HARDWOOD SEED PRODUCTION IN AN OLD-GROWTH MIXED MESOPHYTIC FOREST IN SOUTHEASTERN OHIO

Brian C. McCarthy and Carolyn H. Keiffer[†]

Old-growth forests provide an invaluable ecological benchmark in an otherwise widely managed forest landscape. These forests permit insight into important processes that might not otherwise be observable in the landscape; i.e., processes that only manifest themselves at the latest stages of forest succession or in the absence of anthropogenic disturbance. Dysart Woods is one of a small number of remnant old-growth stands in Ohio and is believed to be the only example of mixed mesophytic forest vegetation in the state.

Previous studies at Dysart Woods (McCarthy and others 2001) surveyed two separate stands and found that the overstory (stems > 10 cm DBH) is dominated by white oak (*Quercus alba*; DEN = 20 stems ha^{-1}, BA = 9.6 m^2 ha^{-1}), sugar maple (*Acer saccharum*; DEN = 68.6 stems ha^{-1}, BA = 3.3 m^2 ha^{-1}), and beech (*Fagus grandifolia*; DEN = 72.86 stems ha^{-1}, BA = 11.0 m^2 ha^{-1}). There are a relatively large number of white oak stems in the 85-125 cm dbh classes. Red oak (*Q. rubra*), tuliptree (*Liriodendron tulipifera*), blackgum (*Nyssa sylvatica*), and cherry (*Prunus serotina*) are also locally important. The midstory (DBH $\geq$ 2.5 and < 10 cm dbh) is dominated by Sugar maple (DEN = 349 stems ha^{-1}) and beech (DEN = 201 stems ha^{-1}), as is the seedling layer (stems < 2.5 cm DBH; DEN = 14,507 and 1,536 stems ha^{-1}, respectively). Interestingly, the canopy dominant white oak is virtually absent from the midstory and understory. Based on dendrochronological studies (Rubino and McCarthy 2000) we estimate that there has been almost no white oak recruitment in these woods for upwards of 200 years.

Our composition and structural results present a conundrum. Recent studies suggest that fire may be an important silvicultural tool in regenerating oaks. A limited disturbance chronology (373 years) was constructed from one large (1.0 m dbh) basal slab of white oak which indicated that the woods burned repeatedly during the major period of regional settlement (1810-1860)(McCarthy and others 2001). No fire scars were detected post 1880. Thus, we would expect a much greater number of mid-diameter size classes of white oak had it recruited during that time frame. The paucity of smaller diameter classes is still consistent with an absence of fire hypothesis. The role of fire is quite unclear, and may be more so under relatively mesic conditions.

Given the lack of regeneration, apparently for a long period of time, we decided to examine seed production in the two stands (ca. 11 ha each). Forty-eight conical seed traps, 0.25 m^2 in size, were arrayed in a 6 × 8 grid in each stand, with each trap spaced 10 m apart (96 traps total, 24 m^2 total sample area). Traps were deployed in mid-August each year and sampled again in mid- September, October, and November from 1996-2000. Seeds were destructively sampled and scored as sound, aborted (not fully developed), or depredated (by fungal pathogen or insect predator).

There was an order of magnitude difference in the number of sound seed produced within and among species (fig. 1). Sugar maple produced from 34 to 6473 seeds (1999 & 1998, respectively), beech produced 349 to 3071 seeds (1999, 2000), tuliptree produced 730 to 3481 seeds (1997, 1998), but white oak produced only 1 to 473 seeds (2000, 1998) per 24 m^2.

There was a strong periodicity to the data for all species (fig. 1). Virtually all species (including cherry, blackgum, and red oak; data not shown) alternated between years of increased and decreased seed production. These data lend support to a resource limitation hypothesis regarding seed production; however, the fact that all species respond on the same schedule also lends considerable support to the

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[†] Forest Ecologist (BCM), Department of Environmental and Plant Biology, Ohio University, Athens, OH 45701. Phone: (740)593-1615; fax: (740)593-1130; e-mail: mccarthy@ohio.edu. Restoration Ecologist (CHK), Department of Botany, Miami University, Middletown, OH 45042.

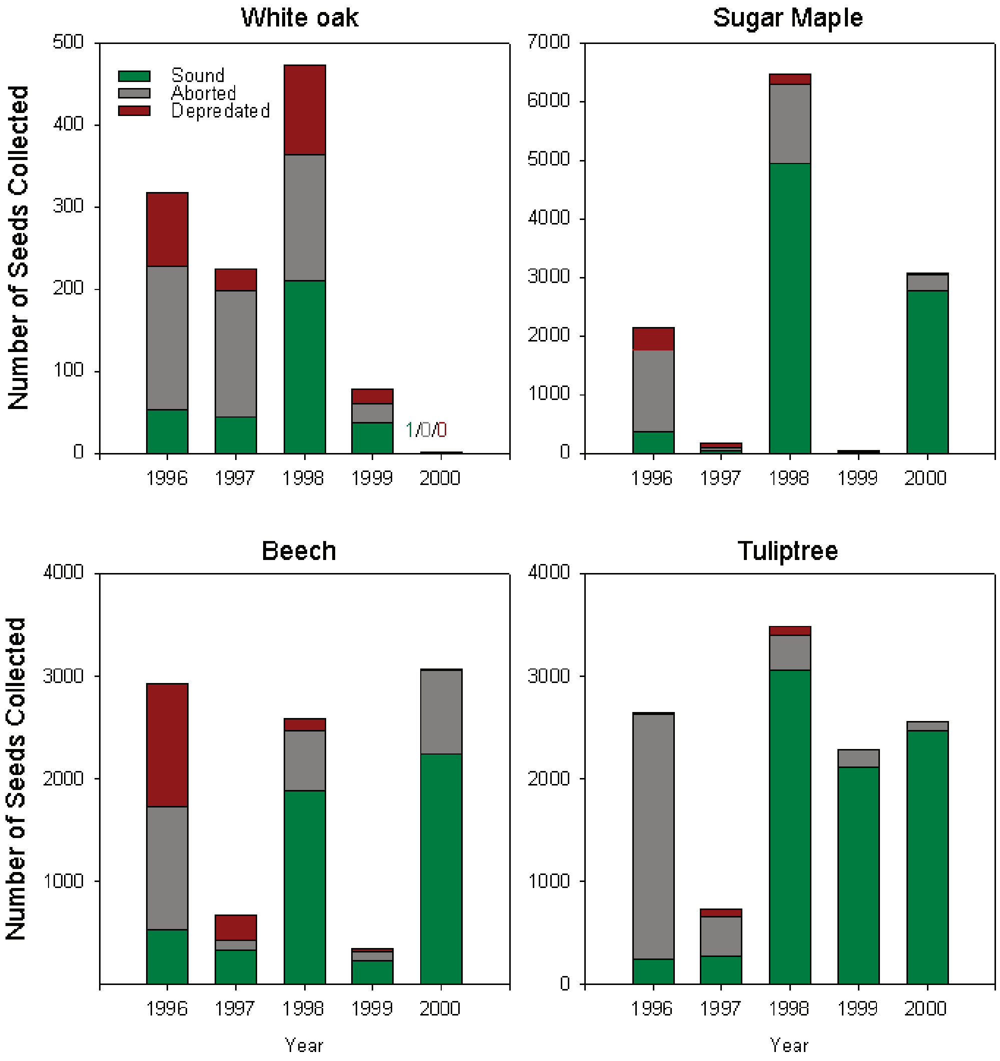

Figure 1.—Number of seeds collected per 24m^2 of sample area for the period 1996-2000. Data shown are for the four major overstory species present at Dysart Woods (Belmont Co., OH) broken down by seed quality (sound, aborted, depredated). Note the difference in scales among the species.

influence of the environment in setting that schedule. Similar patterns have been observed in Missouri (Christisen and Kearby 1984) and elsewhere.

White oak was the poorest seed producer of all the species and its fecundity was generally only 10 percent of its co-dominants (fig. 1). It always produced the most seed in the more xeric of the two stands (data not shown). All species displayed a modest degree of seed abortion (inability to fully mature the fruit) and/or pre-dispersal seed predation (by insects or fungi; largely the former) depending upon the year. However, the proportion of unsound seed for white oak was considerably greater for (range 52 to 83 percent) than it was for most other species in most years of this study. Thus, the absolute number of white oak propagules available for germination is incredibly small. Of the small number of viable seeds reaching the forest floor, most of these likely suffer post-dispersal predation by small rodents. A post-dispersal predation rate of 99 percent is not uncommon among many nut-bearing trees (McCarthy 1994).

With or without fire, white oak will be unable to maintain dominance in these woods—there is no longer a sufficient source of propagules to maintain the population and the woods is relatively isolated in an otherwise agricultural landscape. Most of the white oaks in this stand are of senescent age and past the period of major reproductive output (Johnson 1994). Regeneration of white oak is virtually absent and it is unclear that there has been any recruitment for almost 100-200 years. White oak may hold its dominance a bit longer on the drier of the two stands, but it too will likely give way to beech, sugar maple, and tuliptree populations as they generally support a healthier reverse-J diameter distribution.

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