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The Effect of Growing Season Treatments on Invasive Woody Plant Species

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Introduction

With financial support from the US Departments of Interior and Agriculture's Joint Fire Science Program, we began a study to evaluate the effects of treatments, timed to the annual cycle of carbohydrate depletion and recovery, on the survival of woody invasive species occurring in early successional habitats in the Northeast. Carbohydrate reserves in roots and shoots provide an energy source to support growth prior to leaf-out as well as after disturbance such as herbivory or fire. In woody plants, the extent of carbohydrate reserves contributes to the vigor of individual stems: depleted reserves result in reduced plant vigor. By applying treatments at key times during the natural cycle of reserve depletion and replenishment, we expect to affect the vigor and possibly the survivorship of individual plants. Current practices of cutting and burning during the dormant season do not appear to be effective, because they do not result in the depletion of food reserves in plants. Our research will, in particular, evaluate the success of treatments applied during the growing season relative to those applied during the dormant season.

We are also studying the relationships between fire and invasive species to determine how to describe fire behavior in habitats that have been altered due to invasion (and by attempts to control invasive species). Depending on the species involved, invasives may alter fire regimes by decreasing the abundance of grass fuels (and hence the flammability of grasslands), or by increasing the potential for high intensity fires when control efforts increase the amount of dead, downed material.

In 2001, manipulative experiments were set up at five sites including Naushon Island (off of Cape Cod, Massachusetts), two sites in Berkshire County, Massachusetts, and two sites at the Montezuma National Wildlife Refuge, NY. Two-to-four invasive species are being studied at each site (see Table 1). All species being studied are invasive and a majority is also not native to the Northeast.

Site selection

During the spring and early summer of 2001, we visited approximately 15 sites to determine if they would be suitable for our study. We visited or contacted someone knowledgeable about the six sites listed in the original proposal as possible study locations. Ultimately only the Montezuma National Wildlife Refuge was chosen from those sites. Great Bay NWR, the Albany Pine Bush Preserve, and the Finger Lakes National Forest did not have large enough populations of the target species to

accommodate our study design. Antietam National Battlefield and Morristown National Historical Park were ruled out because they lacked a National Park Service approved fire management plan. Antietam NB had hoped to complete their fire management plan in a timeframe that would accommodate our study, but that was compromised by demands placed on the park staff after 9/11. Other sites (owned by federal, state, or private conservation organizations) evaluated and not selected due to lack of stands large enough to accommodate our design included Manassas National Battlefield (VA), High Ridge Wildlife Management Area (MA), Smith Farm (MA), and several other state-owned sites in Massachusetts.

Table 1: Sites and species included in study.

Site	Species of interest	Common names
Naushon Island	Smilax rotundifolia (native) Cytisus scoparius (non-native)	Catbrier Scotch broom
Bartholomew Property, Sheffield, MA	Berberis thunbergii (non-native) Betula lenta (native, non-invasive)	Japanese barberry Black birch
Bear Rock Brook, Sheffield, MA	Lonicera spp. (non-native) Berberis thunbergii (non-native)	Asian honeysuckle Japanese barberry
Lay Road Fields, Montezuma NWR	Cornus racemosa (native) Cornus sericea (native) Rhamnus cathartica (non-native) Rubus spp. (native)	Gray dogwood Red-osier dogwood Common buckthorn Blackberry, raspberry
Clark Ridge, Montezuma NWR	Cornus racemosa (native) Rhamnus cathartica (non-native) Rosa multiflora (non-native) Rubus spp. (native)	Gray dogwood Common buckthorn Multiflora rose Blackberry, raspberry

Accomplishments during 2001

In the spring and early summer, 2001 we established at each study site four approximately 0.5 acre (40m x 40m) plots (one set of four plots at each site with an additional set at Naushon Island). At the Lay Road (Montezuma NWR) field site, a fifth plot was established during July to allow for an additional treatment at that site. All 25 plots were monitored for vegetative cover and abundance using the point-intercept method. The plots, as listed in Table 2, received either summer or spring treatments, or were left as untreated controls during this first year of our study. We treated the cut plots using hand-held, gasoline powered brushcutters or, in the case of two plots at the Lay Road fields, a tractor with a mowing deck. Prescribed burns were conducted at four sites during the summer of 2001, two sites during the fall of 2001, and two sites during spring 2002. Plots were brush cut during the spring of 2002 at the three sites where burns could not be accomplished in 2001 due to unsuitable weather conditions and/or permitting problems.

To determine changes in root total available carbohydrate content of the target species, we periodically collected a small section of root from at least six individuals of the target species in each of the 25 plots. Collections were made approximately every 4 weeks from April – October, 2001 and began again in March, 2002. The root sections were frozen as soon as possible, brought to UMASS, dried, and sampled for carbohydrate concentration. During 2001, approximately 670 root samples were collected from each site at Montezuma NWR, and approximately 290 root samples from the other three sites for a total of 2,210 samples.

Table 2: Treatment schedule

Plot #	**Treatment**	**Treatment date(s)**	**Summer '02 Treatments**
Naushon 1	Cut & burn	Cut: June 27-28, 2001 Burn: August 2, 2001	Re-cut
Naushon 2	Dormant burn	Burn: April 5, 2002	None
Naushon 3	Cut	Cut: July 19-20, 2001	Re-cut
Naushon 4	Control	No treatment	None
Naushon 5	Cut & burn	Cut: June 27-28, 2001 Burn: August 2, 2001	Re-cut
Naushon 6	Cut	Cut: June 28-29, July 19-20, 2001	Re-cut
Naushon 7	Dormant burn	Burn: April 5, 2002	None
Naushon 8	Control	No treatment	None
Bartholomew 1	Dormant burn	Burn: April 19, 2002	None
Bartholomew 2	Control	No treatment	None
Bartholomew 3	Cut & burn	Cut: July 6, 2001 Burn: August 10 & November 18, 2001	Re-cut
Bartholomew 4	Cut	Cut: July 5 & 6, 2001	Re-cut
Bear Rock 1	Control	No treatment	None
Bear Rock 2	Cut & burn	Cut: July 9, 2001 Burn: August 10 & November 18, 2001	Re-cut
Bear Rock 3	Dormant burn	Cut: April 12, 2002	None
Bear Rock 4	Cut	Cut: July 10, 2001	Re-cut
Lay Road 1	Control	No treatment	None
Lay Road 2	Mow & burn	Mowed: June 23, 2001 Burn: August 24, 2001	Re-mow or cut
Lay Road 3	Cut & burn	Cut: July 16, 2001 Burn: August 24, 2001	Re-cut or mow
Lay Road 4	Mow	Mowed: June 23, 2001	Re-mow or cut
Lay Road 5	Dormant burn	Cut: April 24, 2002	None
Clark Ridge 1	Cut & burn	Cut: July 13, 2001	Re-cut
Clark Ridge 2	Control	No treatment	None
Clark Ridge 3	Dormant burn	Cut: April 23, 2002	None
Clark Ridge 4	Cut	Cut: July 17, 2001	Re-cut

Preliminary results

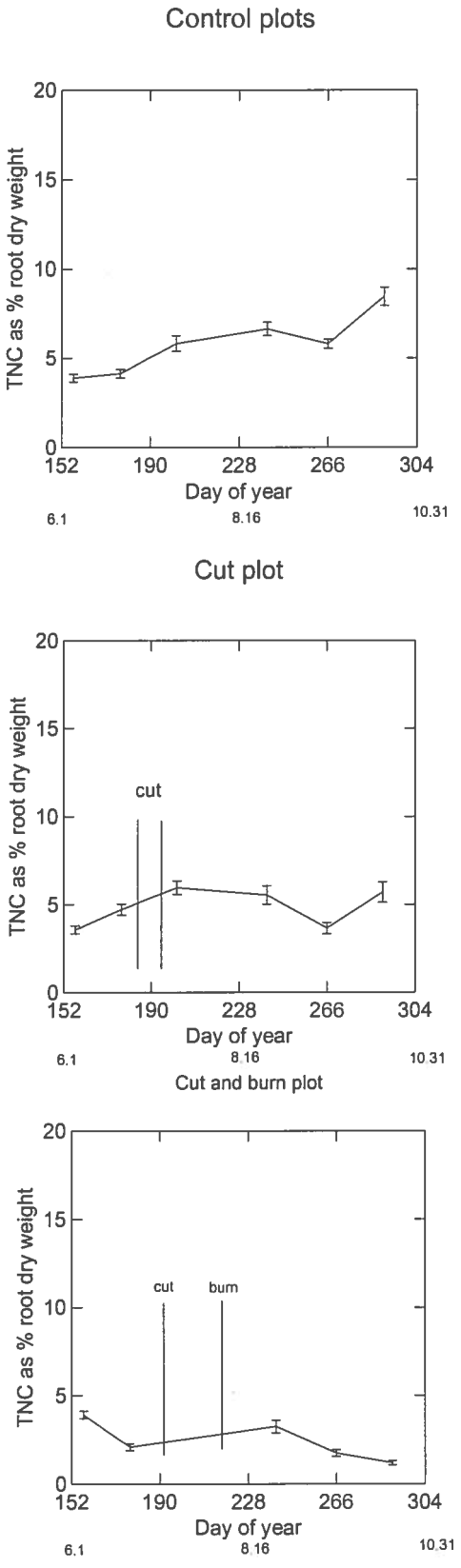
As of May, 2002 we have processed roots for catbrier from Naushon, gray dogwood from Lay Road, and barberry from Bartholomew. Preliminary results support our hypothesis that growing season treatments decrease the total available carbohydrates in the roots of these species. For example, the following series of three graphs for catbrier (Figures 1a-c) depict the variation of total non-structural carbohydrates (as % root dry weight) of catbrier at Naushon from June through October. Figure 1a illustrates results from the control plot and indicates a low level in June. This is likely the result of carbohydrate use to support bud break and new foliage growth during the spring. Once new foliage is fully developed, plants photosynthesize more carbohydrate than is necessary to support shoot growth and maintenance, and the excess is returned to the roots for storage. Figure 1b depicts the carbohydrate cycle in the cut plot (#6). The curve is comparable to the control until the catbrier re-sprouts following cutting. Carbohydrate levels then decrease (by up to 40%) before eventually recovering, but to levels that by fall are close to 50% less than on the control. We observed deer browse on the new sprouts, which probably contributed to the lack of recovery of carbohydrates in the roots. Figure 3 is for the cut plus burn plot (#5). Carbohydrate levels are depressed more than on the other plots and fail to recover at the end of the growing season, at which point they are 80% of those on the control.

Plans for Summer 2002 and 2003

We will be returning to all sites during 2002 to continue collecting roots, apply additional treatments to our existing plots, and collect vegetative cover and fuel load estimates. As indicated in Table 2, the plots that were cut (including those also burned) during 2001 will receive additional cuts during June-July, 2002 and perhaps later during the summer of 2002 as well. These additional cuts will not be as time consuming as the initial cuts as we will be cutting back resprouts. Additional fuel load data will also be collected in both treated and untreated control plots.

Currently we are behind in processing roots for TAC analysis. We hope to complete those roots collected during 2001 and those we will collect during 2002 during the coming academic year. Some additional vegetation data may be collected during early summer 2003.

Figure 1


Control plots
TNC as % root dry weight
20
15
10
5
0
152
190
228
266
304
Day of year
6.1
8.16
10.31
Cut plot
cut
Cut and burn plot
cut
burn

Appendix A: Comparison of the original proposal with what we have done.

From proposal	**What we've done**
Site and species selection	
Six or more sites	5 sites within three locations
4-5 woody invasive species	Total of 10 woody species
Two sites per species	Two sites per species for 4 out of 10 species (approximately what we said we would do).
Experimental design	
Fire behavior of treated and untreated plant populations	Treatments in summer, untreated in spring. Limited fire behavior data collected to date, more planned for '02/03 now that sites are established and logistics negotiated.
4 plots at each site: control, cut/burn/cut, dormant burn with target species, dormant burn without target species	4 plots at each site: control, cut/burn/cut, cut/cut, dormant burn with target species. W/o proved impractical but most sites are standard fuel models or 9
3 treatments per species per location	4 treatments per species per location
Vegetation and fuel sampling	
Vegetation sampling will be done for each plot including pre- and post-treatment in both years 1 & 2	Vegetation sampling pre-treatment in year one, post-treatment in years 2 & 3
10-20 40x40cm fuel subplots within each plot	Maximum of 4 subplots within burn plots, currently evaluating variability. More sampling can be accomplished as necessary
40x40s sampled twice/year	Sampled before and after fire ("twice/year" as far as research objectives are concerned)
Brown lines plus downed woody fuel depths for 5 transects per plot	Brown lines and downed woody fuel depth for 4 transects per plot (currently evaluating variability – total length is more important than number of lines).
TAC sampling	
TAC samples from two plots (control and cut/burn/cut)	TAC samples from all four plots
TAC samples collected every two weeks	TAC samples collected every 4 weeks (impractical to collect root samples after treatments and before sprouting occurs).
Three root samples per plot	Six root samples per plot (3 was providing too much variation – decisions are made on a species by species basis)
10 sample dates per year	7 or 8 sample dates per year (see note – "every two weeks" above)