

Silvicultural Strides toward the Sustainable
Management of Mahogany (*Swietenia macrophylla* King)
in the Rio Bravo Conservation and
Management Area of Belize

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other species. As a result of the differential impact on different species and diameter classes, the effect of girdling is analogous to a disturbance event that generates canopy openness in a patchy manner as opposed to a continuous homogenizing disturbance. By generating canopy heterogeneity, has girdling created conditions favorable to mahogany regeneration? To approach this question I determined how much canopy area of each seed shadow would be opened if the dead trees were to fall. Given that the observed minimum area generated by a commercial tree fall in PG-01 was 35 m² (Robinson, 1998) (I used the minimum gap area because the girdled trees ranged below the commercial size to 9.4 cm) and assuming that all dead girdled trees fall, the percentage of the 2800 m² shadow in new treefall gaps for shadows 4, 10, 54, 78 and 94 after six months is 7%, 25%, 17%, 11% and 5%. Prior to girdling, concentrated selective felling opened 5%, 16%, 15%, 2% and 7% of shadows 4, 10, 54, 78 and 94 (Robinson, 1998). When the area in felling gaps prior to girdling is added to the potential area in felling gaps, the percent shadow opening becomes 12%, 41%, 32%, 13% and 12% for shadows 4, 10, 54, 78 and 94. Negreros-Castillo and Mize (1993) found that one year after girdling, mortality was 53% for trees girdled with a 40 cm band and 57% for trees girdled with a 20cm band. To be conservative I used the smaller percentage to project how much of the shadows will be in treefall gap after one year. For shadows 4, 10, 54, 78 and 94 the projected percentages are 47%, 57%, 38%, 25% and 38%, and when concentrated selective felling gaps are accounted for the percentage rises to 52%, 73%, 53%, 27% and 45%. Is this enough area for mahogany establishment and growth? Projected percentages are promising, but only time will tell.

Oliphant (1926) preferred girdling as a silvicultural means of encouraging mahogany regeneration because a gradual increase in light intensity exposes young seedlings to less water-stress and insect attack, such as shoot borer (*Hypsipyla grandella*) infestation (in Mayhew et al., 1998). Of all the treatments, girdling is the most dynamic in terms of a changing light environment. In the course of a few weeks we noted that several of the dead trees had fallen. Hence girdling has two dimensions of heterogeneity of canopy openness: space and time. A negative result of such change is the potential of dead standing trees to eventually destroy or damage regenerating mahogany saplings. Another possible drawback of this treatment is the potential of sprouting trees, about a quarter of the 313 girdled trees, to suppress establishing mahogany. Snook (1993) noted that mahogany regenerates better after a severe fire than after mild fire, which induces sprouting by many species. In light of these findings I recommend that the status of sprouts be evaluated periodically, and if sprouting trees are detrimentally impacting nearby mahogany seedlings by shading, the trees should be felled or the sprouts cleaned.

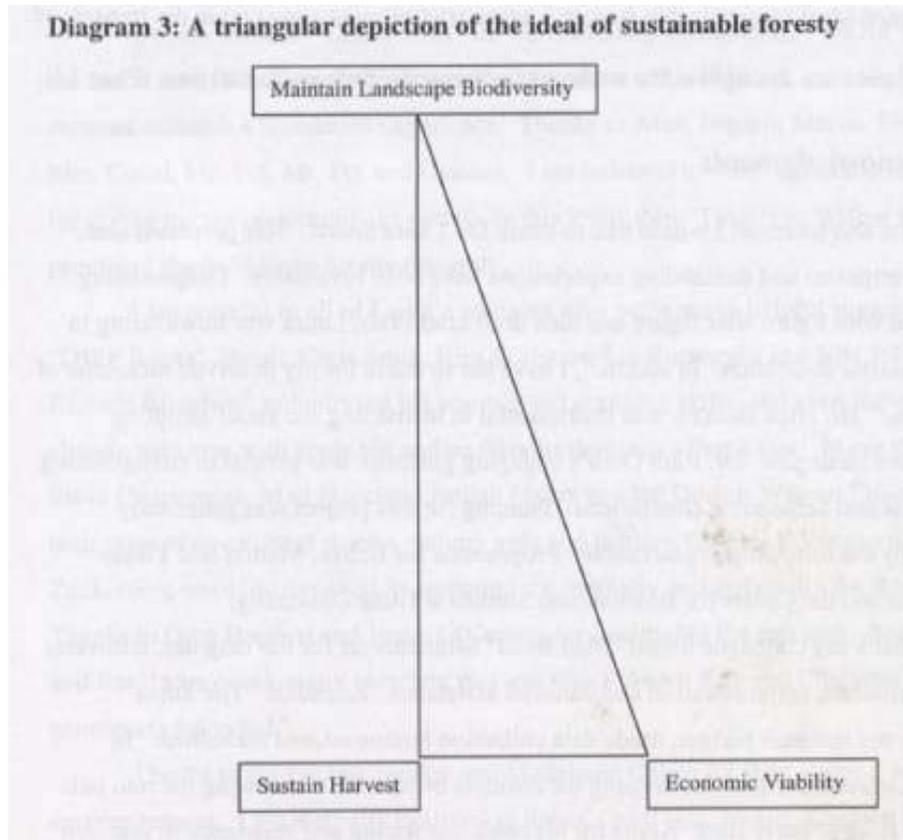
V. Implications for Silvicultural Management

Selective harvest does not generate adequate conditions for mahogany regeneration, implying that sustainable management of mahogany requires silvicultural intervention. Sustaining harvests of mahogany requires maintaining an adequate source of seed and establishing appropriate conditions for regeneration. Ideal seed trees should have high fecundity from year to year, and their selection should be based upon the consideration of height and crown projection area as well as diameter and form. Whether girdling generates appropriate conditions for mahogany regeneration depends on whether the competition from sprouting trees is insignificant and whether the growing, patchy canopy openness provides sufficient light. The gradual increase of canopy openness in the girdling shadows could benefit mahogany seedlings with protection from desiccation and shoot borers.

VI. Future Studies

The goal of PFB's silvicultural experimentation in the Timber Extraction Zone is the development of a sustainable forest management regime for Central American forests. For forestry to be sustainable three criteria must be met: 1) current harvests do not irrevocably diminish future harvests; 2) timber

exploitation is viable economically in the short and long term; and 3) landscape-level biodiversity is maintained (Brokaw, 1998). The focus of this study has been to assess the suitability of girdled seed shadows and treefall gaps as potential sites of mahogany regeneration and growth and to optimize selection of seed trees. Thus the study objectives were narrowly focused on a single component of sustainable forestry. Since mahogany exploitation is such a lucrative trade, the perpetuation of harvest guarantees economic viability overtime. However, ecological and economic gains in mahogany do not guarantee the maintenance of species diversity on the exploited landscape. If one imagines the concept of sustainable forestry of mahogany as a right triangle, each criterion would occupy a corner; the right corner being perpetual harvest, the corner of the acutest angle a haven of the landscape's full complement of biodiversity and the remaining corner harboring economic viability (Diagram 3).



Arrayed in such a manner, perpetual harvest and economic viability are separated by the least distance, symbolizing the correlation of these components. Closest to the criterion of preserving biodiversity is the perpetuation of harvesting potential. Snook (in press) notes that in a landscape where patchy catastrophic disturbance has sustained the existing mixture of species for centuries, intensive silviculture for the production of mahogany need not reduce diversity. Economic viability and maintenance of biodiversity are separated by the greatest distance (the hypotenuse) a metaphor for the negative correlation between sustained profit and species and ecological process diversity. To determine whether the silvicultural strides toward the sustainable management of mahogany in the Rio Bravo Conservation and Management Area are sustainable in terms of the defined ideal of sustainable forestry, future studies must assess what the impacts of implementation are throughout the ecological community over space and time (Plate 14).