Controlling Glossy Buckthorn (*Rhamnus frangula* L.) with Winter Herbicide Treatments of Cut Stumps

James A. Reinartz

Field Station
University of Wisconsin, Milwaukee
3095 Blue Goose Road
Saukville, Wisconsin 53080 USA
jimr@csd.uwm.edu

Natural Areas Journal 17:38–41

ABSTRACT: *Rhamnus frangula* L. (glossy buckthorn) is an aggressive introduced species that has become a serious problem in wetlands in the upper midwestern United States. Three mechanical control methods were tested for effectiveness during the winter. Both cutting and girdling were ineffective as control methods when applied from December through March; neither method caused any mortality in these trials. Cutting, followed by an application of glyphosate herbicide to the cut stump, resulted in a 92% to 100% kill of buckthorn individuals in four trials during the same December through March period.

Index terms: control method, glossy buckthorn, introduced species, Rhamnus frangula

INTRODUCTION

Rhamnus frangula L., a shrub, was introduced to North America as a horticultural species (Rehder 1927). Although *R. frangula* grows in both upland and wetland habitats, it has become a severe pest primarily in wetland habitats (Reinartz and Kline 1988, Heidorn 1991). *Rhamnus frangula* is especially problematic in alkaline bogs, tamarack and cedar swamps, shrub thickets, and low woods, where it displaces native vegetation (Voss 1985). As a tall shrub or small tree that casts dense shade, *R. frangula* is particularly disruptive to shrub and herbaceous understory vegetation. It is capable, over time, of forming near-monocultures even in relatively undisturbed wetlands, although most severely infested wetlands show some evidence of artificial drainage (Reinartz, unpubl. data). Reinartz and Kline (1988) documented *R. frangula* growth rates and population biology in a Wisconsin wetland.

Summer, but not winter methods for the control of *Rhamnus frangula* have been reported (Apfelbaum 1984, Packard 1987, Post et al. 1989, Heidorn 1991). Control of *R. frangula* in winter has two advantages over summer control methods. First, many wetlands are more easily accessed during winter when they are frozen; and second, there is less risk of damage to native vegetation due to trampling, or herbicide drippage and over-spray, during the dormant winter season. Winter identification of *R. frangula* is simple and unambiguous: the pubescent twigs have short internodes and arch upwards, and the naked, hairy winter buds are distinctive. This paper describes a study of three winter control treatments and compares their efficacy for killing *R. frangula*.

METHODS

Study Site

Control treatments were applied to *Rhamnus frangula* in the 900-ha Cedarburg Bog in Ozaukee County, southeastern Wisconsin (Sec. 29, T.11N, R.21E). The mean pH of the wetland is slightly above neutral (7.2). There are 10 distinct vegetation types in the wetland (Reinartz 1985); parts of 4 of these vegetation types (string bog, shrub carr, conifer swamp, and hardwood swamp) are severely infested with *R. frangula*. The study site was located in a mixed conifer and hardwood swamp at the margin of an upland island. This swamp had been somewhat disturbed by flooding in 1960. Dominant trees were black and green ash (*Fraxinus nigra* and *F. pennsylvanica*), with scattered white birch (*Betula papyrifera*), white cedar (*Thuja occidentalis*), and tamarack (*Larix laricina*). (Nomenclature follows Gleason and Cronquist 1991.) The understory was dominated by *Rhamnus frangula* (mean density 5.4 stems of over 1 cm basal diameter per m^2), red-osier dogwood (*Cornus sericea*), slender and Bebbs willow (*Salix petiolaris* and *S. bebbiana*), and winterberry (*Ilex verticillata*). *Rhamnus frangula* extended from the wetland onto the margin of the hardwood-forested upland island.

Control Methods Tested

Three methods for controlling *Rhamnus frangula* were tested in the Cedarburg Bog, on four dates during the winter of

1989–1990. The three methods tested were (1) completely girdling shoots in a band at least 10 cm wide, 5–10 cm above the ground surface; (2) cutting shoots 5–15 cm above the ground surface; (3) cutting shoots 5–15 cm above the ground surface and applying 25% concentration glyphosate herbicide to the freshly cut stumps. The herbicide applied was a 3 parts water to 1 part herbicide dilution (25% concentration) of a glyphosate herbicide (Roundup® by Monsanto Co.) that contained 41% of the active glyphosate ingredient before dilution. A total of approximately 350 plants were treated on four different days; the exact number of plants treated was not recorded. The 12 treatments (3 treatments x 4 dates; see Table 1) were made in separately marked areas so that plants did not have to be individually marked to identify treatment type. At least three plants located in upland soil were included in each treatment on each date; the remaining plants were all located in the wetland. The ground was solidly frozen on all four days, although temperatures were above freezing on three of the four days. There was a snow cover during the January treatments.

All treated *R. frangula* plants had multiple stems, although size of treated plants was intentionally varied over a large range. Only plants that had at least one stem with a basal diameter greater than 10 mm were treated. The number and diameter of stems were recorded for 10 plants randomly selected from each treatment area (total N=120) in order to estimate the average size of the treated plants. Stem number per plant treated averaged 5.33 (range 2–12), and maximum basal stem diameter averaged 53.6 mm (range 12–124 mm). There were no differences in mean size among the 12 treatments. Some of the smaller plants and shoots treated on December 19, 1989, were cut with pruning shears; all other plants were cut with a chainsaw. Girdles were made by cutting through the bark, encircling the stem in two places with a sharp knife, and peeling the intervening bark off the stem. For the herbicide treatment, at least 50% (usually 75%–100%) of the surface area of the cut stumps was covered with glyphosate herbicide from a squirt bottle. Herbicide was applied within 5 minutes of the time the stem was cut. It was easy to tell which stumps had been treated with herbicide because the wood discolored to a bright yellow or orange within 2 minutes of herbicide application.

Evaluation of Treatments

The efficacy of the winter control treatments was evaluated at the end of the following growing season (October 16, 1990). Within the 12 treatment areas, 271 treated plants were relocated and scored as alive (stump sprouts present) or dead (no stump sprouts). All of the plants in the cut and girdled treatments were relocated. Some plants in the cut-and-herbicide treatment were not relocated, owing to small size (near 1 cm in diameter) and presumed mortality caused by the cut-and-herbicide treatment. It was difficult to relocate small, dead, cut stems a full growing season after they were killed. Failure to relocate these plants would cause a small underestimate of the kill rate of the cut-and-herbicide treatment.

Ten girdled plants and 25 plants that were cut and not herbicided were selected to quantify the extent of resprouting. For these 35 plants, number of stems prior to treatment, and their diameters at 5 cm above the ground surface, were recorded; sprout number and length of each sprout were recorded one year after treatment.

The effects of treatment, date and temperature combination, and soil type (wetland vs upland) on the proportion of plants killed were analyzed with log-likelihood ratio (G) tests of association (Sokal and Rohlf 1981; SPSS, Inc. 1988). A comparison of the extent of resprouting between the cut and the girdled treatments on the one hand, and the relationship between plant size and the amount of resprouting on the other, was made using an analysis of covariance, which compared the total length of stump sprouts produced after one growing season between the cut and girdled treatments, using the total of stem diameters as a covariate. When both the main effects and the covariate were found to be significant, separate regressions of total stump sprout length on total of stump diameters were calculated for cut and for girdled plants.

RESULTS

Girdling, and cutting without herbicide application, were both ineffective for killing glossy buckthorn. Resprouting was 100% after these treatments (Table 1). Plant size (measured as the sum of stem diameters) was strongly correlated with total length of stump sprouts produced on both cut and girdled plants (Figure 1). Total sprout length produced on cut plants was greater than on girdled plants (Figure 1, Table 2). Girdled stems did produce a flush of leaves in the spring following treatment, but those leaves died rapidly. Number of sprouts produced per plant, on the 35 plants measured, ranged from 13 to 47. Length of the longest sprout per plant ranged from 90 cm to 2.1 m, and a few of the largest sprouts fruited in their first season of growth.

In contrast to cut and girdled treatments, the cut-and-herbicide treatment was 98% effective. Only 3 of 150 plants survived this

Table 1. Summary of *Rhamnus frangula* control treatments during winter 1989–90, Cedarburg Bog. The number of treated plants that survived each treatment is shown in parentheses.

		Number Treated (Survived)		
Date	Mean Temp. (°C)	Cut Only	Girdled	Cut and Herbicide
12/19/89	-9	26(26)	8(8)	43(1)
1/2/90	+2	17(17)	14(14)	37(0)
1/3/90	+5	31(31)	7(7)	45(0)
3/30/90	+8	12(12)	6(6)	25(2)
Total		86(86)	35(35)	150(3)

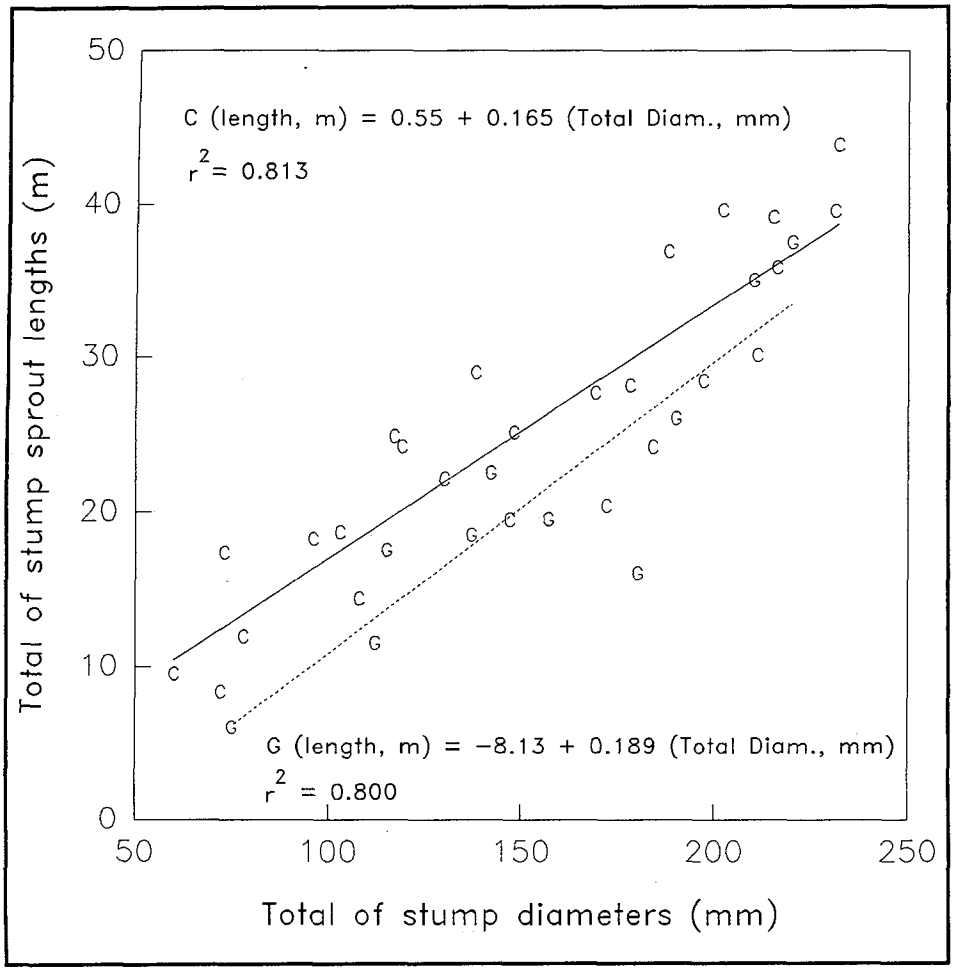

Figure 1. Relationship between total of stem diameters of cut (C) and girdled (G) *Rhamnus frangula* plants and the total length of stump sprouts produced, Cedarburg Bog. Separate regression lines are shown for cut (solid line) and girdled (dashed line) plants.

treatment (Table 1), and all three survivors produced small, extremely deformed, stump sprouts. There was no significant difference between the cut-and-herbicide treatments applied to *Rhamnus frangula* located on upland soils and those on wetland soils ($G = 1.62$; $df = 1$; $p = 0.203$). One of 12 upland plants (8.3%) and 2 of 138 wetland plants (1.4%) survived the cut-and-herbicide treatment. There were also no significant differences among dates in the effectiveness of the cut-and-herbicide treatment ($G = 5.97$; $df = 3$; $p = 0.113$). The two treatment dates on which there were any survivors were the coldest and the warmest treatment periods.

DISCUSSION

The application of herbicide to cut stumps during the growing season is reported to be effective for control of both *Rhamnus frangula* and *R. cathartica* L. (common buckthorn). Apfelbaum (1984) reported that Ortho Bush Killer A® applied to cut stumps of *R. frangula* was effective on an upland site. Heidorn (1991) reported that Trimec® (a formulation of 2, 4-D, MCCP, and dicamba), Roundup,® Garlon 3A® (a formulation of triclopyr), and Rodeo® (a formulation of glyphosate approved for use in wetlands) are all effective for control of exotic buckthorns when applied with the cut-stump method, although he does not provide data or information on rates of kill. *Rhamnus cathartica* can be killed by applying the herbicides Weedone 170® (2, 4-D + 2, 4-DP) (Hefty 1984) or Roundup (Kline 1981) to cut stumps during the growing season. To my knowledge, none of these methods have been tested for use during the winter.

Reports of the effectiveness of burning and girdling during the growing season are somewhat contradictory. Heidorn (1991) said that "fire is very effective in controlling buckthorn"; however, Post et al. (1989) found that 2 years of controlled burns in a dry sand prairie increased densities of all size classes of *R. frangula*. Kline (1981) found that all *R. cathartica* cut in late summer and fall "resprouted vigorously," whereas Gourley and Howell (1984) reported that 27% of *R. cathartica* died following a single cutting in July, and that only 53% resprouted if this first cut was followed by a second, lower cut 4 hours later. Heidorn (1991) suggested that girdling is effective for controlling the exotic buckthorns, but Packard (1987) reported that *R. frangula* "resprouted vigorously below the girdle" in his study. Steve D. Eggers (Ecologist, St. Paul Minnesota District, U.S. Army Corps of Engineers, pers. com.) recorded 100% mortality of about 60 large *R. frangula* that were girdled during the month of May in Minnesota.

In my study, cutting and girdling were ineffective as winter control treatments. Girdling resulted in less vigorous resprouting during the first growing season than did cutting. This was not surprising because

Table 2. Analysis of covariance comparing total length of stump sprouts produced after cutting or girdling *Rhamnus frangula*. Total basal stem diameter of the treated plant was used as a covariate. SS=Sum of Squares, MS=Mean Square, F=F-Statistic.

Source of Variation	SS	df	MS	F	Significance
Covariate (total of stem diameters)	2534	1	2534.0	131.78	$p < 0.001$
Treatment (cut or girdled)	175	1	175.0	9.09	$p = 0.005$
Residual	615	32	9.2		
Total	3324	34			

girdled shoots produced leaves in the following spring, which must have partially depleted carbohydrate and nutrient reserves in the roots. Girdled shoots were top-killed quickly after leaves were produced because their phloem connection to roots had been removed. Nonetheless, 100% of cut and girdled plants survived the treatment and produced multiple sprouts. Girdling is much more labor-intensive than the cut-and-herbicide method.

Winter application of the cut-and-herbicide control method to *Rhamnus frangula* was extremely effective. This method is relatively labor efficient, particularly because it can be done during the winter months when many wetlands are frozen, making working conditions less adverse than during the rest of the year. The winter cut-and-herbicide method described here is selective and very safe for surrounding vegetation, since glyphosate is a foliar herbicide and most native species are dormant during the winter.

Since the formal evaluation of treatments on *R. frangula* in 1990, I have continued less formal evaluations of application of the winter cut-and-treat with glyphosate method: (1) every year between 1990 and 1995; (2) in six different wetland sites; (3) in two upland sites; (4) with stems cut at 30–60 cm above the ground surface as opposed to the 5–15 cm height of the original trials; and (5) on *Rhamnus cathartica* and the exotic bush honeysuckles (*Lonicera tartarica* and *L. morrowii*) in both upland and wetland sites. The concentration of glyphosate herbicide and the method of application have never been varied. I have not tested the winter cut-and-herbicide method extensively at temperatures below about -10° C because very cold temperatures were not conducive to this work.

In these less formal evaluations of winter applications of the cut-and-herbicide method, the following results were obtained (Reinartz, unpubl. data). Kill of *Rhamnus frangula* was nearly 100% in all years, in six different wetland habitats and in two upland habitats, with the basic method described above. Kill of *R. frangula* was poor (well under 50%) in one trial when stems were cut at 30–60 cm above the ground and then treated with glyphosate; the cut stems in this trial sprouted extensively near the ground surface, and leaves on the stump sprouts showed very little sign of herbicide damage. The basic application of the winter cut-and-herbicide method resulted in near 100% kill for *Rhamnus cathartica* and for the exotic bush honeysuckles, *Lonicera tartarica* and *L. morrowii*, although these species were tested less extensively (*R. cathartica*: 2 applications, 2 years, 2 sites, approximately 40 individuals total; *L. tartarica* and *L. morrowi*: 4 applications, 2 years, 3 sites, approximately 80 individuals total). Application of this method should be tested formally with a variety of exotic shrub species.

ACKNOWLEDGMENTS

I am indebted to L. Nelson and M. Klofanda for assistance with various aspects of this project. V. Nuzzo and W. Schennum provided helpful suggestions on an earlier draft of the manuscript. This is publication No. 167 of the University of Wisconsin, Milwaukee, Field Station.

Jim Reinartz is a Senior Scientist at the University of Wisconsin, Milwaukee, Field Station, where he is the Resident Biologist and Manager. In addition to his interests in research on problems of natural area management, he studies wetland ecology, ecological genetics, and the population biology of rare plants.

LITERATURE CITED

Apfelbaum, S.I. 1984. Buckthorn control with herbicide tested. Restoration and Management Notes 2:36.

Gleason, H.A. and A. Cronquist. 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada. 2nd Ed. New York Botanical Garden, New York. 910 p.

Gourley, L.C. and E. Howell. 1984. Factors in buckthorn invasion documented: control measure checked. Restoration and Management Notes 2:87.

Hefty, R. 1984. Buckthorn control with 2, 4-D/2, 4-DP. Restoration and Management Notes 2:36.

Heidorn, R. 1991. Vegetation management guideline: exotic buckthorns—common buckthorn (*Rhamnus cathartica* L.), glossy buckthorn (*Rhamnus frangula* L.), dahurian buckthorn (*Rhamnus davurica* Pall.). Natural Areas Journal 11:216-217.

Kline, V. 1981. Control of honeysuckle and buckthorn in oak forests. Restoration and Management Notes 1:18.

Packard, S. 1987. Mixed results in control of trees by shallow girdling. Restoration and Management Notes 5:41.

Post, T.W., E. McClosky, and K. Klick. 1989. Two-year study of fire effects on *Rhamnus frangula* L. Natural Areas Journal 9:175-176.

Rehder, A. 1927. Manual of Cultivated Trees and Shrubs Hardy in North America. Macmillan Co., New York. 930 p.

Reinartz, J.A. 1985. A guide to the natural history of the Cedarburg Bog. University of Wisconsin–Milwaukee Field Station Bulletin 18(2):1-48.

Reinartz, J.A. and J. Kline. 1988. Glossy buckthorn (*Rhamnus frangula*), a threat to the vegetation of the Cedarburg Bog. University of Wisconsin-Milwaukee Field Station Bulletin 21(2):20-35.

Sokal, R.R. and F. Rohlf. 1981. Biometry. 2nd Ed. W.H. Freeman and Co., San Francisco, Calif. 859 p.

SPSS, Inc. 1988. SPSS/PC+, Version 2.0. SPSS, Inc., Chicago.

Voss, E.G. 1985. Michigan Flora. Part II, Dicots. Cranbrook Institute of Science, Bloomfield Hills, Mich. 724 p.