, to abandoning tropical forest management and using forest protection as the only option for biodiversity conservation.

Protected areas have always been an integral component of sound forest management, regardless of the biome. But the experience in most parts of the world is that land that appears not to be in use or to have some value, is land available for speculation and exploitation. When this happens, the conservation function of the protected area is endangered. The recognition that conservation and active management are the same thing, and that preservation is an integral part of both, is an old notion among professional land managers (Leopold, 1933). In fact, Leopold (1933) defined conservation as wise use. Unfortunately this recommendation has not been understood among certain sectors of society represented by the work of Bowles et al. (1998a,b).

Mares (1986) has eloquently written about the issue of protected areas in the neotropics. He observed that in Latin America, the land fraction under protection is greater than in North America and other so-called first world countries. This high level of protected land in South America occurs in spite of the obstacles to the establishment of protected areas and the roots of the problem of conservation on the continent. Mares listed the barriers to include: lack of data, lack of people trained in conservation, lack of money, lack of a coordinated plan for the long-term, weak economies, short-term strategies, and an air of panic. The magnitude of these obstacles suggests that efforts to either preserve or actively manage forests will face the same types of hurdles. In short, the socioeconomic argument cannot be used to undercut forest management while ignoring its effects on forest preservation.

## 5. Outcomes of these debates

The focus of debates such as the one in *Science* is so narrow and short-sighted that they contribute little to the solution of problems associated with the conservation of biodiversity in the tropics. This debate on tropical forest logging is analogous to previous debates on tropical lands such as those that focused on the myth that all tropical soils were lateritic and nutrient poor (Brown and Lugo, 1981). In fact, these debates undercut the possibility of progress by thwarting human initiatives to use natural resources wisely and by causing confusion and misdirection among those that are not familiar with the tropical situation. A short list of the deficiencies of this debate follows.

1. A false dichotomy is created between active management and conservation and by doing so, resource conservation is weakened in the tropics. In fact, active management is applied conservation.
2. Issues of sustainability, deforestation, and conservation of biodiversity are narrowly focused on forestry activities without adequate consideration to the major forces that cause land use changes in the tropics. Adequate consideration to all land uses is needed particularly the problems of agriculture and landless people in the tropics (National Research Council, 1993).
3. Most of the ecological research quoted in the critiques of forest management is of a short-term nature. Issues such as the evaluation of the effects of logging, land use change, or effects of disturbances on forests require long-term perspectives because these events activate forest responses that take decades to unfold (Waide and Lugo, 1992).
4. Complex resource management issues are evaluated using a single criterion, i.e. biodiversity. The implicit assumption is that biodi-

versity alone is the determining factor of the success of land management. The importance of biodiversity in undeniable, but many other factors come into play in forest management schemes (most notably, human needs).

5. Conspicuously absent from these critiques of forest management are the reasons for, and benefits of, forest management. Human needs such as the need for food, fiber, energy, and shelter, are not considered when proposals are made for excluding forest uses, forest management, and humans from protected areas.
6. The Bolivian example of big-leaf mahogany shows how a local circumstance is generalized to all tropical countries without regards to the diversity of social and natural conditions in the tropics nor to the uniqueness of the silviculture of big-leaf mahogany.

In short, critics of forest management tend to ignore the social forces acting on tropical forests and dismiss before hand any benefits of managing forests. A case can be made that there will be more loss of biodiversity and a greater degradation of forest lands if the solutions proposed by Bowles et al. (1998a,b) are followed at the expense of human needs. People in need will circumvent preservation efforts, degrade sites, and cause losses in biodiversity. It is ironic that the experience in the US (Leopold, 1933; Pinchot, 1998) has not taught us a lesson about the need to manage forests in order to conserve them.

## 6. Paradigms in conflict

The policy question, whose answer resides outside the realm of science, is the degree to which society is willing to accept change in biodiversity to sustain human activity on the landscape. Two conflicting philosophies are colliding and paralyzing human actions in the tropics. On one hand, the paradigm of tropical forest fragility is championed by preservationists, and on the other hand, the paradigm of tropical forest resilience supports the arguments of those who would manage the forest. I have contrasted these arguments (Lugo, 1995a,b, 1998) and concluded that tropical forests are more resilient than previously thought. For this reason, there is even an opportunity to rehabilitate forests and restore them after sites have been damaged (Lugo, 1988, 1997; Brown and Lugo, 1994; Parrotta and Turnbull, 1997). The logical conservation approach within the resilience paradigm is to focus attention on all tropical lands and not only on a selected few million hectares. Chazdon (1998) has recently elaborated this theme and said (p. 1296):

> 'Studies such as Cannon et al. (1998) reinforce a new paradigm of management of tropical biodiversity that embodies a regional approach and extends conservation to human-impacted lands.'

Experience in the Yucatan Peninsula (Gómez-Pompa and Bainbridge, 1995) and the Caribbean (Lugo et al., 1981; García Montiel and Scatena, 1994; Molina Colón, 1998) show that tropical forest composition is dynamic and in constant change in response to anthropogenic and natural disturbances, i.e. it adjusts to the type of economy and human activity within the context of natural disturbances. Changes in species composition do not necessarily lead to changes in function or forest structure unless sites are damaged or changed drastically. One of the reasons for forest resilience is the capacity to maintain forest structure and function in spite of changes in species composition.

The changes that occur in tropical forests as a result of logging and forestry activities in general are small in relation to those introduced by permanent agriculture or urbanization. A critical task of tropical forest conservationists is protecting forest lands from changes to uses other than forests. But even here we need to recognize that human needs will require fertile lands to be dedicated to food production. Maintaining forest uses and rehabilitating forests where they have been lost are the major challenge of tropical forest conservation (Wadsworth, 1997).

To address this challenge, tropical forest conservation needs to be holistic in focus and all-encompassing in scope. All tropical lands and all human activities need consideration. Conserva-

tion of biodiversity transcends the consideration of only protected areas or areas believed to be somehow special in terms of biodiversity. In fact, to protect these precious lands we must pay attention to what happens in urban centers (Lugo, 1991), degraded lands (Brown and Lugo, 1994), agricultural areas (National Research Council, 1993), and secondary forests (Brown and Lugo, 1990). In the new millennium, humans must take control of the planet's environment and biodiversity. Such responsibility will require active management, lest by inaction we allow the forces of the market to degrade the Earth into an inhospitable place for humans.

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