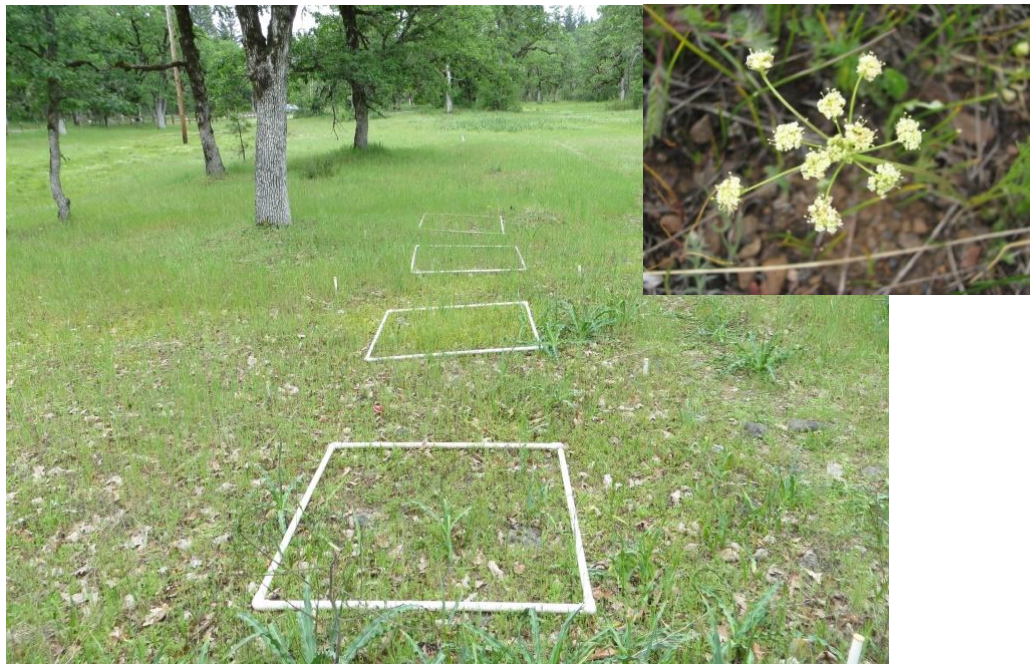


ASSESSING MANAGEMENT TECHNIQUES FOR *LOMATIUM* *COOKII* (COOK'S DESERT- PARSLEY)



2018

Report to the Bureau of Land Management, Medford
District

Report prepared by Denise E. L. Giles, Erin C. Gray,
and Matt A. Bahm

Institute for Applied Ecology



PREFACE

This report is the result of a cooperative project between the Institute for Applied Ecology (IAE) and the Bureau of Land Management. IAE is a non-profit organization whose mission is conservation of native ecosystems through restoration, research and education. IAE provides services to public and private agencies and individuals through development and communication of information on ecosystems, species, and effective management strategies. Restoration of habitats, with a concentration on rare and invasive species, is a primary focus. IAE conducts its work through partnerships with a diverse group of agencies, organizations and the private sector. IAE aims to link its community with native habitats through education and outreach.



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Cover photos: Cook's desert-parsley (*Lomatium cookii*) plot at Illinois Forks State Park and close up of individual Cook's desert-parsley.

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EXECUTIVE SUMMARY

This document summarizes results from two studies involving habitat management techniques for *L. cookii* to support recovery of the species. The studies include 1) an evaluation of herbicide effects at Illinois Forks State Park, in areas occupied and unoccupied with *L. cookii* and 2) the effects of prescribed fire on *L. cookii* and the surrounding plant community at French Flat Middle and French Flat South. This information will inform future habitat management activities in sites that may contribute to the recovery of *L. cookii* and other associated native plant species.

Effects of Herbicide, Illinois Forks State Park

There were no clear differences in survivorship of *L. cookii* by treatment at Illinois Forks State Park in 2015-2018 (up to 4 years post-treatment). Height differed significantly ($P < 0.001$) between herbicide treatments, where plants in the control treatment were taller than plants treated with herbicide; there were no differences in height between types of herbicide.

In occupied habitat from 2014 to 2018 mean forb cover increased or remained stable ($5\% \pm 2$ to $9\% \pm 4$); native and introduced graminoid cover decreased across all treatment types from 2014 to 2018 (native: $26\% \pm 6$ to $7\% \pm 2$, introduced: $30\% \pm 6$ to $4\% \pm 0.5$). The decrease in introduced graminoid cover was due in large part to shifts in hydrology that led to a retreat of the perennial, *Agrostis* sp. from pool edges and out of the plots (from $20\% \pm 8$ to $1\% \pm 0.5$). Introduced annual graminoid cover decreased from $10\% \pm 4$ to $3\% \pm 0.2$ with decreases seen in *Taeniatherum caput-medusae* from $6\% \pm 3$ to $1\% \pm 0.1$ in the occupied plots.

In unoccupied habitat, from 2014 to 2018 mean forb cover increased across all plots ($26\% \pm 5$ and $32\% \pm 8$ respectively); native forbs remained similar in cover from 2014 to 2018 ($8\% \pm 3$ and $9\% \pm 3.0$). Mean cover of introduced forbs varied by treatment though differences were not significant.

Mean cover of total graminoids in unoccupied plots decreased from 2014 ($27\% \pm 4$) to 2018 ($12\% \pm 3$), with decreases occurring in all treatment plots. Native graminoid cover remained low ($< 3\%$) and similar between 2014 ($3\% \pm 2\%$) and 2018 ($1\% \pm 1$). The species richness of introduced annual graminoids decreased from 2014-2018 (10 and 7, respectively).

Effects of Fire, French Flat

Density (and population size) of *L. cookii* at French Flat Middle and French Flat South in 2014 and 2015 were among the lowest recorded at these sites since monitoring began in 1993. While the cause of this decline is unclear, competition with non-native species, increasing litter and thatch, disturbance by off-road vehicles and climatic factors may be playing a role. In the fall of 2015, approximately half of the occupied portion of each meadow was burned under the supervision of BLM staff.

In 2018, density of *L. cookii* did not differ between burned and unburned plots at French Flat Middle and South. Similarly, number of plants in each size/reproductive class did not differ

between burned and unburned plots. Proportion of reproductive plants did not differ significantly between burned and unburned plots, nor were there effects of treatment on herbivory of *L. cookii*.

In 2017, the plant community responded similarly to the burn treatment at both French Flat Middle and South. There was no difference in native forb cover between burned and unburned plots in either meadow. Cover of invasive grasses in both meadows was low (<2%), thus differences between burned and unburned plots were negligible with respect to total cover. Invasive forb cover was low in all plots at French Flat (<1%), however, the presence of non-native forb species observed only in burned plots highlights that management in this ACEC should consider early detection and control of weedy species. The plant community was not monitored in 2018.

ASSESSING MANAGEMENT TECHNIQUES FOR *LOMATIUM COOKII*

REPORT TO THE BUREAU OF LAND MANAGEMENT, MEDFORD DISTRICT

INTRODUCTION

Lomatium cookii (Figure 1), Cook's desert-parsley, is listed as endangered by the State of Oregon and the U.S. Fish and Wildlife Service (USFWS) (ORBIC 2016). *L. cookii* is a member of the Apiaceae (parsley family). The species is endemic to southwestern Oregon in two population centers, one in Josephine County in the Illinois Valley and one in Jackson County in the Agate Desert north of the Medford Plains (Kagan 1994). The plants are usually less than 3 dm tall and inconspicuous except when in flower. Ternately divided leaves feature many narrow leaflets and creamy yellow flowers are produced in compound umbels on leafless stems (Figure 1). Fruits are flattened and oblong. The species was originally described by Kagan in 1986 from specimens collected in the Medford area. The species is closely related to *L. bradshawii*, an endangered species found in the Willamette Valley of western Oregon.



Figure 1. *Lomatium cookii* at French Flat.

Background

L. cookii was first described in 1981 in the Agate Desert in the Rogue River Valley. Habitats for the species in this area are characterized by patterned ground in the form of a series of vernal pools and mounds. *L. cookii* occupies a seasonally wet zone on the margins of the vernal pools. The dominant vegetation at Agate Desert consists of annual grasses (*Deschampsia danthonioides*, *Bromus hordeaceus*, *Alopecurus saccatus*, and *Taeniatherum caput-medusae*) and herbaceous annuals and perennials (*Lasthenia californica*, *Plectritis congesta*, *Collinsia grandiflora*, and *Limnanthes floccosa* ssp. *grandiflora*). The largest populations of this species are on lands managed by The Nature Conservancy and the Medford Airport (Kagan 1994).

The largest federally-owned population of *L. cookii* occurs in the Illinois Valley at the French Flat Area of Critical Environmental Concern (ACEC) managed by the Medford District Bureau of Land Management. Areas around this population were placer-mined for many years. Populations in this area have been monitored annually since 1993 (Pfingsten et al. 2017). These populations are often found in moist, grassy meadows dominated by *Danthonia californica* (Kaye and Blakeley-Smith 2002). Other associated species at French Flat include *Danthonia unispicata*,

Deschampsia cespitosa, *Camassia quamash*, *Ranunculus occidentalis*, *Hesperochiron occidentalis*, *Horkelia daucifolia*, *Isoetes nuttallii*, *Calochortus uniflorus*, and *Viola hallii*. Trees and shrubs, such as *Pinus ponderosa*, *Pinus jeffreyi*, *Arctostaphylos* spp., and *Ceanothus cuneatus* border these grassy meadows (Mousseaux 1993). Populations of *L. cookii* are also found in the Illinois Valley in grass-dominated gaps within oak woodland, especially in the Reeves Creek area. These habitats have upland soils and are on hillsides which are substantially different in character than the wet sites in the Illinois Valley lowlands. The soils at French Flat are moderately serpentine, which restricts the growth of many plant species. In contrast, the soils in Reeves Creek and Agate Desert populations of *L. cookii* are non-serpentine in origin. In addition to French Flat and Reeves Creek, population monitoring of *L. cookii* by IAE is also conducted at the Rough and Ready ACEC and at Indian Hill, also managed by the Medford District BLM. For more information about these populations see Pfingsten et al. 2017.

Mining activities continue to threaten *L. cookii*. Placer gold mining has restricted the population at French Flat and permanently altered much of the natural hydrologic patterns through the meadows. Some of the French Flat subpopulations monitored and discussed in this report are located on BLM managed lands adjacent to the Hillside Placer No. 1 and No. 3 mines owned and operated by a local resident. A proposed mining plan filed in 1993 would involve destruction of a significant portion of this subpopulation. Mining plans have been filed with BLM that will alter habitat immediately adjacent to *L. cookii* at French Flat ACEC.

L. cookii habitat in the Illinois Valley is threatened not only by invasion of non-native species, and mining, but also by rural development and abuse by recreational users in the area. At Illinois Forks State Park, an unofficial trail cuts through one of the populations of *L. cookii* at the site. Unoccupied plots close to the river, which were placed adjacent to an existing *L. cookii* population were disturbed by recreational users between 2014 and 2015 when a bulldozer (or other heavy equipment) was used to create a path to the river from the adjacent private property. Because unoccupied plots were purposefully established in areas without *L. cookii*, we do not know the effects of these activities on the *L. cookii* in this portion of the habitat. French Flat has been repeatedly damaged by ORV use, where we observed fresh vehicle tracks from 2002-2007.

The 2012 USFWS Recovery Plan for the Rogue and Illinois Valley Vernal Pool and Wet Ecosystems states the following regarding the recovery priority and necessary habitat requirements for the species:

“Recovery priority. *Lomatium cookii* has a recovery priority number of 2C, based upon a high degree of threat, a high potential for recovery, and a taxonomic classification as a species. The “C” indicates the potential for conflict between the species and construction, development, or other economic activities.”

“The primary constituent elements for *L. cookii* critical habitat include vernal pools, seasonally wet meadows within oak and pine forests, sloped mixed conifer openings, and shrubby plant habitats, the dominant native plant association of these habitats, and intact hydrology and soils that provides for adequate soil moisture. ***Enhancement and protection of these elements is critical to recovering the species.***”

Goal and Objectives

The goal of this project was to develop management techniques for *L. cookii* to support recovery of the species. The specific objectives were to:

1. Study the effects of herbicide at sites occupied and unoccupied by *L. cookii*, and the surrounding plant community. (Illinois Forks State Park)
2. Study the effects of prescribed fire on *L. cookii* and surrounding the plant community. (French Flat Middle and French Flat South)

METHODS

Effects of Herbicide

To assess herbicide as a potential tool to control annual grasses and other noxious weeds in the presence of *L. cookii*, IAE worked with Oregon State Parks and the Medford BLM to conduct herbicide trials at Illinois River Forks State Park. Management treatments included the application of glyphosate, imazapic and fluazifop, as well as an untreated control. Plots were sprayed with glyphosate on 7 November 2014 and imazapic on 10 November 2014, fluazifop was sprayed on 9 March 2015. All herbicide applications included a non-ionic surfactant (Table 1).

Treatment plots were monitored by IAE staff prior to treatment application in May 2014, and post-treatment in May 2015-2018. Treated plots in the areas without *L. cookii* are 2m x 2m, and 0.5m x 0.5m in the occupied areas. Plant species were identified to species level in all plots, and percent cover estimated. Ground cover classes including bareground, litter, moss, and rock were also quantified. The percentage of litter that consisted of oak leaves vs. other plant materials was also quantified in each of the plots. In the occupied plots, demographic information was recorded for each *L. cookii* individual.

Occupied

In May of 2014, 40 0.5m x 0.5m plots occupied by *L. cookii* at Illinois River Forks State Park were established in a patch of *L. cookii* approximately 20m x 15m wide. A 25 meter baseline was established running roughly N/S along the eastern edge of the *L. cookii* population and is marked with concrete markers placed flush with the ground at both ends. The head of the transect is at the N end, and is marked with tag #801 (end tag #802). See Appendix B for maps of the occupied plots at Illinois Forks State Park.

The 40 plots monitored for both demography and plant community were established on transects that run perpendicular to this baseline (the longest of these transects is 15m). Within each demographic plot, all *L. cookii* plants were mapped, given unique numbers (beginning with #1), assigned to the life history categories discussed in the density section below, the length of the longest leaf was measured, and the presence or absence of grazing was recorded.

Table 1. Herbicide application rates and dates of application at Illinois Forks State Park.

Chemical	Trade Name	Target species	Rate (oz/gal)	Surfactant (Activator 90)	Spray Volume	Time
Fluazifop	Fusilade DX	Grass specific, post-emergence	0.75	0.64 oz/gal	30 gal/acre	3/9/2015, 2:30 pm
Glyphosate	Roundup Custom	Broad spectrum, post-emergence	1.28	0.64 oz/gal	30 gal/acre	11/7/14, 3:00 pm
Imazapic	Plateau	Broad spectrum, pre-emergence	0.16	0.64 oz/gal	30 gal/acre	11/10/14, 1:30 pm



Unoccupied

In May 2014, 12 plots were established in areas not occupied by *L. cookii*. Plots are 2 x 8 meters (divided into four 2m x 2m treatment squares) marked at the corners with 8 yellow capped PVC pipes (Figure 3). The northwest corner is marked with the first plot tag in the series and the opposite corner (southeast) is marked with the next consecutively numbered plot tag. Four 1-m² plots are marked in the middle of each 2m x 2m plot with nails and hot pink washers in the northwest (has plot ID tag) and southeast corners (Figure 3). For plot coordinates and schematics, see Appendix A and Appendix B.

Figure 2. Photo of an unoccupied plot at Illinois Forks State Park. In this photo, the 1m x 1m frames are in the center of each 2m x 2m treatment plot.

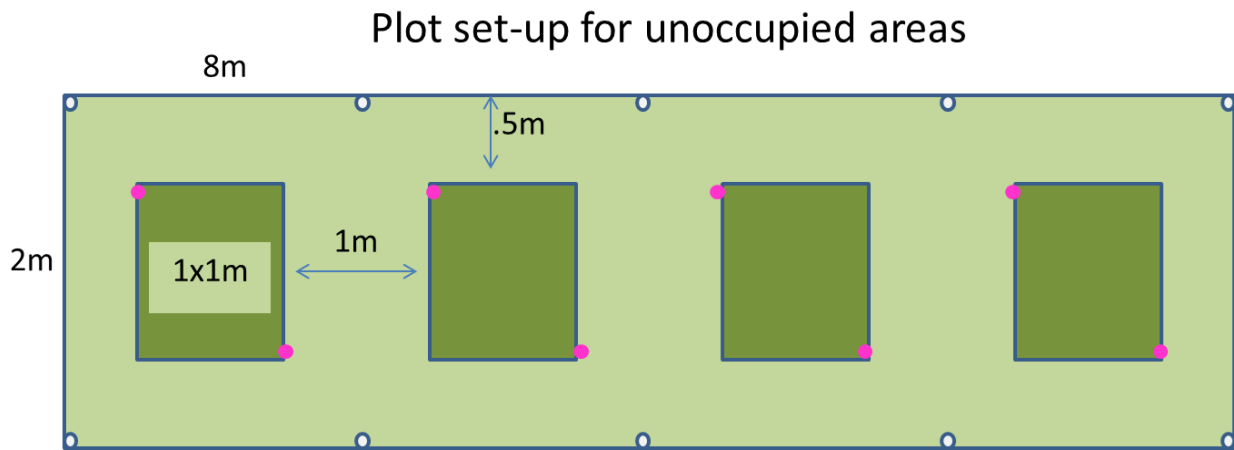


Figure 3. Plot setup for areas not occupied by *Lomatium cookii*. Plots are 2m x 8m, and each treatment block is 2m x 2m. Only the central 1m² of each treatment plot was monitored for community composition.

Effects of Fire

Plant Community and Demography

To study the effects of fire on *L. cookii* and the plant community, French Flat South and French Flat Middle were chosen for an experimental burn treatment. In the fall of 2015, portions of French Flat South and French Flat Middle were burned under the supervision of BLM Medford staff (Appendix C). In addition to fire, some trees were removed or girdled and shrubbery encroaching along the edges of the meadow was thinned. Existing plots established by IAE were chosen in both burned areas and unburned areas to collect plant community data, as well as demographic information. Plant species were identified to species level in all plots, and percent cover estimated. Community data at French Flat was not collected in 2018.

At French Flat Middle and French Flat South, 20-30 existing 0.5m x 0.5m demographic plots were monitored to assess effects of burning on these plots. Approximately half of the plots in each meadow were burned (Appendix C). Similar to the demographic plots at Illinois Forks, within each demographic plot, all *L. cookii* plants were mapped, given unique numbers (beginning with #1), assigned to the life history categories discussed earlier, and the presence or absence of grazing was recorded. For details regarding the longer term history of these plots see Pfingsten et al. 2017.

Lomatium cookii Density Plots

Thirty to forty density plots have been established at both French Flat Middle and French Flat South. In the 40m x 0.10m density plots, all *L. cookii* were counted and assigned to a specific life-history category, as follows:

S seedling

V1/2 vegetative with 1 or 2 leaves

- V3 vegetative with 3 or more leaves
- R1 reproductive with 1 umbel
- R2 reproductive with 2 umbels
- R3 reproductive with 3 or more umbels

Life-history categories were originally developed for *Lomatium bradshawii* monitoring in the Willamette Valley (Kaye et al. 2001). The similarities of the life-history characteristics of these species cause the categories to be applicable to *L. cookii* as well. Reproductive plants were segregated by umbel number because studies of *L. bradshawii* have shown that one-umbel plants rarely produce seed, while two-umbel plants produce seed on the second umbel, and three umbel plants may produce many seeds (Kaye and Kirkland 1994).

Data Analysis

We used analysis of variance (ANOVA; R Development Core Team 2009) to test for the response of mean plant size of *L. cookii* (2017 and 2018), using herbicide treatment (control, fluazifop, glyphosate, and imazapic) as predictors. If differences were detected between treatments, pairwise comparisons were made using the Tukey HSD. To test for differences in survival by herbicide treatment, we used a General Linear Model (GLM) to look at differences in proportions of survival from plants that were originally present in 2014 when plots were established. Due to the high variability recorded within the plots, all other comparisons were based on comparison of 95% confidence intervals. All means are reported $\pm 95\%$ confidence interval.

RESULTS

Effects of Herbicide

Lomatium cookii

In order to evaluate the treatment effects on *L. cookii*, the percent survivorship of original plants and average size were compared by treatment type (Table 2).

There were no effects of treatment on survivorship of *L. cookii* in the herbicide plots. In the first year post-treatment, survivorship in the treatment plots ranged from 81%-92%, and in 2018 survivorship of original plants ranged from 33-57% (Table 2). In each year, plots treated with Fluazifop had the highest survival of plants that had been present at the initiation of the study, ending with 57% of original plants present in 2018. In the population at French Flat, the average survivorship of plants during the same time period from 2014-2018 in both burned and unburned plots was 39%, similar to the survivorship of control plots at Illinois Forks (33%). In 2015-2017 new plants were noted in all treatment plots, with the most occurring in plots treated with glyphosate and fluazifop (Table 2). In 2018, new plants were noted only in the plots treated with glyphosate and imazapic, although with only 3 total new plants recorded in 2018, no inferences can be made (Table 2).

In 2017 and 2018, mean plant size (cm) differed significantly between treatment types; plants in the control treatment were larger than plants in the herbicide treatments (Figure 4, $P < 0.001$). In previous years (2015 and 2016), there were no differences in plant size between treatment plots (Figure 4). From 2014 to 2016, plant size declined steadily, however this decline was independent of treatment (Figure 4). While plant size increased in the herbicide treatment plots in 2017 and 2018, their size did not differ significantly, but did differ from the larger size in the control plots (Figure 4). This pattern was present in both plants that had experienced herbivory and those which had not. There was not a significant difference in the size of plants that had been grazed in any year (Figure 5).

Table 2. Total number of plants in each treatment plot, number and percent of original plants present, and the number of new recruits from 2014-2018 at Illinois Forks State Park.

<i>Total # of plants present in treatment plots</i>									
Treatment	2014	2015		2016		2017		2018	
Control	54	56		55		36		32	
Fluazifop	60	63		64		55		49	
Glyphosate	91	91		89		76		75	
Imazapic	63	55		60		47		44	

<i>Number and % of original plants present</i>									
	2014	2015		2016		2017		2018	
Control	54	42	78%	39	72%	22	41%	18	33%
Fluazifop	60	54	90%	45	75%	38	63%	34	57%
Glyphosate	91	72	79%	61	67%	48	53%	47	52%
Imazapic	63	51	81%	46	73%	34	54%	33	52%

<i>Number of new plants in each year</i>				
	2015	2016	2017	2018
Control	12	4	5	0
Fluazifop	7	11	4	0
Glyphosate	18	11	8	1
Imazapic	4	10	1	2

Table 3. Number and percentage of plants present in 2014 surviving in 2018 in all treated demographic plots at French Flat and Illinois Forks.

Site	Treatment	Present in 2014	Still Present in 2018	% Surviving from 2014 to 2018
French Flat South	Burned	125	51	41%
	Unburned (Control)	130	44	34%
French Flat Middle	Burned	67	26	39%
	Unburned (Control)	99	42	42%
Illinois Forks	Control	54	18	33%
	Fluazifop	60	34	57%
	Glyphosate	91	47	52%
	Imazapic	63	33	52%

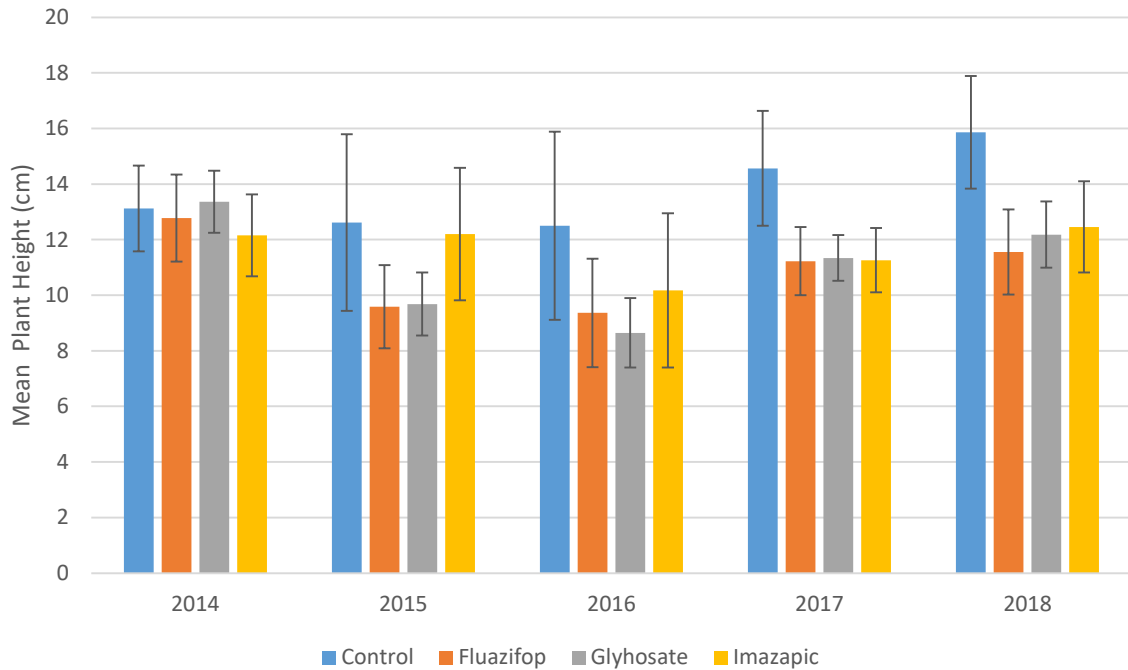


Figure 4. Average plant size (cm) of *L. cookii* in demographic plots at Illinois Forks State Park, 2014-2018. Error bars represent 95% confidence intervals.

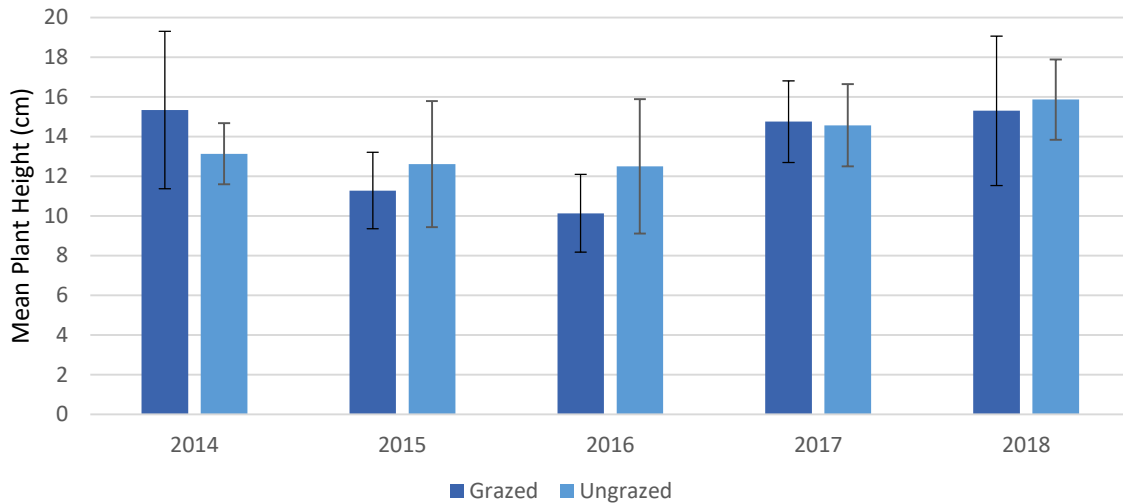


Figure 5. Average plant size of *L. cookii* between plants grazed by insects or rodents and ungrazed plants in control plots at Illinois Forks State Park, 2014-2018. Error bars represent 95% C.I.

Plant Community

Results are reported separately for the two groups, occupied and unoccupied plots, as the initial plant community differed between the two areas. The initial composition of areas occupied with *L. cookii* generally had less forbs (both native and invasive) and more graminoids, with a large proportion of the graminoids present classified as native perennials (often *Danthonia californica*).

Occupied Habitat

Forbs

Mean forb cover across all treatments increased from $12\% \pm 8$ in 2014 to $21\% \pm 4$ in 2018.

Cover of native forbs from 2014 to 2018 increased in all treatments yet remained relatively low with average cover in 2014 of $5\% \pm 2$ and $9\% \pm 4$ in 2018 (Figure 6). Average cover of introduced forbs remained similar from 2014 to 2018 ($7\% \pm 4$ and $11\% \pm 0.5$, respectively).

Dominant non-native forbs include *Hypochaeris radicata* and *Trifolium dubium*. The dominant native forb species observed in all years were *Chloropogon pomeridianum* (2014: $1.5\% \pm 1.6$; 2018: 2.4 ± 4.3), with most forbs having average cover $< 1\%$. Of the 36 forb species noted in 2014, only 11 had average cover higher than 1% ; 17 of the 41 species noted in 2018 had cover $> 1\%$ (Appendix E).

Graminoids

Graminoid cover decreased in all occupied plots from 2014-2018, from $55\% \pm 7$ to $11\% \pm 2$ (Figure 7). Native and introduced graminoid cover decreased across all treatment types from 2014 to 2018 (natives: $26\% \pm 6$ to $7\% \pm 2$; introduced: $30\% \pm 6$ to $4\% \pm 0.5$), including the control (Figure 7). From 2014 to 2018, changes in cover of the perennial *Agrostis* sp. (from $20\% \pm 8$ to $1\% \pm 0.5$) and *Danthonia californica* (from $24\% \pm 6$ to $6\% \pm 2$) were the largest contributors to these decreases (Figure 8).

Native perennial graminoids decreased in cover in all treatments from 2014 to 2018 ($26\% \pm 6$ to $7\% \pm 2$). In 2018, there were two native graminoid to have more than 1% average cover *Danthonia californica*, and *Achnatherum lemmonii*. Invasive annual graminoids with $> 1\%$ cover include *Cynosurus echinatus*, *Taeniatherum caput-medusae*, and *Bromus hordeaceus* (Appendix F). Introduced perennial graminoids (dominantly *Agrostis* sp.) decreased across all treatments ($20\% \pm 8$ to $1\% \pm 0.5$) from 2014 to 2018, including the control (Figure 8).

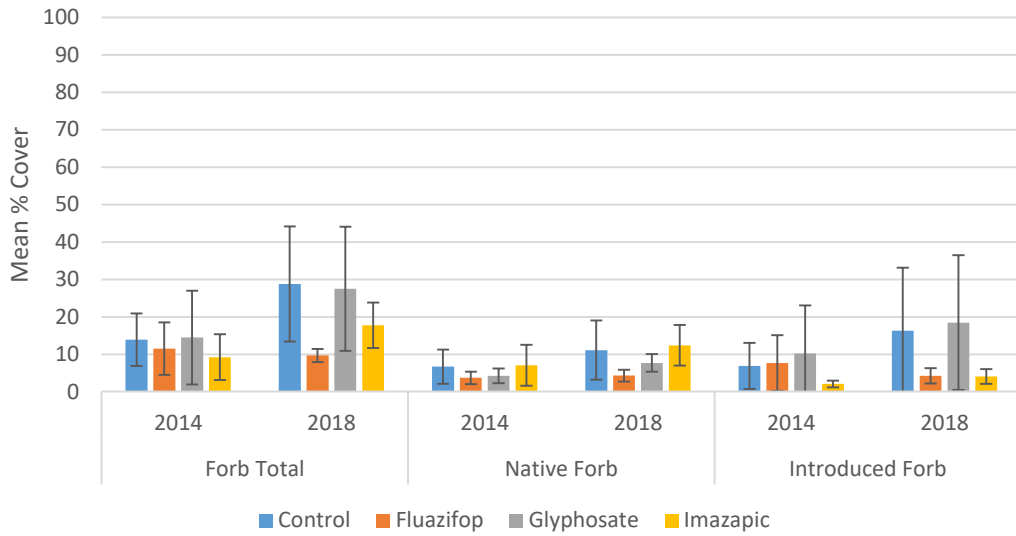


Figure 6. Average percent cover of forbs by treatment in the occupied habitat at Illinois Forks State Park in 2014 and 2018. Error bars represent 95% confidence intervals.

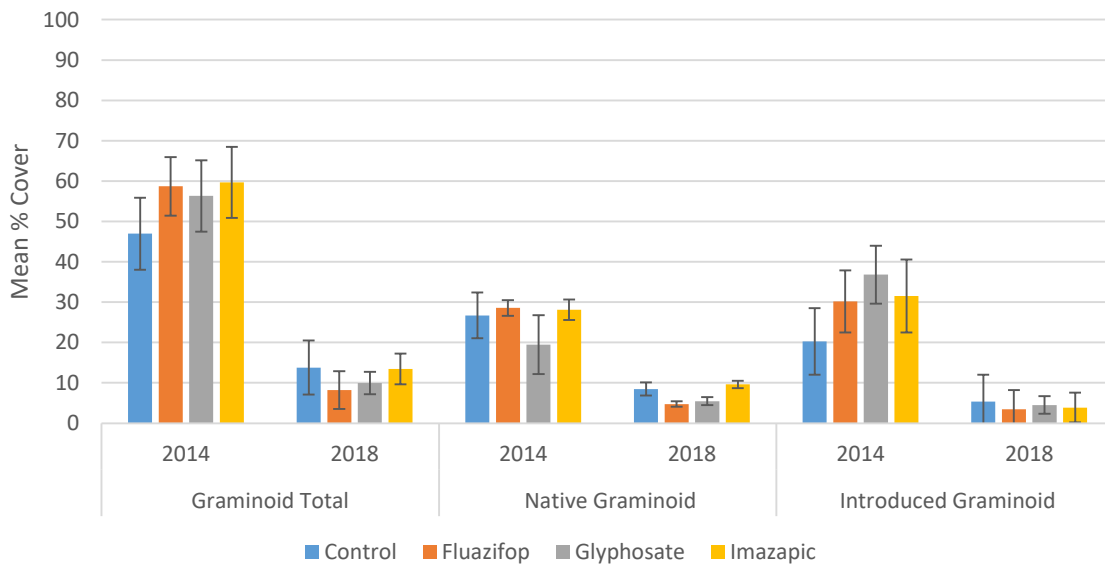


Figure 7. Average percent cover of graminoids by treatment in the occupied habitat at Illinois Forks State Park in 2014 and 2018. Error bars represent 95% confidence intervals.

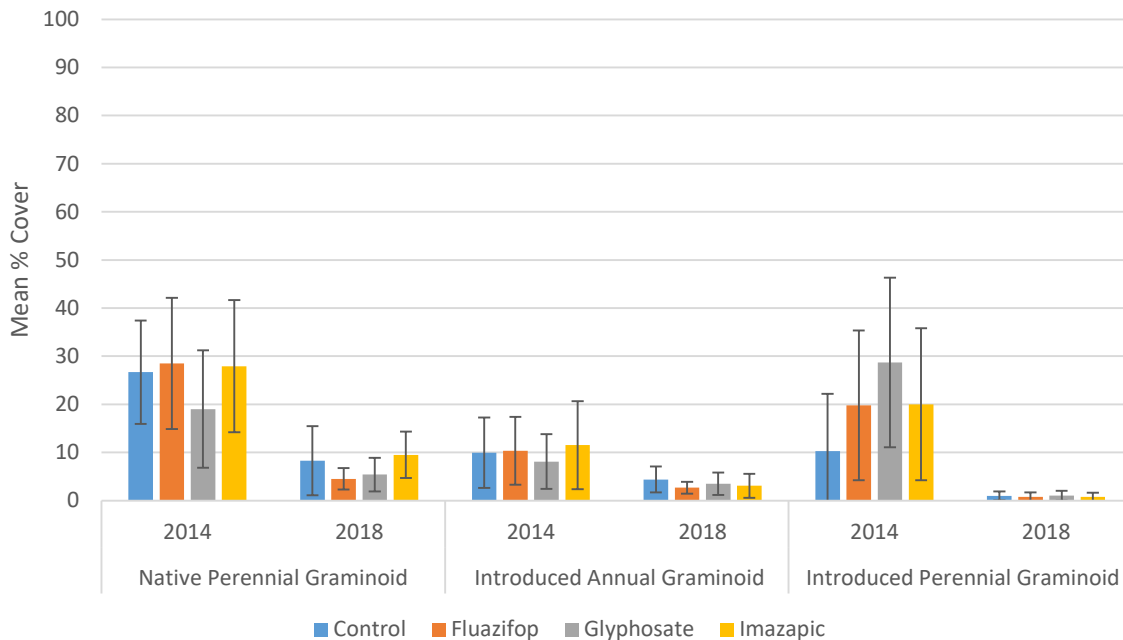


Figure 8. Average percent cover of annual and perennial graminoids in occupied habitat at Illinois Forks State Park in 2014 and 2018. Error bars represent 95% confidence intervals.

Unoccupied Habitat

Forbs

Forb cover increased or remained stable in all plots from 2014 ($26\% \pm 5\%$) to 2018 ($32\% \pm 8\%$). This was following a decrease from 2014 to 2016 (Appendix F). The largest increases in forb cover from 2014 to 2018 occurred in plots treated with glyphosate and imazapic (from $24\% \pm 14$ to $42\% \pm 24$, and $22\% \pm 12$ to $30\% \pm 17$, respectively). Native forbs remained similar in cover ($<10\%$) from 2014 to 2018 with no clear treatment effects. Similar to the occupied plots, a total of 49 forb species were noted in 2018, 29 native and 20 introduced. In 2018, four native forb species had cover higher than 1% including *Madia* spp., *Trifolium variegatum*, *Chlorogalum pomeridianum*, and *Camassia quamash* (Appendix E). In 2018, dominant introduced forbs include *Hypochaeris radicata*, *Trifolium dubium* and *Torilis arvensis*.

Graminoids

Total graminoid cover decreased from 2014 ($27\% \pm 4\%$) to 2018 ($12\% \pm 3\%$), with decreases occurring in all treatment plots (Figure 10, Figure 11). The largest decreases occurred in plots treated with fluazifop (from $26\% \pm 15$ to $10\% \pm 5$) and glyphosate (from $26\% \pm 15$ to $7\% \pm 4$); this decrease was due to decreases seen in introduced graminoids in those treatment plots. On average, native graminoid cover remained low ($<5\%$) and similar between 2014 and 2018, with high variability between plots (Figure 10, Figure 11). The dominant native graminoid in the

unoccupied plots was *Achnatherum lemmonii*. Introduced graminoids in the unoccupied habitat with cover >1% in 2014 (listed in order of decreasing abundance) include *Bromus hordeaceus*, *Cynosurus echinatus*, *Bromus rigidus*, *Taeniatherum caput-medusae*, *Bromus tectorum* and *Vulpia bromoides* (Appendix F).

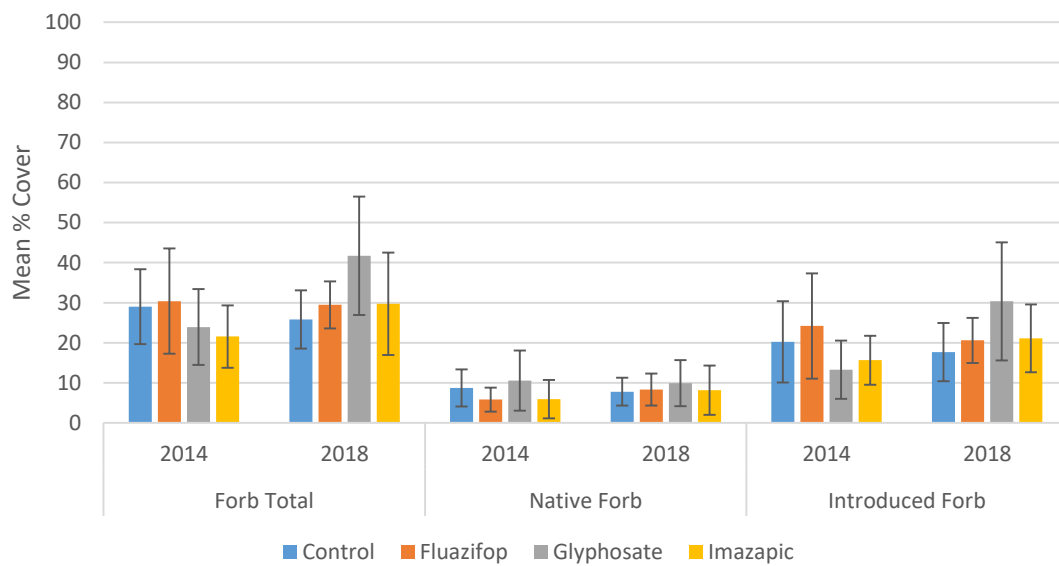


Figure 9. Average percent cover of forbs in unoccupied habitat at Illinois Forks State Park in 2014 and 2018. Error bars represent 95% confidence intervals.

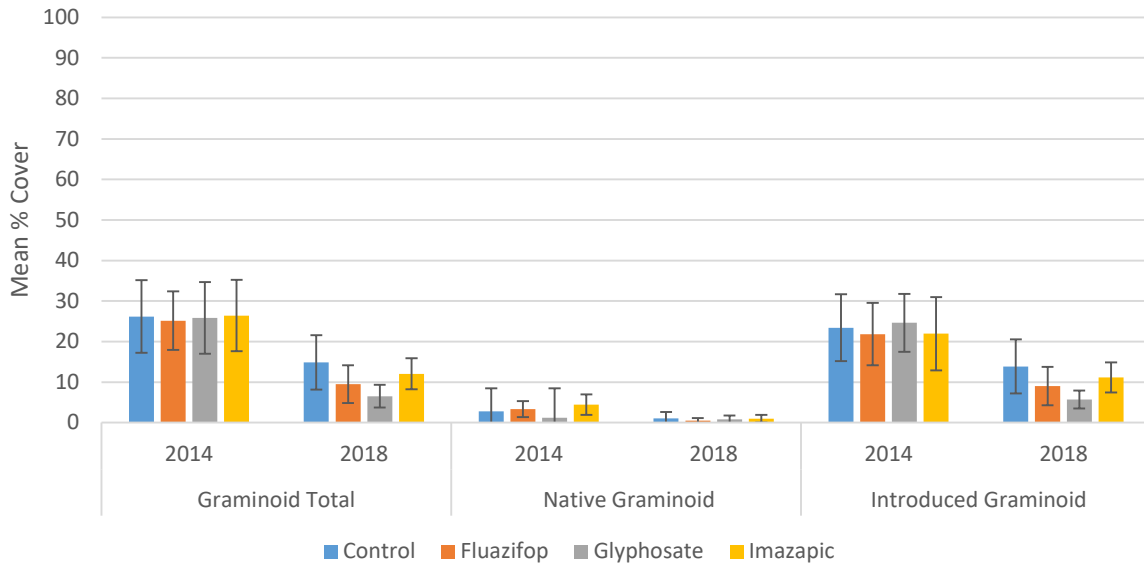


Figure 10. Average percent cover of graminoid species in unoccupied habitat at Illinois Forks State Park in 2014 and 2018. Error bars represent 95% confidence intervals.

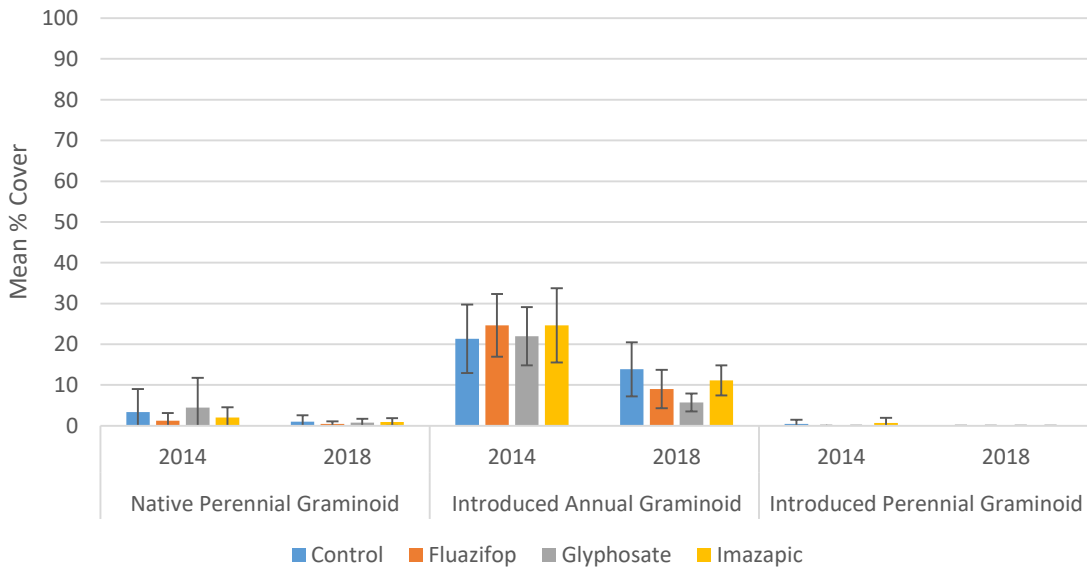


Figure 11. Average percent cover of annual and perennial graminoids in unoccupied habitat at Illinois Forks State Park in 2014 and 2018. Error bars represent 95% confidence intervals.

Effects of Fire

Lomatium cookii Density

In 2017 and 2018, density of *L. cookii* did not differ between burned and unburned plots at French Flat Middle and South (Figure 12, Figure 13). Mean density in burned and unburned plots at French Flat South was $7.5 \pm 3.5 \text{ m}^{-2}$ vs. $9.3 \pm 3.4 \text{ m}^{-2}$, respectively. At French Flat Middle, mean density in burned vs. unburned plots in 2018 was $12.7 \pm 4.9 \text{ m}^{-2}$ vs. $9.8 \pm 1.5 \text{ m}^{-2}$. Similarly, the proportion of reproductive plants was similar at both sites for each treatment (Figure 13). Percentage of reproductive plants did not differ significantly between burned and unburned plots at either site in 2018 (at French Flat South: $26\% \pm 10$ vs. $35\% \pm 9$) respectively, French Flat Middle: $46\% \pm 9$ vs. $28\% \pm 10$ respectively; Figure 14). Similarly, the number and proportion of plants in each vegetative size, and reproductive class was similar between burned and unburned plots, at both sites (Figure 14). At both sites, seedlings were very rare (Figure 13). Across all plots, grazing impacted $45\% \pm 11$ of all plants at French Flat South and $41\% \pm 8$ at French Flat Middle in 2017. In 2018, $38\% \pm 8$ were grazed at French Flat South and $35\% \pm 5$ at French Flat Middle. At both sites, grazing did not differ in burned vs. unburned plots in 2018 (Figure 15).

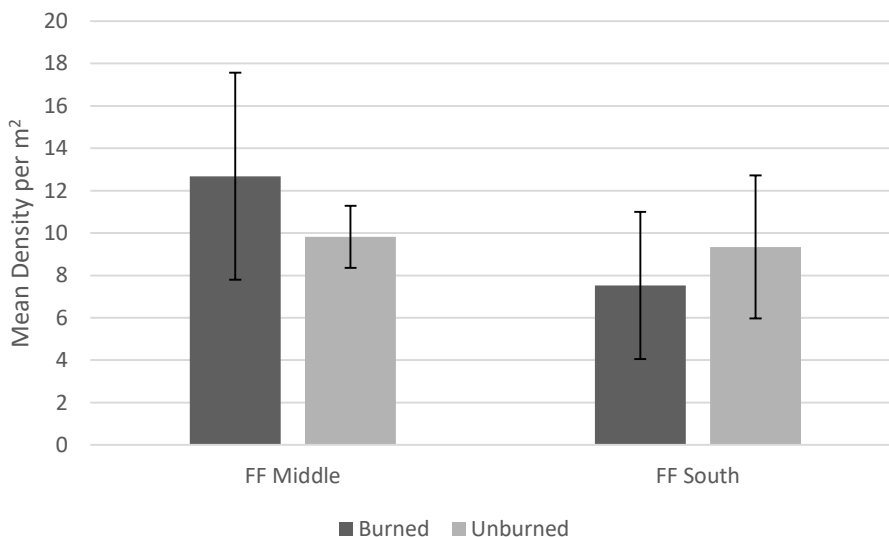


Figure 12. Density of *L. cookii* in 2018 in the burned and unburned portions of French Flat Middle and French Flat South. Error bars represent 95% confidence intervals.

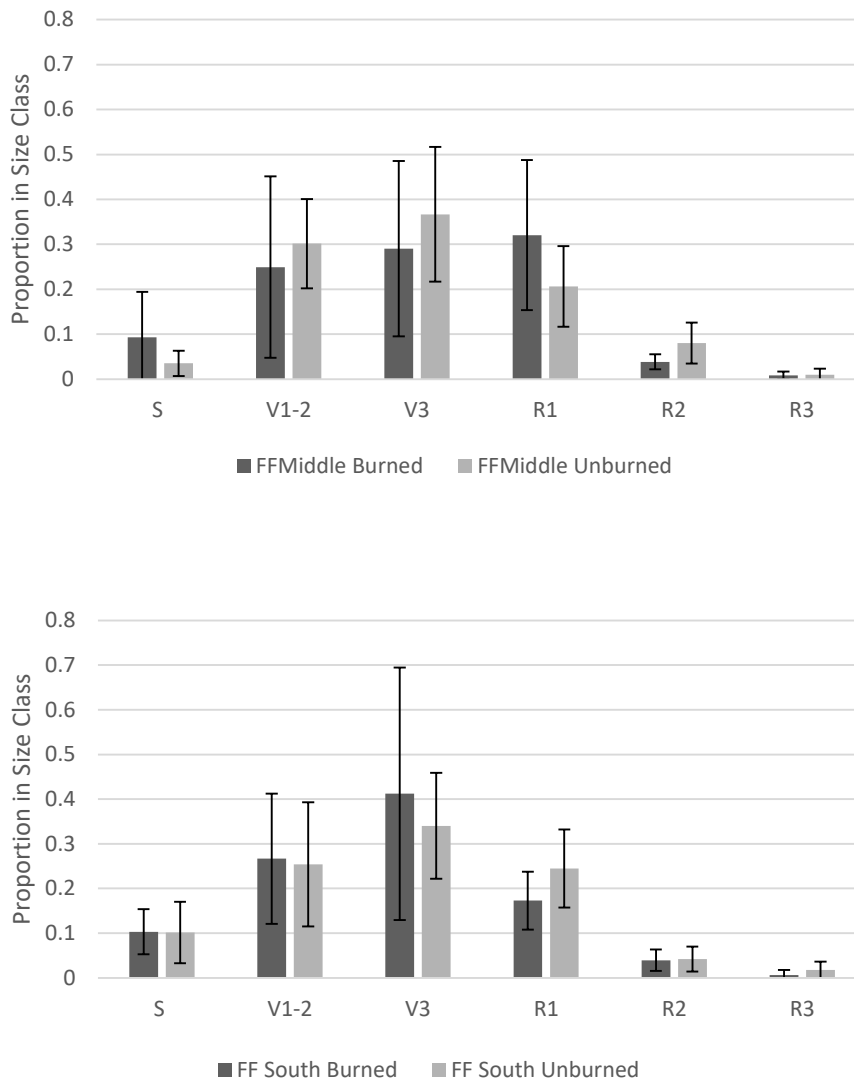


Figure 13. Mean proportion of plants in each size class in density plots at French Flat South and French Flat Middle, 2018. “V” indicates “vegetative” with the number following representing the number of leaves. “R” indicates “reproductive” with the number following representing the number of umbels. Error bars represent 95% confidence intervals.

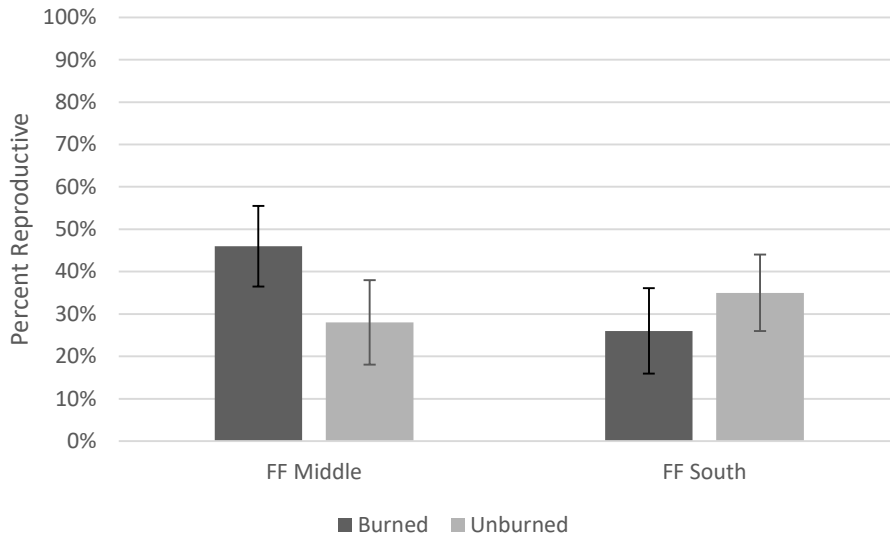


Figure 14. Mean percent of reproductive *L. cookii* in burned and unburned plots at French Flat Middle and French Flat South in 2018. Error bars represent 95% confidence intervals.

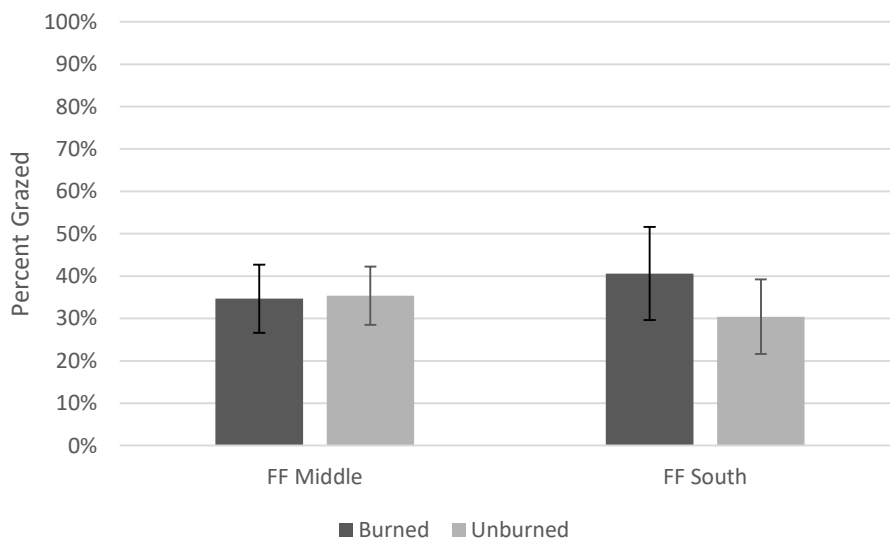


Figure 15. Mean percent of plants grazed in the burned and unburned portions of French Flat Middle and French Flat South in 2018. Error bars represent 95% confidence intervals.

Plant Community

In the second year of monitoring post-burn, the burned plots tended to have less litter cover than unburned plots at both French Flat South (22% \pm 11 vs. 53% \pm 13) and French Flat Middle (49% \pm 13 vs. 66% \pm 13; Figure 16). In 2017 as in 2016, bare ground cover was higher in the burned plots at French Flat South (41% \pm 12 vs. 18% \pm 12 in 2017), whereas at French Flat Middle, there

was no difference in bare ground cover in the burned vs. unburned plots ($16\% \pm 11$ vs $14\% \pm 13$), instead 'Rock/Gravel' cover tended to be greater in burned plots (Figure 16).

There was no difference between burned and unburned plots on the cover of native forb species in either meadow (Figure 17). Native graminoid cover tended to be less in the burned plots at both sites with cover of $31\% \pm 11$ vs. $20\% \pm 8$ at French Flat South, and $27\% \pm 17$ vs. $17\% \pm 10$ at French Flat Middle (Figure 17). Cover of invasive grasses in both areas was low ($<2\%$), thus differences between burned and unburned plots are negligible with respect to total cover. Similarly, introduced forbs were only present in the burned plots at French Flat Middle and covered less than 1% in total.

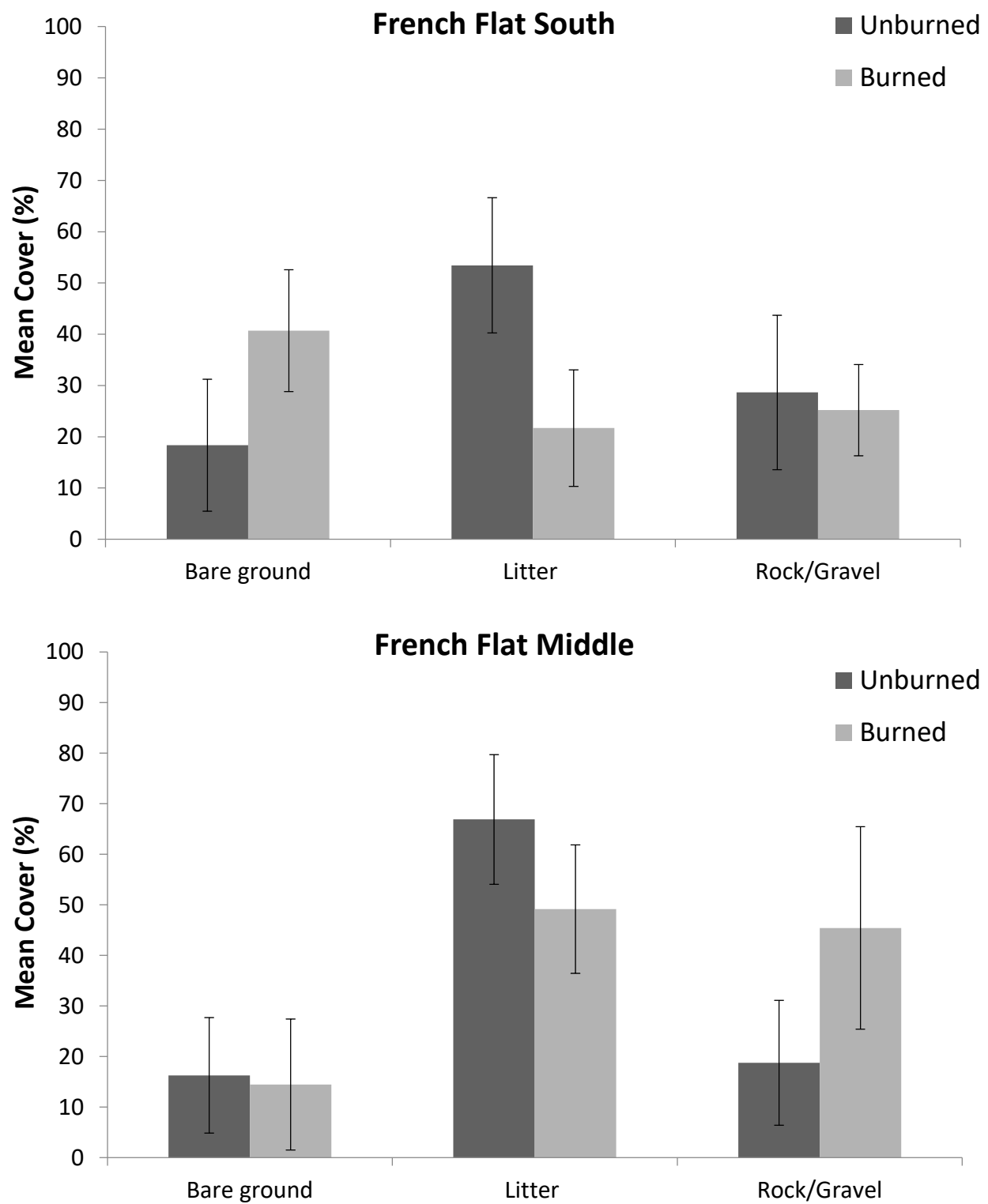


Figure 16. Ground cover in burned and unburned plots at French Flat South and French Flat Middle in 2017. Error bars represent 95% confidence intervals.

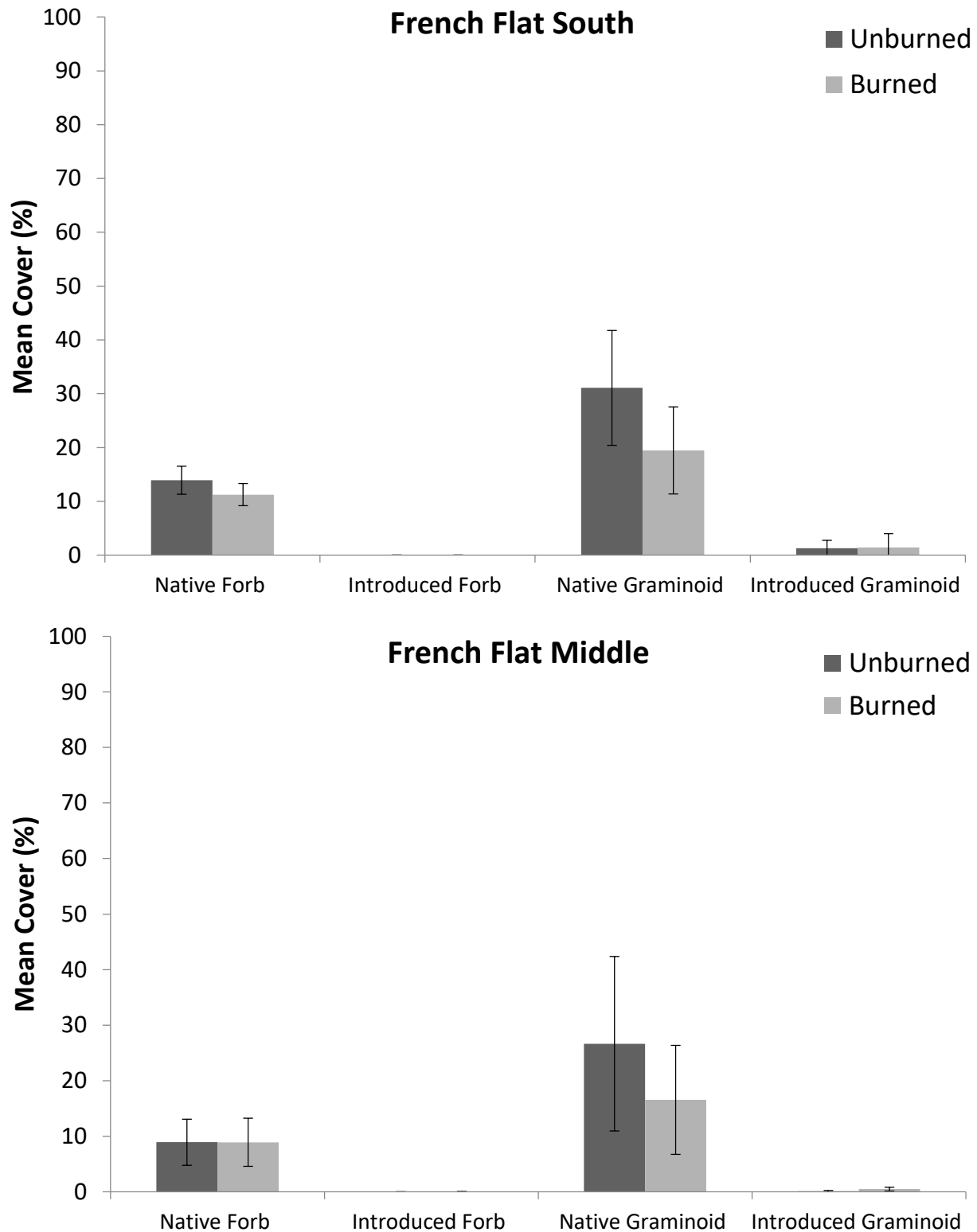


Figure 17. Forb and graminoid cover, by nativity, in burned and unburned plots at French Flat South and French Flat Middle in 2017. Error bars represent 95% confidence intervals.

DISCUSSION

***Lomatium cookii* Response to Habitat Management Treatments**

Prescribed Fire

Since 2014, densities of *L. cookii* at both French Flat Middle and French Flat South have been among some of the lowest recorded at these sites since monitoring began in 1993. Competition from other (introduced) species, changes in soil pH and composition from needle and litter cast, encroachment by shrubby and woody species, as well as climatic, and other factors at French Flat may be contributing to these declines. While burned plots had slightly lower densities of *L. cookii* than unburned plots in the first season, this difference was not statistically significant. In the second and third years post-burn, differences between burned and unburned plots were not significant at either site. This suggests that burning could be a valuable management tool in occupied habitat, and while it may not positively impact the density of *L. cookii*, it isn't detrimental to this rare species either. It was predicted that there would be increases in seedling recruitment and potentially an increase in reproductive effort into the future in the burned plots. In 2017 and 2018 we saw that while burned plants had slightly higher proportions of reproductive plants, these differences were not significant. Likewise, seedling recruitment did not differ between treatments, though the number of recruits was relatively small in both treatments.

In 2018, expansion of the population into the newly cleared meadow edges was noted at French Flat Middle: seed addition (or transplanting) as well as litter removal of *Pinus* (and less so *Quercus*, *Ceanothus* and *Arctostaphylos*) may be recommended to accelerate the colonization of the reclaimed meadow edges at both French Flat South and Middle, and to increase connectivity between the two populated areas.

During monitoring of the *L. cookii* populations at French Flat in the recent past, an increase in the presence of *T. caput-medusae* into the occupied habitat at French Flat Middle and French Flat South has been noted. The presence of this weed species is particularly alarming, as the meadows of the French Flat ACEC, are otherwise dominated by native species. Aggressive control of this invasive grass is recommended.

Herbicide Treatments

At Illinois Forks State Park, no significant differences were observed between survivorship between treated and control plots. Additionally, recruitment was noted in all plots. Although none of the treatments resulted in satisfactory changes in the targeted non-native species, the recruitment of new *L. cookii* individuals at least shows that the treatments did not appear to do harm. Height was found to be statistically greater in control plots than in all plots treated with herbicide. These results are encouraging from a land management perspective, as it indicates that careful, appropriate, and well-timed habitat management can be performed in *L. cookii* occupied populations for the control of some troublesome species.

Plant Community Response to Habitat Management Treatments

Illinois Forks State Park

At Illinois Forks State Park in the unoccupied (and weedy) habitat, there were visual differences between the herbicide-treated plots even in the second year post-treatment, and in 2017 and 2018 these differences were detected in a portion of the plant community composition. While there was a decline in graminoids across all treatments (including the control), the decline in introduced graminoids in the fluazifop and glyphosate treated plots was greater than that in the control. This decline was largely represented by declines in cover of introduced annual grasses. Previous studies have shown that fall application of imazapic (pre-emergent herbicide) and spring application of fluazifop (grass-specific herbicide), alone and in combination, reduced exotic annual grasses for two years after treatment (Menke and Kaye 2016).

Most changes in plant community composition observed in 2017 and 2018 in both occupied and unoccupied habitat occurred across all treatments, including the controls. Because these vegetation changes were observed even in the controls, these changes could be in part due to annual (and seasonal) differences between water levels, or other climatic factors in this ephemeral vernal pool environment. For example, the decrease in *Agrostis* sp. in the occupied plots is likely due to the retreat of the species from the vernal pool edge; *Agrostis* sp. had encroached into the pool area during the exceptionally dry season of 2013. Additionally, our monitoring occurred in the spring (May) of each year, thus we may not have detected changes to the annual grass community in other parts of the year. For example, *T. caput-medusae* germinates in the early fall, and it is possible that due to the timing of our monitoring we did not fully detect changes in this species.

Recreational use at the Illinois Forks State Park has increased over the course of this study. In recent years, a new picnic structure was constructed and bathroom facilities were upgraded. In 2013, a disc-golf course was established at the site, and while the course does not pass through *L. cookii* habitat, an unofficial trail has been established leading through the population discussed herein heading towards the northeast. Development on private property adjacent to the park may also have unknown effects on the plant community and local hydrology.

French Flat

At French Flat, in the area occupied with *L. cookii*, cover of introduced grasses were so low that we were not able to distinguish any effects of the fire on these problematic species in our community data. However, invasive annual grasses (in particular *T. caput-medusae*) are becoming more common, and encroaching from the edges of the meadow (and along the road) into the portions of the meadow occupied by *L. cookii*. Currently, these patches are small and uncommon enough that the species is only rarely detected in our monitoring, which focuses on the occupied portions of the meadow. While native graminoid cover was lower in the first year post-fire at both French Middle and French Flat South, this was mostly related to decreases in the size of bunches of *Danthonia* spp. which continued to rebound in 2017. The longer-term effects of burning on *T. caput-medusae* and other invasive species at this otherwise relatively pristine location can inform future management actions.

At Illinois Forks State Park, in occupied habitat, plots have had a general shift (independent of treatment) away from perennial graminoids towards more annual grasses (both native and invasive). Continued habitat monitoring at French Flat will allow us to see if these changes are also occurring at French Flat, and to detect longer-term responses to burning treatments.

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APPENDIX A. COORDINATES FOR UNOCCUPIED AND OCCUPIED HABITAT PLOTS AT ILLINOIS FORKS STATE PARK.

Unoccupied Habitat

River/ Road	Block tag #s	Meter sq. Plot tag#				Coordinates of NW corner tag (NAD 83)
	NW/SE corners					
Road	901/902	903	904	905	906	42.15844011 -123.65429099
Road	907/908	909	910	911	912	42.1582578 -123.65404523
Road	913/914	915	916	917	918	42.15818086 -123.65393442
Road	919/920	21	22	23	24	42.15805706 -123.65332036
Road	925/926	927	928	929	930	42.15771742 -123.65269465
Road	931/932	933	934	935	936	42.15699775 -123.65173870
Road	937/938	939	940	941	942	42.15760075 -123.65262156
River	943/944	945	946	947	948	42.15576972 -123.65672392
River	949/950	951	952	953	954	42.15575723 -123.65665460
River	955/956	963	964	965	966	42.15552061 -123.65664622
River	961/962	963	964	965	966	42.15518818 -123.65698258
River	967/968	969	970	971	972	42.15531668 -123.65685635

The occupied plots can be found near Plots 901/902. The 25m baseline runs roughly North-South from #801 to #802 and is marked with concrete markers on both ends.

Occupied Habitat

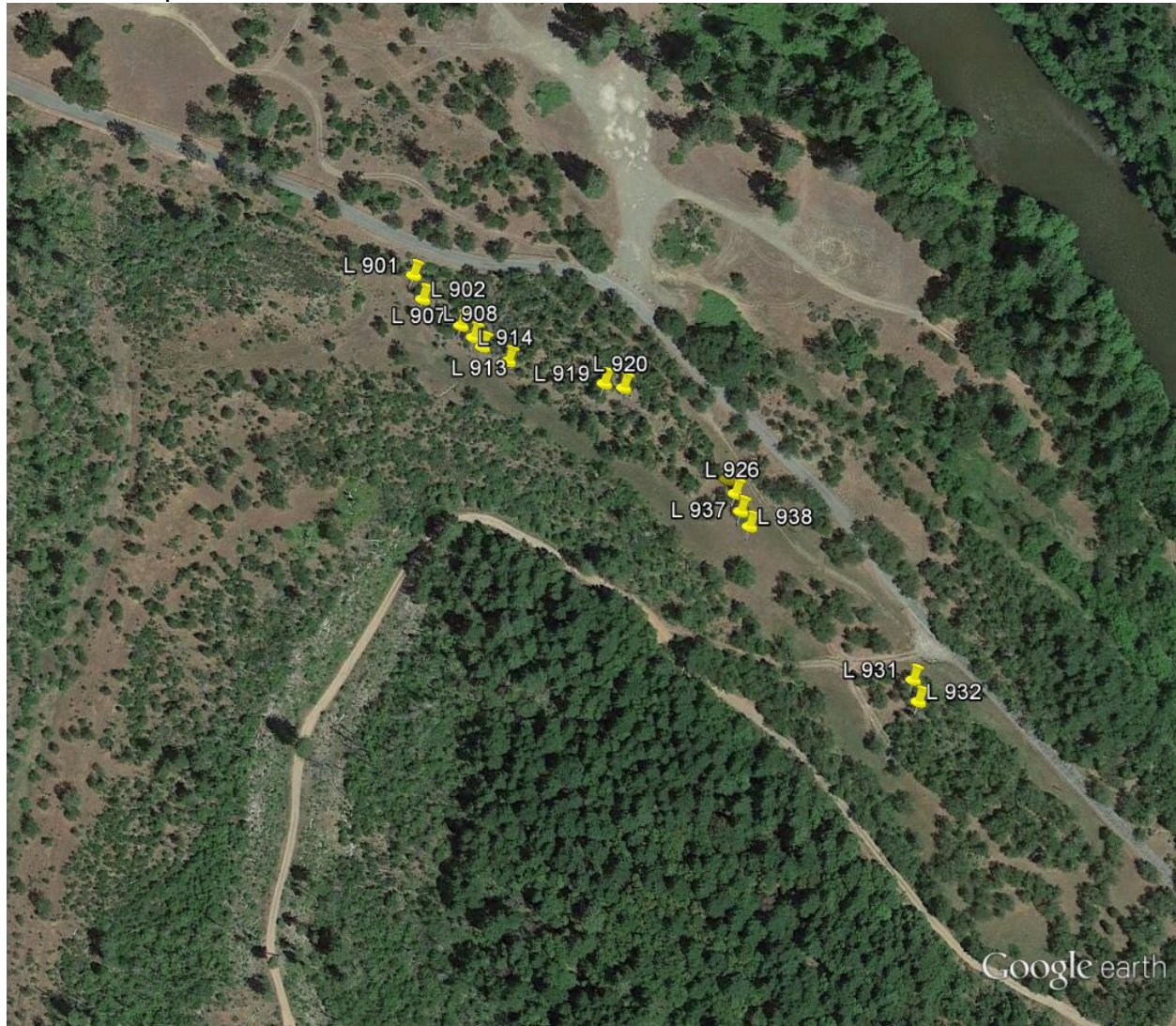
Plot#	Treatment	Transect #/Baseline Meter	Location of Demography Plot (m)
803	Control	843/21.5m	5.45
804	Fluazifop	843/21.5m	6.5
806	Imazapic	844/20.5m	4.6
807	Glyphosate	844/20.5m	5.6
808	Fluazifop	844/20.5m	7.5
809	Imazapic	845/19.5m	6
810	Control	845/19.5m	7.1
811	Imazapic	846/ 18.5m	6
812	Glyphosate	846/ 18.5m	7.4
813	Control	846/ 18.5m	15.15
814	Fluazifop	847/17.5m	5.9
815	Glyphosate	847/17.5m	7
816	Imazapic	847/17.5m	8.5
817	Control	848/16.5m	6.7
818	Glyphosate	848/16.5m	7.7
819	Fluazifop	848/16.5m	9.7
820	Glyphosate	849/ 15.5m	6.6
821	Control	849/ 15.5m	7.8
822	Imazapic	849/ 15.5m	9
823	Glyphosate	849/ 15.5m	10.1
824	Fluazifop	850/14.5	5.3
825	Control	850/14.6	7.8
826	Glyphosate	850/14.7	9.8
827	Fluazifop	850/14.8	10.85
828	Imazapic	850/14.9	13
829	Imazapic	851/13.5m	1.4
830	Fluazifop	851/13.5m	7.3
831	Fluazifop	851/13.5m	10.8
832	Control	852/13m	3.9
833	Glyphosate	852/13m	8.3
834	Imazapic	853/12.5m	4.4
835	Fluazifop	854/12m	3.5
836	Glyphosate	854/12m	5
837	Control	854/12m	7.3
838	Imazapic	855/11.5m	5.6
839	Control	856/11m	3.25
840	Fluazifop	856/11m	13.1
841	Glyphosate	858/9.5m	5.8
842	Imazapic	859/8.5m	3.7
401	Control	859/8.5m	5.9

APPENDIX B. AERIAL PHOTOS AND SCHEMATICS OF PLOTS IN THE UNOCCUPIED AND OCCUPIED HABITATS AT ILLINOIS FORKS STATE PARK.

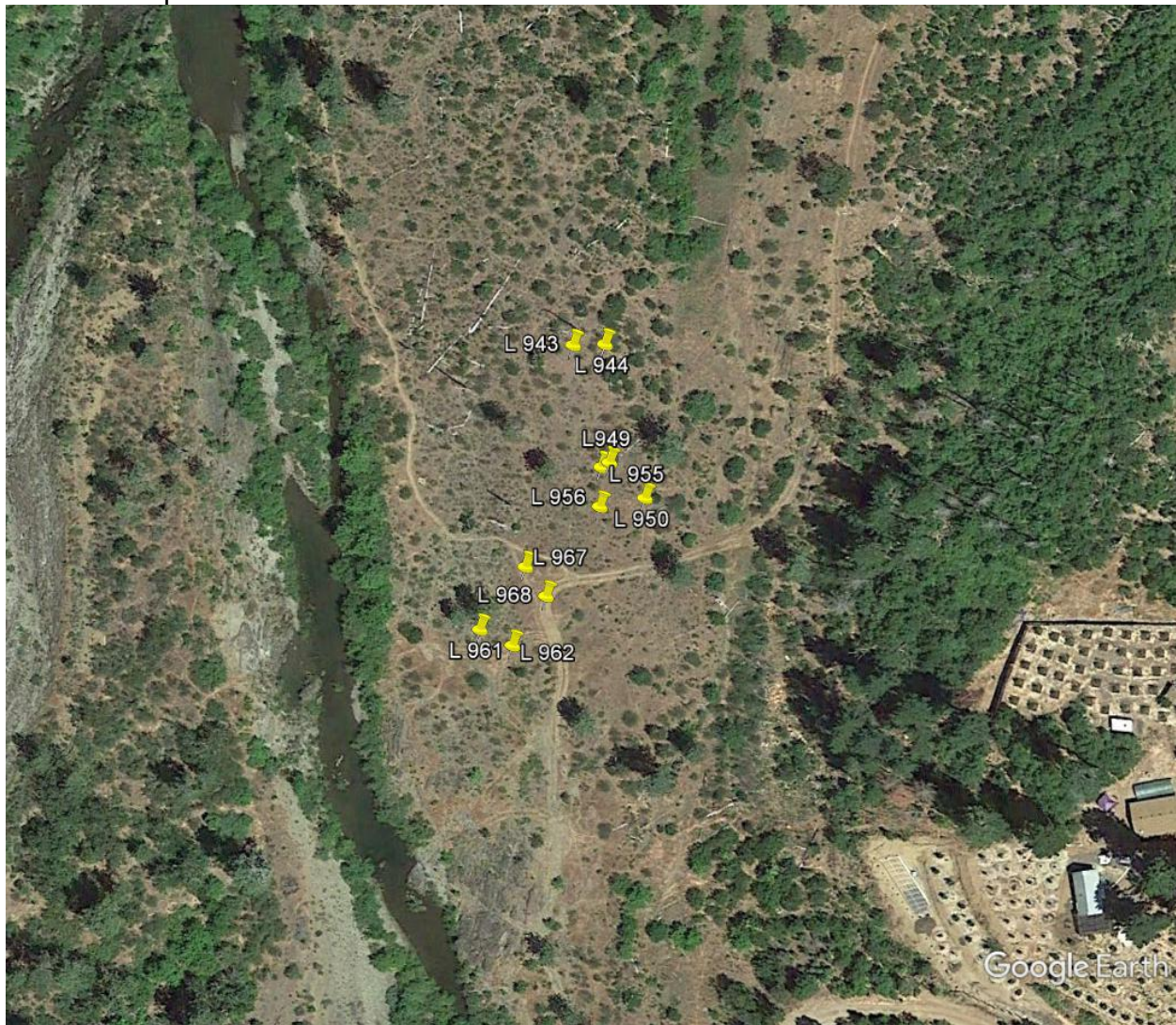
Unoccupied Habitat

There are a total of 12 macroplots, 7 near the entrance road to the park and 5 to the west closer to the Illinois River. The baseline marking the occupied plots can be found near Plot 901/902. GPS points are marked at opposite corners for each plot.

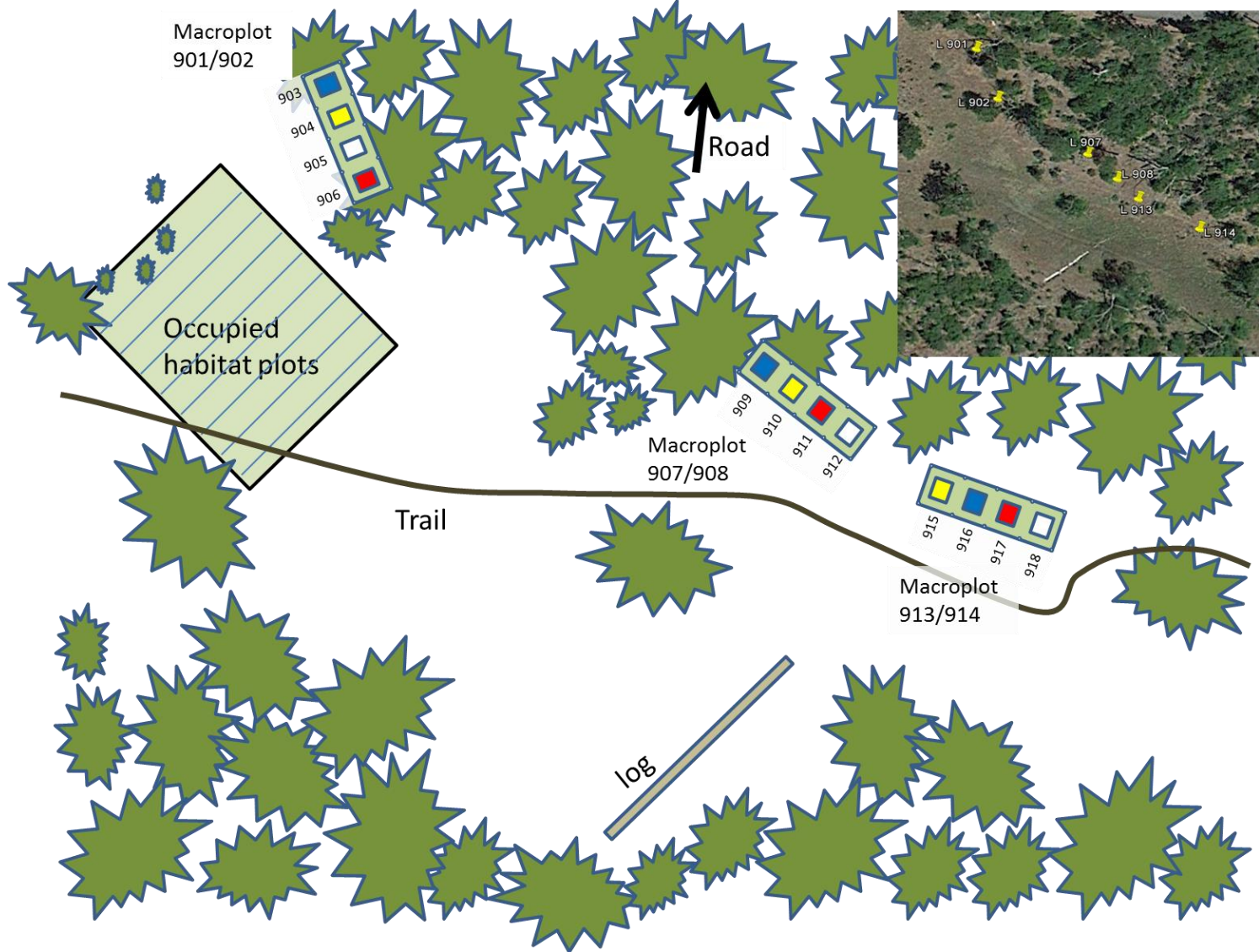
Overview of plots near the road.



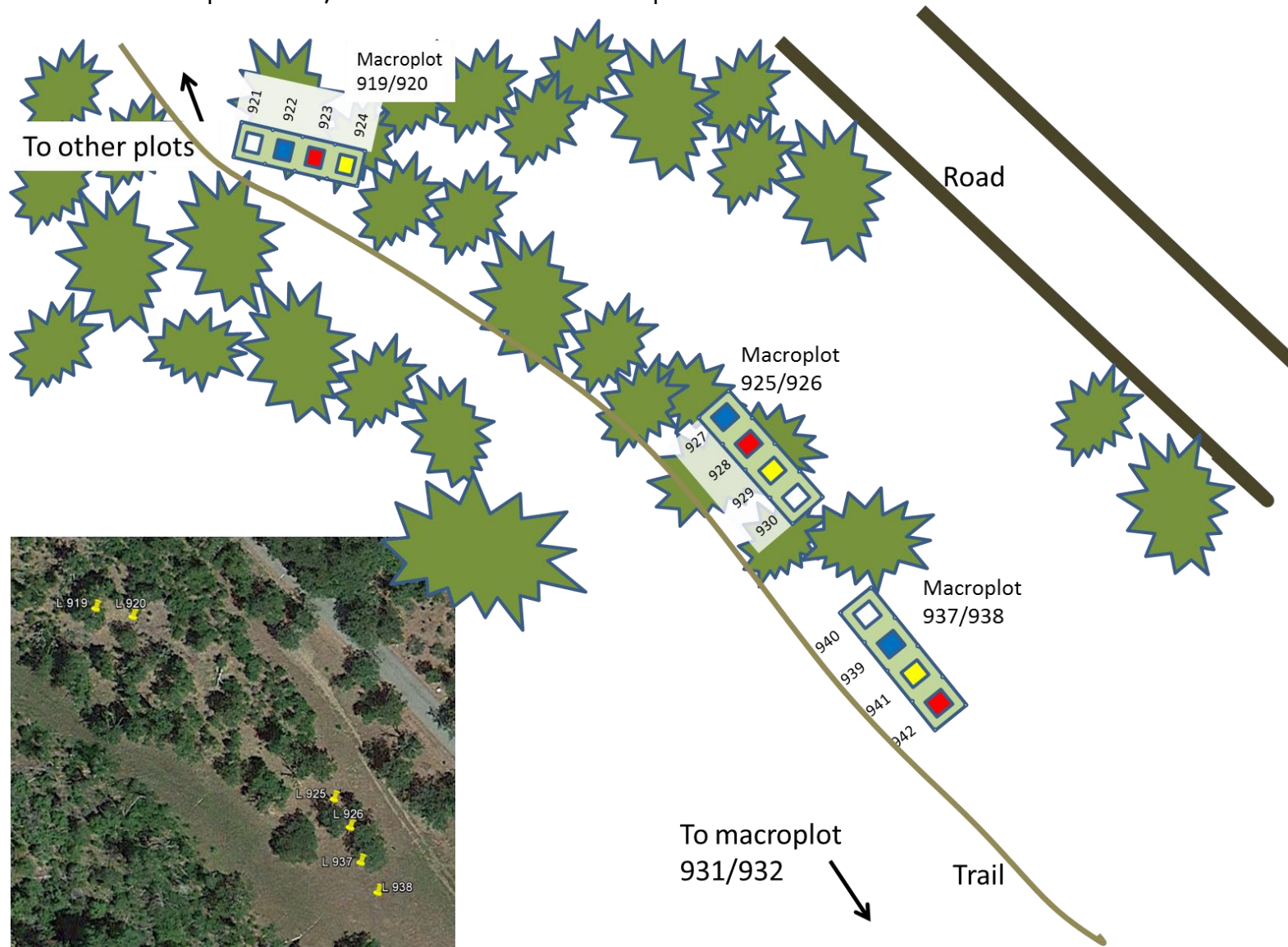
Overview of plots near the river.



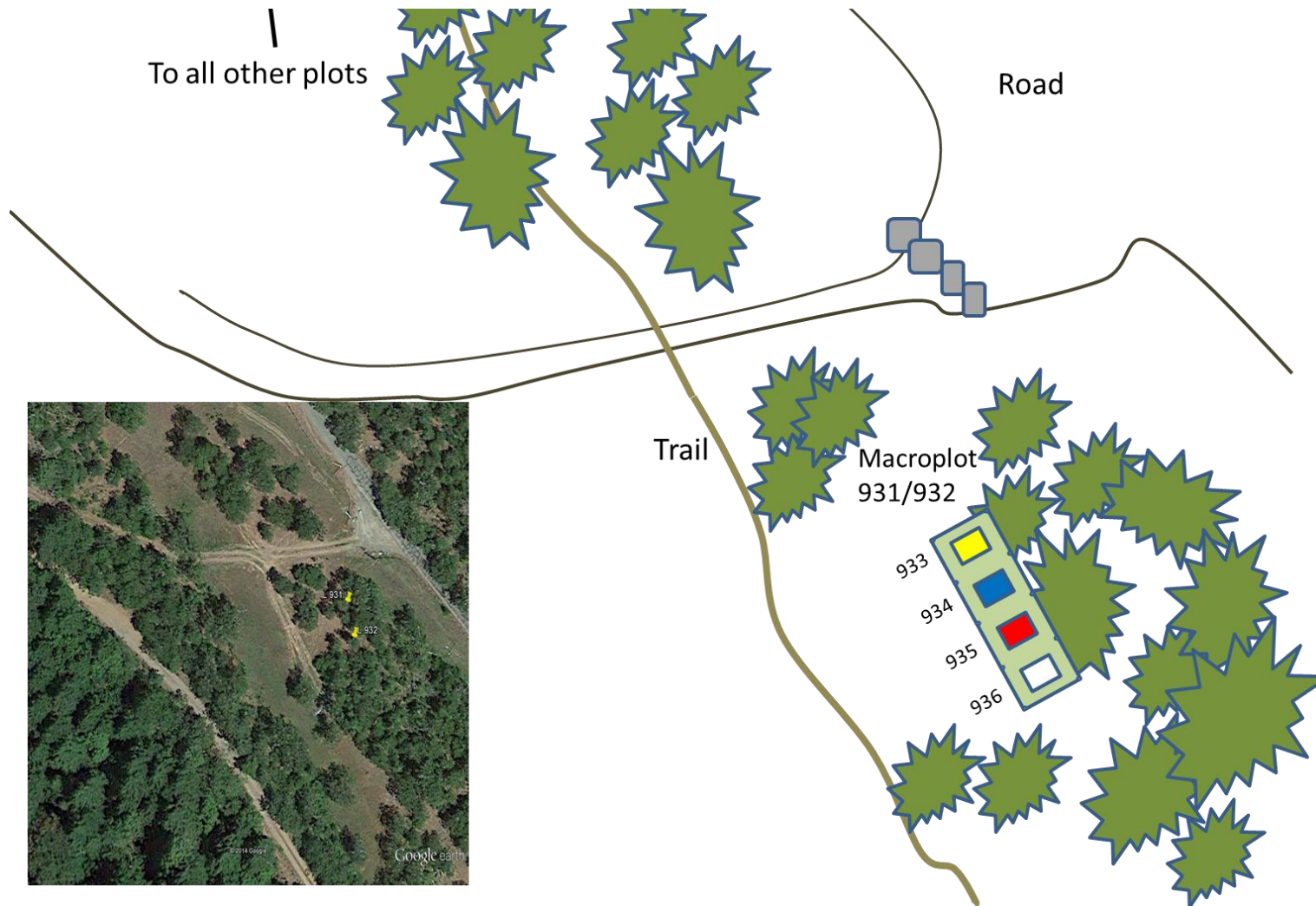
Schematic of macroplots #901, #907 and #913, as well as general location of occupied plots.



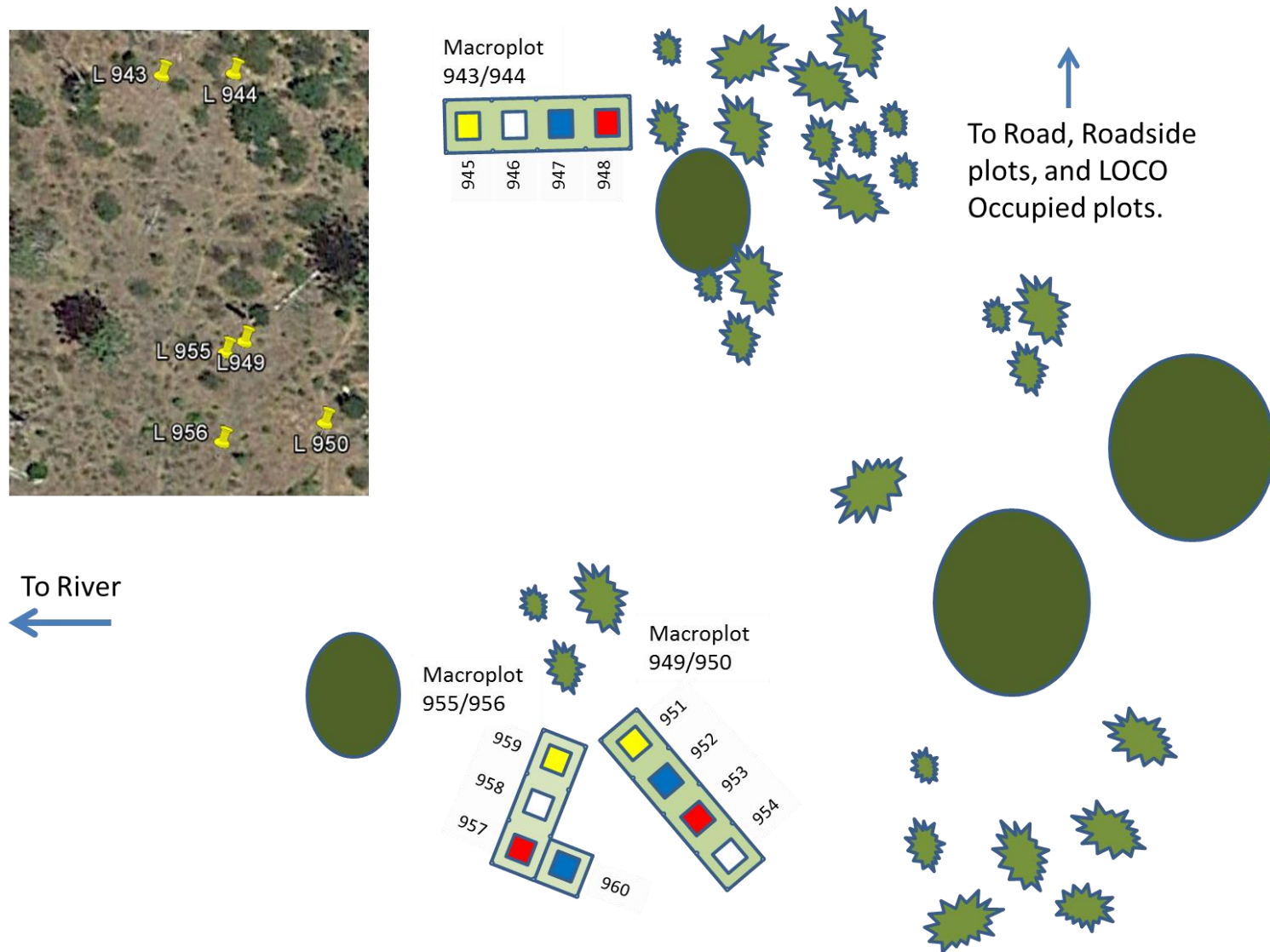
Schematic of macroplots #919, #925 and #937 in the unoccupied area.



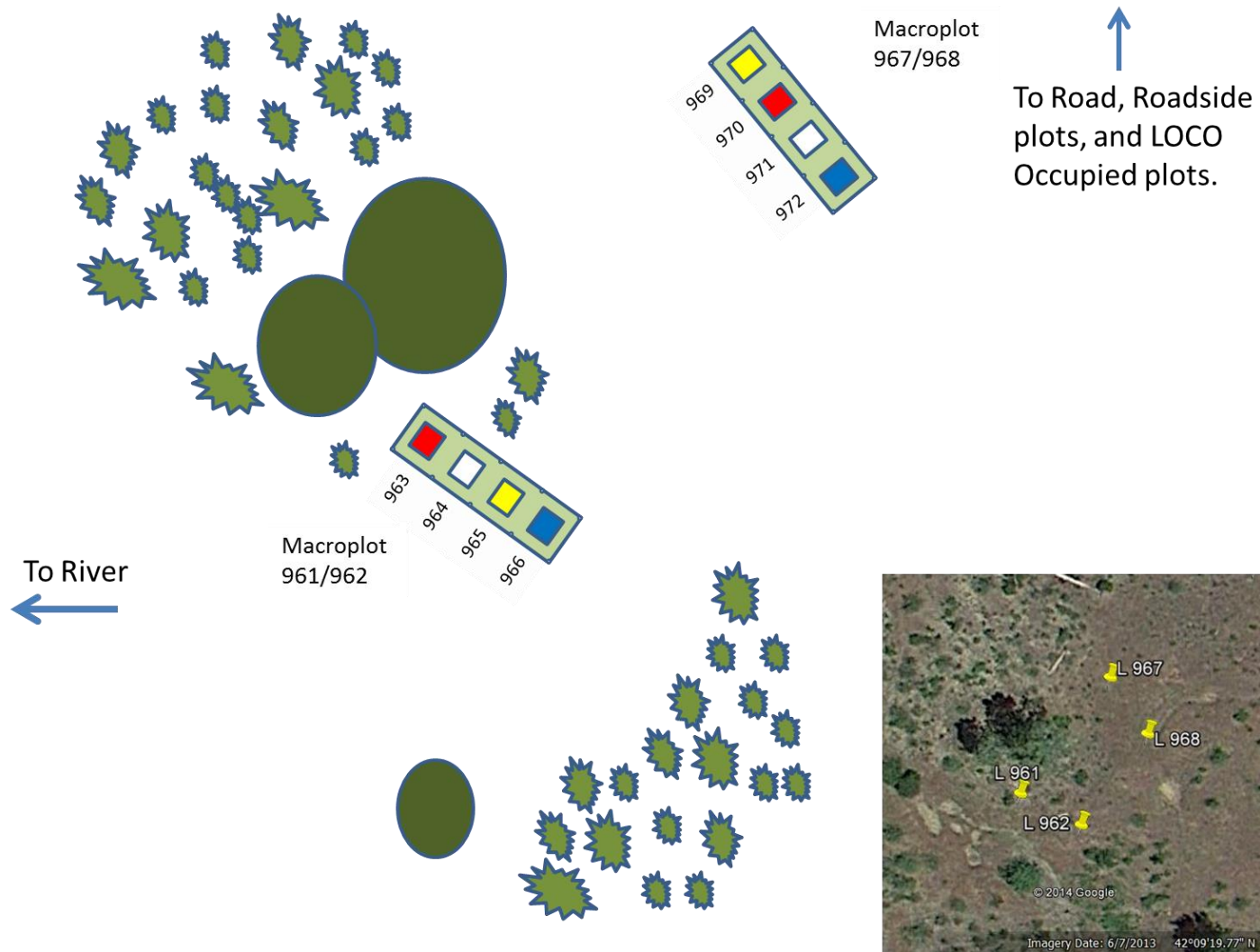
Schematic of macroplot #931.



Schematic of macroplots #943, #949 and #955.

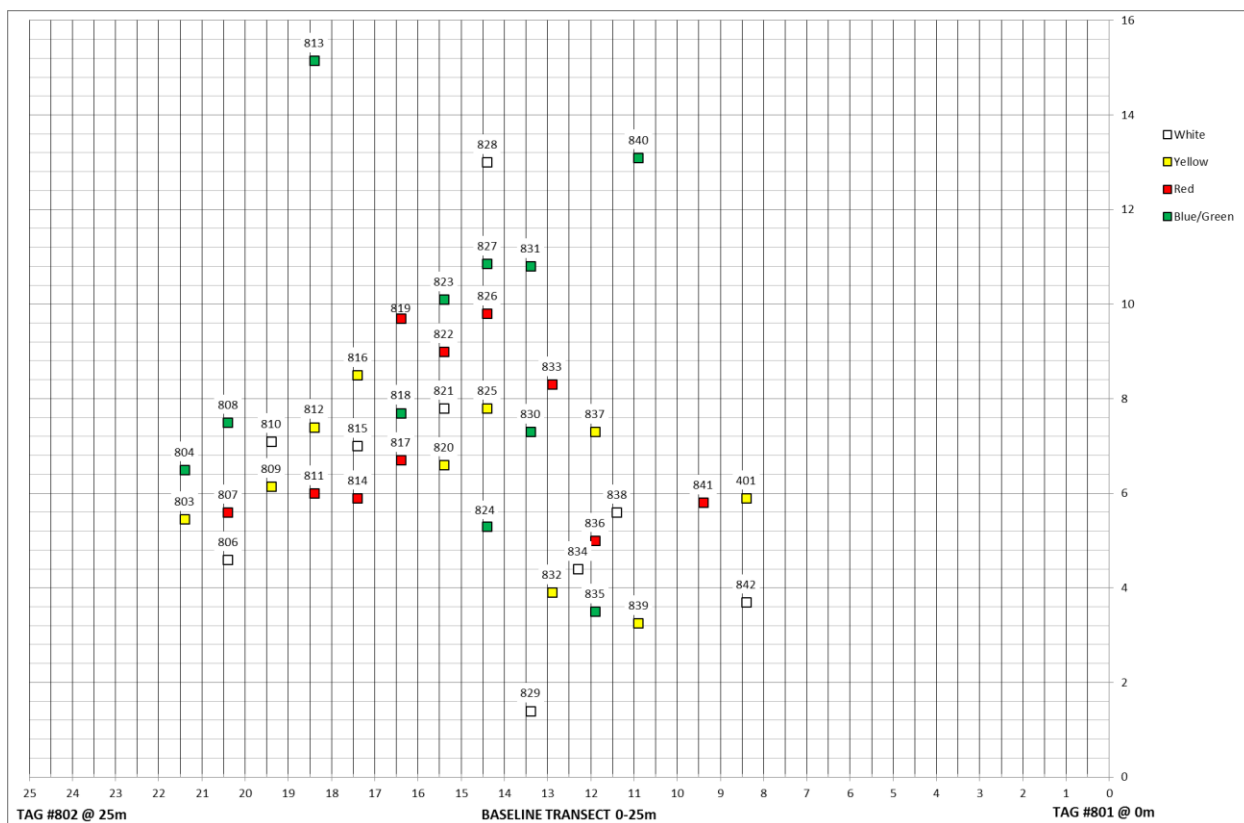


Schematic of macroplots #961 and #967.



Occupied Habitat

There are 40 0.5mx0.5m plots established along 15m transects that run perpendicular to the 25m baseline (#801-802). Location along the baseline, and location of the demography plot(s) along the transects are recorded in the following table. The perpendicular transects are marked at both ends with tagged 18" PVC, capped with IAE labels, and pounded into the ground with ~3-6" exposed. The placement of the perpendicular transects and the location of the demographic plot (s) along these transects were selected using a random number generator. If the randomly selected target location did not have at least three *L. cookii*, the next closest suitable area along the transect (with at least three *L. cookii*) was selected¹. Demographic plots are marked with nails and (hot pink) washers on opposite corners (NE – with tag and SW).



Schematic of plots established in the occupied habitat. In this diagram, white = imazapic, yellow = control, red = glyphosate and blue/green = fluazifop.

¹ Due to the limited size of the population, one to three plots in each treatment have only one or two plants instead of the targeted minimum of three plants.

APPENDIX C. LOCATIONS OF DENSITY AND DEMOGRAPHY PLOTS AT FRENCH FLAT MIDDLE AND FRENCH FLAT SOUTH.

French Flat Middle

Established in 2013.

2013 New Plot #	Side of Tape	Location on Baseline (m)	End Rebar at (m)	End Rebar Tag	2013 Last Plant Found at (m)	Demog. Tag	Demog. Plot Location (NE Corner)	Demog. Plot Location (End)
165	W	2.8	30	166	25.95	33	11.43	10.9
154	W	6.5	37	153	34	1	11.2	10.75
155	E	6.5	37	156	26.5	3	18.05	18.55
161	E	9.1	40	162	35.2	8	23.25	23.75
163	E	9.7	40	164	39.55	7	15.5	16
163	E	9.7	40	164	38.05	10	33.25	33.75
28	W	15	37	29	35.7	876	18.55	19.05
167	E	17.5	40	166	38.05	-	-	-
30	E	19	39.3	31	35.1	-	-	-
33	W	22	40	34	28.1	877	23.45	23.95
169	W	25	40	170	38.7	37	22.24	21.71
171	E	27.1	33.5	172	33	38	2.4	2.9
199	W	31	30	200	29.3	-	-	-
35	E	35	40	36	38.6	-	-	-
173	E	36.6	40	174	36.6	874	20.5	30
173	E	36.6	40	174	36.6	875	11.2	11.7
175	W	40.2	35	176	31.85	167	23.45	23.95
158	W	43.1	30	157	20.6	18	13.2	12.7
159	E	43.5	30	160	28.25	28	5.2	5.7
177	E	46.6	35.5	178	33.9	29	5.1	5.6
179	E	55.1	15.4	180	13.7	31	4.75	5.25
181	W	56	20.4	182	19	-	-	-
183	E	60	11.3	184	11.05	-	-	-
185	E	62	10.8	186	9.7	-	-	-
187	W	67	9.9	188	6.7	-	-	-
189	E	72	15	190	14.9	168	6.5	7
37	W	74	16	38	6.9	-	-	-
191	W	82	15.5	192	11.4	169	2.5	2
193	W	86	10.5	194	3.5	-	-	-
195	E	89	21.4	196	19.5	170	-	-
197	W	95	15	198	10.5	-	-	-
39	W	98	15	40	8.7	-	-	-

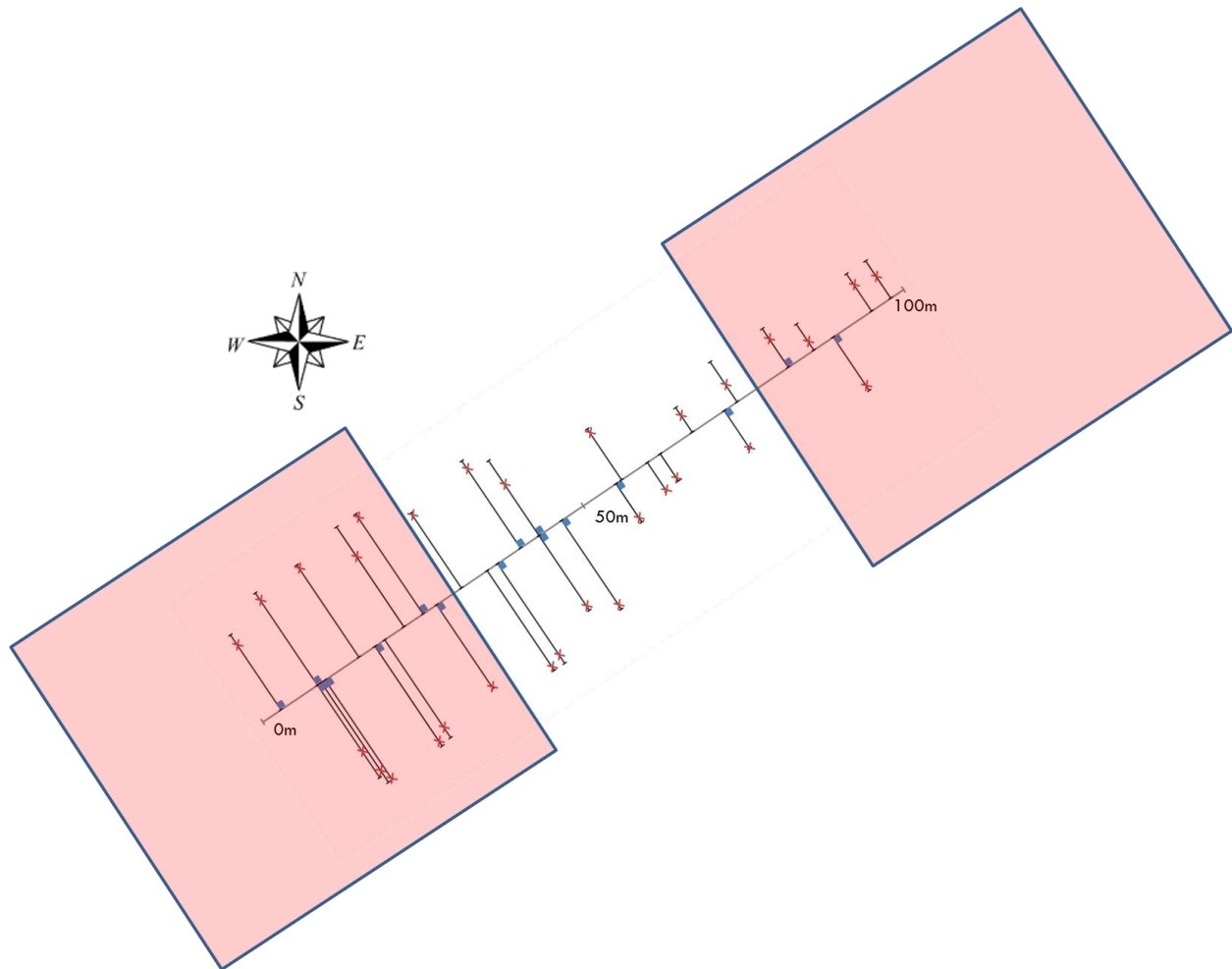
French Flat South

Established in 2012.

2012 New Plot #	Side of Tape	Location on Baseline (m)	End Rebar at (m)	End Rebar Tag	2012 Last Plant Found at (m)	Demog. Tag	Demog. Plot Location (NE Corner)	Demog. Plot Location (End)
362	E	13	23	363	9.3	-	-	-
364	W	27	30	365	10.4	-	-	-
366	W	30	33	367	6.9	-	-	-
707	W	36	21	708	15.9	329	10.5	11
709	W	38	21	710	15.8	330	6.5	7
711	W	42	21	712	12.7	331	4	4.5
749	E	45	40	750	23.6	353	15.5	15
713	E	52	37	714	25.8	332	17.5	17
741	E	57	35	742	27.1	352	20.5	20
743	E	59	40	744	30.1	354	21.5	21
753	E	61	36	754	31.8	357	23	22.5
745	W	65	39	746	23.9	361	13.5	14
747	E	70	40	748	32.1	360	8.5	8
751	E	72	40	752	22.8	355	5.5	5
725	W	79	40	726	11.8	338	3	3.5
715	E	81	40	716	30.4	333	11.5	11
717	W	94	40	718	28.7	334	13.5	14
719	E	95	40	720	30.9	335	19	18.5
721	E	97	40	722	30.6	336	15.5	15
723	W	99	32	724	31.0	337	16	16.5
727	W	107	28	728	24.6	339	13	13.5
701	E	109	40	702	27.2	326	24.5	24
703	E	111	40	704	28.3	327	23	22.5
705	W	116	32	706	23.0	328	19	19.5
729	W	119	33	730	22.8	340	24	24.5
755	E	125	40	756	27	356	16.5	16
731	E	126	40	732	19.1	341	5.5	5
733	W	128	35.5	734	29.2	342	20	20.5
735	E	129	40	736	23.6	343	9	8.5
737	W	136	40	738	31.5	344	15	15.5
757	W	142	33	758	32.8	358	5	5.5
759	W	144	34	760	32.6	359	9.5	10
739	W	154	40	740	32.8	345	18	18.5

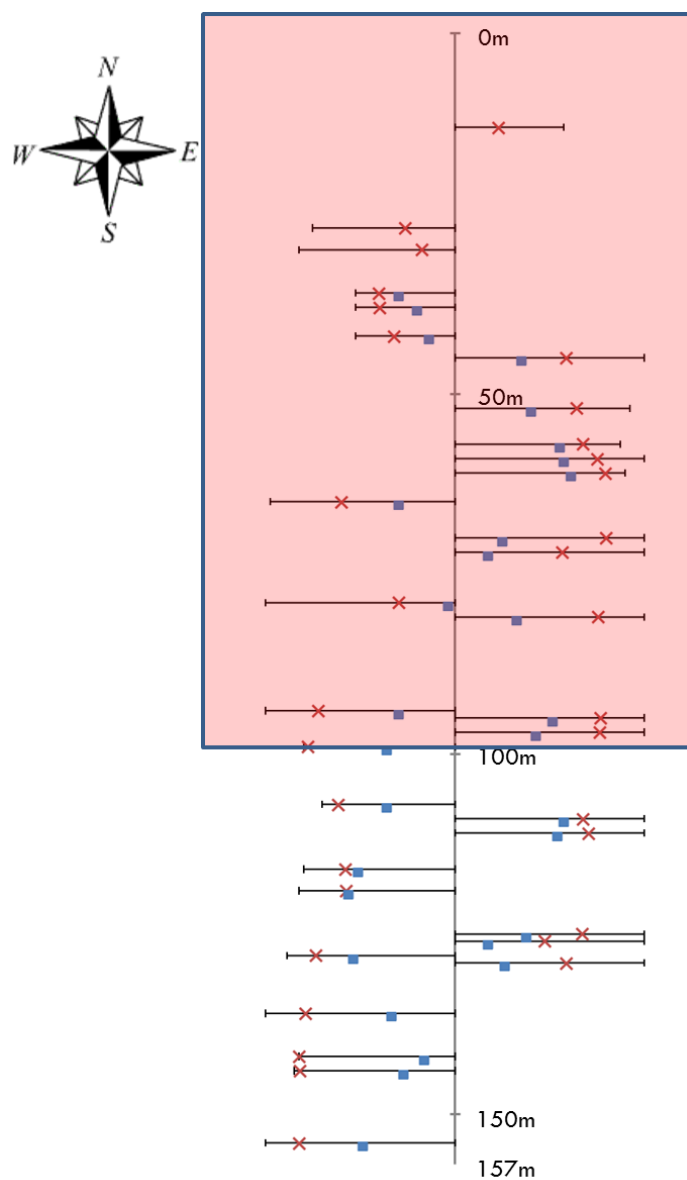
APPENDIX D. SCHEMATIC OF DENSITY AND DEMOGRAPHY PLOTS AT FRENCH FLAT MIDDLE AND FRENCH FLAT SOUTH.

French Flat Middle



Demography and density plots were established in 2013. Baseline transect is 100m with a bearing of 034° (northeast). Last plants located on density plots are indicated by red crosses. Demography plots are indicated by blue squares and are not located along the baseline transect as shown here. The shaded areas were burned in the fall of 2015.

French Flat South



Demography and density plots were established in 2012. Baseline transect is 157m with a bearing due south. Last plants located on density plots are indicated by red crosses. Demography plots are indicated by blue squares. The shaded areas were burned in the fall of 2015.

APPENDIX E. PLANT COMMUNITY DATA (FORBS AND SHRUBS) FROM FORKS STATE PARK IN OCCUPIED AND UNOCCUPIED PLOTS, 2014-2018.

	Forb Total		Native Forb		Introduced Forb		Tree/Shrub	
	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
2014								
<i>Unoccupied</i>								
Control	29.0	16.4	8.7	4.9	20.2	11.4	0.1	0.0
Fluazifop	30.4	17.2	5.8	3.3	24.2	13.7	0.4	0.2
Glyphosate	23.9	13.5	10.6	6.0	13.3	7.5	0.1	0.0
Imazapic	21.6	12.2	5.9	3.3	15.6	8.9	0.0	0.0
<i>Occupied</i>								
Control	13.9	8.6	6.7	4.2	6.9	4.3	5.5	3.4
Fluazifop	11.5	7.1	3.7	2.3	7.6	4.7	0.1	0.1
Glyphosate	14.5	9.0	4.2	2.6	10.2	6.3	0.0	0.0
Imazapic	9.2	5.7	7.0	4.4	2.1	1.3	0.0	0.0
2015								
<i>Unoccupied</i>								
Control	28.0	15.8	7.4	4.2	20.5	11.6	0.0	0.0
Fluazifop	42.2	23.9	4.1	2.3	37.4	21.1	0.4	0.2
Glyphosate	14.3	8.1	9.8	5.5	3.4	1.9	0.1	0.0
Imazapic	23.5	13.3	1.8	1.0	21.6	12.2	0.0	0.0
<i>Occupied</i>								
Control	12.0	7.4	5.6	3.5	6.1	3.8	7.5	4.6
Fluazifop	22.3	13.8	6.2	3.8	15.4	9.5	0.2	0.1
Glyphosate	7.7	4.8	5.1	3.1	1.4	0.8	0.0	0.0
Imazapic	13.5	8.4	6.3	3.9	6.2	3.8	0.0	0.0
2016								
<i>Unoccupied</i>								
Control	27.2	15.4	7.4	4.2	19.4	11.0	0.0	0.0
Fluazifop	43.1	24.4	8.4	4.7	34.1	19.3	0.6	0.3
Glyphosate	27.2	15.4	11.2	6.3	14.9	8.5	0.3	0.1
Imazapic	33.2	18.8	4.9	2.8	27.9	15.8	0.0	0.0
<i>Occupied</i>								
Control	13.4	8.3	5.1	3.1	7.4	4.6	7.5	4.6
Fluazifop	10.7	6.6	2.9	1.8	6.7	4.2	0.1	0.1
Glyphosate	11.2	6.9	4.6	2.8	5.7	3.5	0.1	0.0
Imazapic	13.2	8.2	5.9	3.6	6.3	3.9	0.0	0.0
2017								
<i>Unoccupied</i>								
Control	33.8	19.1	10.9	6.1	22.7	12.9	0.0	0.0

	Forb Total		Native Forb		Introduced Forb		Tree/Shrub	
	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
Fluazifop	51.6	29.2	12.6	7.2	38.4	21.7	1.1	0.6
Glyphosate	51.1	28.9	12.4	7.0	38.0	21.5	0.0	0.0
Imazapic	41.2	23.3	9.5	5.4	31.5	17.8	0.0	0.0
Occupied								
Control	26.2	16.3	12.3	7.6	10.7	6.6	6.0	3.7
Fluazifop	19.4	12.0	9.8	6.1	7.4	4.6	0.0	0.0
Glyphosate	34.8	21.5	19.1	11.9	13.7	8.5	0.0	0.0
Imazapic	32.1	19.9	16.2	10.1	12.8	7.9	0.0	0.0
2018								
Unoccupied								
Control	25.8	14.6	7.8	4.4	17.7	10.0	0.0	0.0
Fluazifop	29.5	16.7	8.3	4.7	20.6	11.7	2.2	1.3
Glyphosate	41.7	23.6	10.0	5.6	30.4	17.2	0.0	0.0
Imazapic	29.7	16.8	8.1	4.6	21.1	11.9	0.0	0.0
Occupied								
Control	28.8	17.8	11.1	6.9	16.3	10.1	0.1	0.0
Fluazifop	9.7	6.0	4.3	2.7	4.3	2.6	0.1	0.1
Glyphosate	27.5	17.0	7.7	4.8	18.5	11.4	0.0	0.0
Imazapic	17.7	11.0	12.4	7.7	4.0	2.5	0.0	0.0

APPENDIX F. PLANT COMMUNITY DATA (GRAMINOIDS) FROM FORKS STATE PARK IN OCCUPIED AND UNOCCUPIED PLOTS, 2014-2018.

	Graminoid Total		Native Graminoid		Introduced Graminoids		Native Perennial Graminoid		Introduced Annual Graminoid		Introduced Perennial Graminoids	
	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
2014												
<i>Unoccupied</i>												
Control	25.2	14.2	3.3	1.9	21.8	12.3	3.3	1.9	21.3	12.1	0.5	0.3
Fluazifop	25.8	14.6	1.2	0.7	24.6	13.9	1.2	0.7	24.6	13.9	0.0	0.0
Glyphosate	26.4	14.9	4.5	2.5	22.0	12.4	4.5	2.5	22.0	12.4	0.0	0.0
Imazapic	27.3	15.4	2.0	1.1	25.3	14.3	2.0	1.1	24.6	13.9	0.7	0.4
<i>Occupied</i>												
Control	47.0	29.1	26.7	16.5	20.3	12.6	26.7	16.5	9.9	6.2	10.3	6.4
Fluazifop	58.7	36.4	28.6	17.7	30.2	18.7	28.5	17.7	10.4	6.4	19.8	12.3
Glyphosate	56.3	34.9	19.5	12.1	36.8	22.8	19.0	11.8	8.1	5.0	28.7	17.8
Imazapic	59.7	37.0	28.1	17.4	31.5	19.5	27.9	17.3	11.5	7.1	20.0	12.4
2015												
<i>Unoccupied</i>												
Control	31.4	17.8	2.1	1.2	29.3	16.6	2.1	1.2	29.0	16.4	0.3	0.2
Fluazifop	2.3	1.3	0.8	0.4	1.6	0.9	0.8	0.4	1.6	0.9	0.0	0.0
Glyphosate	2.0	1.1	1.0	0.6	1.0	0.6	1.0	0.6	1.0	0.6	0.0	0.0
Imazapic	19.5	11.0	2.3	1.3	17.2	9.8	2.3	1.3	17.2	9.8	0.0	0.0
<i>Occupied</i>												
Control	32.1	19.9	11.7	7.3	20.4	12.6	11.7	7.3	17.5	10.8	2.9	1.8
Fluazifop	13.7	8.5	10.4	6.5	3.3	2.0	10.4	6.5	1.5	0.9	1.8	1.1
Glyphosate	1.1	0.7	0.7	0.4	0.4	0.3	0.7	0.4	0.4	0.2	0.1	0.0
Imazapic	24.6	15.3	18.6	11.5	6.1	3.8	18.6	11.5	1.7	1.0	4.4	2.7

	Graminoid Total		Native Graminoid		Introduced Graminoids		Native Perennial Graminoid		Introduced Annual Graminoid		Introduced Perennial Graminoids	
	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
2016												
<i>Unoccupied</i>												
Control	22.8	12.9	1.9	1.1	20.9	11.8	1.9	1.1	20.9	11.8	0.0	0.0
Fluazifop	3.2	1.8	0.8	0.5	2.4	1.3	0.8	0.5	2.4	1.3	0.0	0.0
Glyphosate	4.0	2.3	0.3	0.1	3.8	2.1	0.3	0.1	3.7	2.1	0.0	0.0
Imazapic	21.3	12.0	1.9	1.1	19.3	10.9	1.9	1.1	19.3	10.9	0.0	0.0
<i>Occupied</i>												
Control	26.8	16.6	8.3	5.1	18.6	11.5	8.2	5.1	17.0	10.6	1.5	0.9
Fluazifop	7.8	4.9	3.3	2.0	4.6	2.8	3.3	2.0	3.8	2.4	0.8	0.5
Glyphosate	3.5	2.2	0.8	0.5	2.7	1.7	0.8	0.5	2.4	1.5	0.3	0.2
Imazapic	13.4	8.3	9.4	5.8	4.0	2.5	9.4	5.8	3.2	2.0	0.8	0.5
2017												
<i>Unoccupied</i>												
Control	18.9	10.7	1.1	0.6	17.8	10.0	1.1	0.6	17.8	10.0	0.0	0.0
Fluazifop	8.6	4.8	1.6	0.9	7.0	4.0	1.6	0.9	7.0	4.0	0.0	0.0
Glyphosate	7.9	4.5	1.2	0.7	6.7	3.8	1.2	0.7	6.7	3.8	0.0	0.0
Imazapic	16.9	9.5	2.5	1.4	14.3	8.1	2.5	1.4	14.3	8.1	0.0	0.0
<i>Occupied</i>												
Control	21.0	13.0	13.4	8.3	7.6	4.7	13.4	8.3	6.9	4.3	0.7	0.4
Fluazifop	12.6	7.8	5.9	3.7	6.7	4.2	5.9	3.7	6.2	3.9	0.5	0.3
Glyphosate	12.9	8.0	5.3	3.3	7.7	4.8	5.3	3.3	7.0	4.3	0.7	0.4
Imazapic	22.7	14.1	17.4	10.8	5.3	3.3	17.4	10.8	5.1	3.1	0.2	0.1
2018												
<i>Unoccupied</i>												
Control	14.9	8.4	1.0	0.6	13.9	7.8	1.0	0.6	13.9	7.8	0.0	0.0
Fluazifop	9.5	5.4	0.5	0.3	9.0	5.1	0.5	0.3	9.0	5.1	0.0	0.0

	Graminoid Total		Native Graminoid		Introduced Graminoids		Native Perennial Graminoid		Introduced Annual Graminoid		Introduced Perennial Graminoids	
	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
Glyphosate	6.5	3.7	0.8	0.4	5.7	3.2	0.8	0.4	5.7	3.2	0.0	0.0
Imazapic	12.1	6.8	0.9	0.5	11.1	6.3	0.9	0.5	11.1	6.3	0.0	0.0
Occupied												
Control	13.8	8.5	8.5	5.2	5.3	3.3	8.3	5.1	4.4	2.7	1.0	0.6
Fluazifop	8.2	5.1	4.8	3.0	3.5	2.2	4.5	2.8	2.7	1.7	0.8	0.5
Glyphosate	10.0	6.2	5.5	3.4	4.5	2.8	5.4	3.3	3.5	2.2	1.0	0.6
Imazapic	13.5	8.3	9.6	6.0	3.9	2.4	9.5	5.9	3.1	1.9	0.8	0.5

APPENDIX G. MEAN COVER OF THE PLANT COMMUNITY BY SPECIES IN UNOCCUPIED AND OCCUPIED PLOTS AT FORKS STATE PARK (2014-2018)

	Unoccupied									
	2014		2015		2016		2017		2018	
	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
Bare ground	4.3	2.1	7.2	4.2	9.9	5.8	3.3	2.5	1.7	2.5
Litter	95.9	1.6	92.0	4.1	79.8	8.4	92.1	3.3	59.2	3.3
Moss	3.1	1.9	3.4	1.9	8.7	2.9	3.6	1.6	5.9	1.5
Rock	2.4	0.8	3.8	2.0	8.2	3.6	5.3	1.9	3.3	1.9
Litter grass	--	--	77.8	8.9	73.4	9.2	76.0	8.7	70.9	8.7
Litter oak	--	--	22.2	8.9	26.6	9.2	24.0	8.7	29.1	8.7
<i>Agrostis</i> sp.	0.3	0.4	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0
<i>Aira caryophyllea</i>	0.9	0.4	1.4	1.2	3.4	1.9	2.4	1.0	3.5	1.0
<i>Allium</i> sp.	0.1	0.2	0.5	0.5	0.6	0.4	0.4	0.2	0.7	0.2
<i>Arctostaphylos</i> sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Avena</i> sp.	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
<i>Briza minor</i>	0.0	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.1	0.0
<i>Brodiaea</i> sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Bromus hordeaceus</i>	13.0	4.0	6.8	3.6	4.6	2.9	4.6	1.4	3.4	1.4
<i>Bromus rigidus</i>	4.5	2.4	1.8	1.3	1.7	1.0	2.1	1.3	0.9	1.3
<i>Bromus</i> sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Bromus tectorum</i>	1.2	0.7	0.7	0.8	0.8	1.2	1.1	1.5	0.4	1.5
<i>Calandrinia ciliata</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1
<i>Calochortus uniflorus</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Camassia</i> sp.	0.1	0.0	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.0
<i>Carex</i> sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Ceanothus cuneatus</i>	0.1	0.2	0.1	0.2	0.1	0.2	0.3	0.5	0.5	0.5
<i>Centaurea cyanus</i>	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
<i>Centaureum erythraea</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Cerastium arvense</i>	0.0	0.0	0.1	0.1	0.8	0.5	0.3	0.1	0.1	0.1
<i>Cerastium glomeratum</i>	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0
<i>Cercocarpus betuloides</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Chlorogalum pomeridianum</i>	2.0	2.0	2.3	2.2	2.4	2.2	2.4	2.0	2.1	2.0
<i>Clarkia</i> spp.	0.2	0.1	0.8	0.4	0.7	0.4	0.4	0.2	0.2	0.2

	Unoccupied									
	2014		2015		2016		2017		2018	
	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
<i>Cynosurus cristatus</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Cynosurus echinatus</i>	1.6	1.1	0.0	0.0	0.3	0.2	0.1	0.0	0.1	0.0
<i>Danthonia californica</i>	0.1	0.2	0.0	0.1	0.0	0.0	0.1	0.1	0.1	0.1
<i>Danthonia unispicata</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Daucus pusillus</i>	1.3	0.8	0.3	0.3	1.0	0.7	0.9	0.6	1.0	0.6
<i>Dichelostemma</i> sp.	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0
<i>Dipsacus fullonum</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Dodecatheon</i> sp.	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
<i>Epilobium</i> sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Eriogonum</i> sp.	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
<i>Eriophyllum lanatum</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Erodium cicutarium</i>	0.0	0.0	0.1	0.1	0.2	0.3	0.0	0.0	0.0	0.0
<i>Eschscholzia californica</i>	0.3	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.6	0.3
<i>Festuca roemerii</i>	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
<i>Festuca</i> sp.	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Galium parisiense</i>	0.3	0.2	0.3	0.2	0.3	0.3	0.3	0.2	0.1	0.2
<i>Geranium dissectum</i>	0.2	0.3	0.1	0.1	0.2	0.2	0.3	0.3	0.3	0.3
<i>Geranium molle</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Githopsis specularioides</i>	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
<i>Gnaphalium</i> sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Hypericum perforatum</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Hypochaeris radicata</i>	7.0	3.7	14.9	5.4	15.1	4.4	21.8	5.5	8.6	5.5
<i>Isoetes nuttallii</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Juncus bufonius</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Juncus</i> sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Lactuca</i> sp.	0.0	0.0	0.1	0.1	0.1	0.2	0.0	0.0	0.0	0.0
<i>Lamium purpureum</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Lathyrus nevadensis</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Limnanthes gracilis</i>	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.2	0.2
<i>Linanthus bicolor</i>	0.1	0.1	0.2	0.1	0.9	1.0	1.6	0.8	1.1	0.8
<i>Linanthus</i> spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Lithophragma parviflorum</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Lomatium cookii</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Lotus micranthus</i>	0.4	0.2	0.2	0.1	0.3	0.2	0.5	0.3	0.2	0.3

	Unoccupied									
	2014		2015		2016		2017		2018	
	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
<i>Lotus unifoliolatus</i>	0.3	0.4	0.3	0.4	0.3	0.3	0.6	0.6	1.1	0.6
<i>Lupinus bicolor</i>	1.3	0.6	0.2	0.1	1.1	0.5	2.0	1.0	0.2	1.0
<i>Luzula</i> sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Madia</i> spp.	2.2	1.1	1.3	0.8	1.1	0.6	2.2	1.5	2.3	1.5
<i>Micropus californicus</i>	0.2	0.2	0.2	0.1	0.3	0.2	0.5	0.3	1.8	0.3
<i>Mimulus</i> sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Moenchia recta</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Moerhingia</i> sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Myosotis discolor</i>	0.1	0.0	0.3	0.2	0.1	0.1	0.0	0.0	0.1	0.0
<i>Navarretia</i> sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1
<i>Nemophila</i> sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Orobancha</i> sp. uniflora	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Orthocarpus</i> sp. (white)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1
<i>Pectocarya pusilla</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Pectocarya pusilla</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Peplis portula</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Plagiobothrys</i> sp.	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.0
<i>Plantago lanceolata</i>	0.2	0.3	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1
<i>Plectritis congesta</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Poa bulbosa</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.7	0.0	0.7
<i>Poa secunda</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Quercus garryana</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Ranunculus occidentalis</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Rumex acetosella</i>	0.4	0.6	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0
<i>Saxifrage senesced</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Scleranthus annuus</i>	1.2	0.8	0.3	0.3	0.7	0.5	0.4	0.2	0.3	0.2
<i>Spiranthes</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Stipa lemmonii</i>	2.4	2.4	1.4	1.1	1.2	1.0	1.5	1.2	0.7	1.2
<i>Taeniatherum caput-medusae</i>	1.9	1.2	1.2	0.9	0.8	0.8	0.5	0.4	1.6	0.4
<i>Thysanocarpus curvipes</i>	0.1	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0
<i>Tonella tenella</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Torilis arvensis</i>	2.1	1.5	0.2	0.2	0.8	0.6	0.1	0.1	1.6	0.1
<i>Toxicodendron diversilobum</i>	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0
<i>Trifolium albopurpureum</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.2

	Unoccupied									
	2014		2015		2016		2017		2018	
	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
<i>Trifolium bifidum</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Trifolium dubium</i>	5.0	2.9	3.0	2.5	3.8	2.3	7.6	4.5	8.0	4.5
<i>Trifolium microcephalum</i>	0.7	0.6	0.1	0.1	0.2	0.2	0.4	0.2	0.2	0.2
<i>Trifolium subterraneum</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Trifolium variegatum</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Trifolium willdenovii</i>	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Valerianella locusta</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.2
<i>Veronica</i> sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Vicia sativa</i>	0.0	0.0	0.2	0.2	0.1	0.0	0.1	0.1	0.1	0.1
<i>Viola hallii</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Vulpia bromoides</i>	0.7	0.5	2.3	2.0	2.1	1.8	3.4	1.4	0.8	1.4
Native Forb	7.8	2.6	5.8	2.3	7.9	2.6	11.3	3.0	8.6	3.0
Native Annual Forb	5.6	2.1	3.3	1.2	5.3	1.6	8.8	2.7	6.4	2.7
Native Perennial Forb	2.2	2.0	2.4	2.2	2.7	2.2	2.5	1.9	2.2	1.9
Introduced Forb	18.3	4.8	20.7	6.3	24.1	4.9	32.7	7.1	22.4	7.1
Introduced Annual Forb	10.8	2.8	5.4	2.5	8.1	2.1	10.5	4.4	13.6	4.4
Introduced Perennial Forb	7.6	3.7	15.3	5.4	16.0	4.3	22.1	5.5	8.9	5.5
Forb Total	26.2	5.0	27.0	6.3	32.7	5.4	44.4	7.7	31.7	7.7
Native Graminoid	2.8	2.4	1.5	1.1	1.2	1.0	1.6	1.2	0.8	1.2
Native Annual Graminoid	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Native Perennial Graminoid	2.8	2.4	1.5	1.1	1.2	1.0	1.6	1.2	0.8	1.2
Introduced Graminoid	24.1	3.9	14.6	5.0	13.7	4.6	14.8	2.4	10.7	2.4
Introduced Annual Graminoid	23.8	3.9	14.5	5.0	13.7	4.6	14.8	2.4	10.7	2.4
Introduced Perennial Graminoid	0.3	0.4	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Graminoid Total	26.8	4.1	16.1	5.1	14.9	4.6	16.4	2.6	11.5	2.6
Tree/Shrub	0.1	0.2	0.1	0.2	0.2	0.3	0.3	0.5	0.6	0.5
Species Richness - All Species	60		64		66		67		67	

	Unoccupied									
	2014		2015		2016		2017		2018	
	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
Forbs	39		48		50		50		50	
Introduced Forb	16		25		23		20		20	
Native Forb	22		22		26		28		29	
Graminoids	17		14		13		14		14	
Introduced Graminoid	11		11		10		9		11	
Native Graminoid	6		3		3		5		3	
Species Richness, Cover >1%										
Forbs	14		10		11		12		11	
Introduced Forb	8		4		6		6		8	
Native Forb	5		2		3		2		4	
Graminoids	3		2		3		4		4	
Introduced Graminoid	6		6		5		6		3	
Native Graminoid	5		5		4		5		3	
	1		1		1		1		0	

	Occupied Plots									
	2014		2015		2016		2017		2018	
	Mean	95%	Mean	95%	Mean	95%	Mean	95%	Mean	95%
		CI		CI		CI		CI		CI
Bare ground	1.2	0.8	3.2	2.0	1.6	1.1	2.4	1.7	2.0	1.0
Litter	95.8	2.2	90.0	5.2	75.3	8.0	90.3	3.5	40.9	2.6
Moss	2.7	1.4	9.9	6.2	15.9	6.8	7.0	3.4	10.8	2.6
Rock	4.6	1.6	7.0	2.8	9.6	4.1	18.6	6.3	24.5	6.7
Litter grass	--	--	70.3	7.2	61.0	7.9	51.9	8.5	50.5	5.7
Litter oak	--	--	29.4	7.2	39.1	7.9	47.9	8.5	49.5	5.7
<i>Agrostis</i> sp.	19.7	7.7	2.3	1.6	0.8	0.8	0.5	0.4	0.9	0.5
<i>Aira caryophyllea</i>	0.4	0.4	0.3	0.2	1.3	0.8	1.5	1.1	0.8	0.1
<i>Allium</i> sp.	0.1	0.0	0.8	0.3	1.0	0.3	2.6	1.0	1.3	0.3
<i>Arctostaphylos</i> sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Avena</i> sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Briza minor</i>	0.1	0.1	0.4	0.2	0.1	0.1	0.7	0.3	0.4	0.1
<i>Brodiaea</i> sp.	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Bromus hordeaceus</i>	1.0	0.8	0.4	0.5	0.5	0.4	0.2	0.1	0.1	0.0
<i>Bromus rigidus</i>	0.5	0.5	1.1	1.6	0.7	0.8	1.0	0.9	0.6	0.1
<i>Bromus</i> sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
<i>Bromus tectorum</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Calandrinia ciliata</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Calochortus uniflorus</i>	0.0	0.0	0.2	0.2	0.2	0.2	0.1	0.0	0.1	0.1
<i>Camassia</i> sp.	1.1	1.0	0.9	0.7	0.8	0.7	1.8	1.8	1.3	0.3
<i>Carex</i> sp.	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Ceanothus cuneatus</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Centaurea cyanus</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Centaureum erythraea</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Cerastium arvense</i>	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
<i>Cerastium glomeratum</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Cercocarpus betuloides</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Chlorogalum pomeridianum</i>	1.5	1.6	1.4	1.3	1.0	0.9	2.1	1.9	2.4	4.3
Clarkia spp.	0.1	0.1	0.2	0.1	0.2	0.2	0.2	0.1	0.1	0.0
<i>Cynosurus cristatus</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Cynosurus echinatus</i>	1.7	1.3	0.4	0.4	0.7	0.5	0.1	0.1	0.2	0.1
<i>Danthonia californica</i>	24.4	6.3	9.8	4.4	5.0	2.5	8.5	3.6	6.2	1.8
<i>Danthonia unispicata</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Daucus pusillus</i>	0.6	0.5	0.5	0.6	0.3	0.2	0.3	0.2	0.2	0.0

	Occupied Plots									
	2014		2015		2016		2017		2018	
	95%		95%		95%		95%		95%	
	Mean	CI	Mean	CI	Mean	CI	Mean	CI	Mean	CI
<i>Dichelostemma</i> sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Dipsacus fullonum</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Dodecatheon</i> sp.	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
<i>Epilobium</i> sp.	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Eriogonum</i> sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Eriophyllum lanatum</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Erodium cicutarium</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Eschscholzia californica</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Festuca roemerii</i>	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
<i>Festuca</i> sp.	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Galium parisiense</i>	0.3	0.2	0.7	0.4	0.5	0.4	0.3	0.2	0.1	0.1
<i>Geranium dissectum</i>	0.4	0.2	0.5	0.2	0.3	0.1	0.5	0.2	0.1	0.1
<i>Geranium molle</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Githopsis specularioides</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Gnaphalium</i> sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Hypericum perforatum</i>	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
<i>Hypochaeris radicata</i>	0.5	0.2	3.4	2.2	3.3	1.5	5.0	2.9	2.0	0.3
<i>Isoetes nuttallii</i>	0.0	0.0	0.0	0.1	0.1	0.1	1.0	0.4	0.4	0.2
<i>Juncus bufonius</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Juncus</i> sp.	0.2	0.4	0.0	0.0	0.0	0.0	0.5	0.5	0.0	0.0
<i>Lactuca</i> sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Lamium purpureum</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Lathyrus nevadensis</i>	0.1	0.1	0.2	0.1	0.0	0.0	0.4	0.4	0.1	0.1
<i>Limnanthes gracilis</i>	0.2	0.2	0.2	0.2	0.9	0.5	3.6	2.7	0.9	0.1
<i>Linanthus bicolor</i>	0.0	0.0	0.1	0.1	0.2	0.2	0.7	0.6	0.4	0.0
<i>Linanthus</i> spp.	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
<i>Lithophragma parviflorum</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Lomatium cookii</i>	1.4	0.4	1.8	0.4	0.7	0.2	1.1	0.4	1.0	0.3
<i>Lotus micranthus</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0
<i>Lotus unifoliolatus</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
<i>Lupinus bicolor</i>	0.1	0.1	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0
<i>Luzula</i> sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Madia</i> spp.	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Micropus californicus</i>	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.4	0.0

	Occupied Plots									
	2014		2015		2016		2017		2018	
	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
<i>Mimulus</i> sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.1	0.1
<i>Moenchia recta</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Moerhingia</i> sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Myosotis discolor</i>	0.1	0.0	0.4	0.2	0.3	0.1	0.1	0.0	0.1	0.0
<i>Navarretia</i> sp.	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
<i>Nemophila</i> sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Orobancha</i> sp. uniflora	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Orthocarpus</i> sp. (white)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Pectocarya pusilla</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Pectocarya pusilla</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Peplis portula</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Plagiobothrys</i> sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Plantago lanceolata</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Plectritis congesta</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Poa bulbosa</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Poa secunda</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0
<i>Quercus garryana</i>	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.1
<i>Ranunculus occidentalis</i>	0.2	0.2	0.3	0.4	0.1	0.1	0.2	0.3	0.3	0.7
<i>Rumex acetosella</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Saxifrage senesced</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Scleranthus annuus</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Spiranthes</i>	0.0	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1
<i>Stipa lemmonii</i>	0.6	0.5	0.4	0.3	0.3	0.3	0.4	0.4	0.3	0.1
<i>Taeniatherum caput-medusae</i>	6.3	2.7	2.8	2.4	3.2	2.5	2.8	1.2	1.3	0.0
<i>Thysanocarpus curvipes</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Tonella tenella</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Torilis arvensis</i>	0.9	1.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
<i>Toxicodendron diversilobum</i>	1.4	2.7	1.9	3.7	1.9	3.7	1.5	2.9	0.0	0.1
<i>Trifolium albopurpureum</i>	0.0	0.0	0.1	0.1	0.2	0.2	0.0	0.0	0.0	0.0
<i>Trifolium bifidum</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0
<i>Trifolium dubium</i>	3.6	3.9	1.3	1.2	1.5	1.5	4.5	4.1	7.5	0.2
<i>Trifolium microcephalum</i>	0.3	0.2	0.0	0.1	0.1	0.0	0.8	0.5	0.2	0.0
<i>Trifolium subterraneum</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Trifolium variegatum</i>	0.0	0.0	0.0	0.0	0.0	0.0	1.9	1.0	0.1	0.0
<i>Trifolium willdenovii</i>	0.1	0.1	0.1	0.2	0.0	0.0	0.4	0.3	1.7	1.1

	Occupied Plots									
	2014		2015		2016		2017		2018	
	95%		95%		95%		95%		95%	
	Mean	CI	Mean	CI	Mean	CI	Mean	CI	Mean	CI
<i>Valerianella locusta</i>	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
<i>Veronica</i> sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Vicia sativa</i>	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Viola hallii</i>	0.1	0.1	0.2	0.2	0.1	0.1	0.3	0.3	0.2	0.0
<i>Vulpia bromoides</i>	0.0	0.0	0.1	0.1	0.1	0.1	0.4	0.4	0.0	0.0
Native Forb	5.4	1.9	5.8	1.6	4.6	1.3	14.4	3.9	8.9	4.1
Native Annual Forb	1.2	0.4	1.2	0.5	1.8	0.5	8.4	2.8	2.2	0.6
Native Perennial Forb	4.2	1.9	4.6	1.6	2.8	1.2	5.9	2.6	6.6	4.4
Introduced Forb	6.7	4.0	7.3	2.7	6.5	2.3	11.1	5.1	10.8	0.4
Introduced Annual Forb	6.1	3.9	3.7	1.5	3.0	1.6	6.1	4.1	8.6	0.3
Introduced Perennial Forb	0.6	0.2	3.5	2.2	3.5	1.5	5.1	2.9	2.2	0.4
Forb Total	12.3	4.2	13.9	3.2	12.1	2.7	28.1	5.8	20.9	4.2
Native Graminoid	25.7	6.1	10.3	4.4	5.4	2.4	10.5	3.8	7.1	1.9
Native Annual Graminoid	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Native Perennial Graminoid	25.5	6.2	10.3	4.4	5.4	2.4	10.5	3.8	6.9	1.9
Introduced Graminoid	29.7	6.3	7.6	3.9	7.5	3.2	7.2	2.2	4.3	0.5
Introduced Annual Graminoid	10.0	3.6	5.3	3.8	6.7	3.2	6.7	2.3	3.4	0.2
Introduced Perennial Graminoid	19.7	7.7	2.3	1.6	0.8	0.8	0.5	0.4	0.9	0.5
Graminoid Total	55.4	7.0	17.9	6.3	12.9	4.0	17.7	3.7	11.4	1.9
Tree/Shrub	1.4	2.7	1.9	3.7	1.9	3.7	1.5	2.9	0.0	0.1
Species Richness - All Species	53		50		60		63		60	
Forbs	36		34		41		46		41	
Introduced Forbs	15		13		17		18		18	
Native Forbs	19		19		23		27		22	
Graminoids	15		14		17		16		17	
Introduced Graminoids	10		9		9		10		8	
Native Graminoids	5		5		8		6		9	
Species Richness, Cover >1%	9		9		6		13		8	
Forbs	4		4		2		8		6	

	Occupied Plots									
	2014		2015		2016		2017		2018	
	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
Introduced Forbs	1		2		2		2		2	
Native Forbs	3		2		0		5		3	
Graminoids	4		4		3		4		2	
Introduced Graminoids	3		3		2		3		1	
Native Graminoids	1		1		1		1		1	

APPENDIX H. PLANT COMMUNITY DATA BY PLANT MANAGEMENT GROUPS FOR BURNED AND UNBURNED PLOTS AT FRENCH FLAT MIDDLE AND FRENCH FLAT SOUTH (2017)

Community data was not collected in 2018.

	Native Forb Cover		Invasive Forb Cover		Native Graminoid Cover		Introduced Graminoid Cover		Annual Introduced Graminoid Cover		Perennial Introduced Graminoid Cover	
	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
French Flat Middle	8.92	3.01	0.01	0.01	20.59	8.65	0.34	0.23	0.29	0.22	0.05	0.10
Unburned	8.93	4.15	0.00	0.00	26.65	15.71	0.10	0.14	0.10	0.14	0.00	0.00
Burned	8.92	4.32	0.02	0.02	16.55	9.82	0.50	0.34	0.42	0.34	0.08	0.16
French Flat South	12.49	1.68	0.00	0.00	24.89	6.81	1.36	1.51	0.14	0.14	1.22	1.44
Unburned	13.91	2.62	0.00	0.00	31.09	10.69	1.26	1.50	0.16	0.28	1.10	1.41
Burned	11.24	2.04	0.00	0.00	19.48	8.10	1.44	2.56	0.12	0.12	1.32	2.44

APPENDIX I. MEAN COVER OF THE PLANT COMMUNITY BY SPECIES IN BURNED AND UNBURNED PLOTS AT FRENCH FLAT MIDDLE AND FRENCH FLAT SOUTH (2016-2017)

	FF MIDDLE							
	2016				2017			
	Unburned		Burned		Unburned		Burned	
	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
Bare ground	24.50	13.75	28.43	21.44	16.26	11.42	14.45	12.95
Litter	49.38	24.04	12.68	13.22	66.88	12.82	49.17	12.70
Rock/Gravel	25.88	15.83	44.83	21.10	18.75	12.35	45.42	20.02
Moss	2.14	1.30	12.50	10.57	3.88	3.84	6.42	4.10
Big rock	0.63	0.98	0.25	0.49	0.00	0.00	0.50	0.98
<i>Agoseris heterophylla</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Agrostis</i> sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Aira caryophylla</i>	0.03	0.03	0.12	0.10	0.09	0.12	0.13	0.10
<i>Allium</i> sp.	3.50	1.99	2.48	0.99	1.88	1.06	0.97	0.40
<i>Apocynum</i> sp.	0.00	0.00	0.05	0.08	0.00	0.00	0.00	0.00
<i>Arctostaphylos</i> sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Bromus hordeaceus</i>	0.00	0.00	0.01	0.02	0.01	0.02	0.21	0.21
<i>Bromus rigidus</i>	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00
<i>Bromus tectorum</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Calochortus uniflorus</i>	1.56	1.07	0.41	0.23	2.08	1.22	0.59	0.81
<i>Camassia</i> sp.	0.19	0.14	0.21	0.17	0.00	0.00	0.00	0.00
<i>Carex tumilicola</i>	0.46	0.46	0.29	0.33	0.13	0.16	0.25	0.35
<i>Castilleja attenuata</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Castilleja rubicundula</i>	0.00	0.00	0.06	0.08	0.00	0.00	0.00	0.00
<i>Ceanothus cuneatus</i>	0.00	0.00	0.25	0.49	0.00	0.00	0.00	0.00
<i>Cerastium glomeratum</i>	0.00	0.00	0.76	1.00	0.00	0.00	0.17	0.33
<i>Cercocarpus ledifolius</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Chlorogalum pomeridianum</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Clarkia gracilis</i>	0.01	0.02	0.13	0.13	0.53	0.97	1.13	1.29
<i>Claytonia</i> sp.	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.00
<i>Collomia heterophylla</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

FF MIDDLE

	2016				2017			
	Unburned		Burned		Unburned		Burned	
	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
<i>Cynosurus echinatus</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Danthonia californica/unispicata</i>	30.63	12.45	10.43	3.40	23.63	14.84	14.08	8.85
<i>Daucus pusilis</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Deschampsia cespitosa</i>	1.89	2.04	1.18	1.56	1.00	1.96	1.08	1.66
<i>Elymus glaucus</i>	0.13	0.25	0.08	0.16	0.01	0.02	0.00	0.00
<i>Epilobium brachycarpum</i>	0.13	0.11	0.18	0.18	0.31	0.26	0.10	0.16
<i>Epilobium rigidum</i>	0.38	0.74	0.09	0.16	0.01	0.02	0.00	0.00
<i>Festuca roemerii</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Galium aparine</i>	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00
<i>Galium parisiense</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Geranium dissectum</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Gnaphalium</i> sp.	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.00
<i>Gratiola</i> sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03
<i>Hesperochiron californicus</i>	1.20	1.10	0.09	0.11	0.91	1.12	0.46	0.47
<i>Horkelia daucifolia</i>	0.00	0.00	0.47	0.42	0.13	0.25	0.17	0.18
<i>Hypericum perforatum</i>	0.00	0.00	0.04	0.08	0.00	0.00	0.01	0.02
<i>Hypochaeris radicata</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Isoetes</i> sp.	0.48	0.49	0.18	0.14	1.19	0.72	0.88	0.88
<i>Juncus</i> sp.	0.00	0.00	0.00	0.00	0.50	0.98	0.08	0.16
<i>Lathyrus nevadensis</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Limnanthes gracilis</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Linanthes bicolor</i>	0.01	0.02	0.11	0.11	0.25	0.49	0.39	0.43
<i>Lomatium cookii</i>	0.70	0.40	0.53	0.22	1.40	1.88	0.85	0.66
<i>Lotus micranthus</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Lotus unifoliolatus</i>	0.18	0.14	0.05	0.03	0.36	0.29	0.12	0.16
<i>Lupinus bicolor</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Luzula comosa</i>	0.06	0.12	0.04	0.08	0.06	0.12	0.00	0.00
<i>Madia</i> sp.	1.13	1.93	0.55	0.42	0.36	0.29	0.56	0.55
<i>Micropus californicum</i>	0.00	0.00	0.03	0.03	0.00	0.00	0.10	0.16
<i>Mimulus</i> sp.	0.00	0.00	0.42	0.56	0.00	0.00	1.46	2.43
<i>Montia linearis</i>	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.00
<i>Myosotis discolor</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

FF MIDDLE

	2016				2017			
	Unburned		Burned		Unburned		Burned	
	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
<i>Naverettia intertexta</i>	0.04	0.04	0.03	0.03	0.05	0.04	0.18	0.18
<i>Nemophila</i> sp.	0.00	0.00	0.04	0.08	0.00	0.00	0.05	0.08
<i>Panicum</i> sp.	0.00	0.00	0.08	0.16	0.00	0.00	0.08	0.16
<i>Pectocarya pusilla</i>	0.01	0.02	0.15	0.17	0.00	0.00	0.58	0.65
<i>Peplis portula</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Perennial Brome	0.00	0.00	0.13	0.17	0.06	0.12	0.33	0.50
<i>Perideridia</i> sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Plagiobothrys</i> sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Poa bulbosa</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Poa compressa</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Poa secunda</i>	0.00	0.00	0.00	0.00	0.14	0.24	0.17	0.22
<i>Quercus garryana</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Ranunculus occidentalis</i>	0.25	0.49	0.26	0.35	0.01	0.02	0.21	0.33
<i>Saxifrage</i> sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Scleranthus annuus</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02
<i>Stipa lemmonii</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Taeniatherum caput-medusae</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.08
<i>Thysanocarpus curvipes</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Torilis arvensis</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Trifolium dubium</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Trifolium microcephalum</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Trifolium variegatum</i>	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.00
<i>Trifolium wildenovii</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Valerianella locusta</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Vicia sativa</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Viola hallii</i>	0.25	0.49	0.13	0.18	0.51	0.98	0.84	1.63
<i>Vulpia bromoides</i>	0.00	0.00	0.01	0.02	0.00	0.00	0.01	0.02
<i>Zigadenus venenosus</i>	0.00	0.00	0.00	0.00	0.13	0.25	0.00	0.00

FF SOUTH								
	2016				2017			
	Unburned		Burned		Unburned		Burned	
	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
Bare ground	23.93	7.95	57.19	9.92	18.36	12.87	40.69	11.88
Litter	51.57	12.41	13.81	9.41	53.43	13.19	21.69	11.35
Rock/Gravel	14.29	8.35	26.31	9.28	28.64	15.07	25.19	8.91
Moss	4.29	2.81	4.29	4.23	4.29	2.25	4.62	7.91
Big rock	0.00	0.00	0.56	0.98	0.00	0.00	0.50	0.98
<i>Agoseris heterophylla</i>	0.00	0.00	0.06	0.12	0.00	0.00	0.00	0.00
<i>Agrostis</i> sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Aira caryophylla</i>	0.01	0.01	0.01	0.02	0.01	0.01	0.09	0.12
<i>Allium</i> sp.	3.57	1.91	5.19	1.71	2.57	0.89	3.20	1.51
<i>Apocynum</i> sp.	0.00	0.00	0.51	0.67	0.00	0.00	0.04	0.06
<i>Arctostaphylos</i> sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Bromus hordeaceus</i>	0.00	0.00	0.00	0.00	0.15	0.28	0.00	0.00
<i>Bromus rigidus</i>	0.15	0.19	0.53	0.98	1.03	1.41	1.32	2.44
<i>Bromus tectorum</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Calochortus uniflorus</i>	1.73	1.02	0.64	0.37	2.14	1.23	0.78	0.69
<i>Camassia</i> sp.	0.12	0.09	0.20	0.15	0.14	0.28	0.41	0.43
<i>Carex tumilicola</i>	0.09	0.09	0.24	0.26	0.97	0.73	0.86	0.53
<i>Castilleja attenuata</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
<i>Castilleja rubicundula</i>	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00
<i>Ceanothus cuneatus</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Cerastium glomeratum</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Cercocarpus ledifolius</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Chlorogalum pomeridianum</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Clarkia gracilis</i>	0.01	0.01	0.29	0.38	0.87	1.68	0.07	0.08
<i>Claytonia</i> sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Collomia heterophylla</i>	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00
<i>Cynosurus echinatus</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Danthonia californica/unispicata</i>	30.57	11.90	13.25	3.72	28.07	10.14	17.13	7.52
<i>Daucus pusilis</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Deschampsia cespitosa</i>	0.07	0.14	0.00	0.00	0.00	0.00	0.00	0.00
<i>Elymus glaucus</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

FF SOUTH								
	2016				2017			
	Unburned		Burned		Unburned		Burned	
	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
<i>Epilobium brachycarpum</i>	0.21	0.16	0.06	0.03	0.61	0.54	0.31	0.17
<i>Epilobium rigidum</i>	0.21	0.30	0.00	0.00	0.00	0.00	0.00	0.00
<i>Festuca roemerii</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Galium aparine</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Galium parisiense</i>	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
<i>Geranium dissectum</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Gnaphalium</i> sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Gratiola</i> sp.	0.00	0.00	0.00	0.00	0.25	0.42	0.00	0.00
<i>Hesperochiron californicus</i>	0.14	0.15	0.14	0.11	0.39	0.33	0.48	0.42
<i>Horkelia daucifolia</i>	1.29	1.76	0.50	0.98	0.57	0.86	0.31	0.61
<i>Hypericum perforatum</i>	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
<i>Hypochaeris radicata</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Isoetes</i> sp.	0.09	0.09	0.08	0.06	0.79	0.45	0.70	0.37
<i>Juncus</i> sp.	0.54	0.53	0.03	0.06	0.64	0.64	0.01	0.01
<i>Lathyrus nevadensis</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Limnanthes gracilis</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Linanthus bicolor</i>	0.01	0.01	0.20	0.37	0.01	0.01	0.07	0.08
<i>Lomatium cookii</i>	0.76	0.26	0.89	0.27	1.09	0.70	0.98	0.50
<i>Lotus micranthus</i>	0.01	0.01	0.01	0.01	0.11	0.15	0.01	0.02
<i>Lotus unifoliolatus</i>	0.14	0.08	0.06	0.03	0.25	0.28	0.08	0.06
<i>Lupinus bicolor</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Luzula comosa</i>	0.14	0.28	0.00	0.00	0.14	0.28	0.00	0.00
<i>Madia</i> sp.	2.07	2.14	1.86	1.14	1.97	1.47	2.58	1.53
<i>Micropus californicum</i>	0.00	0.00	0.03	0.02	0.00	0.00	0.25	0.38
<i>Mimulus</i> sp.	0.07	0.10	0.00	0.00	0.50	0.57	0.00	0.00
<i>Montia linearis</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Myosotis discolor</i>	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
<i>Naverettia intertexta</i>	0.35	0.18	0.43	0.17	0.22	0.15	0.30	0.16
<i>Nemophila</i> sp.	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00
<i>Panicum</i> sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Pectocarya pusilla</i>	0.07	0.14	0.02	0.02	0.11	0.15	0.14	0.24
<i>Peplis portula</i>	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00

FF SOUTH								
	2016				2017			
	Unburned		Burned		Unburned		Burned	
	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
Perennial Brome	0.00	0.00	0.28	0.49	0.00	0.00	0.13	0.24
<i>Perideridia</i> sp.	0.01	0.01	0.00	0.00	0.07	0.14	0.00	0.00
<i>Plagiobothrys</i> sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Poa bulbosa</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Poa compressa</i>	0.00	0.00	0.00	0.00	0.07	0.14	0.00	0.00
<i>Poa secunda</i>	0.47	0.33	0.98	0.86	0.46	0.49	0.79	0.80
<i>Quercus garryana</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Ranunculus occidentalis</i>	1.04	0.76	1.26	0.97	2.01	1.39	1.19	0.98
<i>Saxifrage</i> sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.06
<i>Scleranthus annuus</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Stipa lemmonii</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Taeniatherum caput-medusae</i>	0.01	0.02	0.00	0.00	0.01	0.01	0.02	0.02
<i>Thysanocarpus curvipes</i>	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00
<i>Torilis arvensis</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Trifolium dubium</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Trifolium microcephalum</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Trifolium variegatum</i>	0.05	0.07	0.07	0.12	0.26	0.30	0.01	0.01
<i>Trifolium wildenovii</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Valerianella locusta</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Vicia sativa</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Viola hallii</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Vulpia bromoides</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
<i>Zigadenus venenosus</i>	0.07	0.10	0.00	0.00	0.00	0.00	0.00	0.00