

TRANSITIONING TO A COMPLEX ADAPTIVE SYSTEM APPROACH TO NATURAL FOREST MANAGEMENT IN THE TROPICS

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Most tropical production forests are subjected to a range of timber exploitation intensities carried out with different amounts of care. I argue that there needs to be a transition from the current model of tropical forest exploitation for timber, to multiple-objective forest management that employs silvicultural techniques that are close-to-nature, ecosystem-based, and systemic. This will require substantial changes in governmental regulations, markets, and the culture of tropical forestry. The transition to more adaptive approaches to natural forest management in the tropics will also require a substantial increase in the number of trained silviculturalists along with new ways to motivate them to address the many physical, social, and intellectual challenges that await them.

Keywords: reduced-impact logging, multi-objective forestry, forest certification, adaptive management, silvicultural intensification.

Parole chiave: utilizzazioni a basso impatto, selvicoltura multi-obiettivo, certificazione forestale, intensificazione selvicolturale.

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Despite the relative abundance of research publications on a variety of silvicultural approaches to natural forest management in the tropics (reviewed by Gunter *et al.*, 2011), few of the recommended practices are applied outside of research and demonstration areas (personal observation). Instead, most tropical production forests, even those with government-approved management plans, are subjected to timber exploitation carried out over a range of intensities and with different amounts of care. Due to the scarcity of commercially valuable trees in these species-rich forests, logging is selective and harvest intensities vary with timber stocking not with the silvicultural requirements of the harvested species. Generally the best that can be observed involves application of reduced-impact logging (RIL) techniques (e.g., planned skid trails and directional felling; reviewed by Putz *et al.*, 2008) designed to minimize stand damage. Avoiding undesirable environmental impacts (e.g., sediment loading of streams) is always important, but in stands from which light-demanding species are selectively logged, minimization of canopy opening may preclude their regeneration (Fredericksen and Putz, 2003).

There clearly needs to be a transition away from the current model of tropical forest exploitation for timber to multiple-objective forest management that employs silvicultural techniques that are close-to-nature, ecosystem-based, and systemic (reviewed by Puettmann *et al.*, 2009). Overall, these sorts of adaptive management approaches will be fostered by the recognition of forests as complex systems (Filotas *et al.*, 2014; Messier *et al.*, 2014). It also needs to be recognized that capture of the benefits of that fundamental change in approach will require substantial changes in governmental regulations, markets, and the culture of tropical forestry.

Unfortunately, where tropical forestry is actually transitioning from the traditional timber exploitation model, the changes are generally driven by governmental legislation that restricts options for forest managers.

In Indonesia, for example, to increase short-term timber supplies from previously harvested production forests and, ostensibly, to increase long-term yields, new governmental regulations, respectively, reduced the minimum diameter of harvestable trees and mandated enrichment planting of native timber species along cleared lines through harvested forests regardless of the stocking of natural regeneration (Ruslandi *et al.*, 2014). Where carried out with care, by the end of the 25-year rotation, the enriched stands are expected to yield five times as many harvestable trees with three-times the commercial volume of the second cut and twice the volume of the first cut in primary forests (Pamoengkas *et al.*, 2014). From timber production and perhaps financial perspectives, such yields are very promising but it is not clear how such stands can be harvested without the result resembling large clearcuts in forests where the natural disturbance regime does not include such massive openings.

It is not going to be easy in most tropical countries to reject the strict legislated, command-and-control approach to regulation of natural forest management in which managers are prevented from matching stand treatments with stand conditions and locally negotiated management goals. Where continued timber exploitation without regard to future yields is the most attractive short-term financial option (e.g., Pearce *et al.*, 2002), changes in management practices will require enforcement of governmental regulations or those of non-governmental organizations such as forest certifiers. In either case, compliance with new

regulations will need to be verified by auditors.

It is relatively straightforward to audit compliance with the new Indonesian forest regulation that requires planting of nursery-grown seedlings at 5 m intervals along 3 m wide lines cleared at 20 m intervals through logged-over forest. In contrast, where managers are allowed to match silvicultural practices with locally negotiated goals, a great deal more understanding and field time will be required to assess compliance as even adjacent stands may be subjected to very different silvicultural treatments. Furthermore, where management goals are locally negotiated, as often recommended, it might be acceptable to convert high forest into vine tangles by intense timber harvests if coverage by vines serves to reduce soil erosion, the leaves of some of those vines have medicinal value, vine stems are used for basket weaving, and especially if some species of charismatic animals benefit from the protection from predators provided by the dense cover. This example is admittedly extreme, but for governments and certifying bodies to consider adoption of the more enlightened management advocated by proponents of approaches based on complex adaptive system thinking, practical insights into how to avoid such fiascos are needed.

The transition to more adaptive approaches to natural forest management in the tropics will also require an order-of-magnitude increase in the number of trained silviculturalists along with new ways to motivate them to address the many physical, social, and intellectual challenges that await them. They will also need to be well compensated for their efforts lest they succumb to the temptations of corruption as they climb steep hills, wade through swamps, and crawl through vine tangles in remote areas where living conditions are rough, governance failures are common, but natural forest management is a viable land-use option.

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RIASSUNTO

Transizione verso un approccio basato sui sistemi complessi e adattativi nella gestione delle foreste naturali nei Tropici

La maggior parte delle foreste tropicali produttive sono soggette a utilizzazioni legnose condotte con un ampio

spettro di intensità e con livelli di cura e attenzione molto diversificati. Qui sostengo la necessità di un passaggio dall'attuale modello di utilizzazione delle foreste tropicali per il legno a una gestione forestale multi-obiettivo che impieghi tecniche che sono più vicine alla natura, basate sull'ecosistema e secondo un approccio sistemico. Questo richiederà cambiamenti sostanziali nei regolamenti governativi, nei mercati, e nella cultura della selvicoltura tropicale. La transizione verso approcci più adattativi nella gestione delle foreste naturali nei tropici richiederà anche un notevole aumento del numero di selvicoltori professionalmente formati insieme a nuovi modi per motivarli ad affrontare le molte sfide fisiche, sociali e intellettuali che li aspettano.

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