

## Is Seedling Establishment Very Rare in the Oklahoma Seaside Alder, *Alnus maritima* ssp. *oklahomensis*?

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The Oklahoma seaside alder (*Alnus maritima* ssp. *oklahomensis*) is a shrub that grows almost exclusively in Johnston County. While individuals resprout vigorously from rootstocks, few seedlings have been observed in the wild. We surveyed 1,848 one-meter-square plots of suitable microhabitat at two locations on the Blue River and a location on Pennington Creek. We found only 20 alder seedlings, all of them in their first year, and most of them in unsuitable, shaded conditions. These observations are consistent with the interpretation that, despite its abundant production of viable seeds, the Oklahoma seaside alder has effectively no long-term successful seedling establishment. These observations serve as a basis for seedling establishment experiments planned for the near future.

### INTRODUCTION

The Oklahoma seaside alder is one of three subspecies of the seaside alder (Betulaceae: *Alnus maritima* (Marshall) Muhl. ex. Nutt.). All three subspecies are rare and have limited geographical distributions (Schrader and Graves 2002). Subspecies *maritima* J. A. Schrader and W. R. Graves grows in some of the swamps on the Delmarva Peninsula east of Chesapeake Bay; subspecies *georgiensis* J. A. Schrader and W. R. Graves grows in a single swamp in Bartow County, northwestern Georgia; and subspecies *oklahomensis* J. A. Schrader and W. R. Graves grows only along the Blue River and nearby creeks such as Pennington Creek in Johnston County, Oklahoma, and Canyon Creek in Pontotoc County, Oklahoma. A few individuals also occur in Pontotoc County. The three subspecies are genetically distinct and probably represent relicts of a previously widespread species (Gibson, Rice, and Stucke 2008).

In contrast, the hazel alder (*Alnus serrulata* (Aiton) Willdenow) is abundant,

growing in swamps, around lakes, and along streams and rivers throughout eastern North America. One reason for its greater abundance appears to be that individuals of *A. serrulata* can persist in partially to completely shaded conditions, whereas *A. maritima* flourishes in mostly to fully sunny conditions (Schrader, Graves, Rice, and Gibson 2006).

The Oklahoma seaside alder (Fig. 1) grows back vigorously from its rootstock after floods. The floods in the summer of 2007 tore away the aboveground stems of many of the plants, but new branches began to grow from the clumps later that summer. Nearly all of the alders grow as clumps of numerous small trunks rather than forming a single trunk. This may perhaps be the result of past flood events. We have seen only two seaside alders in Oklahoma that had single trunks: one on Canyon Creek in Pontotoc County and one on Pennington Creek near Reagan, Oklahoma. They were growing in locations that may have allowed them to escape severe flooding.

Seaside alder seedlings appear to establish best under moist, sunny conditions, a hypothesis that we plan to test in an upcoming field experiment. Such conditions were probably widespread throughout North America at the end of the most recent ice age. Since the end of the most recent ice age, alder seedling establishment might have been very sporadic, dependent upon occasional disturbances - perhaps on the scale of decades or centuries. If this is the case, we would expect to find alder populations that consist mostly of even-aged stands. Unfortunately, the multi-trunked growth form does not permit an assessment of the age of any individual. Even the rare single-trunked individuals have rotten heartwood.

The apparently rare establishment of seaside alder seedlings contrasts with the production and viability of the seeds. Reproductive *A. maritima* stems produce pendulous male and strobilus-like female catkins. Pollination occurs in early autumn, which is characteristic of *Alnus* subgenus *Clethropsis*, of which *A. maritima* is the only North American representative. The following year, the female catkins expand. In the autumn, brown female catkins open their bracts and release the seeds which are dispersed by water. Each catkin can produce dozens of seeds, and many clumps produce several dozen female catkins. When we have collected seeds for experiments, we have usually had no difficulty obtaining thousands of them. Under artificial conditions nearly all of the seeds germinate and grow into healthy seedlings. We propose that the limited seedling establishment of *A. maritima* in the wild is not the result of poor seed production or viability.

Our hypothesis is that seedling establishment of seaside alder in Oklahoma is extremely rare in a typical growing season. To test this hypothesis, we undertook a thorough search for *A. maritima* seedlings in

May 2008, the year following major flooding along the Blue River and the creeks where *A. maritima* grows.

## METHODS

**Study locations.** We selected three locations in Johnston County (Table) that have large populations of *A. maritima*.

- Hughes Crossing of the Blue River is in the Blue River Wildlife Management Area north of Bullard Chapel Road near Tishomingo (N 34° 19' W 96° 35'). Alders grow along both east and west banks and on shallow islands north and south of the crossing. We surveyed riverbank and island substrate on or near the west bank along transects (total length about 1.2 kilometers) about one-half kilometer north and one-half kilometer south of the crossing (designated Area 1 by the Oklahoma Department of Wildlife Conservation), as well as a short transect (about 0.2 kilometer) about a kilometer north of the crossing (designated Area 2 by the Oklahoma Department of Wildlife Conservation).
- State Highway 7 crosses the Blue River in the Blue River Wildlife Management Area (N 34° 21' W 96° 35'). Footpaths lead to the river on its east and west banks, both north and south of the bridge. Alders are abundant along the banks and on shallow islands in all of these locations. We surveyed riverbank and island substrate on or near the west bank along transects (total length about one-half kilometer) about a kilometer north of the highway.
- Reagan Road crosses Pennington Creek near Reagan, OK (N 34° 21'

W 96° 41'). Alders are moderately abundant in this location. We surveyed along a transect about a quarter of a kilometer west of the crossing.

Dominant tree species above the alders were sycamore (*Platanus occidentalis*), American and slippery elms (*Ulmus americana* and *U. rubra*), chinkapin oak (*Quercus muehlenbergi*), walnut (*Juglans nigra*), box elder (*Acer negundo*), persimmon (*Diospyros virginiana*), and white ash (*Fraxinus americana*). Red cedar (*Juniperus virginiana*), redbud (*Cercis canadensis*), rough dogwood (*Cornus drummondii*), buckbrush (*Rhamnus caroliniana*), and chittamwood (*Sideroxylon lanuginosa*) were also common.

The Blue River and Pennington Creek populations are in different watersheds despite their proximity, and are genetically distinct (Gibson, Rice, and Stucke 2008).

**Survey method.** We searched for seedlings in 1,848 plots, each approximately 1 m<sup>2</sup> in size based on visual estimation. This method, though not precise, was adequate for this survey, given the very low abundance of alder seedlings. We conducted the surveys on 11 and 12 May 2008.

**Choice of survey locations.** Along the transects within each of the three study areas, we looked for alder seedlings in each meter-square plot that met the following characteristics:

- Large reproductive alders were nearby. Our major interest is to eventually understand regeneration within existing alder populations.
- There was evidence of recent flooding.
- Seedlings of other species were growing. We did not examine locations in which seedlings would

have been unable to grow, such as rocks or flotsam.

- Other herbaceous plants (such as sedges) did not form dense stands. Previous surveys have shown that seedlings are unable to grow in these dense stands.

**Recognition of alder seedlings.** *A. maritima* was the only alder species growing in these locations. We grew seedlings of *A. maritima* (Fig. 2) in order to learn to distinguish their characteristics from those of other seedlings. Alder sprouts could be distinguished from seedlings by their thicker stem and lack of cotyledons.

## RESULTS

Most plots contained no alder seedlings. Seedlings were usually solitary, although in one case there were three in close proximity (Figure 3). We located only 20 seedlings in the 1,848 plots. There was therefore an average of 0.01 seedlings per m<sup>2</sup>. Considering the rarity of seedlings, the inverse of that value, one seedling in each 92.4 m<sup>2</sup>, is easier to conceptualize. There were far fewer seedlings than adults, of which there were hundreds.

## DISCUSSION AND CONCLUSION

If this survey method had detected no alder seedlings, our ability to find them might be suspect. The survey took place in the growing season after floods had created new and potentially suitable substrate for seedling germination, although the floods may also have reduced the number of seeds available. The 1,848 plots that we surveyed consisted only of suitable microhabitat. The estimate of one seedling per 92.4 m<sup>2</sup> is therefore a conservative estimate. Although our survey represented only day of one year for each site, our observations were

consistent with our informal surveys in previous years, dating back to 2001.

All of the seedlings were in their first year of growth; we found no older seedlings. Most of the seedlings were in the shade and were unlikely to survive into a second year, given the requirement that *A. maritima* appears to have for bright sunlight (Schrader et al. 2006).

This survey was intended as background to further research. Since it appears that conditions are unsuitable for seedling establishment in the areas where adult Oklahoma seaside alders grow, we now wish to experimentally determine what the conditions of light, substrate, and water depth would be for successful seedling establishment. Because the alders appear to persist only by re-sprouting, preservation of this subspecies appears to require the preservation of the existing adult individuals. It is also possible that we can manipulate substrate conditions in such a way as to encourage seedling recruitment.

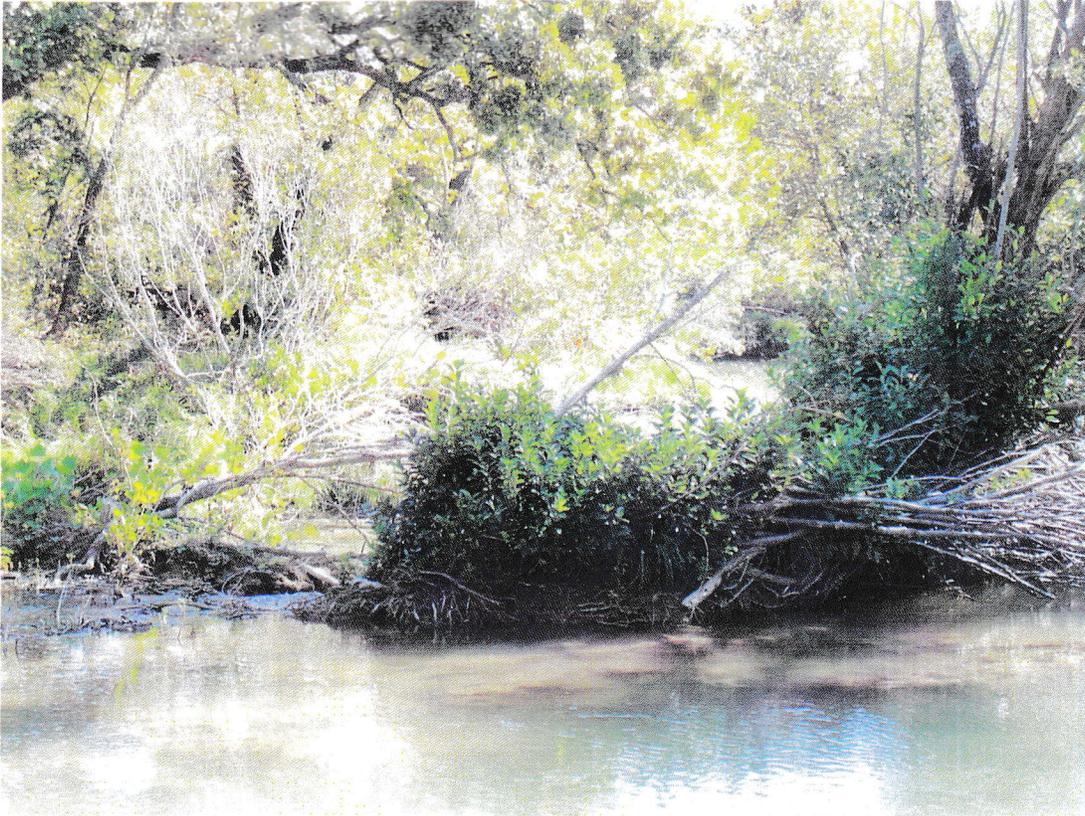
This is included in the next phase of our research.

## REFERENCES

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Table Areas surveyed and number of *Alnus maritima* seedlings found in the three locations surveyed in this study.

Location	Area surveyed (m <sup>2</sup> )	Number of seedlings	Density seedlings m <sup>-2</sup>	m <sup>2</sup> per seedling
Hughes Crossing	1329	16	0.012	83.1
State Highway 7	398	3	0.008	132.7
Pennington Creek	121	1	0.008	121.0
Total	1848	20	0.011	92.4



**Figure 1** New stems of an Oklahoma seaside alder (in the center of the photograph) grow profusely when old stems are damaged or destroyed by flooding or other disturbances. This photograph is from a side channel along the Blue River.



**Figure 2** This *Alnus maritima* seedling was grown in a pot so that the investigators could compare field seedlings to it.



**Figure 3** Three seaside alder seedlings closest to photographer's finger are growing at the Highway 7 location. The seedling further to the right is not an alder.