

Restoration of Willamette Valley Upland Prairies at Fern Ridge Reservoir



2018

Progress Report and Restoration Plan to the
ACOE, Portland District

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PREFACE

This report is the result of an agreement between the Institute for Applied Ecology (IAE) and a federal agency. IAE is a non-profit organization whose mission is conservation of native ecosystems through restoration, research and education. Our aim is to provide a service to public and private agencies and individuals by developing and communicating information on ecosystems, species, and effective management strategies and by conducting research, monitoring, and experiments. IAE offers educational opportunities through 3-4 month internships. Our current activities are concentrated on rare and endangered plants and invasive species.



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Cover photograph: Upland prairie habitat at East Spires, 2015.

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EXECUTIVE SUMMARY

This document summarizes long-term monitoring and provides management recommendations for prairie restoration efforts at Fern Ridge Reservoir on lands managed by the US Army Corps of Engineers. Quantitative and/or qualitative monitoring has occurred annually since 2008, dependent upon whether treatment actions have occurred. In 2018, we quantitatively monitored 9 sites: Big Spires, West Spires, East Spires, Cherry Orchard, West Shore, East Shore, North Eaton, South Eaton, and Middle Green Oaks.

Big Spires

Big Spires has undergone a wide range of treatments over the years including burning, drill seeding, broadcast seeding, and use of herbicides. The plant community has varied greatly in plant management group composition. Introduced forbs decreased from 2008-2012 (from 44.5% to 5.0%), but have since increased to levels similar to the early years of this study (26.6% in 2018). Native forbs, while originally lacking in presence in the site, have increased steadily over the years and peaked in 2017 and then declined to values similar to 2014-2016 (17.5% in 2018). A decline occurred for introduced graminoids from 2016 to 2018 (41.4% to 12.6%); during this time, cover of *Vulpia* spp. declined from 37% cover to 10%. Native graminoid cover was originally almost non-existent at Big Spires and has increased greatly from 2008 to 2015 (58.1%). In 2018 cover of native graminoids was 32.8% which was predominately composed of the seeded *Festuca roemerii*. Native and introduced shrubs have had low cover over the years (<1%).

West Spires

The plant community at West Spires remains dominated by introduced forbs and graminoids. Introduced forbs have steadily increased from 2010-2017 (7.5% to 58%) and then declined in 2018 to 33%. *Galium parisiense* and *Plantago lanceolata* dominated this group in 2018 (9% and 16%, respectively). Native forb cover has remained stable in recent years (2013-2018), and was predominantly composed of *Pteridium aquilinum* (native fern; 12.5%). Introduced graminoid cover increased from 2010 to 2013 (27.3% to 70.9%), and has since declined to levels similar to those in 2010 (25.3% in 2018). Cover was composed primarily of *Arrhenatherum elatius*, *Agrostis* sp., and *Anthoxanthum odoratum*. Native graminoid cover increased slightly to 3.2% in 2018. Introduced trees/shrubs have varied over the years and account for 7.2% cover in 2018, which is due to cover of *Rubus armeniacus*. Native trees/shrubs declined to trace amounts in 2018.

East Spires

While East Spires has been dominated by introduced graminoids in recent years, the site exhibited a decline from 2016 to 2018 from 97.3% to 24.3%, due to a decline in *Agrostis* sp. and *Schedonorus arundinacea*. Native graminoids also declined from 2016 to 2017 from 15.9% to 1.5%, and then increased slightly to 3.3% in 2018. Cover of introduced forbs declined from 37.1% to 19.8% from 2017 to 2018, mostly due to a decline in *Galium parisiense* and *Parentucellia viscosa*. Native forb cover declined from 31.9% to 20.5% from 2017 to 2018, but remains at the second highest level over the course of this study. Common native forbs include *Eriophyllum lanatum* and *Pteridium aquilinum* (native fern). Cover of introduced trees/shrubs remained <5% in 2018 and consists primarily of *Rubus armeniacus*. Cover of native shrubs declined from 5.8% to 2.1% from 2017 to 2018.

Cherry Orchard

The plant community at Cherry Orchard has experienced some large changes in recent years. Introduced forbs declined greatly from 2016 to 2018 (from 46% to 13%), this decline was due to a large increase in *Galium parisiense* recorded only in 2016. Levels in 2018 were similar to in previous years with *Daucus carota* and *Hypochaeris radicata* as the most abundant species. Native forbs increased from 2016 to 2018 (5% to 14%) due to increases in *Eriophyllum lanatum* and *Prunella vulgaris*. Introduced graminoids have declined from 2016 to 2018 (from 27.3% to 13.7%) while native graminoids have increased (from 32% to 51.2%). The decline in introduced graminoids was associated with a decrease in *Vulpia* spp. from 24.4% to 6.4%, and the increase in native graminoids was due to an increase in *Festuca roemeri* from 32% to 51.1%. Trees and shrubs remained less than 2% at the site (both native and introduced).

West Shore

Plant community composition at West Shore has varied over the years of this study. After a sharp increase in introduced forbs in 2016, 2018 values reached the second highest level over the course of this study (40.2%). The most common introduced forbs included *Daucus carota*, *Galium parisiense*, *Hypochaeris radicata*, and *Plantago lanceolata*. Native forb cover declined from 34.4% in 2017 to 29% in 2018. These declines were due to decreases in *Fragaria virginiana* and native forb cover was composed primarily of *Pteridium aquilinum* (native fern; 12.5%) and *Prunella vulgaris* (5.5%), with low cover of other species. Introduced graminoid cover remained similar to 2017 values at 8.2%, composed mostly of *Anthoxanthum odoratum* and *Vulpia* spp. Native graminoid cover remained in trace amounts in 2018. Native tree cover declined from 9.8% to 3% from 2017 to 2018, while introduced trees/shrubs increased from 5.2% to 10.4% in 2018, due to an increase in *Rubus armeniacus* at the site.

East Shore

East Shore is a forb dominated community. Both introduced and native forbs experienced a decline from 2017 to 2018, but they still remain the dominant plant management groups in the community. Introduced forbs peaked in cover in 2017 at 78.8% and declined to 33.7% in 2018; this was largely due to a decline in *Daucus carota*. Native forbs have also increased over the years of this study with the highest cover occurring in 2017 (47.8%), declining to 20.8% in 2018. This is due in part to a decline in *Apocynum androsaemifolium*. Introduced graminoid cover has varied over the years, with an increase occurring from 2017 to 2018 (16.7% to 25.6%), due to an increase in *Anthoxanthum odoratum* at the site. Native graminoid cover has remained low, but consistent with recent years at approximately <2% cover. Introduced shrub cover remained <5% and native shrub cover increased from 1.5% to 13.4% from 2017 to 2018 due to an increase in *Amelanchier alnifolia*.

North Eaton

Introduced forb cover increased greatly from 2013 to 2017 (7% to 40%), but declined in 2018 to 16.5%. *Hypochaeris radicata* was a dominant species at the site in previous years, however it declined from 23% in 2016 to 13% in 2018. Native forbs remain relatively low in cover with a slight increase from 2017 values (3.9 to 6.1%). Introduced graminoids originally decreased from 2010 to 2016, but has been steadily increasing since to 27.5% in 2018. Native graminoids have remained relatively stable in recent years at 32.2% in 2018, primarily composed of the seeded *Festuca roemeri* (31.8%). Cover of introduced shrubs is at the second highest level in 2018 (6.9%). Native shrubs increased slightly from 2017 values (1.5% to 3.7% in 2018), which is due to an increase in *Rubus ursinus* to 3.3%.

South Eaton

Plant community composition has varied in the East, West, and Central sections of the site from 2015-2018. The East and West sections have followed similar trends in graminoid composition, with a decrease in introduced graminoids, and a slight increase in the West section from 2017 to 2018, but still at lower values than in previous years. Native graminoids have increased from 2016 to 2018 in both sections, however 2018 values are slightly less than in 2017, which changes associated with cover of *F. roemerii*. For both sections, introduced forb composition peaked in 2017 and declined slightly in 2018 (West= 32.8%, East=43%); these changes were associated with cover of *Hypochaeris radicata*. Native forbs remained very uncommon in the East and West sections from 2016 to 2018 (<1%). The Central section, which has been treated differently than the East and West sections, has experienced different trends. Introduced forb cover was at its highest in 2015 (57.6%), declined in 2016 (8.5%), and was at 21.7% in 2018; changes recorded were associated with cover of *Plantago lanceolata* and *Rumex acetosella*. Native forb cover remained minimal in the Central section (<1%) in 2018. Introduced graminoids have decreased steadily since 2015 from 38.3% to 2.2%, due to decreases in *Agrostis* sp. and *Aira caryophylla*. Native graminoids have also declined over the years and have remained low (<1%) in 2017 and 2018. Native and introduced shrubs declined to zero in 2017 and 2018.

Middle Green Oaks

Middle Green Oaks has experienced large changes in the plant community in recent years. Introduced forb cover increased greatly from 2010 to 2015 to 67.5%, but declined to 41.5% in 2018. Dominant introduced forbs included *Daucus carota* and *Hypochaeris radicata*. Native forbs remain minimal at the site (mean <1%), however there are some patches of the rare *Lupinus oreganus*. Introduced graminoids have declined from 2010 to 2018 (33.9% to 10.4%), while native graminoids have increased from 0.8% to 7.2%. Introduced graminoids that have declined include *Agrostis* sp. and *Anthoxanthum odoratum*, whereas the increase in native graminoids is associated with *Danthonia californica*. Both native and introduced shrubs and trees have remained at trace amounts in recent years.

Restoration of Willamette Valley Upland Prairies at Fern Ridge Reservoir

PROGRESS REPORT AND RESTORATION PLAN TO THE ACOE, PORTLAND DISTRICT

INTRODUCTION

Upland prairies in the Willamette Valley are among the most endangered ecosystems in North America, and support many imperiled species. Two of these species are the threatened plant *Lupinus oregonus* (Kincaid's lupine, Figure 1) and endangered Fender's blue butterfly (*Icaricia icarioides fenderi*).

Lupinus oregonus is currently known at about 164 sites, comprising 246 hectares (USFWS 2010). The majority of these sites are on privately held land, which is exempt from protections provided by state and federal listing, increasing the importance of management by state and federal agencies on public land. Fender's blue butterfly currently occurs in approximately 44 sites in the Willamette Valley (Mikki Collins, personal communication). Approximately half of these sites are on federal, state, county, or city lands; the remainder are on private lands.

Approximately 100 acres of occupied or potential habitat for Fender's blue butterfly and *L. oregonus* is under management at Fern Ridge Reservoir. The eleven sites in this project are particularly valuable as they have several layers of administrative protection. The Fern Ridge master plan provides them with wildlife habitat or environmentally sensitive land use designations; the current rare species management plan and Biological Opinion place primary emphasis on activities to benefit listed species; and all sites except one are designated Critical Habitat for Fender's blue butterfly, *L. oregonus*, or both.

Current population sizes of these species are similar to other important sites, including Basket Butte, in the Salem West Recovery Zone, and Willow Creek, in the Eugene West Recovery Zone. These populations are also a vital portion of a potentially connected, functioning network of



Figure 1. The endangered Fender's blue butterfly on the threatened Kincaid's lupine. Both species are native to upland prairies in the Willamette Valley.

Fender's blue butterfly sub-populations as they are close to Fir Butte (managed by the West Eugene Wetlands) and other stepping stone sites between Fern Ridge and Eugene.

The sites in this project have been mowed since the 1970's. Mowing was originally intended to maintain habitat for upland birds, but it also allowed native plants to persist despite the presence of aggressive invasive plants including *Arrhenatherum elatius* (tall oat grass), *Cytisus scoparius* (Scotch broom), and *Rubus* spp. (blackberries). Fender's blue butterfly and *L. oregonus* were first identified in 1998 and have since been the primary targets for management. Increasingly intensive management has resulted in increased butterfly numbers, *L. oregonus* cover, and habitat quality. *L. oregonus* and nectar species plantings have yielded over 4,000 new plants and more than 500 m² of lupine leaf area. The population of Fender's blue butterfly has increased from an initial estimate of 17 adult butterflies to approximately 1,282 butterflies in 2009. In 2010, it was estimated that there were roughly 1,135 Fender's blue butterflies at Fern Ridge.

The goal of this project is to build upon these efforts and restore a matrix of native prairie grasses with moderate native forb diversity (emphasizing host and nectar plant species for Fender's blue butterfly). In each of seven sites (or combinations of adjacent sites), we will create a hectare of high-quality habitat for Fender's blue butterfly, which has been identified as the minimum patch size that will allow long-term persistence of Fender's blue butterfly.

METHODS

Treatments

The treatments recommended for this project were based on several long-term restoration projects in the Willamette Valley, including restoration in the West Eugene Wetlands (T. Taylor, *personal communication*), in Wetland Restoration Enhancement Program sites (M. Blakeley-Smith, *personal communication*), and upland prairies in the Willamette Valley and Puget Trough (Boyer 2008; Stanley et al. 2008; Amanda Stanley, *personal communication*).

At several sites, we recommend following a "matrix treatment" (Table 1) for two years. After this period, different treatments will be followed based on the composition of the initial plant community (Table 1). We will also apply several small-scale treatments that have the potential to increase restoration success, but are either relatively new restoration techniques or are prohibitively expensive to apply on a large scale. These treatments could include solarization, pre-emergent herbicides, pre-emergent herbicides combined with carbon banding, and sucrose addition.

As the matrix treatment is relatively aggressive and should result in elimination of most or all species occupying the site, it is not appropriate for sites currently supporting *Lupinus* or large populations of nectar species. At these sites, we will make specific treatment recommendations based on site-specific species composition.

All sites were monitored annually starting the first year of scheduled treatments. At each site, we randomly selected plots and estimated the percent cover of all vegetation. Data from the first several years of sampling has been used to guide the selection of restoration treatments (Table 2).

In addition to conducting large scale treatments, there were several introduced species in the restoration sites that required special treatment, including *Cytisus*, *Rubus*, and *Centaurea pratensis* (meadow knapweed). We recommend these species be treated using herbicides or grubbing each year until eliminated.

Table 1. General treatment schedule for upland prairie restoration at fern ridge reservoir. This schedule was revised February 2011, based on treatment effects as described in this report.

Year	Season	Treatment**
“Matrix” treatment		
Yr 1	Spring	Spray with glyphosate or tank mix ¹
Yr 1	Fall	Burn, propane torch, hay, or mow
Yr 1	Fall	2 -4 weeks post-burn (or after other treatment): glyphosate
Yr 1	Fall/Winter	If possible, spray with glyphosate a second time
Yr 2	Spring	Spray with glyphosate or tank mix ¹
Yr 2	Fall	Burn, propane torch, hay, or mow
Yr 2	Fall	2 -4 weeks post-burn: glyphosate
Yr 2	Fall	Apply small-scale treatments
Treatment for sites dominated by aggressive, weedy forbs		
Yr 2	Fall	Seed with native grasses
Yr 3	Spring	Spray with broadleaf herbicide (e.g. 2,4-D)
Yr 3	Fall	Spray with broadleaf herbicide (e.g. 2,4-D)
Yr 3	Fall	Seed with clopyralid tolerant native forbs
Yr 4	Spring	Spray with clopyralid
Yr 4	Fall	Seed with diverse native forb mix
Yr 4	Fall	Seed with native forbs ²
Treatment for sites dominated by aggressive, weedy grasses		
Yr 2	Fall	Seed with native forbs
Yr 3	Spring	Spray with grass specific herbicide (e.g. fluazifop)
Yr 3	Fall	Spray with grass specific herbicide
Yr 3	Fall	Seed with fluazifop -tolerant native grasses
Yr 4	Spring	Spray with fluazifop
Yr 4	Fall	Seed with diverse native grasses ²

**Once restoration goals have been achieved, sites should be monitored at least annually to detect changes in vegetation (e.g. increased weed abundance). Site maintenance is likely to include regular prescribed fire followed within 1-2 weeks with glyphosate application, mowing, herbicide spot treatment, and other treatments as necessary.

¹Tank mix formulation should be site specific and generally include glyphosate + a more specific herbicide. Dicamba was used initially in combination with glyphosate, as it is effective for legumes and has residual activity. More recent applications using glyphosate + aminopyralid have had good weed control.

²Final seeding assumes that desired control of introduced species has been achieved. Final seeding may need to be delayed and treatments repeated.

Monitoring Schedule

Table 2. Monitoring schedule at upland prairie restoration sites at fern ridge reservoir. "--" indicates no monitoring activities took place in that year. "Qual" indicates qualitative monitoring and "Quant" indicates quantitative monitoring. The 2019 monitoring plan is forthcoming

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Big Spires	Quant	Quant	Qual (spring) Quant (fall)	Qual	Quant	Quant	Quant	Quant	Quant	Quant	Quant
Big Spires NE	—	Quant	Qual	Qual	—	—	Qual	Qual	—	Qual	—
West Spires	—	—	Quant	Qual	Quant	Quant	Qual	Qual	Quant	Quant	Quant
East Spires	—	—	Qual	—	Quant	Quant	Qual	Qual	Quant	Quant	Quant
Cherry Orchard	—	Quant	Qual	Qual	Qual	Qual	Quant	Quant	Quant	Qual	Quant
West Shore	—	—	Quant	Quant	Quant	Quant	Qual	Qual	Quant	Quant	Quant
East Shore	—	—	Quant	Quant	Quant	Quant	Qual	Qual	Quant	Quant	Quant
North Eaton	—	—	Quant, CEPR surveys	Qual	Qual	Quant	Qual	Qual	Quant	Quant	Quant
South Eaton Central	—	Quant (as one site)	Qual	Qual	Qual	Qual	Qual	Quant	Quant	Quant	Quant
South Eaton East	—							Quant	Quant	Quant	Quant
South Eaton West	—							Quant	Quant	Quant	Quant
Middle Green Oaks	—	—	Quant, CEPR surveys	Qual	—	Qual	Qual	Quant	Qual	Qual	Quant



Figure 2. Upland prairie restoration sites at Fern Ridge Reservoir.

BIG SPIRES

Restoration treatments were initiated at Big Spires in spring 2008 (Table 3). This site is currently the furthest along in the restoration process of this project and can serve as an example for other sites and treatment regimes.

Monitoring

Botanical surveys were first completed at Big Spires in June of 2008, shortly after herbicide application. An x and y axis were superimposed on an aerial photo of the meadow (Figure 3) and coordinates were randomly selected for plot placement. The meadow at Big Spires is roughly the shape of an ellipse; randomly selected coordinates that were outside of the meadow were eliminated and replaced with another randomly selected location. Thirty plots were sampled.

Four T-posts were positioned every 90m along the x-axis beginning in the northwest end of the meadow. This axis extends 270m at 133°. The y-axis bisected (i.e. at 135m) the x-axis. This axis extended 110m to the northeast at 23° and 70m to the southwest. We placed a 1x1m sampling frame at the top right corner at each selected sampling point and estimated the percent cover of each species. For analysis, cover of the native fern *Pteridium aquilinum* was included as part of the native forb category.

In May, 2010, we conducted a qualitative survey of the site, noting dominant vegetation and distribution and abundance of species of interest (e.g. valuable native species such as *Sidalcea* or previously dominant invasive species such as *Arrhenatherum elatius*). Due to substantial vegetation changes during the summer, additional treatments and quantitative surveys were deemed necessary in fall 2010. Similar sampling methods were used in October 2010, as in 2009, with the exception that there were no t-posts and plot locations were estimated from an approximate centerline. Qualitative surveys to document the presence and approximate site-wide cover of the most common plant species were repeated in May 2011. Quantitative monitoring occurred annually from 2012-2018 at Big Spires.

Table 3. Treatment schedule for Big Spires at Fern Ridge Reservoir. 2007 was the first year of restoration treatments at this site. Prior to 2007, the site was treated with fall mowing.

Year	Season	Treatment
2007	Fall	Wildfire, east 1/3
2008	Spring	Broadcast glyphosate & dicamba
2008	Fall	Hay
2009	Spring	Broadcast glyphosate
2009	Fall	Broadcast glyphosate, drill grass, broadcast forbs
2010	Spring	Spot spray, aminopyralid
2010	Fall	Treat <i>Rubus</i> , seed and plant matrix, overspray with fluazifop
2011	Spring	Broadcast fluazifop & aminopyralid
2011	Fall	Burn, broadcast glyphosate, drill <i>Festuca</i> , broadcast forbs, plant diversity plots, golden paintbrush and lupine plots, experiments
2012	Spring	Plant 15,333 plugs, lupine seed
2012	Fall	Plant forbs, diversity and lupine. Maintenance: spot spray, hand weed, etc
2013	Spring	Spot spray
2013	Fall	Burn and glyphosate part, drill <i>Festuca</i> , plant plugs, broadcast diversity and lupine seed
2014	Spring	Spot spray as needed
2014	Fall	Fall mow, diversity ctr. planting
2015	Spring	No action
2015	Fall	Burn, broadcast glyphosate, seed diversity
2016	Spring	Broadcast fluazifop two times
2016	Fall	Mow, plant nursery stock
2017	Spring	No action
2017	Fall	No action
2018	Spring	No action
2018	Fall	Burn 2/3 lupine, mow 1/3, meadow pushback, diversity seed, <i>Camassia</i> bulbs, <i>Geranium</i> starts, December fluazifop
2019	Spring	Fluazifop

Results and Discussion

Big Spires has undergone a wide range of treatments over the years including burning, drill seeding, broadcast seeding, and use of herbicides (Table 3). The plant community composition has varied greatly,

with sharp increases and decreases in plant management group composition (Figure 5). Introduced forbs decreased from 2008-2012 (from 44.5% to 5.0%), but peaked in 2016 (45%) and have since declined to levels similar to the early years of this study (26.6% in 2018). While introduced forbs such as *Galium parisiense* and *Parentucellia viscosa* declined from 2017 to 2018, cover of *Hypochaeris radicata* has steadily increased from 2% in 2016 to 22% in 2018 (Appendix A). Native forbs, while originally lacking in presence in the site increased steadily over the years and in 2017 reached their highest total cover of 36%. In 2018 they declined to 17%, similar to levels recorded in 2014-2016 (Figure 5). These trends in native forb cover seem to be associated with that of *Eriophyllum lanatum*, a dominant planted species which has increased over the years from 3% in 2013 to 31% in 2017, and declined to 15% in 2018 (Appendix A). *Castilleja levisecta* (golden paintbrush) has been planted at the site and was first observed in 2016, with an increase to 1.6% in 2017 but we only recorded a small cover amount (<0.1%) in 2018 (Appendix A). This decrease could simply due to sampling random plots each year, and might have missed the blocks in which this species was planted.

Native and introduced graminoids have varied greatly over the years. A decline occurred for introduced graminoids from 2016 to 2018 (41.4% to 12.6%; Figure 5), during this time, cover of *Vulpia* spp. declined from 37% cover to 10% (Appendix A). *Agrostis stolonifera*, which was a dominant species in 2013 and 2014 (32 and 27%, respectively) has declined to less than one percent in 2017 and 2018. Native graminoid cover was originally minimal and has had some years of high cover (2013=56.2%, 2015=58.1%), followed by a sharp decline in 2016 (13.2%). In 2017 and 2018, cover of native graminoids has been >32%; with cover predominately composed of *F. roemerii* which has been seeded throughout the site in multiple years. Native and introduced shrubs have had low relative cover throughout sampling (<1%; Figure 5).

Management Recommendations

We recommend continued treatments to target introduced grasses and forbs, especially with the variability recorded in recent years. While we observed decreases in introduced forbs and in recent years, continued management is necessary to maintain these positive trends. Treatments on introduced forbs should be coupled with actions to increase native forbs on the site. Continued quantitative monitoring is needed to determine the best management practices to reduce introduced species and to continue to promote native species cover.

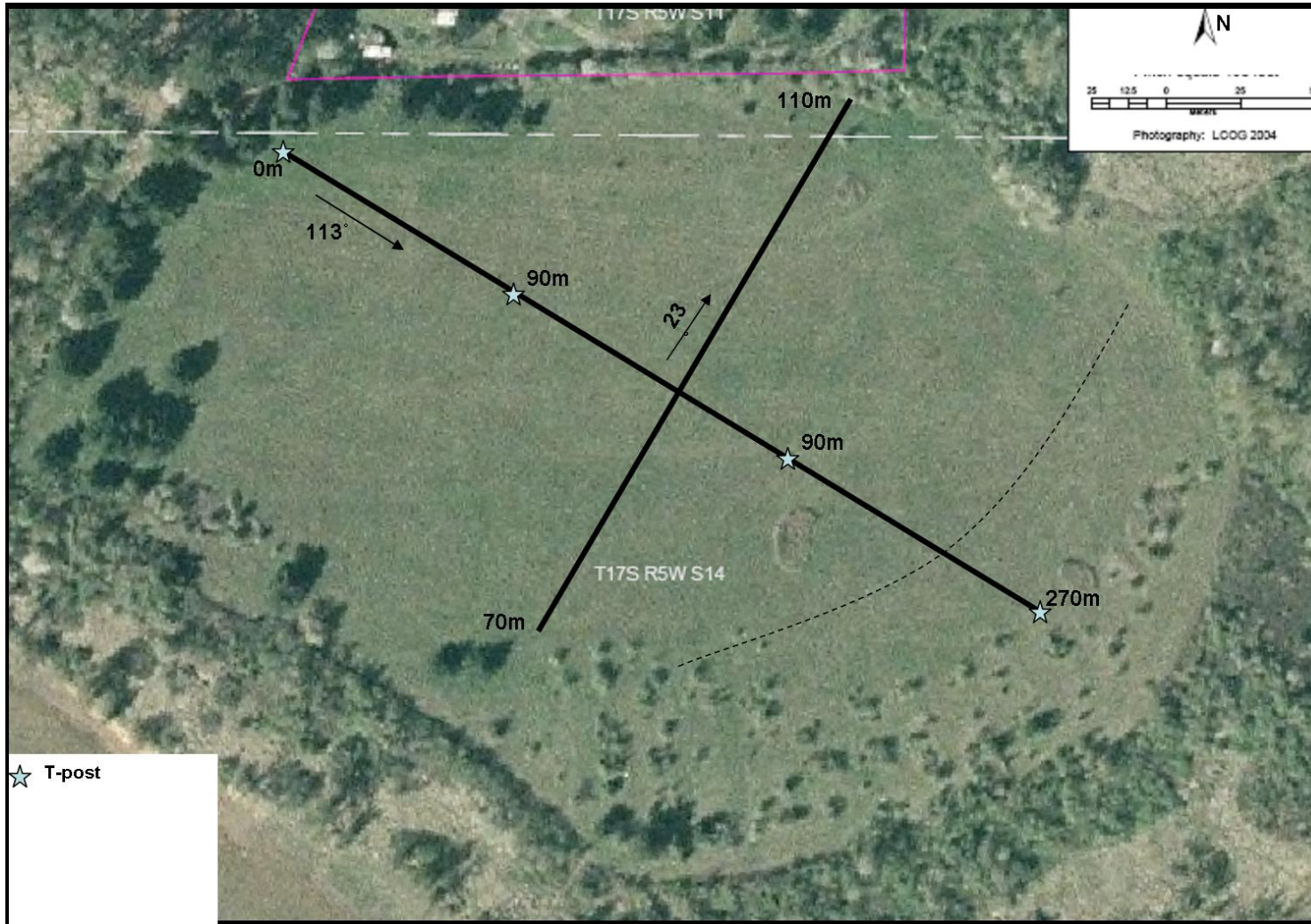


Figure 3. Big Spires upland prairie restoration site at Fern Ridge Reservoir. An x- and y-axis were superimposed on the meadow in order to randomly select locations for sampling plots. T-posts were placed along the x-axis every 90m.

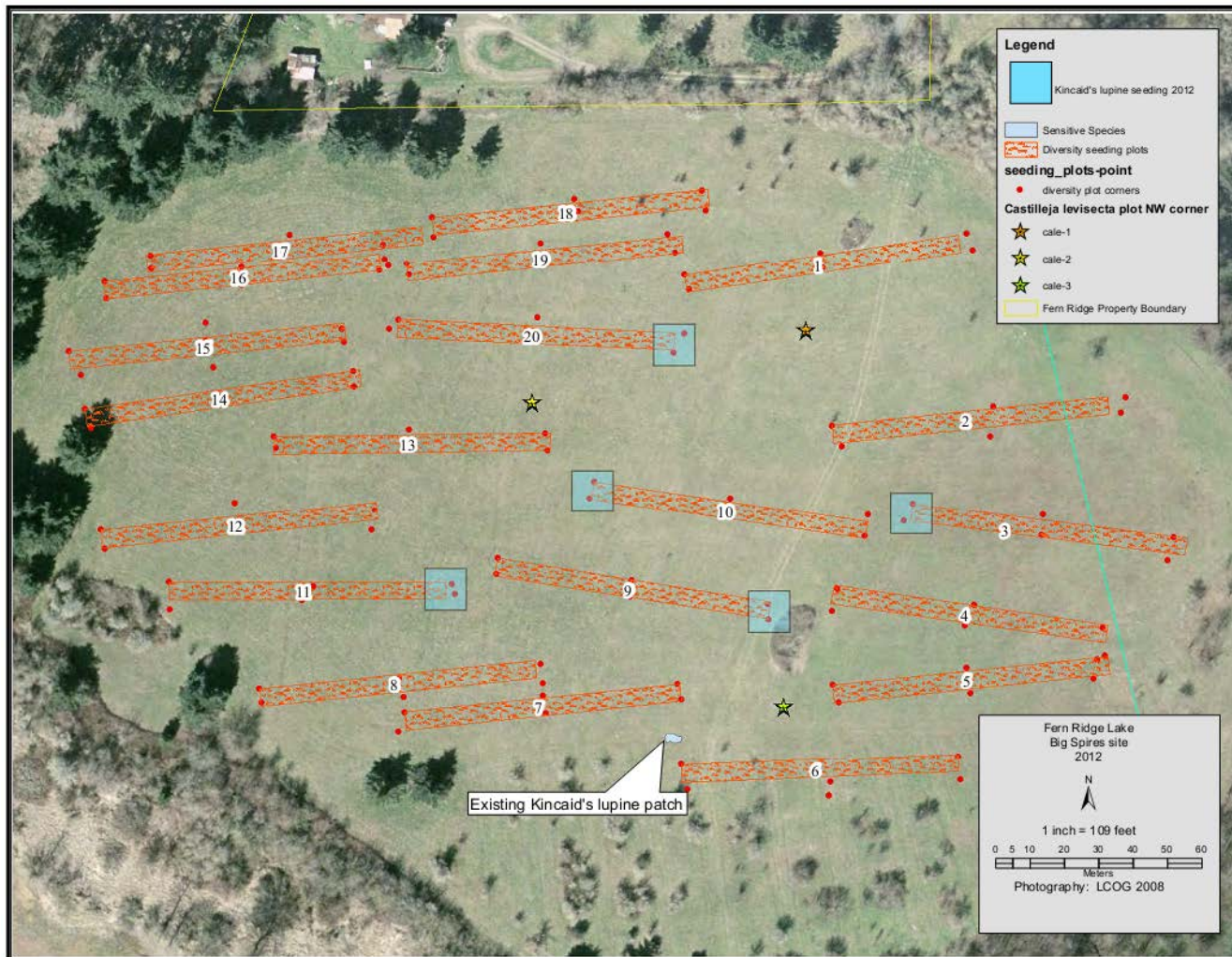


Figure 4. Location of diversity plots at Big Spires. Blue boxes indicate additional plantings of Kincaid's lupine and stars are locations of *Castilleja* plantings.

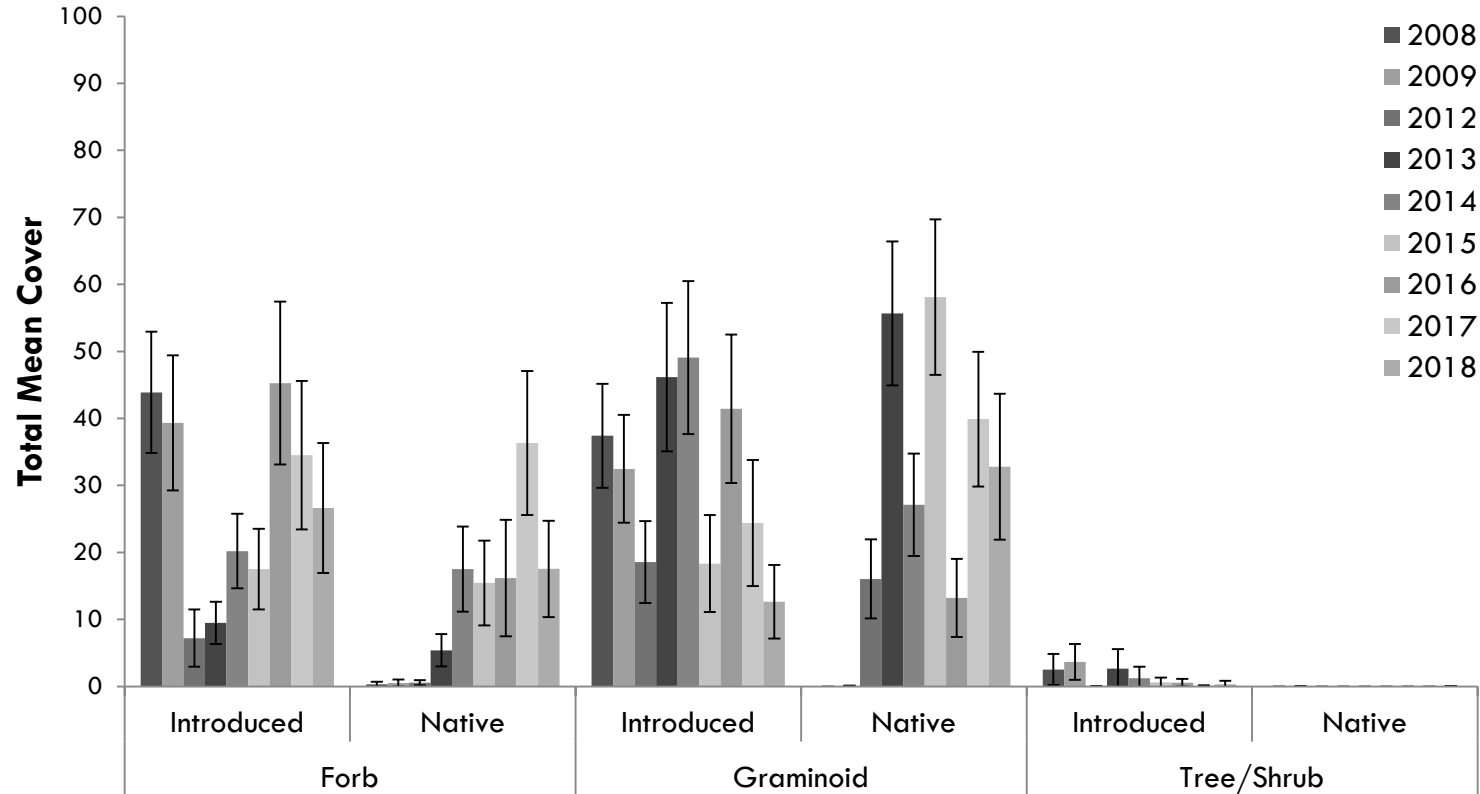


Figure 5. Cover estimates of introduced and native species at Big Spires from 2008 to 2018 (quantitative data were not collected in 2011). Estimated cover of each plant management group*nativity = sum (average cover plot⁻¹ for each species in that category). Error bars represent 95% confidence intervals.

BIG SPIRES NE

Restoration treatments were initiated at Big Spires NE in spring 2009 (Table 4). Big Spires NE has also been referred to South of East Spires.

Table 4. Treatment schedule for Big Spires NE at Fern Ridge Reservoir. 2009 was the first year of restoration treatments at this site.

Year	Season	Treatment
2007	Fall	Wildfire
2008	Fall	Mow
2009	Spring	Broadcast glyphosate
2009	Fall	Broadcast glyphosate
2010	Spring	Broadcast glyphosate
2010	Fall	Broadcast glyphosate
2011	Spring	Broadcast glyphosate and aminopyralid
2011	Fall	Burn, broadcast glyphosate, drill <i>Festuca</i>
2012	Spring	Assess for broadcast, broadcast Chaparral
2012	Fall	Drill <i>Festuca</i>
2013	Spring	Assess for broadleaf spray
2013	Fall	No action
2014	Spring	Declare failure or reset
2014	Fall	Mow
2015	Spring	No action
2015	Fall	Mow
2016	Spring	No action
2016	Fall	No action
2017	Spring and Fall	No action
2018	Spring and Fall	No action
2019	Spring	No action

Monitoring

Botanical surveys were first completed at Big Spires NE in May 2009. Two axes were superimposed on an aerial photo of the meadow (Figure 6) and coordinates were randomly selected for plot placement. We placed a t-post at each end of the longest axis, which extends 90m East-West. The shorter axis is 70m long and runs perpendicular at 180°. Plots that were outside of the meadow were eliminated and replaced with another randomly selected location until 20 plots were selected. We placed a 1m² sampling frame at the top right corner at each selected sampling point and estimated the percent cover

of each species and ground cover category (bare ground, rock, and moss). For analysis, cover of the native fern *Pteridium aquilinum* was included as part of the native forb category.

In May, 2010 and 2011, we conducted qualitative surveys of the site, noting dominant vegetation and distribution and abundance of species of interest (e.g. valuable native species such as *Sidalcea* or previously dominant invasive species such as *Arrhenatherum elatius*). This site was not monitored in 2012, 2013, or 2018, but was monitored qualitatively in 2014, 2015, and 2017.

Results and Discussion

In 2009, the only year of quantitative monitoring, Big Spires NE was dominated by introduced forbs (14%) and graminoids (67%; Figure 7, Appendix B). The dominant introduced species included *Agrostis* spp. (32.9%), *Anthoxanthum odoratum* (16.5%), and *Schedonorus arundinacea* (9.9%). With the exception of the natives *Galium aparine* (3.8%), *Elymus glaucus* (10.1%), and *Spiraea douglasii* (9.5%), there were no other native species with cover <1%. Additional species observed, but not located in plots, included *Sanguisorba minor*, *Toxicodendron diversilobum*, *Phalaris arundinacea*, and *Centaurea* sp. (near the east end of the meadow).

Results from our qualitative surveys in 2017 suggest that the site remains dominated by introduced grasses including *Anthoxanthum odoratum*, *Arrhenatherum elatius*, *Dactylis glomerata*, *Agrostis stolonifera*, and *Holcus lanatus*. The most abundant native species at the site, *F. roemerii*, was patchy and common throughout. This presence is likely the result of drill seeding that occurred in 2012. While the plant community at this site tended to be introduced forb dominated in 2010, introduced grasses were largely dominant in recent years. The forb community remained composed of introduced species including *Daucus carota*, *Plantago lanceolata*, and *Vicia* sp. The site was not monitored in 2018.

Management Recommendations

Given the high introduced graminoid composition at the site, we recommend treatments using a grass-specific herbicide such as fluzifop. After more control of introduced graminoids is achieved, we recommend surveying the site in order to assess the need for spot treatments of introduced forbs and assessment of when select species can be seeded.



Figure 6. Big Spires NE upland prairie restoration site at Fern Ridge Lake. An x and y-axis were superimposed on the meadow in order to randomly select locations for sampling plots. T-posts were placed on either end of the 90m axis running east-west.

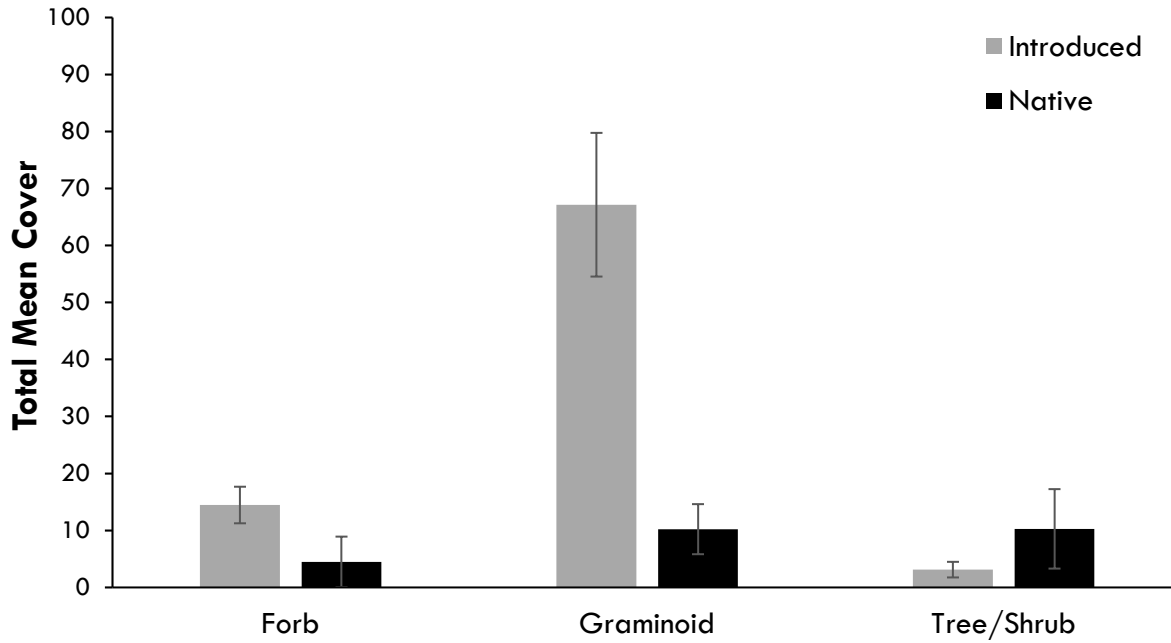


Figure 7. 2009 cover estimates of introduced and native species at Big Spires NE. Bars represent the total cover of all species in each growth form. Estimated cover of each plant management group*nativity = sum (average cover plot⁻¹ for each species in that category). Error bars represent 95% confidence intervals.

WEST SPIRES

Restoration activities started in 2007 at West Spires. Prior to 2011, management at this site included spring and fall mowing (Table 5).

Table 5. Treatment schedule for West Spires at Fern Ridge Reservoir. 2011 was the first year of restoration treatments at this site.

Year	Season	Treatments
2007	Fall	Mow
2008	Spring	Mow south 1/2
2008	Fall	Mow
2009	Spring	Mow south 1/2
2009	Fall	Mow
2010	Spring	No action
2010	Fall	Plant diversity in oak opening
2011	Spring	Mow
2011	Fall	Assess
2012	Spring	No action
2012	Fall	Mow
2013	Spring	Broadcast fluazifop on east half
2013	Fall	No action
2014	Spring	Experimental fluazifop
2014	Fall	Fall mow, aminopyralid <i>Cytisus</i>
2015	Spring	Experimental fluazifop
2015	Fall	Mow
2016	Spring	Broadcast fluazifop two times on the west half of the site
2016	Fall	Burn +glyphosate portion, seed native broadcast + diversity, plant nursery stock, mow
2017	Spring	No action
2017	Fall	Flood with perennial seed (burn portion)
2018	Spring	No action
2018	Fall	Spot spray woodies, mow
2019	Spring	No action

Monitoring

We initiated botanical surveys at West Spires in May 2010. Two axes were superimposed on an aerial photo of the meadow (Figure 8) and coordinates were randomly selected for plot placement. We placed 1m aluminum conduit posts at 0, 100, and 140m along the longest axis, which extends East-West. Plots that were outside of the meadow were eliminated and replaced with another randomly selected location until 30 plots were selected. We placed a 1x1m sampling frame at the top right corner at each selected sampling point and estimated the percent cover of each species and ground cover category (bare

ground, rock, and moss). For analysis, cover of the native fern *Pteridium aquilinum* was included as part of the native forb category. Quantitative surveys were conducted again in 2012, 2013 and 2016-2018. The site was qualitatively monitored in 2014 and 2015.

Results and Discussion

The plant community at West Spires remains dominated by introduced forbs and graminoids (Figure 9, Appendix C). Introduced forbs steadily increased from 2010-2017 to 58%, but decreased in 2018 to 33%. The most common introduced forbs decreased between 2017 and 2018, including *Hypochaeris radicata* (9.6% to 3.9%), *Lotus corniculatus* (6.3% to 0%), and *Parentucellia viscosa* (5.9% to 0.3%). Native forb cover remained similar to values recorded in 2017 and was predominantly composed of *Pteridium aquilinum* (a native fern; 12.5%). *Lupinus oregonus* remained present in low levels in 2018 (0.3%). Introduced graminoid cover increased from 2010 to 2013 (27.3% to 70.9%), and has since declined to levels similar to those in 2010 (25.3% in 2018; Figure 9). Introduced graminoids with the highest cover included *Arrhenatherum elatius* and *Anthoxanthum odoratum* (9.2 and 6.1%, respectively). In 2018 *Agrostis* sp. increased from 1% to 5.9%. Native graminoid cover remained low as in previous years, with *Danthonia californica* as the most abundant native graminoid at 2.8%. Introduced trees/shrubs have varied over the years and accounted for 7.3% cover in 2018, composed primarily of *Rubus armeniacus*. *Cytisus scoparius* declined from 2016 to 2018 from 5.5% to 0.1% (Appendix C). Native trees/shrubs had increased from 2.2% in 2010 to 15.4% in 2017, however in 2018 they accounted for only 0.4% cover. *Spirea douglasii* declined from 7.9% cover in 2017 to 0.1% cover in 2018 (Appendix C), accounting for much of the difference.

Management Recommendations

We recommend treatment of introduced forbs and graminoids using herbicide, then followed by seeding with native grasses and continued planting of native forbs. We also recommend spot treatments of *Hypochaeris radicata*, *Cytisus scoparius*, and *Rubus armeniacus*, as well as ongoing maintenance by mowing. We recommend additional monitoring as treatments are completed, to determine the effects of management actions on the plant community.



Figure 8. West Spires upland prairie restoration site at Fern Ridge Reservoir. *Centaurea pratensis* was found in one patch at the site. 3' aluminum conduit was placed at 0(east end), 100, and 140m on an axis running north-south. X- and Y-axes were superimposed on the meadow in order to randomly select locations for sampling plots.

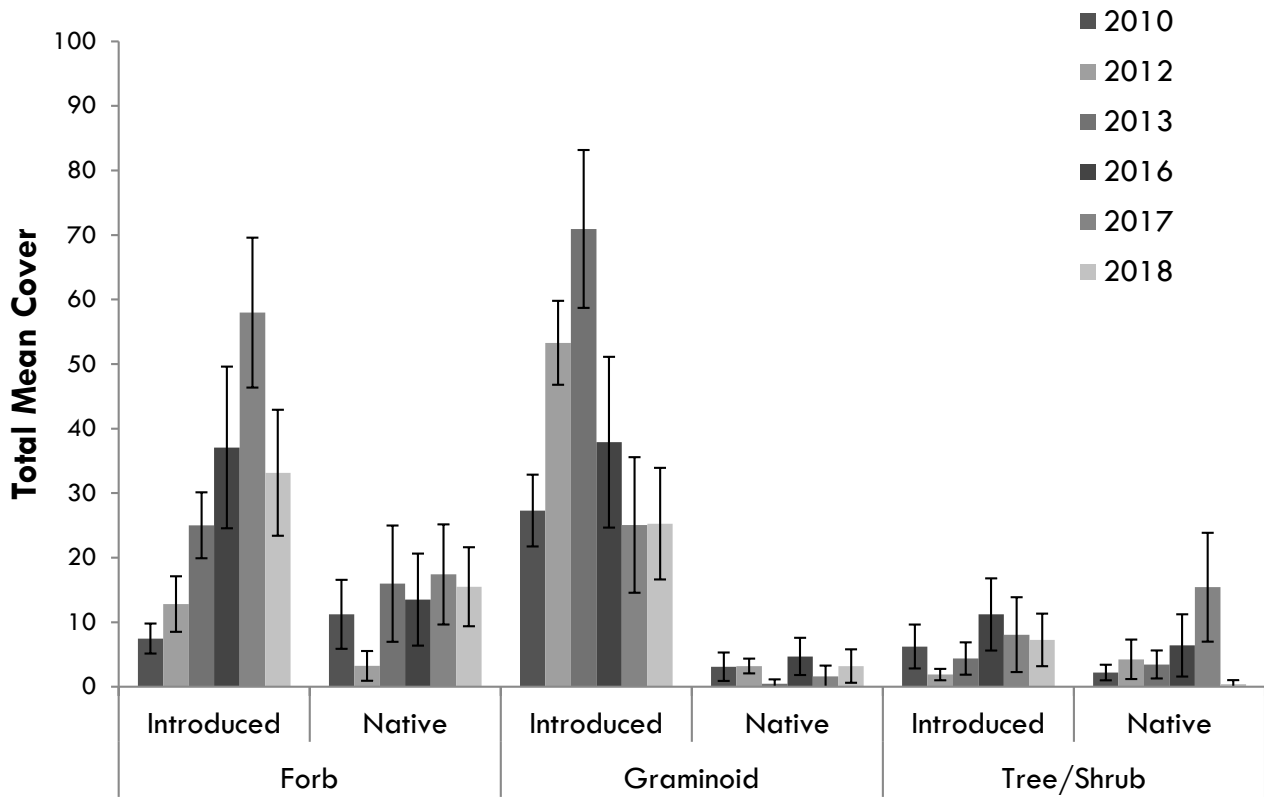


Figure 9. Cover estimates of introduced and native species at West Spires from 2010 to 2018. Bars represent the sum of the average cover of species in each growth form. Estimated cover of each plant management group*nativity = sum (average cover plot⁻¹ for each species in that category). Quantitative surveys did not take place in 2011, 2014 and 2015. Error bars represent 95% confidence intervals.

EAST SPIRES

Treatments at this site began in 2011. Qualitative monitoring took place in 2010, but quantitative data was collected in 2012, 2013, 2016 and 2017. Qualitative monitoring was repeated in 2014 and 2015. Prior to 2011, management at this site included spring and fall mowing (Table 6).

Table 6. Treatment schedule for East Spires at Fern Ridge Reservoir. 2011 was the first year of restoration treatments at this site. Prior to 2011, the site was managed by spring and fall mowing.

Year	Season	Treatments
2007	Spring	Mow
2007	Fall	Burn, broadcast glyphosate, drill grass, plant lupine, nectar, matrix
2008	Spring	Mow
2008	Fall	Mow, tree-grinder to connect with W Spires
2009	Spring	Plant nectar, hand weed <i>Arrhenatherum elatius</i>
2009	Fall	Mow, plant nectar, matrix, lupine, seed nectar
2010	Spring	No action
2010	Fall	No action
2011	Spring	Selectively treat forb weeds
2011	Fall	Burn, broadcast glyphosate, drill <i>Festuca</i> , plant diversity
2012	Spring	Asses for broadcast, plant plugs
2012	Fall	Fall mow
2013	Spring	No action
2013	Fall	No action
2014	Spring	Consider fluazifop or aminopyralid patch treatments
2014	Fall	Mow
2015	Spring	No action
2015	Fall	Mow
2016	Spring	No action
2016	Fall	Burn +glyphosate portion, seed native broadcast + diversity, plant nursery stock, mow
2017	Spring	No action
2017	Fall	Flood with perennial seed (burn portion)
2018	Spring	No action
2018	Fall	Spot spray woodies, mow, December fluazifop
2019	Spring	Fluazifop

Monitoring

We initiated quantitative botanical surveys at East Spires in 2012. Two axes were superimposed on an aerial photo of the meadow (Figure 10) and coordinates were randomly selected for plot placement. We placed 1m aluminum conduit posts at 0, 100, and 129m along the longest axis, which extends north-south. Plots that were outside of the meadow were eliminated and replaced with another randomly selected location until 30 plots were selected. We placed a 1x1m sampling frame at the top right corner at each selected sampling point and estimated the percent cover of each species and ground cover category (bare ground, rock, and moss). For analysis, cover of the native fern *Pteridium aquilinum* was included as part of the native forb category. Quantitative surveys were conducted in 2012, 2013, and 2016-2018. The site was qualitatively monitored in 2014 and 2015.

Results and Discussion

While East Spires has been dominated by introduced graminoids in recent years, we recorded a decline from 2016 to 2018 (from 97.3% to 24.3%, Figure 11). Cover of the most common species, *Agrostis* sp., declined from 17% to 6.7% from 2017 to 2018. *Anthoxanthum odoratum* decreased from 24% in 2016 to 3.4% in 2018. *Arrhenatherum elatius* had low cover in 2017 (2%), but increased in 2018 to 12.3% (Appendix D). Native graminoids remained similar from 2017 to 2018, and were primarily composed of *Festuca roemerii* (Figure 11). Cover of introduced forbs decreased from 2017, which was due mostly to a decline in *Galium parisiense* from 17.9% to 1.1%. Native forb cover also declined from 31.9% in 2017 to 20.5 in 2018.. While *Pteridium aquilinum* and *Eriophyllum lanatum* both increased from 2017 to 2018 (4% to 7.2% and 4.9% to 8.6%, respectively), other native forbs decreased including *Clarkia amoena* (12% to 0%) and *Collomia grandiflora* (3.1% to 0.3%). Cover of introduced trees/shrubs remained <5% in 2018, and native shrubs had similar cover from 2017 to 2018 (5.8% to 2.1%).

Management Recommendations

Treatments on introduced graminoids and forbs have been effective in recent years. We recommend continuing treatments targeting introduced species while increasing native forbs and graminoids at the site. Spot-treatment of introduced forbs should be utilized to minimize impacts to native forbs at the site. We recommend quantitative monitoring in 2019 to record any changes in the plant community due to management actions.



Figure 10. East Spires upland prairie restoration site at Fern Ridge Reservoir. 3' aluminum conduit was placed at 0 (West end), 100, and 129m on an axis running north-south. X and y-axes were superimposed on the meadow in order to randomly select locations for sampling plots.

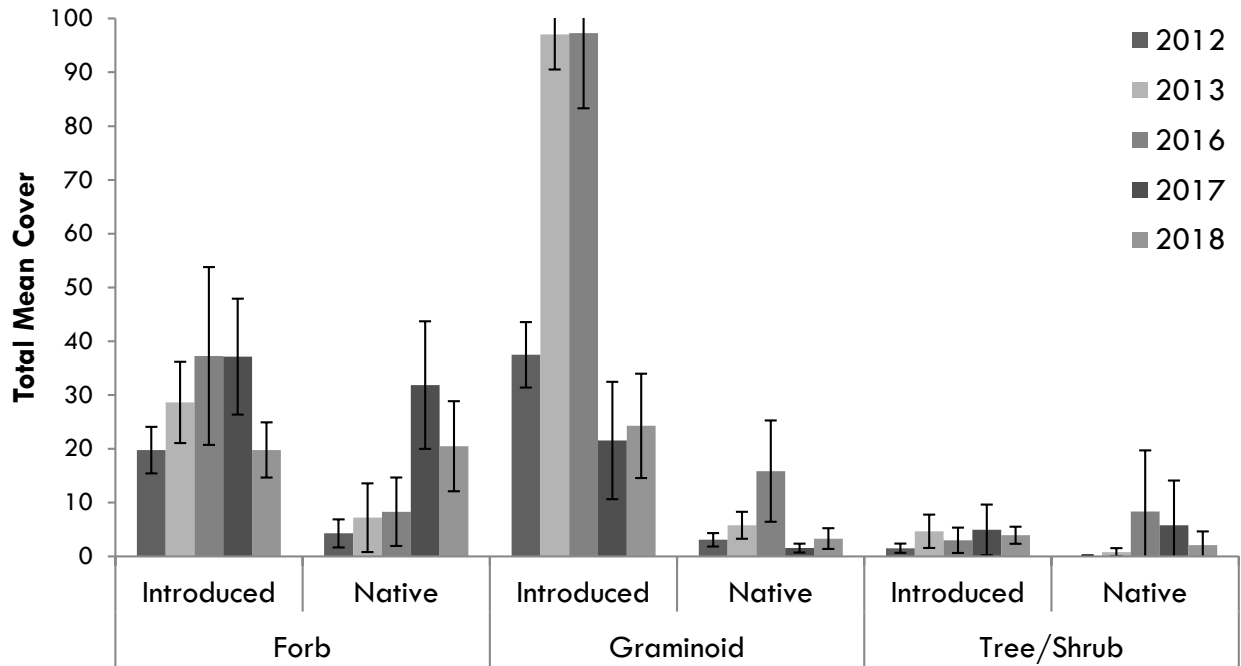


Figure 11. Cover estimates of introduced and native species in at East Spires from 2012, 2013, 2016, 2017 and 2018 (quantitative surveys did not take place in 2014 and 2015). Bars represent the sum of the average cover of species in each growth form. Estimated cover of each plant management group*nativity = sum (average cover plot⁻¹ for each species in that category). Error bars represent 95% confidence intervals.

CHERRY ORCHARD

Restoration treatments and botanical surveys were initiated at Cherry Orchard in spring 2009 (Table 7).

Monitoring

For botanical surveys at Cherry Orchard in 2009, two axes were superimposed on an aerial photo of the meadow (Figure 12) and coordinates were randomly selected for plot placement. We placed a t-post at each end of the longest axis, which extended 228m North-South. The shorter axis was 225m long and ran perpendicular to the long axis. Plots that were outside of the meadow were eliminated and replaced with another randomly selected location until 31 plots were selected. We placed a 1m² sampling frame at the top right corner at each selected sampling point and estimated the percent cover of each species and ground cover category (bare ground, rock, and moss). For analysis, cover of the native fern *Pteridium aquilinum* was included as part of the native forb category. Quantitative monitoring was conducted in 2009, 2014-2016 and 2018.

In growing seasons 2010-2013 and in 2017, we conducted qualitative surveys of the site, noting dominant vegetation and distribution and abundance of species of interest (e.g. valuable native species such as *Sidalcea* or previously dominant invasive species such as *Arrhenatherum elatius*).

Table 7. Treatment schedule for Cherry Orchard at Fern Ridge Reservoir. Prior to 2009, the site was treated with fall mowing

Year	Season	Treatment
2009	Spring	Broadcast glyphosate
2009	Fall	Broadcast glyphosate
2010	Spring	Broadcast glyphosate
2010	Fall	Broadcast glyphosate
2011	Spring	Broadcast glyphosate and aminopyralid
2011	Fall	Assess, broadcast glyphosate, drill fescue for seed production
2012	Spring	Assess for broadcast, broadcast chaparral
2012	Fall	Drill fescue
2013	Spring	Broadcast fluazifop
2013	Fall	Burn +glyphosate, diversity planting, drill <i>Festuca</i> , diversity seed and plugs
2014	Spring	Spot-spray <i>Holcus lanatus</i>
2014	Fall	Fall mow, diversity planting
2015	Spring	No action
2015	Fall	Burn, broadcast glyphosate, seed diversity
2016	Spring	Broadcast fluazifop 2x
2016	Fall	Plant bulbs
2017	Spring	No action
2017	Fall	Seed <i>Lupinus oreganus</i> , plant bulbs
2018	Spring	No action
2018	Fall	Burn, diversity seed, meadow push-back, <i>Camassia</i> bulbs, <i>Geranium</i> stock, <i>Sidalcea virgate</i> gallons, December fluazifop
2019	Spring	Fluazifop

Results and Discussion

The plant community at Cherry Orchard has shifted from an introduced-species dominated community to one with higher native species composition between 2009 and 2018 (Figure 13). Overall, the site has experienced a decline in introduced graminoids coupled with an increase of native graminoids. Introduced graminoid cover decreased from 50% in 2009 to 13.7% in 2018. *Agrostis* spp., *Arrhenatherum elatius*, and *Schedonorus arundinacea* were all dominant species in previous years, but in 2018 had <1% cover (Appendix E). Cover of *Vulpia* spp. has varied over the years but declined from 24.4% in 2016 to 6.4% in 2018. The seeded native graminoid *F. roemerii* remains a dominant species with 51.1% cover. Native forbs have steadily increased at the site reaching their highest level in 2018 (14%, Figure 13). This was due to increases in *Eriophyllum lanatum* (0.1% in 2016 to 3.4% in 2018) and *Prunella vulgaris* (3.9% in 2016 to 8.2% in 2018). While introduced forbs experienced a large increase in 2016, 2018 values were similar to those recorded pre-2016 (Figure 13). Cover of *Galium parisiense* jumped from 0% in 2015 to 37% in 2016, then back to <1% in 2018 (Appendix E). The increase of introduced forbs may be associated with multiple years of herbicide treatments that targeted and reduced graminoid cover (Figure 13). *Daucus carota* and *Hypochaeris radicata* both increased in cover from 2016 to 2018 (0.8% to 3.2% and 1.6% to 6.4%, respectively).

Management Recommendations

We recommend a quantitative survey in 2019 in order to assess need for spot treatments of introduced species and get more clarification regarding the total cover of introduced forbs at the site. Future efforts targeted toward control of *Vulpia* spp. and other introduced graminoids should be considered, with considerations made to limit impact to native graminoids.

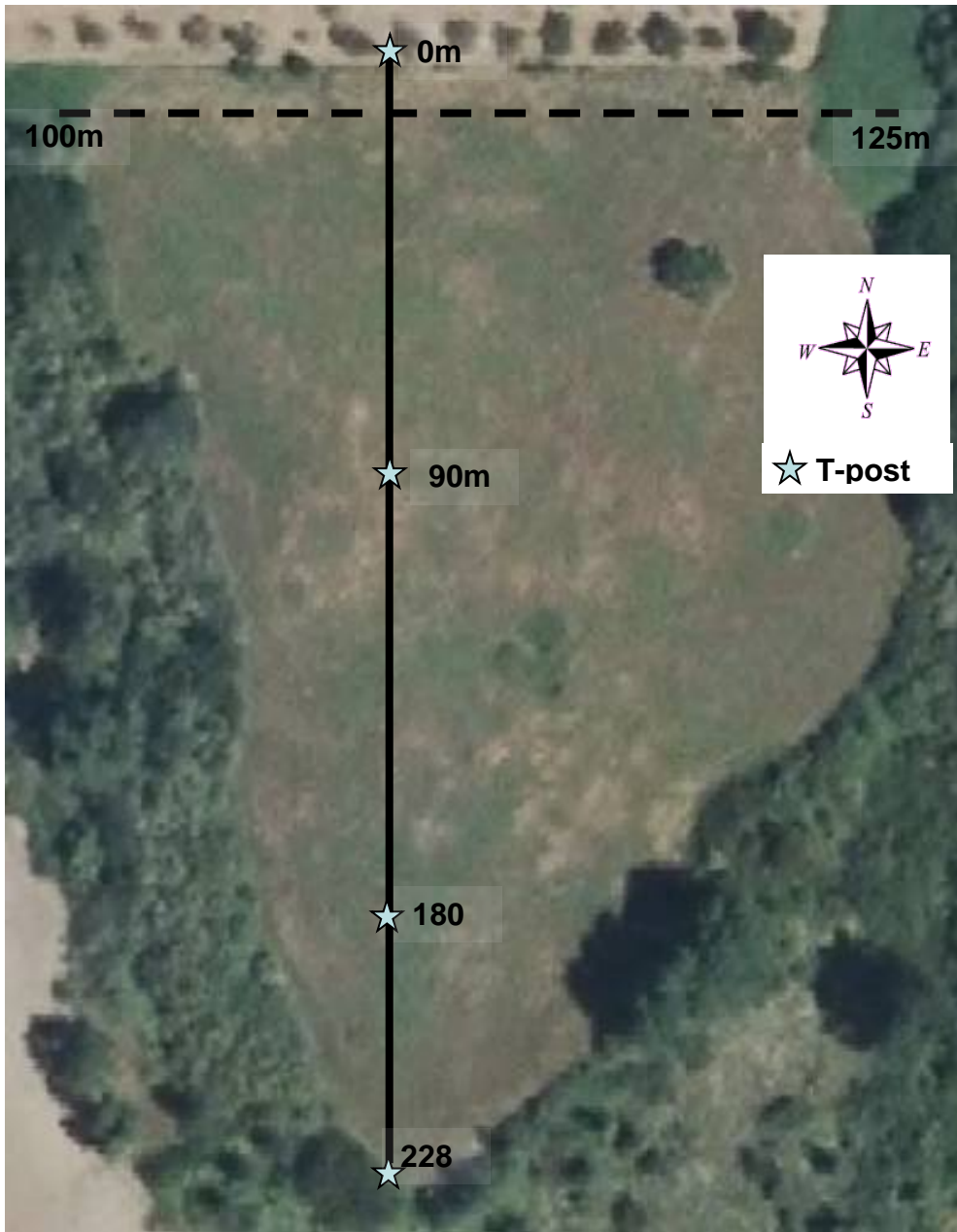


Figure 12. Cherry Orchard upland prairie restoration site at Fern Ridge Lake. An x and y-axis were superimposed on the meadow in order to randomly select locations for sampling plots. T-posts were placed at 0, 90, 180, and 228m on axis running east-west.

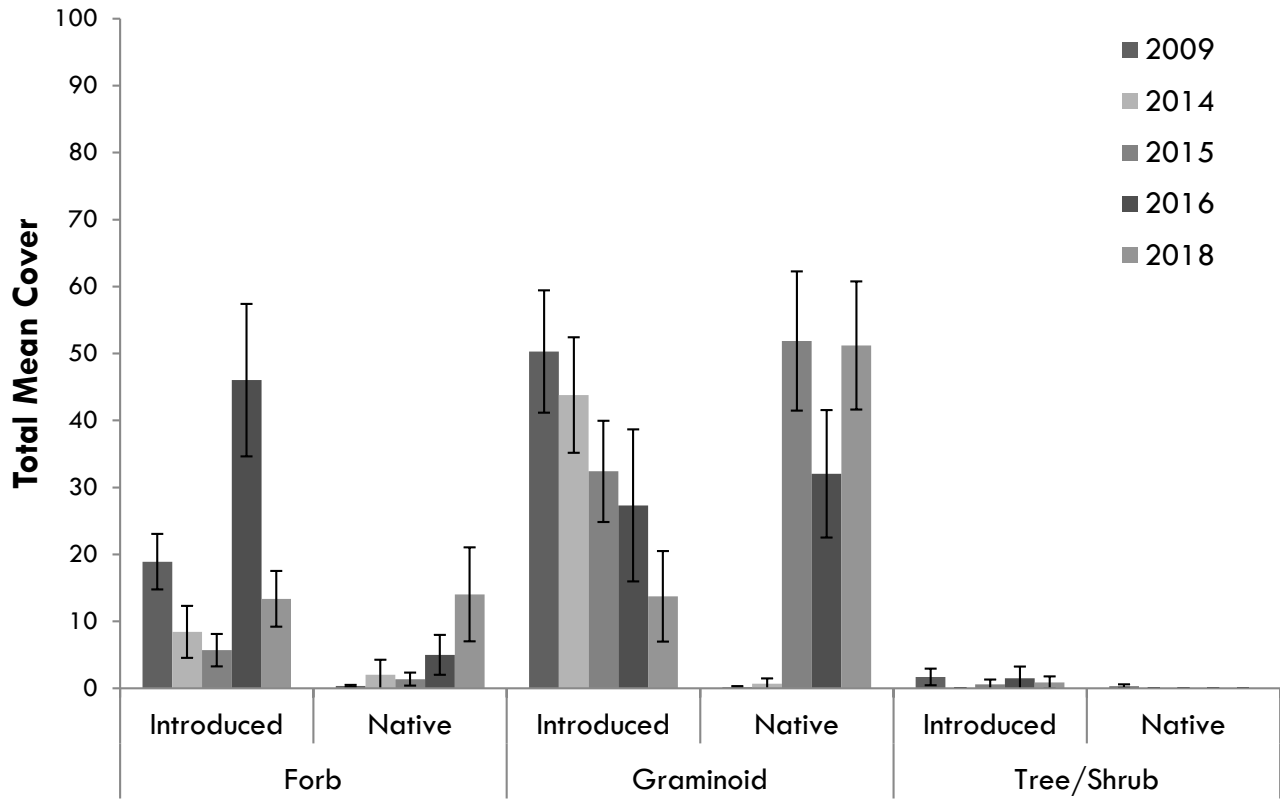


Figure 13. Cover estimates of introduced and native species at Cherry Orchard in 2009, 2014, 2015, 2016 and 2018 (quantitative surveys were not conducted in 2010, 2011, 2012, 2013, and 2017). Bars represent the total cover of all species in each growth form. Estimated cover of each plant management group*nativity = sum (average cover plot⁻¹ for each species in that category). Error bars represent 95% confidence intervals.

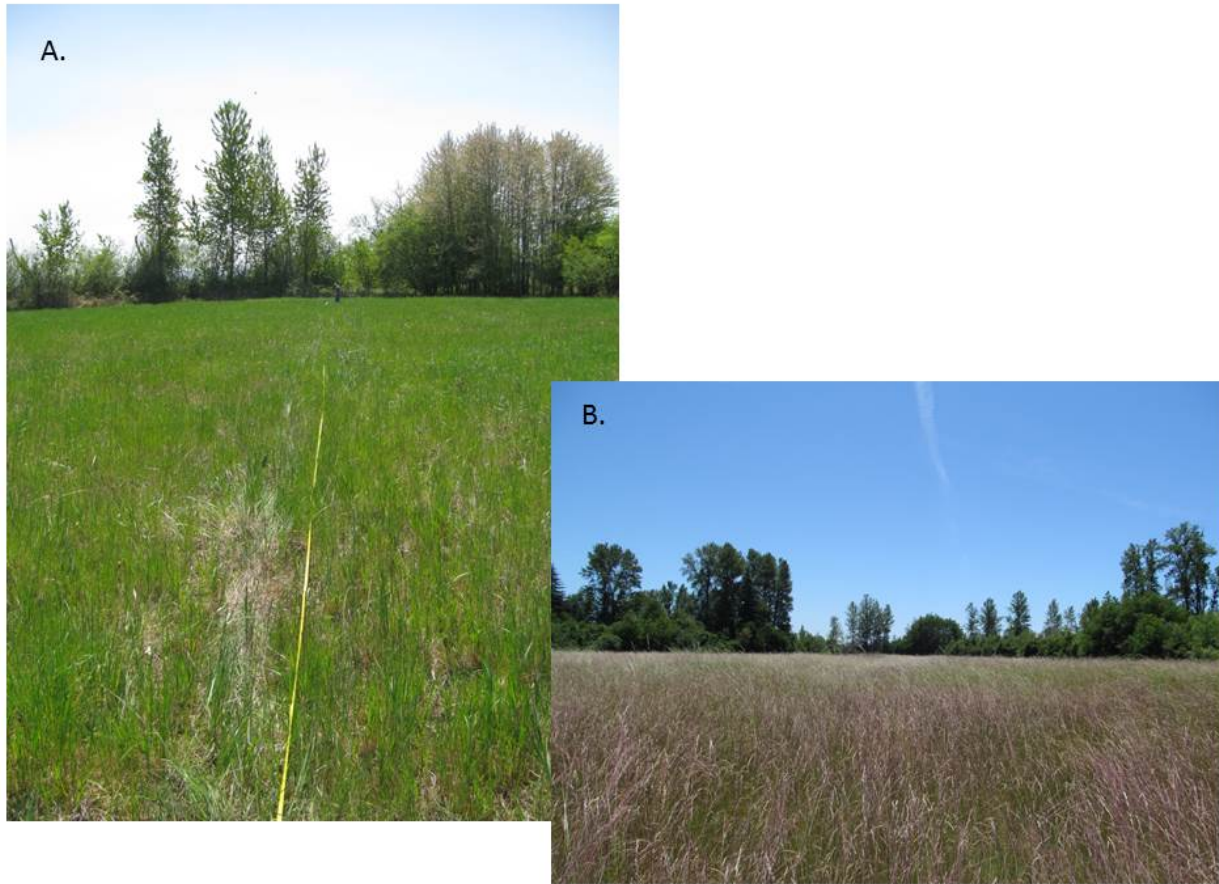


Figure 14. Cherry Orchard site in (a) April 2009 prior to herbicide treatments and (b) in June 2014.

WEST SHORE

Monitoring began in 2010 with treatments commencing in 2011 (Table 8). Prior to 2010, management at this site included spring and fall mowing.

Table 8. Treatment schedule for West Shore at Fern Ridge Reservoir. 2011 was the first year of restoration treatments at this site. Prior to 2011, the site was managed with spring and fall mowing.

Year	Season	Treatments
2011	Spring	Broadcast fluazifop
2011	Fall	Assess experiments
2012	Spring	No action
2012	Fall	Mow
2013	Spring	Broadcast fluazifop except east patch; hand weeding
2013	Fall	Plant plugs, <i>Lupinus</i>
2014	Spring	Experimental fluazifop
2014	Fall	Mow
2015	Spring	Experimental fluazifop
2015	Fall	Mow
2016	Spring	Broadcast fluazifop two times
2016	Fall	Burn + glyphosate portion, seed native perennials, mow
2017	Spring	No action
2017	Fall	Flood with perennial seed
2018	Spring	No action
2018	Fall	Spot spray woodies, mow, meadow pushback
2019	Spring	No treatment scheduled

Monitoring

We initiated botanical surveys at West Shore in May 2010. Two axes were superimposed on an aerial photo of the meadow (Figure 15) and coordinates were randomly selected for plot placement. We placed 1m aluminum conduit posts at 0, 100, and 200m along the longest axis, which extends North-South. We also placed conduit at 0 and 91m along the east-west short axis. Plots that were outside of the meadow were eliminated and replaced with another randomly selected location until 30 plots were selected. We placed a 1x1m sampling frame at the top right corner at each selected sampling point and estimated the percent cover of each species and ground cover category (bare ground, rock, and moss). For analysis, cover of the native fern *Pteridium aquilinum* was included as part of the native forb category. Quantitative surveys were conducted again from 2011- 2013, 2016, 2017, and 2018. Qualitative monitoring occurred in 2014 and 2015. Data presented for these years does not include plots in the northern section of the site which was monitored inconsistently.

Results and Discussion

Plant community composition has varied over the course of this study (Figure 16). The site has experienced an increase in introduced forbs from 2010 to 2018 (Figure 16). *Daucus carota* increased from 4.7% to 14.3% from 2017 to 2018 (Appendix E). Native forb cover shows variability throughout the site over time, but has remained relatively stable, with 29% in 2018. Native forbs with the greatest cover included *Apocynum androsaemifolium* (5.6%), *Prunella vulgaris* (5.5%) and *Pteridium aquilinum* (16.8%). Introduced graminoid cover remained similar to values recorded in 2017 at 8.2%. Introduced graminoids with the highest cover were *Anthoxanthum odoratum* (3.9%) and *Vulpia* spp. (2.1%). Native graminoid cover was <1% in 2018. Native tree cover declined slightly from 2017 to 2018, while introduced trees/shrubs increased from 5.2% to 10.4% from 2017 to 2018 (Figure 16), due primarily to an increase in *Rubus armeniacus*.

Management Recommendations

As introduced forbs are a particular problem at this site, we recommend spot-spraying with a broadleaf herbicide. Introduced graminoids should be spot-sprayed as needed. We also recommend spot treatments of *Rubus* and ongoing maintenance by mowing. We suggest adding a native graminoid seed mix planting in the fall of 2019.



Figure 15. West Shore upland prairie restoration site at Fern Ridge Lake. Aluminum conduit was placed at 0 and 91m on the east/west axis and 0, 100, and 200m on the north/south axis.

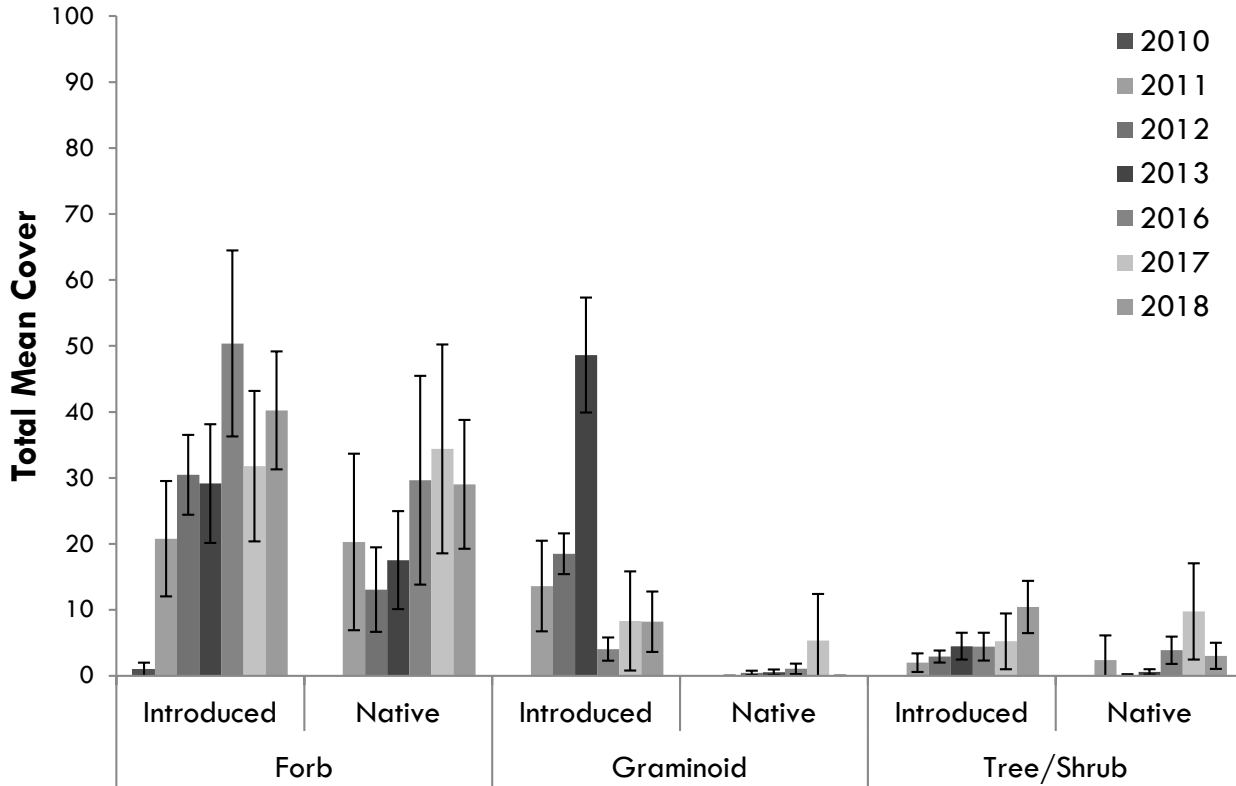


Figure 16. Cover estimates of introduced and native species at West Shore for 2010, 2012, 2013, 2016, 2017 and 2018 (quantitative surveys were not conducted in 2011, 2014 and 2015). Bars represent the sum of the average cover of species in each growth form. Estimated cover of each plant management group*nativity = sum (average cover plot⁻¹ for each species in that category). Error bars represent 95% confidence intervals.

EAST SHORE

Although dominated by invasive grasses, East Shore has a relatively high cover of native forbs, including *Sidalcea*, *Fragaria*, and *L. oreganus*. Prior to 2011, management at this site included spring and fall mowing (Table 9).

Table 9. Treatment schedule for East Shore at Fern Ridge Reservoir. 2011 was the first year of restoration treatments at this site. Prior to 2011, the site was managed by spring and fall mowing.

Year	Season	Treatments
2011	Spring	Broadcast fluazifop
2011	Fall	Assess experiments
2012	Spring	No action
2012	Fall	Mow
2013	Spring	Broadcast fluazifop except east patch; hand weeding
2013	Fall	Plant plugs, <i>Lupinus</i>
2014	Spring	Broadcast fluazifop if needed
2014	Fall	Mow
2015	Spring	No action
2015	Fall	Mow
2016	Spring	Broadcast fluazifop two times
2016	Fall	Mow
2017	Spring	No action
2017	Fall	Flood with perennial seed
2018	Spring	No action
2018	Fall	Spot spray woodies, mow, meadow pushback
2019	Spring	No treatment scheduled

Monitoring

We initiated botanical surveys at East Shore in May 2010. Two axes were superimposed on an aerial photo of the meadow (Figure 17) and coordinates were randomly selected for plot placement. We placed 1m aluminum conduit posts at 0, 100, and 158m along the longest axis, which extends East-West. Plots that were outside of the meadow were eliminated and replaced with another randomly selected location until 30 plots were selected. We placed a 1x1m sampling frame at the top right corner at each selected sampling point and estimated the percent cover of each species and ground cover category (bare ground, rock, and moss). For analysis, cover of the native fern *Pteridium aquilinum* was included as part of the native forb category. Quantitative surveys were conducted again in 2012, 2013, 2016, 2017, and 2018. Qualitative monitoring occurred in 2014, 2015, and 2017.

Results and Discussion

East Shore has been a forb dominated community, with a steady increase in introduced forbs as the dominant plant group in the community, despite a drop in cover in 2018 from 78.8% to 33.4% (Figure 18). Introduced forbs with the highest cover were *Hypochaeris radicata* (8%) and *Daucus carota* (15.1%) (Appendix G). Native forbs have also been increasing over the years of this study, with the highest cover occurring in 2017 (47.8%). Native forb cover decreased to 20.8% in 2018, associated with a decline in *Apocynum androsaemifolium* from 23% to 0% from 2017 to 2018. The most abundant native forbs in 2018 included *Fragaria virginiana* (7.1%), *Sidalcea virgata* (5.1%) and *Pteridium aquilinum* (native fern; 7.6%) (Appendix G). Introduced graminoid cover has varied over the years, with an increase from 2017 to 2018 (16.7% to 25.6%, respectively; Figure 18). Cover of *Anthoxanthum odoratum* increased from 0.3% to 5.4% from 2017 to 2018, while cover of *Vulpia bromoides* declined from 6.9% to 0%. Native graminoid cover has remained low and consistent with past years, with less than 1% cover. In 2018, introduced shrub cover remained similar to in 2017 at 4.8%, this was composed entirely of *Rubus armeniacus*. Native shrub cover increased from 1.5% to 13.4% from 2017 to 2018, and was composed primarily of *Amelanchier alnifolia* (9.6%).

Management Recommendations

We recommend spot treatment to target introduced forbs and reduce impacts to native forbs, and targeted treatment with fluazifop to continue reductions of introduced graminoids, followed by seeding of native species. We also recommend spot treatment of *Rubus* and ongoing maintenance by mowing. Given the changes observed in 2018 we recommend continued quantitative monitoring in 2019 to capture fluctuations in plant community composition.



Figure 17. East Shore upland prairie restoration site at Fern Ridge Reservoir. Aluminum conduit was placed at 0, 100, and 158m on the east/west axis.

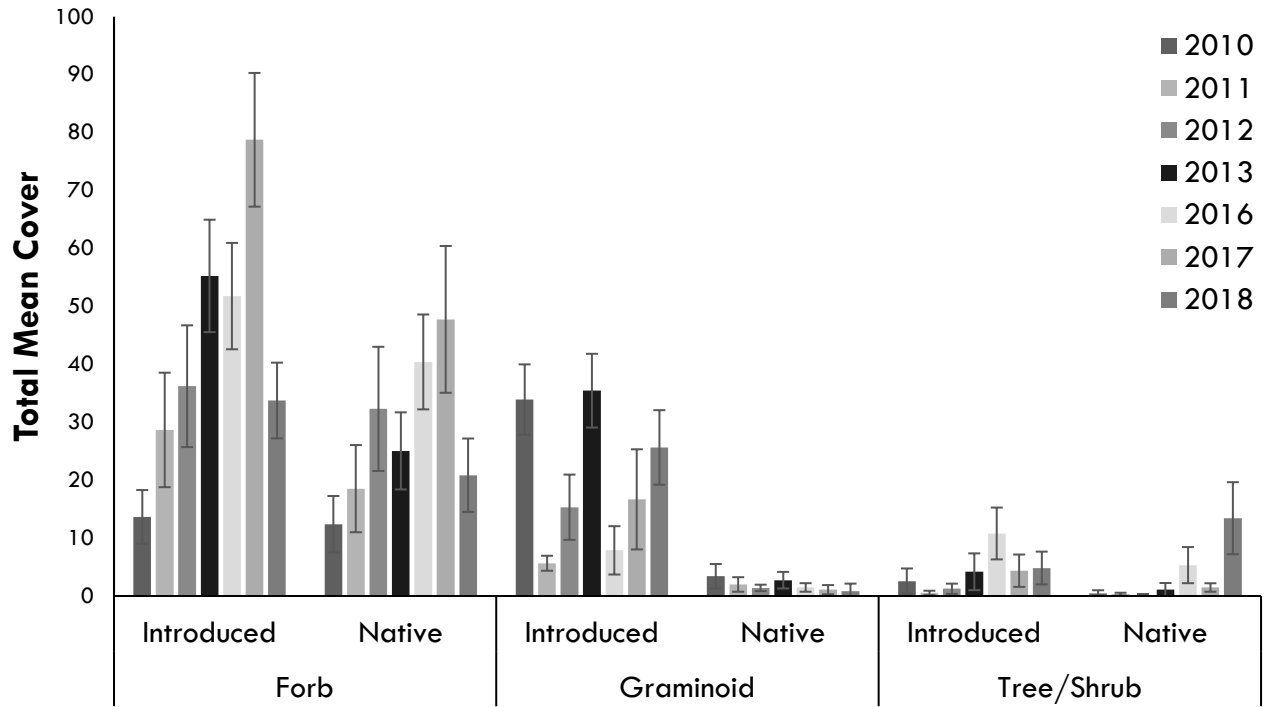


Figure 18. Cover estimates of introduced and native species in at East Shore for 2010, 2012, 2013, 2016, 2017 and 2018 (quantitative surveys did not take place in 2011, 2014, and, 2015). Bars represent the sum of the average cover of species in each growth form. Estimated cover of each plant management group*nativity = sum (average cover plot⁻¹ for each species in that category). Error bars represent 95% confidence intervals.

NORTH EATON

North Eaton has been dominated by *Anthoxanthum odoratum* in previous years, which was suppressing forbs and grasses, both native and introduced introduced species. In recent years it has shifted to a native graminoid and introduced forb-dominated community. This site is occupied by three large patches of *Lupinus*. Treatments were initiated in spring 2010 (Table 10). Prior to this, the site was mowed in the spring and fall of each year.

Table 10. Treatment schedule for North Eaton at Fern Ridge Reservoir. 2010 was the first year of restoration treatments at this site. Prior to 2010, the site was managed with spring and fall mowing.

Year	Season	Treatments
2010	Spring	Broadcast glyphosate + aminopyralid, treat <i>Centaurea pratensis</i>
2010	Fall	Broadcast glyphosate + aminopyralid
2011	Spring	Broadcast glyphosate + aminopyralid, assess for mowing
2011	Fall	Assess, broadcast glyphosate, drill <i>Festuca</i>
2012	Spring	Broadcast Chaparral
2012	Fall	Drill <i>Festuca</i>
2013	Spring	Broadcast fluazifop; assess for broadleaf spray
2013	Fall	Assess for diversity planting (did not plant)
2014	Spring	Asses for fluazifop and/or Chaparral or hand-weeding in spots and patches
2014	Fall	Fall mow
2015	Spring	No action
2015	Fall	Mow
2016	Spring	Broadcast fluazifop two times
2016	Fall	Burn +glyphosate portion, mow, seed native perennials, LUOR, CATO & ALAM bulbs
2017	Spring	No action
2017	Fall	Flood with perennial seed
2018	Spring	No action
2018	Fall	Spot spray woodies, mow, <i>Allium</i> bulbs, fluazifop
2019	Spring	Fluazifop

Monitoring

We initiated botanical surveys at North Eaton in May 2010. Two axes were superimposed on an aerial photo of the meadow (Figure 19) and coordinates were randomly selected for plot placement. We placed 1m aluminum conduit posts at 0, 100, and 200 along the longest axis, which extends east-west. Plots that were outside of the meadow were eliminated and replaced with another randomly selected location until 30 plots were selected. We placed a 1x1m sampling frame at the top right corner at each selected sampling point and estimated the percent cover of each species and ground cover category (bare ground, rock, and moss). For analysis, cover of the native fern *Pteridium aquilinum* was included as

part of the native forb category. In 2013, 2016, 2017, and 2018 we quantitatively surveyed the vegetation as described above.

In spring 2011, 2012, 2014 and 2015, we conducted qualitative surveys of the site, noting dominant vegetation and distribution and abundance of species of interest (e.g. native species such as *Sidalcea* or previously dominant invasive species such as *Arrhenatherum elatius*). We also systematically surveyed the entire site for the presence of *Centaurea pratensis*.

Results and Discussion

Since 2010, cover of introduced forbs has increased greatly, with the largest increase occurring between 2013 and 2016 (7.4 to 41.2%, respectively; Figure 20). In 2018, introduced forb cover declined to 16.6%. *Galium parisiense* declined from 15.6% to 0.5% from 2017 to 2018, while *Hypochaeris radicata* increased slightly from 12.9% to 13.2% (Appendix H). Native forbs remain relatively low in cover with a slight increase from 2017 values (3.9 to 6.2%; Figure 20). *Pteridium aquilinum* (a native fern) had the highest native forb cover at 2.2%. Introduced graminoids had decreased since 2013 (44.6%), however since 2016 cover increased from 15.2 to 27.5% (Figure 20). Introduced graminoids with the highest cover in 2018 were *Agrostis* spp. (20.8%) and *Anthoxanthum odoratum* (6.4%). Native graminoids have increased markedly since 2010 values (from 4.5% to 32%) and have remained stable, primarily composed of the seeded *Festuca roemerii* (31.8%). *Deschampsia cespitosa* was present at 3% in 2017 but declined to 0% in 2018. Cover of introduced shrubs in 2018 remained the same as in 2017 (6.9%). Common introduced shrubs were *Cytisus scoparius* (5.6%) and *Rubus armeniacus* (1.3%). Native shrubs increased from 2017 values (1.5% to 3.6%) which was likely a reflection of an increase in *Rubus ursinus* from 2016 to 2017 (Appendix H).

Management Recommendations

We recommend continued surveys at the site in 2019 to detect post-treatment changes in community composition. At other sites, we have observed a strong increase in cover of sub-dominant invasive species (e.g. *Agrostis* and *Daucus*) after successful treatment of dominant invasive grasses. Continued treatment to increase native forb composition is suggested. Treatments targeting *Cytisus* will be necessary to treat patches in the northeast and western corners of the site. Additionally, spot treatments or hand pulling *Centaurea* is needed to keep the invasive forb out of the site.



Figure 19. North Eaton upland prairie restoration site at Fern Ridge Lake. An x and y-axis were superimposed on the meadow in order to randomly select locations for sampling plots. T-posts were placed at 0, 100, and 200m on an axis running east-west. The small diamonds and coordinates represent the locations of each randomly placed sampling plot.

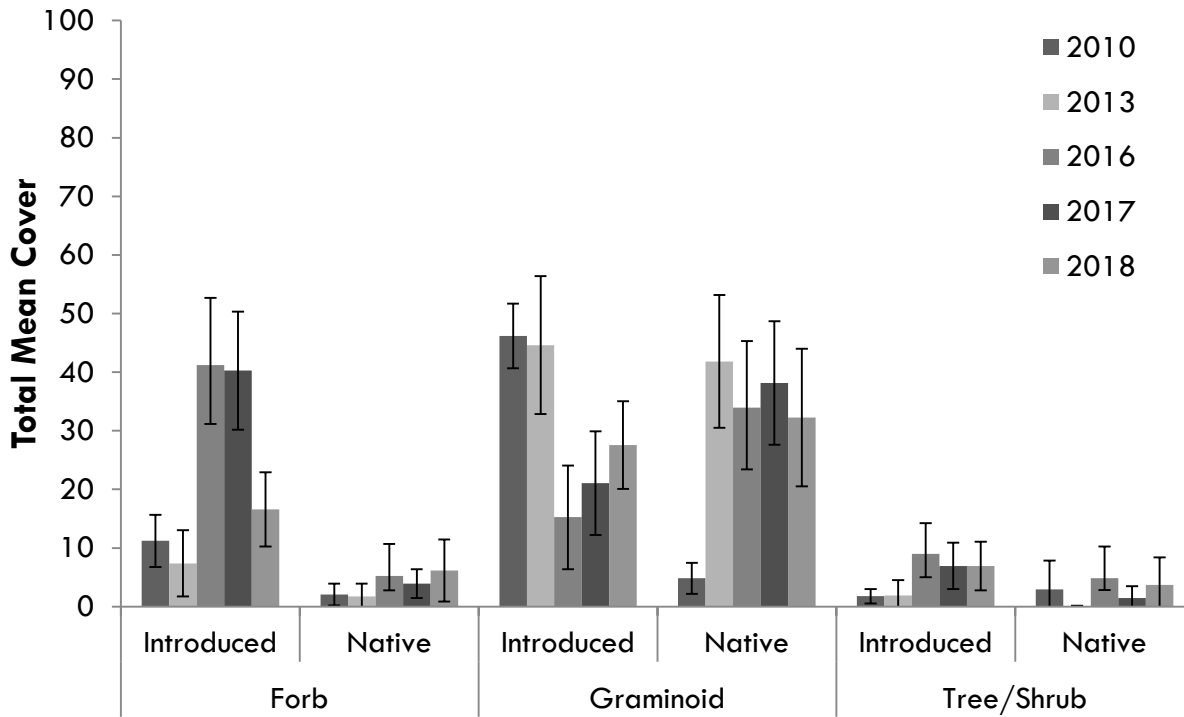


Figure 20. Cover estimates of introduced and native species in untreated and treated increments at North Eaton in 2010, 2013, 2016, 2017 and 2018. Bars represent the total cover of all species in each growth form. Estimated cover of each plant management group*nativity = sum (average cover plot⁻¹ for each species in that category). North Eaton was monitored qualitatively in 2012, 2014, and 2015. Error bars represent 95% confidence intervals.

SOUTH EATON

South Eaton was split along a north/south axis into 3 treatment sections (Table 11). 2007 was the first year of restoration treatments in the central 3.3 acres. Treatments were initiated in fall 2009 for the east 2.4 acres and spring 2010 in the west 3 acres.

Table 11. Treatment schedule for South Eaton at Fern Ridge Reservoir. 2007 was the first year of restoration treatments in the central 3.3 acres. Treatments were initiated in fall 2009 the east 2.4 acres and spring 2010 in the west 3 acres.

Year	Season	Treatments
South Eaton Central		
2007	Spring	Broadcast glyphosate & dicamba ¹
2007	Fall	Mow, broadcast glyphosate & dicamba, drill grass
2008	Spring	No action
2008	Fall	Mow
2009	Spring	Hand weed <i>Arrhenatherum elatius</i>
2009	Fall	Mow, broadcast aminopyralid
2009	Fall	Broadcast aminopyralid, treat <i>Centaurea pratensis</i>
2010	Spring	Broadcast aminopyralid, treat <i>Centaurea pratensis</i> , hand weed <i>Daucus carota</i>
2010	Fall	No action
2011	Spring	Broadcast aminopyralid & fluazifop
2011	Fall	Assess, broadcast glyphosate, drill <i>Festuca</i>
2012	Spring	Assess for broadcast, broadcast Chaparral
2012	Fall	Drill <i>Festuca</i>
2013	Spring	Broadcast fluazifop; assess for broadleaf spray
2013	Fall	Burn and glyphosate; drill <i>Festuca</i> ; assess for diversity planting (no planting)
2014	Spring	Asses for fluazifop and/or Chaparral (no treatment)
2014	Fall	Fall mow

2015	Spring	Asses for fluazifop and/or Chaparral (no treatment)
2015	Fall	Burn, broadcast glyphosate
2016	Spring	Broadcast fluazifop two times, broadcast aminopyralid + glyphosate
2016	Fall	Broadcast aminopyralid + glyphosate
2017	Spring	Broadcast aminopyralid + glyphosate
2017	Fall	Broadcast aminopyralid + glyphosate
2018	Spring	No action
2018	Fall	broadcast glyphosate + triclopyramine
2019	Spring	No treatment scheduled
South Eaton East		
2009	Fall	Mow, broadcast glyphosate
2010	Spring	Broadcast glyphosate & Aminopyralid
2010	Fall	Broadcast spray
2011	Spring	Broadcast glyphosate & aminopyralid
2011	Fall	Assess for broadcast, drill <i>Festuca</i>
2012	Spring	Assess for broadcast, broadcast Chaparral
2012	Fall	Drill <i>Festuca</i>
2013	Spring	Broadcast fluazifop; assess for broadleaf spray
2013	Fall	Burn and glyphosate part, drill <i>Festuca</i> , seed <i>Lupinus</i> , diversity seed and plug planting
2014	Spring	Assess for fluazifop and/or Chaparral or hand-weeding in patches (treatments did not occur)
2014	Fall	Fall mow, diversity planting
2015	Spring	Assess for fluazifop and/or Chaparral or hand-weeding in patches (treatments did not occur)
2015	Fall	Burn, broadcast glyphosate, seed diversity
2016	Spring	Broadcast fluazifop 2x
2016	Fall	Mow, seed <i>Lupinus oreganus</i> and diversity species
South Eaton West		

2010	Spring	Broadcast glyphosate, treat <i>Centaurea pratensis</i>
2010	Fall	Broadcast glyphosate
2011	Spring	Broadcast glyphosate + aminopyralid
2011	Fall	Assess, broadcast glyphosate, drill <i>Festuca</i>
2012	Spring	Assess for broadcast, broadcast Chaparral
2012	Fall	Drill <i>Festuca</i>
2013	Spring	Broadcast fluazifop (except east patch); assess for broadleaf spray
2013	Fall	Burn and glyphosate part, drill <i>Festuca</i> , lupine seed, diversity planting
2014	Spring	Assess for fluazifop and/or Chaparral or hand-weeding in patches (treatments did not occur)
2014	Fall	Fall mow
2015	Spring	Assess for fluazifop and/or Chaparral or hand-weeding in patches (treatments did not occur)
2015	Fall	Burn, broadcast glyphosate, seed diversity
2016	Spring	Broadcast fluazifop 2x
2016	Fall	Mow, seed <i>Lupinus oreganus</i> and diversity species

¹Dicamba is effective against legumes and has some residual activity.

Monitoring

We initiated botanical surveys at South Eaton in May 2009. Two axes were superimposed on an aerial photo of the meadow (Figure 21) and coordinates were randomly selected for plot placement. We placed a t-post at each end of the longest axis, which extended 242 m north-south. The shorter axis was 154m long and ran perpendicular to the long axis. Plots that were outside of the meadow were eliminated and replaced with another randomly selected location until 39 plots were selected. We placed a 1x1m sampling frame at the top right corner at each selected sampling point and estimated the percent cover of each species and ground cover category (bare ground, rock, and moss). When conducting our surveys, we noted which plots were in the central (untreated, n = 17) or east or west (treated, n = 22) segments.

In spring from 2010 to 2014, we conducted qualitative surveys of the site, noting dominant vegetation and distribution and abundance of species of interest (e.g. native species such as *Sidalcea* or previously dominant invasive species such as *Arrhenatherum elatius*). We also systematically surveyed the entire site for the presence of *Centaurea*.

In 2015-2018 we monitored quantitatively, utilizing a similar transect layout. We broke the site up into the three treatment sections (west, central, and east), and randomly selected points to have 10 plots per section (Figure 21). In 2018, the west, central and east sections had 16, 15 and 15 plots monitored, respectively. Percent cover of all species was visually estimated similarly to previous years. For analysis, cover of the native fern *Pteridium aquilinum* was included as part of the native forb category.



Figure 21. South Eaton upland prairie restoration site at Fern Ridge Reservoir, broken into approximate sections for management. West, east, and central sections were monitored separately in 2015 and beyond. An x and y-axis were superimposed on the meadow in order to randomly select locations for sampling plots, monitoring 10 plots per section.

Results and Discussion

Plant community composition has varied in the three sections from 2015-2018 (Figure 22). The East and West sections have followed similar trends in graminoid composition over time, however in 2018 they differed. Both sections experienced a decrease in introduced graminoids from 2016-2017, however in West introduced graminoids increased from 2017 to 2018, whereas they continued to decline in the East section (Figure 22). Introduced graminoids responsible for the decline observed in the East (30% to 6%) and West (50% to 20%) include *Vulpia* spp. and *Aira caryophyllea* (Appendix I). Native graminoids increased in both sections from 2016 to 2017, from 14.6% to 55.6% in the West and from 12.8% to 39.8% in the East. In 2018 native graminoid abundance declined in the West section to 38.8% and remained similar in the East section at 37.8%; these changes are associated solely with the abundance of the seeded native *F. roemerii* at the site (Appendix I). Forb composition differed between the East and West sections across years (Figure 22). In the West section, we observed an increase in introduced forbs from 2016 to 2017 (12.9 to 46.7%). From 2017 to 2018, however, introduced forbs declined from 46.7% to 32.8%, which was associated with a decline in *Hypochaeris radicata* (from 37% to 21%) and *Plantago lanceolata* (17% to 4%) (Figure 22, Appendix I). In the East section, introduced forbs increased from 27.8% to 56.2% from 2016 to 2017, and then declined to 43%, these changes were largely associated with variability in *H. radicata*. Native forbs remain uncommon in the East and West sections from 2017 to 2018 (Figure 22).

The Central section, which has been treated differently than the East and West sections, has experienced different trends. Introduced forb cover declined slightly from 2017 to 2018 (24.7% to 21.7%; Figure 22), which was due in part to a decline in *Plantago lanceolata* from 21.8% to 7.7% (Appendix I). Native forb cover has remained very low over the course of this study (<1%, Appendix I). Introduced graminoids declined from 2017 (12.5% to 2.2%), which is associated with a decline in *Vulpia bromoides*. Native graminoids remain in trace amounts in the Central section of the site (<1%, Figure 22). Native and introduced shrubs were present in trace amounts in 2018 (<1%; Appendix I).

Management Recommendations

At South Eaton, we recommend following the matrix treatments outlined in Table 1. *Centaurea* should be spot-sprayed or hand-pulled. A small trail through the hedgerow between North and South Eaton ends at the *Centaurea* patch in the west segment of South Eaton and may serve as a dispersal corridor for *Centaurea*. As the longevity of *Centaurea* seeds in the soil can be >6 years (Callihan et al. 1993; Davis et al. 1993), monitoring should continue for multiple years after all individuals have been eradicated.

Introduced forbs remain abundant at the site, so spot treatment of introduced forbs such as *H. radicata* should be considered. Following these treatments, seeding with native grasses and forbs would be ideal, particularly in the central section where native composition is very low. Continued treatments that target introduced graminoids while

promoting native graminoids should be maintained as they seem to be effective. We recommend continued monitoring in 2019 to evaluate community response to treatments, which will allow determination of impacts to both native and introduced species.

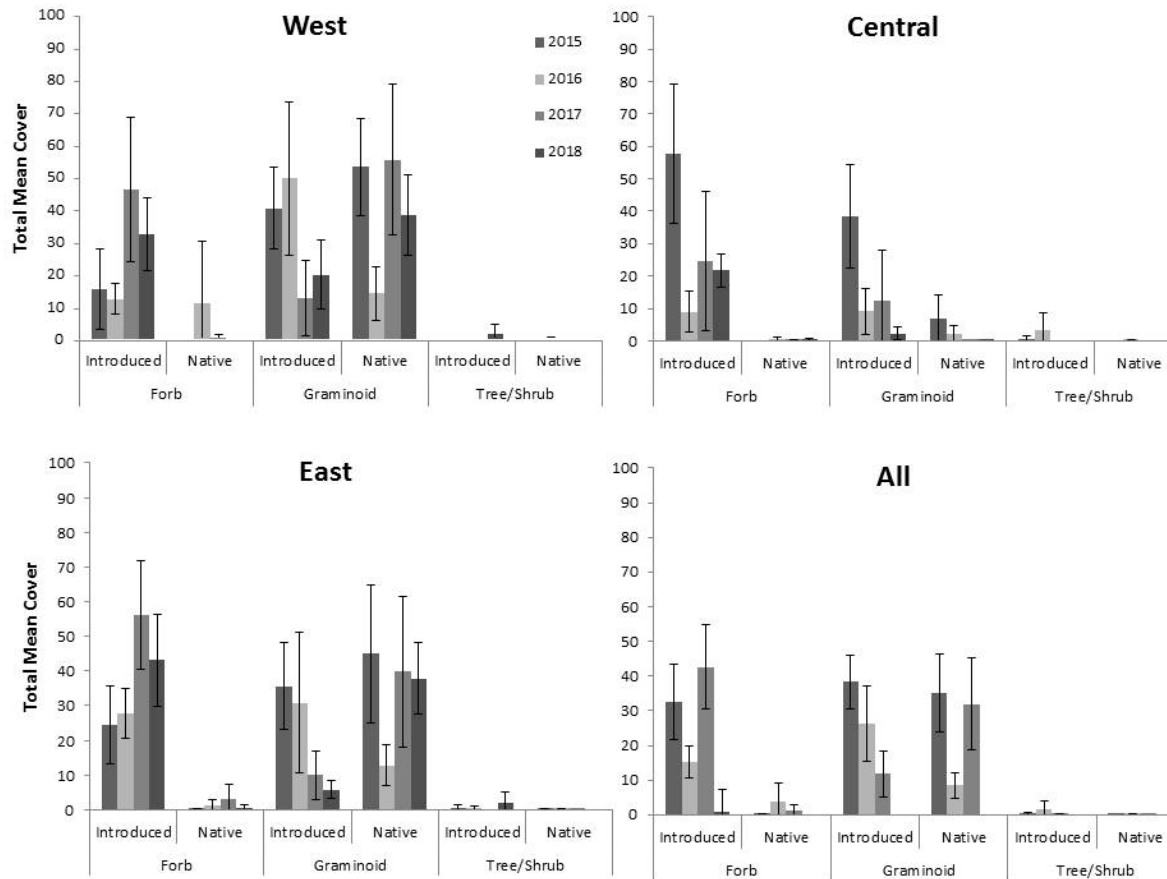


Figure 22. Cover estimates of introduced and native species in west, central and east sections at South Eaton in 2015, 2016, 2017, and 2018. Bars represent the total cover of all species in each growth form. Note the difference in scale on the Y axis. Estimated cover of each plant management group*nativity = sum (average cover cover plot⁻¹ for each species in that category). Error bars represent 95% confidence intervals. The site was monitored in 2009 as all one site; these data were not included as comparisons cannot be made.

MIDDLE GREEN OAKS

Although dominated by introduced species, Middle Green Oaks (referred to as South Green Oaks in previous reports) supports several important native species, including *Lupinus oreganus*, *Eriophyllum lanatum*, and *Brodiaea* spp. This site has been managed with spring and fall mowing. In spring 2009, *Centaurea pratensis* was treated with herbicide (Table 12). Broad scale treatments were initiated in spring 2010.

Table 12. Treatment schedule for Middle Green Oaks at Fern Ridge Reservoir. 2010 was the first year of restoration treatments at this site. Prior to 2010, the site was managed with spring and fall mowing.

Year	Season	Treatments
2010	Spring	Treat <i>Arrhenatherum elatius</i> and <i>Centaurea pratensis</i>
2010	Fall	No action
2011	Spring	No action
2011	Fall	Seed <i>Lupinus oreganus</i> (~10,250 seeds)
2012	Spring	No action
2012	Fall	No action
2013	Spring	No action
2013	Fall	No action
2014	Spring	Experimental fluazifop
2014	Fall	Prescribed fire
2015	Spring	No action
2015	Fall	Mow
2016	Spring	No action
2016	Fall	Mow, plant bulbs and bare-root
2017	Spring	No action
2017	Fall	No action
2018	Spring	No action
2018	Fall	<i>Camassia</i> bulbs
2018	Spring	No action
2019	Spring	No treatment scheduled

Monitoring

We initiated botanical surveys at Middle Green Oaks in May 2010. Two axes were superimposed on an aerial photo of the meadow (Figure 23) and coordinates were randomly selected for plot placement. We placed 1m aluminum conduit posts at 0, 100, and 169 along the longest axis, which extends east-west. Plots that were outside of the meadow were eliminated and replaced with another randomly selected location until 30 plots were selected. We placed a 1x1m sampling frame at the top right corner at each selected sampling point and estimated the percent cover of each species and ground

cover category (bare ground, rock, and moss). For analysis, cover of the native fern *Pteridium aquilinum* was included as part of the native forb category. Quantitative monitoring was repeated in 2015.

In June 2010, we systematically surveyed the entire site for the presence of the invasive forb, *Centaurea pratensis* (meadow knapweed). No surveys were conducted in 2012. In 2013, 2014, 2016 and 2017, we conducted qualitative surveys of the vegetation at Middle Green Oaks. Quantitative monitoring was conducted in 2010, 2015, and 2018.

Results and Discussion

Middle Green Oaks has experienced changes since monitoring began in 2010. Introduced forb cover has varied over time from 23% in 2010 to 67% in 2015, then declined to 41% in 2018 (Figure 24). This increase is associated with an increase of *Daucus carota* from 1.3% to 26.2% from 2010 to 2018. *Hypochaeris radicata* was also very prevalent at the site and increased greatly from 2010 to 2015 (19.5% to 44.9%), but then declined to 12.9% in 2018 (Appendix J). Native forbs remain less than 2% at the site, however there are some patches of *Lupinus oreganus* present (1% in 2018). Cover of introduced graminoids declined over time coupled with an increase of native graminoids (Figure 24). The decline in introduced graminoids from 2010 to 2018 was largely associated with *Agrostis* sp. (10.8% to 1.3%), *Anthoxanthum odoratum* (13.4% to 4%), and *Vulpia* spp. (3.3% to 1.1%). The increase in native graminoids was associated with an increase in *Danthonia californica* from 0.4% to 7.2% from 2010 to 2018. Introduced trees/shrubs remain in trace amounts at the site (<1%, Figure 24), while native trees/shrubs have declined from 5.6% in 2010 to <1% in 2018, due to a decline in *Alnus* sp. (Appendix J).

Management Recommendations

For 2019, we recommend an application of a broad spectrum herbicide such as glyphosate to manage introduced species. To increase native cover, we recommend broadcasting a native seed mix. Quantitative surveys in 2019 are recommended to gain a better perspective of how the community composition responds to treatments at this site.

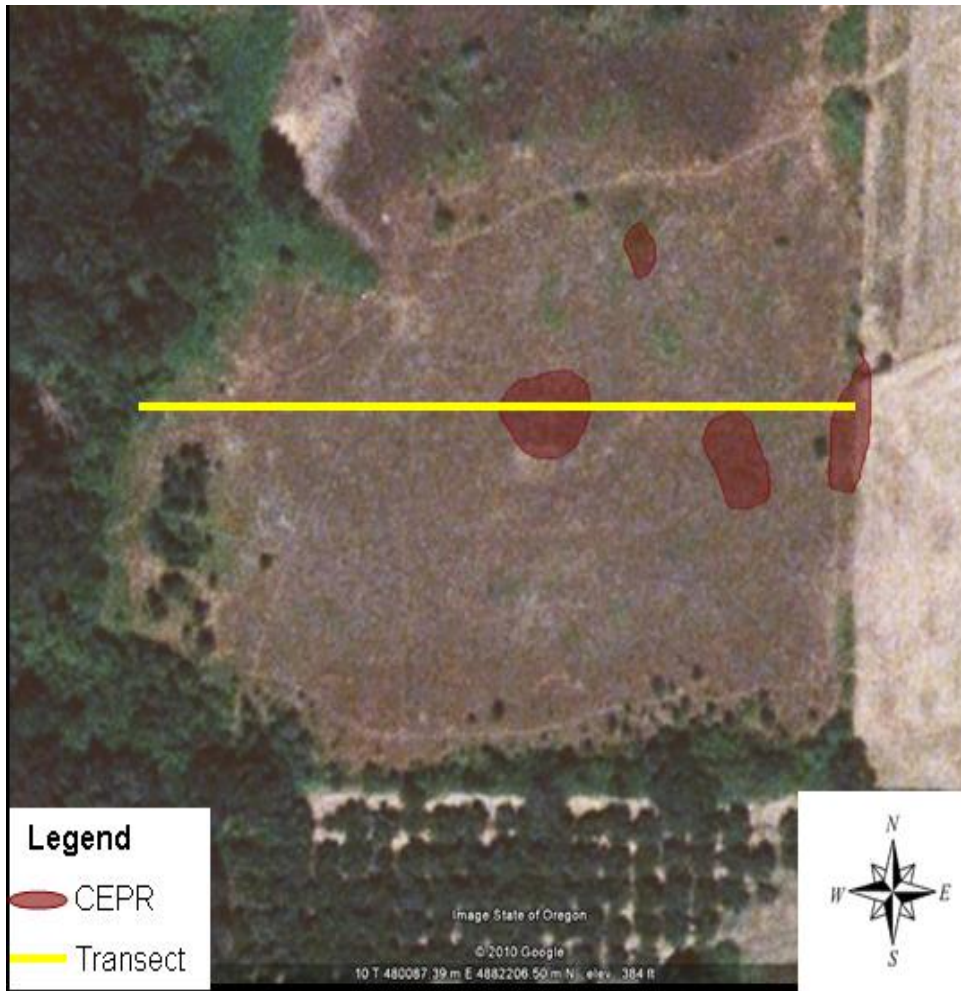


Figure 23. Middle Green Oaks upland prairie restoration site at Fern Ridge Reservoir. *Centaurea pratensis* was found in four patches within the site. T-posts were placed at 0 (East end), 100, and 169m on an axis running east-west. An x and y-axis were superimposed on the meadow in order to randomly select locations for sampling

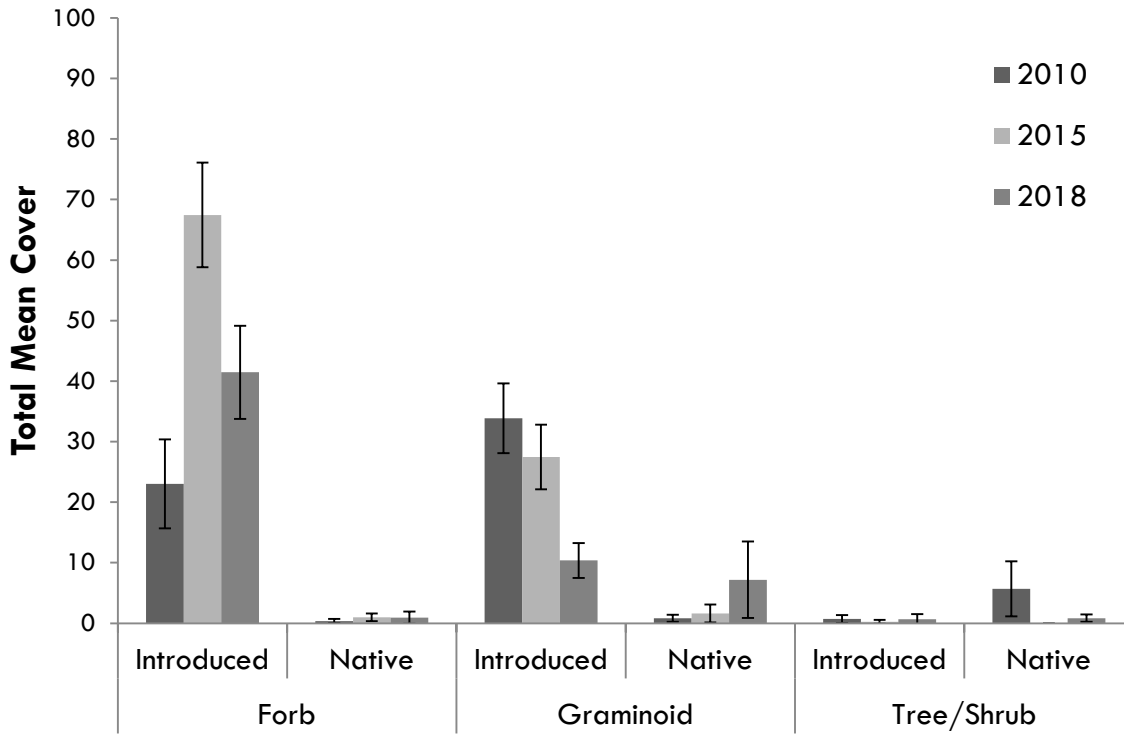


Figure 24. Total mean cover of introduced and native species in at Middle Green Oaks in 2010, 2015, and 2018. Bars represent the sum of the average cover of species in each growth form. Estimated cover of each plant management group*nativity = sum (average cover plot⁻¹ for each species in that category). Error bars represent 95% confidence intervals.

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APPENDIX A. AVERAGE PERCENT COVER OF ALL SPECIES OBSERVED IN MONITORING PLOTS AT BIG SPIRES IN 2008 – 2018 (2011 WAS NOT MONITORED).

Scientific Name	SpCode	US Nativity	Growth Habit	2008	2009	2012	2013	2014	2015	2016	2017	2018
				Bare				7.0	10.3	42.8	0.5	37.7
Moss/lichen				1.9	18.1	35.9	92.6	5.0	1.8	0.3	0.6	0.1
Litter				32.2	11.8	2.3	3.4	29.9	31.8	18.0	91.5	14.0
Basal Veg				0.0	0.0	0.0	0.0	10.8	65.0	53.9	88.3	85.8
Rock				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Achillea millefolium</i>	ACMI	Native	forb	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0
<i>Agrostis</i> sp.	AGRO.SP	Introduced	graminoid	3.6	4.1	8.0	32.5	27.2	8.4	1.3	0.0	0.4
<i>Aira caryophylla</i>	AICA	Introduced	graminoid	1.5	0.1	0.0	0.5	8.5	0.5	0.3	0.3	0.0
<i>Anthoxanthum odoratum</i>	ANOD	Introduced	graminoid	1.0	2.0	2.0	0.0	0.7	0.1	0.4	0.0	1.0
<i>Arrhenatherum elatius</i>	AREL	Introduced	graminoid	29.7	24.6	0.6	5.3	3.1	0.2	2.0	0.1	0.5
<i>Bromus hordeaceus</i>	BRHO	Introduced	graminoid	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
<i>Cardamine occidentalis</i>	CAOC	Native	forb	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Castilleja levisecta</i>	CALE	Native	forb	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.6	0.1
<i>Centaureum erythraea</i>	CEER	Introduced	forb	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Cerastium glomeratum</i>	CEGL	Introduced	forb	0.0	0.5	0.1	0.0	0.2	0.0	0.0	0.0	0.0
<i>Cirsium vulgare</i>	CIVU	Introduced	forb	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0
<i>Clarkia amoena</i>	CLAM	Native	forb	0.0	0.0	0.0	0.0	1.1	0.0	0.1	0.0	0.0
<i>Crepis capillaris</i>	CRCA	Introduced	forb	0.3	0.7	0.1	0.1	0.2	0.0	2.2	1.3	0.6
<i>Crepis setosa</i>	CRSE	Introduced	forb	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Cytisus scoparius</i>	CYSC	Introduced	tree/shrub	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Danthonia californica</i>	DACA	Native	graminoid	0.0	0.0	0.1	0.2	0.2	0.0	0.0	0.1	0.0
<i>Daucus carota</i>	DAUCAR	Introduced	forb	6.1	2.5	0.4	1.1	2.4	0.7	4.0	8.8	0.5
<i>Draba verna</i>	DRVE	Introduced	forb	0.0	0.2	0.0	0.6	0.0	0.0	0.0	0.0	0.0
<i>Elymus glaucus</i>	ELGL	Native	graminoid	0.0	0.0	0.1	2.3	1.3	0.3	0.1	0.0	0.0
<i>Epilobium</i> sp.	EPILO.SP	Native	forb	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0

<i>Eriophyllum lanatum</i>	ERLA	Native	forb	0.0	0.0	0.0	3.2	11.3	14.4	15.1	31.5	15.3
<i>Schedonorus arundinacea</i>	FEAR	Introduced	graminoid	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0
<i>Festuca roemerii</i>	FERO	Native	graminoid	0.0	0.0	18.7	53.7	25.6	57.7	13.2	39.8	32.8
<i>Fragaria virginiana</i>	FRVI	Native	forb	0.2	0.3	0.2	0.0	0.0	0.0	0.0	0.3	0.1
<i>Galium parisiense</i>	GAPA	Introduced	forb	11.9	1.9	0.1	0.5	2.7	0.0	24.9	0.8	0.0
<i>Galium</i> sp.	GAL.SP	Unknown	forb	0.0	0.0	0.0	0.0	8.9	0.0	0.0	0.0	0.0
<i>Geranium dissectum</i>	GEDI	Introduced	forb	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0
<i>Gilia capitata</i>	GICA	Native	forb	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
<i>Gnaphalium</i> sp.	GNA.SP	Introduced	forb	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Holcus lanatus</i>	HOLA	Introduced	graminoid	0.2	0.3	0.1	0.0	0.2	0.0	0.0	0.0	0.0
<i>Hypericum perforatum</i>	HYPE	Introduced	forb	0.0	0.3	0.1	0.0	0.1	0.1	0.1	0.1	0.1
<i>Hypochaeris radicata</i>	HYRA	Introduced	forb	3.5	1.6	0.0	2.2	2.1	4.5	1.5	15.0	22.0
<i>Koeleria macrantha</i>	KOMA	Native	graminoid	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
<i>Leucanthemum vulgare</i>	LEVU	Introduced	forb	0.2	1.2	0.0	0.5	0.2	0.8	4.2	3.8	0.6
<i>Lotus micranthus</i>	LOMI	Native	forb	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.1
<i>Lotus unifoliolatus</i>	LOUN	Native	forb	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Lupinus bicolor</i>	LUBI	Native	forb	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0
<i>Lupinus oreganus</i>	LUOR	Native	forb	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0
<i>Lupinus</i> sp.	LUP.SP	Native	forb	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0
<i>Marah oreganus</i>	MAOR	Native	forb	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
<i>Microsteris gracilis</i>	MIGR	Native	forb	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Myosotis discolor</i>	MYDI	Introduced	forb	0.1	4.9	0.2	0.0	0.0	0.0	0.0	0.0	0.0
<i>Parentucellia viscosa</i>	PAVI	Introduced	forb	3.2	1.2	0.4	0.2	7.5	0.6	5.1	0.7	0.0
<i>Plantago lanceolata</i>	PLLA	Introduced	forb	0.6	0.0	0.1	2.7	3.6	6.9	1.7	2.0	1.6
<i>Potentilla gracilis</i>	POGR	Native	forb	0.0	0.0	0.1	0.4	0.3	0.2	0.2	0.4	0.0
<i>Prunella vulgaris</i>	PRVU	Native	forb	0.0	0.0	0.2	1.4	0.9	0.6	0.2	0.8	1.9
<i>Prunus</i> sp.	PRUN.SP	Unknown	tree/shrub	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
<i>Pteridium aquilinum</i>	PTAQ	Native	forb	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
<i>Rosa</i> sp.	ROSA.SP	Unknown	tree/shrub	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
<i>Rubus armeniacus</i>	RUAR	Introduced	tree/shrub	2.5	3.7	0.0	2.4	1.2	0.6	0.5	0.1	0.3

<i>Rumex acetosella</i>	RUAC	Introduced	forb	1.2	1.2	3.5	0.9	3.7	1.3	0.7	1.2	1.0
<i>Senecio jacobaea</i>	SEJA	Introduced	forb	0.0	0.1	0.0	0.3	0.0	0.0	0.0	0.0	0.0
<i>Sherardia arvensis</i>	SHAR	Introduced	forb	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0
<i>Sidalcea virgata</i>	SIVI	Native	forb	0.0	0.0	0.2	0.0	0.2	0.2	0.0	0.3	0.0
<i>Sisyrinchium</i> sp.	SIS.SP	Native	forb	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
<i>Spergula arvensis</i>	SPAR	Introduced	forb	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Taraxacum officinale</i>	TAOF	Introduced	forb	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Vicia hirsuta</i>	VIHI	Introduced	forb	1.6	9.1	0.0	0.1	0.2	0.0	0.0	0.1	0.0
<i>Vicia sativa</i>	VISA	Introduced	forb	15.7	13.4	0.0	0.3	1.0	0.3	0.7	0.7	0.2
<i>Vulpia</i> sp.	VULP.SP	Introduced	graminoid	1.5	1.4	5.3	7.9	9.4	9.1	37.4	24.0	10.8

APPENDIX B. AVERAGE PERCENT COVER OF ALL SPECIES OBSERVED IN MONITORING PLOTS AT BIG SPIRES NE IN 2009.

Scientific Name	US Nativity	Growth Habit	2009
<i>Acer macrophyllum</i>	Native	Tree/Shrub	0.0
<i>Achillea millefolium</i>	Native	Forb	0.0
<i>Agrostis</i> sp.	Introduced	Graminoid	32.9
<i>Agrostis stolonifera</i>	Introduced	Graminoid	0.0
<i>Aira caryophylla</i>	Introduced	Graminoid	0.0
<i>Amelanchier alnifolia</i>	Native	Tree/Shrub	0.0
<i>Anthoxanthum odoratum</i>	Introduced	Graminoid	16.5
<i>Apocynum androsaemifolium</i>	Native	Tree/Shrub	0.0
<i>Arrhenatherum elatius</i>	Introduced	Graminoid	0.0
<i>Brodiaea coronaria</i>	Native	Forb	0.0
<i>Bromus hordeaceus</i>	Introduced	Graminoid	0.1
<i>Camassia quamash</i>	Native	Forb	0.0
<i>Carex</i> sp.	Native	Graminoid	0.0
<i>Carex tumulicola</i>	Native	Graminoid	0.0
<i>Cerastium glomeratum</i>	Introduced	Forb	0.0
<i>Cirsium vulgare</i>	Introduced	Forb	0.0
<i>Corylus</i> sp.	Native	Tree/Shrub	0.0
<i>Crataegus douglasii</i>	Native	Tree/Shrub	0.4
<i>Crataegus monogyna</i>	Introduced	Tree/Shrub	0.0
<i>Crepis capillaris</i>	Introduced	Forb	1.4
<i>Crepis setosa</i>	Introduced	Forb	0.9
<i>Cynosurus echinatus</i>	Introduced	Graminoid	0.0
<i>Cytisus scoparius</i>	Introduced	Tree/Shrub	0.7
<i>Dactylis glomerata</i>	Introduced	Graminoid	5.5
<i>Danthonia californica</i>	Native	Graminoid	0.0
<i>Daucus carota</i>	Introduced	Forb	4.8
<i>Draba verna</i>	Introduced	Forb	0.00
<i>Elymus glaucus</i>	Native	Graminoid	10.1
<i>Festuca</i> spp.	Introduced	Graminoid	0.6
<i>Festuca roemeri</i>	Native	Graminoid	0.0
<i>Fragaria virginiana</i>	Native	Forb	0.0
<i>Frangula</i> sp.	Native	Tree/Shrub	0.0
<i>Galium aparine</i>	Native	Forb	3.8
<i>Galium parisiense</i>	Introduced	Forb	0.0
<i>Hedera</i> sp.	Introduced	Forb	0.1
<i>Holcus lanatus</i>	Introduced	Graminoid	1.7

<i>Hypericum perforatum</i>	Introduced	Forb	0.0
<i>Hypochaeris radicata</i>	Introduced	Forb	0.8
<i>Ilex</i> sp.	Unknown	Tree/Shrub	0.0
<i>Lathyrus sphaericus</i>	Introduced	Forb	0.0
<i>Leucanthemum vulgare</i>	Introduced	Forb	0.7
<i>Lotus</i> sp.	Native	Forb	0.0
<i>Lupinus oreganus</i>	Native	Forb	0.0
<i>Lupinus</i> sp.	Native	Forb	0.0
<i>Luzula campestris</i>	Native	Graminoid	0.1
<i>Luzula</i> sp.	Native	Graminoid	0.0
<i>Myosotis discolor</i>	Introduced	Forb	0.1
<i>Parentucellia viscosa</i>	Introduced	Forb	0.5
<i>Plantago lanceolata</i>	Introduced	Forb	0.1
<i>Potentilla gracilis</i>	Native	Forb	0.0
<i>Prunella vulgaris</i>	Native	Forb	0.0
<i>Prunus</i> sp.	Unknown	Tree/Shrub	0.1
<i>Pteridium aquilinum</i>	Native	Forb	0.0
<i>Quercus garryana</i>	Native	Tree/Shrub	0.0
<i>Rosa</i> spp.	Native	Tree/Shrub	0.4
<i>Rubus armeniacus</i>	Introduced	Tree/Shrub	2.4
<i>Rubus laciniatus</i>	Introduced	Tree/Shrub	0.0
<i>Rubus ursinus</i>	Native	Tree/Shrub	0.0
<i>Schedonorus arundinaceus</i>	Introduced	Graminoid	9.9
<i>Senecio jacobaea</i>	Introduced	Forb	0.4
<i>Sidalcea virgata</i>	Native	Forb	0.0
<i>Spiraea douglasii</i>	Native	Tree/Shrub	9.5
<i>Torilis arvensis</i>	Introduced	Forb	0.0
<i>Vicia hirsuta</i>	Introduced	Forb	0.6
<i>Vicia sativa</i>	Introduced	Forb	3.9
<i>Vicia tetrasperma</i>	Introduced	Forb	0.0

APPENDIX C. AVERAGE PERCENT COVER OF ALL SPECIES OBSERVED IN MONITORING PLOTS AT WEST SPIRES IN 2010, 2012, 2013, 2016, 2017 AND 2018.

Scientific Name	SpCode	US Nativity	Growth Habit	2010	2012	2013	2016	2017	2018
Bare				2.6	0.5	0.7	0.3	18.2	1.0
Moss/lichen				10.9	11.3	22.2	2.9	11.9	1.2
Litter				65.4	33.6	90.4	65.7	59.8	36.6
Basal Veg				0.0	0.0	0.0	45.0	10.3	61.2
Rock				0.2	0.0	0.0	0.0	0.0	0.0
<i>Acer macrophyllum</i>	ACMA	Native	tree/shrub	0.1	0.0	0.1	0.2	0.0	0.0
<i>Agrostis</i> sp.	AGRO.SP	Introduced	graminoid	2.9	0.0	2.2	0.8	1.0	5.9
<i>Aira caryophylla</i>	AICA	Introduced	graminoid	0.1	0.0	0.0	0.0	0.0	0.3
<i>Alnus rubra</i>	ALRU	Native	tree/shrub	0.0	0.0	0.0	0.0	0.0	0.1
<i>Alnus</i> sp.	ALNUS.SP	Native	tree/shrub	0.1	0.0	0.0	0.0	0.0	0.0
<i>Alopecurus pratensis</i>	ALPR	Introduced	graminoid	0.0	0.0	0.0	0.0	0.4	0.0
<i>Amelanchier alnifolia</i>	AMAL	Native	tree/shrub	0.3	3.0	0.1	0.0	0.0	0.0
<i>Anthoxanthum odoratum</i>	ANOD	Introduced	graminoid	8.0	24.6	23.9	3.9	7.2	6.1
<i>Apocynum androsaemifolium</i>	APAN	Native	forb	0.0	0.0	0.0	0.3	0.0	0.0
<i>Arrhenatherum elatius</i>	AREL	Introduced	graminoid	9.1	10.6	27.3	16.9	12.6	9.2
<i>Bromus carinatus</i>	BRCA	Native	graminoid	0.0	0.0	0.0	0.0	0.0	0.1
<i>Bromus hordeaceus</i>	BRHO	Introduced	graminoid	0.0	1.1	0.0	0.0	0.0	0.0
<i>Bromus sterilis</i>	BRST	Introduced	graminoid	0.0	0.2	0.0	0.0	0.0	0.0
<i>Camassia quamash</i>	CAQU	Native	forb	0.0	0.0	0.0	0.0	0.2	0.0
<i>Carex</i> sp.	CAR.SP	Native	graminoid	0.4	0.0	0.0	0.5	0.0	0.3
<i>Carex tumulicola</i>	CATU	Native	graminoid	0.0	0.0	0.0	0.3	0.0	0.0

<i>Centaurea pratensis</i>	CEPR	Introduced	forb	0.2	0.0	0.0	0.0	0.0	0.0
<i>Cirsium vulgare</i>	CIVU	Introduced	forb	0.0	0.0	0.0	0.1	0.0	0.0
<i>Clarkia amoena</i>	CLAM	Native	forb	0.0	0.0	0.0	0.0	2.2	0.0
<i>Collomia grandiflora</i>	COGR	Native	forb	0.0	0.0	0.0	0.0	0.2	0.2
<i>Corylus sp.</i>	CORY.SP	Native	tree/shrub	0.0	0.0	0.1	0.0	0.0	0.0
<i>Crataegus douglasii</i>	CRDO	Native	tree/shrub	0.0	0.0	0.3	0.6	0.0	0.0
<i>Crataegus monogyna</i>	CRMO	Introduced	tree/shrub	0.0	0.0	0.0	1.2	0.2	0.0
<i>Crepis capillaris</i>	CRCA	Introduced	forb	0.9	0.0	0.1	0.1	0.6	0.4
<i>Crepis setosa</i>	CRSE	Introduced	forb	0.0	0.0	0.1	0.0	0.0	0.0
<i>Cynosurus echinatus</i>	CYEC	Introduced	graminoid	0.0	0.0	0.0	2.4	0.0	0.0
<i>Cytisus scoparius</i>	CYSC	Introduced	tree/shrub	4.9	0.5	1.8	5.5	0.2	0.1
<i>Dactylis glomerata</i>	DAGL	Introduced	graminoid	0.7	0.0	0.3	1.8	0.1	0.0
<i>Danthonia californica</i>	DACA	Native	graminoid	2.8	2.7	0.4	2.4	0.0	2.8
<i>Daucus carota</i>	DAUCAR	Introduced	forb	0.5	0.9	3.1	0.8	3.0	2.0
<i>Deschampsia cespitosa</i>	DECE	Native	graminoid	0.0	0.0	0.0	0.0	0.2	0.0
<i>Draba verna</i>	DRVE	Introduced	forb	0.0	0.0	0.0	0.3	0.0	0.0
<i>Epilobium sp.</i>	EPILO.SP	Native	forb	0.0	0.2	0.0	0.0	0.0	0.0
<i>Eriophyllum lanatum</i>	ERLA	Native	forb	0.0	0.0	0.0	0.0	0.0	0.1
<i>Schedonorus arundinacea</i>	FEAR	Introduced	graminoid	3.1	11.5	13.3	6.1	0.9	3.1
<i>Festuca rubra</i>	FERU	Introduced	graminoid	2.7	2.2	3.3	5.5	0.2	0.1
<i>Fragaria virginiana</i>	FRVI	Native	forb	5.2	0.3	5.9	3.8	2.9	0.4
<i>Frangula purshiana</i>	FRPU	Native	tree/shrub	0.0	0.0	0.1	0.0	0.0	0.0
<i>Galium aparine</i>	GAAP	Native	forb	0.0	0.0	1.9	0.1	0.0	0.0
<i>Galium parisiense</i>	GAPA	Introduced	forb	1.2	0.0	0.0	11.5	11.7	9.0
<i>Galium sp.</i>	GAL.SP	Unknown	forb	0.0	0.2	0.0	0.0	0.0	0.0
<i>Geranium dissectum</i>	GEDI	Introduced	forb	0.0	0.0	0.0	0.0	0.0	0.0
<i>Gilia capitata</i>	GICA	Native	forb	0.0	0.0	0.0	0.0	0.1	0.0
<i>Holcus lanatus</i>	HOLA	Introduced	graminoid	0.7	1.0	0.5	0.6	2.7	0.1
<i>Hypericum perforatum</i>	HYPE	Introduced	forb	0.1	0.0	0.2	0.1	1.1	0.0
<i>Hypochaeris radicata</i>	HYRA	Introduced	forb	2.5	8.6	13.3	10.0	9.6	3.9

<i>Juncus bufonis</i>	JUBU	Native	graminoid	0.0	0.0	0.0	0.0	0.1	0.0
<i>Juncus</i> sp.	JUNC.SP	Native	graminoid	0.0	0.0	0.0	0.0	0.3	0.0
<i>Juncus tenuis</i>	JUTE	Native	graminoid	0.0	0.0	0.0	0.0	1.0	0.0
<i>Lathyrus sphaericus</i>	LASP	Introduced	forb	0.1	0.0	0.1	0.0	0.0	0.0
<i>Leucanthemum vulgare</i>	LEVU	Introduced	forb	0.0	0.0	0.2	0.1	0.0	0.1
<i>Linum bienne</i>	LIBI	Introduced	forb	0.0	0.0	0.0	0.0	0.0	0.2
<i>Lotus corniculatus</i>	LOCO	Introduced	forb	0.0	0.0	0.0	0.0	6.3	0.0
<i>Lotus</i> sp.	LOTUS.SP	Native	forb	0.0	0.0	0.0	0.1	0.0	0.0
<i>Lupinus oreganus</i>	LUOR	Native	forb	2.8	0.0	1.8	0.2	1.2	0.0
<i>Luzula</i> sp.	LUZ.SP	Unk	graminoid	0.0	0.5	0.1	1.5	0.0	0.0
<i>Madia</i> sp.	MAD.SP	Native	forb	0.0	0.0	0.0	0.0	0.1	0.0
<i>Myosotis discolor</i>	MYDI	Introduced	forb	0.2	0.0	0.0	0.1	0.2	0.0
<i>Parentucellia viscosa</i>	PAVI	Introduced	forb	0.2	0.1	0.4	0.3	5.9	0.3
<i>Phacelia nemoralis</i>	PHNE	Native	forb	0.0	0.0	0.0	0.0	0.0	0.3
<i>Plantago lanceolata</i>	PLLA	Introduced	forb	0.7	0.8	2.9	7.3	18.4	16.6
<i>Potentilla gracilis</i>	POGR	Native	forb	0.0	0.0	0.0	1.8	0.0	0.1
<i>Prunella vulgaris</i>	PRVU	Native	forb	0.0	0.1	0.1	0.0	0.5	1.0
<i>Prunus</i> sp.	PRUN.SP	Unknown	tree/shrub	0.0	0.1	0.0	0.1	0.8	0.3
<i>Pteridium aquilinum</i>	PTAQ	Native	forb	1.3	1.6	0.0	4.0	9.1	12.5
<i>Pyrus</i> sp.	PYRUS.SP	Unknown	tree/shrub	0.0	0.0	0.0	0.0	0.0	0.1
<i>Quercus garryana</i>	QUGA	Native	tree/shrub	0.0	0.0	0.0	0.1	0.0	0.0
<i>Rosa</i> sp.	ROSA.SP	Unknown	tree/shrub	1.7	1.1	2.8	2.4	6.1	4.8
<i>Rubus armeniacus</i>	RUAR	Introduced	tree/shrub	1.4	1.2	2.6	3.9	4.0	7.1
<i>Rubus laciniatus</i>	RULA	Introduced	tree/shrub	0.0	0.0	0.0	0.6	2.9	0.1
<i>Rubus ursinus</i>	RUUR	Native	tree/shrub	0.0	0.0	0.0	0.3	1.4	0.1
<i>Rumex acetosella</i>	RUAC	Introduced	forb	0.1	0.0	0.0	0.1	0.0	0.2
<i>Sanguisorba minor</i>	SAMI	Introduced	forb	0.0	0.3	0.0	0.0	0.0	0.2
<i>Senecio jacobaea</i>	SEJA	Introduced	forb	0.1	0.0	0.0	0.0	0.8	0.0
<i>Sidalcea virgata</i>	SIVI	Native	forb	1.8	0.8	2.0	3.1	0.8	0.9
<i>Solidago canadensis</i>	SOCA	Native	forb	0.0	0.0	0.0	0.1	0.1	0.0

<i>Spirea douglasii</i>	SPDO	Native	tree/shrub	0.0	0.0	0.1	2.7	7.9	0.1
<i>Taraxacum officinale</i>	TAOF	Introduced	forb	0.2	0.4	0.0	0.6	0.1	0.0
<i>Torilis arvensis</i>	TOAR	Introduced	forb	0.0	0.0	0.0	0.2	0.0	0.0
<i>Toxicodendron diversilobum</i>	TODI	Native	tree/shrub	0.0	0.0	0.0	0.1	0.0	0.0
<i>Trifolium sp.</i>	TRIF.SP	Introduced	forb	0.0	1.7	0.0	0.0	0.0	0.0
Unknown tree	UNK.TR	Unknown	tree/shrub	0.0	0.0	0.0	0.0	0.4	0.0
<i>Vicia hirsuta</i>	VIHI	Introduced	forb	0.3	0.1	0.7	0.0	0.0	0.1
<i>Vicia sativa</i>	VISA	Introduced	forb	0.4	1.9	2.0	3.6	0.0	0.1
<i>Vicia tetrasperma</i>	VITE	Introduced	forb	0.0	0.0	0.0	2.0	0.0	0.0
<i>Vulpia bromoides</i>	VUBR	Introduced	graminoid	0.0	2.1	0.0	0.0	0.1	0.0
<i>Vulpia sp.</i>	VULP.SP	Introduced	graminoid	0.0	0.0	0.0	0.0	0.0	0.6

APPENDIX D. AVERAGE PERCENT COVER OF ALL SPECIES OBSERVED IN MONITORING PLOTS AT EAST SPIRES IN 2012, 2013, 2016, 2017, AND 2018.

Scientific Name	SpCode	US Nativity	Growth Habit	2012	2013	2016	2017	2018
Bare				47.3	0.5	0.0	8.6	1.6
Moss/lichen				26.7	92.6	2.2	6.7	3.3
Litter				12.6	3.4	74.4	77.5	42.7
Basal Veg				0.0	0.0	61.0	6.4	52.3
Rock				0.0	0.0	0.0	0.0	0.0
<i>Acer macrophyllum</i>	ACMA	Native	tree/shrub	0.0	0.2	0.0	0.0	0.0
<i>Agrostis</i> sp.	AGRO.SP	Introduced	graminoid	15.1	40.3	39.0	16.9	6.7
<i>Aira caryophyllea</i>	AICA	Introduced	graminoid	1.5	3.4	0.6	0.0	0.1
<i>Alnus</i> sp.	ALNUS.SP	Native	tree/shrub	0.0	0.1	0.0	0.0	0.0
<i>Amelanchier alnifolia</i>	AMAL	Native	tree/shrub	0.0	0.1	0.0	0.0	0.0
<i>Anthoxanthum odoratum</i>	ANOD	Introduced	graminoid	11.8	31.3	24.5	0.9	3.4
<i>Arrhenatherum elatius</i>	AREL	Introduced	graminoid	0.7	8.5	18.1	2.0	12.3
<i>Bromus carinatus</i>	BRCA	Native	graminoid	0.8	0.2	0.0	0.0	0.0
<i>Bromus hordeaceus</i>	BRHO	Introduced	graminoid	1.0	0.0	0.0	0.0	0.0
<i>Bromus inermis</i>	BRIN	Introduced	graminoid	1.5	0.0	0.0	0.0	0.0
<i>Bromus sterilis</i>	BRST	Introduced	graminoid	0.7	0.0	0.0	0.0	0.0
<i>Carex</i> sp.	CAR.SP	Native	graminoid	0.0	0.0	0.0	0.0	0.1
<i>Centaureum erythraea</i>	CEER	Introduced	forb	0.0	0.0	0.1	0.0	0.0
<i>Clarkia amoena</i>	CLAM	Native	forb	0.0	0.0	0.0	12.9	0.0
<i>Clarkia</i> sp.	CLAR.SP	Native	forb	0.0	0.0	0.0	0.0	1.1
<i>Collomia grandiflora</i>	COGR	Native	forb	0.0	0.0	0.0	3.1	0.3
<i>Corylus</i> sp.	CORY.SP	Native	tree/shrub	0.0	0.1	0.0	0.0	0.0
<i>Crataegus douglasii</i>	CRDO	Native	tree/shrub	1.1	0.1	0.6	0.0	0.1
<i>Crepis capillaris</i>	CRCA	Introduced	forb	1.9	0.3	0.0	0.0	0.0
<i>Crepis setosa</i>	CRSE	Introduced	forb	4.2	0.3	0.0	0.0	0.0
<i>Cynosurus echinatus</i>	CYEC	Introduced	graminoid	0.0	0.3	0.0	1.7	0.0
<i>Cytisus scoparius</i>	CYSC	Introduced	tree/shrub	0.0	0.0	0.0	0.0	0.1
<i>Dactylis glomerata</i>	DAGL	Introduced	graminoid	0.3	0.3	0.3	0.0	0.0
<i>Danthonia californica</i>	DACA	Native	graminoid	0.2	0.4	8.1	0.0	0.4
<i>Daucus carota</i>	DAUCAR	Introduced	forb	0.2	1.4	2.0	3.6	3.1
<i>Elymus glaucus</i>	ELGL	Native	graminoid	0.2	5.2	1.6	0.9	0.1
<i>Epilobium angustifolium</i>	EPAN	Native	forb	1.3	0.0	0.0	0.0	0.0

<i>Epilobium</i>									
<i>brachycarpum</i>	EPBR	Native	forb	0.4	0.0	0.0	0.0	0.0	
<i>Eriophyllum lanatum</i>	ERLA	Native	forb	0.0	0.1	0.8	4.9	8.6	
<i>Schedonorus</i>									
<i>arundinacea</i>	FEAR	Introduced	graminoid	3.8	12.6	11.3	0.0	1.6	
<i>Festuca roemeri</i>	FERO	Native	graminoid	1.1	0.0	6.1	0.7	2.7	
<i>Fragaria virginiana</i>	FRVI	Native	forb	0.1	0.0	0.0	0.0	0.0	
<i>Fraxinus latifolia</i>	FRLA	Native	tree/shrub	0.0	0.0	0.1	0.0	0.0	
<i>Galium parisiense</i>	GAPA	Introduced	forb	0.4	0.8	0.3	17.9	1.1	
<i>Geranium dissectum</i>	GEDI	Introduced	forb	0.0	0.0	0.1	0.0	0.0	
<i>Gilia capitata</i>	GICA	Native	forb	0.0	0.0	0.0	2.2	0.3	
<i>Holcus lanatus</i>	HOLA	Introduced	graminoid	0.9	0.3	0.2	0.0	0.0	
<i>Hypericum perforatum</i>	HYPE	Introduced	forb	0.2	0.4	0.1	1.2	0.1	
<i>Hypochaeris radicata</i>	HYRA	Introduced	forb	5.3	13.5	6.6	2.3	6.1	
<i>Lathyrus sphaericus</i>	LASP	Introduced	forb	0.1	0.0	0.0	0.0	0.0	
<i>Leucanthemum vulgare</i>	LEVU	Introduced	forb	0.1	0.4	0.0	0.0	0.0	
<i>Linum bienne</i>	LIBI	Introduced	forb	0.0	0.0	0.1	0.0	0.0	
<i>Lonicera hispidula</i>	LOHI	Native	tree/shrub	0.0	0.1	0.0	0.0	0.0	
<i>Lupinus oreganus</i>	LUOR	Native	forb	0.9	2.4	0.0	0.8	0.4	
<i>Luzula sp.</i>	LUZ.SP	Unk	graminoid	0.7	0.0	0.1	0.0	0.0	
<i>Madia sp.</i>	MAD.SP	Native	forb	0.0	0.0	0.0	2.8	1.2	
<i>Myosotis discolor</i>	MYDI	Introduced	forb	0.6	0.0	0.0	0.0	0.0	
<i>Parentucellia viscosa</i>	PAVI	Introduced	forb	0.9	0.8	0.3	3.3	0.4	
<i>Plantago lanceolata</i>	PLLA	Introduced	forb	4.7	5.9	18.1	8.4	6.2	
<i>Prunella vulgaris</i>	PRVU	Native	forb	0.3	0.3	0.5	0.3	1.2	
<i>Pteridium aquilinum</i>	PTAQ	Native	forb	0.6	4.2	7.0	4.0	7.2	
<i>Pyrus sp.</i>	PYRUS.SP	Unknown	tree/shrub	0.0	0.0	0.0	0.0	0.1	
<i>Rosa sp.</i>	ROSA.SP	Unknown	tree/shrub	0.1	1.7	1.5	5.8	0.3	
<i>Rubus armeniacus</i>	RUAR	Introduced	tree/shrub	1.4	3.0	2.8	4.9	3.6	
<i>Rubus laciniatus</i>	RULA	Introduced	tree/shrub	0.0	0.0	0.2	0.0	0.3	
<i>Rumex acetosella</i>	RUAC	Introduced	forb	0.3	0.5	0.4	0.3	0.3	
<i>Sanguisorba minor</i>	SAMI	Introduced	forb	0.0	0.2	7.8	0.0	2.3	
<i>Senecio jacobaea</i>	SEJA	Introduced	forb	0.0	0.1	0.0	0.0	0.0	
<i>Sidalcea virgata</i>	SIVI	Native	forb	0.7	0.2	0.0	0.8	0.1	
<i>Solidago canadensis</i>	SOCA	Native	forb	0.0	0.0	0.0	0.0	0.1	
<i>Spirea douglasii</i>	SPDO	Native	tree/shrub	0.0	0.2	6.2	0.0	1.9	
<i>Taraxacum officinale</i>	TAOF	Introduced	forb	0.1	0.0	0.0	0.0	0.0	
<i>Vicia cracca</i>	VICR	Introduced	forb	0.0	0.0	0.0	0.1	0.0	
<i>Vicia hirsuta</i>	VIHI	Introduced	forb	0.1	1.2	0.5	0.0	0.1	
<i>Vicia sativa</i>	VISA	Introduced	forb	0.5	2.6	0.9	0.0	0.0	
<i>Vicia tetrasperma</i>	VITE	Introduced	forb	0.0	0.0	0.2	0.0	0.0	
<i>Vulpia sp.</i>	VULP.SP	Introduced	graminoid	0.0	0.1	3.3	0.0	0.0	

APPENDIX E. AVERAGE PERCENT COVER OF ALL SPECIES OBSERVED IN MONITORING PLOTS AT CHERRY ORCHARD IN 2009, 2014, 2015, 2016 AND 2018.

Scientific Name	SpCode	US Nativity	Growth Habit	2009	2014	2015	2016	2018
Bare				0.1	29.0	0.9	8.9	0.1
Moss/lichen				19.1	0.1	0.2	0.2	0.0
Litter				55.4	24.1	33.8	65.5	11.7
Basal Veg				0.0	53.3	69.5	52.5	88.2
Rock				0.0	0.0	0.0	0.0	0.0
<i>Achillea millefolium</i>	ACMI	Native	forb	0.0	0.0	0.0	0.1	0.0
<i>Agrostis</i> sp.	AGRO.SP	Introduced	graminoid	3.6	31.3	20.0	0.2	0.0
<i>Aira caryophyllea</i>	AICA	Introduced	graminoid	0.0	0.2	0.0	0.6	0.0
<i>Anthoxanthum odoratum</i>	ANOD	Introduced	graminoid	4.4	0.5	3.0	1.5	0.4
<i>Apocynum androsaemifolium</i>	APAN	Native	forb	0.0	3.3	1.2	2.9	1.3
<i>Arrhenatherum elatius</i>	AREL	Introduced	graminoid	24.9	4.6	3.2	0.4	0.1
<i>Carex</i> sp.	CAR.SP	Native	graminoid	0.0	0.0	0.0	0.0	0.1
<i>Centaurium erythraea</i>	CEER	Introduced	forb	0.0	0.0	0.0	0.0	0.1
<i>Cerastium arvense</i>	CEAR	Unknown	forb	0.0	0.0	0.0	0.1	0.0
<i>Clarkia amoena</i>	CLAM	Native	forb	0.0	0.0	0.0	0.7	0.0
<i>Crataegus douglasii</i>	CRDO	Native	tree/shrub	0.2	0.0	0.0	0.0	0.0
<i>Crepis capillaris</i>	CRCA	Introduced	forb	1.2	0.0	0.0	0.7	1.0
<i>Crepis setosa</i>	CRSE	Introduced	forb	1.2	0.0	0.5	0.0	0.0
<i>Cytisus scoparius</i>	CYSC	Introduced	tree/shrub	0.5	0.0	0.0	0.0	0.0
<i>Dactylis glomerata</i>	DAGL	Introduced	graminoid	0.9	0.0	0.0	0.1	0.0
<i>Daucus carota</i>	DAUCAR	Introduced	forb	3.6	0.0	0.4	0.8	3.2
<i>Eriophyllum lanatum</i>	ERLA	Native	forb	0.0	0.0	0.0	0.1	3.4
<i>Schedonorus arundinacea</i>	FEAR	Introduced	graminoid	14.9	0.0	0.0	0.0	6.8
<i>Festuca roemerii</i>	FERO	Native	graminoid	0.0	48.9	51.9	32.0	51.1
<i>Galium parisiense</i>	GAPA	Introduced	forb	0.7	0.0	0.0	37.0	0.0
<i>Galium</i> sp.	GAL.SP	Unknown	forb	0.0	3.0	0.0	0.0	0.0
<i>Holcus lanatus</i>	HOLA	Introduced	graminoid	1.5	1.6	2.0	0.1	0.0
<i>Hypericum perforatum</i>	HYPE	Introduced	forb	0.0	0.0	0.2	0.6	0.2
<i>Hypochaeris radicata</i>	HYRA	Introduced	forb	4.0	0.9	0.4	1.6	6.4
<i>Lactuca</i> sp.	LACT.SP	Introduced	forb	0.0	0.0	0.0	0.1	0.0
<i>Leontodon taraxacoides</i>	LETA	Introduced	forb	0.7	0.0	0.0	0.0	0.0
<i>Luzula</i> sp.	LUZ.SP	Unk	graminoid	0.2	0.0	0.0	0.0	0.0
<i>Myosotis discolor</i>	MYDI	Introduced	forb	0.2	0.0	0.0	0.0	0.0
<i>Parentucellia viscosa</i>	PAVI	Introduced	forb	0.0	4.9	1.9	3.7	0.0
<i>Phalaris arundinacea</i>	PHAR	Introduced	graminoid	0.1	0.0	0.0	0.0	0.0
<i>Plantago lanceolata</i>	PLLA	Introduced	forb	0.2	0.4	1.0	0.3	1.8

<i>Potentilla gracilis</i>	POGR	Native	forb	0.0	0.0	0.0	0.0	0.2
<i>Prunella vulgaris</i>	PRVU	Native	forb	0.0	0.0	0.0	3.9	8.2
<i>Pteridium aquilinum</i>	PTAQ	Native	forb	0.2	0.0	0.2	0.1	0.7
<i>Rosa</i> sp.	ROSA.SP	Unknown	tree/shrub	0.1	0.0	0.0	0.0	0.0
<i>Rubus armeniacus</i>	RUAR	Introduced	tree/shrub	1.2	0.1	0.6	1.5	0.9
<i>Rumex acetosella</i>	RUAC	Introduced	forb	0.3	0.0	0.2	0.3	0.2
<i>Senecio vulgaris</i>	SEVU	Introduced	forb	0.1	0.0	0.0	0.0	0.0
<i>Sherardia arvensis</i>	SHAR	Introduced	forb	0.0	0.0	1.0	0.0	0.0
<i>Sidalcea virgata</i>	SIVI	Native	forb	0.0	0.0	0.0	0.0	0.0
<i>Taraxacum officinale</i>	TAOF	Introduced	forb	0.4	0.1	0.0	0.0	0.0
<i>Vicia hirsuta</i>	VIHI	Introduced	forb	1.3	0.0	0.0	0.0	0.1
<i>Vicia sativa</i>	VISA	Introduced	forb	4.7	0.1	0.2	0.9	0.3
<i>Vulpia</i> spp.	VULP.SP	Introduced	graminoid	0.0	0.1	4.1	24.4	6.4

APPENDIX F. AVERAGE PERCENT COVER OF ALL SPECIES OBSERVED IN MONITORING PLOTS AT WEST SHORE IN 2010, 2011, 2012, 2013, 2016, 2017 AND 2018.

Scientific Name	2010	2011	2012	2013	2016	2017	2018
Bare	1.4	6.4	8.2	9.6	2.4	37.5	1.4
Moss/lichen	19.6	14.9	28.0	26.6	12.9	19.6	3.8
Litter	48.6	53.9	19.9	64.0	50.5	30.8	12.4
Basal Veg	0.0	0.0	0.0	0.0	58.4	13.2	82.6
Rock	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Acer macrophyllum</i>	0.0	0.0	0.0	0.0	0.0	0.3	0.0
<i>Agrostis</i> sp.	3.2	0.2	1.0	0.6	0.1	0.5	0.1
<i>Aira caryophyllea</i>	0.0	0.0	0.0	0.3	0.0	0.0	0.9
<i>Alnus rubra</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.1
<i>Alopecurus pratensis</i>	0.0	0.0	0.0	0.3	0.0	0.0	0.0
<i>Amelanchier alnifolia</i>	0.1	0.0	0.0	0.1	0.0	0.0	2.2
<i>Anthoxanthum odoratum</i>	12.4	6.5	9.5	21.7	0.2	0.4	3.9
<i>Apocynum androsaemifolium</i>	0.5	4.1	1.3	5.1	4.2	5.6	5.6
<i>Arrhenatherum elatius</i>	6.7	2.5	3.1	14.1	1.7	0.7	1.1
<i>Berberis nervosa</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Brodiaea</i> sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Bromus hordeaceus</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Carex</i> sp.	0.0	0.0	0.0	0.0	0.1	0.0	0.0
<i>Carex tumulicola</i>	0.0	0.0	0.0	0.0	0.6	0.0	0.0
<i>Centaurea pratensis</i>	0.0	0.0	0.0	0.0	0.5	0.0	0.0
<i>Centaureum erythraea</i>	0.0	0.0	0.0	0.0	0.0	0.1	0.1
<i>Cerastium arvense</i>	0.0	0.0	0.0	0.0	0.0	0.2	0.0
<i>Cirsium vulgare</i>	0.0	0.0	0.0	0.0	0.0	0.1	0.0
<i>Clarkia amoena</i>	0.0	0.0	0.0	0.0	0.0	1.3	0.0
<i>Clarkia</i> sp.	0.0	0.0	0.0	0.0	0.0	0.0	1.1

<i>Collomia grandiflora</i>	0.0	0.0	0.0	0.0	0.0	1.1	0.5
<i>Crataegus douglasii</i>	0.1	0.0	0.0	0.3	0.2	0.0	0.2
<i>Crataegus monogyna</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Crepis capillaris</i>	1.2	0.1	4.4	0.0	0.8	0.8	1.0
<i>Crepis setosa</i>	3.8	0.6	5.5	0.0	0.0	0.1	0.0
<i>Cytisus scoparius</i>	0.2	0.0	0.1	0.0	0.4	0.0	0.0
<i>Dactylis glomerata</i>	1.9	0.1	0.1	0.0	0.0	0.0	0.0
<i>Danthonia californica</i>	0.1	0.0	0.3	0.2	0.4	0.0	0.0
<i>Daucus carota</i>	1.7	0.3	0.9	1.2	5.1	4.7	14.3
<i>Elymus glaucus</i>	0.0	0.0	0.0	0.0	0.0	0.1	0.0
<i>Eriophyllum lanatum</i>	0.0	0.0	0.0	0.0	0.0	0.3	1.4
<i>Schedonorus arundinacea</i>	9.0	2.7	2.8	2.9	0.6	2.5	0.0
<i>Festuca trachyphylla</i> ¹	1.3	1.4	1.9	8.5	1.1	5.3	0.1
<i>Frageria virginiana</i>	6.1	15.4	7.2	7.4	10.2	6.9	0.6
<i>Galium aparine</i>	0.2	0.0	0.0	0.2	0.0	0.0	0.0
<i>Galium parisiense</i>	0.1	0.1	0.0	0.4	12.3	13.1	10.7
<i>Geranium dissectum</i>	0.0	0.0	0.0	0.0	0.0	0.3	0.0
<i>Gilia capitata</i>	0.0	0.0	0.0	0.0	0.0	0.5	0.9
<i>Holcus lanatus</i>	0.2	0.3	0.3	0.2	0.0	0.0	0.0
<i>Hypericum perforatum</i>	0.1	0.1	0.1	0.1	0.3	0.5	0.0
<i>Hypochaeris radicata</i>	15.4	15.4	15.5	23.2	19.3	8.1	8.0
<i>Ilex</i> sp.	0.1	0.0	0.0	0.0	0.0	0.0	0.0
<i>Ipomoea</i> sp.	0.3	0.0	0.3	0.0	0.0	0.0	0.0
<i>Leucanthemum vulgare</i>	0.4	0.0	0.2	0.2	0.0	0.0	0.6
<i>Lotus unifoliolatus</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Lupinus oreganus</i>	0.4	0.0	0.8	0.2	0.6	0.1	0.0
<i>Luzula</i> sp.	0.1	0.0	0.2	0.3	0.0	0.0	0.0
<i>Madia</i> sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Myosotis discolor</i>	0.2	0.0	0.1	0.0	0.1	0.0	0.0
<i>Parentucellia viscosa</i>	0.1	0.0	0.0	0.2	0.1	0.5	0.3

<i>Phacelia nemoralis</i>	0.0	0.0	0.0	0.0	0.0	0.5	0.1
<i>Plantago lanceolata</i>	1.5	4.2	1.7	3.2	8.7	3.4	4.9
<i>Polystichum munitum</i>	0.0	0.0	0.1	0.0	0.0	0.0	0.0
<i>Potentilla gracilis</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Prunella vulgaris</i>	0.0	0.0	0.0	0.1	0.2	0.9	5.5
<i>Prunus avium</i>	0.0	0.0	0.0	0.0	0.0	0.3	0.0
<i>Prunus sp.</i>	0.0	0.0	0.1	0.0	0.0	0.0	0.0
<i>Pseudotsuga menziesii</i>	0.0	0.0	0.0	0.2	0.1	0.1	0.1
<i>Pteridium aquilinum</i>	0.8	0.4	0.6	3.4	10.4	16.2	16.8
<i>Rosa sp.</i>	1.2	0.4	0.5	2.0	1.0	4.2	2.7
<i>Rubus armeniacus</i>	1.8	2.0	2.2	2.5	4.0	5.0	10.4
<i>Rubus ursinus</i>	0.0	0.0	0.0	0.0	2.6	5.3	0.0
<i>Rumex acetosella</i>	0.1	0.0	0.0	0.0	0.4	0.0	0.0
<i>Senecio jacobaea</i>	0.0	0.0	0.1	0.0	0.1	0.0	0.0
<i>Senecio vulgaris</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Sidalcea virgata</i>	0.8	0.4	3.1	1.1	4.1	1.0	0.2
<i>Solidago canadensis</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.1
<i>Sonchus sp.</i>	0.0	0.0	0.0	0.0	0.0	0.2	0.0
<i>Spirea douglasii</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.2
<i>Symphoricarpos albus</i>	0.0	0.0	0.1	0.0	0.0	0.0	0.2
<i>Taraxacum officinale</i>	0.8	0.0	1.1	0.0	0.0	0.1	0.0
<i>Toxicodendron diversilobum</i>	0.0	0.1	0.0	0.0	0.0	0.0	0.0
<i>Vaccinium sp.</i>	0.0	1.8	0.0	0.0	0.0	0.0	0.0
<i>Vicia cracca</i>	0.1	0.0	0.0	0.0	0.0	0.0	0.0
<i>Vicia hirsuta</i>	0.3	0.0	0.4	0.6	1.9	0.0	0.0
<i>Vicia sativa</i>	0.2	0.0	0.2	0.0	0.6	0.2	0.2
<i>Vicia tetrasperma</i>	0.0	0.0	0.0	0.0	0.2	0.0	0.0
<i>Viola sp.</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Vulpia sp.</i>	0.0	0.0	0.0	0.0	0.3	4.3	2.1

¹*Festuca trachyphylla* was planted at West Spires and has not been controlled/removed. Can be confused with the native, *Festuca roemerii*, but *F. roemerii* has not been seeded and do not expect at the site.

APPENDIX G. AVERAGE PERCENT COVER OF ALL SPECIES OBSERVED IN MONITORING PLOTS AT EAST SHORE IN 2010, 2011, 2012, 2013, 2016, 2017 AND 2018.

Scientific Name	SpCode	US Nativity	Growth Habit	2010	2011	2012	2013	2016	2017	2018
Bare				0.6	1.6	1.2	1.0	0.1	0.0	1.1
Moss/lichen				17.1	7.7	32.2	59.5	10.8	4.9	3.0
Litter				46.8	77.9	34.0	60.2	64.1	89.4	5.6
Basal Veg				0.0	0.0	0.0	0.0	39.8	6.2	90.6
Rock				0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Acer macrophyllum</i>	ACMA	Native	tree/shrub	0.0	0.0	0.0	0.0	0.1	0.0	0.0
<i>Agrostis</i> sp.	AGRO.SP	Introduced	graminoid	0.4	0.7	0.8	0.0	0.0	0.0	0.1
<i>Aira caryophyllea</i>	AICA	Introduced	graminoid	0.0	0.0	0.0	0.0	0.0	0.0	0.1
<i>Alnus rubra</i>	ALRU	Native	tree/shrub	0.0	0.0	0.0	0.0	0.0	0.0	0.7
<i>Amelanchier alnifolia</i>	AMAL	Native	tree/shrub	0.0	0.0	0.0	0.1	0.0	0.0	9.6
<i>Anthoxanthum odoratum</i>	ANOD	Introduced	graminoid	6.5	2.0	3.2	12.4	0.3	5.4	20.4
<i>Apocynum androsaemifolium</i>	APAN	Native	forb	0.2	1.9	0.7	3.6	10.5	23.4	0.0
<i>Arrhenatherum elatius</i>	AREL	Introduced	graminoid	10.2	0.9	4.7	12.5	4.1	1.8	4.8
<i>Bromus carinatus</i>	BRCA	Native	graminoid	0.0	0.0	0.0	0.0	0.1	0.0	0.0
<i>Camassia quamash</i>	CAQU	Native	forb	0.0	0.0	0.1	0.0	0.0	0.0	0.0
<i>Carex</i> sp.	CAR.SP	Native	graminoid	0.0	0.8	0.0	0.5	0.7	0.0	0.8
<i>Cirsium vulgare</i>	CIVU	Introduced	forb	0.1	0.1	0.0	0.0	0.2	0.0	0.0
<i>Crataegus douglasii</i>	CRDO	Native	tree/shrub	0.1	0.1	0.1	0.4	0.4	0.2	0.5
<i>Crepis capillaris</i>	CRCA	Introduced	forb	0.2	1.0	4.0	0.2	3.2	11.0	2.0
<i>Crepis setosa</i>	CRSE	Introduced	forb	1.8	1.3	9.4	0.8	0.0	0.0	0.0
<i>Cynosurus echinatus</i>	CYEC	Introduced	graminoid	0.0	0.0	0.0	0.0	0.3	0.0	0.0
<i>Cytisus scoparius</i>	CYSC	Introduced	tree/shrub	0.1	0.0	0.0	0.0	0.1	0.2	0.0
<i>Dactylis glomerata</i>	DAGL	Introduced	graminoid	1.6	1.2	1.6	0.0	1.4	0.0	0.0
<i>Danthonia californica</i>	DACA	Native	graminoid	3.0	0.5	0.7	0.2	0.2	0.2	0.0
<i>Daucus carota</i>	DAUCAR	Introduced	forb	0.9	1.3	0.7	2.0	4.7	44.9	15.1
<i>Draba verna</i>	DRVE	Introduced	forb	0.0	0.0	0.0	0.0	0.0	0.1	0.0

<i>Elymus glaucus</i>	ELGL	Native	graminoid	0.0	0.0	0.0	0.0	0.1	0.0	0.0
<i>Eriophyllum lanatum</i>	ERLA	Native	forb	0.0	1.5	0.2	0.0	0.0	0.0	0.0
<i>Schedonorus arundinacea</i>	FEAR	Introduced	graminoid	15.1	0.7	5.0	10.2	1.4	2.6	0.0
<i>Festuca roemeri</i>	FERO	Native	graminoid	0.1	0.5	0.0	0.4	0.1	0.0	0.0
<i>Fragaria virginiana</i>	FRVI	Native	forb	7.4	13.3	27.7	20.4	16.0	13.3	7.1
<i>Frangula purshiana</i>	FRPU	Native	tree/shrub	0.0	0.0	0.0	0.6	0.0	0.0	0.0
<i>Fraxinus latifolia</i>	FRLA	Native	tree/shrub	0.0	0.0	0.0	0.1	0.2	0.0	0.7
<i>Galium aparine</i>	GAAP	Native	forb	0.2	0.0	0.2	0.0	5.2	0.2	0.0
<i>Galium parisiense</i>	GAPA	Introduced	forb	0.2	0.0	0.0	1.9	9.3	9.3	2.4
<i>Geranium dissectum</i>	GEDI	Introduced	forb	0.0	0.0	0.0	0.0	0.2	1.3	0.1
<i>Holcus lanatus</i>	HOLA	Introduced	graminoid	0.1	0.2	0.0	0.3	0.0	0.0	0.0
<i>Hypericum perforatum</i>	HYPE	Introduced	forb	0.0	0.0	0.1	0.3	0.3	0.1	0.2
<i>Hypochaeris radicata</i>	HYRA	Introduced	forb	9.1	22.3	20.2	35.9	12.4	8.6	8.0
<i>Iris tenax</i>	IRTE	Native	forb	0.0	0.0	0.0	0.0	0.0	0.0	0.7
<i>Kickxia elatine</i>	KICK.SP	Introduced	forb	0.0	0.0	0.0	0.0	0.0	0.1	0.0
<i>Leontodon taraxacoides</i>	LETA	Introduced	forb	0.0	0.2	0.0	0.0	0.0	0.0	0.0
<i>Leucanthemum vulgare</i>	LEVU	Introduced	forb	0.2	0.4	0.2	2.2	0.1	0.6	2.6
<i>Lotus unifoliolatus</i>	LOUN	Native	forb	0.0	0.0	0.0	0.0	0.0	0.9	0.0
<i>Lupinus oreganus</i>	LUOR	Native	forb	1.0	0.0	0.1	0.0	0.0	0.0	0.0
<i>Luzula sp.</i>	LUZ.SP	Unk	graminoid	0.3	0.1	0.7	1.7	0.3	0.9	0.0
<i>Myosotis discolor</i>	MYDI	Introduced	forb	0.1	0.0	0.0	0.0	0.2	0.0	0.0
<i>Parentucellia viscosa</i>	PAVI	Introduced	forb	0.0	0.0	0.0	0.1	0.0	0.0	0.0
<i>Plantago lanceolata</i>	PLLA	Introduced	forb	0.2	1.1	0.3	5.1	4.9	2.0	2.8
<i>Polystichum munitum</i>	POMU	Native	forb	0.0	0.0	0.0	0.0	0.2	0.0	0.0
<i>Prunella vulgaris</i>	PRVU	Native	forb	0.0	0.1	0.0	0.0	0.0	0.4	0.3
<i>Prunus emarginata</i>	PREM	Native	tree/shrub	0.3	0.1	0.1	0.0	0.1	0.3	0.0
<i>Prunus sp.</i>	PRUN.SP	Unknown	tree/shrub	0.0	0.0	0.0	0.0	0.0	0.0	1.4
<i>Pseudotsuga menziesii</i>	PSME	Native	tree/shrub	0.0	0.0	0.0	0.0	0.1	0.0	1.7
<i>Pteridium aquilinum</i>	PTAQ	Native	forb	0.2	0.0	0.1	0.1	7.0	8.2	7.6
<i>Pyrus sp.</i>	PYRUS.SP	Unknown	tree/shrub	0.0	0.0	0.0	0.0	0.0	0.0	0.4

<i>Ranunculus occidentalis</i>	RAOC	Native	forb	0.1	0.0	0.1	0.0	0.0	0.0	0.0
<i>Rosa</i> sp.	ROSA.SP	Unknown	tree/shrub	1.1	0.1	0.4	0.2	1.2	0.6	1.7
<i>Rubus armeniacus</i>	RUAR	Introduced	tree/shrub	1.3	0.5	0.9	4.0	10.7	4.2	4.8
<i>Rubus ursinus</i>	RUUR	Native	tree/shrub	0.0	0.0	0.0	0.0	3.4	0.6	0.0
<i>Rumex acetosella</i>	RUAC	Introduced	forb	0.0	0.1	0.2	0.5	0.8	0.1	0.1
<i>Senecio jacobaea</i>	SEJA	Introduced	forb	0.0	0.0	0.1	0.2	1.4	0.0	0.0
<i>Senecio vulgaris</i>	SEVU	Introduced	forb	0.0	0.1	0.0	0.0	0.0	0.0	0.0
<i>Sherardia arvensis</i>	SHAR	Introduced	forb	0.0	0.0	0.0	0.0	0.0	0.7	0.0
<i>Sidalcea virgata</i>	SIVI	Native	forb	3.2	1.7	3.6	0.9	6.6	1.4	5.1
<i>Spirea douglasii</i>	SPDO	Native	tree/shrub	0.0	0.0	0.0	0.0	0.0	0.0	0.4
<i>Symphoricarpos albus</i>	SYAL	Native	tree/shrub	0.1	0.0	0.0	0.0	0.0	0.0	0.0
<i>Taraxacum officinale</i>	TAOF	Introduced	forb	0.3	0.7	0.9	0.1	0.1	0.1	0.1
<i>Vicia hirsuta</i>	VIHI	Introduced	forb	0.3	0.0	0.1	4.9	1.3	0.0	0.2
<i>Vicia sativa</i>	VISA	Introduced	forb	0.1	0.0	0.2	1.1	6.7	0.1	0.1
<i>Vicia tetrasperma</i>	VITE	Introduced	forb	0.0	0.0	0.0	0.0	0.8	0.0	0.0
<i>Vulpia bromoides</i>	VUBR	Introduced	graminoid	0.0	0.0	0.0	0.0	0.3	6.9	0.0
<i>Vulpia</i> sp.	VULP.SP	Introduced	graminoid	0.0	0.0	0.0	0.0	0.0	0.0	0.3

APPENDIX H. AVERAGE PERCENT COVER OF ALL SPECIES OBSERVED IN MONITORING PLOTS AT NORTH EATON IN 2010, 2013, 2016, 2017 AND 2018.

Scientific Name	SpCode	US Nativity	Growth Habit	2010	2013	2016	2017	2018
Bare				1.0	8.3	0.5	4.0	0.9
Moss/lichen				5.1	4.4	1.9	0.8	1.0
Litter				47.4	88.0	78.0	33.2	33.0
Basal Veg				0.0	0.0	53.5	61.6	65.2
Rock				0.0	0.0	0.0	0.0	0.0
<i>Agrostis</i> sp.	AGRO.SP	Introduced	graminoid	7.2	19.3	9.4	13.8	20.8
<i>Aira caryophylla</i>	AICA	Introduced	graminoid	0.1	0.4	0.0	0.0	0.0
<i>Alnus rubra</i>	ALRU	Native	tree/shrub	0.1	0.0	0.0	0.0	0.0
<i>Amelanchier alnifolia</i>	AMAL	Native	tree/shrub	0.0	0.1	0.0	0.0	0.0
<i>Anthoxanthum odoratum</i>	ANOD	Introduced	graminoid	29.9	21.6	3.0	4.8	6.4
<i>Arrhenatherum elatius</i>	AREL	Introduced	graminoid	5.1	3.0	2.6	2.1	0.2
<i>Brodiaea</i> sp.	BROD.SP	Native	forb	0.1	0.1	0.0	0.2	0.0
<i>Bromus hordeaceus</i>	BRHO	Introduced	graminoid	0.3	0.0	0.0	0.0	0.0
<i>Centaureum erythraea</i>	CEER	Introduced	forb	0.0	0.2	0.0	0.0	0.0
<i>Clarkia</i> sp.	CLAR.SP	Native	forb	0.0	0.0	0.0	0.0	0.1
<i>Collomia grandiflora</i>	COGR	Native	forb	0.0	0.0	0.0	0.1	0.0
<i>Crataegus douglasii</i>	CRDO	Native	tree/shrub	0.0	0.0	0.0	0.0	0.0
<i>Crepis capillaris</i>	CRCA	Introduced	forb	0.1	0.0	0.1	0.5	0.0
<i>Cynosurus echinatus</i>	CYEC	Introduced	graminoid	0.0	0.0	0.0	0.1	0.0
<i>Cytisus scoparius</i>	CYSC	Introduced	tree/shrub	1.3	0.5	8.4	5.7	5.6
<i>Dactylis glomerata</i>	DAGL	Introduced	graminoid	0.8	0.0	0.0	0.0	0.0
<i>Danthonia californica</i>	DACA	Native	graminoid	0.7	0.0	0.8	0.1	0.2
<i>Daucus carota</i>	DAUCAR	Introduced	forb	0.3	0.0	1.2	1.1	0.6
<i>Deschampsia cespitosa</i>	DECE	Native	graminoid	0.0	0.0	0.0	2.7	0.0
<i>Dichanthelium oligosanthes</i>	DIOL	Native	graminoid	0.0	0.0	0.0	0.0	0.1
<i>Draba verna</i>	DRVE	Introduced	forb	0.3	0.0	0.0	0.0	0.0
<i>Elymus glaucus</i>	ELGL	Native	graminoid	1.3	0.0	0.0	0.0	0.0
<i>Elytrigia repens</i>	ELRE	Introduced	graminoid	0.4	0.0	0.0	0.0	0.0
<i>Eriophyllum lanatum</i>	ERLA	Native	forb	0.0	0.0	0.0	0.0	0.1
<i>Schedonorus arundinacea</i>	FEAR	Introduced	graminoid	2.3	0.0	0.0	0.0	0.0
<i>Festuca roemerii</i>	FERO	Native	graminoid	2.5	41.8	33.1	33.0	31.8
<i>Fraxinus latifolia</i>	FRLA	Native	tree/shrub	0.0	0.0	0.4	0.0	0.2
<i>Galium aparine</i>	GAAP	Native	forb	0.4	0.0	0.0	0.2	0.0
<i>Galium parisiense</i>	GAPA	Introduced	forb	0.3	3.9	10.5	15.6	0.5
<i>Geranium dissectum</i>	GEDI	Introduced	forb	0.0	0.0	0.1	0.0	0.0

<i>Holcus lanatus</i>	HOLA	Introduced	graminoid	0.1	0.3	0.0	0.0	0.0
<i>Hypericum perforatum</i>	HYPE	Introduced	forb	0.2	0.9	1.5	1.5	0.4
<i>Hypochaeris radicata</i>	HYRA	Introduced	forb	7.8	1.3	23.2	12.9	13.2
<i>Iris tenax</i>	IRTE	Native	forb	0.1	0.0	0.0	0.0	0.0
<i>Juncus bufonis</i>	JUBU	Native	graminoid	0.0	0.0	0.1	1.9	0.0
<i>Juncus tenuis</i>	JUTE	Native	graminoid	0.0	0.0	0.0	0.2	0.1
<i>Lotus unifoliolatus</i>	LOUN	Native	forb	0.1	0.0	0.2	0.0	1.7
<i>Lupinus oreganus</i>	LUOR	Native	forb	1.1	0.4	0.3	0.1	0.3
<i>Luzula sp.</i>	LUZ.SP	Unk	graminoid	0.4	0.0	0.0	0.0	0.0
<i>Madia sp.</i>	MAD.SP	Native	forb	0.0	0.0	0.0	1.3	0.3
<i>Myosotis discolor</i>	MYDI	Introduced	forb	0.3	0.0	0.1	0.0	0.0
<i>Panicum sp.</i>	PAN.SP	Introduced	graminoid	0.0	0.1	0.0	0.3	0.0
<i>Parentucellia viscosa</i>	PAVI	Introduced	forb	0.2	0.8	0.5	1.4	0.2
<i>Plantago lanceolata</i>	PLLA	Introduced	forb	0.5	0.1	2.5	3.8	1.2
<i>Prunella vulgaris</i>	PRVU	Native	forb	0.0	0.1	0.0	0.2	1.3
<i>Pteridium aquilinum</i>	PTAQ	Native	forb	0.3	1.1	4.8	1.9	2.2
<i>Quercus garryana</i>	QUGA	Native	tree/shrub	2.6	0.0	0.2	0.3	0.1
<i>Rosa sp.</i>	ROSA.SP	Unknown	tree/shrub	0.1	0.0	0.4	0.0	0.1
<i>Rubus armeniacus</i>	RUAR	Introduced	tree/shrub	0.5	1.4	0.6	1.2	1.3
<i>Rubus ursinus</i>	RUUR	Native	tree/shrub	0.0	0.0	3.8	1.2	3.3
<i>Rumex acetosella</i>	RUAC	Introduced	forb	0.2	0.2	0.9	0.3	0.3
<i>Scirpus sp.</i>	SCIRP.SP	Native	graminoid	0.0	0.0	0.0	0.2	0.0
<i>Senecio jacobaea</i>	SEJA	Introduced	forb	0.0	0.0	0.2	0.7	0.0
<i>Sherardia arvensis</i>	SHAR	Introduced	forb	0.0	0.0	0.1	0.0	0.0
<i>Sidalcea virgata</i>	SIVI	Native	forb	0.0	0.0	0.0	0.0	0.1
<i>Taraxacum officinale</i>	TAOF	Introduced	forb	0.0	0.0	0.1	0.0	0.0
<i>Vicia cracca</i>	VICR	Introduced	forb	0.3	0.0	0.0	2.6	0.0
<i>Vicia hirsuta</i>	VIHI	Introduced	forb	0.3	0.0	0.2	0.0	0.0
<i>Vicia sativa</i>	VISA	Introduced	forb	0.4	0.0	0.1	0.0	0.0
<i>Vulpia sp.</i>	VULP.SP	Introduced	graminoid	0.0	0.0	0.3	0.3	0.0

APPENDIX I. AVERAGE PERCENT COVER OF ALL SPECIES OBSERVED IN MONITORING PLOTS AT SOUTH EATON IN 2015, 2016, 2017 AND 2018. AVERAGES ARE BROKEN INTO THREE SECTIONS (W=WEST, C=CENTRAL, E=EAST, AND ALL= THE AVERAGE ACROSS ALL). THE SITE WAS ALSO MONITORED IN 2009, BUT WAS BROKEN UP INTO DIFFERENT SECTIONS THAT CANNOT BE COMPARED, SO THOSE VALUES ARE NOT REPORTED HERE.

Scientific Name	2015	2015	2015	2015	2016	2016	2016	2016	2017	2017	2017	2017	2018	2018	2018	2018
	W	C	E	All	W	C	E	All	W	C	E	All	W	C	E	All
Bare	1.3	6.1	0.4	2.6	9.6	19.5	6.4	13.1	0.2	0.0	51.3	16.9	36.6	73.2	0.01	0
Moss/lichen	1.0	7.5	0.3	2.9	0.1	2.6	0.3	1.3	0.4	0.0	2.3	0.9	2.2	4.43	0	0.38
Litter	47.0	40.5	50.5	46.0	82.5	78.5	88.1	82.2	8.1	2.9	8.1	5.6	13.8	3.05	24.5	30.3
Basal Veg	57.5	46.7	57.5	54.1	36.3	12.5	36.9	25.8	91.4	97.1	37.1	76.3	47.4	19.3	75.5	69.4
Rock	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
<i>Agrostis sp.</i>	35.2	14.6	28.9	26.2	0.0	0.2	7.5	2.2	0.1	0.0	0.0	0.0	1.2	1.4	0.9	0.8
<i>Aira caryophyllea</i>	3.4	13.7	2.1	6.4	1.9	2.5	6.8	3.5	0.0	0.0	0.0	0.0	0.4	0.8	0.1	0.3
<i>Anthoxanthum odoratum</i>	0.0	0.5	0.6	0.4	0.0	1.5	1.0	0.9	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.1
<i>Arrhenatherum elatius</i>	0.0	1.7	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Aster hallii</i>	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Brassica sp.</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Bromus carinatus</i>	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Bromus hordeaceus</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Castilleja levisecta</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1	0.0	0.0	0.0	0.0
<i>Centaureum erythraea</i>	0.0	0.4	0.4	0.3	0.0	0.5	0.1	0.3	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1
<i>Cerastium glomeratum</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Cerastium sp.</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Chamaesyce maculata</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.1
<i>Cirsium vulgare</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Clarkia amoena</i>	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.1	0.3	0.1	0.0	0.0	0.0	0.0
<i>Clarkia sp.</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Collomia grandiflora</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

<i>Crepis capillaris</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Crepis setosa</i>	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Cynosurus echinatus</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Cytisus scoparius</i>	0.0	0.5	0.5	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.9	0.6
<i>Daucus carota</i>	0.8	3.2	0.4	1.5	1.3	1.4	2.0	1.5	4.9	1.6	4.2	3.6	5.8	10.7	1.0	3.9
<i>Dichanthelium oligosanthes</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Epilobium minutum</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Eriophyllum lanatum</i>	0.1	0.0	0.1	0.1	10.0	0.4	0.0	2.9	0.0	0.0	1.1	0.4	0.1	0.0	0.1	0.0
<i>Schedonorus arundinacea</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Festuca roemerii</i>	53.6	6.9	44.8	35.1	14.6	2.0	12.8	8.5	55.9	0.0	39.8	31.9	18.9	0.0	37.9	25.8
<i>Galium parisiense</i>	0.0	0.5	0.0	0.2	2.1	0.0	3.4	1.5	0.0	0.3	0.0	0.1	0.1	0.2	0.0	0.1
<i>Geranium dissectum</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Gnaphalium sp.</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.1
<i>Holcus lanatus</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Hypericum perforatum</i>	0.7	3.5	1.4	1.9	2.3	0.0	2.1	1.2	0.1	0.0	0.1	0.1	0.5	0.8	0.2	0.4
<i>Hypochaeris radicata</i>	8.5	26.1	20.3	18.3	5.4	0.1	14.8	5.6	40.2	1.0	48.3	29.8	21.2	1.5	40.8	23.4
<i>Juncus bufonis</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Lotus micranthus</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.4	0.1
<i>Lotus unifoliolatus</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Madia sp.</i>	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.2	0.0	0.0	0.1	0.0	0.0	0.0	0.1
<i>Myosotis discolor</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.1
<i>Panicum sp.</i>	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Parentucellia viscosa</i>	0.3	1.0	0.4	0.5	0.3	0.0	1.0	0.4	0.4	0.0	0.3	0.2	0.1	0.1	0.0	0.1
<i>Plantago lanceolata</i>	4.2	14.9	0.0	6.4	0.5	6.4	3.1	3.9	0.8	21.8	2.8	8.5	4.2	7.7	0.7	4.0
<i>Potentilla gracilis</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Prunella vulgaris</i>	0.0	0.0	0.0	0.0	1.5	0.0	0.1	0.4	0.8	0.0	1.3	0.7	0.0	0.0	0.1	0.0
<i>Quercus garryana</i>	0.0	0.0	0.1	0.0	0.4	0.2	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Quercus sp.</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Rubus armeniacus</i>	0.0	0.0	0.0	0.0	0.1	3.2	0.4	1.6	0.3	0.0	0.0	0.1	0.0	0.0	0.0	0.8

<i>Rumex acetosella</i>	0.1	5.6	0.1	1.9	0.6	0.2	0.7	0.4	0.0	0.0	0.4	0.1	0.1	0.2	0.1	0.1
<i>Sherardia arvensis</i>	0.6	2.4	1.2	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Sonchus sp.</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Vicia hirsuta</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Vicia sativa</i>	0.7	0.4	0.4	0.5	0.5	0.0	0.6	0.3	0.3	0.0	0.1	0.1	0.1	0.0	0.1	0.4
<i>Vulpia bromoides</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	12.5	3.0	6.8	0.0	0.0	0.0	0.0
<i>Vulpia myuros</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.1	0.0	0.5	2.5	0.0	0.0	0.0	0.0
<i>Vulpia sp.</i>	2.2	7.8	4.0	4.7	48.1	5.0	15.5	19.8	1.0	0.0	6.4	2.5	2.3	0.0	4.6	8.6

APPENDIX J. AVERAGE PERCENT COVER OF ALL SPECIES OBSERVED IN MONITORING PLOTS AT MIDDLE GREEN OAKS IN 2010, 2015 AND 2018.

Scientific Name	SpCode	US Nativity	Growth Habit	2010	2015	2018
Bare				0.6	2.5	0.3
Moss/lichen				11.4	12.6	11.8
Litter				56.6	18.1	43.9
Basal Veg				0.0	68.2	44.1
Rock				0.0	0.0	0.0
<i>Agrostis</i> sp.	AGRO.SP	Introduced	graminoid	10.8	11.2	1.3
<i>Aira caryophyllea</i>	AICA	Introduced	graminoid	5.0	1.5	1.8
<i>Alnus</i> sp.	ALNUS.SP	Native	tree/shrub	5.4	0.0	0.0
<i>Amelanchier alnifolia</i>	AMAL	Native	tree/shrub	0.2	0.0	0.6
<i>Anthoxanthum odoratum</i>	ANOD	Introduced	graminoid	13.4	8.9	4.0
<i>Apocynum androsaemifolium</i>	APAN	Native	forb	0.0	0.8	0.0
<i>Arrhenatherum elatius</i>	AREL	Introduced	graminoid	0.1	0.1	0.1
<i>Bromus carinatus</i>	BRCA	Native	graminoid	0.3	0.0	0.0
<i>Bromus hordeaceus</i>	BRHO	Introduced	graminoid	1.0	5.6	1.8
<i>Crataegus douglasii</i>	CRDO	Native	tree/shrub	0.1	0.0	0.0
<i>Crepis capillaris</i>	CRCA	Introduced	forb	0.8	0.0	0.0
<i>Cynosurus echinatus</i>	CYEC	Introduced	graminoid	0.0	0.0	0.2
<i>Danthonia californica</i>	DACA	Native	graminoid	0.4	1.7	7.2
<i>Daucus carota</i>	DAUCAR	Introduced	forb	1.3	18.5	26.2
<i>Draba verna</i>	DRVE	Introduced	forb	0.2	0.0	0.0
<i>Eriophyllum lanatum</i>	ERLA	Native	forb	0.1	0.0	0.0
<i>Schedonorus arundinacea</i>	FEAR	Introduced	graminoid	0.2	0.1	0.0
<i>Galium parisiense</i>	GAPA	Introduced	forb	0.5	0.0	0.4
<i>Geranium dissectum</i>	GEDI	Introduced	forb	0.3	0.0	0.0
<i>Hypericum perforatum</i>	HYPE	Introduced	forb	0.1	0.0	0.1
<i>Hypochaeris radicata</i>	HYRA	Introduced	forb	19.5	44.9	12.9
<i>Linum bienne</i>	LIBI	Introduced	forb	0.0	0.0	0.3
<i>Lupinus oreganus</i>	LUOR	Native	forb	0.0	0.0	0.9
<i>Luzula</i> sp.	LUZ.SP	Unk	graminoid	0.1	0.0	0.0
<i>Myosotis discolor</i>	MYDI	Introduced	forb	0.1	0.0	0.0
<i>Plantago lanceolata</i>	PLLA	Introduced	forb	0.3	0.4	1.6
<i>Quercus garryana</i>	QUGA	Native	tree/shrub	0.0	0.0	0.2
<i>Rosa</i> sp.	ROSA.SP	Unknown	tree/shrub	0.1	0.0	2.0
<i>Rubus armeniacus</i>	RUAR	Introduced	tree/shrub	0.6	0.3	0.7
<i>Rumex acetosella</i>	RUAC	Introduced	forb	0.1	0.3	0.0
<i>Sherardia arvensis</i>	SHAR	Introduced	forb	0.0	4.2	0.0
<i>Vicia cracca</i>	VICR	Introduced	forb	0.1	0.0	0.0

<i>Vicia hirsuta</i>	VIHI	Introduced	forb	0.1	0.0	0.0
<i>Vicia sativa</i>	VISA	Introduced	forb	0.1	0.0	0.0
<i>Vulpia sp.</i>	VULP.SP	Introduced	graminoid	3.3	0.1	1.1