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Conservation Biology
Volume 15 Issue 1 Page 4 - February 2001

Tropical Logging and Human Invasions

Selective logging is an enormously important issue in the tropics. Each year, nearly 6 million ha of tropical forest are logged - an area twice the size of Belgium - most of which is virgin forest (Whitmore 1997). Forest tracts currently allocated for logging are at least 8-10 times larger than the limited areas set aside as nature reserves (Johns 1997). The management or mismanagement of logging operations is emerging as one of the most vital and hotly debated issues in tropical forest conservation (e.g., Rice et al. 1997; Bowles et al. 1998; Frumhoff & Losos 1998; Gascon et al. 1998; Sizer & Plouvier 2000.

Even ardent logging advocates acknowledge that most logging operations in the tropics are poorly managed, resulting in excessive environmental damage. In a recent issue of *Conservation Biology*, Putz et al. (2000) present an insightful assessment of why so few tropical loggers have begun to employ reduced-impact logging (RIL) methods. These methods are well established and have been shown, under some circumstances, to be cheaper and more effective than traditional logging. As Putz et al. demonstrate, however, RIL can actually be more expensive than traditional logging, especially when loggers are prohibited from cutting on steep slopes or in wet weather. Inadequate training for loggers and weak enforcement of harvest operations further weaken efforts to promote RIL methods. Putz et al. conclude that international assistance, such as carbon-offset funds and other financial incentives, may be needed to promote sustainable logging in the tropics.

Although Putz et al. (2000) make a truly meaningful contribution to the tropical logging debate, one key issue requires further consideration: the problem of forest invasion. Loggers create labyrinths of roads that greatly increase physical access to forests for hunters, ranchers, miners, and slash-and-burn farmers. In West Africa and Borneo, for example, logging has led to drastic increases in hunting pressure on larger vertebrates (Wilkie et al. 1992; Bennett 2000). In frontier areas of the Amazon, Southeast Asia, and Africa, logging has sharply increased rates of forest colonization, often leading to large-scale forest destruction (Rice et al. 1997; Kaimowitz & Angelsen 1998; Laurance 1998,

To cite this article:
Laurance, William F.
Tropical Logging and Human Invasions.
Conservation Biology **15** (1), 4-5.
Available from:
http://dx.doi.org/10.1046/j.1523-1739.2001.00_11-2.x

1999). Logged forests are also prone to catastrophic wildfires, especially during droughts (Cochrane et al. 1999; Nepstad et al. 1999).

The secondary effects of logging - drastically increased forest access - are actually far more destructive to forests than is the logging operation itself. As a result, no meaningful discussion of strategies to promote RIL can take place without also consideration of the dilemma of forest invasion.

How can we stop - or at least strongly inhibit - forest invasions after logging? I do not pretend to have an answer to this question, but it is one that the advocates of sustainable forest management (RIL logging and related silvicultural practices) must address in a practical way before their arguments can be taken more seriously. Forest roads can persist for decades. Can physical barriers be created after logging (e.g., establishing locked gates with forest guards, destroying key bridges) that prevent forest colonization? Will these be effective, or will they be so expensive to implement and maintain that they will be impractical? If implemented, does the political will exist in developing countries to ensure that initiatives to reduce invasions are actually enforced?

The simple truth is that, unless hunting pressure is severe, most wildlife populations can persist in logged forests, although their abundances may be reduced for considerable periods (Johns 1997; Fimbel et al. 2000). Few forest species can survive, however, in the mosaic of farmland and degraded scrub that remains after large-scale forest invasion. In my view, the invasion issue lies at the heart of the tropical logging debate. Without practical solutions to limit invasions, logging will continue to pose a major, if indirect, threat to the survival of tropical forests.

William F. Laurance

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