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Monitoring Various Common Buckthorn Control Methods in Maple-Basswood and Oak Woods within the Historic Range of the Big Woods

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Monitoring Various Common Buckthorn Control Methods in Maple-Basswood and Oak Woods within the Historic Range of the Big Woods

ABSTRACT:

Common buckthorn *(Rhamnus cathartica)* is an exotic species that is becoming a major problem in woodlands in the southern half of Minnesota. Numerous reports have dealt with treatment of buckthorn using chemicals and/or fire. To date, however, there has been little research into the long-term control of buckthorn using these, or a combination of these techniques. An economically practical method of treating large areas needs to be identified. The study described herein spanned a six-year period from 1993 to 1999. The DNR Nongame Research Program provided funding support for the project from 1996 through 1998.

The objectives of the study were 1) to measure the success of 3 chemical and 2 mechanical control treatments on buckthorn; 2) to sample the recruitment and survival of buckthorn after initial control treatment; 3) to sample the recruitment and survival of native trees and forbs after initial buckthorn control; and 4) to analyze the cost effectiveness of the various techniques.

The study areas were located in woodlots at Carver Park Reserve (Carver County), and at Crow-Hassan and Hyland Lake Park Reserves (Hennepin County). Mature seed-bearing buckthorn trees were chemically killed or were cut and stump-treated in each study area. Chemical and mechanical follow-up treatments were then applied in various combinations at the different study sites.

Chemical treatment followed by annual controlled burns at Carver Park Reserve reduced the number of buckthorn seedlings from 27 per plot in 1996 to 3 per plot in 1998. Repeated annual spraying of buckthorn saplings > ½ inch diameter at Crow-Hassan Park Reserve reduced the number of saplings from 65 per acre in 1996 to 3 per acre in 1999. At Hyland Lake Park Reserve, results were inconclusive due to difficulties encountered in completing the proposed treatment regime.

One-time removal of mature seed-bearing trees is ineffective in controlling buckthorn. Periodic follow-up treatment is required to control the buckthorn saplings and seedlings that are "released" by removal of the overstory trees. If treatment can be continued until the seed bank is exhausted, buckthorn control is theoretically possible. Fire is an effective method for eliminating buckthorn seedlings, but also eliminates some desirable woody species, and is ineffective in controlling buckthorn saplings. Without follow-up treatment, the density (stems/acre) of buckthorn seedlings and saplings becomes greater than it was before the initial removal of mature seed-bearing trees.

INTRODUCTION:

Common buckthorn *(Rhamnus cathartica)* is an exotic species that is becoming a major problem in woodlands in the southern half of Minnesota and throughout the upper Midwest. Buckthorn invades disturbed woodlands or those with semi-open canopies such as oak woodlands. Densities of buckthorn in these habitats can exceed 14,000 saplings per acre (Moriarty, unpublished data). Buckthorn also becomes a problem on the edges of closed canopy maple-basswood forests (Big Woods). The fringe of buckthorn can hinder the spread of a Big Woods forest community into adjacent old field habitat, and may eventually convert open woods into shrub thickets by retarding or preventing the recruitment of native tree species. Buckthorn has degraded numerous forest fragments in the region and has hindered their natural regeneration. A more comprehensive effort needs to be made to control this exotic tree.

Over the last ten years there have been numerous reports on the treatment of buckthorn using chemicals (Converse 1989, Heidorn 1991) and/or fire (Haney and Apfelbaum 1990, Heidorn 1991). These reports have dealt with the initial results of buckthorn removal programs, but information on long-term control and maintenance is lacking. The use of chemicals, especially triclopyr (Garlon 3A and Garlon 4) on mature buckthorn has shown good results (Hennepin Parks, unpublished data). It has not been used on seedlings and saplings, however, because of the inefficiency of applying the chemical to small stems, and the potential for damage to non-target plant species. Fire has been found to be effective if used on an annual basis for at least five years (Haney and Apfelbaum 1990). This frequency of fire will kill buckthorn seedlings and most other woody seedlings and saplings. There has been little research into the long-term control of buckthorn using these or a combination of these techniques.

Cost effectiveness of the various control techniques is another factor to be considered. Labor intensive methods, such as cutting and stump spraying may only be feasible on a small scale. An economically practical method of treating large areas needs to be identified. This study was part of an effort to determine the most cost effective control techniques. Funding support was provided by the DNR Nongame Research Program.

OBJECTIVES:

1) To measure the success of 3 chemical and 2 mechanical control treatments on common buckthorn.
2) To sample the recruitment and survival of buckthorn after initial control treatment.
3) To sample the recruitment and survival of native trees and forbs after buckthorn control is initiated.
4) To analyze the cost effectiveness of various techniques for controlling buckthorn.

STUDY AREAS:

The study areas were located in woodlots within three Park Reserves owned and managed by Hennepin Parks. All of the woodlots existed prior to acquisition by Hennepin Parks, and most had been grazed prior to acquisition.

The Carver Park Reserve study area is located on the southwest side of Sunny Lake in Victoria, Carver County. The mature trees are primarily red and bur oak, and basswood. The understory of the site was almost all buckthorn when the study began.

The Crow-Hassan Park Reserve study area consisted of all woodlots within the park. Crow-Hassan Park Reserve is located in Hassan Township, Hennepin County. Large areas of Crow-Hassan Park have been restored to native prairie grasses and forbs. The remaining woodlots are generally small (< 10 ha) and consist of a mixture of oak-aspen or maple-basswood forest. At the beginning of the study, buckthorn of all sizes was scattered throughout the park and there were a few pockets of dense seedling and sapling growth.

The Hyland Lake Park Reserve study area is located on the south side of Hyland Lake in Bloomington, Hennepin County. It is a 28-acre woodlot with bur and red oak, hackberry, box elder, and basswood in the canopy. The site had a significant component of elm prior to the outbreak of Dutch elm disease in the 1970's. The area was heavily infested with buckthorn when the study began.

MATERIALS AND METHODS:

Carver Park Reserve – Twenty sample sites were established within the study area. Treatments of these sample sites were as follows:

1) Spray/burn: 10 sample sites were treated by chemical spraying followed by a spring burn in 1995. Chemical treatment consisted of spraying all buckthorn stems > ½ inch diameter using a mixture of Garlon 4 (20%) and bark penetrating oil. The chemical mixture was applied all the way around the trunks of the trees just above the root crown. None of the trees was cut or otherwise removed from the site. The sites were re-sprayed during February 1996 to kill any plants missed in 1995; a spring burn followed the chemical treatment. A third spring burn was conducted in 1997. Subsequent annual spring burns to control buckthorn seedlings were planned, but weather conditions did not permit burning in 1998 or 1999. The sites were chemically treated again in December 1998.
2) Spray only: 5 spray only sample sites were chemically treated during February and March of 1996. Chemical treatment was the same as described above.
3) Control: 5 sample sites were left untreated to serve as controls.

Crow-Hassan Park Reserve – Large, seed-bearing buckthorn trees were sprayed on this site in 1993, 1994, and 1995. Annual spraying of buckthorn > ½ inch diameter was begun in 1996 and has continued to the present. Chemical treatment consisted of spraying all

buckthorn stems > ½ inch diameter using a mixture of Garlon 4 (20%) and bark penetrating oil. The chemical mixture was applied all the way around the trunks of the trees just above the root crown or at the top of the snow. None of the trees was cut or otherwise removed from the site. Records of the number of stems treated were kept beginning in 1996.

Hyland Lake Park Reserve – Hennepin Parks Section of Forestry began a buckthorn removal and control program during the winter of 1994/95. The study area was a 28-acre woodlot located on the south side of Hyland Lake. The initial treatment consisted of removing and stump spraying all buckthorn larger than ½ inch diameter. Stump treatment was with a 50/50 mixture of Garlon 3A and water, or a mixture of Garlon 4 (20%) and Androc diluent. Five study plots were established within the study area. Five 10 X 20-foot deer exclosures were constructed to study the effects of deer browse on buckthorn and on recruitment of native trees and shrubs. Ten 10 X 20-foot rectangular sample areas were established—5 within the deer exclosures and 5 outside the exclosures. 20 circular sample plots were also established—two within each 10 X 20-foot rectangular plot. Five treatment regimes were planned as follows:

Burn/re-spray	Burn/no re-spray	Re-spray/ no burn	No re-spray/ no burn	Control (no treatment)	
2 plots	2 plots	2 plots	2 plots	2 plots	Exclosure
2 plots	2 plots	2 plots	2 plots	2 plots	No exclosure

Unfortunately, although the initial buckthorn removal was completed, the planned follow-up treatments were not. Burning through the sample plots proved to be impossible due to burn restrictions imposed by the city coupled with lack of suitable weather days for burning and lack of fuel on the plots. Re-spraying on the plots was begun but could not be completed because of personnel shortages. Ultimately, what was actually accomplished was as follows:

1) Burn/no re-spray: Plot #3 was burned in fall, 1995, and Plot #5 was burned in both spring and fall, 1995
2) Re-spray/no burn: Plot #2 was re-sprayed in summer, 1995
3) No re-spray/no burn: Plot #1 and Plot #4 received no further treatment after the initial removal.
4) Control: Control plots received no treatment at all.

RESULTS:

Carver Park Reserve: Average number of stems per plot

Year	1996			1997			1998		
Saplings	**Spray+ fire**	**Spray only**	**Control**	**Spray+ fire**	**Spray only**	**Control**	**Spray+ fire**	**Spray only**	**Control**
Buckthorn	11	26	34	21	53	19	38	356	44
Ash	0.8	6	2.4	0	10	1	0.4	13.8	0.8
Oak	1	0	0	0	0	0	1.6	0.2	0
Seedlings	**Spray+ Fire**	**Spray only**	**Control**	**Spray+ Fire**	**Spray only**	**Control**	**Spray+ fire**	**Spray only**	**Control**
Buckthorn	27	78	9	5	51	13	3	89	13
Total Plants	103	92	13	69	59	22	103	104	22
% Buckthorn	26	85	69	7	86	59	3	85	59
Avg. # Species	12	5	4	12	5	5	16	6	6

Carver Park Reserve: Stems/plot extrapolated to average number of stems/acre

Year	1996			1997			1998		
Saplings	**Spray + fire**	**Spray only**	**Control**	**Spray + fire**	**Spray only**	**Control**	**Spray + fire**	**Spray only**	**Control**
Buckthorn	1100	2600	3400	2100	5300	1900	3800	35600	4400
Ash	80	600	240	0	1000	100	40	1380	80
Oak	100	0	0	0	0	0	160	20	0
Seedlings	**Spray+ fire**	**Spray only**	**Control**	**Spray+ Fire**	**Spray only**	**Control**	**Spray+ fire**	**Spray only**	**Control**
Buckthorn	58806	169884	19602	10890	111078	28314	6534	193842	28314
Total Plants	224334	200376	28314	159282	128502	47916	224334	226512	47916

Saplings = all woody plants between 25 and 150 cm. Seedlings = all woody plants less than 25 cm

Crow-Hassan Park Reserve: Stems > ½ inch diameter treated per acre per year

Year	1996	1997	1998	1999
# Stems Treated	7451	8392	2475	1773
# Acres Treated	115	436	296	597
# Stems/Acre	64.79	19.24	8.36	2.96

Hyland Lake Park Reserve: no summary is included here because sample sizes were too small to draw any conclusions.

DISCUSSION:

Species diversity was initially low in the control (untreated) areas. Over the time period of the study, there was little or no change in species diversity or in the abundance of buckthorn seedlings and saplings in the understory of the control plots. Shading by the overstory trees is apparently effective in preventing germination and growth of seedlings.

In every study area, removal of the buckthorn overstory opened up the canopy enough to produce a flush of growth in the understory. Species diversity increased somewhat, but the abundance of buckthorn seedlings and saplings also increased. Where follow-up treatments were not conducted (Carver "spray only" sites and Hyland), the density of buckthorn seedlings and saplings increased dramatically and buckthorn continues to be the dominant species in the understory.

At Crow-Hassan Park Reserve, initial removal of buckthorn stimulated growth of herbaceous plants, but many were exotic species. Repeated annual spraying of buckthorn stems > ½ inch diameter reduced the number of stems treated from 65 stems per acre in 1996 to 3 stems per acre in 1999. The number of stems treated is expected to rise during the next 5 years, as seedlings become large enough to spray. Continued annual treatments are planned, but it is uncertain whether this treatment regime will be sufficient to eventually exhaust the seed bank and bring the buckthorn problem under control.

The economic cost for winter spraying is highly variable depending on the amount of snow. Deep snow hampers the operation and greatly increases time spent to complete the work. The most economical results are obtained if spraying is conducted between mid-October and mid-November, when leaves have fallen from other tree species and buckthorn is easily identifiable, and before major snowfall hampers the effort.

At Carver Park Reserve, where buckthorn removal was followed by controlled burns, species diversity increased from 12 species per plot to 16 species per plot, and the number of buckthorn seedlings was reduced from 27 per plot in 1996 to 3 per plot in 1998. Burning, however, did not eliminate buckthorn saplings. The saplings were set back by fire, but they re-sprouted afterward. In the absence of follow-up treatment the number of buckthorn saplings continues to increase. Moreover, controlled burning also eliminates the seedlings of some desirable woody species and favors the development of an understory composed primarily of grasses.

Controlled burning of woodlots can be accomplished economically given the right set of circumstances. If conducted as part of a larger burn program – for example a prairie management plan – the cost of hiring and training a burn crew can be spread over a large number of burns, minimizing the cost of each individual burn. Other factors influencing economy include the amount of pre-burn work required (mowing of burn breaks) and the amount of post-burn or mop up work (putting out smoldering logs). Labor costs increase dramatically where municipal regulations require that a fire be completely out before the burn crew leaves the site.

CONCLUSIONS:

With careful timing, chemical spraying of buckthorn stems > ½ inch diameter can be an economical method of treating large areas of buckthorn infestation. However, one-time removal of mature seed-bearing trees is ineffective in controlling buckthorn. Periodic follow-up treatment is required to control the buckthorn saplings and seedlings that are "released" by removal of the overstory trees. Once the seed bank has been exhausted, buckthorn control is theoretically possible. Repeated annual chemical treatment at Crow-Hassan Park Reserve over a four-year period has thus far been insufficient to exhaust the seed bank.

Annual prescribed burns, following the removal of seed bearing buckthorn trees, are an effective method for eliminating buckthorn seedlings. However, fire also eliminates desirable, native, woody species, and it is ineffective in controlling buckthorn saplings. Chemical follow-up treatment is imperative to control re-sprouting of fire damaged buckthorn saplings. Controlled burns can be completed economically if they are done as part of a larger burn program – for example, a prairie management plan.