Ecological and Silvicultural Sustainability of Traditional Selective Logging in a Mature Tropical Forest in Belize

Report of the 1993 field season for the

HILL BANK SUSTAINABLE FORESTRY PROJECT

From

MANOMET OBSERVATORY FOR CONSERVATION SCIENCES

and

PROGRAMME FOR BELIZE

Andrew A Whitman, Nicholas V.L. Brokaw, and John M. Hagan III

Manomet Observatory, P.O. Box 1770, Manomet, MA, 02345, U.S.A.

and

Programme for Belize, P.O. Box 749, Belize City, Belize, CA.

December23, 1994

Executive Summary

Introduction

A great deal of tropical biodiversity, including migrant birds, exists in areas outside strictly protected reserves. Conservation of that diversity depends on developing economically and ecologically sustainable management practices for those unprotected lands. This is true in parts of Latin America, and especially in Belize where large areas of forest are traditionally used for timber harvest. The economic sustainability of traditional forest management practices in Belize is beginning to be questioned, with the possible result that forest area might be converted to other uses incompatible with conservation of biodiversity. The aim of our project is to develop economically practical forest management that justifies keeping large areas of land in forest.

In 1993, Manomet Observatory (MO) and Programme for Belize (PfB) began research to determine how to sustainably manage tropical forest in the 250,000 acre Rio Bravo Conservation and Management Area (R.B.C.M.A.), an area owned and managed by PfB. In 1994, we concluded the first phase of this project, the evaluation of traditional selective logging to determine its silvicultural and biological sustainability. Silvicultural sustainability was simply determined by asking 'was the amount of mahogany harvested equal to its growth and regeneration?". Biological sustainability is more complex and was determined by asking "does logging detrimentally affect or radically change bird and plant communities?". Specifically, we accomplished all of our (the) goals:

I. assessed the impact of traditional selective logging on the resident avifauna and vegetation;

2. quantified the effect of traditional selective logging on Neotropical migratory land birds;

3. assessed the response of economically important tree species to selective logging, and made recommendations for enhancing regeneration of these species;

4. trained seven Belizeans in field methods of ecological and habitat analysis; and

5. designed and began to implement silvicultural techniques to improve mahogany regeneration and determine impacts on biodiversity.

Study Site

Field work occurred February to May 1993 and January to April 1994 in the Hill Bank area of the R.B.MC.A., Belize. The originally proposed research site, Duck Ridge, about 10 miles away, was not accessible because of poor road conditions. Therefore, we shifted our research to the Hill Bank area. The Hill Bank area was a better study area because the several forest types are more representative of the landscape in northern Belize and this allowed us to design studies of logging that would have greater applicability to the R.B.C.M.A. and to other forests.

Project personnel

The project was directed by John Hagan (MO), who has extensive research experience with forest ecology and birds, and Nick Brokaw (MO), who has considerable research experience in the ecology of tropical trees and ecosystems. Logistical support by Programme for Belize was coordinated by Roger Wilson (PfB) and directed by Bail Romero (Pm). Field work was supervised by Andrew Whitman (MO). In addition, five U.S. nationals (MO) and seven Belizeans (PfB) assisted field work during two field seasons. The Belizean assistants were trained in bird and tree species' survey techniques and identification.

Project Results

1. Forest Regeneration

We examined forest regeneration by conducting surveys of seedlings and saplings in forest openings created by logging, on logging roads, and in nearby unlogged forest, and by conducting surveys of large trees in unlogged forest. We intensively surveyed 14 forest openings created by logging and 14 logging road sites for seedlings and saplings. We also surveyed 20 non-logged plots for seedlings and saplings to make comparisons to logged sites and for large trees. As a result, over 4000 seedlings and saplings, and over 800 trees (≥10 cm in diameter) of species of primary and secondary commercial importance were measured and tagged to determine their growth and survival. All of these tagged plants were measured in 1993 and 1994 to determine their annual growth and survivorship. Thirty-six sites were surveyed for large trees of commercially important species to determine if they were sufficiently abundant to make their logging feasible.

Mahogany, a species of primary importance, was uncommon in unlogged forest. Seedlings of mahogany were moderately common in forest openings created by logging but their survivorship in these openings was too low for these seedlings to successfully grow in large trees. Saplings of mahogany were very rare and only occurred along the main logging roads where canopy openness and hence light levels were quite high. Cedar, the other species of primary importance, was rare in unlogged forest and never occurred as saplings or seedlings. Therefore, the lack seedlings, saplings, and large trees of cedar and mahogany and low survivorship of mahogany seedlings in forest indicate that regeneration was inadequate for sustained logging of these species using current, selective logging practices. Furthermore, logging removed about one mahogany tree / 20 ha (0.05 / ha), or perhaps as much as 50% of all mahogany ≥10 cm in diameter. Thus, current logging practices greatly over-harvest mahogany.

Five species of secondary economic importance show much potential for sustained logging. They are shade tolerant to various degrees, occur abundantly as seedlings, sapling, and trees, and therefore regeneration of these species probably would offset removal due to logging. Regeneration of most species may benefit from forest disturbances. Thus, alternative logging practices that create large opening would be necessary to sustainably manage and harvest mahogany. Overall, current logging practices seem to reduce only the number of mahogany trees and not populations of other species (see Appendix I for more details).

2. Forest damage

We determined forest damage by mapping the logging roads and forest openings created where trees were logged, counting the number of trees damaged or killed by logging, and measuring soil compaction on logging roads and in the same forest openings. We mapped 34 forest openings resulting from logging and over 8.83 km of logging roads. Of these, we intensively surveyed 14 forest openings and Jogging road sites for damage to trees and saplings and soil compaction resulting from logging.

Forest openings created by logging created a total of 1.84 ha of disturbed forest while logging roads created about 3.09 ha of disturbed forest. Each forest opening created by logging averaged 0.054 ha (or approximately 75 feet x 75 feet). Cutting down trees may have damaged about 0.6 % of the logged forest and making logging roads may have damaged about another 0.8 % of the logged forest. This is slightly less than was found in a mahogany logging operation in Columbia. However, the number of logs removed per unit area appears to be much lower than that found for other tree species in other the tropical forests.

Tree damage occurred along logging roads and in forest opening when trees where removed. Sixty percent of damaged trees in forest openings were species that were not commercially important. Logging equipment mostly compacted soils primarily on logging roads and only slightly affected soils in forest openings because the logging equipment usually made several passes over each logging road. Not surprising, the greatest compaction occurred in the center of the ruts from logging equipment. Thus approximately 28.6% of the logging road area had compacted soil or about 0.2% of the total logged area. The amount of forest damage was much lower than that found in many other studies because logging removed relatively few trees and because logging at this intensity did not require the construction of wide hauling roads. Thus, forest damage by logging may not significantly affect the trees (see Appendix 3 for more details).

3. Avian biodiversity

We determined the effect of logging on bird communities by conducting bird surveys in logged and nearby unlogged forest to determine if the abundance of bird species in each was the similar. Bird work was conducted from February 10 to March 28 at two sites. We surveyed birds at 60 points by point count methods (where birds were detected by sight, songs, and calls) and by using mist nets (where birds were caught and released). Point counts detected 125 species and revealed that Brown-hooded Parrot, Lesser Greenlet, Black- faced Grosbeak, Northern Bentbill, Red-bred Parrot, and White-breasted Wren were the most common residents. American Redstart, Gray Catbird, Magnolia Warbler, and Wood Thnish were the most common Neotropical migrants. Mist netting detected 58 species and revealed that White-breasted Wood-wren, Ruddy Woodereeper, Red-throated Ant-Tanager, Tawny-winged Woodcreeper, Stub-tail Spadebill, Thrushlike Manakin, and Red-capped Manakin were the most common residents and Wood Thrush, Gray Catbird, and Kentucky Warbler were the most common Neotropical-Nearctic migrants.

Logging only slightly increased the number of bird species and species diversity and changed the species composition of the bird communities in logged forest. It also slightly increased the number of species using the canopy, alive-foliage, and edges and number of Neotropical-Nearctic migrant species. The species responsible for the increase in the number of Neotropical-Nearctic migrants included: Hooded Warbler, Indigo Bunting, and Ovenbird, all species associated by disturbance in Neotropical forests. Only six of 66 tested species were affected by logging, and only the Tawny-crowned Greenlet seemed negatively affected by logging. Thus, selective logging at this intensity does not strongly affect the bird community (see Appendix 2 for more details).

Summary of Project Findings and Conclusions

(1) Forest Regeneration

• Mahogany seedlings are light demanding and therefore require a greater level of disturbance than created by current logging practices to achieve successful regeneration.

• The rate of mahogany regeneration was less than the harvest rate.

• Alternative logging practices such as patch cutting would probably improve regeneration of many commercially important species.

• Natural regeneration of tree species of secondary commercial importance is probably adequate to replace low to moderate levels of logging of these species.

• *Traditional selective logging of mahogany was not silviculturally sustainable.*

(2) Forest Damage

• Forest damage occurred was less than damage found in other studies.

• While logging damaged tree species of commercial importance, damage of these species was less serious than damage to other species.

• Seedling recruitment was often greater in forest openings created by logging and thus may offset damage caused by logging.

• *Logging damage appears to occur at levels compatible with sustainable forestry.*

(3) Avian Biodiversity

• Logged forest had slightly greater species diversity than unlogged forest.

• Most resident and Neotropical-Nearctic migrant species were unaffected or positively affected by logging.

• Only the Tawny-crowned Greenlet was negatively affected by logging.

• Therefore, the effect of logging on bird communities while apparent, was not

substantial.

• *Traditional selective logging of mahogany appears sustainable in terms of its impact on bird communities, including Neotropical-Nearctic migrants.*

(4) In conclusion traditional selective logging in northern Belize is not silviculturallv sustainable but appears sustainable fm maintaining avian biodiversity