

# GREAT BARRINGTON RIVER WALK EXPERIMENTS: PROGRESS REPORT AND PRELIMINARY RESULTS

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## INTRODUCTION

The Great Barrington River Walk lies in a severely degraded riparian zone with an inalterable river cross-section consisting of filled flood plain, soils of municipal waste, extremely steep slopes prone to erosion, and riverbank armoring. For the past 20 years, we have been reclaiming riverbank areas through aggressive plantings of native species. We aim to diversify the habitat, mitigate non-point source pollution and erosion, and enhance flood storage capacity. Our long-term goal is to reclaim a total of 15,500 sq ft or 0.36 acres of degraded riparian buffer by achieving a stable, diverse, native, and self-propagating plant community.

While our planting schemes have been successful, we had not been quantifying our results. In 2006, we began to design a monitoring program to quantify plant success at River Walk. Such quantification is necessary to develop future planting strategies within River Walk's boundaries, and our results can help other efforts along the Housatonic River. Focusing on four species (*Agrimony gryposepala*, *Helianthus decapetalus*, *Lindera benzoin*, *Viburnum acerifolium*), we expanded the native plant program to include quantified monitoring of plant growth. We also designed an experiment to quantify the effects of compost tea applications on these same four species.

## METHODS

We chose to plant and monitor four species of native plants: *Agrimony gryposepala*; *Helianthus decapetalus*; *Lindera benzoin*; *Viburnum acerifolium*. These plants represent a diversity of physiology and growth strategies. We chose species that were available locally. The *A. gryposepala* and *H. decapetalus* were propagated from seeds collected in Berkshire County, by Marconica, Inc. (Glendale, Mass.). The *L. benzoin* and *V. acerifolium* were propagated from seed collected in Franklin County by Sudbury Nurseries West (Gill, Mass.).

*Creating quadrats* -- In summer of 2006, we created 8 “pilot” quadrats, each 0.5m by 0.5m, and separated from each other by a minimum of 0.5 m. We started by pulling out the existing vegetation and tilling the soil. All of these quadrats were at the Rain Garden site, near the southern border of the River Walk. We demarcated the quadrats with stakes in the corners and flagging tape around the perimeters. In the spring of 2007, we expanded our efforts and created 14 more quadrats (also 0.5m by 0.5m, separated by a minimum of 0.5m) at an additional 4 sites along the River Walk. The sites represent the variability in River Walk’s soils, slopes, and cover types, and they span the length of the River Walk. The new sites in 2007 are called: Searles School (SS), Stanley Overlook (SO), Church Parking Lot (CPL), and Norway Slope (NS).

Before planting the four test species, we randomly chose which corner of each quadrat would receive which species. In 2006, the 8 Rain Garden (RG) quadrats were planted on 9 August. In 2007, the 14 additional quadrats were planted on 16 May (Table 1). In 2007, we added feather meal to each quadrat: 0.5 cup per quadrat on both 8 August and 31 October. This was to aid the growth and diversity of fungi in the soils.

*Plant growth monitoring* – On each test plant, including any new stems, we took various measurements of plant growth 2 times and 3 times during the 2006 and 2007 seasons, respectively (Table 1). The following measurements were taken on each plant: stem length; total number of leaves; number of leaves on the main stem only; number of side branches; number of buds; number of flowers; number of seed heads (or indication of seed production, such as peduncles).

**Table 1.** Schedule of data collection at River Walk’s test sites, 2006-2007.

Site	No. of quadrats (no. individuals at planting)	Date planted	Growth measurements taken	Weed collection	Herbaceous plant collection
Rain Garden (RG)	8 (32)	9 Aug. 06	9 Aug. 06 20 Sept. 06 20-23 Jun. 07 12-18 Sept. 07	27 Sept.-4 Oct. 06 25 Jun. 07 21 Sept. 07	4 Oct. 06 28 Oct. 07
Searles School (SS)	2 (8)	16 May 07	17 May 07 20-23 Jun. 07 12-18 Sept. 07	9 Jul. 07 21 Sept. 07	28 Oct. 07
Stanley Overlook (SO)	4 (16)	16 May 07	17 May 07 20-23 Jun. 07 12-18 Sept. 07	25 Jun. 07 21 Sept. 07	28 Oct. 07
Church Parking Lot (CPL)	4 (16)	16 May 07	17 May 07 20-23 Jun. 07 12-18 Sept. 07	25 Jun. 07 21 Sept. 07	28 Oct. 07
Norway Slope (NS)	4 (16)	16 May 07	17 May 07 20-23 Jun. 07 12-18 Sept. 07	25 Jun. 07 21 Sept. 07	28 Oct. 07

*Weed collection and biomass* – We collected all weeds inside all quadrats once and twice during the growing season of 2006 and 2007, respectively (Table 1). In 2006, we measured the weeds' wet weights. However, in 2007, we dried the weeds first (in the greenhouse at Simon's Rock College of Bard), then weighed them. We will continue taking dry weights in subsequent years, because it is a more accurate measure of biomass.

*Herbaceous plant collection and biomass* – Right before the first killing frost of the falls of 2006 and 2007, we collected the herbaceous plants (*A. gryposepala*, *H. decapetalus*) from our quadrats (Table 1). We clipped them at the base, dried them in a greenhouse (at Simon's Rock College of Bard), and measured their dry weights (biomass).

*Compost tea treatment* – At each site, we randomly selected quadrats to receive compost tea treatment. All sites contain an even number of quadrats (2-8 per site), so half of the quadrats at each site were randomly chosen to receive tea treatment, while the other half remained controls.

In 2006, we applied compost tea to the treatment quadrats (4 at RG site) 6 times from 16 August to 4 October. Each treatment consisted of 1.5 liters of tea. Control quadrats received an equal amount of water each time tea was applied. In 2007, we applied 6 separate tea treatments from 6 June to 17 October, to all treatment quadrats (11 across all sites). Treatments varied from 1 to 1.5 liters, but were consistent by date applied. Control quadrats were given an equal amount of water on days when tea was added.

*Preliminary analysis* – We examined the changes in leaf counts, number of stems, and biomass (herbaceous species) at RG, from 2006 to 2007. We only have one year's data for other sites, so did not include them in this preliminary analysis of plant growth. We did not analyze stem length, because so many of the plants (n=51) suffered damage to the apical meristem; many plants appeared to have been browsed. Likewise, we have not yet analyzed numbers of buds, numbers of flowers, or evidence of seed production, because the test plants are not producing these consistently until the second growing season (e.g. RG plants produced these consistently this past growing season, but we do not yet have 2 years of data to compare).

We quantified the effects of compost tea treatment by comparing means of leaf counts as well as mean biomass, by species. Combining leaf count data from all sites in 2007, we compared mean number of leaves on control plants to mean number of leaves on treatment plants. Similarly, we compared biomass means between control and treatment plants, by species, combining 2006 and 2007 data.

## **PRELIMINARY RESULTS AND DISCUSSION**

A comparison of the 2006 and 2007 growing seasons showed that the numbers of leaves produced by each species increased in RG control quadrats from one year to the next (Table 2). Numbers of stems also increased in 3 species: *A. gryposepala*; *H. decapetalus*; *L. benzoin*. However, the number of *V. acerifolium* stems decreased from 3 at the end of the 2006 growing season to 2 at the end of the 2007 growing season (Table 2). In other words, one *V. acerifolium* died during the 2006 season, and 2 more died in 2007. The two herbaceous species also showed an increase in biomass from 2006 to 2007 in the control quadrats, further indicating successful growth (Table 3).

Our biomass, leaf count, and stem count data clearly indicate that *H. decapetalus* is growing the fastest at RG, while the same data points for *V. acerifolium* have decreased. *A. gryposepala* and *L. benzoin* appear to be growing successfully, but at slower rates than *H. decapetalus*.

**Table 2.** Leaf counts, numbers of stems, and biomass of Rain Garden (RG) plants in control quadrats, Sept. 2006 and Sept. 2007.

Species	A Control no. leaves (no. stems) 2006	B Control no. leaves (no. stems) 2007	Control difference (B-A)	X Tea no. leaves (no. stems) 2006	Y Tea no. leaves (no. stems) 2007	Tea difference (Y-X)
<i>A. gryposepala</i>	52(4)	81(14)	<b>29(10)</b>	66(4)	81(10)	<b>15(6)</b>
<i>H. decapetalus</i>	99(4)	1,194(23)	<b>1,095(19)</b>	109(4)	1,486(22)	<b>1,377(18)</b>
<i>L. benzoin</i>	32(4)	64(5)	<b>32(1)</b>	48(4)	68(5)	<b>20(1)</b>
<i>V. acerifolium</i>	16(3)	37(2)	<b>21(-1)</b>	25(4)	0(0)	<b>-25(-4)</b>

**Table 3.** Biomass (grams) of Rain Garden (RG) herbaceous plants, Oct. 2006 and Oct. 2007

Species	A Control biomass 2006	B Control biomass 2007	Control difference (B-A)	X Tea biomass 2006	Y Tea biomass 2007	Tea difference (Y-X)
<i>A. gryposepala</i>	5.1	13.8	<b>8.7</b>	4.9	18.5	<b>13.6</b>
<i>H. decapetalus</i>	6.0	212.7	<b>206.7</b>	8.4	246.5	<b>238.1</b>

*Effects of compost tea treatment* – In comparing mean numbers of leaves in control versus treatment quadrats, we combined data from all sites, by species. We performed one-tail t tests using Excel, to test for statistically significant differences. There was no significant difference in numbers of leaves for *A. gryposepala* (N=83; control mean=8.1; tea mean=9.3; p=0.18), *H. decapetalus* (N=140; control mean=30.6; tea mean=41.3; p=0.15), or *L. benzoin* (N=60; control mean=22.6; tea mean=23.7; p=0.38). However, the mean number of leaves on *V. acerifolium* was significantly **less** in treatment quadrats (N=58; control mean=10.0; tea mean=5.4; p=0.03).

Several of the *V. acerifolium* died over the course of the two growing seasons. Eight of the *V. acerifolium* in treatment quadrats died, while only 6 control plants died. If the loss of plants is due to a factor independent of the compost tea, the tea itself may not be the reason for the significantly lower number of leaves on tea treated plants.

Our comparison of mean biomass in control versus treated herbaceous plants showed a similar pattern to the leaf counts. Pooling 2006 and 2007 biomass data, we found no significant differences for *A. gryposepala* (N=17; control mean=6.0; tea mean=5.3; p=0.42) or for *H. decapetalus* (N=23; control mean=22.4; tea mean=33.2; p=0.22).

Despite our many non-significant differences between control and treatment plants, an examination of rates of increase is warranted. We compared the increases in biomass of herbaceous species at the Rain Garden (RG) site, where we have 2 seasons of data. The increases in biomass for both *A. gryposepala* and *H. decapetalus* were greater in treatment quadrats (Table 3). This indicates that compost tea may have long term positive effects, which may not be apparent in the short term.

The increases in leaf and stem counts from 2006 to 2007 (Table 2) do not show as clear a pattern as biomass. Only *H. decapetalus* grew more leaves in tea quadrats than they did in control quadrats (1,377 versus 1,095), and they did *not* produce more stems when treated (19 control; 18 treated). The other plants show a slower rate of leaf production when treated. In the case of *V. acerifolium*, the decrease is dramatic (Table 2).

*Loss of plants* – Several plants died over the course of the two growing seasons. Twenty-two of each species were initially planted in 22 quadrats. Of those, the following plants died: 3 *A. gryposepala*; 4 *L. benzoin*; 7 *H. decapetalus*; and 14 *V. acerifolium*. Although *H. decapetalus* showed the fastest growth rate (based on increases in leaves, stems, and biomass) it did not have the highest survival rate. Over time, *A. gryposepala* and *L. benzoin* may show higher success rates relative to *H. decapetalus*, if their survival rates continue to be higher.

Of the 28 plants that died, 13 were controls, while 15 were tea-treated. Because these numbers are similar, plant loss overall appears to be independent of tea treatment. Further monitoring in 2008 and 2009 will confirm or disprove this.

The Norway Slope (NS) site suffered the greatest loss of test plants (Table 4): 11 died of 16 planted (68.8%). This slope has a history of non-generation, most likely due to the stand of Norway maples (*Acer platanoides*), a tree with allelopathic roots. In contrast, no plants died at the Searles School (SS) site (Table 4). This may be a function of the amount of direct sunlight relative to other quadrats, and it indicates the need to monitor the amount of sunlight each quadrat receives.

**Table 4.** Plant loss by site at River Walk, 2006-2007.

Site	No. dead/no. planted	Percent dead
Norway Slope (NS)	11/16	69
Church Parking Lot (CPL)	5/16	31
Rain Garden (RG)	9/32	28
Stanley Overlook (SO)	3/16	19
Searles School (SS)	0/8	0

### CONCLUSIONS

*H. decapetalus* has been the most successful species so far, in terms of gaining biomass and numbers of leaves. However, *A. gryposepala* and *L. benzoin* appear to have higher survival rates at River Walk, and they are both showing positive growth trends. None of these species has shown a positive response to compost tea treatment, although biomass measurements indicate that effects of the tea may not be apparent in the short term. *V. acerifolium* may be adversely affected by the tea.

We need to address some questions that our 2006 and 2007 work raises. First, how do we deal with dead plants? Do we replant them, thereby introducing another source of variability (plants of each species not all from the same stock)? Or do we continue to work with decreasing sample sizes? This question is especially important in terms of the Norway Slope (NS) site, where we have lost 69% of our plants.

Second, how do we continue to work with the high rate of browsing (or other causes of loss of apical meristems)? Are we confident that numbers of leaves, flowers, buds, seeds, will accurately indicate plant growth even in the absence of an apical meristem? Or should we be correcting for the loss of apical meristem somehow?

And third, how can we measure the amount of direct sunlight at each quadrat? It would be worthwhile to look for correlations in plant growth and direct sunlight, especially in comparison to correlations with tea treatment. This way can either rule in or rule out that sunlight is more important to plant growth at River Walk.