

Forest Management and Biodiversity Conservation in Bolivian Tropical Forests

(Manejo Forestal y Conservación de Biodiversidad en Bosques Tropicales de Bolivia)

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Abstract

Although Bolivian tropical forests have been selectively logged in the past for a few valuable species, these forests and their biodiversity are still largely intact. If more markets for tropical timber begin to open, forest management activity in Bolivia will increase. While the preparation of management plans and adherence to best management practices are mandatory in Bolivia, there is still a strong tendency towards high-grading practices and a lack of investment in sustainable forestry. Most studies of selective logging practices in Bolivia do not show significant direct impacts on biodiversity and the potential for sustainable timber management is high if silvicultural treatments are used to maintain tree species composition and provide for regeneration. In contrast, the secondary effects of logging pose real threats to forest conservation in Bolivia. Logged forests must be managed to maintain their timber value in order to prevent their conversion to other uses. In addition, protective measures must be developed to control the negative effects of wildlife poaching, timber theft, and wildfire.

Key Words: Bolivia, Biodiversity Conservation, Fire, Forest Management, Logging, Wildlife.

Resumen

Si bien los bosques tropicales de Bolivia fueron aprovechados selectivamente en el pasado, extrayéndose sólo algunas especies valiosas, éstos y su biodiversidad se mantienen en gran parte intactos. Al ampliarse los mercados de madera tropical, las actividades de manejo forestal se incrementarán en Bolivia. Si bien la elaboración de planes de manejo y el cumplimiento de normas técnicas son obligatorios en el país, aún existe una marcada tendencia hacia prácticas de explotación altamente selectiva y falta de inversión en actividades de manejo forestal sostenible. Afortunadamente, la mayoría de los estudios efectuados en Bolivia sobre las prácticas de aprovechamiento selectivo no muestran impactos directos significativos en la biodiversidad y existe un gran potencial para el manejo forestal sostenible, si se aplican tratamientos silviculturales a fin de mantener la composición de especies arbóreas y garantizar la regeneración. En contraste, los efectos secundarios de la extracción maderera constituyen amenazas tangibles para conservación de los bosques en Bolivia. Los bosques aprovechados deberán manejarse para mantener su valor maderable y evitar su conversión a otros usos. Asimismo, deberán formularse medidas de protección para el control de los efectos negativos de la cacería ilícita, el robo de madera y los incendios.

Palabras clave: Bolivia, conservación de la biodiversidad, fuego, manejo forestal, aprovechamiento forestal, incendios forestales.

Introduction

Bolivia contains extensive tracts of tropical lowland forest, covering more than 40% of the country. Many forests have been selectively harvested, but at very low levels ($\approx 0.25 \text{ m}^3/\text{ha}$) and with low human population pressures, allowing them to remain largely intact (Pacheco 1998). However, deforestation pressures are increasing due to colonization by peoples displaced from the poverty-stricken highlands, as well as by forest clearing for agriculture and cattle ranching.

The Bolivian Forestry Law of 1996 requires the preparation and approval of management plans and adherence to best management practices. The law has been widely praised for increasing the efficiency and sustainability of forest harvesting and has been instrumental in making Bolivia a world leader in certification of natural forests (Nittler & Nash 1999). However, Bolivian foresters still need to confront some serious management problems, such as a lack of commercial tree regeneration (Mostacedo & Fredericksen 1999) and deterioration of stand quality due to selective diameter-limit harvesting (Fredericksen 1998).

In addition to sustainable harvesting, there is great concern about protecting the rich biodiversity of Bolivian tropical forests. On paper, Bolivia has a strong conservation program with 24% of its territory in protected areas (Ergueta & Gómez 1997). However, many of these areas are not totally exempt from resource extraction. In addition, government agencies are poorly equipped to enforce regulations in protected areas.

In managed forests, logging and other forest management activities may directly affect biodiversity through changes in forest structure and/or function (e.g., Grieser Johns 1997). There is also a concern that logged forests may provide increased access to human disturbances via logging roads (Laurence 2001) and have increased wildfire risk due to higher fuel loads and drier environmental conditions (Uhl & Kauffman 1990). The purpose of this article is to explore the relationship between forest management for timber and the likely primary and secondary impacts on biodiversity based on research conducted in Bolivian tropical forests.

Primary Effects of Timber Management on Biodiversity

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Since logging directly affects tree species composition through the removal of commercial trees, logged forests are prone to losses in tree diversity and changes in tree species composition. If provisions are made for the regeneration of commercial tree species, these effects may be short-lived. However, commercial timber regeneration is generally poor in Bolivia and 78% of important timber species have inadequate regeneration (Mostacedo and Fredericksen 1999). In addition, there is a tendency for higher extraction rates for the highest valued species (*Swietenia macrophylla*, *Cedrela* spp., *Amburana cearensis*, *Machaerium scleroxylon*) potentially leading to the loss of these species in the forest canopy and reduced overall abundance due to poor regeneration (Gullison et al. 1996, Fredericksen 1998). Under these conditions, forest species composition shifts in dominance to aggressive, non-commercial species (Fredericksen and Licona 2000) with losses in residual stand value and unknown consequences for biodiversity.

Studies of the effects of forest management on non-timber plant species are rare in Bolivia and mostly confined to dry forests. Studies of plant communities in logged areas compared to undisturbed areas in one dry forest did not show significant changes in species composition or diversity of understory plant species due to logging (Mostacedo et al. 1998, Toledo et al. 2001). Perhaps the opening of the canopy by logging and exposure of soil through extraction activities do not create changes in vegetation structure that differ markedly from those created by natural disturbances, such as fire. In more humid forests, the impacts of logging on vegetation may be more severe. However, there is evidence that these forests have also been disturbed at intervals by indigenous peoples (Deneven 1992) and by natural disturbances (Gullison et al. 1996, Fredericksen 2000).

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Many studies of the impacts of forest management activities on wildlife have been conducted in Bolivian tropical forests including before and after logging studies (Flores et al., *in press*) studies of logged vs. unlogged forest (Woltmann 2000, Herrera 2001), and studies of logging gaps vs. surrounding undisturbed forest (Coro 1999, Fredericksen et al. 1999a, Flores et al. 2001, Fredericksen & Fredericksen, *in press*). Studies have also been conducted on the impact of logging on fruit abundance (Fredericksen et al. 1999b, Ruiz, *in preparation*) and the impact of vine cutting on different types of fauna (Davies 1998, Rojas 1999). Most of these studies have shown a relatively minor impact on wildlife species abundance or diversity with some species or guilds benefiting from harvesting and others being negatively affected. Taxa most negatively affected by forest management activities typically include ants, beetles, and frogs; groups that typically have benefited include reptiles, small mammals, and frugivorous or nectivorous birds. The minor impacts on fauna observed in these studies may be partially attributed to the relatively low logging intensities in Bolivia (normally $< 10 \text{ m}^3/\text{ha}$).

Secondary Effects of Timber Management Biodiversity

While timber management itself may not present extensive damage to biodiversity in Bolivian forests, activities that coincide with logging or improved access to forested areas could potentially be devastating. Hunting and fire have often accompanied logging in Bolivia and logging roads provide access for wildlife poachers, squatters, and timber thieves. Increased human access is equivalent to an increased risk of wildfire because fire is commonly used by settlers and ranchers to clear vegetation and to provide temporary increases in soil fertility. This burning occurs at the end of the dry season when forest flammability is at its peak.

Before the advent of the forestry law in Bolivia, hunting was very common in logging camps within forestry concessions (BOLFOR 1993). Today, with some exceptions, there is fairly strict enforcement of hunting bans within most concessions and notable increases in wildlife have been observed within these areas. Hunting is still permitted on indigenous lands, but the impact of hunting there is considerably less than that observed in the past within concessions (Rumiz et al. 1997). In addition to areas managed for timber, wild game hunting continues to feed Brazil nut and palm heart gatherers in northern Bolivia (Rumiz 1999, Paredes 2001), as it did the rubber tappers before them.

Wildfire is another important secondary effect of management interventions in Bolivian forests. With or without timber extraction, wildfire poses a serious threat to standing forests, but wildfire intrusion into logging areas is increased through increased access of settlers via logging roads and because the increased woody debris in logged forests and increased insolation in the understory provides conditions for ignition and travel of fire in areas where fire could not normally occur. Wilfires burn over 100,000 ha of Bolivian forests each year, and in particularly severe fire seasons, such as in 1999, over 1.6 million ha of forest burned in the Department of Santa Cruz in only one month (Cordero 2000).

Access roads not only provide inroads for hunters and wildfire, but also facilitate infiltration by slash and burn farmers and pirate loggers. A disorganized land titling system and poor regulatory control combine to make it difficult to monitor and prevent illegal settlements or resource extraction in rural areas. A cascading chain is often initiated by the construction of roads, where the forest is subsequently degraded by timber thieves and partially deforested by migrant farmers. Conversion of these areas is then completed by cattle ranchers. This pattern can be observed radiating from many settlements in lowland Bolivia.

Recommendations for Biodiversity Conservation in Managed Forests in Bolivia

There are many cases in Bolivia where productive forestry may be the most economically feasible land use, but conversion occurs due to poor forest management. In order to avoid these conversions, Bolivian forestry must move beyond conventional and simplistic prescriptions for “good” forestry (i.e., maintaining some canopy cover) and search for silvicultural systems that enhance regeneration, accelerate growth of timber species, and maintain stand quality. More monitoring is needed to ensure that management plans are being implemented and that they are modified appropriately when they fail to produce desired results. Monitoring is also needed to determine the impacts of these practices on biodiversity.

Forest managers must control access to the forests in which they harvest. No matter how well forests are managed silviculturally, sustainability could be compromised by wildlife and timber poaching or through infiltration by wildfire and colonists. Controlling access to forests is not easy, but may be the single most beneficial management action for the conservation of Bolivian forests. In addition to controlling stand access, forest managers in Bolivia must confront the pervasive effects of wildfire. In order to avoid re-occurrences of past disasters, better fire protection measures should be initiated, including the training of work crews in firebreak construction and back-firing techniques that could prevent entry or control the spread of wildfires within managed forests.

Conclusion

Unlike many other tropical countries, the primary forests of Bolivia are still largely intact. The government policies and management practices of the next five to ten years may determine whether Bolivia retains viable and productive forest ecosystems or is left with only degraded forest remnants. Social and political forces threaten to cause large-scale deforestation regardless of how well Bolivian forests are managed, but poorly managed forests are likely to be more prone to conversion. A system of well-protected primary forests preserved from logging will be an important basis for a conservation strategy, as well as forested areas which are set aside as carbon offset reserves or managed for ecotourism. However, most Bolivian forests are likely to be subjected to logging and it is unrealistic to believe that any more of these forests will be set aside in protected reserves. The conservation of forests managed for timber will require a reassessment of current silvicultural prescriptions and the implementation of forest protection practices.

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