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Final report to
Utah Department of Natural Resources
Division of Wildlife Resources

Assessing approaches to manage *Phragmites* in Utah wetlands

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Problem statement and report overview

Phragmites australis (common reed; hereafter *Phragmites*) is an invasive grass that has rapidly invaded wetlands across North America (Marks et al. 1994) and is widespread and dominant in wetlands and disturbed habitats in northern Utah (Kulmatiski et al. 2011, Kettenring et al. 2012a, Kettenring and Mock 2012). This plant is undesirable because it crowds out native vegetation and profoundly alters habitat quality for wildlife including waterfowl and other migratory birds by creating large monotypic stands (Marks et al. 1994). Great Salt Lake (GSL) wetlands are the most important wetland habitat for migratory birds in the region and are continentally significant (Evans and Martinson 2008). Unfortunately, tens of thousands of acres of diverse native wetland vegetation have been replaced by invasive *Phragmites*, reducing the availability and quality of habitat in GSL wetlands.

Given the extent of the *Phragmites* problem in Utah and elsewhere, managers are eager to understand what techniques are most effective for killing *Phragmites* while simultaneously fostering native plant recovery. A variety of strategies have been widely employed for *Phragmites* management including summer or fall herbicide application, mowing, burning, and flooding (Marks et al. 1994, Kettenring 2012, Hazelton et al. 2014). But, as is often the case with natural resource management, due to limited time and money, there has been little monitoring of success nor any systematic evaluation of management strategies across the varied environmental conditions where *Phragmites* is found, particularly in Utah. Given the interest in effective management strategies for *Phragmites*, there is a need to evaluate and monitor the success of different techniques. Another complicating factor in effective *Phragmites* management is that, contrary to popular belief, *Phragmites* spreads largely by seeds rather than rhizomes (Kettenring and Mock 2012). While a fall herbicide spray is widely used to manage *Phragmites*, this occurs <u>after</u> *Phragmites* has produced its seeds. Managers need additional tools to prevent seed production in conjunction with managing existing stands (e.g., mowing in conjunction with herbicide or using herbicide application earlier in the year). Finally, while the herbicide glyphosate has been widely used to manage *Phragmites*, another herbicide, imazapyr, has also been shown to be effective for managing *Phragmites* (Mozdzer et al. 2008, Hazelton et al. 2014). Further research is needed to compare the effectiveness of these herbicides, including the best time for application, for *Phragmites* management and native plant recovery. We have embarked on a five-year set of experiments where we are evaluating potential strategies for dealing with new infestations of *Phragmites* (small patch study) as well as large, dense monocultures of *Phragmites* (large stand study). Here we report on the effectiveness on the first three years of management treatments (2012-2014).

Objective: To evaluate potential management strategies in small patches and large stands of *Phragmites* for restoring wetlands in the GSL watershed.

Methods

The management studies are being conducted at two spatial scales – 0.25 acre treatment areas to evaluate strategies that may be effective for dealing with initial invasions of *Phragmites* and 3 acre treatment areas to evaluate strategies that may be more effective and logistically feasible for dealing with large, well-established stands of *Phragmites*.

Large stand study. We have four sites with extensive stands of *Phragmites* where we are conducting the management treatments: Ogden Bay Waterfowl Management Area (WMA), Farmington Bay WMA, sovereign lands west of Ogden Bay WMA, and sovereign lands northwest of Farmington Bay WMA. At each site, we are applying 5 treatments to each 3 acre *Phragmites* stand (15 acres total per site). The five treatments we are applying are: (1) summer glyphosate spray followed by winter mow, (2) summer imazapyr spray followed by winter mow, (3) fall glyphosate spray followed by winter mow, (4) fall imazapyr spray followed by winter mow, and (5) untreated area. Management techniques were applied each year 2012-2014.

Small patch study. We have six sites (Inland Sea Shorebird Reserve, Ogden Bay WMA, Farmington Bay WMA, Bear River Migratory Bird Refuge, and two areas at TNC Shorelands Preserve) where we are evaluating *Phragmites* management treatments that might be effective for small *Phragmites* invasions. At each site, we are applying one of six management treatments to a 0.25 acre *Phragmites* patch. The six treatments we are applying at each site are: (1) summer mow, then cover with heavy duty black plastic; (2) summer mow followed by fall glyphosate spray; (3) summer glyphosate spray followed by winter mow; (4) fall glyphosate spray followed by winter mow; (5) summer imazapyr spray followed by winter mow; and (6) untreated area. These treatments were applied in 2012 and 2013 and will be applied again in 2014.

The *Phragmites* treatments for both studies were chosen based on our initial survey of GSL wetland managers (Kettenring et al. 2012b); extensive conversations with Randy Berger and other state, federal, and private managers; and our reading of the *Phragmites* management literature. We chose treatments that were logistically feasible for managers to apply, and chose a balance of treatments that represented commonly applied strategies as well as less common ones that hold great promise for GSL wetlands.

For both studies, treatment effectiveness is being assessed by looking at *Phragmites* and native plant cover. Vegetation is being monitored with on-the-ground surveys for both studies. In addition, we are characterizing sites with respect to nitrogen (ammonium, nitrate), phosphorous (phosphate), salinity (electrical conductivity), organic matter content, and soil moisture / flooding levels, all factors that could affect treatment success. Such data will be critical for making recommendations on which treatments to apply in which areas of the GSL. However, the soil analyses are not completed yet and as such, are not presented here.

Results

Large stand study. After three years of herbicide treatments, all plots had significantly reduced *Phragmites* cover compared with the untreated plots. Type of herbicide used and timing of application are not statistically different when compared to each other (**Figure 1**). Across all sites and all herbicide treatments, *Phragmites* cover was reduced by at least 60%. However, in 2014, we saw an increase in *Phragmites* cover with some herbicide treatments compared with 2013 *Phragmites* cover.

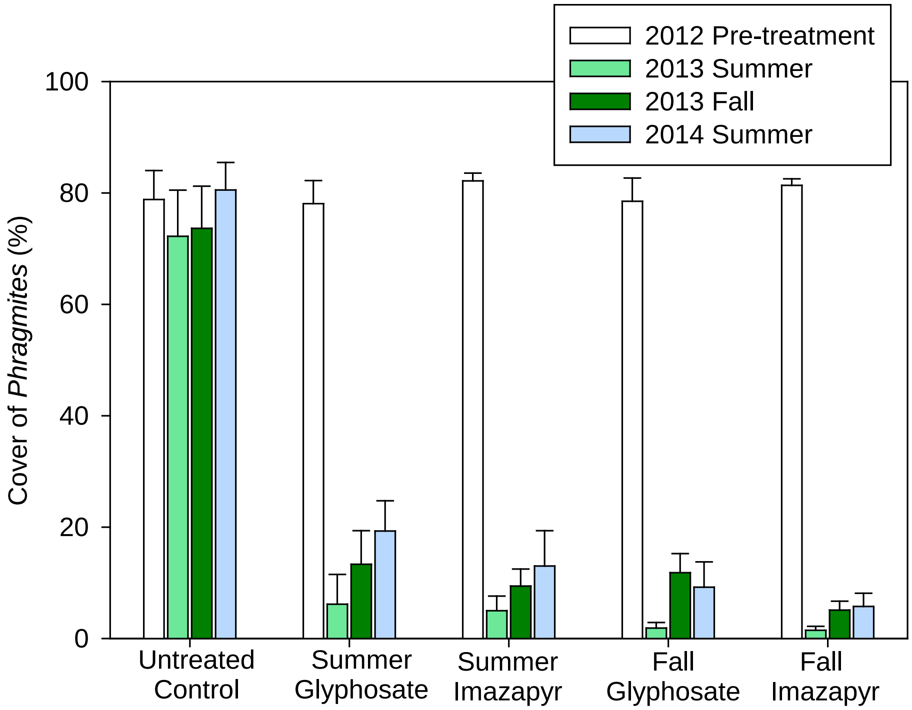

Figure 1. Effects of treatments on *Phragmites* percent cover pre-treatment (2012), two sampling occasions one year post-treatment (summer and fall 2013), and one sampling occasion two years post-treatment (summer 2014).

Germination of native plant species was very minimal at all sites for all treatments, with only trace amounts of emergent species returning including; *Schoenoplectus maritimus* (alkali bulrush), *Schoenoplectus americanus* (three-square bulrush), and *Typha* spp. (cattails) (**Figures 2 and 3**). We believe one factor contributing to minimal native plant recovery was the large litter layer left after mowing. In some cases this litter layer is 25-35 cm deep. Sites with deeper (>12 cm) water appeared to decompose the litter faster, or move it around, leading to more open water habitats with large amounts of *Lemna* spp. (duckweed) (**Figures 4 and 5**). With minimal amounts of native vegetation coming back after three years of treatments, the effect of treatment type on native plant recovery is indistinguishable.

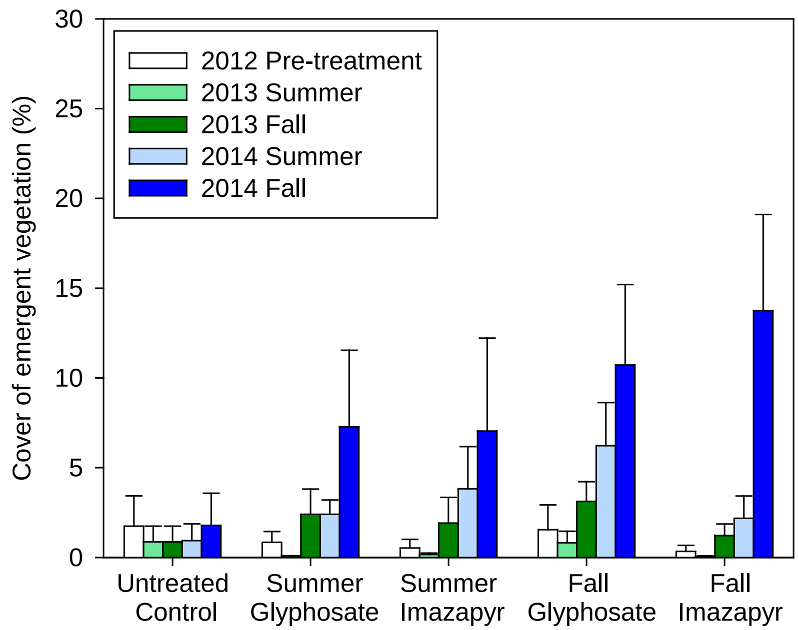

Figure 2. Effects of treatments on native emergent plant percent cover pre-treatment (2012), two sampling occasions one year post-treatment (summer and fall 2013), and one sampling occasion two years post-treatment (summer 2014).

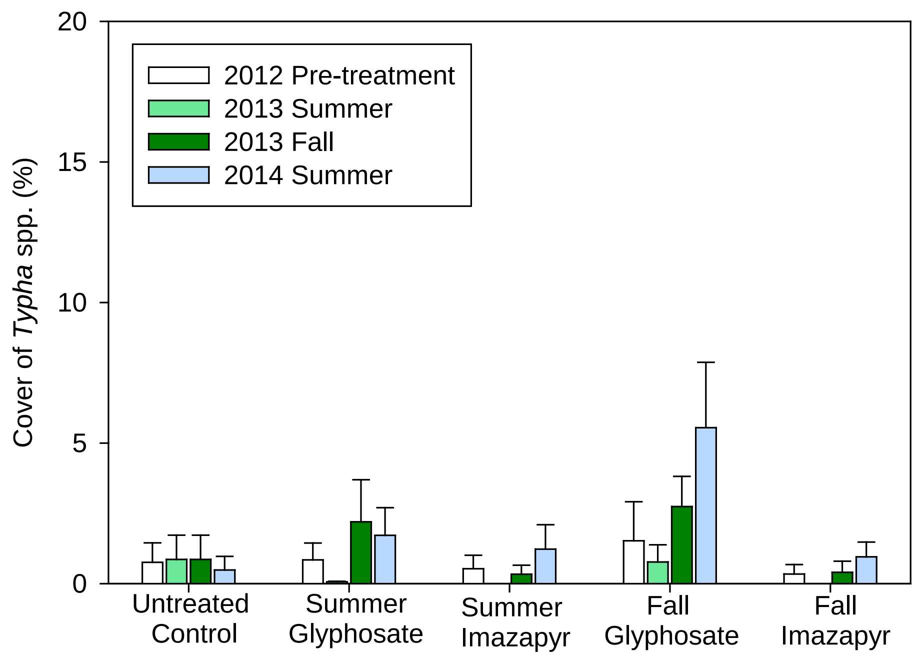

Figure 3. Effects of treatments on *Typha* spp. percent cover pre-treatment (2012), two sampling occasions one year post-treatment (summer and fall 2013), and one sampling occasion two years post-treatment (summer 2014).

Figure 4. Howard Slough WMA summer glyphosate treatment plot showing large litter layer left behind by mowing.

Figure 5. Treatment plot at Farmington Bay WMA with > 12cm water. Lower portion of picture shows large amounts of *Lemna* spp. on the surface of the open water.

Small patch study. All treatments, except the mow + black plastic, were effective at significantly reducing the cover of *Phragmites* (**Figure 6**). *Phragmites* cover has been reduced in the herbicide spray plots by 40-60%. The four herbicide and mowing treatment combinations were statistically indistinguishable from each other. In other words, they were equally effective at reducing *Phragmites* cover.

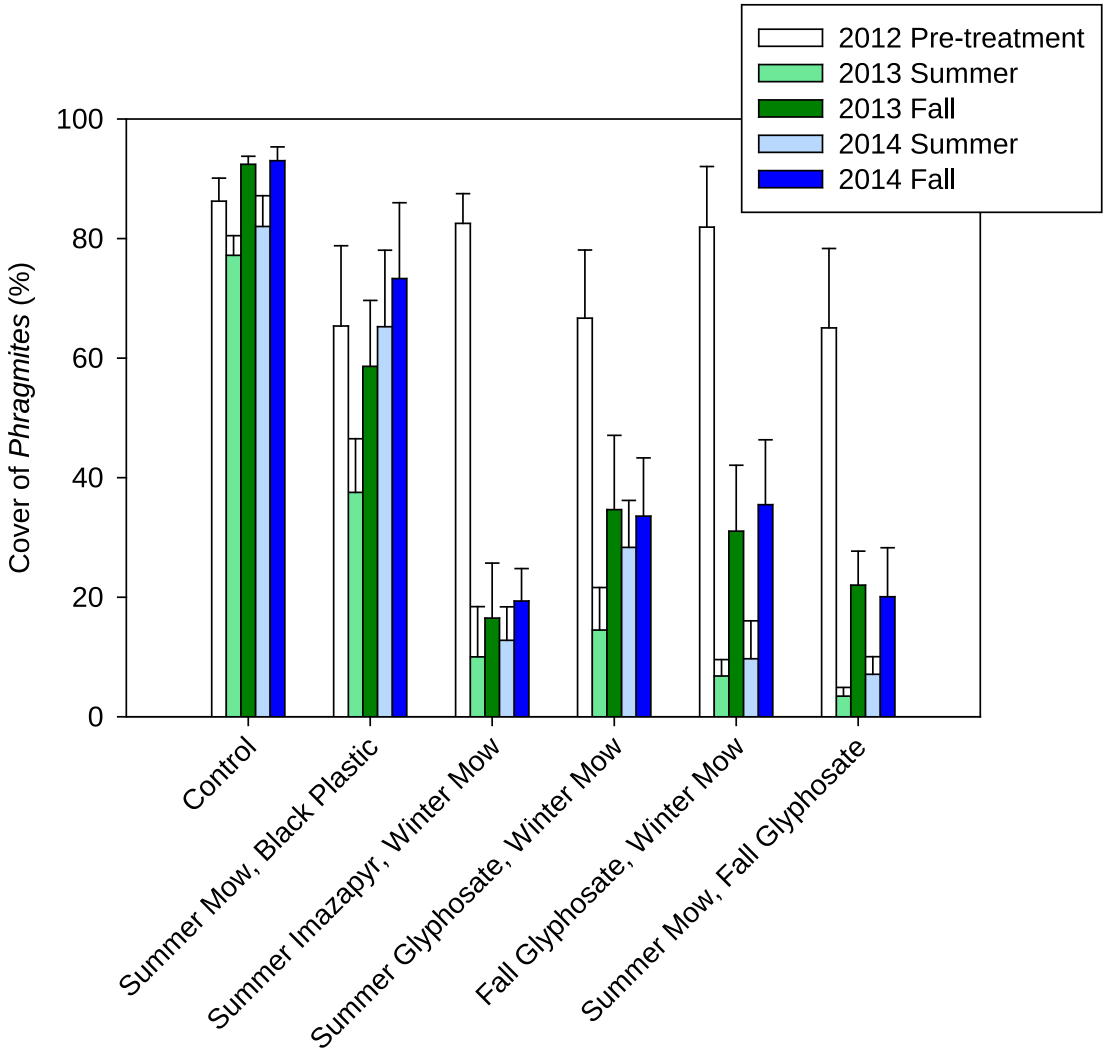

Figure 6. Effects of herbicide treatments on *Phragmites* cover in the small patch study.

The summer mow and spray treatments significantly reduced *Phragmites* inflorescence density (**Figure 7**). Given that *Phragmites* spreads predominantly by seeds (Kettenring and Mock 2012), these findings indicate multiple treatments that can be used to reduce *Phragmites* invasion potential via seeds.

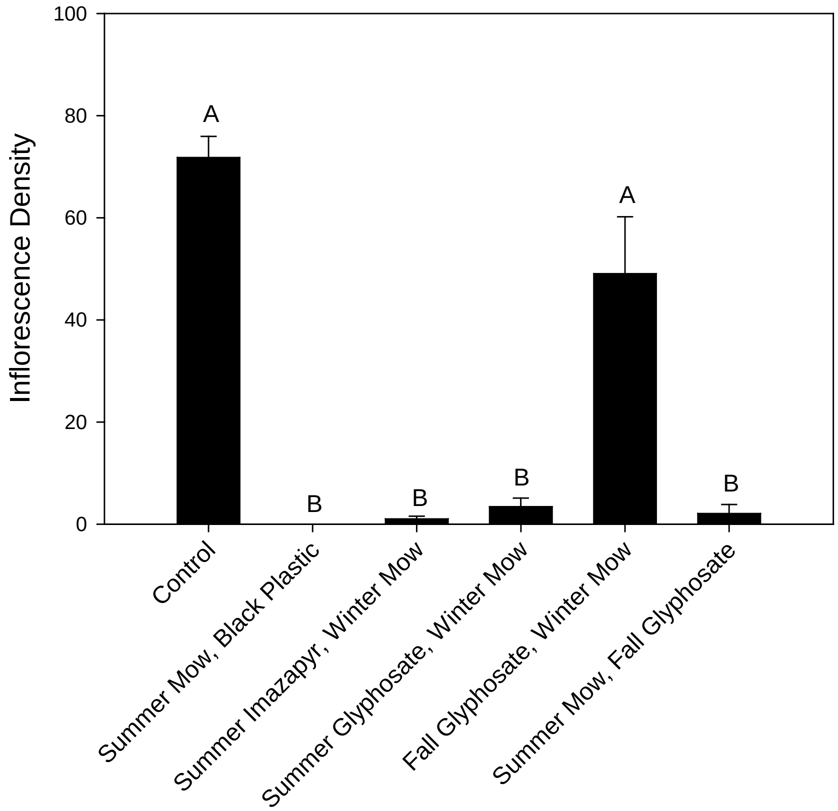

Figure 7. Effects of herbicide and mowing treatments on *Phragmites* inflorescence density, as measured in fall 2013.

There has been some recovery of native species in the various *Phragmites* treatment plots but at this stage, native plant cover is still quite low, including for *Typha* spp. (**Figure 8**) and *Schoenoplectus maritimus* (alkali bulrush; **Figure 9**).

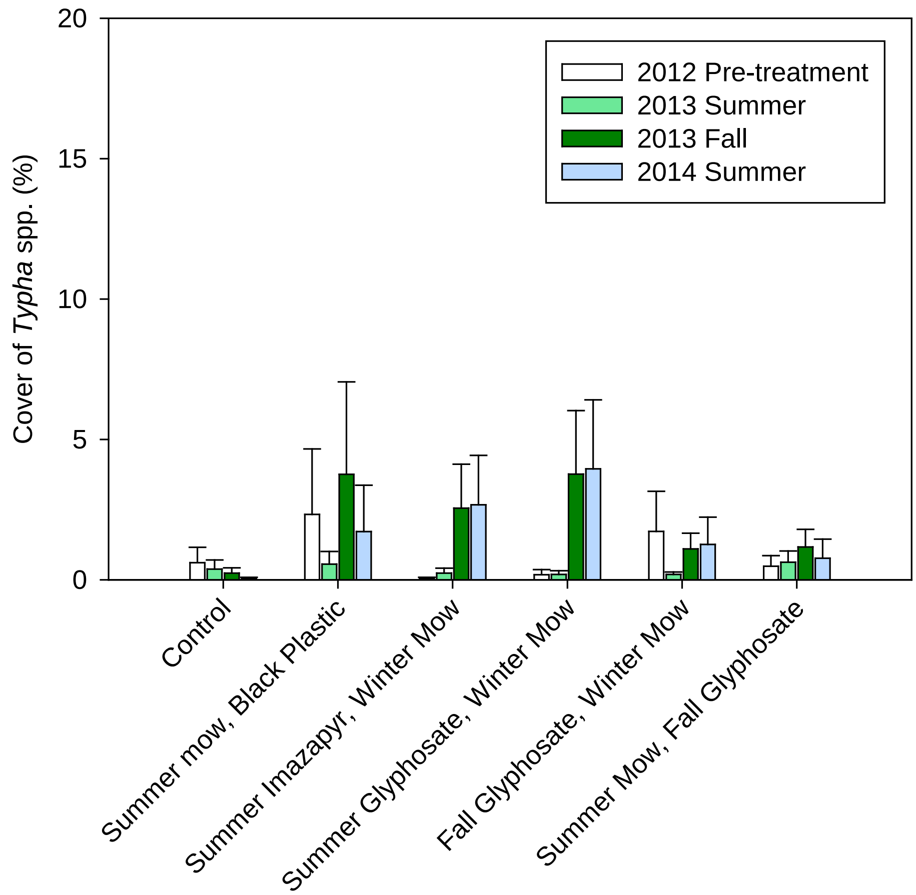

Figure 8. Cover of *Typha* spp. (cattails) in treated and untreated *Phragmites* plots.

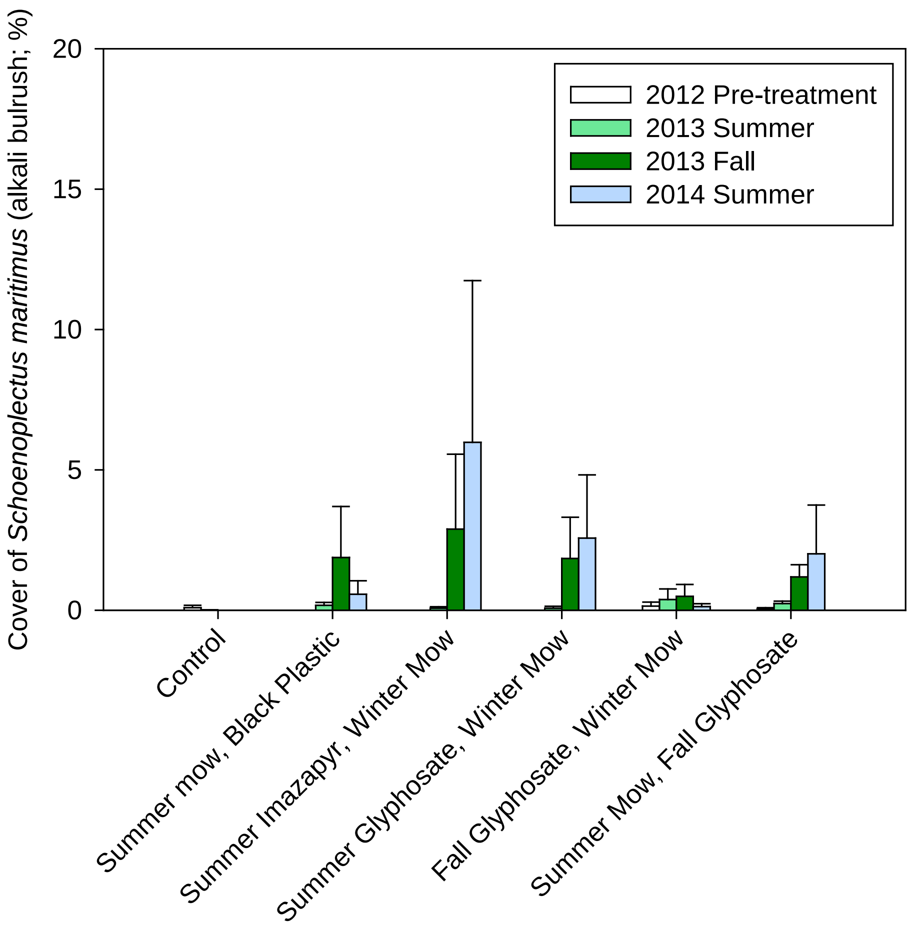

Figure 9. Cover of *Schoenoplectus maritimus* (alkali bulrush) in treated and untreated Phragmites plots.

The very large amounts of litter left behind from mowing seem to be the most substantial impediment to the regrowth of native species in all plots, but more so in the plots that were mowed in the winter (although differences between treatments were not statistically significant; **Figure 10**). The fall glyphosate, winter mow treatment consistently had very high amounts of litter, greater than the summer spray treatments (perhaps because the *Phragmites* had more time to accumulate biomass). The summer mow followed by a fall glyphosate spray treatment resulted in substantially less litter, but this did not seem to have a detectable influence on the cover of native species.

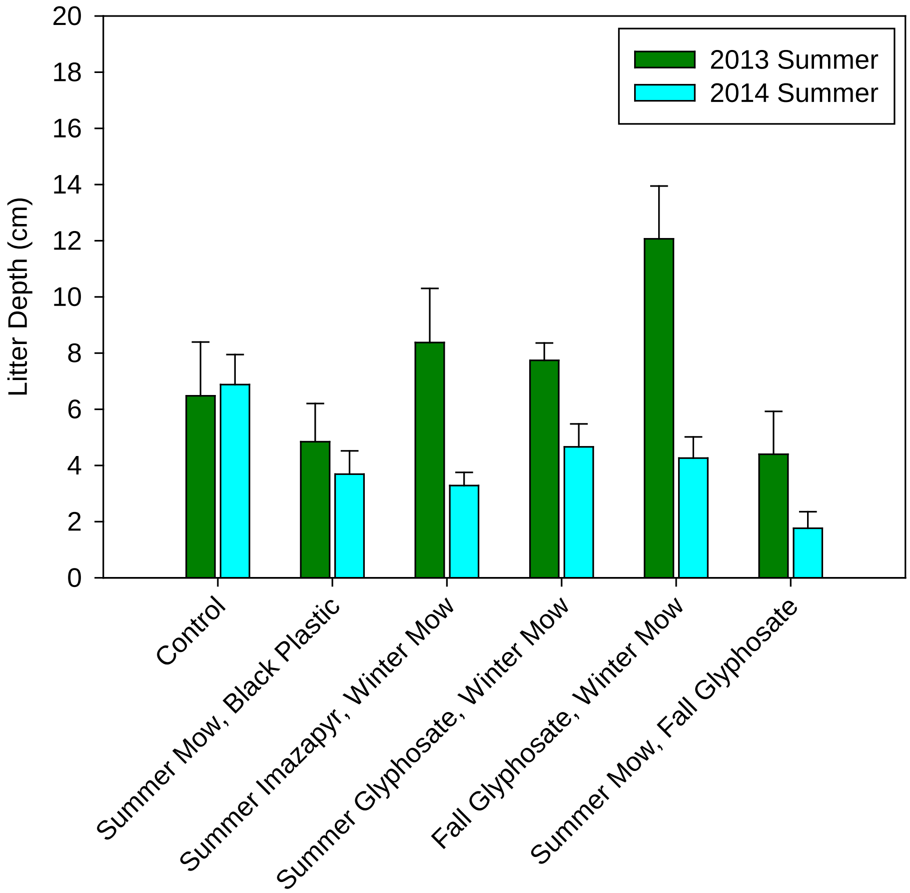

Figure 10. Effects of herbicide and mowing treatments on litter depth, as measured in summer 2013.

Concluding remarks and management recommendations

The results of our study suggest that most herbicide treatments – summer vs. fall and imazapyr vs. glyphosate – are equally effective at killing *Phragmites*. However, native plant recovery is limited across all treatments, likely due, in part, to the thick litter layer that persists following *Phragmites* herbicide application and mowing. However, we do not know if native plant recovery will occur much more rapidly once the litter breaks down or if more active revegetation with native plants will be required. We expect that we will have a much better sense of limits to plant recovery following our planned data collection in 2015 and 2016. Nonetheless, summer treatments are effective at preventing *Phragmites* from producing inflorescences. Thus, if at all possible, herbicide treatments should be timed to prevent inflorescence reproduction to stop further spread of *Phragmites* and the addition of more seeds to the soil seed bank.

Literature cited

Evans, K., and W. Martinson. 2008. Utah's featured birds and viewing sites: a conservation platform for Important Bird Areas and Bird Habitat Conservation Areas. Sun Lith, Salt Lake City, Utah.

Hazelton, E. L. G., T. J. Mozdzer, D. Burdick, K. M. Kettenring, and D. F. Whigham. 2014. Phragmites australis management in the Unites States: 40 years of methods and outcomes. AoB Plants 6:plu001.

Kettenring, K. M. 2012. Management of *Phragmites* in the Great Salt Lake watershed. Final report to Utah Department of Natural Resources, Division of Forestry, Fire & State Lands.

Kettenring, K. M., S. de Blois, and D. P. Hauber. 2012a. Moving from a regional to a continental perspective of *Phragmites australis* invasion in North America. AoB Plants:1-18.

Kettenring, K. M., K. Garvie, E. L. G. Hazelton, N. Hough-Snee, and Z. Ma. 2012b. *Phragmites* invasion and control in the Great Salt Lake watershed: 2012 land manager survey.

Kettenring, K. M., and K. E. Mock. 2012. Genetic diversity, reproductive mode, and dispersal differ between the cryptic invader, *Phragmites australis*, and its native conspecific. Biological Invasions 14:2489-2504.

Kulmatiski, A., K. H. Beard, L. A. Meyerson, J. R. Gibson, and K. E. Mock. 2011. Nonnative *Phragmites australis* invasion into Utah wetlands. Western North American Naturalist 70:541-552.

Marks, M., B. Lapin, and J. Randall. 1994. *Phragmites australis* (*Phragmites communis*): threats, management, and monitoring. Natural Areas Journal 14:285-294.

Mozdzer, T. J., C. J. Hutto, P. A. Clarke, and D. P. Field. 2008. Efficacy of imazapyr and glyphosate in the control of non-native *Phragmites australis*. Restoration Ecology 16:221-224.