Steward's Circle

Control of Autumn Olive (*Elaeagnus umbellata* Thunb.) at Beall Woods Nature Preserve, Illinois, USA

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Native to Japan, China and Korea, *Elaeagnus umbellata* Thunb. (autumn olive) was first cultivated in the United States in 1830 (Rehder 1940). Beginning in1940, autumn olive was evaluated for possible introduction by the U.S. Soil Conservation Service (Foose 1974). Today a common exotic shrub of the northeastern United States, autumn olive was widely planted to provide food and cover for wildlife. Extensively planted in Illinois during the 1960s, this species was not expected to escape from cultivation (Allan and Steiner 1972).

Autumn olive was first listed as adventive in Illinois by Myers (1972); Mohlenbrock (1975) reported it as rarely escaping from cultivation in southern Illinois. By 1981 autumn olive was naturalized at many localities in east-central Illinois, where estimates of 5225, 27,500 and 33,975 stems ha^{-1} were recorded in a pine plantation, a grazed woodlot, and an old field, respectively (Ebinger and Lehnen 1981, Ebinger 1983). More recently, up to 2,250,000 autumn olive stems ha^{-1} were found near plantations in three Illinois state parks (Nestleroad et al. 1987). During the past 10 years we have found large populations of autumn olive at many disturbed and open sites throughout much of Illinois, and occasional individuals and small populations in dedicated nature preserves.

Autumn olive seedlings and small shrubs were encountered during recent vegetation studies in the upland forests of Beall Woods Nature Preserve, Beall Woods State Park, Wabash County, Illinois, USA. This high quality old-growth forest is located at the edge of the Wabash River about 40 km southwest of Vincennes, Indiana, USA (Lindsey 1962, Ashby and Ozment 1967). Located in the Bottomland Section of the Wabash Border Division (Schwegman 1973), this 133-ha preserve contains floodplain, terrace, and upland forests, remnants of the once-extensive forest associated with the Wabash River Valley. Though not abundant, scattered individuals of autumn olive were common in recent tree falls, other canopy openings, and at the forest edge.

Autumn olive is extremely common just outside the boundaries of the nature preserve. Originally planted in and around Beall Woods State Park in the early 1970s, autumn olive soon became naturalized. The species is now extremely abundant in tree plantations along the west and south edges of the nature preserve. These tree plantations were established soon after the preserve was dedicated in 1966 (McFall and Kearns 1995). Today the trees in the plantations are between 14 and 35 cm dbh, with 688 stems ha^{-1} and a basal area of 23.8 m^2 ha^{-1}. *Liriodendron tulipifera* L. (tulip tree) and *Liquidambar styraciflua* L. (sweet gum) dominate the overstory, with *Platanus occidentalis* L. (sycamore), *Fraxinus americana* L. (white ash), and *Diospyros virginiana* L. (persimmon) as secondary species.

By 1995 autumn olive reproduction around the preserve had become a major concern. In April and May 1996, autumn olive plants in the tree plantations near the preserve and in the forest edge of the preserve were treated with basal bark applications of Garlon 4 (active ingredient 61.6%) mixed with penevator oil (1 liter Garlon/5 liters oil) using Solo backpack sprayers. A follow-up treatment was done from March to May 1997 (Terry Esker, Natural Heritage Biologist, Illinois Department of Natural Resources, Springfield, pers. com.). During an intensive search in early summer 1997 we did not find autumn olive plants in the treated areas.

To monitor the autumn olive eradication program, in early spring 2000 we established three belt transects 50 m long by 1 m wide in each of three habitat types along the west edge of the nature preserve. The first transect was located about 5 m inside the old-growth forest edge, the second transect 25 m to the west in the tree plantation where autumn olive had been eradicated in 1996 and 1997, and the third transect 25 m farther west in the tree plantation where autumn olive had not been treated. During summer 2000, all individuals of autumn olive in each 25-m section of each 50-m belt transect were pulled or cut at the base and separated into height classes. Only the longest stem of multiple-stemmed individuals was counted and measured. Stem density (plants/m^2) was calculated for each height class in each belt transect. A random set of stems representing 35% or more of the individuals from each height class in each transect was aged using annual rings at the stem base. From these data the average age of the autumn olive individuals in each height class was determined (Table 1).

In the treated part of the tree plantation autumn olive averaged 3.9 plants m^{-2} (39,000 individuals ha^{-1}). Smaller plants (1–60 cm tall) had one to three annual rings and were single-stemmed, while most plants over 60 cm tall had three or four annual rings and were multiple-stemmed

Table 1. Density (stems/m^2) and average age (years) for the height classes of *Elaeagnus umbellata* in belt transects at the Beall Woods Nature Preserve, Illinois, USA.

Height Class (cm)	Site and Treatment: Plantation No herbicide Density	Plantation No herbicide Age	Plantation Herbicide Density	Plantation Herbicide Age	Forest Edge Herbicide Density	Forest Edge Herbicide Age
1–20	4.2	1.9	0.3	1.8	0.01	2.0
21–40	5.4	3.3	1.1	2.3	0.03	2.0
41–60	1.7	3.6	1.1	2.9	0.01	2.0
61–80	0.5	4.5	0.7	3.3	0.02	3.0
81–100	0.2	5.5	0.4	3.9	—	—
101–150	0.1	4.8	0.3	4.1	—	—
151+	0.4	9.3	—	—	—	—
Total	12.5		3.9		0.07	

(Table 1). Nearly 11% of the larger stems (80–150 cm tall), however, had an enlarged basal caudex and probably represented resprouts from plants that were only top-killed by the herbicide treatment. Remaining autumn olive plants probably represent individuals that sprouted from seeds in a seed bank, or from seeds dispersed into the area after herbicide treatment.

In the untreated area of the tree plantation, autumn olive formed a nearly impenetrable thicket, commonly being the only woody understory species present. Here autumn olive averaged 12.5 plants m^{-2} (125,000 individuals ha^{-1}). Larger plants commonly had 3–11 basal stems and averaged 2.7 m tall with some stems exceeding 4.5 m in height. Basal stem diameter of these larger plants was usually less than 4 cm and most had less than 11 growth rings. Occasional stems with basal diameters of 6 cm and 15 growth rings were encountered.

Eliminated from the forest edge in 1996 and 1997, autumn olive was reestablished by 2000. Small numbers of seedlings and small shrubs were found along the forest edge (Table 1). Though not found in the belt transect, autumn olive plants to 150 cm tall were occasionally observed at the forest edge. The few individuals encountered here, and the restriction of autumn olive plants to open canopy areas in the interior of the old-growth forest, suggest that this species is not well adapted to low light intensities.

The large number of autumn olive stems encountered during this study suggests that intensive control efforts focusing on relatively small areas in large well-established populations are only moderately effective. It appears that control efforts must be repeated every 5 years or so, even if near eradication is achieved during the initial effort. As autumn olive seeds are commonly dispersed by birds, eradication of all autumn olive stands near the sensitive area may be the method of choice for reducing the threat to the target area. However, if eradication is not feasible, land managers may wish to concentrate their efforts in the most ecologically significant portions of the target area. In closed-canopy forests, control can be achieved through routine monitoring and eradication by hand pulling or application of herbicide, emphasizing vegetation at the forest edge and in canopy gaps.

For very large populations of autumn olive, particularly those covering many acres, development of a biological control agent may be the only practical solution. Regardless of the control measure chosen, follow-up efforts will be necessary and should be provided for in a management plan.

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