SPECIES REGENERATION RESPONSE to CLEARING SIZE: A SWIETENJA MACROPHYLLA KING HARVESTED FOREST in NORTHERN BELIZE

by
Carissa M. Wong

Date:
Approved:

Dr. Ram Oren, Advisor

Dr. Norman L. Christensen, Dean

Master's project submitted in partial fulfillment of the
requirements for the Master of Environmental Management degree in
the Nicholas School of the Environment of
Duke University
2001

Abstract

SPECIES REGENERATION RESPONSE to CLEARING SIZE:
A *SMETENIA MACROPHYLLA* KING HARVESTED FOREST
in NORTHERN BELIZE

by
Canssa M. Wong
May 2001

Swietenia macrophylla King (common name: big-leafed mahogany) is cited as a catalytic species in the destruction of American forests (Feamside 1997). Its regeneration requires the catastrophic forest disturbance associated with hurricanes, fire, and flood, and its management may be incompatible with the preservation of overall biodiversity, or alternative economically valuable timber species (Rice et al. 1997). This study investigates the impact of clearing size on natural tree species regeneration in the Belizean subtropical moist forest of the Rio Bravo Conservation and Management Area. Using height-frequency distributions, I classified 32 out of 68 identified species according to light tolerance with a literature and expert verified accuracy of 91%. Analysis of Variance (ANOVA) of relative height and percent density for shade tolerant and intolerant trees does not show significant trends with increasing patchcut size. A Shannon-Wiener index of diversity varies significantly ($p = 0.047$) between only the intermediate 1000 and 2500 m^2 patch sizes. Insufficient variation in light levels between the patchcuts is a likely explanation for the lack of significant species performance and diversity responses to variations in gap size.

DISCUSSION

I. Light

Underlying the possible trade-off in growth hypothesized between shade intolerant and tolerant species in large and small openings, is the corresponding trade off in photosynthetic capacity (Brokaw 1985). Linear regression analyses of light intensity (or PAR, photosynthetically active radiation) on density, height and diversity however, show that light is not a significant explanatory variable for any of these variables.

	Density	*Height*	Diversity
Shade Tolerant	$p = 0.397$	$p = 0.493$	
Shade Intolerant	$p = 0.780$	$p = 1.00$	
All Species			$p = 0.87$

Table 1. *p*-values for regression of light intensity on density, height and diversity.

A closer look at light intensity reveals, in fact, that although gap size increases by a factor of 10 from the 500 to 5000 m^2 opening size, the greatest change in light intensity occurs between the control (under the canopy) and the 500 m^2 (Fig. 13). Thus, changes in gap sizes within the range used in this study do not adequately reflect changes that could be explained by light. In fact, previous studies investigating gap- building regeneration focus on large tree fall gap sizes of 50-705 m^2 and gaps as small as 40 m^2 (Arriaga 2000, Brokaw 1985).

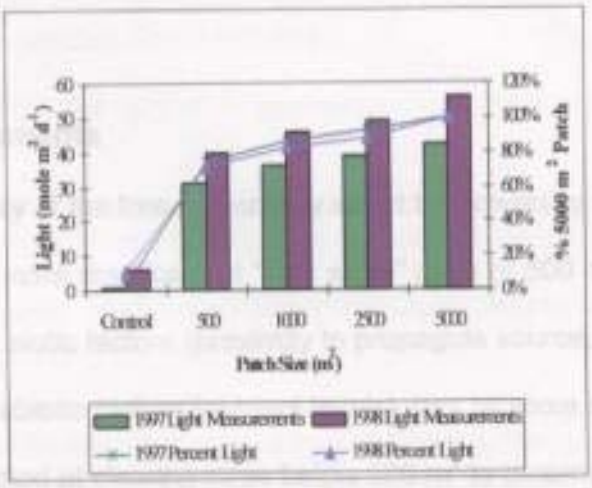

Figure 13. Changes in Light intensity from control to 5000 m^2 patchcut. *Courtesy of Jennie O'Connor, 2000.*

Indeed small gaps (from a single branch or tree) are typically more common than large gaps (several trees) (Denslow 1980). On the basis of their formation frequency, small forest gaps may be more important in supporting overall tree diversity than larger gaps, and this crucial range of changing environmental conditions is not addressed by this study's gap size range.

II. Diversity

Although I suspected that diversity would decrease with gap size, I found that diversity remains relatively constant with gap size. Since light is not a significant factor influencing diversity it remains unclear whether diversity is affected at gap sizes below the 500 m^2 or, alternatively, in the best scenario, opening size has no affect on diversity. It is possible that all losses in forest diversity occur at clearing sizes below 500 m^2 and without a more detailed look at the impact of these smaller openings on biodiversity in mahogany rich forests, it is not possible to say whether this species silviculture should impact diversity.

Concluding Comments

Light intensity at the forest floor may affect tree diversity and performance, but light levels change more drastically at "very small" gaps (<500 m^2 and above this clearing size, other biotic factors (proximity to propagule source, invasion of herbivores or pathogens) and abiotic factors (nutrient levels) may be more important than opening size. Study is needed at clearing sizes below 500 m^2 to determine the ecological sustainability of *Swietenia macrophylla* King silviculture.