Journal of the Arkansas Academy of Science

Volume 43 Article 21

1989

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REPRODUCTION OF *LINDERA MELISSIFOLIA* IN ARKANSAS

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ABSTRACT

Field reproduction was investigated in several populations of the endangered dioecious species *Lindera melissifolia.* Fruit set was light and erratic, and even where fruiting was heavy no effective seed bank was found. Field transplantation of greenhouse-grown seedlings was successful for one growing season. Rhizome sprouting was widespread, and produced rapid recovery from fire. Without enhancement of natural reproduction, the species will probably decline.

INTRODUCTION

Pondberry, *Lindera melissifolia,* is a federally and State endangered shrub known in Arkansas from only a few populations in three areas of the northeastern part of the state (Wright, 1989). Individual stands of this dioecious species grow as understory shrubs in bottomland hardwood forest, but only where temporary ponds occur in depressions between old dunes formed from glacial outwash (Saucier, 1978). Ponds are typically well isolated from each other, due both to natural topography and to agricultural modification of the landscape.

Pondberry stems are shortlived (Tucker, 1983) but replace themselves readily by rhizome sprouts. Survival of the species requires that existing stands maintain themselves and if possible spread to other ponds. Sexual reproduction may be ineffective, judging from the frequency and size of single-sex clones (Wright, 1989). Apparent preponderance of male clones suggests that survival may be related to difference in allocation of resources between males and females, as has been observed for other dioecious species (Agren, 1988; Doust and Doust, 1988). Populations are prone to disturbance from fire and from wood cutting, although their topographic position has tended to protect them from destruction through land clearing. This study focused on sexual reproduction and response to disturbance of several field populations in 1987-1989.

METHODS

1) Fruit set was observed in 1988 and compared with observations the previous two seasons. 2) The 1988 seed bank was assessed in sections of the forest floor beneath plants that had fruited heavily in 1987. On July 22 six plots (totalling 0.47 m^2) of forest floor were removed to depths of 8-10 cm, and placed intact in the greenhouse. Seedling and rhizome sprout emergence were observed over an eight month period. 3) 100 fruits were sown in the mineral A horizon of an upland forest in November 1987. Germination was assessed in 1988 and 1989. 4) 1987 fruit germinated in the lab at greater than 90% when seed coats were removed (Wright, 1989). These were grown in the greenhouse during winter and spring of 1988. From late April through early June a total of 64 seedlings was transplanted to a pond containing an existing population as water receded. Transplants were watered seven times between May 12 and September 29, and their survival monitored. 5) Three stands were monitored for recovery from fires that killed above-ground stems between November 1987 and May 1988.

RESULTS

1) Fruit set varied from year to year. Fruit set in one stand was extremely heavy in 1987, with an estimated 100,000 fruits set (Wright, 1989). This amounted to 2000 fruits per m^2. In 1988 the stand produced no more than 2000 fruits. Stands that had fruited well in 1986 had low fruit production the next two years. Stems that had fruited heavily in 1987 were prone to dieback for about half their length. Of six populations observed over three seasons, three had only male plants and thus bore no fruit.

2) An effective natural seed bank was not demonstrated. Forest floor samples grown in the greenhouse from July 1988 to March 1989 produced no new seedlings, although the samples came from an area estimated to have produced about 1000 fruits the previous season. During that same time 94 new rhizome sprouts emerged from the samples. There were two seedlings of the current year present in the samples when they were dug, and no signs that any seed had already germinated and died.

3) Fruits sown in the upland forest in November 1987 produced no seedlings in 1988. In May and June 1989, five seedlings emerged (out of 100 fruits planted).

4) Seedling transplantation from the greenhouse to a native stand was successful except where plants were placed too high on the pond bank. Survival to September 29 was as follows:

Top of bank .....1/10, 10% (transplanted April 26)
Bank slope .....14/20, 70% (transplanted April 26)
Edge of bottom....11/16, 69% (transplanted June 2)
Lower bottom ....16/18, 89% (transplanted June 14)

Seedlings generally attained heights of around 10cm, with little new growth after transplantation except for seedlings in the lower bottom, several of which grew to double their pre-transplantation height. The lower bottom was a few cm below the lowest elevation of the existing pondberry stand in this pond.

5) Pondberry plants that burned during the dormant season (November 1987 fire) resprouted as soon as the pond receded late in May. One stand with 109 stems before the fire produced 134 from new growth. In another burned stand extending up a pond bank, vigorous regrowth by associated shrubby and herbaceous vegetation outpaced pondberry about two to one in rate of stem elongation.

DISCUSSION

During the years 1986-88, pondberry in Arkansas did not fruit heavily. All-male stands (Wright, 1989) had no fruit, and of those stands with female plants only one stand fruited heavily in one year. Whether due to failure of pollen transfer, pollen inviability, cyclic fruiting or other causes, fruit production was clearly low. A parallel exists with *Neviusia alabamensis,* another rare plant with a range similar to that of *Lindera melissifolia,* which in Arkansas has not been seen to produce fruit (Long, 1986). Other clonal dioecious species are known to produce abundant fruit (Doust and Doust, 1988; Lloyd, 1984), suggesting that low fruit production may be a critical factor among life history events for pondberry.

Very low seedling production also characterizes pondberry (Wright, 1989). This is corroborated by failure of the seed bank to reveal any viaible seed, even though some hundreds of fruits would have been shed on the seed bank plots. It is possible that the occasional new seedlings germinated where I disturbed the forest floor while harvesting the year

before, and therefore, some viable seed sown into disturbed soil may germinate. This is suggested by the 5% germination after two winters where fruit was sown in mineral soil. Possibly low seedling recruitment is sufficient in species with strong vegetative reproduction, yet it appears that in some populations females have died out completely, indicating total failure of seedling recruitment. It may also be that lower allocation of resources to reproduction had favored males, as has been found for species of *Rubus* (Agren, 1988), *Rhus* (Doust and Doust, 1988), and other plants (Lloyd, 1984).

The transplant study gives clear indication that stands can be enhanced or recovered by transplanting greenhouse-grown seedlings into moist pond bottoms and banks. Precipitation in 1988 was below average for the summer months in Arkansas, totalling 265mm unofficially in Conway from June through September, yet transplants survived the season with minimal watering.

As is true for many species (Wright and Bailey, 1982), recovery from fire was robust, both for pondberry and for its associates. Since there is little competition in the understory for most of the populations (Wright, 1989), fire should be no problem. However, where better drainage or breaks in the tree canopy promote vigorous understory growth, competitors may well outgrow pondberry after fire, and at other times as well.

In summary, *Lindera melissifolia*, as long as its ponds with their forest canopies remain intact, should do well where it is now established. However, if the canopy trees are removed and a fire follows, severe impacts to the stand will occur. The stands have little capacity to increase genetic variability within populations by sexual reproduction, and no real ability to colonize new locations. Present distribution of sexes indicates that one or another of these hazards has over the years reduced populations. There is every likelihood this will continue unless management by establishing new seedlings or ramets counteracts natural attrition.

ACKNOWLEDGMENTS

This study was supported by grants from the Arkansas Nongame Committee and the University of Central Arkansas Research Council.

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