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Evaluating ipê (*Tabebuia*, Bignoniaceae) logging in Amazonia: Sustainable management or catalyst for forest degradation?

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ABSTRACT

Prized for their dense, rot-resistant wood, *Tabebuia impetiginosa* and *T. serratifolia* (vernacular name = ipê) are among the most valuable Amazonian timbers. We analyzed the geographical extent, spread and trajectory of ipê logging in Brazilian Amazonia, and evaluated harvest pressure on this forest resource. We also examine *Tabebuia* population response to reduced-impact logging, a more ecologically benign alternative to destructive conventional harvest practices in Amazonia. Based on eight years of population monitoring at multiple sites in the eastern Brazilian Amazon, we project second harvest ipê yields in forests logged using RIL under legally allowable (90% of commercial stems) and reduced (70%) harvest intensities.

In recent years ipê harvests have declined or ceased in the majority of old logging frontiers in eastern Amazonia while spreading to new logging frontiers in central and southwestern Amazonia. With current timber market prices, transportation infrastructure and harvesting costs, logging of ipê would be profitable in an estimated 63% of the Brazilian Amazon; in the more remote logging frontiers only logging of ipê and a few other high-value timbers is currently profitable. All populations of *T. impetiginosa* and *T. serratifolia* in northeastern forests showed drastic population declines over multiple RIL harvests in simulations, with no indication of population recovery over the long term. We conclude from study of *Tabebuia* populations in eastern Amazonia and modeling of response to logging that these two species are endangered by logging activity and merit additional protection under forest legislation.

1. Introduction

Since the 1980s logging has been an important catalyst for deforestation in many regions of Amazonia. Much of the deforestation along the southern rim of Amazonia has been facilitated by loggers penetrating primary forests in search of sparsely distributed big-leaf mahogany (*Swietenia macrophylla*) trees, in the process providing access to ranchers and

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farmers who transform forests to pasture and farm fields (Veríssimo et al., 1995; Fearnside, 1997; Asner et al., 2005, 2006). Today, mahogany is recognized as a threatened species under Appendix II of the Convention on International Trade in Endangered Species; significant commercial populations of mahogany exist only in remote regions of Amazonia, primarily in the southwest (Grogan et al., 2008). Meanwhile, the logging industry has migrated from the impoverished landscapes along the so-called arc of deforestation to new forest frontiers in central and western Amazonia, pursuing high-value timbers that occur in these regions and are not subject to the legal protections belatedly bestowed upon mahogany. Many of the characteristics rendering mahogany vulnerable to commercial extinction are shared by other high-value timber species in Amazonia (Grogan et al., 2008).

Efforts to transform an uncontrolled and destructive Amazonian logging industry into an engine for sustainable economic development have achieved tangible, if limited, successes: certified 'well-managed' forest area has increased to >5 million ha since Forest Stewardship Council (FSC) certification arrived in the region in the 1990s (primarily in Bolivia and Brazil; FSC, 2007); a growing segment of the timber industry has demonstrated interest in reduced-impact logging (RIL) techniques as an economically viable alternative to haphazard conventional or predatory logging; and big-leaf mahogany was listed on Appendix II of the UN-chartered Convention on International Trade in Endangered Species of Fauna and Flora (CITES) in 2002, necessitating more stringent harvest regulations and tighter controls on timber exports (Grogan and Barreto, 2005). This progress notwithstanding, the vast majority (95–98%) of timber harvesting in Amazonia continues to occur by conventional logging that is often a precursor to forest conversion to ranching or farming (Lentini et al., 2003, 2005; Veríssimo and Barreto, 2004). This boom-and-bust exploitation cycle has been well described elsewhere: loggers migrate to new frontiers as timber stocks in historic logging centers dwindle, instigating new cycles of timber mining, forest clearing, and land conflicts in what were previously intact forests on unclaimed public lands (Uhl et al., 1991, 1997; Veríssimo et al., 1992, 1995, 2002a; Grogan et al., 2002; Veríssimo and Barreto, 2004). The pursuit of high-value timber species for export markets drives much of this expansion into heretofore unlogged regions of Amazonia (Veríssimo et al., 1995; Lentini et al., 2005).

Tabebuia (ipê, pronounced "ee-pay") are the new mahogany. These are prized neotropical timber species whose dense, rot-resistant wood is exported primarily to North America for use in boardwalks and residential decking. Although the commercial name ipê encompasses several *Tabebuia* species, *T. impetiginosa* and *T. serratifolia* comprise the bulk of ipê extraction from Amazonia and are the focus of this study. Widely advertised on websites for outdoor construction materials, ipê is the most common tropical 'species' in the $3 billion residential decking market in the US, and its dominance is expected to continue for the near future as restrictions on chemical treatment of woods reduce market share of temperate zone species (Metafore, 2004). Responding to export prices (FOB – Free On Board) ranging from US$ 400 to 500 per m^3 of sawn timber (Lentini et al., 2005), logging companies profitably extract ipê from remote Amazonian regions where timber harvests would not otherwise be feasible. Meanwhile export markets for *Tabebuia* are well developed and growing: there was a 500% increase from 1998 to 2004 in ipê timber exports from the Brazilian Amazon, and ipê accounted for ca. 9% of the total value of wood exports from the Brazilian Amazon in 2004 (Table 1; SECEX, 2005).

Conventional selective logging in the Brazilian Amazon typically resembles a mining operation characterized by poor planning and execution. Over-exploitation of commercial species combined with excessive damages inflicted on forest stands during harvest can compromise future production potential as well as the ecological integrity of logged forests (Johns et al., 1996; Holdsworth and Uhl, 1997; Uhl et al., 1997; Nepstad et al., 1999; Vidal, 2004). Reduced-impact logging practices mitigate forest-level damages and improve operational cost effectiveness through improved inventory and infrastructural planning (Barreto et al., 1998; Boltz et al., 2001; Holmes et al., 2002). Yet even operating under RIL guidelines, loggers can legally harvest up to 90% of commercial-sized individuals of a given species in Brazil on the assumption that future harvests will be supplied by recruitment of today's sub-merchantable individuals (juvenile and pole-sized trees, saplings, and seedlings) into commercial size classes during proposed 25–35 yr cutting cycles (Brazil, 2006). Poor logging practices and disregard for basic principles of sustained resource use may lead to depletion and regional commercial extinction of desirable timber species, as has been observed for mahogany throughout much of its natural range (Rodan et al., 1992; Veríssimo et al., 1995; Gullison et al., 1996; Snook, 1996; Grogan et al., 2002; Kometter et al., 2004).

In this paper we describe mounting logging pressure on natural *Tabebuia* populations in the Brazilian Legal Amazon. We examine geographical range, density patterns, population dynamics, and prospects for sustained timber yield at current and hypothetical extraction rates for the two most widely distributed and heavily exploited ipês, *T. impetiginosa* (ipê roxo) and *T. serratifolia* (ipê amarelo). We ask: what is the geographical extent and annual rate of *Tabebuia* exploitation in Brazil-

Table 1 – Timber exports in 2004 from eight states comprising the Brazilian Legal Amazon showing the dollar value of ipê exports[a] and the percent of total ipê exports by dollar value

State	Total exports (US$)	Ipê exports[b] (US$)	Ipê % of total
Acre	5,440,552	124,316	2.3
Amapá	42,311,249	–	–
Amazonas	24,139,739	314,467	1.3
Maranhão	12,681,694	208,458	1.6
Mato Grosso	197,596,200	30,857,124	15.6
Pará	543,441,974	31,811,577	5.9
Rondônia	113,456,363	19,496,032	17.2
Roraima	3,660,606	45,618	1.2
Legal Amazon	942,728,377	82,857,592	8.8

a *Source:* SECEX (2005).

b *Tabebuia* are generally not distinguished commercially by species. Although ipê may refer to any species in the genus, *T. impetiginosa* and *T. serratifolia* are the most commonly logged species in Amazonia.