From Forest Nursery Notes, Winter 2009

23. © Evaluating dispersal limitation in passive bottomland forest restoration. Battaglia, L. L., Pritchett, D. W., and Minchin, P. R. Restoration Ecology 16(3):417-424. 2008.

Restoration Ecology
THE JOURNAL OF THE SOCIETY FOR ECOLOGICAL RESTORATION INTERNATIONAL

Evaluating Dispersal Limitation in Passive Bottomland Forest Restoration

Loretta L. Battaglia,[1,2] Davis W. Pritchett,[3] and Peter R. Minchin[4]

Abstract

Dispersal limitation can retard natural establishment of desirable species on restoration sites, especially where landscapes are fragmented, but dispersal limitation is assumed to become less critical with time as early colonists become reproductively mature. Distribution patterns of recruiting trees in a 20-year-old passively restored bottomland in northeast Louisiana suggested persistent dispersal limitation in some bottomland hardwood species and influence of dense shrub patches on colonization. To test these hypotheses, we measured seed rain as a function of distance to seed source and association with shrub cover. Seed rain of the wind-dispersed *Fraxinus pennsylvanica* was highest near the forest edge, except where mature recruits occurred. Although shrub presence did not influence dispersal of *F. pennsylvanica*, its negative influence on probability of occurrence in the sapling layer suggests that shrub cover may limit its regeneration. The bird-dispersed *Crataegus viridis* and *Ilex decidua* were found in the seed rain and as reproductive individuals within the field; neither had a positive relationship with shrub presence. Dispersal of heavy-seeded *Quercus* spp. and *Carya aquatica* was limited to within 20 m of the forest edge. These results imply that dispersal limitation is diminishing in wind- and bird-dispersed species with maturation of in-field recruits and that shrub patches may influence these patterns. Heavy-seeded species, however, remain restricted to field edges that directly abut a seed source. If canopy closure by wind- and bird-dispersed species precedes dispersal of heavy-seeded species into the field, establishment of *Quercus* and *Carya* spp. may remain low for the foreseeable future.

Key words: bottomland hardwoods, dispersal, Louisiana, recruitment limitation, succession.

Introduction

In unfragmented communities, such as expansive tracts of tropical rainforest, recruitment limitation has been linked to high species diversity (Hubbell et al. 1999; Hubbell 2006). Light-seeded, inferior competitors may coexist on a larger scale with heavy-seeded, superior competitors if the former "win some areas by default" because the latter are dispersal limited and therefore never arrive and compete. In a restoration setting, dispersal is a critical filter that can limit establishment of species, depending on seed size and mode of dispersal. Heavy-seeded species, many of which are considered desirable, may be precluded (McEuen & Curran 2004; Hooper et al. 2005), leading to communities dominated by pioneer species—a "pioneer desert" (sensu Martínez-Garza & Howe 2003). In more extreme cases, where large patches of unsuitable habitat separate seed sources from target restoration sites, even dispersal of light-seeded species may be impeded (Golley et al. 1994; Allen 1997; Seabloom & van der Valk 2003). Natural establishment of desirable species may be curbed for many decades in large sites with a low edge-to-interior ratio (Pinder et al. 1995; Young et al. 2005). This limitation is assumed to eventually decline as immigration continues, but also as volunteer (and planted) species become reproductively mature. The rate of decline in dispersal limitation, which also depends on distance to seed source, should influence the sequence of arrival (Zanini & Ganade 2005) and thus the assembly trajectories of communities.

Bottomland hardwood forest is one of the most fragmented vegetation types in the United States (Creasman et al. 1992). Historically, the largest extent of this forest type was in the Lower Mississippi Alluvial Valley (LMAV). Of the original 10 million ha, approximately 72% has been lost (Sharitz 1992; King & Keeland 1999). Once extensive along streams and rivers, bottomland hardwood forests have been reduced by conversion to agriculture and urban development (Sharitz & Mitsch 1993). Since the mid-1970s when soybean prices dropped, interest in converting flood-prone marginal cropland back to hardwoods has increased (Amacher et al. 1998; Twedt 2004). State and federal agencies, as well as private conservation organizations, have endeavored to restore bottomland hardwood habitat on public and private lands (King & Keeland 1999).

Active and passive restoration is occurring in many abandoned bottomlands in the LMAV. Afforestation, with

[1] Department of Plant Biology and Center for Ecology, Southern Illinois University Carbondale, Carbondale, IL 62901, U.S.A.
[2] Address correspondence to L. L. Battaglia, email lbattaglia@plant.siu.edu
[3] Department of Biology, University of Louisiana Monroe, Monroe, LA 71209, U.S.A.
[4] Department of Biological Sciences, Southern Illinois University Edwardsville, Edwardsville, IL 62026, U.S.A.

doi: 10.1111/j.1526-100X.2007.00319.x