ECOLOGICAL IMPACTS OF SILVICULTURAL TRIALS IN CRIQULBUL FOREST RESERVE AND THE RIO BRAVO CONSERVATION AND MANAGEMENT AREA, BELIZE: PRE-TREATMENT SURVEYS

A Report To The Belize Forest Department and Program for Belize

Edited by

ELIZABETH P. MALLORY[1] and NICHOLAS V. L. BROKAW[1,2]

With contributions by

Andy Whitman[1], Trevor L Lloyd-Evans[1], Mark Kaspryzk' Daniel Frochlich[1]

[1]Manomet Observatory for Conservation Sciences, Box 1770, Manomet, Massachusetts 02345 USA, FAX 508 224-9220

[2]Programme for Belize, 2 South Park Street, Belize City, Belize

and students:

Diane Banuwart, Elizabeth Burroughs, Paul Champlin, Tracey Crowningshield, Katherine Richter, and William Thevenin

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Ecological Impacts Of Silvicultural Trials

SUMMARY

I. This report describes the first phase of studies on the impact on the bird community of silvicultural trials carried out by the Forest Planning and Management Project (FPMP) of the Belize Forest Department in the Chiquibul Forest Reserve and the Rio Bravo Conservation and Management Area. The FPMP seeks to make better use of Belize's forest resources than is achieved through traditional selective logging. While selective logging in Belize seems to have only minor effects on the bird community, forest management represented by the silvicultural tials may have larger effects. Birds have an important ecological role in the forest This study aims to provide forest managers with information on silvicultural impacts on birds, so that biodiversity issue can be considered, along with forestry issues, in management decisions.

2. The study is designed to answer the following questions: a) What impact do the FPMP silvicultural trials have on forest habitat structure; b) What impact do the silvicultural trials have on the forest bird community; c) Does the impact on forest structure cause increases in bird species typical of treefall gaps in unlogged forest or of open areas such as along roads; cause decreases in species that prefer undisturbed forest; and/or cause existing species in the forest to adapt behaviorally to accommodate the changes in forest structure?

3. To answer these questions we must: I) compare forest structure and bird communities at the sites of the silvicultural trials before and alter timber extraction, (2) compare those bird communities with birds typical of treefall gaps and along roads, and (3) document how species respond behaviorally to the changes in vegetation structure. In this report we describe the results of pre-trial studies of the vegetation structure and avifauna of the trial plots, forest gaps, and roadsides.

4. The study took place in subtropical moist forests in the Chiquibul Forest Reserve and the Rio Bravo Conservation and Management Area (Hill Bank). The silvicultural treatment sites were 300 x 600 m (18 ha) forest plots installed by the FPMP, four at Chiquibul and two at Hill Bank. Two of the Chiquibul plots were in deciduous seasonal forest and two in deciduous semi-evergreen seasonal forest. One half (nine contiguous hectares) of each plot was randomly selected for extraction of all merchantable trees, the other half to be an undisturbed control. Gap study sites were within the 18 ha trial plots. Roadside plots were seven 800 m segments near the Las Cuevas Research Station. Gaps and roadsides were not studied at Hill Bank.

5. To quantify forest structure we measured canopy height, canopy openness, and small stem density in each plot, and we located and measured the area of all treefall gaps. We measured the height of roadside vegetation along the road study areas.

6. In each of the silvicultural treatment plots we made point counts of birds three times at each of 12 points in each of the plots (Fig. I). Birds were also mist-netted and released unharmed at 24 points in each plot. Additionally, we systematically plotted territories or bird locations in the plots on at least three days and recorded information about the location and behavior of these birds and others in studies in forest gaps and along roadsides.

7. The four Chiquibul plots were significantly different from one another in terms of canopy height, canopy openness, and stem density. But large sample sizes make statistical comparisons highly sensitive to small differences in vegetation structure that may not be biologically meaningful. There were few differences between deciduous seasonal forest and deciduous urn/-evergreen seasonal forest. Due to the great spatial heterogeneity of the vegetation within each of the four Chiquibul plots, the two treatment halves of each plot were structurally different from each other in most comparisons. Nonetheless, the comparative design of the silvicultural trial is robust because the logging treatment will undoubtedly produce a much greater contrast than existed before treatment between the logged and unlogged plot halves and in pre- and post-treatment comparisons of the logged half.

8. A total of 139 bird species were recorded on the Chiquibul forest plots in censusing, mist-netting, or opportunistic observations. Point counts in the treatment plots detected 1021 individual birds in 109 species, while 359 individual birds in 45 species were caught in mist-nets. Emberizids (sparrows and allies, warblers, tanagers, and orioles), flycatchers, wrens, vireos, and hummingbirds were the more common families detected in censuses, whereas Emberizids, woodcreçpers, flycatchers, wrens, and manakins dominated the mist-net samples. In terms of foraging guilds, small insectivores and small omnivores dominated the point count and mist-net data, while large insectivores and nectivores were less abundant. Migrants made up between 11.8 and 18.8% of the birds censused and between 21.6 and 29.2% of birds netted.

9. Comparisons among the four Chiquibul sites indicate significant differences in relative abundances of individuals, species, and families of birds, according to point count data, but only for individuals, according to mist-net data. There was no difference in the bird species richness or diversity between *deciduous seasonal forest* and deciduous *semi-evergreen seasonal forest* types, although there were some differences between forest types in relative abundances of some bird species. This suggests the two forest types contain similar bird communities. Censusing and mist-net results revealed some significant differences between treatment halves of the silvicultural plots. Birds foraging in treefall gaps differed little from those in the forest interior.

10. Point counts from the forest plots were combined those from roadside plots to evaluate the degree of habitat specialization in bird species. Species were categorized as to whether they were observed both in the forest interior and along the roadsides (both habitats), observed only in the forest interior (only interior), or only along roadsides (only roadsides). The combined list included 147 species, 79 of which occurred in both habitat 31 in only interior and 37 in only roadsides. When comparing the relative abundances of individuals, the relatively high proportions of large omnivores and large insectivores in the forest interior specialists and the high numbers of small omnivores and the low numbers of small insectivores and nectivorous species among roadside specialists stands out. Most of the small insectivores used both habitats. Neotropical migrants made up 20.7% of the individuals in the species using both habitats, a remarkable 36.3% of the individuals in the species only detected in the roadside counts, but only 1.5% of the individuals in the species only found in the interior. Although relative abundances of species differed significantly between forest interior and roadsides, only 8% of species seen in forest plots were never recorded in gaps or along roads. Birds in the forest interior and in gaps are more often observed foraging than birds along roadsides, which are realitively (*relatively*) more frequently engaged in other behaviors, like vocalizing or watching for predators.

II. As at Chiquibul, at Hill Bank there were pre-treatment differences in forest structure between the two silvicultural plots. Most comparisons of the bird community showed little differences between plots; however there were some significant differences between plots in abundance of certain species. Both census and mist-net data indicated little difference in the pre-treatment bird communities of treatment and control halves of the plots.

12. These results enable us to make several predictions concerning the effects of the silvicultural treatments on the forest bird community. If disturbance to the forest by the logging treatment is similar to increasing the number of treefalls, it may have little effect on bird species composition and numbers. But if the forest is opened dramatically the birds may encounter a significant change in the foraging substrates available and be more vulnerable to aerial predators and species composition and/or abundances could shift significantly. Most of the species that appear to prefer the forest interior, and may be most at risk to disturbance, are tropical residents. These include trogons, motmots, cotingids, woodpeckers, woodcreepers, and hummingbirds may be adversely affected. However, most species in the forest (small insectivores in the Emberizidae) may adjust ably to or even due better (like neotropical migrants) in a modestly disturbed forest habitat.

13. In the short-term, because birds do move about the landscape, adversely affected species will recolonize habitats as they recover the necessary habitat features. If silvicultural management is mindful of maintaining good forest habitat for source populations and allowing the treated areas to recover critical forest characteristics sufficiently between harvests, the managed forests will be recolonized and should maintain most if not all the avian biodiversity in the landscape.

HILL BANK STUDIES

Marimba and Punta Gorda were different in their bird communities and vegetation structure. The mist-netting data also suggested that the sites had different frequencies in the number of individuals of different species and of different families. Mist-netting and point count data both suggest that Marimba had more migrants than Punt Gorda. Marimba had a taller and more open canopy than Punta Gorda. Marimba may have better soil or be less disturbed than Punta Gorda, permitting trees to grow taller at Marimba.

No significant differences occurred between logged and paired unlogged plots before logging. Numbers of individual species, individuals in different families, foraging guilds, and migratory status guilds occurred with similar frequency between logged and unlogged plots in Marimba and in Punta Gorda. Species richness and numbers of individuals were also the same between logged and unlogged plots in Marimba and in Puma Gorda. Therefore, paired unlogged plots appear to be valid controls for the logged plots.

PLANS FOR NEXT PHASE OF THE PROJECT

The degree to which the post-trial forest bird community differs from the pre-trial community, and comes to resemble communities of gaps and along roads, will indicate the short-term ecological impact of the trials on the forest. Thus, in February and March 1996 Manomet plans to repeat the forest structure and bird surveys on the forest silvicultural plots to determine how the habitat has changed and what bird species and their relative abundances are on the plots after the logging on the treatment halves (see Appendix H for field methods).

If there area sufficient personnel and resources in Chiquibul we will continue the behavioral studies to examine how the birds use the vegetation in the treated versus untreated plot halves. We will also add studies on butterfly diversity and the small stems (sapling and pole) of the tees (see Appendix H for methods).

CONCLUSION

The use of birds as an index of the impact of the silvicultural treatment on the forest biodiversity has several strengths and weaknesses. Birds hold key ecological roles in the forest as pollinators, seed dispersers, and predators on herbivorous insects. The forest bird community is one of the better known taxonomic groups in the tropical forest, and the techniques for studying them are well-established and the reliability of these understood. Birds are mobile and thus respond to habitat change both behaviorally as well as demographically. This means they can respond to habitat changes immediately by adapting behaviorally or moving. Some species, like many migrants, already use a variety of habitats and should be better able to adapt to the changes in forest habitat caused by the silvicultural treatment, whereas others will be more sensitive to changes and have to seek new undisturbed habitats.

Because birds do move about the landscape, most affected species will recolonize habitats as they recover the necessary habitat features. The most sensitive species will decrease or disappear in the short-term and may recover only in the long-term. Not only because it may take awhile for the forest habitat to recover the characteristics required for these species, but also because, if the treatment is landscape wide, the remaining population may be diminished to the point that recolonization must come from long- distance dispersal and new reproduction from scattered individuals, potentially a slow process. On the other hand, the Belizean forest bird community has inhabited forests that have been exposed to repeated, large scale, devastating hurricanes and thus should be able to adapt to comparable disturbance from other sources. If silvicultural management is mindful of maintaining good forest habitat for source populations and allowing the treated areas to recover critical forest characteristics sufficiently between harvests, the managed forests will be recolonized and maintain avian biodiversity in the landscape.